



10<sup>th</sup> PAN-EUROPEAN VOICE CONFERENCE  
Prague, Czech Republic

Celebrating Interdisciplinary Collaboration

Book of Abstracts  
21. – 24. 8. 2013



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## In Memoriam: Professor Karel VRTIČKA, MD, PhD

*F. Šram, J. Sopko, J. Vydrová, J.G. Švec*

Professor Karel VRTIČKA died on April 2, 2013 in Luzern, Switzerland. He was one of the direct representatives of the Prague Phoniatic School who significantly contributed to the development of phoniatics in the Czech Republic and in Switzerland.

Karel VRTIČKA was born on October 15th, 1930 in Hodonín, in the region of South Moravia in Czechoslovakia. His father was a general practitioner, his mother was a teacher. After medical graduation in Brno at the Masaryk University and basic ENT training in Hradec Králové, he joined the team of the Phoniatic Clinic and Laboratory at the Charles University in Prague as an assistant, and later as a scientific collaborator of Miloslav SEEMAN and Eva SEDLÁČKOVÁ. Already in the sixties, VRTIČKA published in the journal *Folia Phoniatica* three important texts on the physiology, pathophysiology and acoustic structure of the substitute esophageal voice. At the IALP Congress in Padua in 1962 he presented, together with SEDLÁČKOVÁ, a contribution to the congenitally shortened velum (the Sedláčková Syndrome).

At that time, the Phoniatic clinic was responsible for the postgraduate training of numerous Czech and foreign specialists in phoniatics and speech therapy. In 1964 Karel VRTIČKA was in charge of organizing an International ENT Congress focussing on phoniatics, where he met, for the first time, Prof. K. GRAF from Luzern, Switzerland. Shortly after, GRAF invited VRTIČKA for a study trip to Switzerland and France. In Lyon, France he worked with Prof. J.-C. LAFON and G. CORNUT as an „assistant étranger de l' Institut d' Audiophonologie“.

Prof. GRAF then invited VRTIČKA to move to Switzerland in order to found and lead the Phoniatic Department at the ENT Clinic at the Cantonal Hospital in Luzern. He moved there in 1967 and continued his scientific work started in Prague. He also took over postgraduate education of phoniaticians and speech therapists.

In early sixties, Prof. R. LUCHSINGER - a Swiss phoniatician of world reputation, a former president of IALP and, together with SEEMAN and TARNEAUD, a co-founder of *Folia Phoniatica* journal - had substantially reduced his professional activities. Only a few enthusiastic Swiss ENT specialists treated phoniatic patients at the time. Thus, the new Phoniatic Department in Luzern became for years the sole specialized phoniatic service in Switzerland working full time. H. Zwalen, H.- L. Giger, J.Sopko, A. Sommerhalder and V. Schweizer started their post gradual phoniatic training in Luzern and provided their support for three international symposia and numerous postgraduate courses. 25 Swiss speech therapists received their clinical training in Luzern.

In 1968, Prof. Vrtička started lecturing at the University of Fribourg, where he introduced the subject of Physiology and Pathophysiology of Verbal Communication to hundreds of speech therapists. Joseph Sopko worked with Prof. Vrtička during the years 1974 and 1975 in his Phoniatic Department and accompanied him to his lectures and international congresses. Together, they presented and published a text on spasmodic dysphonia. Since then, they had remained connected by a close professional and friendly relationship.

Prof. Vrtička with his collaborators published more than 90 scientific articles. They performed the very first CT of the pseudoglottis in larygectomees and the first clinically relevant CT study of the velopharyngeal closure. By proving the identity of the Sedláčková (1955) and Shprintzen ( 1978 ) syndromes, Prof. Vrtička highlighted the world priority of the discovery done by his former teacher. He also wrote 80 popular articles covering the whole field of phoniatics.

The musical tradition of his native country inspired Prof. Vrtička to numerous texts on relation of speech and music.

Prof. Vrtička was a founder and honorary member of the Swiss Phoniatic Society, member of the Swiss ENT Society and a honorary member of the Czech ENT Society. As an individual member of International Association of Logopedics and Phoniatics (IALP), European Union of Phoniaticians, Société Françoise de Phoniatrie, and Deutsche Gesellschaft für Sprach- und Stimmheilkunde, he presented several keynote lectures and numerous communications at the congresses of these societies, as well as at the „Stuttgarter Stimmtage“ and at the „Artistic Voice Symposium“ organised regularly in Prague.

With respect we remember our friend.





## Care of the Professional Voice: State of the Art *(no. 1)*

R.T. Sataloff

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Other
- Invited Keynote Lecture

Extraordinary advances in laryngology during the last forty years developed as new paradigms in voice health care and research evolved. Multidisciplinary teamwork has led not only to remarkable advances in knowledge but also to unusually rapid clinical application of new scientific information. Advances in diagnosis and treatment of voice disorders, prevention of dysphonia, clinical and research instrumentation and application of techniques from numerous scientific disciplines have improved the standard of care of patients with voice disorders. Establishment of laryngology as a sophisticated subspecialty should result in continued advances.

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He holds an undergraduate degree from Haverford College in music theory and composition, graduated from Jefferson Medical College, Thomas Jefferson University, received a Doctor of Musical Arts in voice performance from Combs College of Music; and he completed his residency in otolaryngology – head and neck surgery and a fellowship in otology, neurotology and skull base surgery at the University of Michigan. Dr. Sataloff is chairman of the boards of directors of the Voice Foundation and of the American Institute for Voice and Ear Research. He has also served as chairman of the board of governors of Graduate Hospital; president of the American Laryngological Society, the International Association of Phonosurgery, and the Pennsylvania Academy of Otolaryngology – Head and Neck Surgery; and in numerous other leadership positions. Dr. Sataloff is editor-in-chief of the Journal of Voice, editor-in-chief of Ear, Nose and Throat Journal, associate editor of the Journal of Singing, and on the editorial boards of numerous otolaryngology journals. He has written over 1,000 publications, including 48 books. His medical practice is limited to care of the professional voice and to otology/neurotology/skull base surgery.

## Professional Voice Care and the Need for Voice Clinics (no. 243)

M. Hess

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Other
- Invited Keynote Lecture

Singers, actors, and other professional voice users have a highly specialized communication system: the human voice. Diseases and disorders of the voice may have various reasons, and in most cases, the ENT doctor or phoniatrian are the first specialists that are contacted. Therefore, it is the responsibility of the physician to make a diagnosis, or to recruit other specialists for optimal assessment and treatment of the patient. In this keynote speech the multidisciplinary approach and the newest assessment possibilities for voice disorders are discussed. One conclusion of this presentation is that only the constitution of well equipped multidisciplinary voice clinics seems to be the adequate answer for coping with the multifaceted problems that we encounter when caring for professional voice users.

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Markus M. Hess, MD, is Professor and Director of the Department of Voice, Speech and Hearing Disorders at the University Medical Center of Hamburg-Eppendorf, Germany. He is a dedicated otolaryngologist and phoniatrian (speech-language pathology and medicine), subspecializing in laryngology, phonosurgery, and disorders of professional voice users.

The special environment in Hamburg enables the performance of the highest level of patient care in a center of excellence. Dr. Hess brings a multidisciplinary approach to such patients as public speakers, singers, and actors. Patients receive cutting-edge minimally invasive techniques in laryngeal microsurgery as well as office-based voice surgery in topical anesthesia. Dr. Hess is a founding member of the 'German Society of Phonosurgery' and continuously contributes to the voice field as a member of editorial boards, medical journals and numerous national and international committees. In 2014 he and his colleagues will establish a voice clinic called 'Deutsche Stimmklinik'.

# Overview of the Management of Unilateral Vocal Fold Paralysis (no. 2)

M. Benninger

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Professional Voice

The assessment and management of patients with a unilateral vocal fold paralysis requires a careful assessment of etiology, an evaluation of the severity of the voice and swallowing function and some determination of the likelihood and timing of recovery. This presentation will set the stage for a series of lectures on assessment and management of unilateral and bilateral vocal fold paralysis. It will serve as a quick overview of incidence, evaluation, the roles of objective measures of vocal fold function and the importance of quality of life measures and electromyography. The presentation will include a brief discussion of the various treatment options, including voice therapy, injection and medialization laryngoplasty.

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## Injection Thyroplasty: When and What? (no. 3)

A. Hantzakos

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Injection laryngoplasty for vocal fold augmentation has evolved into a popular phonosurgical technique for correction of glottal insufficiency. Its indications are most notably unilateral vocal fold paralysis, vocal fold paresis, vocal fold atrophy, vocal fold scar, and sulcus vocalis. Since its introduction in 1991 by Brunings, several materials, autologous or synthetic, have been used with variable success. Since the properties of each material differ, selection of one as opposed to another is not always a matter of preference, but has certain indications and limitations.

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# Injection Laryngoplasty in the Office Setting and in the Hospital Wards (no. 4)

M. Benninger

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Unsedated injection laryngoplasty is a common temporary treatment for unilateral vocal fold immobility. This presentation will discuss our experience with office based and inpatient hospital vocal fold injection medialization and provide technical pearls.

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# Surgical Medialization with Silastic Implant: Thirty Years Experience *(no. 5)*

H.M. Tucker

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Laryngologists have been proposing procedures to medialize a paralyzed vocal fold since early in the last century. Injection medialization remains a useful technique, but since the first report by Isshiki, many of us have found surgical medialization safe and effective in restoring near normal voicing for patients so afflicted. The author has used and developed several of these techniques for over thirty years, including the addition of reinnervation in selected cases. Long term results are reported.

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# Multidimensional Assessment of the Functional Results of Thyroplasty Type I

(no. 6)

V. Uloza, R. Pribuisiene

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

The aim of the study was to evaluate the functional outcomes of thyroplasty type 1 (TP1) in 52 unilateral vocal fold paralysis (UVFP) patients, comparing multidimensional perceptual and instrumental measures of voice before and after surgery.

## Methods

Video laryngostroboscopy (VLS), auditory perceptive evaluation of voice, the patients' self-evaluation of hoarseness on the Visual Analogue Scale (VAS) and calculation of the Voice Handicap Index (VHI), analysis of objective acoustic voice parameters, and quantitative assessment of phonetograms and measurement of maximum phonation time were conducted. Vocal function was evaluated before the surgery and for the period from 1 month to 3 years after TP1.

## Results

VLS confirmed remarkable medialization of the paralyzed vocal fold after TP1. As a consequence, hoarseness and breathiness were found to be significantly decreased after TP1. A high degree of patient satisfaction with the TP1 was confirmed by a significant decrease of VHI. Pitch and intensity range and phonetogram area were significantly increased. A significant decrease of jitter, shimmer and normalized noise energy reflected improvement of the stability of acoustic signal and a more efficient pattern of phonation. Thus, the perceptual and acoustic voice parameters studied showed statistically significant differences ( $p < 0.001$ ) between preoperative and postoperative voices, and these objective measurements of voice changes provided accurate and documentary evidence of the results of surgical treatment. However, the means of acoustic voice parameters measured in the study have not reached normal limits, probably because of the remaining underlying condition of UVFP. In addition, this provides the patient with evidence-based information to form realistic expectations of MT and to avoid overestimation of the outcome of the operation.

## Conclusions

Results of the present investigation confirm the functionality and effectiveness of TP1 in UVFP patients' voice rehabilitation.

**Keywords:** thyroplasty, vocal fold paralysis, acoustic voice parameters, phonetogram, VHI

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## Managing the Arytenoid: When and How (no. 7)

G. Woodson

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Surgery to reposition the arytenoid cartilage can be effective in selected patients with laryngeal paralysis. In some patients with unilateral paralysis, the vocal process is not in a favorable position to approximate the opposite vocal process during glottic closure. In such cases, medialization of the paralyzed fold by injection or thyroplasty is usually not sufficient to restore glottic competence. Arytenoid adduction is an external procedure that internally rotates the arytenoid cartilage. Anterior traction is applied to a suture in the muscular process of the arytenoid. This repositions the vocal process inwards and downwards into a physiologic phonatory position. A posterior suspension suture, mimicking tone in the posterior cricoarytenoid needs to be added if the arytenoid is prolapsed into the lumen. Patients with bilateral laryngeal paralysis may benefit from arytenoid abduction, which mimics action of the posterior cricoarytenoid muscle to open the glottis. The effectiveness of this procedure is limited in the presence of significant synkinetic reinnervation of the thyroarytenoid muscle. This presentation will review the anatomy of the cricoarytenoid joint and the pathophysiology of recurrent laryngeal nerve. Arytenoid surgery will be described in detail and results reviewed.

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- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Trans-sexualism
- Invited Lecture

Voice offers valuable clues to the bodily and emotional condition of the speaker, and gives information about age and sex. Voice excites speculations about speaker's appearance and attractiveness. These links become important in voice intervention, e.g. in women with overproduction of androgens or under androgen treatment, in men with mutational voice disorders, in transsexuals, and in professional speakers, striving towards an attractive voice. The mean fundamental frequency (F0) seems to be the best indicator for sex identification. Gelfer and Mikos (2005) collected sustained vowels from 10 male-to-female transgenders, 10 biological women, and 10 biological men and synthesized vowel files with different fundamental frequencies but unaltered formants and bandwidths. As result, sex identifications by 30 listeners were based on fundamental frequency, even in case of contradictory fundamental frequency and formant frequency information. Hillenbrand and Clark (2009) created four versions of 25 sentences with upward and downward shifted F0, formants or both. The authors observed, that changing the perceived sex was more effectively achieved by shifting both, F0 and formants, less effectively by shifting F0 and least by shifting formants. According to Feinberg et al (2005) low male voices are more attractive for women; Collins (2012) specifies this finding relating to men voices with closer harmonics and lower frequencies. In addition, Feinberg et al. described higher attractiveness of high female voices for men. But social customs and cultural differences have to be borne in mind.

Analogous to the attractiveness of average faces, Bruckert et al (2010) showed that averaging voices resulted in more attractiveness independent of speaker's or listener's gender. They suppose prototype-based coding as a central phenomenon of voice perception. Deuster et al (2013) compared self- and external rating of voice characteristics. Regarding attractiveness and femininity sparse correlation of self-assessment and external rating was found in female voices. According to his study, F0 is of high relevance for masculinity, attractiveness and identifying with voice in men. The results confirmed the relevance of decreasing F0 to perceive a male like voice, e.g. in patients with mutational falsetto or in female-to-male transsexuals. But male-to-female transsexuals, even if a functional or surgical pitch elevation could be achieved, are often not entirely satisfied with their voices. Already, Gelfer and Schofield (2000) noticed that a higher F0 is not sufficient for perceiving a voice as feminine. Mordaunt (2006) postulated changing of intonation and pitch variation as necessary to perceive a voice as feminine. Different appraisals between self- and external rating of voice characteristics may impede successful therapeutic intervention. Previous to voice therapy the reachable and desired „ideal voice“ has to be clarified between patient and therapist.

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## Sex Hormones and the Larynx (no. 9)

B. Schneider-Stickler

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues
- Invited Lecture

Vocal changes following hormonal influences confirm the assumption that the human larynx is a secondary sex organ. In both male and female genders the voice evolves from childhood to senescence under the varied levels of estrogens, progesterone and androgens. Altered voice quality in women during menstrual cycle and menopause is also assumed to be the result of hormonal changes. Own studies on voice impairment in the menopause revealed that voice alterations due to estrogen deficiency and the relative surplus of androgen should be regarded as a climacteric symptom.

Further, we studied the expression of estrogen receptor  $\alpha$  (ER $\alpha$ ), progesterone receptor (PR), and androgen receptor (AR) using immunohistochemistry in order to clarify the expression and localization of the sex hormones in healthy laryngeal mucosa as well as in benign vocal fold lesions as not only biomechanical factors but also hormonal influences are assumed to cause benign vocal fold lesions.

As we varied our staining protocols several times and thereby providing good positive and negative controls, we have to conclude, that using immunohistochemistry sex hormone receptors in the larynx mucosa was not detectable. This is a very surprising result, as up to now all voice changes, which occur from childhood to adolescence and senescence, respectively, are regarded as a result of the hormonally induced impact on the larynx. For more than twenty years, a growing number of publications is available, in which the effects of sex hormones on cortical, motor, neural, and sensory processes are examined and reported. Several authors reported voice alterations and the morphologic appearance of the vocal folds as a result of altered estrogen and progesterone levels, e.g., prior to and during menstruation or menopause. However, some other authors assume that affected vocal behavior is caused by alterations in the afferent and efferent processes involved in laryngeal neuromotor control. Earlier studies determined the voice quality across the menstrual cycle and suggested that ovarian hormone fluctuations alter neurotransmitter levels, which results in changes in the motor and sensory processes involved in laryngeal control. The absence of any specific staining pattern indicating the sex hormone expression in laryngeal components strengthens that assumption.

Sex hormone receptors could also not be detected in the specimens of benign vocal fold lesions, thus, the direct influence of sex hormones on the development of benign vocal fold lesions is rather unlikely.

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# Transsexuality - Definition and Treatment (no. 10)

P. Weiss

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues
- Invited Lecture

Gender Dysphoria Disorder (GID) is the condition of being in a state of conflict between gender and physical sex. The cause of gender identity disorder is not known. It has been theorized that a prenatal hormonal imbalance may predispose individuals to the disorder. Transsexualism is then the most severe manifestation of gender identity disorder in adults, being a prolonged, persistent desire to relinquish their primary and secondary sex characteristics and acquire those of the opposite sex. Transsexual is a person in whom the sex-related structures of the brain that define gender identity are exactly opposite the physical sex organs of the body. We distinguish two types of transsexual persons: female-to-male (biological women, psychologically men) and male-to-female (biological men, psychologically women).

In most countries the legal sex reassignment surgery is possible under certain conditions. In the Czech Republic two main legal conditions are: 18 years of age and non-married status. From the sexological viewpoint minimum of 12 months hormonal treatment and at least 12 months Real Life Experience (living in the role opposite to the biological gender) are necessary conditions before surgical treatment. Due to the new law all applications for sex reassignment must be approved by a special central ministerial commission.

Author introduces also the statistical data about the trends in the number of transsexual patients in the Czech Republic before and after political changes in 1989 (so called Velvet Revolution). The most noticeable result of these comparisons is the MtF:FtM ratio adjustment (as manifested by the increase of MtF patients) – whereas in the pre-1989 period it was 21:79 (i.e. roughly 1:4), it jumped to near-parity (42:58) right after 1989 and in the last few years actually reversed in favor of the MtFs.

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## Hormonal Treatment in Transsexualism (no. 11)

V. Weiss

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Trans-sexualism
- Invited Lecture

Subjects with female-to-male (FtM) and male-to-female (MtF) transsexualism are controlled by psychiatrists – sex-uologists. When transsexualism diagnosis is determined by sexuologist medical treatment by “opposite” hormones can be after Real life test and Real life experience periods recommended. Duration of hormonal treatment must be at least 1 year before gender reassignment surgery. Hormonal treatment lasts after surgery throughout the life, there are no recommendations about treatment in old age. Hormonal treatment suppresses former gender and induces sexual characteristic of required gender. In last time a lot of young subjects visit doctor and hormonal treatment is starting still sooner. Cross-sex hormones are now in many countries prescribed at the age 15-16 years and sometimes analogues of gonadoliberin even earlier (especially in girls with clearly diagnosed FtM transsexualism for menstrual bleeding and breast growth cessation).

In MtF transsexualism hormonal treatment includes oestrogens (synthetic ethinyl oestradiol and better natural 17-beta oestradiol hemihydricum). 17-beta oestradiol in transdermal therapeutic system (TTS) is recommended for older patients and/or with other comorbidities (thromboembolism etc.). Depot monthly applied intramuscular oestrogen is not suitable because of effective levels fluctuation, depot oestradiol applied every six months does not offer sufficient doses for younger MtF transsexuals. In combination with oestrogens are prescribed antiandrogens (cyproterone acetate, gonadoliberin analogues and only rarely spironolactone, finasteride and flutamide). Therapy with antiandrogens continues in most cases after surgery because of low androgens production in adrenal glands.

Androgens are given in FtM transsexualism. In the beginning lower doses are subsequently increased (combination of orally and intramuscularly used testosterone). Subjects wish to use mainly depot androgens after surgery. Modern drugs maintain therapeutic levels even 12 weeks after testosterone injection.

Mortality in FtM transsexuals is unchanged but in MtF transsexuals increases because of non-hormonal reasons (ethinyl oestradiol increases mortality because of cardiovascular reasons). Oestrogens and antiandrogens increase triglycerides and high density lipoproteins, markers of inflammation and oxidative stress and alterate homeostatic and fibrinolytic factors. Increased number of tumors were not proved. Osteopenia and/or osteoporosis during both types of hormone treatment is not present. Androgen treatment increases levels of triglycerides and haemoglobin. Testosterone therapy increases LBM.

Both hormonal treatment cannot impact on adult larynx size. Role of voice education and eventually larynx surgery is important. Androgen therapy in case reports decreases mean fundamental frequency and pitch range. During prepubertal period could hormone treatment probably change voice depth in transsexuals.

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# Testosterone Induced Voice Changes in Female-to-male-transgenders (no. 12)

D. Deuster

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Trans-sexualism
- Invited Lecture

In contrast to male-to-female transgenders, female-to-male transgenders rarely consult phoniaticians or voice therapists because of voice problems. The reason seems to be that lowering of voice takes place automatically upon testosterone treatment and various studies in healthy probands showed that especially mean fundamental frequency distinguishes men from women. Therefore, only few data are available on voice change and self-perception of the own voice in this group. For that reason, we prospectively investigated ten female-to-male transgenders with regard to voice change up to a period of 12 months. In the majority of probands we found an exponential decrease of mean fundamental frequency and stabilization at 16 to 20 weeks after beginning of testosterone treatment. However, three probands showed different patterns of change with a continuous decrease over the entire time frame of 12 months. These differences are an interesting field of further investigations with regard to voice physiology and mutation.

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# Voice Assessment and Voice Therapy in Female-to-male Transgender Clients During Hormonal Treatment *(no. 13)*

U. Nygren

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Trans-sexualism
- Invited Lecture

Approximately 25-30 female-to-male (FtM) transsexual (TS) clients undergo sex reassignment surgery each year in Sweden. All FtM TS clients in the Stockholm area are referred for voice assessment to the Department of Speech and Language Pathology at the Karolinska University Hospital after confirmation of the diagnosis Transsexualism by the psychiatric team at the hospital. Voice assessment includes self-ratings of voice function and voice problems, digital audio recordings of the patient's habitual and loud voice, and of a voice range profile (VRP). Habitual voice is recorded during reading and narrating to a series of pictures and loud voice during reading in pink noise presented in head-phones. The software programmes Soundswell and Phog (Saven Hitech AB) are used. The following variables are extracted using the analyses tools in the software programmes: Average fundamental frequency (F0 in Hz), lowest and highest F0, average sound pressure level (SPL in dB), lowest and highest SPL and VRP area (ST\*dB). All clients are recorded systematically before start of the testosterone treatment and regularly up to 2 years during the process of sex-reassignment. Some clients do also need speech/voice/communication therapy, usually because of vocal fatigue, hoarseness and vocal strain or if the clients are unsatisfied with the voice change. Results from a longitudinal study of FtM TS clients examining voice changes during ongoing testosterone treatment will be presented. Preliminary results show that the largest voice change happens before six months of testosterone treatment, that the average F0 lowers up to 12 months and that VRP area can increase up to 24 months.

Annual national meetings with all specialists involved in the care of transgender clients are held in Sweden focusing on issues to unify assessment and treatment programmes in different parts of the country. The work is supported by the National Board of Health and Welfare with the aim to increase knowledge about transgender care.

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# Functional Warm-up Exercises for Singers (no. 14)

W. Schuessler

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Warm-up Exercises

## A Practical Workshop

How do I best get into gear for my concert, rehearsal or audition?

This demonstration will be focused on muscular action and relaxation, kinaesthetic perception, vowel sound structure and ease of the tone production, based on function voice training principles.

We will be taken through individual, partner and group exercises, implying some physical and acoustic massage elements given to our partner's shoulder regions.

There will also be hints at tools and devices we can use either to refine our hearing, balance our posture or build up more projecting energy in our vowel sounds.

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[www.wernerschuessler.de](http://www.wernerschuessler.de)

# Warm-Up in Singing: How to Improve the Voice Resonance by Blending the Registers? (no. 15)

B. Šulcová, J. Vydrová

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

This workshop deals with warm-up techniques focusing on how to blend the head and chest resonance. Exercises will be used to show how to use the different articulators, (especially the tongue) in order to improve the voice resonance.

Model singers will be present to show the techniques.

We will have a chance to look at the MRI pictures of the vocal tract settings during the exercises using the different singing techniques.

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Brigita Sulcova, was one of the leading concert Sopranos of Czech Republic. With a rare and rich tone of voice, strong technique, perfect intonation and profession range encompassing three octaves, Brigita, remains an exemplary role model of many aspiring concert artists, all over the world. Equally supreme have been her dramatic capabilities and her immense focus to convey the emotions of the songs. She has won many audiences with her unique sense of style and interpretations. Her repertoire includes a wide range of songs from Baroque to classical contemporary music. Personally, she has a keen interest in later, from the outset of her career. Her premier performance included songs which were tailored to bring out the colours of her voice. These were specially composed by several contemporary composers. Since 1985, she has been teaching in the prestigious Prague Conservatoire, Presently, she shoulders the major responsibility of the head of the department since the year 1992 - 2007. She teaches students from all over the world with commitment and enthusiasm. She has produced many fine artists who perform today at several esteemed theatres all over the world.

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# Technique of Voice and Speech Expression (no. 16)

R. Szymiková

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

The workshop participants will experience practically the education of voice using their inner tactile body sensations connected with breath, resonance, active production of vowels, varying body tension, including self-reflection and feedback.

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Regina Szymiková is the Head of the Vocal and Training Laboratory at the Department of Dramatic Theatre of the Theatre Faculty at the Academy of Music Arts in Prague. She is specialized in voice and speech education and in the theory of stage speech. She worked as a pedagogue for stage speech and opera acting at the singing department of the Prague Conservatory. She also collaborated with the colleagues of the Music Acoustics Research Centre of the Music Faculty of the Academy of Music Arts on a research project related to speaking and singing voice timbre.

She is a permanent advisor of dramatic theatres, a permanent member of committees at theatre competitions and an instructor of speaking expression for the redactors of Czech television.

At the Voice Centre Prague, she leads voice education courses and carries out voice reeducation therapy. She collaborates with the clinicians of the ENT clinic of the Faculty Hospital in Hradec Králové on the courses of voice reeducation.

She is a coauthor of the chapter on Voice education in the Czech textbook „Phoniatics: Voice.“

# Resonance Tube Phonation into Water – a Tutorial Workshop on the Method and Some Observations from High-speed Imaging, Electroglottography and Oral Pressure Registration (no. 17)

S. Simberg, S. Granqvist, S. Hertegård, S. Holmqvist, H. Larsson, P.-Å. Lindestad, M. Södersten, B. Hammarberg

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Treatment Methods

Phonation into glass tubes (“resonance tubes”), keeping the free end of the tube in water, has been a frequently used voice therapy method in Finland, and more recently also in other countries. Little is known about the physiological effects of the resonance tube phonation in water.

Part 1 of the workshop aims at demonstrating the resonance tube method and to present some examples on how it can be used in various ways depending on the kind of voice disorder and the aims of the therapy. In part 2, observations from high-speed imaging and electroglottographic registrations of vocal fold vibrations as well as oral pressure registrations will be presented from two participants.

Preliminary results from our experiments showed that the fluctuation in the backpressure during tube phonation into water alters the vocal fold vibratory patterns. In the high speed imaging an obvious impact by the tube phonation into water was observed on the vocal fold vibrational pattern and especially in the open/closed quotient and amplitude variation of the glottal opening.

1. As calculated from the glottal area variation by the high speed imaging, the open/closed quotient increased with increasing water depth (from 2 cm to 6 cm)
2. As observed from the high speed images, the mucosal wave of the vibrating vocal folds seemed to increase with increasing water depth
3. The modulation effect by the water bubbles on the vocal fold vibrations was seen both in the high speed glottal area tracings and in the EGG signal. The bubble amplitude variation also increased with increased water depth. At 2 cm water depth, which is the most common way to use the resonance tubes in clinical practice, the signals were regular. At 6 cm water depth, however, the amplitude variation increased and got quite irregular.

The clinical implications of these findings have to be further explored.

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Susanna Simberg graduated as a speech language pathologist in 1972 and worked clinically for more than 30 years. Since 2005 she has worked as a senior lecturer and is now professor in Speech Language Pathology at the Department of Psychology and Logopedics, Åbo Akademi University, Turku, Finland. Main areas of interest are occupational voice disorders, prevention of voice disorders and voice therapy methods.

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Svante Granqvist, PhD since 2003, is an electrical engineer and associate professor in medical acoustics and human voice production at the Royal Institute of Technology (KTH) School of Technology and Health, Stockholm, Sweden. Main research interests are voice acoustics and computer methods for measurement, analysis and synthesis of voice.

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Stellan Hertegård, MD, PhD, is a specialist in ENT and Phoniatics at the Karolinska University Hospital, Stockholm, Sweden. He is an associate professor at the medical and Speech Language Pathology schools at the Karolinska Institutet. Areas of interest are voice disorders, esp. in professional singers and actors. He is engaged in stem cell research, i.e. how scarred vocal folds and laryngeal injuries can be reconstructed with human mesenchymal stem cells.

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Hans Larsson, PhD, is a research engineer at the Dept of Speech Language Pathology at the Karolinska Institutet, Stockholm, Sweden. Main research interests are methods for high speed filming and analyses of vocal fold vibrations, voice acoustics, computer methods for voice measurement and systems for patient recordings and documentation.

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Per-Åke Lindestad MD, PhD, is since 1988 specialist in ENT and Phoniatics at Karolinska University Hospital, Stockholm, Sweden. He is an associate professor at the medical and Speech Language Pathology schools at Karolinska Institutet and has been engaged in voice research since 25 years.

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Maria Södersten is a speech language pathologist, received her PhD in 1994, and became an associate professor at the Karolinska Institutet, Stockholm, Sweden, in 2006. She has worked as a clinician at the Karolinska University Hospital and is specialized in patients with voice disorders. Main areas of interest are occupational voice disorders and voice ergonomics. She is a member of a national interdisciplinary gender team to investigate the national care of transsexual patients.

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# Introduction to Pneumo-phono-resonantial Interactions in Speech and Singing (no. 18)

N. Henrich

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech
- Invited Lecture

Respiratory, phonatory and articulatory gestures allow the production and control of human voice. A coordination between these different actions adapted to the physiological constraints and the communication situation is critical to the proper use of the voice. Many vocal techniques in speech and singing are based on this coordination to increase voice intensity or change voice quality. In contrast, voice disorders of functional origin arise well often for an inadequate coordination, which should then be re-educated. Functional rehabilitation exercises in speech-language pathology are currently based on empirical knowledge of human-voice physiological and physical functioning. Exercised on breathing and phonation are often preferred to exercises on resonantial and articulatory adjustments. From the theoretical point of view, human voice production is modeled by the source-filter theory, which has proved its accuracy for modeling normal speech, but that shows its limitations when there is interest in voice quality, in synthesis naturalness, in dysphonia, vocal loading aspects and the development of vocal disorders of functional origin. In this theoretical approach, the phonatory aspects are decoupled from the articulatory aspects in first approximation. Respiratory aspects are very indirectly taken into account, the vocal tract being considered acoustically closed at the glottis during phonation. The aim of this special session is to present recent studies on the interactions between breathing, phonation, articulation and resonance in speech and singing, from several points of view: singing pedagogy, voice physical modeling, voice physiology.

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# Effects of Vocal Fold Material Anisotropy and Nonlinearity on Vocal Fold Vibration *(no. 19)*

Z. Zhang

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Modelling/Simulation
- Invited Lecture

Although phonation involves a complex coordination and interaction between the respiratory, laryngeal, and articulatory subsystems, the voice source is primarily determined by vocal fold properties which are regulated through laryngeal muscle activities. Previous work has demonstrated that vocal fold vibration and thus voice quality is sensitive to the stiffness conditions of the vocal folds, but the exact relationship still remains to be investigated. In this study, the effect of laryngeal muscle contraction on phonation will be discussed based on our recent numerical and experimental studies. The results showed that, compared to isotropic vocal folds, increasing anisotropy in vocal fold stiffness between the anterior-posterior direction and the transverse plane allowed vocal fold to better maintain adductory position against varying subglottal pressure without significantly increase in phonation threshold pressure. Increasing anisotropy also led to a more in-phase and uniform medial-lateral motion along the anterior-posterior direction, increased amplitude ratio between the medial-lateral and vertical motion, and increased vibration asymmetry between glottal opening and closing, thus facilitating efficient energy transfer from airflow into the vocal folds. Although such anisotropy is inherent in human vocal folds, due to material nonlinearity, the degree of anisotropy can be significantly increased by vocal fold elongation due to the action of the cricothyroid muscle, and decreased by the action of the thyroarytenoid muscle but to a less degree than the CT. [Work supported by NIH.]

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# Phonation into Straws: Impact of an Aeroacoustical Load on In-Vitro Vocal Fold Vibration (no. 20)

N. Hanna, X. Laval, N. Henrich

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Acoustics
- Invited Lecture

Vocal exercises involving the partial occlusion of the vocal tract, such as phonating into a straw, are commonly used in voice training and therapy. Such exercises modify the aerodynamic and acoustical loads downstream of the vocal folds, thus affecting their vibration. Human subjects, however, rapidly adapt their vocal gesture to compensate for such changes, making articulatory and acoustical adjustments that affect laryngeal muscle activity and glottal adduction.

This study attempts to distinguish the physical effect of the downstream load from the effect of the subject's automatic compensation. We compare the response of human subjects to that of a vocal fold model, constructed of latex and filled with water. The vocal fold replica is held in a fixed position, so that its mechanical properties may be modified solely by controlling their internal water pressure. Increasing this water pressure causes the latex to stiffen, thereby affecting the mechanical resonances of the folds.

The artificial vocal folds are connected to a rigid vocal tract model, which is loaded either by the radiation field at the open 'lips' or partially occluded with straws whose geometry was varied. The upstream ('subglottal') pressure is then adjusted to allow self-oscillation to occur. When pressurised air is supplied to the subglottal tract with the supraglottal tract open, the vocal fold replica oscillates at a fundamental frequency close to its second mechanical resonance. When a straw is used to occlude the tract at the output, the fundamental frequency decreases so that the oscillation occurs close to the first mechanical resonance of the vocal fold replica.

As the vocal folds are made to stiffen by increasing the water pressure, the air pressure required to begin self-sustained oscillation (onset pressure) increases. Initially the onset pressure for the open vocal tract is lower than when it is occluded by a straw. However, with very stiff folds, occluding the tract with a straw lowers the onset pressure required.

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## How the Vocal Tract Affects Voice Registration (no. 21)

I.R. Titze

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Modelling/Simulation
- Invited Lecture

The origin of vocal registers has generally been attributed to differential activation of cricothyroid and thyroarytenoid muscles in the larynx. Register shifts, however, can be affected by glottal pressures exerted on vocal fold surfaces, which can change with loudness, pitch, and vowel. In particular, the medial surfaces of the vocal folds are shown to be driven toward abrupt changes in angular orientation, toward either a convergent or divergent glottal shape, by changes in intraglottal pressure. The intermediate shape between convergent and divergent, namely a rectangular glottal shape with nearly parallel vocal fold surfaces, is less stable unless transglottal pressure is reduced and upper stiffness of vocal fold tissues is balanced with lower stiffness. This intermediate state of adduction, also known as mixed register, is a desirable target because it leads to the lowest phonation threshold pressure. Achieving this target consistently across wide ranges of F<sub>0</sub>, lung pressure, and vocal tract shapes appears to be a delicate balancing act of coordinating laryngeal muscle action with supraglottal pressure. Surprisingly, a large transglottal pressure is not facilitative in this process, exacerbating the bi-stable configuration and the associated register contrast. Hence, modern techniques of voice training and rehabilitation rely heavily on reducing transglottal pressure with a positive supraglottal pressure. Semi-occluded vocal tract (SOVT) exercises accomplish this. They are the path toward mixed registration, and therewith “ease of phonation.”

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# Breathing and Phonation: Important Considerations for Vocal Performance

(no. 22)

B. Gill

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Voice Pedagogy
- Invited Lecture

Phonation, the conversion of aerodynamic energy into acoustic energy at the level of the vocal folds, could not happen without airflow. Breathing and Phonation are intimately intertwined and when one understands how each system operates one can make informed decisions regarding how to alter the systems in order to encourage more efficient interdependence. This talk will focus on the different ways breathing can affect phonation and will include a discussion of the breath cycle, how vocal folds vibrate, the appoggio technique, tracheal pull, laryngeal height and different breathing methods.

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## 3D Digital Waveguide Vowel Synthesis (no. 23)

D. Howard, M. Speed, D. Murphy

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

Speech synthesis is typically highly intelligible but rarely is it highly natural in that it is rarely, if ever, mis-taken for a human output. One way to strive after improved naturalness is to make use of articulatory synthesis based on oral tract shapes that are derived from magnetic resonance imaging. In this paper we report on work to synthesise vowels using virtual vowel oral tracts that are based on MRI images. The excitation is the electrolaryngograph output and the experimental protocol adopted provides anechoic versions of the vowels for comparison. This procedure will be explained along with the results from synthesis for adult male and female vowels.

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# Is Jitter Irregularity the Missing Link Between Measured Speech Cycle Length Jitter and Perceived Vocal Timbre? (no. 24)

J. Schoentgen, J. Lucero

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Modelling/Simulation

Jitter designates small perturbations of the glottal cycle length or vocal frequency. The relative size of jitter is given as a percentage of the average vocal frequency or speech cycle length. The decision to describe jitter by means of a single number suggests that a quasi-definitional model of a jittered instantaneous vocal frequency would be equal to the unperturbed vocal frequency (i.e. intonation, declination) to which a small controlled amount of white noise is added. Recently, this model has been inserted into a speech synthesizer with a view to carrying out perceptual experiments. Results show that this model may indeed generate natural-sounding hoarse voices. But, precise glottal cycle length measurements reveal that the synthetic voices are perceived as hoarser than expected given the measured perturbations. That is, artificial jittered speech sounds sampled at 200 kHz may exist to which scores of 1 or 2 are assigned (on a roughness scale between 0 and 3) for measured cycle length jitter less than 1 %. It is also observed that the same model may not be able to simulate even moderately hoarse voices when one requests that the instantaneous sample-to-sample perturbations must remain well below the unperturbed instantaneous vocal frequency so as to stay within the conceptual framework of jitter as (small) perturbations. The explanation for both observations appears to be that the bandwidth of jitter (i.e. its irregularity) contributes to timbre and perceived degree of hoarseness. That is, low-pass filtering the instantaneous perturbations enables controlling the degree of perceived roughness, while keeping constant the size of the measured perturbations of the glottal cycle lengths. For instance, the rule of thumb that a measured cycle length jitter of 1 % causes vocal timbre to be perceived as border-line hoarse is applicable only when the instantaneous perturbations are low-pass filtered at a frequency of the order of magnitude of 100 Hz. Preliminary experiments show that for a given size of the measured perturbations of the glottal cycles, the timbre of the voice is perceived the hoarser and rougher (i.e. is assigned higher G and R scores on the GRABS scales) the larger the bandwidth of the perturbations of the instantaneous vocal frequency. Perturbation bandwidth appears however to influence perceived hoarseness less than perturbation size. That is, changes of perturbation size of the same order of magnitude are auditorily detectable, whereas changes of perturbation bandwidth may request variations over more than one order of magnitude to be perceptually discernable. Also, the auditory effect of bandwidth manipulations appears to be the more easily discernable the larger the perturbation size.

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# Characterization of the Physical Properties of the Vocal Tract in the Singing and Non-singing Configuration Based on Geometrical Realistic Finite Element Models (no. 25)

M. Fleischer, S. Pinkert, A. Poznyakovskiy, A. Mainka, D. Mürbe

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Other

The vocal performance of voice professionals strongly depends on the configuration of the vocal tract. Modeling of the vocal tract provides additional information on these characteristics, which might contribute to the improvement of educational strategies. Based on MRT-scans in case of singing the vowels /a/, /i/ and /u/ and the non-singing equivalent for three subjects, we build up a set of geometrical realistic finite element models of the vocal tract for calculating the transfer functions for the above-mentioned configurations.

Based on the Helmholtz-equation in the frequency domain the acoustics in the frequency range up to 5 kHz, depending on the chosen boundary conditions, will be discussed.

Depending on the vowel type, we will also discuss the differences in the pressure fields and the characteristics of the pressure in the time domain by considering an adequate pressure source at the vocal folds. Further, we will outline possibilities for using this framework in supporting the training of singers.

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# Influence of Piriform Sinuses and Valleculae on the Resonance and Antiresonance Characteristics of the Human Vocal Tract - Numerical Simulation (no. 26)

T. Vampola, J. Horáček, J.G. Švec

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Acoustics

The influence of the vocal tract on vocal output has been studied rather extensively, the influence of side cavities of human vocal tract, such as the piriform sinuses (PS) and valleculae (VA) has received much less attention. Generally, these cavities have been reported to cause antiresonances in the resulting vocal spectrum, i.e., largely decreasing the radiation of some frequencies out of the mouth, particularly around 4-5 kHz. As such, their role for the resulting vocal intensity may be considered undesirable, since it contrasts with the general goal of achieving maximum vocal output with the smallest vocal effort. However, a more detailed analysis reveals that besides the antiformants there are also new formants which occur due to these side cavities. In technical terms, the effect is side cavities can be described as creating a zero-pole pair in the overall transfer function of the vocal tract. The contribution investigates the influence of PS and VA and their size on the resonance and antiresonance characteristics of the vocal tract. The resonances as well as the antiresonances caused by the side branches of the vocal tract (PS and VA) were identified in the resulting acoustic output of the vocal tract. Increased sizes of both the PS and VA shift the corresponding antiresonances and resonances to lower frequencies. The change in sizes of PS and VA cavities alters the resulting voice quality. These changes can be explored by humans and play a role, e.g., in forming the speaker's or singer's formant cluster. Pilot studies reveal that additional formants caused by PS and VA can occur in the frequency range of 3 – 5 kHz, i.e., in the range which is important for the production of the so called singer's formant (in operatic voices) or speaker's formant (observed in professional speakers). It can thus be speculated that these cavities can help in establishing a "better" voice quality in speaking and singing. This contribution therefore aims at investigating the influence of the side cavities of the vocal tract in more detail using two sophisticated computational models of the vocal tract. First, is presented an analytical analysis of the influence of the acoustic spaces of PS and VA on the existence of resonances and antiresonances in the spectra of the acoustic signal simulated in front of the mouth using a reduced FE model of the human vocal tract. Then the full 3D FE model is used for the analysis by using direct numerical simulations of phonation.

This work is supported by the Grant Agency of the Czech Republic by the project No P101/12/1306 "Biomechanical modeling of the human voice production – way to artificial vocal folds"

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# Glottal Flow in the Absence of Vocal Fold Vibration on One Side - A Numerical Study (no. 27)

M. Willy, B. Christoph, M. Dirk

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Modelling/Simulation

Various behaviour of vocal folds motion during phonation in case of voice disorders was examined by Svec et al. 2007 by means of Videokymography (VKG). The absence of vibration of one vocal fold is observed in case of strong disorder. From the fluid dynamic point of view this type of asymmetric vocal fold motion and the resulting glottal flow field is in contrast to the symmetric lens-like opening type as presented by Mattheus et al. 2011.

The time resolved three dimensional pressure and velocity fields of the incompressible flow through the glottal gap are studied by numerical simulation for an asymmetric motion of the model vocal folds and compared to the results of the symmetric case.

Strong jet deflection in case of one vocal fold at rest is observed and also minor an influence of the presence of ventricular folds on jet deflection. The present letter addresses the ongoing discussion whether observations of jet deflection in simulations and model studies of the glottal flow are indicative for the presence of the Coanda effect in human phonation. The objective of the study is to demonstrate the sensitivity of the pulsating jet flow to the asymmetry of the movement of the orifice and to underline the need for adequate models that replicate the 3D motion of the glottis in a more realistic way.

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## What are Formants *(no. 28)*

G. Regner

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Acoustics

Physical explanation of the phenomenon “formant” easily explained and demonstrated.

In addition to its own oscillation, each medium compatible for resonance can take over other vibrations which show a multiple of the basic oscillation. This explains why the flageolet tones are possible. The singer stimulates parts of his/her body, “flageolet tones” or formants respectively, in order to increase the capacity of his/her voice.

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# Investigation of Formants with Children and Adolescents (no. 29)

G. Regner

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Child's Voice

Are children's voices predetermined for a specific singing style?

An initial investigation suggests, that some children have a clear disposition of voice, either for the classical or the non-classical singing (although with most children no absolute disposition can be ascertained).

A second study has investigated whether this disposition is congenital or whether it is influenced by the milieu the children live in during the first years of their lives.

In addition to its own oscillation, each medium compatible for resonance can take over other vibrations which show a multiple of the basic oscillation. This explains why the flageolet tones are possible. The singer stimulates parts of his body, "flageolet tones" or formants respectively, in order to increase the capacity of his voice.

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# The Use of Real-time Visual Feedback to Monitor and Minimise the Effects of Chemotherapy on the Singing Voice (no. 30)

S. Yarnall Monks

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

This paper illustrates the relationship between medicine, voice science and voice therapy and has important implications for teachers of singing who have students undergoing cancer treatment. The side effects of chemotherapy and the effect on a singer's vocal timbre and sense of vocal identity have been under researched.

Chemical side effects, psychological changes, gender, age, vocal technique and general health are all factors which make analysis complex but this case study suggests that using real-time visual feedback can be a useful tool for a singer to monitor changes in vocal quality.

A diary was kept monitoring the perceived vocal changes while preparing for several public performances. Frequent recordings were made of similar octave and scale exercises covering a two and half octave range using the Sing and See real-time visual feedback spectrographic programme.

- Data suggest auditory perception was responsible for some apparent vocal changes due to side effects of temporary hearing loss.
- Post-operative muscle strength also influenced vocal timbre and perception but the use of the Sing and See real-time visual feedback enabled the singer to modify and minimise the effects of treatment
- Markers of perception were identified including dryness and difficulties with lower range notes below middle C
- By using real-time visual feedback pitching variants, unevenness in tone, weak onset and breathy tone were detected and improved

This case study offers discussion across disciplines and provides a starting point for future research. Anecdotal evidence suggests that singing can provide beneficial therapy during cancer treatment but for professional singers the side effects of treatment can cause subtle changes in vocal timbre which can affect performance. The use of visual feedback technology could re-assure singers that vocal quality was more consistent than the perception experienced and close monitoring could enable singers to feel more in control when preparing for performance.

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# Student Singer's Vocal Development During Higher Education: Testing a Measurement Protocol (no. 31)

F.M.B. Lã, A. Mainke, D. Mürbe, J. Sundberg

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Clinical Issues

Training of the singing voice is associated with development of kinaesthetic feedback (1), auditory pitch control (2), as well as with changes in (i) acoustical characteristics (e.g. vocal timbre and loudness (3) voice source properties, e.g. contact quotient (4), and physiological aspects of voice production, e.g. respiratory adjustments, larynx position and articulatory gestures (5). However, longitudinal data on the development of these dimensions are scarce. Therefore it seems relevant to monitor, in an objective manner, effects of education in singing.

The current study aims at developing a recording protocol which would allow quantitative assessment of vocal skills during professional education of the singing voice.

Recordings of audio, electrolaryngograph, oral pressure and air flow signals were made of fourteen first-year singing students at the beginning of their university studies. Spontaneous speech, singing a vowel sequence on different sustained pitches and a messa di voce repeating the syllable /pae/ at low, middle and high pitch were recorded. Oral pressure during the /p/ occlusion was accepted as an estimate of subglottal pressure. Voice source was analysed by means of inverse filtering and relations between this pressure and maximum flow declination rate, normalised amplitude quotient, dominance of the fundamental, closed quotient, contact quotient and sound pressure level were examined. In addition, long term average spectra were analysed. Comparisons are made with the corresponding data previously reported for professional classically trained singers.

The results of this exploratory study suggest that the used protocol represents a comprehensive dataset allowing quantitative longitudinal assessment of vocal proficiency during higher education of the singing voice.

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# Listen to Your Own Voice – Others Do It: Intonation and Blend of Timbre of Choral Singers (no. 32)

S. Zadig

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Psychoacoustics

PhD-project in progress paper

## Aims

This study wants to identify specific ways choral singers improves their own singing by listening to and adapting to the voice of their neighbour singers. It is interesting both in aspects of vocal sound production, together with other singers, and also hearing and listening to and adopting neighbour singers vocal quality, timbre and blend.

## Background of the study

There have not yet been done very much research in this area with choral singers. My own earlier research has concerned the findings of existing formal and informal leaders in the choral voice.

## Background to this area of research

Some studies both on the voice and the choral voice has been done at the centre of acoustics at the Royal Technical Academy, KTH, in Stockholm, most often supervised by Johan Sundberg or Sten Ternström. Together Harald Jers & Sten Ternström has done multi-track recordings of a sixteen voices choir with regard to intonation and synchronisation as well as cooperation between the singers.

## Method

Ongoing recording studies are in progress with a semi professional choir of twenty four voices recorded with close up microphones individually on separate tracks. Small experiences are being done to emphasis the question on how they cooperate vocally (and audible). For example an unknown piece has been introduced and asked to sing a prima vista, first with earplugs in their ears, then without and then again without hearing each other. This repeats week after week. The recordings are done in Cubase and analyzed with the function VaryAudio.

## Findings

It is clear that there is a quite different quality to the sound when the singers have the possibility to cooperate compared to when they sing all by themselves. Another result is that the quality of the vowels is much more together and equalized when the singers can hear the voices of each other. When they can't hear each other, the vowels and also the pitch of each single chord, wobbles and is unstable.

## Discussion and implications

The possibility to hear fellow singers in the choral voice matters for the quality of the sound. This raises the question on how this can be achieved in the best way. With close up microphones on the singers in a choir, and recordings of their voices on separate tracks, it is possible to investigate the vocal communication between both the singers in the same choral voice and the communication between all the singers in the choir. This can be done in different seating or standing formations, rows in semi circles, wedges, mixed, many small quartets and others. Perhaps this can give new insights to which formation give best results for one or the other situation.

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# Neuroscience in Voice Work - Voice Starts in Your Brain (no. 33)

C. Macha

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Psychology

## Subject and goal

Voice is a matter of personality. Personality starts in your head as neuro-mental process. Today we can watch the brain during singing, thinking, performing etc. Our personality influences our voice tremendously. My speech offers the audience a peek into the interrelation of voice and neuroscience. Based on the knowledge of neuroscience, I will explain subjects like stress and stage-fright, motivation, human potential, basic needs of a voice-worker and how to deal with it.

## Demand position

The question is: What is the knowledge of neuroscience useful for in the every day life of a voice-worker? Here I will offer some answers.

## Result

The way we perform is a matter of our mental potential, of our thoughts. With mental techniques singers and other voice-workers can easily improve their hidden potentials.

## Objective

My goal is the transparency of the function of our brains. As soon as people recognize the way our brain works, they can influence it, they can become the coach of their own brain. In voice-work, they can develop their potential.

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# Design and Implementation of a Workplace Vocal Health Promotion Action. The Experience of 10 Public Schools in Bogota D.C., Colombia *(no. 34)*

L.C. Cantor Cutiva, A. Fajardo, L.E. Gacharná León, M.L. González Ceron, E.M. Mora Cárdenas, A. Burdorf

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Other

## Purpose

To design a workplace vocal health promotion (WVHP) action planned in a way to answer to voice needs among school workers of 12 schools in Bogotá D.C., Colombia.

## Methods

Occurrence of voice disorders among teachers compared with other occupations is high (ranging from 9% to 94%), but limited evidence on implementation of workplace vocal health promotion actions among Colombian teachers exists. Therefore, we conducted a (WVHP) action among 369 Colombian school workers. Design of the action was based on three sources: Literature search, previous experience on these actions and previous results on voice symptoms among the participants. A systematic review of the available scientific literature was conducted on the application of (WVHP) actions. Previous material used in similar actions was assessed and taken into account to design the (WVHP) action. Finally, previous results on self-reported voice symptoms among the participants were analysed; the three most often reported symptoms by school were selected to take into account in the (WVHP) action design. Satisfaction levels among participants were assessed at the end of the implementation of the (WVHP) action on each school.

## Results

The (WVHP) action was implemented on 10 out of 12 participant schools. Systematic review showed that good quality studies assessing interventions of voice disorders among teachers have been developed; however, most of the studies had small samples sizes, and satisfaction levels have not been investigated. The principal topics in the (WVHP) action were: Vocal Hygiene and Voice Projection Techniques. Vocal hygiene information was addressed by the prospectus. Voice projection techniques were the focus of the workshop. Participants were instructed on some techniques to breath, produce and project their voices. Satisfaction levels on the workplace vocal health promotion action were high among the participants.

## Conclusion

Workplace vocal health promotion actions could be a good tool to approach voice disorders at work. Future research including big sample sizes is needed in order to assess the impact of these actions in the prevention of occurrence of voice disorders at work.

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# Vocal Loading Among Primary and Secondary Classroom Teachers with Self-reported Voice Problems: The Relationship Between Voice Production and Background Noise Over the Teaching Day (no. 35)

S. Leão, J. Oates, S. Purdy, R. Morton, G. Dodd, D. Scott

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

Studies involving practical and objective measures in field conditions are needed to better characterise teachers' daily voice use, to identify potential causal factors for voice problems and to examine the effects of vocal load on teachers' voices. In this study, primary and secondary classroom teachers (males and females) with self-reported voice problems and matched-controls (by gender, age and ethnicity) without self-reported voice problems had their vocal dose assessed during two typical teaching days using the Kay Pentax Ambulatory Phonation Monitor (APM). Self-assessment questionnaires, auditory perceptual and acoustic analyses of voice, endoscopic evaluation of the larynx, and environmental measures of background noise during the teaching day (using a dosimeter attached to teacher's shoulder), reverberation time and room dimensions were completed. Teachers also answered a self-assessment questionnaire before and after classes, and filled in a voice diary. For this presentation, data related to vocal load, background noise and voice self-ratings (before and after using the APM) will be presented. Preliminary data from six teachers with self-reported voice problems have shown that female teachers phonated approximately 22% of teaching day, with speech levels averaging 80 dB SPL. The day's recordings were divided into three parts of equal time to examine change in voice and dosimeter values over the day. Overall F0 and voice SPL increased from the start to mid and end of the day. Teachers' voice levels increased over the day despite the dosimeter levels (LAeq and peak levels) indicating a drop in classroom noise levels over the same period. The change in voice self-ratings (comparing the beginning and end of the day) was correlated with middle ( $R_s=0.94$ ) and end of day ( $R_s=0.83$ ) F0 values (Spearman's,  $p<.05$ ). Additional teachers will have been assessed by the time of the conference, so the full data set will be presented and discussed in this presentation.

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# Occupational and Personal Factors Associated with Voice Problems in Teachers – Potential Predictors? (no. 36)

S. Leão, J. Oates, S. Purdy, D. Scott, H. Cooper-Thomas, R. Morton

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

Although risk factors for voice problems in teachers have been the focus of many studies, associations between some personal and occupational factors and voice problems remain equivocal. Teaching environments, teaching approaches and cultural/genetic factors differ across countries and so risk factors may also differ between countries. This study investigated potential occupational and personal predictors of voice problems in New Zealand teachers using a self-report questionnaire. This research constitutes the second phase of an epidemiological study involving a large sample of primary and secondary teachers. Responses from 634 teachers with complete data were analysed (response rate of 77.7%). The survey investigated a range of risk factors previously described in the literature as well as several novel factors: voice use patterns, teaching subjects and style, acoustic and air quality features of the teaching environment, and personal aspects. Standardized questionnaires were used to evaluate psychological factors such as stress, anxiety, depression, personality, coping style, engagement, self-efficacy, and voice-related quality of life. Health conditions were also assessed (e.g. reflux, sinus infections, and hearing problems). Four voice outcome measures were investigated: frequency of voice problems (considering a voice problem as an impairment), voice quality self-rating, voice-related quality of life scores (V-RQOL) and frequency and severity of voice symptoms. Females ( $p=.007$ ) and primary teachers ( $p=.035$ ) reported more voice problems. There was a trend for teachers of Languages/ESOL (English as a Second or Other Language) and the National Curriculum ( $p=0.09$ ) to report voice problems. Teachers with self-reported voice problems presented with significantly higher mean scores for harmful vocal patterns during teaching ( $p<0.001$ ), stress ( $p=.013$ ), depression ( $p<0.001$ ), and anxiety ( $p<0.001$ ) and lower scores on emotional stability ( $p=.020$ ). The teachers with voice problems rated their classrooms as having poor acoustics (e.g. poor sound absorption and background noise) ( $p<0.001$ ) and poor air quality (e.g. cold/draughty, dust, humid) ( $p<0.001$ ). Voice problems were also associated with colds, sinus infections, throat and sinus infections and hearing problems. Results from regression models used to elucidate possible predictors will be presented and discussed.

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# Voice Assessment and Laryngeal Findings Among Kindergarten Teachers

(no. 37)

A. Geneid, E. Kankare, E. Vilkmán, A.-M. Laukkanen

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

Kindergarten teachers received less attention in comparison to school teachers with respect to their voice problems. This is despite the fact that kindergartens are expected to have high noise levels and usually part of the day activities are carried outdoors. This study aimed to investigate the voice problems among kindergarten teachers and working conditions affecting them negatively. It also aimed to carry out laryngeal examination for them in their places of work. We studied 119 teachers through internet questionnaire that covered voice habits, voice symptoms and working conditions affecting negatively their voices. In addition, laryngeal examination was carried for the teachers in their places of work. Results showed that 71% reported monthly or more often strain on the voice. In addition, 56% reported hoarseness without infection. Noise at work stood as most detrimental to the voice. Laryngeal examination revealed organic findings among 11% of the examined teachers. Such findings did not correlate with the subjective voice symptoms reported by them. The results point to kindergarten teachers being a risk group that suffer remarkably from voice problems. Noise in their work environment is most harmful to their voices. Still the diagnosis and management on their voice disorders should be based on their self-assessment of voice rather than only findings of organic lesions in their larynges that do not correlated with their voice problems.

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# Influence of the Voice Pitch in the Credibility of the Broadcast Radio News

(no. 38)

J. Vila-Rovira, M. Llussà

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

## Introduction

The voice is the vehicle for the transmission of news by radio. The speaker uses his voice to make give sense to of the news. The speaker intends the audience to believe in the information.

The voice pitch has an influence on the attraction and seduction and in the authority conveyed by the speaker (1, 2, 3, 4, 5, 6, 7). In general, these studies show that low voices of men are valued by women as attractive, seductive voices that convey authority. These perceptions are related to the inference of the action of hormones on growth and muscle power.

Also, in the same way, Klofstad et al (8), show that voices with lower frequencies transmit greater leadership skills. In terms of radio news, De Meo et al (9) studied the influence of accent and intonation in the credibility. In his work, they report that the voices with less tonal inflections show more credibility.

The aim of our study is to determine the influence of the speaker's pitch voice on the credibility of the news. We hope to see the broadcast of radio news with a more low vocal frequency are considered more credible than those issued with high pitch voices.

## Subjects and methodology

A professional speaker issued six news written for this study and had been considered, by a group of twenty readers, as ambiguous news. The announcer spoke with a spontaneous tone. The voice samples were modified with the program Praat (10) following the procedures submitted Klofstad et al (8). The samples were modified increasing 0.5 ERB and decreasing 0.5 and 1 ERB. These modifications allowed us to obtain 4 different versions of each story.

The 24 news were presented randomly to a total of 69 journalism students from the Universitat Ramon Llull (Barcelona, Spain). The students evaluated the credibility of the story on a scale of 5 stretches, as well as other parameters which are not showed in this research.

## Results

Our results show that the news showed a high pitch (between 146 and 167 Hz.) were less credible than that presented a pitch between 106 and 145 Hz. ( $t = 3,822$ ,  $P < 0.01$ ). Moreover, it was observed that the news had a lower pitch to 106 Hz. were rated as less credible than those of 106 and 145 Hz. ( $t = 10,838$ ,  $p < 0.01$ ).

Our research allows us to state that low voices are considered more credible by listeners than high voices or extremely low voices.

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# Distance Based Evaluation and Cloud Storage: The Future of Voice Care?

(no. 39)

M. Benninger

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Measurement
- Invited Lecture

Imaging has become a major component in the assessment and treatment of Otolaryngology patients and the specialty has benefited from the introduction of imaging technology including computerized radiology and endoscopic imaging. Media archive systems extend this benefit by allowing comparative review of serial examinations and facilitate image review by otolaryngologists in locations that are connected through these systems. Cloud based media storage offers a method to provide collaborative diagnostic capabilities using a patient's recorded and archived diagnostic images and videos, while providing accessibility to the patient and potentially to multiple providers in multiple locations. This functionality is achieved through use of a computer based digital media acquisition platform, which captures, encodes, and encrypts the recorded imagery, then transfers the secure encrypted media file to the cloud storage repository. Once in the cloud the encrypted file can be accessed for viewing and collaboration via a password protected web-browser based application accessible from any computer with internet access. The development and implementation of a cloud based image archive and diagnostic system will be described. The presentation will include a discussion of how the technical aspects of deploying a cloud based collaborative image archive system have been overcome and discuss some clinical applications of this technology, as well as the essential security and privacy related issues that need to be addressed to meet patient and regulator standards will be defined.

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Dr. Michael S. Benninger is the Chairman of the Head and Neck Institute at The Cleveland Clinic and is a Professor of Surgery at the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University. The Head and Neck Institute comprise the specialties of Otolaryngology, Audiology, Speech and Language Sciences, Oral Surgery and Dentistry.

In addition to his work at the hospital, Dr. Benninger has been very involved in Regional, National and International medical organizations. He is the Past-President of the American Laryngologic Association, the President of the International Association of Phonosurgery and Vice-President and a member of the Board of Directors of the Voice Foundation. He served on the Board of Directors of the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) for 12 years, having been a former Vice President and Chairman of the Board of Governors of that organization. He is also a Past-President of the American Rhinologic Society and the Michigan Oto-Laryngological Society. He is the former Editor-in-Chief of the Journal, Otolaryngology-Head and Neck Surgery, which is the largest peer-reviewed journal in the world for that specialty. He has served on the Residency Review Committee for Otolaryngology and as a member of the Medical Advisory Board for WebMD. He is the Past-Chairman of the Steering Committee for the Sinus and Allergy Health Partnership.

Dr Benninger has authored or edited 6 books, including his most recent books, "Techniques of Botulinum Toxin Injections in the Head and Neck", "The Performer's Voice" and "The Singer's Voice". He has 2 additional books in press. He has also has written over 75 book chapters and over 170 scientific articles, focusing primarily on voice care and laryngology, nasal and sinus disease and health care management. He has lectured extensively across the country and throughout the world.

A graduate of Harvard University, Dr. Benninger received his medical degree from Case Western Reserve University in Cleveland, Ohio. He completed his residency at the Cleveland Clinic Foundation.

# Identification of Epithelial Stem Cells in Human and Porcine Laryngeal

## Mucosa (no. 40)

G. Woodson, D. Crosby, D. Laugh

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Vocal Fold Healing
- Invited Lecture

Vocal fold scar is a significant cause of voice disability. Current treatments do not satisfactorily restore the voice. Stem cell implantation has been proposed as a potential treatment. However, little is known about the role of endogenous stem cells in vocal fold healing. Recently, skin and intestinal cells expressing leucine-rich orphan G protein-coupled receptors (Lgr) have been described as multipotent adult stem cells. To determine whether these proteins are present in laryngeal epithelium, we harvested mucosa from porcine and murine vocal folds. Immunohistochemistry documented the presence of Lgr5 and Lgr6 markers. This was confirmed by PCR. This suggests that there are stem cells in laryngeal mucosa that play a role in vocal fold healing.

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# Establishing Nomenclature and Guidelines: Experience of the European Laryngological Society (no. 41)

G. Friedrich

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues
- Invited Lecture

Since its beginning the European Laryngological Society made it its task to provide proposals for classification and nomenclature standards and to establish guidelines. Several of these have gained widespread acceptance not only in Europe but also internationally. An overview on the protocols published by the ELS will be given.

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# Phonosurgery, Where We Have Been and Where We Are Going (no. 42)

*M. Courey*

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Medicine
- Invited Lecture

Not Available

## What's New in Laser Surgery in the Larynx? (no. 43)

M. Remacle

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues
- Invited Lecture

The introduction of the scanning CO<sub>2</sub> laser micromanipulators for use with microscopes has enabled very precise surgery, especially on the vocal folds. However, delivery of the laser beam via a micromanipulator mounted on the microscope makes access to some laryngo-pharyngeal regions challenging because the laser beam must travel to the tissue target in a straight line. To alleviate this issue, flexible CO<sub>2</sub> hollow fiber waveguides were created. The most recent product in the hollow fiber family is the FiberLase™ CO<sub>2</sub> laser waveguide (CO<sub>2</sub> LWG) (Lumenis, Santa Clara, CA).

This carbon dioxide laser emits laser powers of up to 40 W of Continuous Wave laser mode and 15 W average power in SuperPulse mode. It utilizes a flexible 2-m long waveguide (WG) with an outer diameter of 1.04 mm to transmit the laser energy to the tissue site.

Power transmission is 60–70% through the WG and the effective spot size at the tip is 320μ. Beam divergence is low so the fiber can be used at working distances of up to 5 mm in non-contact mode. A red aiming beam, emitted through the same WG, allows for precise targeting of the laser energy.

Although the CO<sub>2</sub> LWG lacks the precise automation of the CO<sub>2</sub> laser microscopic scanning system, it has the same CO<sub>2</sub> tissue effect profile and less thermal effect than the PDL or the KTP used in office-based laser surgery.

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## Medialization of Vocal Cord - History, Present and Future (no. 44)

V. Chrobok

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery
- Invited Lecture

Glottic insufficiency is one of the most common contributing factors in patients who present with dysphonia. The most common causes of symptomatic glottis insufficiency are unilateral vocal cord paralysis or paresis and presbylaryngis. Medialization (approximation) can change the position and tension of the vocal folds safely.

Many different phonosurgical techniques have been used for unilateral vocal fold paralysis or atrophy: augmentation of the vocal folds by means of intracordal injections (hydron rod, fat, calcium hydroxylapatite and hyaluronic acid) or laryngeal framework surgery, medialization thyroplasty (customized silicone implant). Author reviews progress in augmentation of vocal fold and laryngeal framework surgery in Czech Republic. Advantages and disadvantages of different techniques are described.

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# Cloud-based Storage and Archiving of Laryngology Images and Files (no. 45)

M. Benninger

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Diagnosis
- Invited Lecture

Imaging has become a major part in the assessment and treatment of Otolaryngology patients and the specialty has benefited from the introduction of imaging technology including computerized radiology and endoscopic imaging. Media archive systems extend this benefit by allowing comparative review of serial examinations and facilitate image review by otolaryngologists in locations that are connected through these systems. Cloud based media storage offers a method to provide collaborative diagnostic capabilities using a patient's recorded and archived diagnostic images and videos, while providing accessibility to the patient and potentially to multiple providers in multiple locations. The development and implementation of a cloud based image archive and diagnostic system will be described. The presentation will include a discussion of how the technical aspects of deploying a cloud based collaborative image archive system have been overcome and discuss some clinical applications of this technology. The essential security and privacy related issues that need to be addressed to meet patient and regulator standards will be defined.

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## Lasers in Phonosurgery (no. 46)

*M. Remacle*

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Medicine

Not Available

# Surgical Management of Vocal Fold Scar (no. 47)

G. Friedrich

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Scarring of the vocal folds leads to a deterioration of the highly complex micro-structure with consecutively impaired vibratory pattern and glottic insufficiency. The resulting dysphonia is predominantly characterized by a reduced vocal capacity. Despite considerable progress in understanding of the underlying pathophysiology, treatment of scarred vocal folds is still an unresolved chapter in laryngology and phonosurgery. Decisive for a successful treatment is an individual, multi-dimensional concept that comprises the whole armamentarium of surgical and non-surgical (i.p. voice therapy) modalities.

The chosen phonosurgical method is determined by the main clinical feature: Medialization techniques for treatment of glottic insufficiency, or epithelium freeing techniques for improvement of vibration characteristics often combined with injection augmentation or implantation. In severe cases buccal mucosa grafting can be an option. New developments include treatment with angiolytic lasers (PDL, KTP), or techniques of tissue engineering. However, despite promising results by in-vitro experiments, animal studies and first clinical trials, the step into clinical routine application has yet to be done.

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# Endoscopic Laser Thyroarytenoid Myoneurectomy for Adductor Spasmodic Dysphonia (no. 48)

M. Remacle

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

## Introduction

Adductor spasmodic dysphonia is a voice disorder characterized by spasms of the laryngeal muscles during phonation, producing an interrupted, strained, forced and strangled voice. At the moment, botulinum toxin injection is considered to be the first-choice therapy by most services. Disadvantages of this treatment include the need of reapplications every 3 to 4 months, vocal instability observed at the beginning and at the end of drug action, lack of result's uniformity among patients, the drug's high cost, the need for adequate equipment for its application and large dosage therapeutic range with wide variation among physicians and patients treated by the same physician. In view of the disadvantages cited above a new technique was developed in which endoscopic neurectomy of the thyroarytenoid branch of the inferior laryngeal nerve is combined with CO2 laser partial myectomy of the thyroarytenoid muscle.

## The Surgical Technique

- Step 1: Partial thyroarytenoid myectomy is performed by vaporizing the lateral portion of the vocal cord with a CO2 laser.
- Step 2: Neurectomy of the thyroarytenoid branch of the inferior laryngeal nerve is performed by the use of a tip of an electrical surgical knife (specially designed for this purpose) connected to an electrocautery apparatus. The thyroarytenoid branch of the inferior laryngeal nerve is located between the internal perichondrium of the thyroid cartilage and the fasciae of the lateral cricoarytenoid and thyroarytenoid muscles. The surgical knife is introduced at the posterior limit of the myectomy and upward movements are then performed with the electrocauterizer in order to catch and section the nerve by electrocoagulation. Both vocal folds are submitted to the same surgical procedure.

## Objective

The aim of this presentation is to show the surgical technique and the long-term outcome on voice quality of this technique based on documented videos of the surgery and of speaking patients. Voice Handicap Index (VHI) from 22 patients was also obtained before and after surgery and its results which are very promising are also presented.

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## Office Based Laryngeal Surgery (no. 49)

P.C. Bryson

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Office-based laryngeal procedures have become more common. The renaissance of office-based laryngeal surgery has allowed the surgeon to offer appropriately selected patients treatment without undergoing general anesthesia. This presentation will discuss the various treatment opportunities for surgeons in awake, unsedated patients.

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## Laryngeal Stenosis *(no. 50)*

*G. Campos*

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Medicine

Not Available

# Surgical Treatment of Vocal Fold Scar Using Fibroblast Growth Factor (no. 51)

S. Hirano

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Vocal fold scar still remains a therapeutic challenge. Several surgical procedures have been developed including excision of scar, slicing technique, fat implant/injection, fascia implant, thyroplasty, etc. Multiple operations are often required for difficult cases, and it is important how to select appropriate procedure according to each case's problem. We have developed a regenerative surgery using basic fibroblast growth factor (bFGF) with gelatin/collagen sponge. This procedure consists of dissection of scar and implant of scaffold with bFGF. Basic FGF has strong angiogenetic effects as well as regenerative effects of epithelial and mesenchymal cells. Basic FGF also affects cell function of fibroblasts, which leads to increased production of hyaluronic acid (HA). It is therefore expected that bFGF stimulates ingrowth and HA production from vocal fold fibroblasts, which can lead to regeneration of the vocal fold mucosa. However, it is not so easy to achieve the aim by a single procedure even with bFGF, and staged operation may be occasionally needed. How to surgically approach the vocal fold scar is discussed.

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## Update on Vocal Fold Regeneration: Cells and Gel (no. 52)

S. Thibeault

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Normal vocal fold vibration is crucially dependent upon tissue composition and viscoelasticity. When composition of the extracellular matrix (ECM) of the vocal fold cover (i.e. lamina propria – superficial and middle layers) is altered, vocal fold vibratory function can be severely disrupted due to alterations in tissue viscoelasticity. The dysphonias that result are generally difficult to treat effectively with current surgical paradigms and available biomaterials. Treatment failures have been ascribed to poor understanding of pathologic processes in the ECM, as well as suboptimal materials that may negatively affect vocal fold biomechanical properties. Accordingly, there is a clinical need for improved understanding of the pathophysiology of disrupted ECM and the development of advanced biomaterials that appreciate the biomechanical properties of the lamina propria. We will present an update on our research whose long-term aim is to engineer injectable products that promote wound repair and induce tissue regeneration, for treatment of scarring and other existing ECM defects of the lamina propria, exclusively for the superficial and middle layers. Manipulation of the ECM with injectable HA hydrogels and sols that have been encapsulated with living cells will be presented with emphasis on stem cells, macrophages and induced pluripotent stem cells.

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# Introduction to the Special Session “Voice and Speech in Male-to-Female Transgender Clients: Current Knowledge on Effectiveness of Voice Therapy and Surgery, and Outcome Measures” (no. 53)

M. Södersten

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Trans-sexualism
- Invited Lecture

The prevalence of Male-to-Female Transsexualism has been reported to range from 1:30000 to 1:10000 in different countries. The number of transsexual clients seeking support from health professionals appears to be increasing. Many request professional help with their voice, speech and communication skills in order to pass in their desired gender. The World Professional Association for Transgender Health (WPATH) provides clinical guidance through the publication Standards of Care. This guidance is for health professionals to assist transsexual and other gender variant persons “to maximize their overall health, psychological well-being, and self-fulfillment”. The latest publication of Standards of Care (no 7, 2011) states that “this assistance may include primary care, gynecologic and urologic care, reproductive options, voice and communication therapy, mental health services (e.g., assessment, counseling, psychotherapy), and hormonal and surgical treatments”. The Standards of Care are based on the best available science and expert professional consensus.

In this special session, an update on research and evidence for the effectiveness of speech pathology interventions and for pitch raising surgery will be presented. Methods for the difficult task of transferring what is learnt in the voice clinic into everyday life will be given and discussed. Because good assessment protocols are crucial for guiding intervention and evaluating therapy outcomes, the newly developed Transsexual Voice Questionnaire will also be presented.

Coleman, E., Bockting, W., Botzer, M., Cohen-Kettenis et al. (2011) Standards of Care for the Health of Transsexual, Transgender, and Gender-Nonconforming People, Version 7. *International Journal of Transgenderism*, 13:165–232.

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# Evidence for the Effectiveness of Speech Pathology Interventions (no. 54)

J. Oates

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Clinical Issues
- Invited Lecture

Since the late 1970s, speech pathology interventions, particularly those focused on voice, have been recognised as an important contributor to the quality of life of male-to-female transsexual people in terms of successful transition to the female role, social and vocational participation and psychosocial well-being. In particular, voice therapy aims to assist these clients to develop voice characteristics that are congruent with their desired female gender identity. The targets of voice therapy interventions traditionally include voice pitch (average, range and variability), loudness (average, range and variability), voice quality, and resonance. These voice targets have been recommended on the basis of research findings on voice differences between non-transsexual female and male speakers, voice features that are predictive of listener perceptions of speaker gender, voice features that differentiate transsexual from non-transsexual speakers and transsexual, and voice characteristics that distinguish transsexuals who are perceived by listeners as women from those who are perceived as males. A range of general recommendations for voice training procedures have been documented in the literature and it is clear that there is reasonable consensus in the literature and among experienced speech pathologists as to the most effective voice therapy methods. However, critical appraisal of published research demonstrates that the evidence for the effectiveness of voice therapy for male-to-female transsexuals comes mainly from expert opinion, case reports and observational case series studies without control groups rather than from randomised controlled trials or quasi-experimental studies. It remains the case that there are no research reports that provide even moderately strong evidence for the effectiveness of voice therapy in this population. Further, no studies have demonstrated the relative effectiveness of specific intervention methods or the relative effectiveness of targeting specific voice characteristics and the research literature provides little information as to the prognostic indicators for successful voice interventions. Despite this somewhat bleak picture concerning the evidence base for voice therapy with male-to-female transsexuals, clinicians must remember that best clinical practice must also be informed by clinical expertise, the goals and preferences of our clients, reports of client satisfaction with the voice therapy, and the outcomes of voice therapy demonstrated through case studies and case series reports. This presentation will review the best available scientific evidence for voice therapy with transsexuals and provide some guidance as to how clinicians might combine that evidence with expert consensus, individual client data and recent sociologic conceptualisations of gender to guide their practice. Recommendations will also be provided as to research approaches that would improve the evidence-base in this field.

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# Evidence for the Effectiveness of Pitch Raising Surgery and Potential Side-effects (no. 55)

S. Hertegård, V. Kelly

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Trans-sexualism
- Invited Lecture

This presentation will focus the result of different surgical techniques for correcting the pitch in male-to female transgender patients. Several techniques are used for pitch correction/adjustment. We will compare short term and longer term results and discuss pro and cons with different surgical approaches.

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# Self-report in Voice Assessment: The Transsexual Voice Questionnaire (MtF)

(no. 56)

G. Dacakis, S. Davies, J. Oates, J. Johnston

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Trans-sexualism
- Invited Lecture

Appropriate voice therapy intervention relies heavily on the accurate assessment of the individual's voice. Evaluation of therapy outcomes similarly relies on accurate assessment of voice change across the course of therapy. Traditionally, this assessment for male-to-female transsexuals has focused primarily on the acoustic analysis of fundamental frequency (i.e., the acoustic correlate of voice pitch). This measure, however, may have no bearing on the impact of voice on the individual and whether therapy has improved an individual's voice-related functioning in everyday life.

Over the past 20 years, development of the World Health Organisation's framework for health and disability (International Classification of Functioning, Disability and Health) has triggered the development of a range of questionnaires to measure the impact of voice disorders on an individual's functioning in every day life. Self-evaluation questionnaires such as the Voice-Related Quality of Life (V-RQOL) and the Voice Handicap Index (VHI) are available for use with people demonstrating a range of voice disorders. These scales, however, do not capture the unique voice-related difficulties experienced by transsexual individuals in their everyday lives (TSjoen et al., 2006).

This presentation reports on the development and initial psychometric evaluation of the Transsexual Voice Questionnaire for male-to-female transsexuals (TVQMtF). Responses on the TVQMtF for a group of male-to-female transsexuals will also be presented and discussed in relation to the voice-related concerns expressed by these individuals.

T'Sjoen G, Moerman M, Van Borsel J, et al. Impact of voice in transsexuals. *International Journal of Transgenderism*, 2006; 9: 1–7.

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## Transfer: The Missing Link? (no. 57)

G. Dacakis, S. Davies, J. Oates, J. Johnston

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Trans-sexualism
- Invited Lecture

Despite the steady increase in publications and research reports in the area of voice feminisation for male-to-female transsexuals, the majority of recent publications focus on therapy outcomes and aspects of voice that contribute to perceptions of gender (Carew, Dacakis and Oates, 2007; Owen and Hancock, 2011; Van Borsel, Janssens, De Bodt, 2009) with little attention to the equally important processes and procedures involved in voice therapy. Reports investigating the suitability of individual therapy techniques for voice feminisation and the factors that promote maintenance of vocal skills learnt in therapy are rare. One important aspect of the therapeutic process that is under-represented in the literature and that may have a bearing on long-term maintenance of voice change is that of transfer i.e., the transfer of voice skills learnt in clinic to the individual's everyday life. In the absence of research reports concerned with methods that facilitate transfer of newly acquired voice skills to extra-clinical contexts for transsexuals, clinicians are dependent on anecdotal evidence from expert clinicians, supplemented by the broader speech pathology literature regarding practice regimes and motor learning (e.g., Block, 2004; Wong, Ma and Yiu, 2011; Verdolini Abbot, 2011). This presentation will combine available sources of information regarding transfer to provide preliminary guidelines on transfer specific to the transsexual population.

Block, S. (2004). The evidence base for the treatment of stuttering. In: S. Reilly, J. Douglas. and J. Oates, Editors. *Evidence based practice in speech pathology*. London: Whurr Publishers. 83-109.

Carew, L., Dacakis, G., Oates, J. (2007). The effectiveness of oral resonance therapy on the perception of femininity of voice in male-to-female transsexuals. *Journal of Voice*, 21(5), 591-603.

Owen, K. & Hancock, A. (2011) The role of self- and listener perceptions of femininity in voice therapy. *International Journal of Transgenderism*, 12:4, 272-284

Titze, I.R. and Verdolini, K. *Vocology: The science and practice of vocal rehabilitation*. Utah: National Center for Voice and Speech, 2012

Van Borsel, J., Janssens, J. and De Bodt, M. (2009). Breathiness as a feminine voice characteristic: A perceptual approach. *Journal of Voice*, 23:3, 291-294.

Wong, A., Ma, E. and Yiu, E. (2011). Effects of Practice Variability on learning of relaxed phonation in vocally hyper-functional speakers. *Journal of Voice*, 25:3, e103-e113

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# Voice Treatment for Neurological Disorders: Part 1 (no. 58)

L. Ramig, C. Fox

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice
- Invited Workshop

Parkinson disease (PD) is a progressive, neurodegenerative disorder with no known cure. More than 6 million people in the world suffer from PD. Nearly 90% of these individuals have a speech or voice disorder. Even early in the disease, reduced loudness, monotone and hoarse voice quality are commonly observed and contribute to social isolation, frustration and embarrassment. These disorders have been associated with inadequate activation of the speech musculature (hypokinesia/bradykinesia) and are generally unresponsive to neuropharmacological and neurosurgical treatments. Over the past 20 years with NIH support, our research team has developed and advanced the first efficacious speech treatment for PD. This intensive, exercise-based intervention, known as the Lee Silverman Voice Treatment (LSVT LOUD), is a PD-specific, neuroplasticity-principled standardized protocol. Published data from a series of Randomized Control Trials (RCT) document improvements in variables critical to functional speech production: vocal loudness (sound pressure level (SPL)) and pitch variability (fundamental frequency (F0) variability) during reading and monologue that are maintained 24 months post-treatment. Such increases in SPL and F0 variability in people with PD have been shown to positively impact listener intelligibility. External validation of positive LSVT outcomes has been reported by independent labs and reviews. In addition, improvements in physiologic, acoustic, perceptual and psycho-social measures have been reported post-LSVT. Although LSVT has potential to offer a low-risk, high yield impact on speech, there are real-world challenges that must be addressed to facilitate implementation. Geographical barriers limiting access to speech clinicians and the time, effort and expense of travel to treatment sessions can be prohibitive. Preliminary studies suggest that LSVT delivered by telemedicine is feasible, promotes accessibility and has effective outcomes.

## The Aims of Part I of this Workshop are to:

1. Review the research findings on LSVT LOUD.
2. Describe key elements of treatment and their relationship to the complex origins of the speech disorder in PD.
3. Discuss neural bases underlying the key treatment concepts of LSVT LOUD: Target (voice/amplitude), Mode (intensive/high effort) and Calibration (sensory, cueing, and neuropsychological deficits).
4. Discuss increased treatment accessibility through technology-supported delivery.

## Support

National Institutes of Health (NIH-NIDCD): R01 DC1150, R21 RFA-NS-02-006, R21 DC006078, R21 NS043711 and The Michael J. Fox Foundation.

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Dr. Ramig is a Professor in the Department of Speech-Language and Hearing Science at the University of Colorado-Boulder, a Senior Scientist at the National Center for Voice and Speech-Denver, an Adjunct Professor at Columbia University in New York City and Co-founder and President of LSVT Global, Inc. She is an internationally recognized clinical scientist with an established research record in the areas of aged and neurological voice disorders. Her research has been funded by the National Institutes of Health (NIH) for over twenty years. She has lead teams of researchers and clinicians through the process of developing a voice intervention for PD (LSVT LOUD), initial studies of its efficacy, describing the underlying physiologic and neural bases accompanying intervention, and developing technologies to scale patient accessibility to intervention. The work of these teams has contributed substantially to the knowledge base on speech and voice in PD, making an impact on the neurology, otolaryngology and speech communities, improving patient care globally and as such has positioned speech intervention within the forefront of rehabilitation science research today. Dr. Ramig has been a member the National Advisory Council for the National Institutes of Deafness and Communication Disorders and has received a number of awards including the Honors of the American Speech Language Hearing Association, the highest award of her professional organization.

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Cynthia Fox, Ph.D., CCC-SLP received her doctorate degree in Speech and Hearing Sciences from the University of Arizona, Tucson. Her training included a focus in the areas of neuroscience and motor control. She is an expert on rehabilitation and neuroplasticity and the role of exercise in the improvement of function consequent to neural injury and disease. Dr. Fox is a world leader in administration of LSVT LOUD speech treatment for people with Parkinson disease. Dr. Fox began working with Dr. Ramig over 18 years ago conducting efficacy research on LSVT in people with Parkinson disease. She was the first to apply this treatment to disorders other than Parkinson disease (e.g., multiple sclerosis) and pioneered the application to pediatric populations including children with cerebral palsy and Down syndrome. Dr. Fox worked closely on the development of a physical therapy program, LSVT BIG, that was modeled after the speech treatment protocol. More recently, she has collaborated in the development of a novel HYBRID approach that simultaneously delivers speech and physical therapy for people with Parkinson disease. Dr. Fox has been a key part of the LSVT Training and Certification Workshop faculty developing and delivering LSVT LOUD and LSVT BIG Training and Certification Workshops globally. Currently there are over 13,000 speech, physical and occupational therapists in 54 countries trained to deliver the LSVT protocols. Further, Dr. Fox has numerous publications in these areas of research and has presented extensively nationally and internationally. Dr. Fox is a Co-Founder and Vice President of Operations of LSVT Global, Inc.; a Research Associate at the National Center for Voice and Speech in Denver, CO; and an adjunct faculty in the Department of Speech-Language-Hearing Sciences at the University of Colorado, Boulder.

## Voice Treatment for Neurological Disorders: Part 2 (no. 59)

C. Fox, L. Ramig

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice
- Invited Workshop

Over the past 20 years of research, we have made great advances in understanding key elements of successful speech and physical therapy in humans living with Parkinson disease (PD). The recent advances in neuroscience that define parameters of skill training that promote activity dependent neuroplasticity have allowed us to evolve our thinking to another level of understanding. Research with animal models of PD have shown that exercise may interfere with the cell death associated with PD and may bring about improvement in how the brain functions. Collectively, these findings challenge the rather long-standing assumptions held by some in the rehabilitation community that there is no potential for neural recovery (or perhaps prevention) in people with PD. The Lee Silverman Voice Treatment (LSVT LOUD) began as a physiologically based treatment focused on laryngeal function. Over years of clinical efficacy research our observations expanded to include distributed effects of treatment to articulation, facial expression, and swallowing. Given these distributed effects, together with physiological and imaging data, today we hypothesize that LSVT recruits a wide network of brain regions including phylogenetically old regions and right hemisphere associated with amplitude scaling, emotive vocalization and prosody. In addition, the evolution of our work within the greater field of sciences, has led us to the recognition of the significance of embedded elements of motor learning and neuroplasticity, providing a perspective on the underlying bases for the speech disorder in PD. This broader perspective is the basis for the application of LSVT beyond individuals with PD to other neural disorders.

### The Aims of Part II of this Workshop are to:

1. Briefly explain recent advances in neuroscience that have had a positive impact on the field of rehabilitation for individuals with PD.
2. Discuss the neural correlates of post-LSVT LOUD outcomes. Recent imaging studies in humans with PD support that behavioral intervention may directly or indirectly modulate basal ganglia function and recruit other right hemisphere areas associated with improvements in vocal functioning in PD.
3. Introduce emerging animal models of vocal sensorimotor deficits in PD including rodent and songbird models. These models may provide insight into the relationship between dopamine depletion and vocalizations as well as knowledge about interventions that might improve vocal function or prevent dysfunction.
4. Describe the application of speech treatment concepts to the limb motor system including the physical/occupational therapy LSVT BIG and the simultaneous delivery of voice and body treatments in LSVT HYBRID.
5. Provide the background and rationale for application of LSVT beyond PD including adults with multiple sclerosis, and children with cerebral palsy and Down syndrome.

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Cynthia Fox, Ph.D., CCC-SLP received her doctorate degree in Speech and Hearing Sciences from the University of Arizona, Tucson. Her training included a focus in the areas of neuroscience and motor control. She is an expert on rehabilitation and neuroplasticity and the role of exercise in the improvement of function consequent to neural injury and disease. Dr. Fox is a world leader in administration of LSVT LOUD speech treatment for people with Parkinson disease. Dr. Fox began working with Dr. Ramig over 18 years ago conducting efficacy research on LSVT in people with Parkinson disease. She was the first to apply this treatment to disorders other than Parkinson disease (e.g., multiple sclerosis) and pioneered the application to pediatric populations including children with cerebral palsy and Down syndrome. Dr. Fox worked closely on the development of a physical therapy program, LSVT BIG, that was modeled after the speech treatment protocol. More recently, she has collaborated in the development of a novel HYBRID approach that simultaneously delivers speech and physical therapy for people with Parkinson disease. Dr. Fox has been a key part of the LSVT Training and Certification Workshop faculty developing and delivering LSVT LOUD and LSVT BIG Training and Certification Workshops globally. Currently there are over 13,000 speech, physical and occupational therapists in 54 countries trained to deliver the LSVT protocols. Further, Dr. Fox has numerous publications in these areas of research and has presented extensively nationally and internationally. Dr. Fox is a Co-Founder and Vice President of Operations of LSVT Global, Inc.; a Research Associate at the National Center for Voice and Speech in Denver, CO; and an adjunct faculty in the Department of Speech-Language-Hearing Sciences at the University of Colorado, Boulder.

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Dr. Ramig is a Professor in the Department of Speech-Language and Hearing Science at the University of Colorado-Boulder, a Senior Scientist at the National Center for Voice and Speech-Denver, an Adjunct Professor at Columbia University in New York City and Co-founder and President of LSVT Global, Inc. She is an internationally recognized clinical scientist with an established research record in the areas of aged and neurological voice disorders. Her research has been funded by the National Institutes of Health (NIH) for over twenty years. She has lead teams of researchers and clinicians through the process of developing a voice intervention for PD (LSVT LOUD), initial studies of its efficacy, describing the underlying physiologic and neural bases accompanying intervention, and developing technologies to scale patient accessibility to intervention. The work of these teams has contributed substantially to the knowledge base on speech and voice in PD, making an impact on the neurology, otolaryngology and speech communities, improving patient care globally and as such has positioned speech intervention within the forefront of rehabilitation science research today. Dr. Ramig has been a member the National Advisory Council for the National Institutes of Deafness and Communication Disorders and has received a number of awards including the Honors of the American Speech Language Hearing Association, the highest award of her professional organization.

# Laryngeal Position in Singing: Strategies and Techniques for Maintaining a Low, Relaxed Laryngeal Posture in Classical Singing (no. 60)

C. LeFevre

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

Vocal pedagogy texts, almost without exception, cite a low, relaxed laryngeal position as one of the fundamental components for a healthy, successful singing technique. This position occurs naturally when the larynx descends during inhalation. Provided there is no extraneous muscular action, such as that of a depressed tongue or over-extended jaw, phonation that occurs within this descended laryngeal posture not only yields optimal resonance, it represents a balanced muscular state ideal for optimal vocal production.

Attaining this posture can be an elusive task, with difficulty increasing as the pitch ascends. It is important that the singing teacher be equipped with a large variety of methods that dissuade the singer's natural tendency to recruit inappropriate muscles to "assist" with phonation, as this often causes laryngeal elevation and tension. Also important are various approaches to developing the independent function of the depressor muscles, which are especially necessary in the upper parts of the singer's range. The proposed workshop will include instruction and demonstration for a variety of approaches that encourage an optimal laryngeal position in singing.

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## Education

DMA (Voice Performance and Pedagogy)—University of Iowa

## Voice Teaching Positions

University of North Carolina-Greensboro; National Opera Company; Bradley University

## Special Skills

Knowledge, ability, experience in rehabilitation of disordered and injured singers

Master Classes at Universities throughout the United States

## Student Achievements

Young Artists includes following opera companies:

San Francisco; Santa Fe; Pittsburgh; Glimmerglass; Central City; Chautauqua; Des Moines; Lake George; Baltimore; Ash Lawn

Winners in various national competitions

## Professional Presentations, Publications, Research, Grants

- Maintaining Low Laryngeal Position in Classical Singing, Workshop, Voice Foundation 41 1st Annual Symposium
- "Tongue Management," Journal of Singing, Nov/Dec, 2011.
- Management of Tongue Tension in Singers: Strategies and techniques for addressing muscle tension issues related to the tongue, Workshop, Voice Foundation 40th Annual Symposium
- Tongue Management: Innovative Devices for Addressing Technical Issues Related to the Tongue
- Paper/Poster presentation, National Association of Teachers of Singing National Conference
- Travel Grant, UNCG, Bastian Voice Institute, Chicago, for observation of therapy and laryngeal micro-surgery
- Research Leave, UNCG, Voice Therapy and the Teaching of Singing: Intersection of Methodology, intensive study of voice injury and rehabilitation



## Chiaroscuro: Out of the Darkness, Into the Bright (no. 61)

S. Austin

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

The timbre most closely associated with singing in the western tradition of opera and art song has been called *chiaroscuro*, *voce chiusa*, *voix sombrée et couverte*, etc. No matter what it is called it is often described as a balance of darkness and brightness in the tone. It was discovered by Garcia and others that maintaining the larynx in a low position during singing would allow a singer to extend the chest voice higher than its usual limits. This led to the famous story of Duprez at the Paris opera in 1837 offering the 'do di petto' or the high C in the chest voice for the first time for the Parisian audience. This was an historical event in that it fundamentally changed the expectation for all singers. The positioning of the larynx in this way also provided the unique acoustic environment which results in the presence of a special clustering of vocal tract formants into what we know as the 'singer's formant', typically centered around 3k Hz. With the low laryngeal posture the laryngeal mechanism is best able to function under the extreme stresses required of operatic singing and at the same time it produces a spectrum where a great deal of acoustic energy is present in a part of the spectrum where the orchestra does not produce significant sound. In this workshop I will talk about the historical development of the concept and present the written legacy of its pedagogy as found in important historical sources. I will use recordings to demonstrate singers with and without the lower laryngeal posture and discuss the limitations of not utilizing it. I will use singers from the audience – or maybe some who are pre-arranged – to demonstrate how to effectively establish the lowered laryngeal posture using traditional pedagogical tools.

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Stephen F. Austin, M.M., Ph.D. is associate professor of voice at the College of Music, University of North Texas. He teaches applied voice and vocal pedagogy. Dr. Austin received a masters degree in vocal performance from UNT and continued his studies at the University of Iowa where he earned the Ph.D. in voice science from the Department of Communication Disorders under the direction of Dr. Ingo Titze. His unique training in performance and voice science has placed Dr. Austin at the forefront of interdisciplinary work in vocal pedagogy.

Dr. Austin is an active performer, published author, and a popular lecturer in vocal pedagogy and voice science. He has presented recitals, lectures, and master classes across this country, in England, The Netherlands, and in Australia. He is regularly featured on the faculty of the "Annual Symposium: Care of the Professional Voice" sponsored by the Voice Foundation and held in Philadelphia each summer. He has made presentations to national conventions and conferences around the world.

Dr. Austin is known for his ability to clarify for the voice teaching community the complexities of voice science and to make it applicable to the studio teacher and singer. His articles appear in a featured column in the JOURNAL OF SINGING called 'Provenance' where he examines the historically significant treatises on vocal pedagogy and elucidates important pedagogical principles from the past. Dr. Austin has over 60 papers published in the area of voice science and applied vocal pedagogy. His scientific research has focused on the articulatory behavior of classically trained singers and has been published in the JOURNAL OF VOICE.

# Vocal Fold Morphology Reflects the Acoustic Needs in Mammalian Vocalization (no. 62)

I.R. Titze

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Animal Bioacoustics
- Invited Lecture

The layered tissue structure of vocal folds develops in stages. The fully developed human system consists of an epithelium, three layers of a lamina propria (superficial, intermediate, and deep), and the thyroarytenoid muscle (Hirano, 1975; Hirano and Sato, 1993). A layered structure is present in all mammals, but the depth and ordering of the layers are species specific. For example, in some mammalian species (e.g., lions), a layer of fat is present where ligament and muscle resides in other species (Klemuk et al., 2011). Deer and elk have an extensive ligament that occupies most of the lamina propria space (Riede and Titze, 2008; Frey and Riede, 2013). Dogs have a continued superficial layer in place of a ligament (Alipour and Titze, 1991). It is assumed that the organization of the tissue layers is genetically determined for survival of a species, but can perhaps be modified in a life span by vocal demands of an individual from birth to death. In order to understand the evolutionary or life-span changes in the morphology of the vocal folds, it is important to determine the acoustic requirement for vocal communication. Is the vocal priority a wide range of loudness, a wide range of pitch, the ability to create melodic tonality or rhythmic bursts (e.g. birds), to sound a rescue call (e.g. lambs), to create a unique call recognizable only to family members (e.g. penguins), or to make the sound production efficient with a low cost if vocalization continues over extended durations (e.g., elk in the mating season)? In humans, the ideal morphology for an infant cry may be different from that required for adult speech, for calling for help in an emergency, or for long durations of vocalization among professional voice users. If precise and rapid intonation patterns are needed, as in bird vocalization or human singing, the ideal morphology may again be different. Thus, a systematic description of morphological variations and the corresponding acoustic output may lead to a better understanding of vocal capability and limitation.

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# Phonatory Characteristics of the Excised Human Larynx in Comparison to other Species (no. 63)

F. Alipour, E. Finnegan, S. Jaiswal

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Acoustics
- Invited Lecture

## Objective

The purpose of this study was:

1. To determine the conditions needed to elicit phonation (i.e. phonation threshold pressure and subglottic pressure) from excised human larynges and the resultant range of phonations produced (i.e. F0 and SPL)
2. To compare that with similar information previously obtained from canine, pig, sheep and cow and then
3. To relate those findings to previously reported information about viscoelastic properties of the vocal fold tissue (i.e. stress strain curves and Young's Modulus).

## Methods

Six human larynges of the geriatric group (age ranges 70-89) were mounted on the bench without supraglottic structures and phonation was achieved with the flow of heated and humidified air through the tracheal tube. Using various sutures to mimic the function of the laryngeal muscles, the larynges were put into a series of sustained oscillations with adduction as a control parameter. During oscillations, subglottal pressure, flow rate, electroglottograph, and microphone signals were recorded on digital media for later analysis.

## Results

The human larynges oscillated with an average frequency that was close to the canine larynges, but the oscillation behavior and wide frequency range were similar to those of pig larynges. The similarity of the wide vibration frequency ranges of human and pig larynges may be due to the nonlinear behavior of their elasticity which is related to their vocal folds high collagen content. On the contrary, other species that show almost linear stress-strain curves due to the higher elastin and lower collagen contents had limited frequency ranges.

## Conclusions

The physiological differences in the linearity and ranges of oscillation of excised larynges reported in this study and previous studies are reflective of the tissue composition and mechanics.

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# Super Size Me! – Vibratory Characteristics of an Elephant Larynx (no. 64)

C. Herbst, J.G. Švec, J. Lohscheller, R. Frey, M. Gumpenberger, A. Stoeger, W.T. Fitch

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Animal Bioacoustics
- Invited Lecture

Elephants are the largest land-based mammals. Their low-frequency vocalizations in the infrasonic range (fundamentals below 20 Hz) have been hypothesized to be produced by either of two fundamentally different sound production mechanisms: (a) by a regular pattern of successive EMG bursts (e.g. 20-30 Hz for cat purrs) resulting in consecutive active muscle contractions (AMC); or (b) by flow-induced self-sustaining oscillations in accordance with the myoelastic-aerodynamic (MEAD) theory of sound production.

In a recent publication [1] the author and collaborators have documented self-sustaining, flow-induced vocal fold oscillations in an excised elephant larynx (*Loxodonta africana*), thus rejecting the AMC mechanism as a plausible cause for elephant infrasound vocal production. Rather, sounds were produced in a manner directly paralleling human speech or song.

Here, a more detailed analysis of the vibratory phenomena seen in the excised elephant larynx is presented [2]. Vocal fold oscillation occurred with a wide variety of vibratory modes, including periodic and complex subharmonic regimes, as well as irregular patterns typically seen in deterministic chaos. Phase delays along the inferior-superior and anterior-posterior (A-P) dimension were commonly observed, as well as travelling wave patterns along the A-P dimension, as yet not documented in the literature. These phenomena might have been facilitated by the large dimensions of the elephant vocal folds (length: 104 mm, thickness: 32 mm). The vestibular folds, when adducted, participated in the tissue vibration, effectively increasing the generated sound pressure level by 12 dB.

In conclusion, the same basic physical principles of voice production apply to mammals of various sizes (i.e. bats, humans, elephants), suggesting that the myoelastic-aerodynamic theory extends across a remarkably wide range of body sizes and vocal frequencies (more than four orders of magnitude). The elephant larynx is, however, not simply a linearly scaled version of the human model, thus giving rise to a range of vibratory phenomena not regularly seen in non-pathologic human phonation.

## References

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- [2] Herbst, C. T., Švec, J. G., Lohscheller, J., Frey, R., Gumpenberger, M., Stoeger, A. S., Fitch, W. T. (in review). *Complex vibratory patterns in an elephant larynx*.

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# The Quest for Speed: Unraveling the Evolution of Superfast Muscles Used in Sound Production and Control *(no. 65)*

C.P.H. Elemans

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Animal Bioacoustics
- Invited Lecture

Superfast muscles are the fastest vertebrate muscles known that can produce power at cycle rates over 100 Hz. Until recent, superfast muscle fibers were considered rare adaptations and only found in the rattlesnake tail shaker muscle and the toadfish swimbladder muscle.

We have discovered the first superfast muscles in two large group of vertebrates: mammals and birds. We show that bats have evolved superfast laryngeal muscles that allow them accurately control their echolocation calls. These calls consist of rapid downward sweeps of fundamental frequency from 45 - 20 kHz in <0.5 ms, and are produced up to 160 times/sec during aerial pursuit of prey. We also discovered that songbirds have superfast muscles in their vocal organ, the syrinx. Syringeal muscles are even faster and can modulate the position and tension of the sound producing membranes up to 250 times/sec. This extreme performance allows songbirds to actuate the submillisecond temporal precision observed in premotor brain areas. Superfast muscles can no longer be considered a rare adaption, and occur in most vertebrate lineages.

However, the extreme performance of superfast muscles comes at a cost. Space constraints at the muscle ultra-structural level and the kinetics of muscle proteins dictate a trade-off between force production and maximal attainable frequency at which positive work can be produced.

Because extreme function involves extreme modifications, superfast muscles provide unique opportunities to study regular muscle function. We are currently trying to understand the cellular and molecular mechanisms that underlie the extreme superfast muscle performance, and to elucidate the evolutionary origin of this rare muscle type.

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# Singing in a Jar: The Neuromuscular Control of the Songbird Syrinx in Vitro

(no. 66)

C.P.H. Elemans

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Animal Bioacoustics
- Invited Lecture

Song behavior depends on the integrated action of neural systems for auditory perception, song production, song learning and the processing of social information. In songbirds, many components of these specialized and interacting neural circuits have been identified but mechanistic insights into their function remain incomplete. To understand the neural basis of birdsong we need a more detailed knowledge of how neural motor patterns are translated into sound in the peripheral sound producing system.

The accessibility and small size of the uniquely avian vocal organ, the syrinx, make it difficult to visualize modulation of syringeal parameters in undisturbed freely singing birds *in vivo*. This experimental setback constraints progress in understanding how neural signals translate into the acoustic output for vocal communication. A quantitative understanding of how syringeal structure relates to function is still lacking.

Here, I present a novel experimental setup that allows for studying the syrinx *in vitro* under experimentally controlled conditions. The setup combines independent and accurate control of air pressure and flow downstream (bronchial), upstream (tracheal), and in the air sac system surrounding the syrinx, with synchronized high-speed visualization of labial movement from different orientations. These data allow for the exploration of the pressure-flow parameter space in which vocalizations occur. Furthermore, the syrinx and its associated musculature can be kept alive for several hours using micro-perfusion techniques. This addition allows for quantitative study of controlled muscle recruitment on 1) the biomechanical/kinematic effects of the modulation of structural elements and 2) the control of the syringeal pressure parameter space with its associated acoustic modulations. Sound parameters, such as amplitude and fundamental frequency, can now be mapped on either single or synergistic muscle recruitment patterns and their corresponding neural activity. This setup is useful to study basic sound production physiology and opens the way to comparative studies of sound production in a variety of (small) birds, mammals and frogs.

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# Call Classification Design of the Wild Boar (*Sus Scrofa*) Complex Vocalization System (no. 67)

M. Garcia, C. Herbst, B. Gingras, M. Böckle, Y. Locatelli, W.T. Fitch

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Animal Bioacoustics
- Invited Lecture

Wild boars live in complex social systems in which individuals interact intensively using multicomponent communication signals such as olfactory and acoustic cues.

Possibly related to their complex vocal tract anatomy, characterized by two pairs of vocal folds, wild boar vocalizations are very diversified, and their heterogeneity was reported in an empirical study led by Klingholz et al. (1979). This analysis had however no statistical support and relied mainly on visual inspections and manual measurements of the parameters generally used in bioacoustics studies at the time. Due to technical advances and deeper knowledge of the physical properties of sounds nowadays, this classification could potentially be validated, or improved, based on a more objective, "hands-off" signal analysis and statistical approach.

Here, following a primary visual inspection and computer - aided extraction of acoustical parameters, we applied on the resulting dataset several multivariate analysis approaches, which have proven useful in the identification of vocal repertoires in various species. We attempted to establish, by a comparative means, which classification method is the most appropriate, based on objectivity and repeatability of the measurements.

Quantification and structural characterization of wild boar vocal repertoire is crucial to a better understanding of this species' acoustic communication. This study can provide a solid foundation for further investigation on the production mechanisms (Excised Larynx Experiments), functionality (Playback Experiments), geographical variation, as well as social relevance and transmission of these acoustic signals. Eventually this will help identifying the context and selection pressures that drove the emergence of such vocal displays.

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## 'Ring' in the Solo Child's Singing Voice (no. 68)

D. Howard, J. Williams, C. Herbst

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

The singing solo voice of a pre-pubescent child is often described as being 'pure' or 'clear' and for many listeners, it is a sound that is highly prized, particularly in a cathedral chorister. This paper reports on the acoustic findings in 10 child solo singing voices based on data gathered when they sang Come unto him, all ye that labour from Messiah (GF Handel) in a major concert hall venue in the UK. Productions that exhibit 'ring' are compared with sections where that 'ring' is less evident perceptually and findings suggest that there are spectral changes in the singers' formant cluster area and also in the region around 7-12 kHz. Comparisons are made with a professional soprano and potential articulatory differences will be discussed.

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# Comparison of Voice Parameters Between Classically Trained and Untrained Females (no. 69)

M. Frič, K.A. Kadlecová-Jačková

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

Voice education and training of special voice skills is the basis for an effective voice management of prospective professional voice users. Voice range profile (VRP) and acoustic parameterization of voice samples is widely used in vocology research. VRP's contour comparison shows differences between trained and untrained subjects and is very good indicator for voice disorders. The average values of acoustical parameters of the voice samples correlate with perceptual features and are used as predictors of voice quality. However, most of acoustical parameters (mainly spectral parameters) depend on the pitch and intensity of voice, so the interpretation of acoustical parameter measurement should include the position in VRP. The aim of this study was to compare the vocally trained (in classical singing) and untrained group of females and to study the relationships among perceptual, acoustical properties and electroglottographically derived closed quotient.

For purposes of study were made recordings of habitual reading, the song singing and voice range profile examination by scale singing in 7 classically singing trained and 8 untrained female students of Pedagogical faculty.

Perceptual assessment of voice quality, resonance and timbre (bright - dark) were made by mean of visual ranking and rating method by 2 listeners.

Comparison of acoustical data and correlation with perceptual results were made in average data and considering the pitch and position in VRP.

The perceptually dominant differences between trained and untrained group was in the perception of voice resonance.

The comparison of speech range profiles did not show any differences, but VRP's contours revealed significantly higher intensities in the higher half of the vocal range for trained females. The VRP normalization to average pitch and intensity of habitual voice showed that differences were only trends. VRPs of song singing find out the difference in intensities above C5. The VRP's contour correlation with the perception of resonance commonly shows increasing of intensity for both habitual and singing voice.

The comparison of CQEGG considered the pitch or the position in the VRP shows the main difference in habitual voice - lower values for trained females and negative correlation with resonance perception. Comparison of CQEGG in VRP reveals the main difference in singing, that untrained females sung the higher tones in the lowest intensity without glottis closure and with higher perturbations.

The method for evaluation of acoustical parameters considering their location in the voice range profile seems to be a useful tool for distinguishing the different vocal groups as well as for objective interpretation of perceived voice quality properties.

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# Non-invasive Automatic Detection of Phonatory State Transitions (no. 70)

A. Selamtzis, S. Ternström

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

The vocal folds can oscillate in several different ways, manifest to practitioners and clinicians as 'registers' or 'mechanisms', of which the two most commonly considered are modal voice and falsetto voice. Here we will refer to them as different phonatory states. State transitions are common in nonlinear oscillators; the transitions are usually abrupt and impossible to predict exactly. Switching state is much like switching to a different voice. Therefore, phonatory states are a source of confounding variation, for instance, when acquiring a voice range profile (VRP). In the quest for a state-aware, non-invasive VRP analysis, a method based on the electroglottographic signal (EGG) was developed to identify automatically phonatory state transitions of various kinds, including the modal/falsetto switch.

Following Herbst et al. (Science, vol 337 no 6094, 2012), the state-space loop representation of the high-pass filtered EGG signal is constructed, cycle by cycle. Then, a combination of Fourier descriptor analysis and entropy estimation is applied to the loop, yielding a new period-synchronous signal, which peaks when the attractor shape changes abruptly, but remains close to zero when the phonatory state is stable. A corpus was compiled of 50 EGG recordings of 1-4 known state transitions ('register breaks'), in sustained phonation tasks similar to those used in VRP protocols. After some initial tuning, the algorithm located 96% of these breaks on the time axis. It also indicated numerous places where the phonatory state appeared to be changing in other ways, such as into or out of diplophonia. The next step will be to recognise different states automatically.

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# Spectral Register Differences in the Overlap Area (no. 71)

P. Pabon

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Acoustics

Most voices have within their range an area of overlap where, for the same fundamental frequency ( $F_0$ ), the voice may exhibit different acoustical properties that link to the underlying register mechanism or vibratory state. The differences may be clear-cut but they can also be subtle, reflecting minute changes in quality. The extent to which such a state dependent difference may express itself is expected to be conditioned by the fundamental frequency and also by the sound level at which the tone is produced. This study aimed at characterizing these register-related spectral differences, and to map the amount of spectral contrast seen as a function of  $F_0$  and SPL.

Pairs of VRP recordings were made, one for each register, for groups of male ( $N=8$ ) and female ( $N=12$ ) singing students, as well as for a group ( $N=20$ ) of untrained female voices, all using the vowel /a/, and with each voice covering the full SPL range for each semitone in the range. Spectral differences were evaluated for the register overlap zone only, and averaged using both a fixed frequency scale as well as a harmonic frequency scale.

Analysis along the harmonic scale revealed a register contrast in the form of a linear alteration in the low frequency spectrum slope up to harmonic four. Analysis along the fixed frequency scale revealed an additional systematic contrast in the amount of spectrum detail (prominence of the resonances). Both difference descriptions correspond to a specific filter characteristic. A rating of the average amount of filtering needed to transform from M1 (modal/chest) to M2 (falsetto/head) was used to map the amount of register contrast as a function of  $F_0$  and SPL in the overlap area.

Sound examples will be presented that demonstrate the characteristic quality change associated with these filters, and the possible interpretation of these characteristic curves will be discussed.

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# Tone Repetitions and Alternations in Persian Singing (In Search for Caccini's Trillo and Gruppo) (no. 72)

H. Biglari

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

Rapid tone repetitions and alternations, labeled as trillo and gruppo by Caccini, are considered as the two most basic melodic ornaments of the early Italian Baroque singing. But these repetitive melodic patterns also exist in some eastern traditions, e.g. in the highly ornamented singing style of Persian avaz.

Audio and EGG signals were simultaneously recorded from professional male Persian singers, singing stylistically typical avaz song excerpts as well as isolated repetitive ornaments. Voice source parameters were measured from inverse filtering of the audio signal, using the custom made DeCap and S-naq (Svante Granqvist) and the commercial Soundswell softwares. Fundamental frequency F0 was measured from the EGG signal using the Soundswell CORR tool.

Both the repeated and the alternating melody tones were sung in the modal register while being interleaved by remarkably short falsetto episodes in which F0 jumped up to a peak and descended immediately. Thus, the phonation was continuous and each intermittent modal tone was initiated through (and followed by) a register break. These findings will be discussed in relation to other ways of producing trillo, as studied by Hakes et al (1987), and by Brown and Scherer (1992). The results will also be compared to commercial recordings of Persian avaz as well as the neighboring singing styles of Kurdish, Azeri and Turkish traditions.

Our results provide physiological alternatives to the existing interpretations of trillo, especially as the vocal technique used by Persian singers complies with the instructions written out by Caccini and Bovicelli, saying that tone repetitions and alternations must be practiced and performed in the same way. This can also bring new insight to the musicological discussions dealing with plausible physiological implications of the early Italian sources on the aforementioned melodic ornaments and other melismatic embellishments (Stark 1999; Greenlee 1985 & 1987, MacClintock 1976; Galliver 1973).

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# Discrimination of Three Basic Male Voice Types by Voice Range Profile Derived Parameters *(no. 73)*

F. de Jong, H. Lycke, W. Decoster, A. Ivanova, M. Van Hulle

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

## Introduction

There is no generally accepted objective method for voice classification. One may question the existence of three basic voice types by nature. A data-driven approach is applied, which imposes minimal assumptions on the nature of the data, what elements to use for its analysis, and even the existence of natural voice groups. The aim of this study was to verify the existence of Voice Range Profile parameters with which the data can be partitioned into a number of clearly separated clusters as a basis for discriminating between basic male voice categories.

## Methods

The data from 256 male subjects (18 - 52 years) was investigated. In this study parameters were used, derived from the geometry of the VRP; the register transition zone; the geometry of the chest/head voice parts and the linear characteristics of the minimum and maximum intensity curves. Additionally, a number of voice frequency and intensity ratios and differences were defined based on some of the above parameters. After preprocessing the data we applied Ward's minimum method to assess whether the data displays any natural clusters (groupings). However, Ward's method could not be decisive as it could return more than one statistically plausible cluster solution. In order to break the tie, we need an additional method. We decided to use K-means clustering in combination with a backward feature selection procedure to define the discriminative parameters and the cluster migration index to decide which cluster solution is more consistent across discriminative parameter combinations identified, and adopt that as the final cluster solution.

## Results

In the male voices Ward's procedure indicated that there could be three or four clusters in the data. In using K-means clustering, a backward feature selection procedure was applied to both clustering options. Based on the migration index, the three-cluster solution turned out to be the most consistent one. The parameter that led to the best three-cluster separation was the frequency of the register dip. The parameter that led to the best three-cluster separation in the female voices in a previous study was the ratio of the perimeter length of the chest voice part of the voice range profile versus the total perimeter length. A second salient result of this study is the finding that each of these features has to do with register transition, which is an important aspect in voice classification in singing practice.

## Conclusions

This study demonstrates that parameter combinations of the VRP exist that generate a clear separation of voice clusters. This suggests that the complexity of voice classification may be reduced to a more compact, yet adequate formula, easily obtainable from the VRP. However, more studies are required to link the statistically obtained cluster separation to the three basic voice categories as they are traditionally used, even to date.

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# Art and Science: Building a Partnership Between Voice Pedagogy and Voice Science (no. 74)

L. Gates

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Acting Voice

Like so many other voice teachers, I began my teaching career as a result of my vocal training as an actress. I knew little or nothing about the physiology and science of the voice and what I did know tended to be anecdotal rather than factual.

In the early 80's I was teaching at NYU and someone told me about the Voice Foundation, founded by Dr. Wilbur Gould, an Otolaryngologist, who had ministered to the vocal needs of a wide range of performers, and hosted a symposium every year at the Julliard School "The Care of the Professional Voice." I remember wandering in and discovered a world of the voice that I never knew existed. The attendees were voice scientists, otolaryngologists, physicists (IBM was trying to teach computers to talk and had sent them to Julliard), singing teachers and they were all often shouting at each other. I remember Dr. Ingo Titze trying to forcefully make a point and being shouted down by the moderator who repeatedly pounded on the table with "Sit down and be quiet, Dr. Titze." It was all very exciting. There were medical lectures on how to care for voices including an admonition from Dr. Van Lawrence to always: "pee pale". One of the physicists was so horrified at my lack of scientific knowledge that he gave me "William Vennard's Singing: The Mechanism and the Technique" and told me to read it. The highlight of the symposium was a confrontation between some of the voice scientists and a famous singing teacher who loudly challenged them to put their theories into practice by taking singing lessons. And to my great surprise they accepted!

Since then, I have continued to work in the theatre as an actress, director, vocal coach and for the past twenty years have been the Head of Voice in the Department of Theatre at Northwestern University. While there is progress, we still struggle to connect these two disciplines. At Northwestern, while we have a Department of Communication Sciences and Disorders, a Department of Theatre, and a School of Music, there are no courses to train the voice of the therapist who will be responsible for improving the voices of patients.

I would like to explore the possibility of more direct connection between the art of the voice and the science of the voice and how the artist and the scientist can work more closely together. Here are some of the topics I would like to explore and open up for discussion:

- Incorporating actor vocal training for voice therapists
- Incorporating voice science into the speaking and singing voice curriculum
- Vocal screening for all singing and acting students
- Establishing partnerships between speech therapy department and performance in training.

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# The Efficacy of Vocal Function Exercises in the Practice Regimen of Undergraduate Musical Theatre Majors (no. 75)

S. Maines

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Musical theatre performers are versatile artists who face grueling schedules, experience high rates of vocal problems, and may be trained by teachers with little or no experience in musical theatre styles. In light of these challenges, it is imperative that these performers develop strategies to promote wellness, health, and physiologic efficiency of the vocal mechanism.

Vocal function exercises (VFE) have been shown to have a positive effect on the phonation systems of both classical graduate singers and amateur choral singers over age 50, yet research prior to this study had not examined the efficacy of VFE with musical theatre singers. The purpose of this study was to demonstrate the effects of VFE on the vocal production of young musical theatre singers in a pre-professional training program.

Eighteen undergraduate musical theatre majors were randomly assigned to treatment and control groups, each containing 9 subjects. Subjects in the treatment group completed VFE, while subjects in the control group completed a set of placebo exercises. All subjects were screened for pathology and continued their normal singing routines over the 4-week duration of the experiment. Results of pre- and posttest assessments of maximum phonation time (MPT) and singing voice handicap index (SVHI) will be discussed.

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# The Causes of - and What to Do About - Poor Pitch Singing (no. 76)

I.B. Hansen

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Singing in tune is an ability that develops naturally in early childhood in most people, but for some, known as tone deaf or poor pitch singers, this development is not successfully fulfilled.

As a singing teacher and a speech therapist, I have through the years worked with about 250 adults who were poor pitch singers. I have wondered why many were quite easily taught to sing in tune while others really had difficulties, and some never did learn to sing in tune. I assumed that the severe cases of poor pitch singing had to be a disability like i.e. dyslexia.

The research in the field of poor pitch singers has intensely developed in the latest 10-15 years, centered at BRAMS, International laboratory for Brain, Music and Sound Research in Montreal. Here amusia - a learning disability connected to music - has been documented in 2002, and the Montreal Battery of Evaluation of Amusia (MBEA) - a tool to diagnose amusia as primarily pitch discrimination deficit - has been developed in 2003. This research has showed that amusia and severe states of poor pitch singing is in fact based on disabilities in brain functioning.

Research from 2007 and 2011, that isolates listening and voice production, has shown that about 17-60 % of a population think they can't sing, 10-15% have problems singing in pitch, but only about 4 % of the population may be diagnosed with congenital amusia. Thus a large group of people is capable of pitch discrimination, but still have problems with singing in tune. For this group the cause of the problem probably lies in toneproduction, memory and sensorimotor integration.

In the continuum from tone deafness to perfect pitch I have roughly categorized poor pitch singers in 3 groups: the True Poor Pitch Singers, The Singalong'ers and The Not Yet Developed In Tune Singers. The first group is most likely to be diagnosed with amusia to some extent, and the most severe cases will not be able to learn to sing in tune. The Singalong'ers are able to sing in tune together with other singers, but are not able to sing alone in tune all the way through a song – because of the lack of internal sense and security of key. The Not Yet Developed In Tune Singers “just” need to develop the courage to use the voice and develop the motor skills of throat and ear-connection to be able to sing a whole song in tune by them selves. What I think separates them from the two former groups is that they have the inner sense of key – they are (like most people) without help from outer sources able to judge the tonestep-distance relationship of the intervals (a theme that has not yet been scientifically studied).

Teaching poor pitch singers is holistic and involves i.e.: courage, confidence, bodywork, getting to know the voice by voice-plays and exercises, and developing the listening ability.

The oral presentation will elaborate the former scientific results and educational practice and add relevant issues.

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# The Advantages of a Common Accepted Terminology Among Voice Teachers *(no. 77)*

H. Kjelin, C. Sadolin

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

By taking the stand, that the lack of a common accepted terminology among singing teachers presents a major obstacle in the development of singing- and speech techniques, this presentation is intended as a contribution to the voice terminology debate. Many of the terms widely used today have different definitions depending on who are using them, or the definitions are very vague or not there at all. This problem is often ignored, or explained as a cultural necessity caused by the difference between musical genres. But can we not have a clear communication and still keep the diversity in musical genres? The presentation includes examples of what is meant by 'unclear terminology', as well as examples from Complete Vocal Institute where a strictly defined terminology makes it possible for teachers to pass on detailed information about a singers technical status, not unlike in a hospitals patient report. Voice professionals meet at conferences like PEVOC. This indicates that we want to learn from each other so we can help singers better. Why then do we accept blurred communication, and how clear can it become?

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# What Descriptors Do Singing Teachers Use to Describe Sound Examples?

(no. 78)

J. McGlashan, M. Sayles, H. Kjelin, C. Sadolin

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

## Aim

To assess the range of terms used by singing teachers to describe sound samples from different vocal genres

## Method

36 singing teachers from 12 countries from a range of different teaching environments (e.g. Conservatory, private) were recruited to take part in the study. They were asked to listen to 11 short sound samples of different contemporary and classical songs. They were asked to describe each of the sound samples in terms that could be used pedagogically.

## Results

As an example the first sound sample consisted of 12 elements: "Don't dream of wo-men 'cause they on-ly bring you down". Eighty different words were used to describe the various elements reflecting a range of different approaches, training backgrounds, methods and personal choice. The terms used related to Register ('Chest', 'Head', 'Mix' etc.) terms used in a pedagogic method such as Complete Vocal Technique (CVT), Estill Vocal Training ('curbing', 'tilted thyroid cartilage' etc.), descriptors of activity of various anatomical structures ('high larynx position', 'narrowed vocal tract') or physiological activities ('high subglottic pressure'), voice quality ('shouted', 'pressed', 'vibrato'), emotional response ('angry', 'dirty') or simply a comment ('projected voice', 'a no-go in the classical', 'could be unhealthy if used too much'). Ten CVT singing teachers used terms more consistently and warrants further study but other terms such as 'Speech quality', 'Chest' and 'Projected voice or sound' were used with some frequency although at times conflicting terminology was used for the same sound element e.g. 'Chest' and 'Head'.

## Conclusion

Singing teachers use a variety of terms to describe the singing voice which seems based on previous training and experience. However there appears to be a lack of clear definition of many of these terms. More focus in training in pedagogic methods which define specific vocal qualities that can be applied across genres may help in communication between singer teachers, singers and other professionals.

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# How Do Music Experts and Non-experts Evaluate the Vocal Accuracy of Operatic Singing Voices? (no. 79)

P. Larrouy-Maestri, D. Morsomme

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Professional singers are expected to sing in tune. However, when an operatic singing technique is employed, the objective measurement of the vocal accuracy (i.e. pitch interval deviation) shows particularly low scores, whatever the melody performed. This study focuses on the perceptual judgment of operatic voices in order to observe the evaluation process of singing voice accuracy by music experts and non-experts. In addition, this study aims to better understand the relationship between the subjective and objective measurements of operatic singing voices.

22 music experts and 22 non-experts paired in age and gender participated in a test and a retest (8 to 15 days in between). Fourteen sung performances performed by professional operatic singers were presented with a pairwise comparison paradigm. The participants were asked to indicate the most "in tune" melody for each pair (N = 91). The performances obtained thus a ranking by each judge. In addition, the 14 sung performances were objectively analyzed in order to confront the objective measurement of singing voice accuracy with the perceptual rating of the judges.

Computing the variances of rank differences between the test and the retest, we observed that 20 music experts and 16 non-experts were consistent in their judgments. Among each group, the correlations between consistent raters were positive. However, 67.38% of these correlations were significant ( $p < .05$ ) for the music experts whereas only 42.10% were significant for the non-experts. In addition, no relationship occurred between the objective measurements (from 9.5 to 115.5 cents,  $M = 40.57$ ,  $SD = 34.42$ ) and the perceptual ratings, except for two music experts. This study highlights the consistency of a judge when rating operatic singing voices and the difference between music experts and non-experts concerning the inter-judges reliability. Despite the fact that the majority of the music experts used similar strategies to evaluate the vocal accuracy of operatic voices, their judgment was obviously not linked with the objective measurement of vocal accuracy. This finding supports the tolerance of music expert listeners regarding the singing voice accuracy of operatic singers. Furthermore, this study provides some directions about the perception of operatic singing voices, which are particularly complex.

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## Overview of Professional Voice Care (no. 80)

M. Benninger

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

The field of Vocal Arts Medicine and Professional Voice Care has grown as there has become increased awareness that the vocal demands of performers may be unique and may lead to performance-specific voice disorders. An increase understanding of the methods of voice and singing production, coupled with increased sophistication of both basic science research and refined objective testing has allowed for improved diagnostic and therapeutic options for vocal performers. Improved diagnostic capabilities through better visualization of the larynx, and increased ability to assess the pliability and vibratory characteristics of the vocal folds has led to refinements in clinical and surgical techniques supported through pre and post treatment observations. This presentation will set the stage for a series of lectures on assessment and management of Professional Voice users. It will serve as a quick overview of evaluation, the roles of objective measures of vocal fold function and the importance of quality of life measures and stroboscopy.

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## "Recipes" for Treating Singers (no. 81)

M. Hess

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Singing Voice

This presentation will deal with the approach of a phoniatriest/laryngologist/phonosurgeon to the treatment of singers. Because of the 'artistry' nature of singers, the approach has to take into account that singers are individual interpreters of singing, thus choosing their own way how to use their voices. Consequently, the physician has to understand the singer and her/his thoughts, demands and needs – and how the singer wants to express himself/herself vocally. More specific, e.g. in the field of contemporary commercial music, the offering of 'recipies' has to be made in a highly individual approach for each patient. - This talk will focus on the fundamentals of voice physiology, vocal hygiene and on some tips and tricks that will be of use for singers, no matter if classical or non-classical in their repertoire.

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# “To Sing or Not To Sing!” When Is It Safe to Perform and How Long Should Voice Rest Be? (no. 82)

L. Maron

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Being called upon to make the decision as to whether a singer is able to use their voice when sick or after having sustained a vocal injury often places the physician in a very difficult and unenviable predicament. By advising an artist that it is safe to perform, we may place them in a situation that could jeopardize the future of their career. This emphasizes the serious nature of the advice we give our patients and even when this may be the case, artists are often reluctant not perform at the risk of missing out on important career opportunities, while managements and producers want the show to simply go on! And then there's the question...“For how long is absolute or relative voice rest indicated after medical or surgical intervention has been instituted?”

Experience has shown that there is no clear algorithmic pattern for the management of these problems. The management decisions depend on careful consideration of a host of important factors. With the aid of the presentation of some clinical cases, this discussion aims to highlight these factors and what becomes clear is that conventional text book “wisdom” is often not appropriate in many instances.

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## Considerations for Surgery in Performers (no. 83)

R.K. Yazaki

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Performing voice surgery in performers (Actors/Singers/Dancers) is still a challenge for most laryngologists. Sometimes it is not only because of the technical difficulties and the well-known surgical risks, but those related to the high vocal load and need they would present right after the procedure, in many instances with an insufficient period to recover from surgery. Surgery can take off the lesion that disturbs the voice, but we must think about adequate post-operative voice rest and exercises, which also take time and dedication. São Paulo City, in Brazil, is living a "Broadway/West End Musical Theatre's Boom", and the performers can have roles in sequential different shows, and they do not want to lose the opportunity, neither their health. We aim to show how the decision-making procedure may be done regarding those aspects in deciding when to take a performer to the operating room, and show specific surgical tips to a faster surgical recover.

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## Surgery in Performers, Technical Considerations *(no. 84)*

*M. Courey*

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Not Available

# Phonosurgery in Singers: A Global Approach (no. 85)

F. Ferran Vilà, C. Casanova Barberà

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Singing Voice

## Objectives

The authors intend to show how in the singing voice scope several collateral factors around phonosurgery must be kept on mind.

- Need of a global and not only lesional diagnostic
- Specific vocal needs for every style: lyric, modern, flamenco, pop
- Selection of the appropriate moment in the singer's agenda, permitting the postsurgical voice rest and readaptation of the postoperative vocal mechanisms (specialized speech therapy)
- Adaptation of the surgical procedure to the vocal needs: range, pitch and intensity.

## Method

A review of 56 phonosurgical procedures in singers is analyzed, 59% being modern singers and 41% lyric singers. Factors taking part in the vocal anomaly, preoperative and postoperative procedures and surgical indication are analyzed.

The presentation will be illustrated with pre, post and surgical images.

## Conclusions

Meanwhile in modern singers 66% of the lesions were acquired-functional, in lyric singers the ratio functional/congenital was quite equivalent: 47% functional and 53% congenital (sulcus type I, epidermic cysts, vergetures or sulcus type II).

Prudence is essential when assessing professional singing voice. Multifactoriality of voice disorders is specially important in singing voice: emotional aspects, systemic, technical,... whereas phonosurgery focuses exclusively to solve problems depending on the biomechanical properties of the vocal folds.

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# Voice Changes in Male-to-Female Transsexuals Following Feminization Laryngoplasty and Thyrohyoid Approximation (no. 86)

J. Thomas, P. Amarante Andrade, J.G. Švec

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

## Objectives

A surgical technique called Feminization Laryngoplasty (FemLar) was developed to raise the vocal pitch from male-to female-like. In addition, the technique of Thyrohyoid Approximation (TH) was applied in which the thyroid cartilage is raised towards the hyoid bone with the intent to shorten the vocal tract, hence producing a more female-like voice quality. This study investigates the changes in voice quality due to these techniques.

## Methods

23 patients that underwent FemLar, 55 patients that underwent FemLar+TH and 13 patients that were submitted to Cricothyroid approximation (CTA) took part on this study. Changes in fundamental frequency (F0), third (F3) and fourth formants (F4) were measured using Praat software. Auditory perceptual evaluation was further implemented to assess human perception of the voice quality pre and post-surgery.

## Results

F0 was found to differ between pre-and-post surgical procedures. After the surgery, the FemLar+TH procedure was found to produce significantly higher F0 than the FemLar or CTA procedures. For all techniques auditory perceptual evaluation showed significant differences between scores for pre-and-post conditions. A moderately significant correlation was found for auditory perceptual evaluation and F0 for post-surgery.

## Conclusion

All techniques successfully increased F0; however FemLar+TH showed larger effect post-surgery when compared to FemLar and CTA. Surprisingly, no significant changes were observed for F3 and F4, suggesting little change in vocal tract resonance after surgery. Auditory perceptual evaluation (APE) confirmed successful changes to a more female-like voice quality for all techniques.

## Acknowledgments

The data analysis has been supported in the Czech Republic by the European Social Fund Project OPVK CZ.1.07/2.3.00/20.0057 and by the Palacký University student's projects PrF\_2012\_026 and PrF\_2013\_017.

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# Subjective and Objective Vocal Parameters in Women With Polycystic Ovary Syndrome (no. 87)

M. Gugatschka, C. Gerstenberger, G. Friedrich

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Analysis of Voice and Speech

## Introduction

Despite the relatively high prevalence of the polycystic ovary syndrome (PCOS) affecting up to 15% of all women of reproductive age, only little is known about vocal changes related to this endocrinologic disorder that is characterized by biochemical or clinical hyperandrogenism, impaired cycles, and/or polycystic ovaries. The aim of our study was to describe objective and subjective vocal changes in women with a diagnosed PCOS compared with a control group.

## Materials and Methods

Our study group comprised 34 women—24 cases with confirmed PCOS and 10 controls in whom PCOS was excluded. A complete endocrinologic laboratory status was obtained by all participants; study procedures included a videolaryngostroboscopy, voice recording, and completion of the German version of the Voice Handicap Index.

## Results

A trend toward lower mean fundamental frequency was detectable, but this failed statistical significance. No differences were found in the objective and subjective voice parameters.

## Conclusion

Elevated serum levels of androgens, as found in women with PCOS, were shown not to have an impact on the subjective and objective voice parameters.

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## Web Formation for Pitch Elevation (no. 88)

J. Anderson

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Trans-sexualism

Pitch elevation is a rare indication for phonosurgery and there are several treatment options available for patients who require this type of intervention.

One of the parameters impacting pitch of the voice that can be manipulated surgically is the length of the vibrating vocal fold. Shorter vocal folds length correlates to higher fundamental frequency as observed in the normal lowering of pitch with age from childhood to adult and female to male vocal fold length differences.

Microalaryngeal surgery to shorten vocal folds has been done by various methods and this report is a description of a modification of a novel approach to anterior web formation. This technique has been successful in shortening the vibrating vocal fold length causing dramatic increase in fundamental frequency.

Endoscopic web formation with the use of Radiesse voice gel has been utilized successfully in primarily male to female transsexual patients to increase pitch of the voice. A detailed description of the technique and voice outcome measures in ten patients will be presented.

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# A Current View of Voice Rehabilitation in Laryngectomized Patients (Surgical and Phoniatic Aspects) (no. 89)

I. Šebová, A. Ziethé

- **Form:** Workshop
- **Category:** Medicine
- **Topic:** Surgery

The content of the workshop involves a discussion about present possibilities of voice rehabilitation in laryngectomized patients. The workshop will open with a survey lecture monitoring the current state of problems highlighting surgical and phoniatic aspects. Within the surgical part we will concentrate on: indications and performance of the tracheo-esophageal puncture, procedures in pharyngeal surgery needed to create optimal prerequisites in the pharyngo-esophageal segment for subsequent voice rehabilitation, problems and complications that result from these procedures. In the phoniatic section we will present current possibilities for laryngeal voice rehabilitation, problems, and complications during the phoniatic methods. In conclusion, we will focus on the voice quality provided to the patient by particular methods. At the same time, we will offer a current view on the quality of life following the removal of larynx in relation to voice problems.

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# Voice Conservation for Laryngectomy Patients (no. 90)

J. Betka, M. Šteffl, J. Romportl, Z. Hanzlíček, J. Matoušek

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Voice Rehabilitation after Laryngectomy
- Invited Lecture

Modern speech technologies based on artificial intelligence approach introduce a way for significant improvement of life quality of patients after total laryngectomy or other procedures that disable or damage the functionality of vocal folds. Development of a fully functioning speech prosthesis allowing the patient to speak in a very similar fashion as before the surgery is a very complex multi-level process. One of its steps is so called “voice conservation” – i.e. a procedure when a personalised speech synthesiser is created before the surgery on the basis of the patient’s original voice. This synthesiser is embedded in a text-to-speech (TTS) system, which means that the patient basically receives a computer program that is able to speak with the patient’s voice (and can be used e.g. in mobile devices such as smartphones).

We have undertaken preliminary experiments with a patient with a laryngeal cancer, recorded approx. 1 hour (500 sentences) of her speech and created an HMM-based TTS system using this raw data without any manual modification or enhancement. The results were very promising and the synthesised speech is definitely identified as produced by the patient’s voice [1].

The current stage of the research involves recording of a larger set of patients under real conditions directly at the ENT clinic. The patients are instructed to record as many predefined sentences as possible using a laptop with specially developed recording software. Evaluation of this stage will comprise technical aspects of influence of the recording quality and conditions on the quality of the resulting synthesised speech. Psychological and social aspects will be analysed as well – mainly motivation of the patients to undergo the recording procedure, their endurance and the number of the sentences recorded, recording comfort and the patients’ acceptance of the sentences and ability to read them aloud.

[1] Zdeněk Hanzlíček and Jan Romportl and Jindřich Matoušek: “Voice Conservation: Towards Creating a Speech-Aid System for Total Laryngectomees.” In *Beyond Artificial Intelligence: Contemplations, Expectations, Applications. Topics in Intelligent Engineering and Informatics (TIEI)*, vol. 4, p. 203-212, Springer, Heidelberg, 2012.

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# Voiceworks Method/Singing (no. 91)

L. Popeil

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice
- Invited Workshop

In this workshop, participants will be introduced to the basic skills of singing in any style: Posture, Support, Breathing, Range, Vibrato Type and Speeds, Vocal Fold Closures, Resonance Control of Ring, Brightness and Nasality, and Ingredients of Vocal Styles.

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Lisa Popeil, MFA in Voice, is the creator of the Voiceworks® Method and the Total Singer DVD instructional program. A professional teacher for 35+ years with 50 years of vocal study, Ms. Popeil is an expert in the performance and pedagogy of multiple vocal styles. She has conducted vocal research using video-fluoroscopy, stroboscopy, kymography, high-speed photography, phonovibrograms and MRI with scientists in Japan, Norway, Germany, and in the US. She is on the Advisory Board of the Voice Foundation and is a voting member of NARAS, the Grammy organization.

In addition to a busy private studio based in Los Angeles, Lisa offers the Total Singer Workshops, is a contributor to the 'Oxford Handbook of Music Education' and the 'Oxford Handbook of Singing', has co-written the book 'Sing Anything - Mastering Vocal Styles' and the 'Daily Vocal Workout for Pop Singers' CD.



## Articulation Workshop: “Rhythm Is Gonna Get You!” (no. 92)

K. Chandler

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Articulatory precision is one of the hallmark signs of the rhythmic styles of popular music such as Soul, Funk, Pop R&B, Latin Pop etc. The articulatory style is quite distinctive; the general ‘rule of thumb’ being emphasised initial consonants (for rhythmic drive & intensity) and de-emphasised final consonants (in order to sound suitably ‘slang’). Consonant pressure can also lead to increased vocal efficiency in these styles, and the stylistically appropriate accent is ‘mid-Atlantic’ in most cases.

This energetic, interactive workshop will explore the percussive side of singing by taking delegates through various ‘funky’ preparatory articulation exercises, relevant song excerpts from popular repertoire as rhythmic coordination exercises, and will conclude with basic beat-boxing (i.e. replication of drum patterns with the voice) – the ultimate articulation exercise. These exercises are appealing to younger singers and therefore will form a useful basis for a building a stylistically relevant & fun vocal exercise repertoire for singing teachers.

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KIM CHANDLER MMus(Dist) BMusEd AMusA

Kim Chandler is one of the UK’s leading session singers and contemporary vocal coaches. She runs a busy private vocal studio in London where she teaches an elite clientele of professional singers, established artists, artists in development and other vocal coaches.



Kim has coached several high-profile artists and has featured as a vocal coach in the media (TV, radio, magazines, websites). She is invited to do many vocal master classes, workshops & teacher training events around the UK and abroad. Kim is a regular presenter at national & international voice conferences, including being a keynote speaker in Australia in 2010, and is the current President of the British Voice Association.

Kim is a Principal Lecturer at Leeds College of Music and was a lecturer to Senior Lecturer level at the London College of Music for ten years; the institution from where she also holds a Master’s degree in Performance and was the recipient of the Post-Graduate Prize. She was also the Academic Head of the UK’s first contemporary vocal college (‘Vocaltech’) for three years. Her pioneering “Funky’n Fun” vocal training series is a favourite of many music institutions & singing teachers and is a popular seller internationally ([www.funkynfun.com](http://www.funkynfun.com)).

Kim has over two decades of high-end performing experience in both live performance and studio singing. Aside from her voice being featured on thousands of jingles in many countries, she has also sung with some of the world’s most famous artists and performed at some of London’s most iconic locations such as the Royal Albert Hall, Abbey Road Studios, Downing Street and Buckingham Palace ([www.kimchandler.com](http://www.kimchandler.com)).

## Interactive Workshops - Voice Release Through Movement (no. 93)

I. Jezowska

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

Interactive Workshops/Demonstrations of my author's method of voice release through movement, has to present my own research and work on a publication on the subject, which is produced in collaboration with a specialist - a physiotherapist.

I'll show relationship between practice and research, so the practical use of the mechanisms functioning in areas such as biomechanics, physiology, exercise physiology, anatomy and physical education in the process of releasing the voice.

I will present aspects from the borderline of physical culture and culture of the word - spoken and sung. I will show the work of the body in the process of voice training (emission and impostation).

One of the most important elements of work in my proprietary, authors' method of voice liberation by the movement, are rubber expanders.

Target of this demonstration are actors, singers, vocalists, teachers of singing and instructors and trainers who use the voice as an instrument of their work, or learn to use the voice.

I will try to answer the question, how do we know that the movement can influence the liberation of voice?

Triggering of voice with use of exercise treatment is a kind of voice therapy, creating, forming of habits and skills (proper speech or singing), prevention of voice problems in the employment of the body's reactivity to stimuli (in this case, the incentives in the form of physical exercise and changes in body position).

That is why this method was created in close cooperation with a physiotherapist. This will clarify the mechanisms of action and effectiveness of the exercise - of course, provided that the method will control specialist and will be implemented the methodology of conduct, so repeatable and systematic.

I will demonstrate cycle of exercises, which should consist of three parts:

1. Adaptive (initial) part, popularly known as a "warm up"
2. Fundamental part
3. Leading part

I'll show you in practice, in cooperation with the audience examples of exercises used in the method.

The author is a professor at the State Theatre Academy in Wroclaw, where she teaches subjects: vocal technique and impostation of the voice, while the method was established and based on many years of working with students of acting and observation of results achieved by students through physical exercise combined with work on the voice. The form of 45-minutes presentation will require a larger hall with wooden floor (parquet, wood, panels), with a keyboard instrument (piano, keyboards), and preferably that the room was equipped with gymnastic ladders. Participation of pianist-accompanist would be an advantage.

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Izabela Jezowska (mezzo soprano) graduated from the Vocal and Acting Department Academy of Music. K. Lipinski in Wrocław, in prof. Eugeniusz Sasiadek's class. She improved her vocal skills at master classes with Shirley Verrett (as part of an Italian government scholarship at the Accademia Chigiana in Siena), Fedora Barbieri, Mirella Freni and prof. Christine Szostek-Radkova. In 2002 she defended her doctorate thesis in vocal at the Academy of Music in Katowice, and in early 2011 with decision of the Council of the Vocal Department of Music Academy in Łódź, she received a habilitated doctor degree.

She works as a professor at the National Theatre School, Puppetry Department in Wrocław. She carries out scientific research in the field of vocal pedagogy, but also an active scientific and organizational activity in the Board of the Polish Association of Teachers of Singing as Secretary of PATS. She is the general and artistic director of Music Festivals with vocal workshops for young artists and young singers in Szczawno-Zdrój. She also lectures at the Polish Academy of Sciences.

# Lax Vox Voice Therapy Technique (no. 94)

I. Denizoglu, M. Sihvo

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

Voice therapy is not only the behavioral way of changing the human voice for treatment of voice disorders but also the best way to understand it. The aim of voice therapy is to help the patient to obtain the best possible voice within the patient's anatomic and physiologic capabilities. Among numerous methods, Lax Vox Voice Therapy Technique with the combination of a silicone tube and water resistance works as an easy tool for healing the voice production apparatus and improving its function. It is a direct technique for general use which is adapted easily both by the patient and the therapist. The procedure automatically balances the functions included in voice production. It also gives a multichannel biofeedback and creates holistic cognition of the complex vocalizing process.

The Lax Vox Voice Therapy Technique suits all speakers and singers desiring to learn vocal ergonomics and voice care. In Pedagogical Vocology, it is useful for the singers for specific demands such as blending the registers, vocal warm-up and cool down as well as for the professional voice users for developing a resonant and an effective voice. In Clinical Vocology, it is an effective treatment method for various functional and organic voice disorders. Lax Vox is also useful for pre- and post-operative voice therapy which can be applied by otolaryngologists who are interested in Clinical Vocology.

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Ilter Denizoglu MD is a laryngologist, phonosurgeon and director of Voice Clinic in Katip Celebi University Ataturk Education and Research Hospital, Izmir, Turkey. Near the Clinical Vocology practice, he is interested in Pedagogical Vocology as a university lecturer of Vocology in three different universities' conservatories. He is now studying biophysics in order to form the whole picture of human voice with Basic Vocology.

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Marketta Sihvo graduated in Turku and later in Helsinki and Tampere universities in logopedics and vocology (Ph.D.1997). For twenty years she worked in voice therapy and lecturer at the phoniatic department of Tampere University Hospital. There she started by implementing instrumental voice measurement to the clinical setting. Her research, targeting to prevention of occupational dysphonia, is focused to the effects of working conditions on speech production. She is one of the authors of Voice Ergonomics (in Finnish and Swedish) and of a handbook for evaluation of professional speakers working conditions. Her book Healthy Voice is ABC for voice care (in Finnish and in Estonian). - She developed "the first-aid for voice patients" in which the LAX VOX - tube inserted in water is used. The method serves as diagnostic short term voice therapy. The tool gives multi-channel biofeedback to the vocalist. - She has presented her work in numerous international voice congresses. Marketta Sihvo retired from work in 2009.



# Experimental Investigation of Vibration, Pressure and Acoustic Characteristics of Normal and Soft Phonations on a Physical Model (no. 95)

J. Horáček, V. Radolf, V. Bula, J. Veselý, A.-M. Laukkanen

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Modelling/Simulation
- Invited Lecture

The contribution compares measurements of phonations: on vowel [u:], into a resonance tube and into a narrow straw for a "normal" and "soft" phonation at the phonation onset. The acoustic impedance of vocal tract was increased by phonation through the tube into water loading the phonatory model by the hydrodynamic pressure and bubbling.

The measurements were carried out with silicon vocal folds replica joint to the trachea and vocal tract models for vowel [u:] prolonged by a glass tube or by a plastic straw. The measurements were performed for a normal phonation at the airflow rate  $Q=0.4$  l/s and at the phonation threshold. The root mean square ( $P_{rms}$ ) and mean ( $P_{oral}$ ) pressure inside the oral cavity were measured using the B&K microphone probe and by the digital manometer, respectively. Acoustic signal outside the vocal tract was recorded by the B&K sound level meter. The recording was made using the measurement system B&K PULSE. The mean ( $P_{sub}$ ) and peak-to-peak ( $P_{p-p}$ ) subglottal pressures were measured by dynamic pressure transducers. The vocal folds vibrations were registered by a high speed camera.

The measured flow resistance ( $P_{sub}/Q$ ) was the lowest for [u:], higher for tube in air and in water, and the highest for straw. Similar tendency was found for  $P_{oral}$  and  $P_{sub}$  especially for "normal" phonation. Completely different results were obtained for transglottal pressure  $P_{trans}$ , which was found nearly a constant for a normal phonation in all studied cases but for the soft phonation being the highest for [u:], the lowest for straw, and for tube in between these cases. The time variation amplitude of the subglottal pressure was similar for both type of phonation: the smallest for [u:] and the highest for tube. The similar tendency was found for peak-to-peak variation of the glottis opening. The SPL outside the vocal tract varied between 60-75 dB for soft and 75-85 dB for normal phonation. Fundamental frequency  $F_0$  was between 170-200 Hz in all cases. The pressure  $P_{rms}$  in all cases of the prolonged vocal tract were substantially higher than for the vowel [u:]. For tube in water the considerably high acoustic energy was generated by bubbling with the dominant frequency in the spectrum between 16-19 Hz for soft and up to 40 Hz for normal phonations.

The results show that phonation onset is given by the airflow rate, which was found constant  $Q=0.12$  l/s for tube, tube in water and straw even if the  $P_{sub}$ ,  $P_{oral}$  and  $P_{trans}$  varied considerably. It confirms the conclusions of previous studies: a principle controlling mechanism for phonation onset is given by a critical mass flow rate when the vocal folds start to vibrate due to the loss of aeroelastic stability. Only for vowel [u:], the higher  $F_0$  than in all other cases resulted according to the theory in the higher airflow rate 0.22 l/s needed for the loss of the system stability.

The study was supported by the project GAČR P101/12/1306.

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# Finite Element Modelling of the Effect of Lamina Propria Properties on Vocal-fold Vibrations and Produced Sound (no. 96)

P. Švancara, J. Horáček, T. Martínek, J.G. Švec

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Modelling/Simulation
- Invited Lecture

The study presents a two-dimensional (2D) finite element (FE) model of the fluid-structure-acoustic interaction during self-sustained oscillation of the human vocal folds. The effect of lamina propria thickness and material properties on simulated videokymographic (VKG) images of vocal-fold vibrations and produced sound spectra is analyzed. Such variation of the lamina propria properties can be caused by certain vocal-fold pathologies such as Reinke's edema.

The FE model combines the FE model of the vocal folds and the FE models of the trachea and of the simplified human vocal tract shaped for phonations of Czech vowels [a:] and [i:]. The vocal tract models were created by converting the data from magnetic resonance images (MRI). The vocal folds are modelled using four layers -epithelium, lamina propria, ligament and muscle. For each layer homogenous and isotropic material properties are assumed. The fluid-structure interaction is solved using explicit coupling scheme with separated solvers for structure and fluid domain. For modelling the acoustic wave propagation in fluid domain, compressible Navier-Stokes equations were utilized. The FE model was developed using the program system ANSYS 14.0. The developed FE model includes large deformations of the vocal-fold tissue, vocal-fold contact, fluid-structure interaction, morphing the fluid mesh according to the vocal-fold motion (Arbitrary Lagrangian-Eulerian approach), unsteady viscous compressible airflow described by the Navier-Stokes equations and airflow separation during the glottis closure. The constant inflow velocity of the air at the entrance to the subglottal space is prescribed by a single driving parameter.

For simulation of videokymographic (VKG) images from the results of the FE model, a special program was developed in Matlab. The program uses the emission cosine law for computation of light intensity reflected from the visible vocal-fold surface depending on the surface angle. Numerically simulated VKG images show close similarities with those observed laryngoscopically in vivo. The developed FE model can be used to study relations among pathological changes in vocal folds tissue, the resulting VKG images and the produced sound spectra.

## Acknowledgement

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# Framework for Adaptive Fluid Structure Interaction Simulation of Human Vocal Folds (no. 97)

N.C. Degirmenci, J. Jansson, J. Hoffman

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Modelling/Simulation
- Invited Lecture

We present a computational framework for simulation of self-oscillating vocal folds based on an adaptive finite element method, where the ultimate goal is to predict how the voice is affected by physiological changes of the vocal folds geometry and constitutive properties.

The framework is based on a unified continuum mathematical model for fluid-structure interaction [1] and automatic adaptive refinement of the mesh using the residual of a computed solution weighted with the output from the solution of a dual problem.

The software for the numerical simulations (Unicorn-HPC) is developed at the Computational Technology Lab at the High Performance Computing and Visualization department of KTH, Royal Institute of technology [2].

**Keywords:** high performance computing; fluid-structure interaction; adaptive mesh refinement; finite element method

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# Human Voiced Sound Simulation by the Acoustic Perturbation Equations and Lighthill's Analogy (no. 98)

S. Zörner, P. Šidlof, A. Hüppe, M. Kaltenbacher

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Modelling/Simulation
- Invited Lecture

Human voice has its source inside the human larynx, as air is forced through the trachea and starts to pulsate as it interacts with the vocal folds. The pulsating air stream generates the main part of the sound, the phonation, which is then filtered by the vocal tract to modulate it and produce human speech.

We model this phenomena by the corresponding partial differential equations. To compute the flow field, which is confined to the larynx, the open source solver OpenFOAM is employed. The vibration of the vocal folds is considered by using prescribed vocal folds movement. In a separate step, the acoustic source terms are determined, based on the fluid field results and in a last step the acoustic wave propagation is calculated. We compare two approaches, Lighthill's acoustic analogy and an aeroacoustic analogy based on a perturbation ansatz. The acoustic simulations are performed with the finite element solver CFS++. In order to analyse the acoustic pressure in a propagation region, and not only inside the flow field, a realistic but geometrically fixed vocal tract geometry is connected to the larynx. The results show, that between both acoustic approaches, the simulated sound leaving the artificial mouth is in good agreement. However, inside the flow region Lighthill's acoustic analogy is found to overestimate the acoustic pressure. As this is a hybrid approach the vocal tract can be interchanged, making it possible to examine its effects on the acoustic without repeating the costly fluid simulation.

Furthermore, the presented method is capable of analysing the impact on the radiated sound for different phonation scenarios, which we exploit to analyse insufficient glottis closure and compare convergent/divergent vocal folds position.

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# The Glottal Cam Model: Potentials and Limitations in the Flow Study of Voice Disorders (no. 99)

M. Triep, C. Kirmse, W. Mattheus, R. Schwarze, C. Brücker

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech
- Invited Lecture

Numerous models of the glottis have been generated by different authors over the past decades. Many of them were employed in the study of the flow downstream of a model glottis. One of the models is the glottal cam model which has been widely used in the detailed study of the three-dimensional glottal jet. The cam model has been applied in experiment and numerical simulation for the generation of a typical glottal jet flow and its study by methods of flow visualization. The jet emerges and decays periodically over one cycle downstream the dynamic glottal gap. The glottal jet can interact with supraglottal structures. The vortex dynamics in the supraglottic space of the dynamical glottal model develops differently for a case without and with prominent ventricular folds. The main focus was laid on: the 3-D nature of the glottal jet, the effect of the ventricular folds, the implications of an asymmetric vocal fold motion and the behaviour of the jet edge. The change of the glottis motion pattern or the supraglottic geometry can have important implications with regard to the flow and acoustics in the human voice production.

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# Effects of Eliminating Paranasal Sinus Resonance on Acoustic Properties of the Nasal Tract (no. 100)

M. Havel, T. Kornes, E. Weitzberg, J. Lundberg, J. Sundberg

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

The significance of nasal resonance and antiresonance to voice production is a classical issue in vocal pedagogy and voice research. These acoustic effects, in which the paranasal cavities are often assumed to play an important role, must be associated with the complex morphology of the nasal tract.

Previous investigations have attempted to elucidate the resonance properties of the nasal tract using model and in some cases also in vivo. The results have revealed also a highly complex resonatory landscape, difficult to relate to singers' systematic voice timbre control. This complexity is not only due to the anatomy of the nasal tract but also to the influence of the paranasal sinuses. These sinuses are difficult to access in living subjects, and their immediate effects on voice production have not been extensively examined.

The paranasal sinuses communicate with the nasal cavity via the sinus ostia, through which air is constantly exchanged, especially during humming. High amount of nitric oxide (NO) gas is produced in the paranasal sinuses and contribute to nasal NO levels. These can be conveniently and non-invasively measured by means of a chemiluminescence NO analyser. To eliminate the influence of paranasal sinus resonance on voice, we blocked the middle nasal meatus by application of maltodextrin mass under endoscopic control in vivo and used NO measurements to assess the efficiency of this blockage. Blockage was associated with almost a halving of the sinus NO output during humming.

In vivo experiments were carried out with a female trained singer performing some samples of singing and glide tones covering the fundamental frequency range 220 – 880 Hz, approximately. All these exercises were sung on the consonant /ng/ and repeated after the middle meatus had been occluded by means of endonasal application of maltodextrin under endoscopic control. The sung material was analyzed by long-term-average spectra and the results suggested minor but clear shifts of resonance frequencies. The glide tones indicated level dips near 600 Hz as well as 1400 Hz and seemed more pronounced under the occluded condition.

An epoxy mold of a CT scan of the nasal tract of an adult male was acoustically excited by a sinesweep running from 200 to 2000 Hz. The response was picked up in front of the nostrils after systematic and additional elimination of the maxillar and sphenoidal cavities. In addition, measurements were made with occlusion of one nostril. Highly damped resonances were observed while more or less pronounced zeros appeared in the vicinity of 600 and 1400 Hz. The zeros were found to shift substantially in frequency, depending on what cavities were eliminated.

The results do not provide any clear support for the idea that nasal resonances and antiresonances are used for the purpose of tuning vocal timbre. It is more likely that a more stable property, such as resistance, can be used for that purpose.

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# Epilaryngeal Configuration in Professional Classical Singing - A MRI-based Case Study (no. 101)

A. Mainka, A. Poznyakovskiy, D. Mürbe

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

## Introduction

For voice production in professional classical singing the configuration of the vocal tract is decisive. Thereby professional singers produce the singers formant while non-professional singers don't.

For acoustical and fluidic reasons the formation of the singers formant is related to the morphologic configuration of the laryngeal structures superior the ventricular folds – the so called epilarynx tube. Yet visualisation techniques like the MRI have been of limited virtue to display that very region during phonation with sufficient resolution. With refinements of the data acquisition and data processing we have been able to overcome this limitation partly. Our aim was to track morphologic changes of the vocal tract while producing the singers formant.

## Method

A male subject studying classical singing at the Dresden University of Music was asked to produce sustained vowels in a 3T MRI machine. Sustained vowels /a/, /e/, /i/, /o/ and /u/ were performed on pitch A3. This task was conducted twice distinguishing two different types of phonation: at first a speech like phonation mode (SLPM) and secondly a resonant phonation mode (RPM) as used in professional classical singing. After the MRI-measurements an audio recording was made with the same instructions.

For image data processing the image stack was being cut to compute a set of images whose planes are orthogonal to the tangent of a previously defined centerline. With help of a semi-automatic algorithm the resulting images were segmented along the air-tissue-border. The assembled two-dimensional segmentations allowed a detailed analysis of 2D and 3D measures within the centerline-based coordinative system.

With the audio recordings a long term average spectrum (LTAS) analysis was undertaken to verify the amplification in the frequency region of the singers' formant.

## Results

Comparing the RPM to the SLPM the LTAS analysis showed a characteristic enhancement in the frequency region of the singers' formant for all measured vowels. Analysis of the different area and volume measures in the region of the epilarynx tube showed a uniform decline in the RPM compared to the SLPM. The largest narrowing of the epilarynx tube was observed for vowel /a/ where the volume measure during RPM decreased to 36% in comparison to the SLPM. For the other vowels this measure ranged between 64% and 86%.

## Discussion

The applied MRI-based data acquisition and segmentation procedure seems suitable for a sufficient resolution of the epilaryngeal morphology during phonation. The findings indicate the influence of the morphologic configuration of the epilaryngeal region on acoustic characteristics of professional singer voices. Further investigations of these relations are necessary to describe characteristic articulatory adjustments during a classical singing education.

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# The Posterior Pharyngeal Ridge (Passavant's Wall) in Various Singing Styles

(no. 102)

L. Jansen, S. Algoet, W. Decoster, H. Smits, M. Helsen, C. Van den Hove, F. de Jong

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

Resonance and carrying capacity of the voice are basic elements in classical voice teaching. 'Opening the throat' is a well known kinesthetic phenomenon in singing. In anatomical respect maximalisation of the caudal-cranial dimensions of the vocal tract occurs. It is a technique of raising the soft palate (velum) and lowering the larynx. Optimal vocal tract also involves and assumes the adequate and optimal positions of the articulators (jaw, lips and tongue). The shaping of the mouth as well as the use of facial muscles also plays an important role in the supraglottal functioning in order to find the optimal shape of the vocal tract. Singing borrows basic anatomical structures and functions of the larynx and pharynx, i.e. respiration and swallowing. Therefore, in singing stereotypic reflex patterns are used and modified. One of these reflex mechanisms is velopharyngeal closure. Depending of the desired style, the singer aims to guide these mechanisms specifically. In this procedure, the singer bases his technique on acoustic perceptions and kinesthetics. But what is really happening in that vocal tract? What is happening in anatomical and physiological respect when a singer feels the raising of the soft palate and some more space in the back (the pharyngeal wall)? Direct visualization is limited. We can see tongue, lips, jaws, face and mouth working but laryngeal and pharyngeal structures can only be visualized by the use of technical instruments such as endoscopy and the MRI scan. In this ongoing study various shapes of the posterior pharyngeal ridge (Passavant's wall) in different singing styles was observed in MRI scanning during singing. Closure of the nasopharynx by the soft palate was associated with various shapes of the posterior pharyngeal ridge, ranging from a flat structure to a distinct curving, grasping the posterior part of the soft palate. Apparently, the posterior pharyngeal ridge plays an active and differentiated role in the various singing styles. These mechanisms are demonstrated and discussed in this paper.

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# Applying Statistical Shape Modeling Methods to the Vocal Tracts of Professional Singers (no. 103)

A. Poznyakovskiy, A. Mainka, I. Platzek, D. Mürbe

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

Statistical shape modeling has become an important trend in medical imaging in the recent decade. Statistical methods provide a possibility to overcome interindividual differences in the geometry of anatomical structures to create a model that reflects the statistical mean and displays interindividual variability depending on the position. We applied established methods of statistical shape modeling to study geometrical variations of the vocal tract in professional singing students. By means of MRI, we have recorded 27 students in the process of singing different predefined vowels. The MRI images were filtered with anisotropic diffusion in order to remove speckle noise and sharpen the edges of structures. Then, each image was resampled along a manually defined centerline of the vocal tract ranging from the mouth to the trachea. On the transformed image stack, the cross-section of the vocal tract was segmented using a modified active contours approach. The resulting segmented contours were combined to form a polygonal surface. The surfaces which correspond to the same vowel were subjected to rigid-body point-to-point Procrustes alignment to minimize mean error between points. For this study, an alternative norm has been applied to deal with outlying points better. Subsequently, point-to-point correspondence was established by proximity. This allowed the computation of the mean shape and variational mapping. Subsequently, the principal component analysis was done by eigendecomposing the covariance matrix of the point clouds. The result was a set of statistical shape models for various vowels which could be used to deepen our understanding of the learning process during professional singing education.

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# The Effect of Supine and Upright Position on Vocal Tract Configurations During Singing in Untrained Voices (no. 104)

L. Traser, M. Burdumy, B. Richter, M. Vicari, M. Echternach

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

## Introduction

Previous studies using dynamic real-time MRI in order to analyze vocal tract configurations in singers were performed with the subject in supine position. Recently, a study with professional tenors in a rotating MR system could indicate that the effect of supine vs. upright position on the vocal tract shape can be considered to be rather small. However, it remains unclear whether this is an effect of compensation due to vocal training.

## Material and Methods

The vocal tract profiles of 20 untrained subjects were analyzed using a rotating MR scanner that can be rotated from 0-80 degrees (0.25T). The singers performed sustained tones in an ascending scale from C4 (262 Hz) to A4 (440 Hz) on the vowel /a/ in supine and upright positions, starting in modal register and changing to falsetto register for higher fundamental frequencies. The results were compared with the data of 9 professionally western trained tenors.

## Results

The untrained subjects showed only small differences in their vocal tract configuration between supine and upright position. Many articulators, such as lip opening, jaw opening, tongue position and uvula position, were not affected by the subjects' positions. Also, in accordance with the professional singers, the larynx was found to be higher and the jaw more protruded in supine position. In contrast to professional singers the untrained subjects raised their larynx above the resting expiratory level (REL) during singing even for lower fundamental frequencies.

## Conclusions

The data in the present study suggests that the lack of great differences in the vocal tract configuration between upright and supine position in professional singers are not caused by training, but by intuitive proprioceptive control of the articulators.

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# Thyroarytenoid and Cricothyroid Muscle Activity in Seven Female Singers during Chest, Chestmix, Headmix and Head Registers (no. 105)

K. Kochis-Jennings, E. Finnegan, H. Hoffman, J. Jaiswal

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

Although there have been numerous investigations of laryngeal muscle activity in male singers during phonation in the chest and falsetto registers, little research has been conducted examining laryngeal muscle activity in female singers. Previous studies have examined chest and head phonation in two female classical singers during ascending scales and another chest, middle and head phonation in one female classical singer during sustained phonation (Hirano 1969; 1970). However, no research has been conducted to investigate laryngeal muscle activity in female contemporary commercial music singers during the production of chestmix and headmix registers, two 'mixed' registers commonly described by singers and singing teachers. The purpose of this study was to test the hypotheses that (a) CCM singers produce chestmix by maintaining or increasing adduction of the vocal processes and by engaging the thyroarytenoid muscle to a greater degree than they would to produce a headmix or head register, (b) thyroarytenoid muscle activity decreases during the chest to head register transition but does not cease, and (c) headmix and head registers utilize CT muscle dominant voicing, while chest and chestmix registers use TA muscle dominant voicing.

Simultaneous recordings of thyroarytenoid and cricothyroid muscle activity, videonasendoscopy, and audio were obtained from seven female singers (5 trained, 2 untrained) during sustained phonation and song phrases produced in chest, chestmix, headmix, and head registers and during ascending pitch glides. Thyroarytenoid and cricothyroid muscle activity was normalized to a percent of mean maximum activity and compared across registers and frequencies within and across subjects. Video stills of the vocal folds during phonation were rated for degree of vocal processes adduction and also compared across register and frequency. All audio samples were rated for register by two singing teachers and audio samples of sustained phonation were analyzed via Fast Fourier Transform to measure the number and amplitude of the harmonics between 2000 Hz - 5500 Hz in each sample. Interjudge and intrajudge reliability tests were conducted.

The results of the study showed that (a) thyroarytenoid activity and adduction of the vocal processes was greater for chestmix than headmix or head, particularly during production of higher frequencies, but less than for chest productions, (b) during ascending pitch glides, thyroarytenoid activity decreased at the moment of the chest to head register transition then increased as pitch increased, and (c) most productions, but particularly chest productions, were produced with greater activation of the CT muscle than of the TA muscle and thus the idea of CT dominance for head register and TA dominance for chest register was not supported.

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# Occupational Voice Disorders in Greece (no. 106)

A. Prachali

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

It is a well-known fact that, in most cases, voice problems are related to certain professions. However, unique socio-economic and lifestyle factors may affect the degree and the type of this relationship. This study is the first attempt to define professionals typically seeking help for their voice, to identify most common voice problems, and relate certain professions with certain voice problems in the Greek population. Data (n= 332) were derived from the database of Athens Voice And Swallowing Centre over the period of 1 year. Demographic analysis was conducted. According to the results, professionals seeking help most frequently were singers (15.06%), sales/sales-related occupations (13.5%), actors (12.95%), and teachers (9.04%). Most frequently diagnosed types of voice disorders were mucosal-submucosal (39.16%), muscular (24.10%), neurologic (9.34%), and inflammatory (8.13%). Voice clinic visitors were classified in different levels of voice use, according to their profession. Elite voice users (level 1) were diagnosed mostly with problems related to vocal abuse, but were also visiting the clinic with the slightest complaint of dysphonia without any diagnosed pathologic conditions. Professional voice users (level 2) were reported with a high degree of polyps and nodules, as well as Muscle Tension Dysphonia. Non-vocal professionals (level 3) were related to a high degree of mucosal and sub-mucosal voice problems, but also visited the clinic for vocal palsy and inflammatory conditions. Non-vocal/non-professionals (level 4) visited the voice clinic mostly for neurological problems, but also presented with a relatively high percentage of malignant and premalignant conditions, as well as "hysterical" aphonia.

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# The Voice Problems of Vocalists and the Situations Behind: A Pilot Study

(no. 107)

A. Vurma, K. Kalling

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

## Background

There is the shortage of studies where the voice problems of singers have been addressed together with the situations on background which may have led to these problems, as most investigations have been focused on speaking voice (Vilkman 2004, Boucher & Ayad 2010). Singing uses the vocal apparatus in much wider limits compared to the speaking. Therefore we assume that the nature of the voice problems of vocalists and their typical causes need more specific attention.

## Aims

The aim of present research is to describe voice problems of vocalists who are seeking for medical help and to describe the typical situations related to voice load which are causing these problems.

## Method

We examined altogether 77 vocalists (49 female, 17 male and 11 children) who visited the ENT department of East-Tallinn Central Hospital during one year due to voice complaints. The selection criteria were: (1) professional singer, (2) professional singing instructor or choir conductor, (3) regular singing in some amateur choir or as an amateur soloist. The following procedures were conducted: (1) larynx endoscopy, (2) the measurements of acoustical parameters of the voice - jitter, shimmer, HNR, SPL, the level of the singers formant, H1-H2, and some others (a) from a single vocalized note, (b) from a spoken excerpt and (c) from a sung excerpt, (3) the measurement of the closed quotient and related statistical parameters from EGG signal, and 4) the determination of the VRP and related statistical parameters (by using the Voice Profiler, © Peter Pabon). In addition all patients were interviewed about the situation which may have caused their vocal problems, they filled the questionnaire VHS-10 and indicated on the VAS scale the severity of their problem.

## Results

On the background of the voice problems of professional singers was often the need to accomplish some vocal task which did not fit well with the type of their voice or with the training which they had. Voice problems of singing instructors and conductors had lasted the longest before they decided to seek for medical help. The problems of amateurs were most often related with the insufficient vocal training and with one-time overload. Also the results of the acoustic, EGG and endoscopic investigations were addressed separately by the groups of patients and the cross-correlations between the measured parameters were calculated.

## Main contribution

Better awareness of vocalists as well as of their employers about typical situations which may lead to voice problems would help to avoid such situations and improve the working capability of the employees who need to use singing voice. Voice problems often do not manifest in the single parameters characterizing voice instability or concomitant noise but rather on the limited ability of the singers to fulfill more demanding vocal tasks.

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# Analysis of Paired Patient/Non-patient Data from a Voice Accumulator Device *(no. 108)*

S. Granqvist, A. Graca, L. Öhlin, S. Ternström, M. Södersten

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

A portable voice accumulator device (VoxLog from Sonvox AB) was used to record data from an accelerometer and a microphone attached to the speaker's neck over several days. The accelerometer signal is used to detect fundamental frequency (F0) of the voice and to classify the sound into segments of own speech and background sound. The microphone is used to detect the sound pressure level (SPL). Every 5 seconds average data regarding F0, voice SPL and background SPL was stored.

For the present study data from 8 pairs of female participants with and without voice disorders and with vocally demanding occupations were recorded over a period of 7 days. Each pair consisted of one patient with a diagnosed voice disorder and one person from the same or a similar working place, with similar tasks but without voice disorder. Each day was divided into four parts for which the participants also made a self-estimation of perceived voice symptoms. The data was exported to Matlab for further analysis.

The present study explores how the data can be analysed. Averages of F0, voice SPL and background SPL are obvious measures, but the study also reports on covariations between voice and background SPL, variations over time and generates speaking range profiles. These measurements are compared within the participant pairs

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# How a Voice or Speech Disorder Affects Future HRM-consultants Perceptions of Personality and Professional Suitability (no. 109)

M. Zetterstrøm

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Sociopsychology and Voice Disorders

The purpose of this study was to investigate if and how future Human Resource Management (HRM) consultants' perceptions of possible job applicants' personalities and professional suitability are affected by voice and speech disorders. The method used is the Matched Guise Test. Four different speakers with authentic voice or speech disorders were included: a man with severe strained and breathy voice, a woman with severe grating – a hoarseness characterised by high frequency turbulence, a man with interdental lisp and a man with stuttering. Four normally speaking persons who were found to be comparable according to sex, perceptual age of voice, fundamental frequency, rate of speech and dialect were included as matched controls. Eleven raters from the master of HRM at Copenhagen Business School were presented to sound clips of the eight speakers reading aloud the same neutral text. In order to avoid social desirability bias, the raters were by way of introduction given a fictional purpose of the study, but were informed of the true purpose once the ratings were finished. The rating of each speaker consisted of three parts: an open questions about the raters' immediate impressions of the speaker, a series of eight semantic differential scales with bipolar adjective pairs and a rating of the impressions of the speakers' degree of suitability for twelve different occupations. The results showed that the voice and speech disorders affected the raters' impressions of personality negatively in three semantic scales for the speaker with strained and breathy voice, six semantic scales for the speaker with hoarse voice, two semantic scales for the speaker with lisp, and five different semantic scales for the speaker who stuttered. In the impressions of professional suitability there was a tendency showing that speakers with the two different voice disorders and the stuttering speaker were rated as less suitable for professions with high requirements on level of skills and functioning of voice and speech, and they were rated as more suitable for professions with little requirements on the level of professional skills and functioning of voice and speech. There was some discrepancy in some of the raters' answers about, especially, the person who stuttered and to some degree the person with a lisp. This, and the fact that some raters commented on the speech disorders, primarily the stuttering and the lisp, indicate that the raters to an unknown degree had been aware of the fact that some speakers had a speech disorder, and therefore their ratings may have been affected by a social desirability bias. If the tendencies found in this study can be found among other future and current HRM consultants, this may imply that individuals with voice or speech disorders may have to make a greater effort in order to make a good impression in job interviews and other professional relations, than individuals with normal voice and speech.

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# It Is Too Loud! Teachers and Children's Opinions on Preschool Environment

(no. 110)

A. McAllister, L. Rantala, V. Johnsdottir

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

High background noise levels, affecting hearing and voice production, have been found in several investigations of the preschool environment. However, the general knowledge on voice, voice production and voice disorders is limited since little information on voice is found in textbooks in general, and specifically for school- and preschool teachers. Also, most education programs for teachers don't include any, or very limited, vocal education. The aim of this study was to investigate how preschool children and their teachers feel about their environment at the preschool and also their knowledge about good vocal ergonomic practices.

As part of a larger project aiming at educating young children and teachers on voice, voice production, vocal health etc. focus group interviews were conducted in x preschools in Sweden, Finland and Iceland using a semi-structured interview technique. A total of 44 children and 12 teachers' participated, 16 children and 6 teachers in Sweden, 16 children and 3 teachers in Finland and 12 children and 3 teachers from Iceland. The interviews were audio-recorded and transcribed verbatim. Transcribed data was then analyzed using qualitative content analysis (Graneheim & Lundman 2004). The main themes and sub-categories were identified.

Results showed that children are aware of high noise levels at the preschool and the risk it poses on hearing but unaware of the effects on voice production. Some children said they preferred to be outdoors since it is less noisy. The teachers express several effects of the daily noise exposure such as a need for breaks including vocal rest during the work day, social avoidance and a sustained high vocal loudness also after work. The teachers are aware of effects of noise on hearing but unaware of the effects on voice production and have never heard the term voice ergonomics. The teachers suggest several changes at the preschool that could reduce noise levels such as number of children in each group, acoustic dampening and changed furniture

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# How Does the Teacher's Voice Affect Childrens' Comprehension and Learning? (no. 111)

V. Lyberg-Åhlander, M. Haake, S. Schötz, K. Hansson, A. Gulz, B. Sahlén

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

The spoken word is the major means of communication in the classroom. The teaching profession is acknowledged as an occupation with high vocal demands and a heavy voice load. Thus far, only a small number of studies have described the child's perception of speaker's voice quality and to the possible consequences for comprehension and learning. Back-ground noise and adverse room acoustics have been shown to affect listener's memory and recall of information. The hypothesis is that the verbal content communicated by a dysphonic voice due to its deviant acoustic properties may cause the child to allocate cognitive capacity to the processing of the voice-signal. Thus, the capacity to process the content of the message is reduced. The child's working memory capacity and executive functioning will therefore be important for performance in the task. A total of 95 eight year old children were recruited for the study. After testing cognitive capacities (complex working memory and executive functioning) two groups were constructed where n=40 and n=45 children were included. The groups were comparable regarding cognitive capacity, age, gender, multilingualism; contact with SLP and school adherence. The two groups were tested with a digital version of Test for Reception of Grammar (TROG-2, Bishop 2003). The test was digitally presented to the two groups through recordings of the same female speaker but in different voice qualities, Group A with a typical voice, and Group B with dysphonic voice. The voice qualities had been assessed with the "SVEA" protocol by three experienced voice pathologists. The dysphonic voice was described as a hyperfunctional voice with reduced sonority and vocal fry. The results showed that the dysphonic voice affected the children's performance. In the group presented for the dysphonic voice ANOVAs showed that the frequency of mistakes increased concurrently with increase of the test's grammatical complexity. Also the frequency of the children's auto-corrections where increased already at the easier tasks. The result suggests that more cognitive resources are needed for coping with a dysphonic voice. Even though the working-memory capacity and executive functions were associated to the language comprehension test results for the entire group, there was a stronger relationship between working-memory capacity and the language comprehension results for Group B. There was also a relationship between the children's executive functioning and the number of corrections in the group presented for the dysphonic voice. The results are thus largely consistent with the findings in earlier studies. Except for the cognitive challenge for a child listening to a dysphonic voice, the strain a dysphonic teacher - or examiner may need to make their voice work can be misinterpreted and influence the teaching relationship. There is thus, a need to include voice and communication training in teacher education.

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# Method of Directive Musical Therapy - Rehabilitation of Selected Disorders of Voice and Speech by Playing the Overblown Flute (no. 112)

M. Kučera

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

The workshop is aimed at practical training of using the endblown flute during indirect rehabilitation of selected disorders of voice and speech. It is a method of so-called directive musical therapy. The overblown flute (unlike the flute it has no finger openings) is an archaic instrument of herdsmen from the Carpathian arc (Eastern Europe). It is constructed very simply, the principle is that the tone height is changed only by intensity of expiration (9 basic tones). The principle in treatment of selected disorders of voice and speech is the fact that patients try to manage the exercises in order to create a sound. During repeated training the impaired function is gradually corrected.

## Basic philosophy

Man is perceived as an integral unit of three levels – biological, psychological and social. The quality of phonorespiration and articulation is influenced by a tension at all three levels. The relation between postural habits and suspense of postural muscles, which determine the final tension of muscle groups involved in phonorespiration and articulation, is important at the biological level. The indirect training of breathing with the help of a musical instrument is significantly influenced by the tension of postural muscles as well as muscles affecting the involvement of voice and articulation. An overlap to psychological and social levels may occur in widespread therapeutic usage.

## Basic use

1. Natural straightening of the body with physiological activation of postural muscles from the waist up and down. Creation of physiological „working“ tension of the body.
2. Improvement of breathing: coordination of respiratory muscles, intensification of breathing in, creation of natural diaphragmatic support, prolongation of phono-respiration time, softening of vocal beginning.
3. Adequate coordination of muscles involved in phonorespiration and articulation.
4. Release of excessive energy of the child through the flute sound, without using the voice.

## Special use

1. Influencing of the ability to make use of the real voice range, with parallel involvement of the voice and playing the flute.
2. Deliberate training of spastic or non-coordinated use of respiratory muscles. The exercise is suitable for selected types of disorders of speech fluency. This training leads to understanding of speech impairment at biological level. The next step involves working with deliberate simulation of one's own disorder by means of influencing the place of tension maximum and its intensity. Then a moderation of the disorder may occur.

## Conclusion

The method can be used in children during rehabilitation of hyperfunctional dysphonia and vocal cords knots. In other cases it is used in a parallel or supplementary way. The patient concentrates on playing a simple instrument, thus influencing the postural habits, phonorespiration and articulation.

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### Publications

Co-author of the textbook - Phoniatics - voice

Author of textbook - Practical course of voice rehabilitation and reeducation

# Voice Therapy: From the Past to the Present (no. 113)

J. Wendler

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Voice Therapy
- Invited Keynote Lecture

The roots of voice therapy can be traced back to the professional use of the voice. In antiquity, so-called phonasci, voice coaches, were training and monitoring their clients with regard to public speaking, in particular keeping an appropriate physiologic mean speaking pitch. During the times of Baroque, aspects of the singers' voice came to the fore and can, still, be found as wide spread elements of several training procedures, with quite a lot of irrational, metaphoric dimensions of imagination. In the beginning of the 20th century, vocal hygiene was established as an obligate part in Prussian teacher education, and with Hermann Gutzmann's public lectures on health care for voice and speech in Berlin at the same time, physiologic and medical perspectives concentrating on the peripheral areas of respiration, phonation, and articulation were introduced as basic references of therapeutic measures. In parallel, holistic approaches stressed psychological and behavioral conditions (Froeschels) and, finally, arrived at a communicative way of looking at the phonatory process with interindividual and sociocultural interrelations forming the basis as well as the targets of voice therapy. This philosophy also implies that, obviously, what we, the voice specialists, use to call a physiologic, healthy and pleasant sound is going to be more and more replaced in the public perception by hoarse and harsh professional voices (in singing as well as in speaking), be they really pathologic or arbitrarily maltreated. We have to realize that these voices are not only generally accepted, but, even are attracting special interest, and therapy may, primarily, aim at a resilient and effective voice instead of a perfect sound. Thus, all in all, a vast amount of specific methods and strategies has been developed, in parts scientifically based, others intuitively emerging from personal experiences, and some of them even extremely contradictory. In spite of the availability and, increasingly, the application of recently recommended rating criteria (basic protocol of the European Laryngological Society, Dysphonia Severity Index, Voice Handicap Index a. o.), no evidence based comparing evaluation of the efficacy of the various approaches could be found in the literature, and it seems, indeed, rather unrealistic to hope for such an appraisal due to overwhelming methodological problems. And in addition, as it is true always if several methods are in use for the same purpose, it is mostly not the method that makes the difference, but the person who uses it. Consequently, it is, now as before, the personal decision of the experienced, competent clinician to responsibly make the choice of an appropriate approach from a large arsenal of tools in optimal accordance with the patient's individual requirements, with always the Hippocratic imperative in mind: primum nil nocere - first do no harm.

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- Reopening and direction of the Phoniatic Department at the ENT-Clinic of the Charité University Hospital Berlin, 1969 - 1995,
- Scientific work mainly on voice,
- Numerous lectures and workshops in Germany and abroad
- On the Boards of several national and international scientific and professional associations



# Experiences with Thyroplasty Type I (Isshiki) at the Department for Phoniatics and Paedaudiology at the Erlangen University Hospital (no. 114)

I. Šebová, J. Wagner, U. Eysholdt

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Thyroplasty (TPL) type I (Isshiki) with the help of a silicone block has been performed at the Department for Phoniatics and Paedaudiology in Erlangen (Germany) since 1993. We analyzed the medical records of patients operated here and concentrated on the surgical technique and on the problems and complications that accompany this treatment. We found out in accordance with available literature that the surgery was accompanied with a small number of surgery-related complications. Up to now we have operated on 117 patients, only in 6 case a revision surgery was necessary. The reason for it was as follows: 3x persistent dysphonia following surgery, 2x shift of applied cartilage, 1x extrusion of the implant intralaryngeally and its sinking into the lower respiratory tract. 2x the patients developed serious dyspnea after the surgery: 1) in the first case we had to intubate the patient several hours following the operation, as he had a large swelling in the larynx, 2) in the second case the patient under anticoagulation treatment developed a massive haematoma in the hemilarynx on the side of the operated vocal fold 6 hours following surgery. 1x we noticed that a young female patient with fine tissues had a rejecting reaction of the body 8 months after thyroplasty - a silicone block dislocated gradually from the larynx to the outer throat and its extrusion through subcutis and skin was a threat. In general, it can be said that the problems and complications with TPL I are rare. Heightened caution is required with the patients under anticoagulation treatment and patients with hypotrophic or atrophic tissues in the larynx and throat areas.

Further we analyzed the quality of voice based on the objective parameters (Shimmer, Jitter, Closed Quotient, HNR) and phonovibrograms in the group of operated patients. The quality of voice will considerably improve, nevertheless it will not reach the parameters of healthy voice.

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# Longitudinal Voice Outcomes Following Advanced CO<sub>2</sub> Laser Cordectomy for Glottic Cancer (no. 115)

A. Mendelsohn, N. Matar, V. Bachy, G. Lawson, M. Remacle

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

## Objective

CO<sub>2</sub> laser cordectomy for glottic carcinoma offers excellent oncologic control on a per stage basis as compared with primary radiotherapy with long-term vocal outcome equivalence. We aim to further investigate the fluctuations of postoperative vocal outcomes following extended laser cordectomy for glottic cancer.

## Design

Single center retrospective cohort study.

## Methods

10 patients with glottic SCC who received CO<sub>2</sub> laser cordectomy European Laryngological Society (ELS) type III-IV with complete datasets at preoperative, immediate postoperative (4 months) time points were included. Non-normally distributed data was analyzed by Wilcoxon matched-pairs signed-ranks test.

## Results

All patients (n=10) received cordectomy as their primary treatment. Tumor stage was divided evenly between T1/T2. One patient was referred for post-cordectomy thyroplasty. Mean VHI scores increased in the immediate postoperative period (43.3 to 46.2), but did not reach significance ( $p>0.05$ ). Delayed postoperative VHI (23.3) demonstrated substantial improvement from both pre- and immediate post-operative levels ( $p=0.047$ ). Objective voice rating significantly declined initially ( $p=0.03$ (Grade),  $p=0.01$ (Breathiness)) and recovered to similar preoperative levels. Maximum phonation time (MPT) showed substantial decreases at the initial postoperative period ( $p=0.007$ ). While significant improvement was made at the delayed postoperative point ( $p=0.009$ ), MPT remained below the preoperative level ( $p=0.028$ ). No significant changes were seen in phonatory subglottic pressures.

## Conclusions

Patients undergoing extended CO<sub>2</sub> laser cordectomy for glottic cancers can experience initial decline in voice quality; however, vocal function routinely returns to preoperative levels following the initial healing period. A small percentage of extended cordectomy patients may require further vocal interventions.

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# Survival of Patients with Early Glottic Cancer Treated with Either Laser Excision or Radiotherapy (no. 116)

R. Rydell, N. Clarhed, J. Wennerberg

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Between January 1998 and March 2010 a total of 367 patients with laryngeal cancer were treated at Skåne University Hospital in Sweden. Of these, 317 were glottic carcinoma. The distributions of T-classes were: T1a = 166, T1b = 35, T2 = 78, T3 = 26, T4 = 12. We studied the treatment effect for patients with T1 and T2 tumors, a total of 276 patients (of the original 279, 237 were male and 42 were female; 2 patients died before treatment and 1 patient moved to another part of Sweden. Of the 276 patients with T1/T2 cancers, 124 were treated primarily with radiotherapy and 152 with laser excision. The distributions of primary treatment were: for radiotherapy T1a = 41, T1b = 22, T2 = 61 patients respectively; and for laser excision T1a = 125, T1b = 12, T2 = 15 patients respectively. 6/124 patients got additional treatment after radiotherapy, 4 with laser excision and 2 with laryngectomy. 4/152 patients got additional treatment after laser excision, all 4 with radiotherapy. Minimum follow up was 2 years.

## Preliminary results

For the 59 patients who experienced recurrences after primary treatment, a total of 85 treatments were performed. Total laryngectomy was performed in 25 patients primarily treated with radiotherapy, which represents 20% of this group. Total laryngectomy was performed in 7 patients primarily treated with laser excision, representing 5% of the group. A total of 23 recurrences were treated with laser excision, 21 of these earlier also treated with laser excision, and 2 as salvage after radiotherapy failures. 17 recurrences were treated with radiotherapy due to recurrences after laser excision.

At 2 years 233 patients (84%) showed no evidence of disease. Three patients had recurrent cancer, 7 were dead due to their glottic cancer, 22 dead of other diseases and 11 lost to follow up. Disease specific survival after two years was, for patients primarily treated with radiotherapy: T1a = 100, T1b = 89 and T2 = 94%, and for patients primarily treated with laser excision: T1a = 100, T1b = 89 and T2 = 93%.

At follow up after 5 years, 22/236 patients had died due to their glottic cancer, 68 had dies from other causes. Disease specific survival after 5 years was, for patients primarily treated with radiotherapy: T1a = 98, T1b = 70 and T2 = 90%, and for patients primarily treated with laser excision: T1a = 95, T1b = 75 and T2 = 70%.

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# The ELS Classification for Endoscopic Cordectomy: Did it Reach Its Goal for Standardization of Reported Outcomes? (no. 117)

N. Matar, M. Remacle

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

## Background

Transoral laser microsurgery (TLM) is being widely used as a therapeutic option for early stage glottic cancer. The working committee of the European laryngological society (ELS) proposed in 2000, a classification for endoscopic cordectomies to allow interpretation and comparison of postoperative results achieved by different centers around the world.

## Objective

Our aim is to assess the extent of use of this classification in published articles reporting treatment results for glottic cancer.

## Methods

We searched Pubmed by using the Mesh terms "laser" and "surgery" and "larynx" and "classification". We applied the limits between 2000 and February 2013. We completed the research by reviewing the related articles. All the abstracts available in English were searched for the use of the ELS classification and the outcomes of the study.

## Results

A total of 129 articles in English fitted the inclusion criteria. More than 30 articles available only in other languages were not reviewed. Among the 127 articles 70% were published between 2000 and 2010 and 30% were published between 2010 and 2013. Seventy one percent were published by European teams (Italy, Spain, Belgium, Netherlands, France, Austria, UK), 15% by Asian teams, 8% by North American teams, 6% by South American Teams. Oncological results were the main outcomes in 33% of the articles and functional outcomes (eg: voice quality) were the main outcomes in 30% of the articles. The rest were histological studies, review articles or experts opinions...

## Conclusion

It seems that the ELS working committee classification for endoscopic cordectomies is being widely adopted by European and non-European teams in reporting oncological and functional outcomes in endoscopic laryngeal surgery for early glottic cancer.

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# Voice Improvement after Radiation Treatment for T1 Glottic Cancer (no. 118)

M. Žargi, I. Hočevnar-Boltežar, P. Strojan

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Treatment Methods

## Background

Patients with glottic cancer seek medical help early because of their hoarse voice. Dysphonia obviously affects the quality of their life. After successful radiation treatment the quality of their voices improves. The aim of the study was to determine the time course of the voice improvement in the first two years after the completed treatment.

## Methods

Thirty-nine successive patients (34 M, 5 F, age range 32-85 years, mean 61.54 years) who had been successfully treated for glottic carcinoma with irradiation were included in the study. The patients were examined before the beginning of the treatment and 3, 6, 12 and 24 months after the irradiation. A videostroboscopy, subjective voice assessment by a patient (visual analogue scale) and by a phoniatician (grade, roughness, and breathiness), Voice Handicap Index (VHI), acoustic analysis of the vowel /a/ samples (fundamental frequency-F0, jitter, shimmer) and maximal phonation time (MPT) were determined in all participants. The data on extension of the tumor, type of biopsy, smoking, symptoms of laryngopharyngeal reflux (LPR), and voice problems (voice fatigue, insufficient voice loudness) at every visit were obtained from the medical documentation. The findings of the two successive control visits were compared (before the treatment vs. 3 months after the treatment; 3 months vs. 6 months after the treatment, etc.).

## Results

Three months after the treatment, the subjective patient's assessment, two items of the phoniatician's assessment of voice quality (grade, roughness), F0, total VHI score and all VHI subtests' scores significantly improved compared to the findings before the treatment. There was no significant improvement in any of the assessed items in the next three months. Twelve and 24 months after the treatment, only the patient's assessment of voice quality significantly improved. Two years after the irradiation, videostroboscopy, subjective voice assessment, VHI, MPT and acoustic analysis of voice showed normal voice quality only in three patients. A significant correlation between the LPR and voice fatigue was detected 3 months and 12 months after the treatment. The other factors did not affect the voice quality.

## Conclusions

An improvement of voice quality can be expected already within three months after the successful irradiation treatment. It improves a little further with time but rarely becomes completely normal again. The treatment of other diseases adversely influencing voice quality (LPR, allergy, pulmonary diseases) can contribute to better voice quality and patient's quality of life.

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## Voice Evaluation after Partial Laryngectomy (no. 119)

B. Wiskitska-Woźnica, M. Leszczyńska, P. Świdziński, H. Czerniejewska, J. Jackowska, W. Szyfter, B. Maciejewska, A. Żebryk-Stopa

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Analysis of Voice and Speech

### Background

Treatment of laryngeal cancers, may include surgery, radiotherapy, chemotherapy, or a combination. Total laryngectomy (TL) has been the standard surgical treatment. Partial laryngectomy procedures were performed, their advantage over TL is preservation of laryngeal functions.

### Methods

The investigation was carried out on a group of 20 patients (3 female and 17 male), who underwent surgery according to the techniques mentioned above. The methods of investigation were based on perceptual voice estimation (GRBAS), videolaryngostroboscopy, acoustic voice analysis, aerodynamic measure maximum phonation time, voice self-assessment (VHI).

### Results and Conclusions

The perceptual voice estimation revealed a good phonation result in only 3 cases after using surgery with the Callearo method as well as the best results of MPT. The VHI reflected severe voice handicap in 2 patients (26 to 40 points). No statistically significant differences were observed between the values of the acoustic parameters in MDVP analysis after following operation –CHEP, Callearo, Sedlacek.

**Keywords:** reconstructive laryngectomy, neoglottis, voice estimation

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# Improving Vocal Function Using Skin Surface Stimulation on Acupoints: An Alternative Approach for Treatment of Voice Problems (no. 120)

E. Yiu, K. Chan, E. Kwong, Z.X. Lin, E.P.M. Ma, R. Tsang, K. Verdolini-Abbot, S. Wong

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Treatment Methods

## Objective

To determine the effectiveness of stimulating acupoints in treating vocal nodules and improving vocal functions.

## Methods

A total of 123 dysphonic subjects with a mean age of 38.75 years (SD = 10.33 years) participated in the study. They were randomly assigned to a group which either received no acupuncture, genuine acupuncture, or skin surface stimulation on Renyin (St 9), Lianquan (CV 23), Lieque (Lu 7), Zhaohai (Ki 6) and Hegu (LI 4). Skin surface stimulation involved needles pressing on the acupoints but not penetrating the skin. The intervention involved 12 sessions over a 6-week period. Vocal function analysis using acoustic measurement, voice-related quality of life measurement, and laryngoscopic evaluations were conducted to measure changes over time.

## Results

Subjects receiving genuine acupuncture showed significant improvements in their vocal function (highest fundamental frequency produced), quality of life (Voice Activity and Participation Profile), and size of the vocal nodules following acupuncture treatment when compared to the no-treatment group. The group with skin surface stimulation also demonstrated significant improvement in the vocal function and quality of life. However, the vocal pathologies in the placebo group showed no significant improvement over time.

## Conclusions

Both the genuine acupuncture and the skin surface stimulation improved significantly vocal function and quality of life related to voice. It is evident that only the acupuncture protocol is effective in both treating vocal nodules and improving vocal functions. The skin surface stimulation can be considered as a treatment protocol for improving vocal function in individuals who have inefficient vocal function.

## Acknowledgement

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# Vocal Fold Deposits and Their Differential Diagnoses (no. 121)

P.-A. Lindestad

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Collagenous disease, such as RA, SLE or Hashimotos disease may cause vocal fold deposits. The position of the lesion is close to the middle of the membraneous portion and the tissue becomes stiff in quality. The disease is acquired. Voice is rough, breathy and unstable. This kind of lesion can occur in healthy individuals, most often with a positive RA factor.

Lipoglykoproteinosis Cutis et Mucosae or Urbach Wiethe´s disease often shows its first signs at childhood but may have a later debut. Apart from the vocal folds the deposits affect the skin, eyelids, pharyngeal and oral mucosa and sometimes the kidneys causing renal insufficiency. This disease is purely genetic. When the vocal folds are affected the voice becomes extremely breathy, thin and hyperfunctional.

Amyloidosis may be a generalized disease but also very local, which is mostly the case in laryngeal affection. The amyloid deposits are most often localized to the epiglottis, ventricular folds or subglottal mucosa. Thus, unless the deposits affect the vocal fold vibrations, the lesion may very well occur without vocal engagement.

Vocal nodules or cysts resemble rheumatoid deposits and very often constitute the preliminary diagnosis in the referral. The lesions of Urbach Wiethe look like leukoplakias, but their mechanical features are different. Tissue reactions due to inhaled corticosteroids may look similar to Urbach Wiethe at an early stage. In amyloidosis the lesions are covered with normal mucosa and may be suspected for submucosal cysts, chronic oedemas or tumours.

Illustrations of the different lesions will be presented.

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## Voice Therapy for Vocal Fold Paralysis: Yes or No? (no. 122)

A. Gillespie

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Voice Therapy

Unilateral vocal fold paralysis (UVFP) is one of the most common voice problems encountered in otolaryngologic clinics. Despite this prevalence, treatment options are non-standardized and varied. Behavioral voice therapy is an often used, yet controversial, treatment modality for patients with UVFP.

Voice therapy, as delivered by a qualified, specialized speech-language pathologist (SLP), can be implemented at different times during the course of treatment for a patient with UVFP. It is the role of the SLP and laryngologist team to determine appropriateness for initiation and termination of voice therapy. The purpose of this presentation is to define the role of voice therapy in the treatment of patients with UVFP. Topics to be covered include assessment of candidacy for therapy; indirect vs. direct therapy; treating both sound quality and vocal effort, and how to differentiate these components; appropriate and inappropriate therapeutic techniques; and the importance of a team approach to treatment of patients with UVFP.

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# Correlations between the Video Laryngostroboscopic and Multidimensional Voice Assessments (no. 123)

A. Vegiene, V. Uloza

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Video laryngostroboscopy and multidimensional voice assessment

## Objective

The aim of this study is to evaluate correlations among the basic video laryngostroboscopic (VLS) parameters and vocal function assessed using a multidimensional set of perceptive, acoustic, aerodynamic and subjective measurements.

## Methods

Digital VLS recordings and multidimensional voice assessment were performed for 108 individuals: 26 healthy and 82 patients with mass lesions and paralysis of vocal folds. VLS variables (glottal closure, regularity, mucosal wave on the affected/healthy side, symmetry of vibration, and symmetry of image) were rated and quantified on the visual analogue scale. Voice assessment included acoustic voice analysis, phonetography, maximum fonation time (MPT), Dysphonia Severity Index (DSI), Voice handicap index (VHI), Glottal function index (GFI), perceptual evaluation on GRBA scale (G-grade, R-roughness, B-breathiness, A-asthenic). Correlations among the VLS parameters and results of voice analysis measurements were tested using Pearson's correlation coefficient.

## Results

The inter-correlations of VLS parameters in vocal performance were moderate-to-strong and statistically significant for the entire functional measurements obtained through different modalities and used in the present study. However, correlations between VLS and Phonetogram parameters were stronger to compare with correlations between VLS and acoustic voice parameters. The best correlations between VLS and Phonetogram parameters were as follows:  $r=0.69-0.79$  for normal profile coverage,  $r=0.67-0.76$  for dynamic intensity, and  $r=0.67-0.74$  for maximum intensity. VHI correlated moderate to all VLS parameters ( $r=0.5-0.65$ ). The GFI revealed moderate correlations with all VLS parameters ( $r=0.4-0.57$ ), as well. All VLS parameters correlated moderate with DSI ( $r=0.61-0.69$ ) as an aggregate measure, and with the separate components of the DSI, individually. The strongest correlations were found between VLS parameters and G factor of GRBA scale ( $r=0.68-0.88$ ).

## Conclusions

Correlation analysis of the vibratory pattern of the vocal folds obtained via VLS has the potential to provide more comprehensive insight into the pathophysiology of phonation and suggests the documented and measurable evidence of complex mechanisms of vocal outcome.

**Keywords:** laryngostroboscopy, acoustic voice assessment, Phonetogram, VHI, DSI, GFI.

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# Voice Tremor in Parkinson's Disease (PD): Myth or Reality? (no. 242)

P. Gillivan-Murphy, N. Miller, P. Carding

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Analysis of Voice and Speech

Voice tremor features are associated with the PD speech voice symptom complex, however defining characteristics or measurement approaches have not been delineated to date.

Thirty participants with PD (pwPD) and twenty eight age-sex matched neurologically healthy controls were evaluated for voice tremor features using acoustic analysis, auditory perceptual rating, and nasendoscopic vocal tract examination.

The results show that pwPD were more likely to show a greater amount of perceived instability, and of frequency and amplitude tremor, using auditory perceptual and acoustic measurement respectively, relative to controls. However the difference was not statistically significant. PwPD had a statistically significantly higher rate of amplitude tremor than controls. Using nasendoscopy, pwPD were identified as having a statistically significant greater amount of tremor in the palate, tongue and larynx than the control group in nine out of ten tasks ( $p < 0.05$ ). PwPD had a statistically significant greater voice disability than matched controls, however voice tremor did not relate to disability.

This prospective study enhances understanding of PD voice tremor, determining optimal ways in which it can be measured and characterised. Acoustic analysis and nasendoscopic examination are valuable tools for characterising voice tremor.

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## Allergic Rhinitis and Voice Change (no. 124)

A.-C. Ohlsson

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Occupational Voice

In Sweden 15-20 % of the youngsters suffer from birch pollen allergy every spring. The upper airways are the target for the allergic reactions and thereby there is a risk for laryngological influence affecting the voice function. The purpose of this study was to investigate if and how the voice was affected during the season of birch pollen. At an Allergy Centre in Western Sweden 30 patients diagnosed for allergic rhinitis to birch pollen and 30 controls were selected for an investigation of voice function. Patients on inhalation therapy or with suspected asthma were excluded. All participants were examined twice, once during pollen season in May, and once during non-pollen season in October. On both occasions all of the participants filled in a questionnaire about symptoms in the upper and lower airways. The participants' voices were recorded while reading aloud a standard text. A blinded perceptual voice analysis was performed. The pairwise voice samples, each participant's recording from pollen season and from non-pollen season, were randomized, within each pair and between pairs, onto a listening file. From each pair the listeners determined which voice sample had the best voice quality or if there was no difference. An acoustic analysis was performed targeting average fundamental frequency and fundamental frequency variation. The participants also filled in a Voice Handicap Index and a Swedish questionnaire about own voice quality and voice function including visual analog scales. The results show significant group differences during pollen season. The allergy group stated more voice symptoms such as hoarseness, roughness and vocal fatigue and estimated their own voice quality to be worse than did the control group. Voice Handicap Index showed higher total score and also higher scores for all three domains in the allergy group compared to the control group. Results from the acoustic analysis showed that the fundamental frequency as well as the fundamental frequency variation was significantly lower in the allergy group compared to the controls. All differences between groups remained during non-pollen season. The perceptual analysis did not reach significant difference between groups. Conclusions from this study are that individuals with birch pollen allergy suffer from voice symptoms not only during pollen season but also during non-pollen season. The results from the acoustic analysis with lower fundamental frequency and lower fundamental frequency variation in the allergy group also during both seasons speak for vocal edema as a possible cause. It is recommended that patients diagnosed for birch pollen allergy should be examined with videostroboscopy.

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# Functional Status Condition of the Heart Rate Vegetative Regulation of Patients with Voice Disorders (no. 125)

E. Osipenko, M. Gerasimenko, N. Lazarenko

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Many researchers have marked participation of the vegetative nervous system (VNS) in the larynx regulatory function. There is a concept that violation of VNS adaptive - trophy function violation of patients with deceases of larynx results in a neurological - dystrophic process.

Our research is aimed at improving the treatment efficiency of patient with the larynx pathology based on a complex etiological – genetic approach to therapy.

For this purpose according to rates of the central hemodynamics analyzed was a variability of the heart rate (VHR). On the hardware – software complex “REODIN-504” (Russia) in an automatic mode, with using the method of Kubicek tetrapolar rheography, made was an express-analysis of records with 5-minute ECG intervals prior to and after treatment. At that analyzed was a large number (over 20) of total functional rates in the cardiovascular system.

The observation period made 12 months; observations were made each 3 months. Determined were the following groups: 1<sup>st</sup> (control, 30 persons) and 2<sup>nd</sup> (primary, 100 persons) groups of patients with voice functional disorders, and two groups of patients with the larynx organic pathology – 3<sup>rd</sup> (control, 30 persons) and 4<sup>th</sup> (primary, 100 persons) groups. The larynx functional condition and expressed voice disorders were estimated by an endoscopical high speed imaging, videolaryngostroboscopy and acoustic voice analysis.

## Results

Change in the spectral range power of major studied VHR parameters in process of drug and physiotherapy for patients in 1<sup>st</sup> and 3<sup>rd</sup> (control) groups and for patients in 2<sup>nd</sup> and 4<sup>th</sup> (primary) groups of a complex treatment was significantly varied. When estimating the main parameters characterizing the vegetative homeostasis, patients in 4<sup>th</sup> (primary) group prior to treatment has signs of sympathetic imbalance, at that total spectral power made 1910,74 ms<sup>2</sup>, and its high-frequency component made 926,71 (48,5%, at the norm of 34,8%). The achieved results of the vegetative regulation were considered by us as des-adaptation of parasympathetic nervous system. After the course of a complex treatment, parameters of the total VHR spectral power for these patients have decreased to 1259,18 ms<sup>2</sup> and by the ninth month the value was no more than 1309,40 ms<sup>2</sup>.

## Conclusion

Complex treatment including the drug therapy and electro stimulation have effected positively on the vegetative regulation functional status of the heart rate for patients in 2<sup>nd</sup> and 4<sup>th</sup> groups which improved adaptation facilities of their body. It resulted in statistically authentic changes in most important parameters of the central haemodynamic and the regression analysis data.

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## Master Class Lied (no. 126)

N. Enns

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Master Class Lied
- Invited Workshop

In what ways should the interpretation of a Schubert Lied differ from Brahms, Mahler or Webern? How do symbolism and the cultural climate affect our understanding of the Lieder of the 19th century? How do they translate into our world? How do non-native speakers deal with the peculiarities of the German language? How important is the gender question in choosing appropriate Lieder?

Stylistic differentiation, cultural and literary context and language issues are recurring themes in the study of Lied. These will be central to this Master Class.

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# Hands-On Laryngoscopy (no. 127)

M.Hess

- **Form:** Workshop
- **Category:** Medicine
- **Topic:** Medicine

Not Available

# Effective and Healthy Practice Methods for Singers (no. 128)

A. Holmberg

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

Voice training generally includes vocal exercises that shall be continuously repeated by the voice student. The goal is often a gradual and general improvement of the voice.

In the case a voice student would be left without guidance, or has not been properly instructed on how to perform the exercise in a healthy manner and in correlation to the intended purpose - practicing efforts can be in vain or even have opposite to the intended effect. Continuous repetition of incorrectly performed vocal exercises can not only cause voice damage, but also thoroughly train in incorrect vocal technique.

This workshop focuses on training of vocal technique for singing but the content also applies for speech. It stresses the importance of proper and thorough instructions for both guided and unguided practice, of designing exercises that achieve specifically intended purposes, and the need of defined strategies for problem solving along the way. Further it goes through methods and strategies for making voice training constructive, healthy and effective.

The workshop will describe and demonstrate the methods of voice training according to Complete Vocal Technique (C. Sadolin) as well as some findings within the field of Psychology and Sports Psychology.

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More information at [www.vocalsoul.se](http://www.vocalsoul.se) and [www.cvtteachers.com](http://www.cvtteachers.com)





# Voice Initiation and Its Measurement: The Background for Vocal Attack Time

(no. 129)

A.L. Cooper, R.F. Orlikoff, B.C. Watson, D. Deliyski, R.J. Baken

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Clinical Issues
- Invited Lecture

The speed with which the vocal folds adduct to the midline is considered an important variable in the etiology of some voice disorders and may also be a meaningful indicator of central or peripheral neural dysfunction. It is proposed that the time lag between the rise of the sound pressure (SP) and electroglottographic (EGG) signals, measured at the onset of phonation, provides a useful index of vocal attack time. The experimental validation of this measure was accomplished by obtaining recordings of the SP and EGG signals simultaneously with high-speed videoendoscopy at voice initiation, from which a digital kymogram was generated. It was shown that, after appropriate signal processing, the intersignal time delay provides a potentially useful measure that varies with vocal attack characteristics. The proposed method calls for no invasive procedures and relies on signals that are routinely obtained in most clinical settings. Unlike acoustic "rise time" measures of voice onset, the glottographic measure involves no operator intervention, requires no arbitrary decisions about measurement points, and may be accomplished quickly and automatically on any personal computer.

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## Measuring VAT: A Fully-Automated System (no. 130)

R.M. Roark

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Measurement
- Invited Lecture

An automated computer analysis system is described that computes VAT on the basis of generalized sinusoidal models of recorded sound pressure and electroglottographic signals, for each of which the rate of amplitude change are assessed. VAT is computed from the time lag of the cross-correlation function using a fully-automated process. The software involves no user measurements or intervention, but does ask for operator validation of the results of each stage of analysis. A companion "figure of merit" is reported to quantify the strength of the SP/EGG association, and serves as an index of validity.

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## VAT in Normal American Adults (no. 131)

R.J. Baken, R.M. Roark, B.C. Watson

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Measurement
- Invited Lecture

Normative values for vocal attack time (VAT) were obtained from 57 females aged 22-50 y (mean = 28.0y) and 55 male adult speakers aged 21-50 y (mean = 29.1y) of American English producing several tokens each of sustained /a/ at comfortable pitch and loudness. Measurement was accomplished with custom software that was fully automated and that provided a measure of validity. Measurement data showed good normality of distribution. Mean (sd) VAT for the women was 0.79 ms (5.39) and for the men 3.05 ms (4.90). The male/female difference was statistically significant ( $p < .001$ ). Stratification of the subjects into four age groups failed to reveal an age-associated effect, except for males in the 25-29 year old group who had significantly longer VATs.

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# F0 Influences on VAT: Cantonese and English Speakers (no. 132)

E.P.-M. Ma, B.C. Watson, R.M. Roark, P.-M. Li

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Measurement
- Invited Lecture

Separate studies examined the influence of vocal fundamental frequency on VAT. In one, 59 native Cantonese speakers (31 females and 28 males) each read 12 disyllabic words comprising homophone pairs of the six Cantonese lexical tones. Overall, females had significantly smaller VATs than males. Mean VAT values were also lower for level tones (tones 1, 3, and 6) than for the contour tones (tones 2, 4, and 5). In a parallel study of speakers of American English (in which F0 plays no lexical role) 5 male and 9 female subjects sustained /a/ at comfortable pitch, and at target F0s of -3 ST and +6 ST re: each subject's self-selected comfortable pitch and VAT was computed for each production. VAT was significantly smaller for the +6 ST condition compared to the other F0s; there was no significant difference between mean VAT of the comfortable and -3 ST productions. A comparison of the results for the two studies has implications for implementation of the VAT measure and perhaps for more general aspects of understanding voice onset.

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## Bubbling Therapy (no. 133)

J. Ramlakhan, R. Mudde, M. Oosterbaan-Beks, B. Goes-de Graaff, J.W. Arendse

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Treatment Methods

The 'resonance tube' is a long-used method in voice therapy and has been subject to research for many years [1]. Nowadays the tube is also often used in 'bubbling therapy', where the patient blows air through a tube into a tank of water, creating bubbles while phonating on a low frequency. It is known that this therapy greatly improves the closure of the vocal folds, but it remains unknown how it actually achieves that improvement [2].

The current study is a collaboration between speech therapists, physicists, and E.N.T. specialists. This combination of different disciplines combines the perspectives of the separate fields of researchers, so that all the aspects of the problem can be coupled, instead of solving the physical and medical parts of tube flow and vocal fold reactions separately.

A variety of techniques is used to analyze the workings of the 'bubbling' therapy. These techniques include the usage of high-speed images of the bubbles exiting the tube, camera images of the glottis and the epiglottis, EMG signals and physical computer models.

The high-speed images show a steady alternating pattern of bubbles exiting the tube and water flowing back into the tube. This back flow of water creates pressure waves with a prescribed frequencies that propagate all the way back into the oral cavity and is most likely the main cause of the effectiveness of the therapy. A combination of camera images, EMG signals and other models is used to find out which of the prescribed frequencies are adopted by the internal tissues and play the most important role in the therapy.

Furthermore relations are derived to find the optimum in therapy effectiveness. These relations concern tube length and width, frequencies of the phonation, flowrate of the air through the tube and the physical properties of the surrounding fluid.

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[2] Simberg, S., & Laine, A. (2007). *The resonance tube method in voice therapy: description and practical implementations. Logopedics Phoniatrics Vocology*, 32(4), 165-170.

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# Breathing Pattern Differences in Belt and Legit Styles of Singing (no. 134)

M. Thalén, J. Sundberg

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

It is commonly assumed that the breathing pattern has strong effects on phonation. For instance, the discussions between teachers believing in the "belly-in" and "belly-out" strategies still continue; in the absence of data and theory discussions do not tend to stop. Belt singers are often assumed to need a specific breathing strategy. In the present investigation we measured the inspiratory and phonatory breathing patterns in a group of well established female singers, all well acquainted with the belt style. They sang a sequence of /pae/ syllables and a song excerpt, the latter with the original lyrics as well as with the syllables of the lyrics replaced by the syllables /pae/. They performed the tasks with belt voice as well as with legit voice. Breathing patterns were measured by means of elastic bands (Respirtrace) around the rib cage and the abdominal wall. Oral pressure during /p/ occlusion was measured as an approximation of subglottal pressure. For each inhalation and for each phrase 1000 samples were collected of the ribcage and the abdominal wall movements and averaged. Differences between the styles with respect to subglottal pressure, sound pressure level, and contributions of the upper and lower breathing compartments will be described.

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# Acoustic Analysis of Vowel Equalization - A Longitudinal Survey in Classical Singing Students (no. 135)

D. Mürbe, F. Schwandtke, M. Bornitz, H. Zabel

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

Since more than one decade the Voice Research Laboratory of the University of Music Carl Maria von Weber Dresden has been collecting acoustic data of all matriculated classical singing students. In annual recording sessions basic vocal exercises as well as pieces from Vaccai's »Metodo pratico« have been taped. The main objective of this effort is to document the progress of professional voice education over the period of study. The survey in hand embodies the first attempt to analyse the vast data material and concentrates on vocal exercises dealing with vowel equalization.

The main question the study is supposed to answer is how the singer's formant characteristics differ in a phrase of changing vowels. It is likely that keeping the energy level in the relevant spectrum area similarly for every vowel should be an intention of classical singing training in order to gain a consistently focused sound. Hence, the recordings of 55 students during three to four years of education are being examined and the corresponding data are being investigated in two ways. Firstly, the sound pressure levels of the singer's formant in all vowels are being calculated and are being put into ratio with each other. Secondly, the periods of vowel transition are being divided into equal time portions in order to reveal the course of the singer's formant level through the changing process. For both characteristics it is being tried to identify statistically significant models of how singer's formant behaviour is developing during the first years of professional voice training.

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## Breathing Patterns in Yoga Teachers (no. 136)

E. Svanström, J. Sundberg

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

It is commonly assumed that yoga breathing exercises, called “pranayama” are not only mentally beneficial but also useful as a tool for improving vocal technique, particularly in singing. For example, many exercises seem to direct the attention to breath management in general, an important aspect of voice control. In particular, the resting expiratory level (REL) seems to play an important role in yoga breathing exercises and is also relevant to singing, in the sense that phonation at lung volumes below REL is perceived as uncomfortable. Information about behavior in pranayama exercises is scarce. In the present study we analysed pranayama breathing patterns in seven subjects, all working as yoga teachers. Inductive plethysmography (Respirace©) was used to gather data on relative lung volume as well as on ribcage and abdominal wall movements during four common pranayamas (ujjayi, kapalabhati, bhastrika, fire breathing). Also data on REL and normal breathing were collected. Results showed that the ujjayi exercise, described as a series of “complete” inhalations and exhalations, mostly involved inhalations up to 80% of vital capacity (VC) and exhalations reaching between 20% and 40% VC. Some exercises include episodes of quick breathing cycles, on the order of magnitude 0.3 s per cycle and with inhalations mostly initiated in the vicinity of REL. With respect to lung volumes and to the movement patterns of the rib cage and the abdominal wall, the same exercises were not performed in the same manner by all subjects and there was no strict agreement between the generally accepted yoga instructions and some of the subjects’ behaviors. The kapalabhati exercise, supposed to include passive inhalations, was rarely performed that way, but rather with active inhalations. In the subjects, who used the most extreme lung volumes during the exercises, REL immediately after the exercises was 12% and 14% VC higher than before the exercises. Relevance to vocal technique of breathing patterns in yoga exercises, particularly of awareness of REL, will be discussed.

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# Spectral Characteristics of Traditional Singing in the North of Portugal (no. 137)

A. Araújo, F. Lã, J. Sundberg

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

In the Alto Minho region in the north of Portugal, traditional singing is usually performed by women, called cantadeiras. Their singing is perceived as being strident, loud and high pitched. The cantadeiras are non-professional singers and they learn the style by oral tradition. In the Alto Minho region there are about 100 ethnographic groups, containing approximately 200 female soloists. This type of singing is usually performed in groups and accompanied by loud instruments. In a previous single-case study attempting to describe this style in a more objective manner, equivalent sound level was found to be high and phonation type was highly pressed. The present study aims at describing (i) acoustical and physiological properties of this style of singing, and (ii) whether there is a relationship between these aspects of voice production and the degree of the singers' representativeness of the style.

Older and experienced ethnographic groups in Alto Minho region were identified and their soloist singers were included in this study, resulting in a total of 16 cantadeiras. They were recorded performing a representative song of the Minho's traditional repertoire. A listening test was carried out with 72 listeners from several other ethnographic groups in the region. Their task was to rate how typical singing samples were of the style. The most and least typical singers were then selected and recordings of several speech and singing tasks were made, including audio, electro-laryngograph, flow and oral pressure. Using the Soundswell Signal Workstation software long-term average spectrum, equivalent sound level, alpha ratio and subglottal pressure were analyzed. The data observed for the singing tasks will be compared with those obtained from the speech tasks. In addition, multiple regression analysis will be carried out to determine whether the acoustical data can predict the mean ratings obtained from the listening test.

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# A Comparison of the Speaking Fundamental Frequency and Voice Type of Opera Singers (no. 138)

S. Chernobelsky

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

In terms of classical singing voices are categorized as being of one of a number of types (tenors, baritones etc.). However, some voices fall in between the standard categories. Many singing teachers, when attempting to determine voice type, are guided by habitual Speaking Fundamental Frequency (SFF) of the student's voice, believing that the lower SFF the lower the voice type, and vice versa. This study was conducted in order to determine the validity of this hypothesis.

Seventy five opera singers (45 men and 30 women) aged between 19 and 40 years were examined. Male voices were classified as tenors, baritones or basses; female voices as sopranos or mezzo-sopranos. The software package Praat was used for determining SFF. It was found that inter-subject variation of SFF in all groups was large: 120-161 Hz in tenors, 111-147 Hz in baritones, 110-123 Hz in basses, 207-285 Hz in sopranos and 173-275 Hz in mezzo-sopranos. The mean SFF was 142.4 Hz (SD 15.0) in tenors, 123.2 Hz (SD 10.2) in baritones, 118.8 Hz (SD 8.7) in basses, 233.7 Hz (SD 23.1) in sopranos and 205.9 Hz (SD 18.9) in mezzo-sopranos. In tenors and baritones, tenors and basses, sopranos and mezzos the mean SFF differences were significant, respectively. However, the difference between the mean SFF of the basses and baritones was nonsignificant; this could be explained by the fact that eight of the basses were of the bass-baritone fach and were capable of singing dramatic baritone roles.

It is concluded that voice type does depend on SFF: the lower the SFF, the lower the singing voice and vice versa. However, classification of the voice solely on the basis of SFF is unreliable; nevertheless, SFF could be used in conjunction with other evidence to assist in a classification. Singers should be aware of the possible discrepancy between SFF and voice type: this applies particularly to students and their singing teachers.

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# Ageing Effects on the Singing Voice in Professional Choirs, Differentiated between Voice Types (no. 139)

G. Berghs, P. Pabon, W. Decoster, F. de Jong

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Singing Voice

In an era with art budget cuts all over Europe, professional symphonic choirs, opera choirs and chamber choirs are limited in engaging young singers and have to face the fact that in a few years' time the average age of their choir singers could be around or even above 50 years. Whether this has to be considered as old, is not an easy question. Changes in the singing voice due to age may differ per person, depending on such things as the vocal load and the singers' personal history. In an attempt to reveal ageing effects, 195 professional choir singers were examined (age between 21 and 65 years). These were mainly conservatory graduated vocalists, singing in The Netherlands Radio Choir, The Netherlands Chamber Choir, the Chorus of the Netherlands Opera, the Chorus of the Flemish opera, Cappella Amsterdam and The Amsterdam Baroque Choir. Analysis of the speaking voice and the singing voice was done by means of recording Voice Range profile (VRP), for each singer, using Voice Profiler 4.0 Spectral, and acoustic analysis (PRAAT). From these data, vibrato was analysed by FoTraceAnalysis. Register transitions were assessed with help of spectral register differences. In addition the Maximum Phonation Time was determined.

A decrease of the highest fundamental frequencies of the singing voice showed to be the main characteristic of voice changes over the years, in all voice types, especially in sopranos. Sopranos showed also a decrease of the Fo in the speaking voice, related to age. In altos, tenors and baritones a decrease of the vibrato frequency was found. Only the elderly bass-baritones seemed to lose their ability to sing the very soft tones. Smaller overlap areas between chest voice and head voice were seen in tenors and baritones over the years. The slow and wide vibrato, well known as a feature of the aged voice, was not found in this study population.

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# Vocal Tract and Glottal Function During and After Vocal Exercising with Resonance Tube and Straw (no. 140)

M. Guzman, A.-M. Laukkanen, P. Krupa, J. Horáček, J.G. Švec, A. Geneid

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

The purpose of the present study was to investigate the vocal tract and glottal function during and after phonation into a glass tube and a stirring straw. A male classically trained singer was asked to produce the vowel [a:] at comfortable speaking pitch, phonated into the resonance tube and then repeating [a:] after the exercise during computerized tomography (CT) examination. The same procedure was carried out with a narrow stirring straw after fifteen minutes vocal rest. Anatomic distances and cross sectional areas were obtained from CT midsagittal and transversal images. Electroglottographic (EGG), subglottic pressure, oral pressure, acoustic and perceptual measures were also obtained. During and after phonation into the tube or straw the velum rose to seal the nasopharyngeal port, the larynx position lowered and hypopharynx area widened. Furthermore, the ratio between the inlet of the lower pharynx and the outlet of the epilaryngeal tube increased during and after tube/straw phonation. Acoustic results showed a stronger spectral prominence in the singer/speaker's formant cluster region after tube and straw phonation. Listening test demonstrated better voice quality after exercising than before. EGG contact quotient decreased during both tube and straw and remained lower after exercising. Subglottic pressure became higher during straw and remained somewhat higher after it. CT and acoustic results indicated that vocal exercises with increased vocal tract impedance lead to increased vocal efficiency and economy. One of the major changes was the more prominent singer's/speaker's formant cluster. Vocal tract and glottal modifications were more prominent during and after straw exercising compared to tube phonation.

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# Effects of Resonance Tube Voice Therapy in a Patient Operated for Glottal Stenosis: A Three Year Follow-up (no. 141)

A. McAllister, S. Simberg, A.-B. Mjönes

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Treatment Methods

The patient was intubated several times during the neonatal period and tracheotomised at one month old. He had a narrow and long stenosis and could not breathe at all through the larynx. Several unsuccessful attempts were made to dilate the stenosis that started just under the vocal folds and stretched down to the upper part of the trachea. At two years old he was referred to professor Monnier in Lausanne and was operated at age 2 years and 3 months. Decannulation was made without complications. The post-operative control using microlaryngoscopy was satisfactory.

In late 2009, at the age of 14 years old, the speech and language pathology department was contacted since the patient was not satisfied with his own voice. The voice quality was very deviant with primarily hyperfunctional, breathy and rough characteristics. At times he did not use voice at all but whispered. All utterances were short, usually consisting of one or two words. A laryngoscopic examination revealed a very hyperfunctional voice production with a compressed larynx, probably mostly involving the ventricular folds in the voice production. Stroboscopic examination could not be performed due to the dysperiodicity of the voice source.

Voice therapy started using resonance tube phonation in a glass tube with one end submerged a few centimeters in water (Simberg & Laine 2007). During his first attempt he immediately produced a much less strained, quite normal voice when phonating into the tube. Titze (2006) proposed that a semi-occlusion in the front of the vocal tract heightens the source-tract interaction by raising mean supra- and intraglottal pressures. This may lead to decreased hyperfunction and more efficient and economic vibrations in terms of tissue collisions. Since the start in December 2008 the therapy has differed in intensity. In total the patient has received 40 sessions until the end of March 2013. The patient is motivated to therapy and uses the resonance tube at home regularly two to three times/week or when his voice feels worse. The voice quality is still hyperfunctional and at times quite rough but the patient can control his voice better and use the improved technique in special situations, such as when speaking on the phone. Acoustic measures including F0 histograms, as well as registrations using Voxlog will be presented.

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# Electroglottographic Study of Seven Semi-occluded Exercises: LaxVox, Straw, Lip and Tongue Trills, Humming, Hand Over Mouth and Tongue Trill Combined with Hand Over Mouth *(no. 142)*

*P. Amarante Andrade, G. Wood, P. Ratcliffe, R. Epstein, A. Pijper, J.G. Švec*

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

## Introduction

Semi-occluded vocal tract exercises (SOVTE) have long been used in voice clinics throughout the world. SOVTE change the acoustic vocal tract impedance in relation to the glottis impedance and improve voice quality. However differences among SOVTE are often disregarded by clinicians. An often overlooked aspect is the number of vibration sources into the vocal tract. Some SOVTE present a single source while others a double source. The aim of this study is to assess changes in voice production pattern for a series of SOVTE. We hypothesised different vocal fold vibration patterns among exercises presenting single or double sources of vibration into the vocal tract. A combined exercise was implemented (tongue-trill coupled with hand-over-mouth) to illustrate the effect of a secondary source of vibration in the vocal tract.

## Method

23 healthy volunteers were submitted to a series of SOVTE: LaxVox, straw, lip and tongue trills, hand-over-mouth, humming, and tongue-trill combined with hand-over-mouth. Comfortable phonation served as control group. The dependent variables were: EGG contact quotient (CQ), contact quotient range (CQr), F0, fundamental frequency range (F0r) and difference between the first formant frequency and F0 (F1-F0).

## Results

A significant difference for CQr scores compared to comfortable phonation was found for the combined tongue-trill with hand-over-mouth, lip-trill, Laxvox and tongue-trill exercises. The F1-F0 acoustic analysis shows significant differences in scores for exercises with one versus two sources of vibration.

## Discussion

The results indicate that SOVTE may be divided into two groups: Steady (single sourced) with lower CQr and F1-F0 difference - (Hand-over-mouth, humming and straw).

The research has been supported in the Czech Republic by the European Social Fund Projects OP VK CZ.1.07/2.3.00/20.0057 and CZ.1.07/2.4.00/17.0009 and by the Palacky University student's project PrF\_2013\_017.

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# Comparison and Efficacy of Two Semi-occluded Vocal Tract Voice Therapy Protocols (no. 143)

K.T. Cox, M. Kapsner-Smith, I.R. Titze

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

Many successful voice therapy techniques and programs are based on exercises that semi-occlude the vocal tract. Semi-Occluded Vocal Tract (SOVT) exercises have centuries of use in performing voice communities. Engle (1927) described it for the acting voice when he suggested that narrowing the mouth produced more efficient voicing. Many others developed and described techniques by partially covering the mouth or creating an inverted megaphone shape with speech.

SOVT exercises have been validated by several theoretical investigations. Titze (1988) showed that an inertive vocal tract results from a semi-occlusion, which reduces phonation threshold pressure (PTP). Also, the oral pressure behind the lips acts to separate the vocal folds, reducing collision. This separation, with variable vocal fold tension and adduction, promotes an optimal rectangular glottal shape that lowers PTP. Physicians speak to optimal deep/lateral injection procedures to promote this rectangular glottal configuration for conditions of vocal fold bowing.

While many clinicians tout the benefits of SOVT exercises, the efficacy of phonation with tubes or straws has not yet been established. This study compares a therapy program based on phonation through flow-resistant tubes (FRT) with Vocal Function Exercises (VFE), a well established set of exercises that utilize semi-occlusion. Twenty subjects (16 female, 4 male) with dysphonia and or vocal fatigue were randomly assigned to one of four treatment conditions: 1) immediate FRT therapy, 2) immediate VFE therapy, 3) delayed FRT therapy, and 4) delayed VFE therapy. Subjects receiving delayed therapy served as a no-treatment control group. Clinical voice measures were made before and after the treatment/no treatment phases, including the Voice Handicap Index (VHI) (Jacobson et al., 1997) and Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) (Kempster et al., 2009).

## Results

A mixed effects ANCOVA was used to test for significant differences between treatment groups (VFE and FRT) and the no-treatment control condition. Post testing was conducted comparing the slopes of change coefficients between the two treatment groups to test for superiority. Both treatment groups showed significantly more change in the VHI than the control group ( $p < 0.001$  for FRT;  $p = 0.015$  for VFE). Post testing indicated that FRT was superior to VFE in terms of VHI total score improvement ( $p = 0.010$ ). Further examination of VHI subscores indicated that the treatment groups improved significantly in the Physical domain (FRT  $p < 0.001$ ; VFE  $p = 0.037$ ) and Functional domain (FRT  $p < 0.001$ ; VFE  $p = 0.004$ ), while no significant change was seen in the Emotional domain (FRT  $p = 0.104$ ; VFE  $p = 0.717$ ). While it did not reach significance, there was suggestive evidence that FRT provided superior gains in the Functional domain ( $p = 0.069$ ), while there was no significant difference between treatments in the Physical domain ( $p = 0.113$ ).

CAPE-V scores were similarly examined. Both treatment groups showed significant improvement in Roughness relative to control (FRT  $p = 0.010$ ; VFE  $p = 0.043$ ). Results approached significance for the dimensions Overall Severity (FRT  $p = 0.092$ ; VFE  $p = 0.057$ ) and Strain (FRT  $p = 0.060$ ; VFE  $p = 0.064$ ). Results for Breathiness were not significantly different than control (FRT  $p = 0.266$ ; VFE  $p = 0.170$ ). No significant differences were found between the two treatment groups for any voice quality dimension.

Results of this study suggest that both Flow Resistant Tube therapy and Vocal Function Exercises are effective in improving voice quality of life and voice quality. FRT is more effective than VFE in improving voice quality of life, especially in the Functional domain.

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# Two Case Studies of Changes in Vocal Fold Adjustment Caused by Phonation into a Tube Investigated by Computed Tomography (no. 144)

V. Hampala, A.-M. Laukkanen, M. Guzman, J. Horáček, J.G. Švec

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Measurement

Phonation into a tube is a widely used method for vocal training and therapy. Previous studies and practical experience show, that the phonation becomes easier and louder and the vocal tract shape changes after such an exercise. In order to find out whether there is any change in the physical adjustment of the vocal folds, two volunteer subjects (male and female) were examined with computed tomography (CT). Both produced vowel [a:] at comfortable pitch and loudness. Recordings were performed before, during and after the exercise, twice for each condition. The gathered CT images were used for measurements of length, vertical thickness and cross-sectional area of the vocal folds, and glottal width.

Results showed considerable variability in the intra- and inter-individual vocal fold configuration but did not reveal any unified trends in vocal fold adjustment during and after the phonation into the tube.

The data indicate that the changes of voice quality after tube phonation are more likely due to vocal tract adjustments rather than due to vocal fold adjustments. Therefore, any systematic changes in vocal fold vibration observed after the tube phonation may better be searched in the source-filter interaction effects rather than in the laryngeal muscle adjustments.

The research has been supported in the Czech Republic by the European Social Fund Projects OP VK CZ.1.07/2.3.00/20.0057 and CZ.1.07/2.4.00/17.0009 and by the Palacky University student's project PrF\_2013\_017.

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# On the Use of Straws and Tubes in Vocal Exercising. In Vivo Measurements of Air Pressure Characteristics of Phonation into a Straw and a Resonance Tube in Air and in Water (no. 145)

V. Radolf, A.-M. Laukkanen, J. Horáček, J. Veselý, D. Liu

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

Different variations of phonation into tubes and straws have become increasingly popular methods in voice training and therapy. This study investigates the differences between three most widely used methods: Phonation into a glass resonance tube (26.4 cm in length, 6.8 mm in inner diameter) (1) the outer end in the air, (2) the outer end submerged 2-10 cm below water surface (water resistance therapy with bubbling effect), and (3) phonation into a very narrow straw (12.7 cm in length, 2.5 mm in inner diameter). One female speech trainer served as subject. Acoustic samples, electroglottographic (EGG) signals and both static mean and oscillatory airpressures in the mouth cavity were registered for repetitions of /pu:pu/, and for phonation into the tubes, while the outer end was randomly shuttered, in order to get an estimate of subglottic pressure  $P_{sub}$ . Both phonation threshold and ordinary, most comfortable phonation were recorded. The same measurements were done with an artificial model of vocal folds connected with an artificial model of human vocal tract.

Compared to vowel phonation and the other vocal exercises, phonation into resonance tube in air brought about the lowest phonation threshold pressure PTP ( $P_{sub} = 310$  Pa), tube 10 cm under water the highest (1.37 kPa) and straw second highest (910 Pa). With the model straw gave the highest oral pressure and tube 10 cm in water the second highest. Oral pressure  $P_{oral}$  was surprisingly lower for tube in air than for vowel /u:/. It may be caused by a reduced lip opening during vowel phonation. Thus a very closed vowel seems to be an effective exercise, increasing oral pressure compared to more open vowels.

Oral pressure oscillation was highest for tube 10 cm in water (270 Pa peak-to-peak), which may offer strongest massage effect on the vocal tract and vocal folds. Transglottal pressure ( $P_{trans} = P_{sub} - P_{oral}$ ) was larger for all exercises, being largest in those exercises which seem to offer highest supraglottic impedance. The result was the opposite with the model. Thus, the subject of the present study seems to overcompensate for an increase in oral pressure by increasing  $P_{sub}$ .

In EGG signal the CQ was higher for the tubes compared to vowel phonation. The largest change was observed for tube 10 cm in water. It is also possible to see the effect of water bubbling on the EGG signal. That causes a baseline shift of the signal and a decrease in the vocal fold contact, due to variation in vertical laryngeal position caused by water bubbling at 15 Hz.

Exercises that increase supraglottic airpressure offer a possibility to train glottal and respiratory adjustments under the influence of increased backpressure which may both assist vocal fold vibration and prevent excessively loading vocal fold collision.

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# The Acoustics of Male Passaggio Pedagogy (no. 146)

K. Bozeman

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice
- Invited Workshop

Awareness of the acoustic registration events caused by changing interactions between the lower harmonics of the voice source and the first formant of the vocal tract assists in training the transition into the upper range of the male voice. This workshop will demonstrate how knowledge and anticipation of all acoustic events surrounding the male passaggio, and of the passive and active vowel modifications that accompany them, can form the basis for effective pedagogic strategies.

A relatively stable tube (vocal tract) length is necessary for timbral consistency and balance across the fundamental frequency range, since it stabilizes the general location of all formants and especially of the singer's formant cluster. Upon ascending the scale, untrained males instinctively activate muscles that shorten the tube when faced with harmonic/formant intersections that surround the zona di passaggio, especially the first formant tracking of the second harmonic (F1/H2) of voce aperta yell timbre. If tube length and shape are kept stable during pitch ascent, blatant timbre can be avoided by allowing harmonics (other than H1) to pass through and above the first formant. The predictability of first formant locations and of all F1/lower harmonic intersections, provides a basis for developing effective strategies for training the male passaggio. This workshop will demonstrate these events in recorded examples of student singers and on the Madde synthesizer, and present registration exercises based upon them.

At the end of the workshop, participants will:

1. Be familiar with all formant-harmonic interactions that surround the male passaggio
2. Have experience in discerning the vocal "turn" as recorded singers keep their vocal tract shape constant through the F1/H2 and F1/H3 crossings
3. Understand why /i/ and /u/ must be handled differently through the passaggio
4. Understand the implications and use of open and close vowels, open and close timbre, and "yell" and "whoop" acoustic couplings
5. Learn pedagogic techniques used in dealing with these acoustic realities in passaggio training

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Kenneth Bozeman, tenor, Professor of Music, Chair, voice department, Lawrence University Conservatory of Music, Appleton, Wisconsin; B.M., Baylor University; M.M., University of Arizona; post graduate study, Staatliche Hochschule fuer Musik, Munich, Germany; NATS Intern Program Master Teacher, June 2013. Students have sung with Houston Grand, Boston Lyric, Seattle, Deutsche Oper Berlin, New York City, San Francisco, Metropolitan and Santa Fe Opera companies.



# Videolaryngostroboscopy Workshop for Voice Trainers (no. 147)

M.-A. Faure

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Acting Voice

Basic observation of the vocal folds involving our habits of voicing as:

- Different pitches of the vowels used for VLS observation
- Gentle ascending and descending scales
- Gentle increasing and decreasing intensities
- Laryngeal mechanisms
- Various glottal onsets
- Noisy or silent inhalation

An ATMOS Mediastroboscope will be required for this workshop. On request to the ATMOS manager, volunteers for this videolaryngostroboscopic exam can receive a copy of their recorded session (loaded on their own USB storage devices).

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Phoniatrician in France, trained first as singer then physician during her vocal performances as soloist.



# Management of Tongue Tension in Singers: Strategies and Techniques for Addressing Muscle Tension Issues Related to the Tongue (no. 148)

C. LeFevre

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

The vocal tract contains numerous muscles, the contraction of which have the ability to negatively or positively affect articulation, resonance, and efficiency of phonation. The tongue comprises a significant portion of these muscles; thus, the optimal balance of muscle activation and relaxation in this organ is essential for developing and maintaining a healthy, efficient vocal technique.

The location of the tongue and the interrelatedness of its musculature enable it to potentially impact the function of the jaw, velum, pharynx, and larynx. As a result, a pedagogical approach that focuses directly on the tongue can have a wide-ranging impact on technical outcome.

This lecture/demonstration will encompass:

1. Presentation of information regarding the identification of technical issues related to the tongue
2. Instruction for specific methods that are both directly and indirectly effective in remediating these issues
3. Application of the suggested strategies and techniques through demonstration with the audience and/or master class singers

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## Education

DMA (Voice Performance and Pedagogy)—University of Iowa

## Voice Teaching Positions

University of North Carolina-Greensboro; National Opera Company; Bradley University

## Special Skills

Knowledge, ability, experience in rehabilitation of disordered and injured singers

Master Classes at Universities throughout the United States

## Student Achievements

Young Artists includes following opera companies:

San Francisco; Santa Fe; Pittsburgh; Glimmerglass; Central City; Chautauqua; Des Moines; Lake George; Baltimore; Ash Lawn

Winners in various national competitions

## Professional Presentations, Publications, Research, Grants

- Maintaining Low Laryngeal Position in Classical Singing, Workshop, Voice Foundation 41 1st Annual Symposium
- "Tongue Management," Journal of Singing, Nov/Dec, 2011.
- Management of Tongue Tension in Singers: Strategies and techniques for addressing muscle tension issues related to the tongue, Workshop, Voice Foundation 40th Annual Symposium
- Tongue Management: Innovative Devices for Addressing Technical Issues Related to the Tongue
- Paper/Poster presentation, National Association of Teachers of Singing National Conference
- Travel Grant, UNCG, Bastian Voice Institute, Chicago, for observation of therapy and laryngeal micro-surgery
- Research Leave, UNCG, Voice Therapy and the Teaching of Singing: Intersection of Methodology, intensive study of voice injury and rehabilitation

## Voice Science Vision: Where Are We Going? (no. 149)

I.R. Titze

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Voice Science Overview

Voice Science, or Vocology in its broader definition, has grown from a small focus of describing the “sound source for speech” to a much larger scope of describing “sound production in airways.” Sound production in airways includes all primal and learned sounds produced across species, gender, age, and disorders. It includes skilled sound making (singing) as well as undesirable sound making (snoring or wheezing). The theoretical underpinnings for such a broad description include fluid structure interaction, nonlinear dynamics of couple oscillators, biomechanics of muscular and connective tissues, and acoustic wave propagation in soft-walled air ducts. The science is both empirical and theoretical. Basic physical laws of momentum, energy, and mass conservation have been successfully applied to air and tissue movement, but airway and tissue morphology must be determined experimentally. Furthermore, control of the physical plant with variables that relate to perception and cognition is a huge challenge for the future. Simulation can become an important virtual laboratory in this venture. Incomplete or fragmentary measurements obtained from glottography and visual imaging can be interconnected for cause-effect studies. Huge questions remain, however, about the “learning capabilities” of these simulators to mimic human or animal vocalization. The challenge is to discover and embed biological constraints so that hundreds of physical parameters can be controlled with a few simple inputs, all the while retaining the great variety of sounds that the physical plant can offer.

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Ingo R. Titze is Distinguished Professor of Speech Science and Voice at the University of Iowa and Executive Director of the National Center for Voice and Speech at the University of Utah. His formal education is in physics and electrical engineering, but he has devoted much of his studies to vocal music and speech. Dr. Titze has published more than 400 articles in scientific and educational journals, coedited two books titled *Vocal Fold Physiology*, and now has three books in print: *Principles of Voice Production*, *The Myoelastic Aerodynamic Theory of Phonation*, and *Fascinations with the Human Voice*. He has lectured throughout the world and has appeared on such educational television series as *Innovation*, *Quantum*, and *Beyond 2000*. He is a recipient of the William and Harriott Gould Award for laryngeal physiology, the Jacob Javits Neuroscience Investigation Award, the Claude Pepper Award, the Quintana Award, and the American Laryngological Association Award. He is a Fellow and a Silver Medalist of the Acoustical Society of America, and a Fellow of the American Speech-language-Hearing Association. Dr. Titze has served on a number of national advisory boards and scientific review groups, including the Scientific Advisory Board of the Voice Foundation and the Division of Research Grants of the National Institutes of Health. In addition to his scientific endeavors, Dr. Titze continues to be active as a singer. He is married to Kathy Titze and has four children and eight grandchildren.

# Human Papilloma Virus Infections *(no. 150)*

V. Dvořák

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Medicine

Not Available

# Is Vaccination a Chance for Recurrent Respiratory Papillomatosis Patients?

(no. 151)

J. Vydrová, O. Bendová, J. Dubová, R. Domagalská

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Papillomatosis Laryngis

## Introduction

Recurrent respiratory papillomatosis is a disease caused by human papilloma viruses HPV 6 and 11. HPV causes benign lesions of the mucous and skin, including the mucous of the larynx and trachea. This disease is manifested in various degrees of dysphonia or dyspnoe. Frequent recurrence is typical for this disease. Treatment is difficult and involves a combination of surgical and immunomodulatory treatment. Recurrence and repeated surgical procedures often lead to permanent voice disorders.

Existing immunomodulatory therapies do not seem to be effective. Therefore we have been looking for new treatment options that would reduce the number of relapses of the disease. The antibody responses of patients with laryngeal papillomatosis are investigated and testing of the virus from the affected tissue of the larynx is performed. Vaccinations against several types of HPV have been available since 2006. The aim of this study was to monitor the possibility of influencing of the course of the disease in patients who had been vaccinated.

## Materials and methods

The monitored patients underwent these diagnostic and treatment procedures:

1. Anamnesis, one questionnaire focused on information about the papillomatosis, the number of surgical procedures, genital wart disease in monitored patients and their sexual partners
2. Laryngostroboscopy with digital video recording
3. Serological examination of HPV 6, 11, 16, 18 antibody levels in the blood of the patients
4. Sampling of affected tissue for the detection of HPV DNA and virus typology of HPV 6, 11 (low risk) and HPV 16,18 (high risk of tumor)
5. Application of quadrivalent vaccine
6. Serological examination of antibody levels after a month and after a year after completed vaccination

## Results

We show two case studies of patients with RRP. We monitored 55 patients with RRP and we will present our results after finishing our study.

## Conclusion and discussion

RRP is chronic and potentially aggressive disease. Causal treatment does not exist. Vaccination can be a chance for patients with RRP.

Patients who were vaccinated with quadrivalent vaccine have been monitored. We examine local recurrence of papillomatosis on their laryngeal mucous. We suppose that vaccination could lead to a decline in the number of recurrent laryngeal respiratory papillomatosis cases.

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- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Papillomatosis Laryngis

## Introduction

Recurrent Respiratory Papillomatosis (RRP) is caused by the Human Papillomavirus (HPV) types 6 and 11. It affects both children and adults. The disease is potentially very aggressive and tends to reccure and spread into the respiratory tract. Younger age at diagnosis is associated with more serious course of the disease.

The standard of care is surgical removal, but in patients with aggressive disease, adjuvant therapy is indicated. Contemporary opinions on antivirotics, interferon, anti-reflux medication, indole – 3 carbinole etc. are mentioned. Recently, a preventative quadrivalent vaccine against HPV types 6, 11, 16, 18 has become available. In future generations it may decrease the incidence of RRP. Possible favourable change of the disease course after vaccination is being evaluated recently.

## Material and methods

The course of the disease, number of surgical procedures and adjuvant therapy, if used, was described in all patients suffering from RRP, who were observed at the Outpatient Office for Voice Disorders of the Department of Otolaryngology University Hospital Ostrava, between November 2008 and March 2013.

## Results

During the period 37 patients were observed for RRP, 2 children and 35 adults, the average age was 49 years. Seven patients suffered from the Juvenile onset form, 30 patients from the Adult onset form. There are 24 men and 11 women in the group. Thirty five patients had to undergo minimally one and maximally 10 surgical removals of papillomas during the period, in all cases the CO<sub>2</sub> laser was used.

Ten patients, 2 children and 8 adults, got vaccinated with 3 doses of the quadrivalent HPV vaccine. The condition for vaccination were minimally 2 surgeries for RRP during last 4 years. In one of the children there was a dramatic improvement of the disease course after vaccination, in the second child the intervals between surgeries got longer. Two adult patients didn't require any further operation for RRP after vaccination. In one of them complete remission of the small solitary papilloma was observed after vaccination. In 6 patients the vaccination didn't seem to cause any significant change in the disease course.

## Conclusion

RRP is a disease with very unpredictable prognosis. There is no curative treatment for it so far. The gentle surgical removal of the lesions is the standard of care. There is a need for further investigation of adjuvant therapy options.

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# HPV Vaccination as an Adjuvant Therapy for Laryngeal Papillomatosis (no. 153)

I. Hočevnar-Boltežar, M. Šereg-Bahar, N. Gale, M. Poljak, M. Matičič, M. Žargi

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Treatment Methods

## Introduction

The most successful treatment for laryngeal papillomatosis is surgery. In the cases of aggressive disease adjuvant therapy is used. There are rare case-reports on improvement of the laryngeal papillomatosis course after HPV vaccination. The results of HPV vaccination as an adjuvant therapy for laryngeal papillomatosis are presented.

## Method

Eleven subjects (5 M, 6 F; 4 juvenile cases; HPV type 6 in seven patients, HSV type 11 in 4 patients) with an aggressive form of the disease were vaccinated with three doses of the quadrivalent HPV vaccine (Silgard®, MSD) and followed up 6-48 months, mean 34.92 months. The intervals between the successive laser surgeries, the stage of LP according to Derkay protocol, the total number of surgical procedures, and the number of surgical procedures/year were compared before and after the vaccination. The influence of virus type and gender on the success of vaccination was also tested. The nonparametric test of two related samples and the  $\chi^2$ -test were used for the statistical analysis.

## Results

The mean interval between the surgeries was 212.16 days before and 603,60 days after the vaccination ( $p=0.050$ ). The mean score for the disease severity was 6.21 before and 2.88 after the vaccination ( $p=0.575$ ). The mean total number of surgeries was 14.88 before vaccination and 2.88 after the vaccination ( $p=0.018$ ). The mean number of surgeries / year was 2.34 before and 0.89 after the vaccination ( $P=0,050$ ). A complete response was observed in one, partial response in seven and no response in three patients. The virus type and gender did not influence the success of vaccination. Among the patients with partial response there were three women with a small recurrence of laryngeal papillomatosis not growing for more than 2 years and not causing dysphonia.

## Conclusions

The vaccination with quadrivalent HPV vaccine can favorably influence the course of the laryngeal papillomatosis in selected cases. For final conclusions, a longer follow-up and larger series are needed.

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# Bevacizumab (Avastin) in the Treatment of Recurrent Respiratory Papillomatosis *(no. 154)*

A. Barbu

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Papillomatosis Laryngis

A review of our experience at Massachusetts General Hospital with the anti-angiogenic agent bevacizumab (Avastin) in its role for treatment of recurrent respiratory papillomatosis will be discussed. The prospective open-label investigation that was conducted in 20 adults patients with bilateral vocal fold RRP will be reviewed, as well as the safety and dosing follow-up data will be provided.

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# Introduction of Vocal Cord Augmentation with Radiesse in the Czech Republic (no. 155)

J. Dršata, M. Černý, K. Smatanová, V. Chrobok, K. Zeleník, H. Kopřivová, M. Zábrodský

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

## Introduction

Radiesse Voice™ (Radiesse) is an injectable material, containing calcium hydroxylapatite (CaHA). Its indication is an injection with long-term biostability. The application can be performed via direct laryngoscopy, transorally or transcutaneously. In the first year of being on the Czech market, Radiesse was implanted in 12 patients, at the following workplaces: ORL Hradec Kralove (8x), ORL Ostrava (2x) and ORL Prague (2x). At ORL Hradec Kralove, the patient is to be prepared with preoperative physical examination, coagulation test, informed consent and complex voice analysis. The augmentation is then performed at hospitalization under local anesthesia, with transcutaneous approach and help of flexible laryngoendoscopy with photo and video documentation. After the postoperative control the following day, the patient can be discharged from the hospital. One month after the procedure, a follow-up voice analysis is performed to assess the primary results of the procedure.

## Patients

In the year 2012, eight patients were implanted with Radiesse at the ORL Hradec Kralove: 5 males and 3 females in the average age of 60,75 years (median 64,5 years). The diagnosis for surgery was vocal cord paralysis (6x) presbyphonia (1x) and dysphonia after chordectomy (1x). Right side of injection prevailed (5x). The approach was transconic (first 3 patients) and suprathyroid (5x). No complication was observed during the procedure or postoperative period.

## Method of evaluation

Before the operation and one month after the procedure, all patients underwent a complex voice analysis consisting of laryngostroboscopy, perceptual evaluation, voice range profile, examination of maximum phonatory time with S/Z-ratio and VHI-30 psychometric testing.

## Results

In the laryngostroboscopic view, the width of glottic insufficiency improved at 1,125 point of 5-point scale in average. In the perceptual evaluation (GRBAS), a slight worsening of roughness was observed (0,25 pt.) while improving the breathiness (1 pt.). In the voice range profile, an average of 18,9 dB improvement of maximum voice loudness was achieved (median 8,26). The MPT prolonged at 4 sec. (80%). In the VHI-30 query, the best result was met in the functional criterion (20%) the emotional one being the most variable (0% - 80%).

In conclusion, the vocal cord augmentation with Radiesse in Czechia was confirmed as safe and minimally invasive procedure. The material is not paid within the insurance system, thus making a limitation for some indicated patients. The character of the material and procedure predestinates the indication of the operation to patients requiring a quick solution of their dysphonia, and/or those unable undergoing a more demanding surgery (i.e. thyroplasty). The preliminary results are encouraging, but further follow-up of results is needed.

Supported by a grant from the Czech Ministry of Health, IGA No. NT 13725/4-2012

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## Master Class - Czech Music (no. 156)

J. Marková-Krystlíková

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

### Czech Music

Composers B. Smetana, Ant. Dvořák, B. Martinů, L. Janáček

Master Classes about the correct interpretation of these classical masters will be led by Jiřina Marková-Krystlíková - an Opera soloist, professor of the Prague Conservatory, and the principal of a private school and director of the Prague Children's Opera.

The correct interpretation of Czech classical music has its specific traits, which additionally manifest differently in the works of these famous composers - Dvořák, Smetana, Martinů, and Janáček.

To achieve the correct artistic presentation, one must take into account not only correct phraseology, but also correct pronunciation and the associated breathing techniques, and an understanding of Slavic mentality.

If any participant is particularly interested in a specific composition, please let us know.

While learning about the creative periods of these composers we will also touch upon the cultural events of the surrounding times.

All of these composers became famous not only for their lyrical works, but for their operatic compositions as well.

### Author no. 1

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Jiřina Marková-Krystlíková has led these Master Classes in many countries, and you now have the opportunity to study these composers in the Czech Republic and directly immerse yourselves in their cultural heritage.





## How to Belt (no. 157)

L. Popeil

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy
- Invited Workshop

In this workshop, participants will learn the secrets to belting to the top of one's vocal range without vocal fold pressing.

### Topics covered are:

Support, an innovative model of registers, 'belter's bite', 'laryngeal lean', 5 vocal fold closures and the 5 Belting Sub-styles for Musical Theater singing.

### Author no. 1

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Lisa Popeil, MFA in Voice, is the creator of the Voiceworks® Method and the Total Singer DVD instructional program. A professional teacher for 35+ years with 50 years of vocal study, Ms. Popeil is an expert in the performance and pedagogy of multiple vocal styles. She has conducted vocal research using video-fluoroscopy, stroboscopy, kymography, high-speed photography, phonovibrograms and MRI with scientists in Japan, Norway, Germany, and in the US. She is on the Advisory Board of the Voice Foundation and is a voting member of NARAS, the Grammy organization.



In addition to a busy private studio based in Los Angeles, Lisa offers the Total Singer Workshops, is a contributor to the 'Oxford Handbook of Music Education' and the 'Oxford Handbook of Singing', has co-written the book 'Sing Anything - Mastering Vocal Styles' and the 'Daily Vocal Workout for Pop Singers' CD.

# Belting: It's Origins, History and Current Variations (no. 158)

J. LoVetri

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice
- Invited Workshop

Much is made today of the quality of singing called "belting", however, few know or understand its origins and history. This has contributed to confusion about what it is and is meant to be and how it is best taught. Also, the unique attributes of belting make it unlike any other vocal quality and, this, too, contributes to general misunderstanding in the multi-disciplinary voice community. Belting will continue to be an ever-increasing vocal quality found in all kinds of Contemporary Commercial Music due to the influence of rock and world music, which rely heavily on belt sounds. Both scientists and teachers of singing must understand the roots of belting since they do not derive from any one teacher or researcher's point of view or experience. This presentation will present historic audio examples, contemporary audio examples, and cover a range of music in which singers, both male and female, are belting. It will discuss a simple approach to teaching belting to those who wish to learn how to make the sound in a healthful manner.

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# The Influence of Laryngeal Adductory Muscles on Fundamental Frequency

(no. 159)

D.A. Berry, D.K. Chhetri, J. Neubauer

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Measurement

The primary role of the cricothyroid muscle in fundamental frequency control is well understood. However, the secondary role of the laryngeal adductory muscles (e.g., the thyroarytenoid muscle, and the lateral cricoarytenoid and interarytenoid muscle complex) in fundamental frequency control is less well understood. Using a recently developed technique for automated, graded simulation of intrinsic laryngeal muscles (Chhetri et al. 2010; 2012), we measured fundamental frequency in an in vivo canine larynx as a function of the aforementioned intrinsic laryngeal muscles. Across all activity levels of the cricothyroid muscle and the lateral cricoarytenoid/interarytenoid muscle complex which were investigated, an increase in thyroarytenoid muscle activity always first raised and then subsequently lowered fundamental frequency. This finding challenges previous studies which maintain that (1) the vocal fold cover must be lax in order for an increase in thyroarytenoid muscle activity to result in an increase in fundamental frequency, and that (2) an increase in thyroarytenoid muscle activity must always lower fundamental frequency in the canine larynx (because of its presumed relatively thick, superficial layer of the lamina propria). Thus, untested by appropriate systematic studies, previous assumptions regarding the difference between canine and human phonation may have exaggerated the phonatory differences between the two species. The influence of the lateral cricoarytenoid/interarytenoid muscle complex on fundamental frequency is more complex. However, this cartilaginous adductor (e.g., the lateral cricoarytenoid/interarytenoid muscle complex), in combination with the membranous vocal fold adductor (e.g., the thyroarytenoid muscle), introduces new strategies for control of fundamental frequency and vocal register. As noted in previous studies, these two independent methods of glottal adduction appear to be necessary to produce different registers in classical singing (Herbst et al., 2009), and both singers and non-singers may be trained to produce phonatory output which requires the independent manipulation of both methods of adduction (Herbst et al., 2011).

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# Using the Interpolation Method for Estimating Subglottal Pressure during Speech and a New Real-Time Implementation (no. 160)

M. Rothenberg

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Measurement

The air pressure in the lungs, or more precisely, the subglottal air pressure, is the primary energy source in speech. Yet many clinicians avoid estimation of subglottal pressure in treating patients because of the difficulty in measuring it. However, since its first reported use in 1973 (M. Rothenberg, A new inverse-filtering technique for deriving the glottal air flow waveform during voicing, J. Acoust. Soc. Amer., Vol. 53, #6, 1632 – 1645), the so-called Interpolation Method, in which the subglottal pressure during voiced speech is estimated from samples of intraoral pressure obtained during unvoiced stops, has achieved acceptance as a feasible and reliable method, if used properly. This paper reviews some of the uses and misuses of the Interpolation Method over the past four decades and questions some assumptions that have been made about its use. Suggestions are given as to the proper use of the method. A new version of the method will also be described that uses a combination of interpolation and extrapolation to provide subglottal pressure estimates in real-time for speech evaluation and biofeedback. By way of validating this new real-time method, it will be compared with estimates using the more standard interpolation method.

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# Measurements of the Dynamic Range of Human Voice (no. 161)

H. Šrámková, S. Granqvist, J.G. Švec

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Measurement

A comprehensive understanding of the dynamic extremes of the human voice is important for voice diagnostics and for scientific purposes. The literature on this topic reveals considerable discrepancies in published sound levels. The methodology of these measurements has been heterogenous and the exact values of the extremes are often unclear. This study therefore aims at a precisely documented study about measuring extreme limits of normal voice with an easily reproducible methodology.

A group of eighty healthy and untrained individuals, 40 male and 40 female, participated in this study. Two microphones were used and calibrated at a standard distance 30 cm from the mouth. A head-mounted microphone (at 5-10 cm) was used for measuring of the softest phonations and a stand-mounted microphone (at 30 cm) for the loudest phonations and for calibration. The loudest level was determined from calling Czech words "Hej, Hou, Haló" as the peak sound level. The softest level of a sustainable phonation of the vowel [a:] was determined using various methods. The data was analyzed using programs Praat and Matlab. An acoustically treated room and filtration (standard A, C or Z filters or custom high-pass filter) were used to eliminate the influence of ambient and instrumental noise.

The average level of the loudest phonation was found to be within the range of  $122 \pm 10$  dB ( $\pm 2SD$ ) in male voice and  $116 \pm 9$  dB in female voice (Z-weighted peak sound level) at the distance of 30 cm from the mouth. The extreme level was 139 dB in male voice and 125 dB in female voice. The softest phonation in male voice was found to be within the range of  $43 \pm 12$  dB ( $\pm 2SD$ ) and  $48 \pm 9$  dB in female voice (A-weighted 1s-equivalent sound level) at the distance of 30 cm from mouth. The extreme level was 32 dB in male voice and 33 dB in female voice. These levels appear to be more extreme than those previously measured and can serve to further specifications and recommendations for microphones and for the methodology of the measurements of human voice.

The research has been supported in the Czech Republic by the European Social Fund Project OP VK CZ.1.07/2.3.00/20.0057 and by the Palacky University student's project PrF\_2012\_026 and PrF\_2013\_017.

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# Method for Vocal Fold Elasticity Measurement (no. 162)

H. Larsson, S. Hertegård

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Examination Techniques

Vocal fold elasticity is a crucial factor for the normal vocal fold vibration. Stiff vocal folds require a higher onset pressure to start vibration and a higher subglottal pressure to maintain phonation. Examples of lesions and conditions that increase the stiffness of the folds are scars, chronic inflammation, vocal fold atrophy, sulcus glottidis, cysts and deposits. Chronic edema and vocal fold paresis on the other hand may increase softness and elasticity. It has been shown that vocal nodules affect the elasticity resulting in severe voice problems for many patients.

Measurement of vocal fold elasticity are still a difficult problem. Many ideas have been presented but still there are no clinical practice method. We have earlier presented a method where we with a small catheters blow a small air pulses on the vocal folds. From that we have tried to measure the depth of the cavity which in some aspect reflect the elasticity of the vocal fold. The method works in principal, but was required frequently calibration and the measurements were very sensitive to angle between vocal fold and catheter and the distance. We have now simplified that method so instead of measuring the depth of the cavity we measure the time constant of the slope when the air pulse end. The advantage of that is that it require no calibration and have less sensitivity for not perpendicular measurement.

With this setup it is possible to repeat a measurement every two second, so in relative short time it is possible to have many measurements.

In vitro test show of variability of about 6% with when the probe is hand held over an object and variable angle. Result from in vivo tests will be presented.

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# Comparing Vocal Fold Contact Criteria Derived from Electroglottographic and Acoustic Signals (no. 163)

L. Enflo, C. Herbst, J. Sundberg, A. McAllister

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Acoustics

Collision threshold pressure (CTP), i.e., the lowest subglottal pressure resulting in vocal fold contact during phonation, is a parameter likely to reflect relevant vocal fold properties. The amplitude of an electroglottographic (EGG) signal or the amplitude of its first derivative (dEGG) has been used as the criterion of such contact in previous studies (1-3). Manual measurement of CTP is time-consuming, making the development of a simpler, alternative method desirable. In this investigation we compare CTP values which were automatically derived from the dEGG signal to values measured manually, and to values derived from a set of alternative parameters. Of these, two were obtained from the acoustic and five from the EGG signal. One of the parameters was the novel EGG wavegram, which visualizes sequences of EGG cycles, normalized with respect to both period and amplitude (4) and another the slope of the EGG spectrum envelope. Raters with and without previous experience of EGG analysis marked the disappearance of vocal fold contact in the dEGG and in the wavegram displays of /pa:/-sequences produced with continuously decreasing vocal loudness by seven singer subjects. Vocal fold contact was equally well identified in both displays of dEGG amplitude and the EGG wavegram. Automatically derived CTP values showed high correlation with those measured manually, with those derived from the ratings of the visual displays and with those derived from the EGG spectrum slope.

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# Effects of Hyper- and Hypocapnia on Phonatory Laryngeal Resistance (no. 164)

A. Gillespie, W. Slivka, C. Atwood, K. Verdolini-Abbott

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Voice Motor Control

The larynx has a challenging dual role in the simultaneous regulation of gas flow into and out of the lungs while also establishing resistance required for vocal fold vibration in voiced communication. Particular challenges may arise when the larynx is required to alter upper airway resistance to meet respiratory demands in a way that conflicts with requirements for voice production. Little if anything is known about reciprocal relations between these functions, particularly under conditions of respiratory abnormality that affect large sectors of the population. In order to address this gap, the current study investigated two specific aims in a single prospective, randomized, within-subjects experiment: Specific Aim 1 (SA1) assessed spontaneous fluctuations in phonatory laryngeal resistance during states of (a) induced hypocapnia (low arterial carbon dioxide) and (b) induced hypercapnia (high arterial carbon dioxide), in comparison to a eupneic control condition and Specific Aim 2 (SA2) investigated the reciprocal effects of laryngeal resistance modulations on respiratory homeostasis.

Results of the first aim demonstrated that phonatory laryngeal resistance (R<sub>law</sub>) did not significantly change despite manipulations of inspired gas concentrations causing significant increases and decreases in carbon dioxide (CO<sub>2</sub>) levels. Separate analyses of airflow and estimated subglottic pressure (P<sub>sub</sub>) data, the component parameters of R<sub>law</sub>, revealed that these parameters were modulated by respiratory condition. Thus, phonatory control parameters were affected by the breathing conditions; they were simply affected in a way that maintained the constancy of R<sub>law</sub>.

For the second aim, results showed that phonation significantly increased levels of end-tidal carbon dioxide (PetCO<sub>2</sub>) in all experimental conditions, compared to PetCO<sub>2</sub> levels during rest breathing. This result supports findings from past research, which have shown PetCO<sub>2</sub> values to be greater during speaking than during rest breathing under normal breathing conditions.

Findings provide support for a theory of voice motor control suggesting that R<sub>law</sub> may be an essential, relatively immutable control parameter in phonation. Specifically, data from the study are consistent with the proposal that the vocal control system is a regulated system, capable of maintaining normal phonatory laryngeal resistance values despite significant respiratory perturbations – moreover suggesting that such resistance may be a critical control parameter in voice production.

The current work sets the foundation for future interdisciplinary studies of laryngeal function during phonation in individuals with lower airway disease. Future studies might also be specifically designed to test hypotheses about the voice motor control system. Those studies could provide further depth to the experimental framework for studies on interactions between voice and respiratory functions.

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# Voice Handicap and Psychosomatic Well-being in Vocal Fold Lesions vs. Functional Lesions (no. 165)

F. de Jong, R. Smits

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Clinical Issues

## Introduction

It has been demonstrated that a voice handicap and impaired general well-being are positively correlated. Voice disorders have a multifactorial genesis and may be present in various ways. Vocal fold lesions often are more concrete than functional disturbances. Therefore, vocal fold lesions are more likely to be handled as criterion of a voice disorder, and various health insurance institutions apply the presence of a vocal fold lesion as a norm for indemnity or alimony. The aim of this study is to assess whether vocal fold lesions have a greater impact on voice handicap and psychosomatic well-being, compared with pure functional lesions. Furthermore, the relation between the quality of voice and the appraisal of the patient's voice handicap and psychosomatic well-being was assessed.

## Methods

Eighty-two female voice patients, aged 18–65 years were assessed. Laryngostroboscopic examination and acoustic voice analysis were carried out, and the patients were asked to fill in the Voice Handicap Index (VHI) and Symptom Check List-90 questionnaires.

## Results

In 43 patients (52.4%), a vocal fold lesion was observed. The VHI and psychosomatic well-being did not differ significantly between patients with and without a vocal fold lesion. The patients with a vocal fold lesion showed lower scores on the Dysphonia Severity Index (DSI) compared with those without a vocal fold lesion. However, the DSI was not correlated with voice handicap and psychosomatic well-being, except for the VHI physical subscale.

## Conclusions

The results of this study underline the importance of functional aspects in voice problems and their influence on quality of life. Objective measurement does not necessarily correlate with the subjective appraisal of the patient's voice handicap and psychosomatic well-being. Besides organic lesions, functional aspects are important features in the design of diagnosis, treatment, and prevention of voice problems. The individual personal perception of the voice problem holds a high place in voice care. Moreover, various criteria on which health insurance departments base their indemnity and alimony should be questioned.

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# The Ability of the Norwegian Voice Handicap Index (VHI-30N) to Differentiate Between Voice-related Diseases (no. 166)

T. Karlsen, A.R.H. Grieg, J.-H. Heimdal, H.J. Aarstad

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Measurement

## Aims

To study the ability of the Norwegian version of the Voice Handicap Index (VHI)-30 to discriminate between voice-diagnoses dependent on disease origin, as well as to study the psychometrics of the VHI based on specific laryngeal diseases. Abbreviated scales as published by Nawka et al. and Rosen et al. were also tested.

## Method

126 healthy subjects and 355 laryngeal diseased patients answered the VHI-30(N), a visual analogue scale where the subjects were asked to rate their voice disease, as well as a seven-level scale where the subjects rated their degree of voice use. The different laryngeal diseases were allocated to disease groups according to commonly used standard criteria. The disease groups with the most included patients were: Paresis of the recurrence nerve (n=40), functional disease (n=76), Reincke's oedema (N=24), laryngitis (n=20) and laryngeal cancer (n=81).

## Results

The VHI score of the above specifically mentioned patient groups were psychometrically examined. The VHI scores showed e.g. high Cronbach's alphas when studied with the patients of individual disease groups included only. A visual analogue scale where the subjects were asked to rate their voice disease correlated well with the VHI-30(N) scores within the different patient groups. When studied by an ANOVA analysis with VHI scores as dependent variable a highly significant dependence of disease group was obtained. By post hoc analyses the above mentioned laryngeal patients groups scored all differently from each other except cancer versus Reincke oedema patients, and the functional versus laryngitis patients. The Reincke oedema patients had the highest VHI scores and laryngeal cancer patients scored lowest of the above mentioned disease groups. Furthermore, the two highest scoring patient groups among all groups were the aphonic and spastic dysphonic patients. All patient groups scored differently from the controls. Closely parallel results were obtained with the total VHI, the subscales of VHI and the abbreviated scales.

## Conclusion

This Norwegian version of the VHI questionnaire was psychometrically well functioning also when specifically studied among different laryngeal disease patients. When deploying large groups of patients, the VHI-30(N) had the capability to discriminate between voice-diagnoses dependent on disease origin.

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# On the Accuracy of Adult's Perception of Normophonic and Dysphonic Children's Personality on the Basis of Vocal Cues (no. 167)

I. Verduyckt, D. Morsomme, M. Remacle

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Child's Voice

## Context

The link between personality and dysphonia has traditionally been studied from two separate angles. On the one hand, studies have sought to identify personality profiles specific to patients with vocal fold nodules or functional dysphonia. On the other hand, studies have studied the impact of dysphonic voice quality on perception of speaker personality; generally assuming that negative attributions are the result of negative stereotyping and as such forcedly erroneous. The possible accuracy of personality judgments of dysphonic speaker on the basis of their voice has never been studied. In this work where we set out to compare the actual personality profiles of normophonic children (NP) and children with vocal fold nodules (VN) with the evaluation of their personality made by external raters having only heard their voices.

## Methodology

Actual personality was defined as the profiles of the children such as evaluated by their mother on a scale measuring the personality dimensions Openness (O), Conscientiousness (C), Extraversion (E), Agreeableness (A), and Emotional Stability (ES). Maternal ratings were gathered for 36 VN and 36 age and gender matched NP children. 48 external raters later estimated the personality of 6 VN children and 4 NP children on the basis of their voice only with the same scale used by the mothers. Separate ratings were obtained for sustained vowels and continuous speech.

Group differences for VN and DP children were analyzed and the pooled personality profiles of VN and NP children such as rated by mothers or external raters were then compared.

## Results

Mother's ratings.

Statistically significant group differences were found for the E dimension, VN children were rated as moderately more extroverted than NP children ( $t(70)=2,567$ ;  $p=0,012$ ;  $d=0,61$ ). Clinically relevant differences were found for the A and O dimensions (A:  $t(70)=1,922$ ;  $p=0,059$ ;  $d=0,47$ , and O:  $t(70)=1,899$ ;  $p=0,062$ ;  $d=0,46$ ); VN children were rated as being more agreeable and more open than their NP peers. The ES and C dimensions revealed no difference between child groups.

External judges' ratings on the basis of vowels.

The VN group was judged as slightly less extroverted and open than the NP group (E:  $t(568)2,637$ ;  $p=,009$ ,  $d=-,23$ ; A:  $t(568)2,267$ ;  $p=,024$ ,  $d=-,19$ ).

External judges' ratings on the basis of sentences.

The VN group was judged as much more extroverted and slightly more open than the NP group (E:  $t(568)-9,507$ ;  $p<,001$ ,  $d=,81$ ; O:  $t(568)2,605$ ;  $p=,009$ ,  $d=,22$ ). The VN children were also judged as slightly less agreeable than the NP children but this difference failed to reach significance level (A:  $t(568)1,720$ ;  $p=,086$ ,  $d=-,15$ ).

## Conclusion

External judgments made from the vowels lacked accuracy; VN children were judged as less extroverted and less agreeable than NP children but maternal ratings suggested that they actually are not only more extroverted and agreeable but also more open than NP children. Judgments made from the sentences were more accurate. In accordance with the maternal ratings, VN children were rated as more extroverted and open than the NP children. Although the difference went in the accurate direction for E and O, the magnitude was not accurate. Maternal ratings had suggested VN children to be moderately more extraverted and open but external judges rated VN children as much more extraverted and only slightly more open than NP children. Possible reasons for the discrepancy between vowel and sentence based ratings are discussed.



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# Gender Differences in the Prevalence of Vocal Symptoms in Smokers (no. 168)

S. Simberg, H. Udd, P. Santtila

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Other

Smoking has generally been seen as a primary cause for voice disorders and it is well documented that it is a central factor in the etiology of laryngeal cancer and Reinke's edema. Smoking causes edema and erythema on the vocal folds, affects fundamental frequency and causes irregularity in the vibration of the vocal folds. Still, the results of several questionnaire studies do not seem to show any association between the prevalence of vocal symptoms and smoking.

Some smoking related diseases, such as stroke and coronary heart disease, seem to affect men and women who smoke in different ways. The purpose of the present study was to explore the prevalence of self-reported vocal symptoms among male and female smokers, occasional smokers and non-smokers.

1728 twins (555 men, 1173 women) born between 1961 and 1989 reported the occurrence of the symptoms throat clearing or coughing, a sensation of pain or lump in the throat, difficulty in being heard, the voice becomes low or hoarse, the voice becomes strained or tires and voice breaks while talking by indicating the frequency of these symptoms occurring during the past years as "daily," "weekly," "less often," and "not at all". Symptoms occurring daily or weekly were considered as frequently occurring symptoms. Alternatives for smoking habits were regular smoker, occasional smoker and non-smoker.

The results showed that 20% of the women and 19% of the men were regular smokers. Overall, women reported significantly more often occurring vocal symptoms than men. Also, when analyzing women and men combined, smokers reported significantly more often occurring symptoms than non-smokers. There was no significant difference in the prevalence of any of the symptoms between male smokers, occasional smokers and regular smokers. As to the women, there were significant differences for four of the symptoms. These were throat clearing or coughing, the voice becomes low or hoarse, the voice becomes strained or tires and voice breaks while talking. These symptoms were significantly more common for female smokers than non-smokers.

The results showed that female smokers reported significantly more vocal symptoms than female non-smokers whereas this was not the case for men. It is possible that smokers ignore vocal symptoms and understate their voice problems and this could be the case to a larger extent for men compared to women. One reason for overlooking symptoms may be that persons adapt to worsening of voice quality such as hoarseness. It is also possible that the vocal folds in men are better protected from the adverse effects of smoking because they have a higher concentration of hyaluronic acid in their vocal folds. Since the female voice seems to be more vulnerable to the exposure of tobacco smoke it is of outmost importance to inform female smokers of the effects that smoking has on their voice.

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## Dysphonia is Beautiful! (no. 169)

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- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Analysis of Voice and Speech

The evaluation of vocal quality and its perceived decline through various acoustic indexes is a major concern for voice professionals implicated in the process of vocal rehabilitation. Accordingly, it is appropriate to give particular attention to all indexes likely to yield pertinent information for the purposes of both diagnosis and the evaluation of the effects of proposed programs for vocal rehabilitation. Hence, the contribution of experimental phonetics to clinical practice is a well-known fact. Though the analysis we are proposing is about the perceptual evaluation of vocal quality, our concern is more directed towards the aesthetic dimension of voices in the specific context of vocal pathologies.

This study, connecting phonetics and logopedic sciences, deals with the aesthetic quality of dysphonic voices. The aim of this work is to evaluate if women can perceive masculine dysphonic voices as attractive. Results show that masculine voices that are slightly rough (i.e. R1 on GRBAS scale) are evaluated as the most pleasant ones among a number of normal and dysphonic voices. From there on, an acoustic study was undertaken on the basis of spontaneous speech and sustained vowels (1) to quantify the acoustic characteristics of each type of pathological voices and (2) to examine the acoustic correlates of voices that have been perceived as the most attractive.

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# The Dutch Pediatric Voice Handicap Index: A Self-report Instrument for Children Aged 7-12 to Measure Impact of Dysphonia (no. 170)

M. Schouwerwou, D. Dautzenberg, M. Fris, M. Bosma, M. Aprea, E. de Haan

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Child's Voice

The objective of this study was to develop a Dutch instrument to evaluate the effects of dysphonia on children. Instead of using parent-proxy reports, we set out to develop a self-report instrument suitable for children aged 7-12 years of age. Based on the Pediatric Voice Handicap Index (Zur et al., 2007), a questionnaire for parents, we constructed The Dutch Pediatric Voice Handicap Index for children (pVHI-k-NL), an instrument that quantifies the functional, physical and emotional consequences of dysphonia as experienced by the child him-/herself.

A pilot study was performed to review the usability of the pVHI-k-NL and to obtain an impression of its reliability, internal consistency and (clinical) validity. Seven children with dysphonia and eight healthy children completed the questionnaire. Parents completed a similar questionnaire regarding their child (i.e. parent-proxy report). Usability was reviewed by assessing children's comprehension of the questions, their ability to complete the questionnaire and the time they needed to complete it.

Based on this pilot study we conclude that the comprehensibility of the pVHI-k-NL is satisfactory: children are able to complete the questionnaire on their own and within twenty minutes. A detailed comparison of parent and child responses showed little difference between their scores. The internal consistency of the pVHI-k-NL as a whole appears to be good (Cronbach's alpha = 0.818). With regard to the subscales, only the physical scale shows good internal consistency (Cronbach's alpha = 0.804). Total scores were higher for children with dysphonia compared to healthy children (respectively 29 and 9 points on average), influenced mostly by the higher scores obtained by dysphonic children on the physical subscale.

Given the limited number of participants in this pilot study, the results regarding reliability and validity should only be considered as indicative. A study to validate this self-report instrument for dysphonic children is currently carried out in the Netherlands. Based on the present study, we believe that the pVHI-k-NL is a useful addition to the clinical practice of speech and language therapists and otorhinolaryngologists working with a pediatric population.

## Learning objectives

The Participant will be able to:

1. Understand why a self-report instrument is of value regarding clinical decision making in voice disordered patients aged 7-12
2. Understand what changes were made to adapt the pVHI to a self-report instrument for 7-12 year olds
3. Understand what parallel assessment of parent and child responses revealed

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# Hands-On Injection Laryngoplasty *(no. 171)*

*M. Hess*

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Medicine

Not Available



# Qigong for Muscular Tension Dysphonia (no. 172)

G. Tveteraas

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

Functional voice problems or muscular tension dysphonia (MTD) is a very common reason for referring clients to our Voice Department in Oslo. MTD is related to vocal abuse, misuse, or overuse syndromes, often with components of psychological stress. This may be due to personality traits and difficulties in managing the different kinds of stress/press the person is exposed to.

The respiration is vulnerable to emotions and stress. Clients with stress management problems often have a costal breathing pattern with reduced diaphragmatic movement and abdominal support during voice production, a so called "held/locked" breathing pattern. This gives tension in the muscles of chest, neck and shoulders, and has an effect upon the position of the larynx. The muscular tonus and the air flow involved in voice production are not balanced and will not give the appropriate subglottic air pressure needed for good phonation.

Voice therapists have a number of strategies to help the clients. Additionally, I have experienced that simple qigong exercises may be a useful tool in voice treatment.

Qigong originated more than 3000 years ago in China. Qi (chi): breath, vital/life energy. Gong: method, work, exercise, training. Qigong is "working with energy" or "working with breath". It is based on the same principle as acupuncture. Medical qigong belongs to the traditional Chinese medicine, and keywords are: grounding, slow movements, free breathing flow, and mental awareness/mindfulness.

The breathing technique in qigong, with calm and harmonic movements, may increase the manifestation of good head and body posture, and help to establish and reinforce the natural diaphragmatic/abdominal breathing pattern. This is needed for natural breathing with a balanced subglottic air pressure and a good phonation flow. The exercises can also reduce muscular tension, increase the ability to relax, and restore and balance the client's vital energy; eutonus, meaning the comfortable tonus. It may also influence the energy and effect of other voice treatments, like for instance, the Resonance tube method/Lax vox voice therapy, the Accent method, or H. Coblenzer's rhythmic breathing and phonation method.

This workshop invites you to take part in simple exercises and discuss the combination of training voice and qigong.

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Voice therapist Gry Tveteraas has long experience in working with patients with all sorts of voice problems. She also gives lectures in voice theory and practical voice training to the speech therapy students in their Master's Degree Programme, University of Oslo. She is particularly interested in the connection between voice, body and mind.



# Usage of Tai chi Principles in Vocal Therapy and Vocal Pedagogy (no. 173)

M. Kolasa-Hladikova

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

## Introduction (10 min)

Introduction to Tai Chi general principles and their main influence on human life.

## Practice and description (25 min)

1. Presentation of basic movements
2. Practicing presented movements with participants of the workshop
3. Discovering how the body is relaxing and breath deepening during the exercises
4. Explanation how presented movements may influence over the posture and may help with its defects
5. Understanding how body confidence may have a power to affect proper breathing

## Discussion (10 min)

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Monika Kolasa-Hladikova PhD, mezzosoprano, vocal teacher, Tai Chi instructor.

At the age of seven she began learning the piano and later chose to pursue singing as her career. She graduated from the Vocal and Theatrical Faculty of the Music Academy in Lodz as a student of Professor Zdzisław Krzywicki. Subsequently, she was awarded a scholarship by the Polish Culture and Arts Ministry to further her studies in the Carl Maria von Weber Musikhochschule in Dresden under the guidance of Professor Christian Elsner.

Following her studies in Dresden she spent 2 years in the Czech Republic where she taught in music schools in Liberec and Frydlant. She has since developed her vocal skills during master courses with Teresa Zylis-Gara. Her repertuar consists among other works of Stabat Mater and Gloria by Vivaldi, Requiem by Mozart, Weihnachtsoratorium, St. Mathew and St. John Passions and Alto Solo Cantatas by J.S. Bach, Stabat Mater and Salve Regina by G. B. Pergolesi and the Messiah by G.F.Haendel. She has sung in Germany, Poland, Morocco, Czech Republic, Ukraine and Lithuania. She has appeared at numerous Chamber and Liturgical Music Festivals.

In November 2003 following studies with Professor Piotr Kusiewicz, she received an Academic degree of Doctor of Art from the Music Academy in Gdansk. She is currently a lecturer at The Jan Kochanowski University in Kielce and a tutor at the Music High School in Lodz. Slavonic music is of particular interest to her. She has recorded for radio and TV. The Festival of Days of Music in Ostrowiec Świętokrzyski was initiated by her and for two seasons she has been its artistic manager. She also composes songs from her owl lyrics. She has been practicing Tai Chi since 1996 and has been teaching it for 9 years.

She cooperates with Czech vocal teacher Alena Ticha PhD



# Laryngeal Synkinesis: Diagnosis and Treatment (no. 174)

I. Garcia-Lopez, A. Lekue, S. Santiago-Perez, J. Gavilan

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

## Introduction

Laryngeal synkinesis is defined by the abnormal laryngeal innervation that may exist following injury to the recurrent laryngeal nerve.

75% of recurrent laryngeal nerve fibers innervate adductor muscles, thyroaritenoid (TA), lateral cricoarythenoid and interarythenoid and 25% innervate the posterior cricoarythenoid muscle, the only abductor muscle. When a nerve disruption occurs, adductor fibers can reinnervate abductor muscles or viceversa.

Symptoms of synkinesis may extend from the asymptomatic patients to severe dysphonia or airway impairment.

## Methods

Retrospective study of 7 patients with laryngeal synkinesis diagnosed by electromyography. The variables studied were: demographics, presenting symptoms, findings of laryngeal examination and laryngeal electromyography, treatment and outcome.

## Results

Seven patients presented with vocal fold paralysis, and have laryngeal synkinesis diagnosed by LEMG. 60% of cases were unilateral paralysis. The main symptom was dyspnea, followed by dysphonia. In all cases a recruitment pattern was found in TA muscles with respiratory tasks, at least with the same amplitude than with phonatory tasks. All patients with dyspnea were treated with toxinum botulinum injections in the paralyzed vocal fold. Improvement of dyspnea was found in all cases, with maximum duration of one year.

## Conclusions

Laryngeal electromyography (LEMG) can be useful in the diagnosis of synkinesis, finding recruitment pattern in TA muscles with respiratory tasks.

Intralaryngeal botulinum toxin can provide temporal improvement in patients with unilateral or bilateral vocal fold paralysis presenting with dyspnea.

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## Allergic and Pollution-induced Laryngitis (no. 175)

R.E. Chavez

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

New trend for environmental and allergological effects on artistic voice

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# Reflux Laryngitis (no. 176)

L. Maron

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Laryngopharyngeal Reflux Disease

Hoarseness, chronic throat clearing, excess throat mucus, difficulty swallowing, troublesome or annoying cough and breathing difficulties are symptoms that raise a high level of suspicion amongst ENT's that a patient may be suffering from extra-oesophageal reflux. This condition, also referred to as reflux laryngitis, laryngo-pharyngeal reflux (LPR), silent reflux or atypical GERD, is characterized by reflux of liquid or gaseous stomach contents into the laryngo-pharynx.

In contrast to typical gastro-oesophageal reflux disorder (GERD), patients with LPR do not commonly experience heartburn and/or regurgitation, so-called "Silent Reflux" and most patients have no oesophageal erosions seen at the time of endoscopy thus giving rise to the entity of Non Erosive Reflux Disease (NERD). This is not a milder form of GERD - as quality of life impairment is the same and the symptoms are often even more difficult to manage with conventional acid suppression therapy.

This presentation aims to look at some of the latest trends regarding this sometimes very challenging condition, including the more recent advances in diagnostic testing and the clinical management of reflux laryngitis.

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# Professional Voice Users Are Frequently Affected by Extraesophageal Reflux

(no. 177)

K. Zeleník, H. Kopřivová, P. Komínek

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Laryngopharyngeal Reflux Disease

## Objectives

Extraesophageal reflux (EER) is considered to be one of the most common disorders affecting professional voice users. The aim of this study was to determine the proportions of professional voice users in the group of patients with diagnosed EER and in the group without EER based on pH-monitoring study.

## Material and methods

The study was approved by the Ethics Committee of the University Hospital Ostrava. Patients with symptoms attributed to EER (hoarseness, throat cleaning, coughing and globus pharyngeus) lasting at least three months and/or symptoms of reflux laryngitis were included in this prospective study. Reflux finding score was assessed by rigid videolaryngoscopy. Afterwards, ambulatory 24-hour dual probe pH-monitoring was performed. Digitrapper pH400 device (Alpine Biomed, Denmark, 2007) with double probes with a fixed distance of 15 cm was used. The proximal sensor was placed immediately above the upper esophageal sphincter using flexible laryngoscopic guidance (Smit technique). Recorded data was analyzed using GastroTrack™ software (Alpine Biomed, Denmark, 2007). Upper probe events with pH < 4.0 were only accepted as EER events when Postma's criteria were fulfilled. Reflux area index (RAI) higher than 6.3 was considered to be the threshold for EER.

## Results

A total of 90 patients were recruited for the study between January 2009 and June 2010, nine of them were excluded from the statistical analysis (5 did not tolerate catheter and 4 did not come to the last visit). A total of 81 patients, 31 men and 50 women completed the study. Pathological EER (RAI higher than 6.3) was detected in 21 (24.9%) patients coming to the ENT clinic with symptoms and/or signs of EER. The other 38.3% of patients had sporadic episodes of EER, but these were not severe enough to meet criteria for pathological EER. In 35.8% of patients pH-monitoring demonstrated no one EER episode.

There were 21 (25.93%) professional voice users identified in the study group according to the criteria given by Union of the European Phoniaticians. The percentage of professional voice users was higher in the group with diagnosed EER (47.6%) than in the group without EER (18.3%), the difference was statistically significant ( $p = 0.008$ ).

## Conclusions

Pathological EER was demonstrated using pH-monitoring study in a quarter of patients coming to the ENT clinic with clinical symptoms and/or signs of EER. Almost half of the patients diagnosed with substantial EER are professional voice users. According to the results of our study, EER seems to play significant role in the voice problems of professional voice users. Results described in this paper were obtained with the financial support of Grant IGA MZ CR NR13500-4/2012 provided by the Ministry of Health of the Czech Republic.

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# Pepsin and Bile Acids in Saliva in Patients with Laryngopharyngeal Reflux

(no. 178)

M. Sereg Bahar, A. Jerin, I. Hočvar-Boltežar

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

## Background

Laryngopharyngeal reflux (LPR) can cause serious damage of laryngeal mucosa and voice problems. Biliary reflux in the contents of LPR is a particular problem. The patients with biliary LPR do not respond to the usual treatment with proton pump inhibitors.

The aim of the study was to find out if pepsin and bile acids are present in the saliva of the patients with LPR as diagnostic markers of LPR and particularly biliary LPR.

## Methods

Twenty-eight patients with LPR proved with 24-hour pH monitoring and high-resolution manometry and 48 healthy controls without symptoms of LPR were included. The level of total pepsin, active pepsin, bile acids and the pH of the saliva were determined in all participants and compared between the groups. Reflux symptom index (RSI), reflux finding score (RFS), voice handicap index (VHI) and voice analysis of vowel samples (Multi-Dimensional Voice Program, Kay Pentax, USA) were also performed and compared. Smoking and alcohol consumption were observed in both groups.

## Results

The groups differed significantly in RSI ( $p=0.00$ ), RFS ( $p=0.00$ ), VHI ( $p=0.00$ ), jitter ( $p=0.02$ ) and shimmer ( $p=0.00$ ). There was no significant difference in the level of active pepsin between the groups. The levels of bile acids ( $p=0.005$ ), total pepsin in saliva ( $p=0.023$ ) and the pH of the saliva ( $p=0.034$ ) were significantly different between the groups. The levels of total pepsin and bile acids were about three times higher in the patients with LPR (mean 29.8  $\mu\text{g/L}$  and 2.1  $\mu\text{g/L}$ , respectively) than in the healthy controls (mean 9.3  $\mu\text{g/L}$  and 0.75  $\mu\text{g/L}$ , respectively). Smoking and alcohol drinking habits were similar in both groups.

## Conclusions

The preliminary results show that the levels of total pepsin and bile acids in saliva are significantly higher in patients with LPR than in the controls, thus representing an important diagnostic marker for LPR and particularly the biliary LPR. In order to improve the patient's voice, the real causative agents for voice problems must be identified and properly treated.

**Keywords:** laryngopharyngeal reflux, gastric acid, pepsin, bile acids, 24-24-hour pH monitoring and high-resolution manometry.

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## Office-based Esophagology (no. 179)

D. Seth

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Voice disorders are often complex and are aggravated from disorders of the upper airway including esophageal dysfunction. Esophageal reflux, esophageal spasm, cricopharyngeal dysfunction and other disorders are common contributors to voice production despite a somewhat indirect relationship to the larynx itself. Clinical case presentations and an evidence-based approach will be used to display some examples of this common relationship as well as rational approaches for evaluation and management. Patience and diligence are required to uncover sometimes subtle findings that can greatly impact the long-term outcome for upper airway health and optimal voicing. Office-based approaches such as transnasal esophagoscopy (TNE), high resolution pharyngoesophageal manometry (HRPEM), functional endoscopic evaluation of swallowing (FEES) will be highlighted as useful evolving office-based tools.

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# Sleep and Voice Abnormalities in a Non-Professional Voice Cohort with Systematic Review (no. 180)

B.T. Woodson

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

## Introduction

Sleep deprivation is speculated to affect voice quality and phonation with sleep disorders also associated with laryngeal sensory neuropathies. To assess this the association of sleep disorders and voice pathology was assessed in a systematic review of sleep disorders voice and phonation. Furthermore, perception of voice abnormalities was evaluated in a sleep clinic cohort.

## Methods

Cross sectional data from a sleep clinic cohort of 94 adult patients assessed self reported measures of hoarseness, insomnia, obstructive sleep apnea risk, polysomnographic metrics, sleep related quality of life, reflux symptom index (RSI), nasal obstruction (NOSE), and measures of anxiety and depression. A systematic review of articles using Medline was performed of sleep, sleep apnea, snoring, voice and phonation was performed.

## Results

Univariate associations of hoarseness were associated with insomnia, functional quality of sleep, extra-esophageal reflux, anxiety/depression, and nasal obstruction symptoms ( $p < 0.01$ ). Hoarseness was not associated with sleep apnea risk. In a multivariate model, hoarseness and RSI but not subjective sleep complaints remained significant. In the literature review, over 220 articles were reviewed, the majority addressed associations with sleep apnea surgery. Limited data supported a potential association sleep disorders and of voice dysfunction independently. Virtually, no data exists on sleep and voice recovery and dysfunction. Voice abnormalities (laryngeal sensory dysfunction) are associated with development of sleep apnea.

## Conclusions

This study supports that sleep and voice disorders such as insomnia interact. The clinical interaction of sleep and voice remains largely uninvestigated. It is uncertain whether laryngeal sensory abnormalities associated with sleep apnea are manifested in voice and phonatory abnormalities which could act as markers of disease.

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# Voice Range Profile Measurements in Vocally Trained and Untrained Singers

(no. 181)

B. Schneider-Stickler, F. Feichter, D. Gattinger, A. Birgitta, W. Bigenzahn

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Analysis of Voice and Speech

## Background

The voice range profile measurement (VRP) is an important tool to assess vocal capacity and voice constitution. Although the effect of vocal training on voice is well known, its impact on VRP parameters is hardly considered in the literature. Further, little is known about the gender-specific effect of voice training on female and male singers. The aim of the study was to investigate differences in the VRP parameters of vocally trained and untrained males and females in order to contribute to normative data for VRP interpretation.

## Subjects and methods

Speaking and singing VRP measurements of 120 vocally healthy adults were performed using the software lingWAVES (Fa Wevosys); 60 of those subjects were vocally trained (30 female and 30 male) and 60 vocally untrained (30 female and 30 male). Voice range, sound pressure level (SPL) of soft and loud singing voices, as well as SPL and fundamental frequency (F0) of soft speaking and shouting have been analyzed.

## Results

Trained voices had not only a larger singing voice range but also larger dynamic ranges in singing and speaking. It is of interest to note that both vocally trained and untrained male subjects showed a larger frequency range between F0 of soft speaking and F0 of shouting in comparison to female subjects.

## Conclusions

In this study for the first time normative data measured with the software program lingWAVES have been presented. Our results confirm the positive effect of voice training on vocal capacity and vocal constitution. Additionally, differences in vocal performance between women and men have been identified which might be explained by anatomical differences and need to be further investigated.

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# Dosimetric Results and NIHL Prevention Rules in Choir Singers and Orchestra's Musicians: Gordio's Knot? (no. 182)

O. Calcinoni

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Occupational Voice

NIHL prevention rules in Europe apply to Music and Entertainment Sector since 2008. So sound levels above 80dBA "should" be considered as harmful for hearing.

Besides, this OSHA limit should "protect" from voice effort and vocal abuse aptitude -in spoken voice-

The Author presents data from repeated dosimetries in choir singers during performances and rehearsals and match them with audiometric results in singers and in orchestra musicians. These data are discussed, in respect of those noise regulations, about feasibility of NIHL prevention devices in classical music sector.

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# Task-Specific Singing Dystonia: Vocal Instability that Technique Can't Fix

(no. 183)

L. Halstead, H. Shaw-Bonilha, D. McBroom

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Task specific dystonia, a well recognized entity that can plague instrumentalists, particularly pianist and violinists, can also occur in singers. As the name implies, only precise tasks are affected, leaving the remainder of the performance unaltered. That this phenomenon can also occur in the singing voice is virtually overlooked and the “blame” for the instability of the singing voice is placed squarely on the singer’s technical ability. The result is that singers will toil for years on their technique while making no improvement in their vocal problem.

Singer’s dystonia, or focal laryngeal dystonia, is a rare variation of spasmodic dysphonia which presents only during specific tasks in the singing voice. Singer’s dystonia is believed to be underdiagnosed since it is commonly attributed to singing technique problems such as register transition or wobble within the singer’s vibrato. Singer’s dystonia differs from technique related issues in that it is task and/or pitch-specific, reproducible and occurs independently from the above mentioned technical issues; this will be demonstrated.

## Objectives

The objectives of this case series are to compare and contrast profiles of four patients with singer’s dystonia to increase our knowledge of the diagnosis of this disorder, of possible medical therapies, and of vocal strategies singers may use to continue singing.

## Methods

The methods used in the evaluation of the four cases included: a detailed case history, results of singing evaluations from individual voice teachers, ENT evaluation with endoscopy, voice spectrograms and laryngeal electromyography. Samples of the singer’s voices will be played to reinforce these findings.

## Results

Results demonstrate the similarities and unique differences of individuals with singer’s dystonia. Information regarding current case status, response to treatment and singing status is detailed. Results vary from nearly complete relief of symptoms with Botox injections and continuation of an active semi-professional performance career, to minor relief of symptoms and discontinuation of singing. In two singers, the dystonia later manifests in their speaking voices.

## Conclusions

Three conclusions from this case series are: 1) singers dystonia exists as a separate entity from wobble or technique issues due to register transition, 2) singer’s dystonia may be indicative of a larger neurological disorder, and 3) correctly diagnosing singers dystonia allows singers to acknowledge that their voice problems are not due to errors in technique and gives them an opportunity to modify their singing repertoire to continue singing.

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# What Can We Learn from Voice Therapy of the Speaking Voice for Singer's Voice? (no. 184)

K. Neumann, H.A. Euler, V. Osma-Ruiz, N. Sáenz-Lechón, J.M. Gutiérrez-Arriola, R. Fraile

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Voice Therapy

## Objective

Voice therapies of muscle tension dysphonia in Germany need to be increased in effectiveness by applying intensive, manualized procedures and standardized assessment protocols. The same holds true for therapies of disturbed singer's voices. According to a Cochrane review on the effectiveness of therapies of functional dysphonia neither direct nor indirect voice therapies alone but combinations of both elements are effective (Ruotsalainen et al., 2007).

## Method

A voice therapy concept has been developed in a Spanish-German research project which includes the following elements: a 10-day intensive training, performed in small groups, which aims predominantly on an improvement of resonance and 'placement', and a computer-feedback-based home training. Twenty patients with dysphonia of different etiology underwent the therapy, 10 of them using the computer feedback, 10 who did not.

## Results

There were (1) highly significant pre-post-treatment improvements with large effect sizes in nearly all perceptive parameters (GRBAS scale) and tendentious improvements in the (2) self-perceptual (Voice Handicap Index), and (3) some acoustic parameters. A comparison of case (home training using computer feedback) and control group (without computer feedback) showed an additional increase of effectiveness by the newly developed software.

## Conclusion

It can be assumed that a therapy of disturbed singer's voices may function similarly. Elements which train singer's placement, resonance, breath support, and register techniques should be constituents of this therapy. We propose an adapted concept of the described voice therapy which has been proven to be evidence-based for dysphonia of the disturbed singer's voice.

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\*Project "Software tools for real-time feedback in voice therapy", funding by the German Academic Exchange Service (DAAD, grant number 50750387) and by the Spanish Ministry of Science and Technology (grant number: AIB-2010DE-00304)

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# Telemedicine and its Potential Applications to Voice *(no. 185)*

*J.S. Rubin*

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

Telemedicine has become pervasive in aspects of the medical profession. Its cost-benefit analysis is still unclear. This talk reviews aspects of telemedicine in particular as to their potential impact upon ENT, Phoniatics and Voice.

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# Voice Production at Very High Soprano Fundamental Frequencies (no. 186)

M. Echternach, M. Döllinger, J. Sundberg, L. Traser, B. Richter

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Measurement

## Introduction

Human voice production at very high fundamental frequencies is not yet understood in detail. It was hypothesized that these frequencies are produced by turbulences, vocal tract/vocal fold interactions or vocal fold oscillations without closure. Hitherto it has been impossible to visually analyze the vocal mechanism due to technical limitations.

## Material and Methods

A single soprano subject was asked to sing a scale from C6 (1047Hz) to G6 (1568Hz). For analysis of vocal fold behavior we applied latest high-speed technology which captures 20000 frames per second using transnasal endoscopy. Furthermore, also dynamic MRI with 24 frames per second was used in the same subject for analysis of the associated vocal tract configurations.

## Results

Up to 1568Hz human vocal folds do exhibit vocal fold oscillations with complete closure. A register shift between D6 and E6 was mainly associated with narrowing of the pharyngeal walls. Conclusion: Our results suggest that human voice production at very high F0s is not caused by turbulence, but rather by airflow modulation from vocal fold oscillations.

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# Research and Modern Voice Pedagogy: The Use of Spectrography and Principles of Acoustic Registration in Voice Instruction (no. 187)

K. Bozeman

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy
- Invited Workshop

## Spectrography

Of all the ways we analyze and graph sound, the spectrographic image (especially when coordinated with pressure waveform display) is the most approachable and useful for students. With minimal initial explanation, students can both see and hear important characteristics of their singing in the playback, leading to productive commentary or discussion. Very practical matters of vocal line are readily apparent: clean onset of pitch, immediacy of complete timbre, continuousness and consistency of vibrancy, dynamic shaping, duration of any interruption of the tonal flow, and consistency of resonance balance. This workshop will include some demonstration of the uses and limitations of spectrography in the voice studio.

## Acoustic Registration

First formant tracking (of H1 and of H2) has been shown to be pedagogically relevant (Sundberg, 1977; Miller, 2008). Avoiding formant tracking has also proven to be significant: if vocal tract length and shape are kept stable across changes of fundamental frequency, source harmonics inevitably pass through vocal tract formants, causing audible timbral effects. Whenever a harmonic rises through the first formant, there is some degree of timbral "closure." Whenever a harmonic drops below F1, there is some degree of timbral "opening." The passing of H2 through F1 has been identified as the primary acoustic event of the male passaggio (Bozeman, 2007; Miller, 2008). Other formant/harmonic intersections have pedagogic relevance as well, especially for male range. Since these events are predictable by vowel and fundamental frequency for each vocal Fach, they can be used both to assess and to train the stability of vocal tract length, a characteristic desirable in Western classical singing. This workshop will explore the effects and implications of various formant harmonic relationships across range, with special attention to those that surround the male passaggio.

At the end of the workshop, attendees will be familiar with:

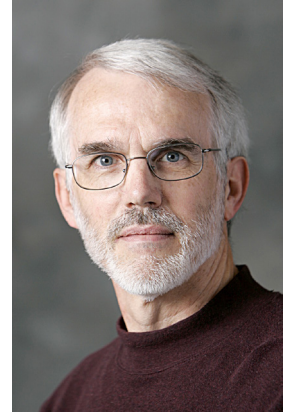
1. The most reliable and efficient uses of real-time spectrography in voice instruction
2. The first formant-harmonic interactions that occur in all singers
3. The pedagogic implications of open and close vowels, open and close timbre, and "yell" and "whoop" formant tunings
4. The pedagogic implications of F1/H3 and F1/H2 crossings, and F1/H1 formant tuning
5. All first formant-harmonic interactions that surround the male passaggio

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# Voice in Relation to Coping and Personality in the Framework of Voice

## Ergonomics (no. 188)

F. de Jong, D. Deuster

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Clinical Issues
- Invited Workshop

A voice problem is a dynamic process of causal and maintaining factors. Voice performance requires an effort not only physically but also in the psychosocial field, especially in professional voice users. Internal factors such as general condition, psychological factors and personality traits may influence the ability of the voice to withstand the demands of the profession. Persons with a combination of high negative affectivity and high social inhibition (type-D personality) have shown to have the tendency to underestimate their voice problem and to seek less care. Persons with a relative high voice handicap have shown to use more passive and less active general coping strategies. Furthermore, a dysfunctional way in shaping interpersonal relationships (e.g. in intrapsychic conflicts of autonomy, self-worth, or autarchy) can cause and maintain voice disorders.

Persistent voice problems are shown to be associated with externalizing and unawareness of the problem. Besides internal factors, external circumstances are involved, such as planning of the vocal demands, vocal load, acoustics, and psychological pressure. An adequate balance of internal and external factors is necessary for optimal vocal performance. All above mentioned factors are interconnected and have a mutual influence. The relation with man and his environment is the object of ergonomics. i.c. voice ergonomics. In the light of the above mentioned statements it is opportune to assess the biopsychosocial profile of the person with a voice problem. In this perspective, voice health care workers have to ask themselves with what person he has to do, how is the person's approach towards life and career? What are the person's ambitions? With what problem is the person faced with? On nonverbal and interpersonal level: what emotions are elicited by the patient? It is important to find out the timing: why occurs the voice problem now, at this very moment and why have the complaints specifically developed? There must be clarity of the context in which the complaints have developed in terms of exposure to stressors and what the consequences in a broad perspective are. The final question is: why does recovery not occur, what are the maintaining factors, does a morbid gain exist? Assessment and treatment of the factors that maintain the voice problem and the way in which the person copes with his problem may turn out to be of crucial importance in solving the voice problem. A broad approach has to be adopted in order to solve a persisting voice problem, especially if previous treatment has failed and the person finds himself in a deadlocked situation, likely sliding down into a chronic disease. In this workshop a holistic approach of voice problems is discussed and practical clues are supplied.

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# A Multidisciplinary Clinical Based Approach to Vocal Cord Dysfunction (VCD) (no. 189)

P. Ericson, J. Løvbakk, J. Devold

- **Form:** Workshop
- **Category:** Voice Therapy
- **Topic:** Vocal Cord Dysfunction

Team of voice disorders at the Department of Speech and Language Disorders in Norway, offers treatment to approximately 300 clients with different voice disorders each year. An increasing number of clients at our center is related to vocal cord dysfunction, VCD (paradoxical vocal fold movement, PVFM). VCD is a disorder where the vocal cords start to close when inhaling, instead of opening. This condition leads to difficulties in breathing with symptoms like feeling of being choked, stridor, wheezing, coughing and pain in the chest.

The last five years we have treated about 90 persons with this diagnosis, referred to us by ENT-specialists. Most of our clients are young people, mostly girls, 14-18 years of age. Usually they are active in sports and some of them compete at a high level. Their main symptoms are breathing difficulties during training and competition. Another group with VCD symptoms is those who do not do sports. Their symptoms appear more occasionally, such as before going to sleep, before exams at schools and other situations regarded as stressful. In both groups we see that VCD symptoms can lead to different degrees of anxiety.

Due to our clinical work, this is a complex group who need a holistic, multidisciplinary approach. These clients are often conscientious with high ambitions and increased vulnerability of failing. They often have high muscle tension and restricted breathing patterns.

This presentation is based on our experience and will focus on a multidisciplinary and holistic approach by some speech therapists and a specialist in psychomotor physiotherapy. After a thorough interview and two different questionnaires our approach is based on information/instruction, basic body awareness training, respiratory training techniques and counseling. This presentation will also be exemplified by some case-studies. Still we experience that this disorder may have multiple causes, biological as well as psychological, but could we find a common denominator that characterize this group? We welcome you to share our experiences and ideas.

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# High Speed Studio a Low Budget High Speed Recording System (no. 190)

H. Larsson, S. Hertegård

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Imaging

High speed camera are still not so common in clinical practice, depending on many factors like time consuming, complicated software, low camera sensitivity, high cost and specially that normal stroboscopic examination in many cases give very good examination. We have developed a software for a low budget high speed camera called High-Speed Studio. With this setup it takes only a few minutes to make a high speed recording. During 2 years for about 1000 patients we have done a normal videostroboscopic recording and then a high speed recording on all patients. Depending on relative low light sensitivity of the camera the high speed recordings are only done in black and white. All recording are done with a rigid endoscope but with a 300W xenon light source it was also possible to use flexible endoscope. The camera is a "Hispec 1" from "Fastec Imaging". It is relatively small and light (280 g) we use a monochrome model with a resolution of about 500x250 and 4000 images/sec. The camera is relative cheap and are connected direct to a laptop and the only extra equipment is a light source, there is also possible to make synchronous voice recordings..

The software has a database for patient data and recordings and diagnose. A prior recording can by played just by mark patient and date. There are search options for patient, age, gender, diagnoses for different type of studies. High speed studio gives many possibilities to analyse high speed recordings. There are tools for kymmography, area detection, open/close coefficient. It is possible to show a graph over vocal folds movement, sound etc. Data from recording of different type of diagnose and analyses will be presented.

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# High-speed Laryngoscopic Analysis of Vocal Fold Vibration in Fatigued Voices (no. 191)

E. Yiu, G. Wang, K. Chan, E.P.-M. Ma, J. Kong

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Imaging

## Objectives

To determine the physiological patterns in the vocal fold vibration between non-fatigued and fatigued voices using high-speed laryngoscopic imaging and quantitative analysis.

## Methods

Twenty amateur singers aged from 18 to 23 years (mean = 21.2 years, s.d. = 1.3 years) with normal voice participated in an extended singing task which induced vocal fatigue. Laryngoscopic images of /i/ phonations using high-speed imaging system were recorded before and after the singing task. The quantitative High-Speed Video Processing (HSVP) program was used to extract indices related to the antero-posterior dimension (length), transverse dimension (width), and the speed of opening and closing.

## Results

A significant change (reduction) in the glottal length to width ratio index was found after the singing task, presumably due to vocal fatigue. This indicated either a significantly shorter (antero-posteriorly) or wider (transversely) glottis following vocal fatigue physiologically.

## Conclusion

High-speed imaging technique can be used to identify vocal fatigue by examining the configuration of the glottis using quantitative analysis.

This study was supported by a grant from the Hong Kong Research Grant Council General Research Fund (#HKU757811).

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# Characterizing Vocal Fold Dynamics Using a Wavelet-Based Analysis of Phonovibrograms (no. 192)

J. Unger, M. Schuster, D.J. Hecker, B. Schick, J. Lohscheller

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Imaging

Laryngeal high-speed videoendoscopy (HSV) is presently the only technique that captures the intra-cycle vibratory behavior through full images of the vocal folds (VF) [1]. A subjective assessment of HSV playback, however, is laborious and furthermore might be restricted by insufficient reproducibility. In order to facilitate a comprehensive documentation of laryngeal dynamics, phonovibrograms (PVG) were introduced that allow -besides visualizing even long HSV videos in compact graphs- also a computerized and hence, objective analysis of VF vibration.

From the PVG a limited number of clinical relevant parameters can be derived by employing a wavelet-based analysis [2]. These features were found to be closely related to the current European Laryngological Society guideline [3] for the assessment of pathologic voices. But rather than describing vibration patterns in a subjective and categorical way, the wavelet parameters provide furthermore an objective normative map of healthy VF vibration and allow examining different groups or systematic changes of vibratory patterns.

A complete and precise description of VF vibration patterns is obtained by glottal closure, symmetry, regularity and synchronicity measures. On the basis of these parameters an automated diagnostic system is proposed to evaluate the predictive power of these measures. In this context, healthy and pathologic subjects were considered for an automated classification: paresis, muscle tension dysphonia and polyps (40 subjects each group). The system achieved an accuracy of  $79.5 \pm 3.3\%$  for differentiating between healthy vibratory patterns and functional voice disorders.  $92.4 \pm 1.8\%$  and  $89.5 \pm 2.1\%$  were obtained for identifying paresis and polyps. The results clearly show the great potential of the proposed wavelet analysis for voice research and diagnostic issues.

## Acknowledgement

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# VKFD: Computerized Analysis of Videokymographic Data (no. 193)

A. Novozámský, J. Sedlář, A. Zita, C. Herbst, J.G. Švec, B. Zitova, J. Flusser

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Imaging

Videokymography (VKG) is a recently developed imaging method, which is used in laryngology and phoniatics for observation and diagnosis of vocal fold vibrations. The method was designed in 1994 as a low-cost, clinic-friendly alternative to the classic digital high-speed imaging systems. It is based on a specially adapted video camera that captures images only from a single selected line of the vocal folds at a high-speed rate (7200 lines/s). The new generation of VKG cameras can simultaneously deliver both the classic laryngeal images and the spatiotemporal videokymographic images. Even though the amount of the captured VKG data is not as excessive as in the case of high-speed imaging techniques, their visual evaluation can be tedious and time consuming. Hence, the development of computer-assisted diagnostics is of great interest.

Our paper proposes a software solution for the enhancement of videokymographic data and the extraction of typical characteristics of vocal folds vibrations, such as, e.g., the time-varying extent of rima glottidis and the progression of mucosal waves, and corresponding vibration parameters (e.g. frequency, symmetries, amplitude). The proposed methodology is based on well-established digital image processing methods; namely image denoising, edge detection, image segmentation, and object identification. The set of evaluated features was designed by experts, drawing on their longtime expertise with videokymography. These features are mostly based on the estimated shape of the glottal contour, i.e. the boundary between the vocal folds and the rima glottidis, but also on mucosal waves. We trace a set of base features - opening and closing points and ventral and medial peaks. They determine the duration of the vibration cycle and the symmetries. They are used for deriving the shape, the amplitudes, and the extent of mucosal waves, too. Accurate detection and measurement of these base features is critical for proper computation of further vocal fold vibration parameters. In addition to the automated detection of analysis parameters, the proposed software offers clinicians an option to manually intervene in any algorithm step.

A representative set of videokymographic data with a wide range of vibration patterns was used for testing the developed system (50 videokymograms evaluated by 18 expert and non-expert raters). The performance of the new software was assessed by comparing the outcome of the automated parameter detection to the manual/visual ratings.

The proposed software tool, VKFD – the Videokymography Feature Detection Software, was developed for computerized analysis of videokymographic data, but also enabling direct inputs from clinicians. Such computer-assisted feature extraction and parameter estimation will facilitate the diagnostic process. Moreover, it will produce parameter sets, which can be numerically compared to previous analyses.

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# Spatiotemporal Vocal Fold Vibrations: Children Versus Adults (no. 194)

D. Dubrovskiy, R. Patel, M. Döllinger

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

## Introduction

Aim of the study was to identify the type and nature of differences in vocal fold vibratory motion in typically developing pre-pubertal children and adults, through spatiotemporal features derived from high speed digital imaging.

## Methods

In this prospective study vocal fold oscillations were analyzed from 66 participants (31 children, 35 adults). Spatiotemporal features were computed from Phonovibrograms, which were created from high-speed endoscopic (70° endoscope, 4000 fps) recordings of vocal fold vibrations during sustained phonation on the vowel /i/. An in house developed software called "Glottis Analysis Tools" was used to derive the spatiotemporal features. From each high-speed recording, a sequence of steady state phonation of 50 oscillation cycles was selected for analysis. A total of 12 spatial features describing the opening and closing patterns of the vocal folds along the anterior and posterior regions of the vocal folds were investigated along with the left-right symmetry indices. Additionally a total of 12 temporal features representing the variability of the spatial features between the oscillation cycles were investigated. Differences between the three groups (adult males, adult females, and children) were statistically investigated.

## Results

Statistical significant differences between the 3 groups were observed in 10 of the 24 features. These differences were clearly pronounced within the temporal features compared to the spatial features. Children showed greater aperiodicity compared to adults. Statistical differences between children and adults were noted for temporal features for the anterior part of the glottis during the closing phase of the glottal cycle. All groups showed similar left-right symmetry index. The spatiotemporal features differed more between children and males than between children and females: 10 features were statistically different between children and males; 6 between children and females.

## Conclusion

Typically developing children exhibit greater instability (aperiodicity) during typical phonation compared to adults. This study provides preliminary evidence that, in children, the glottis opens in a zipper-like pattern similar to that of adults. However children demonstrated longer phase delay in the anterior/posterior and medio-lateral parts during the opening phase compared to adults. The closing phase in children is more shutter-like unlike the zipper-like closing phase typical of vocal fold motion in adults. The preliminary data provided by this study suggests that children are functionally different compared to adults rather than scaled down version of adults, in terms of their vibratory motion. The data may build the basis for differentiation between regular and pathological characteristics of vocal folds oscillations in children.

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# Analysis of the Mechanism of Effects such as Distortion, Growl, Grunt and Rattle Used in a Healthy Way by 18 Professional Singers (no. 195)

C. Sadolin, J. McGlashan, H. Kjelin

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Analysis of Voice and Speech

Intentional effects such as Distortion, Growl, Grunt and Rattle are sounds commonly used in Rock, Folk, Pop, Jazz and other music genres for effect adding a grating noise to the quality of the singing voice. There is debate as to whether these voice qualities are damaging to the voice and vocal folds.

## Objective

To understand the mechanism of production of Intentional effects of Distortion, Growl, Grunt and Rattle during singing.

## Methods

Eighteen trained singing teachers in the Complete Vocal Technique pedagogic method of singing were examined using digital videolaryngostroboscopy while producing Intentional effects during singing. The video images and synchronized electrolaryngograph (ELG) waveforms were assessed by two raters. The laryngeal structures involved in the sound production and the regularity of the ELG waveforms were documented.

## Results

The number of subjects able to produce analysable results are indicated in parenthesis. During Intentional Distortion the main contributing factor to the sound quality was the false folds (n=15). During Intentional Growl the main contributing factor to the sound quality was the arytenoids vibrating against the epiglottis (n=15). During Intentional Grunt the main contributing factors to the sound quality were the whole of the supraglottic structures associated with large amplitude vibration of the vocal folds (n=10). During Intentional Rattle the main contributing factor to the sound quality was vibrations at the arytenoid cartilages (n=5).

The ELG waveform analysis confirmed that the fundamental frequency of vibration of the vocal folds was maintained during the various effects but the shape and complexity of the waveform changed during the periods of Intentional effect.

## Conclusion

Intentional effects such as Distortion, Growl, Grunt and Rattle should be considered as an additional sound quality to that from vocal fold vibration. They can be added to a sung tone at will in appropriately trained singers in a healthy manner for vocal effect.

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# An Attempt to Reconstruct the Forgotten Voice Quality of the “Voce Faringea” (Modified Falsetto) – an Artistic Research Project *(no. 196)*

A. Mayr

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Music education, and vocal training in particular, has experienced major changes over the last three centuries, as have the aesthetic ideals of vocal production and the approaches to the vocal instrument.

Is it not reasonable to assume that modern vocal methods often neglect important aspects of vocal practices of past eras, and that many characteristics of historical sound ideals remain undiscovered? Can we expect that a tenor in Donizetti's lifetime would have sung Nemorino's “Una furtiva lagrima” in the same way as we hear it in today's opera house? If we intend to properly interpret the vocal music of earlier eras from the perspective of historical performance practice, or to rediscover distinctive historical sound qualities, should we not then question the conventions of current singing practice?

In classical singing today the use of the falsetto is something of a taboo for tenors. This technique, which is the basis of the countertenor's art, is nowadays used by singers of other voice ranges almost exclusively for buffo purposes or in contemporary music. For this reason training the falsetto register is barely relevant to modern vocal education. However, it is clear from various passages in singing method books from the 18th and 19th centuries and colorful descriptions in historical sources, such as reviews and articles in music magazines, that the artistic use of the falsetto was part of the singer's technical repertoire, especially for the great tenori di grazia of the Rossini-Bellini-Donizetti period. They were trained to use a modified form of the falsetto known as the voce faringea.

The purpose of my artistic-scientific research project is to discover new opportunities of vocal expression for the interpretation of voice literature of the 18th and 19th centuries by reconstructing the forgotten voice quality of the voce faringea. As a professional tenor and countertenor I have the necessary technical tools and artistic experience with both the modal and the falsetto voice to allow me to experiment with different voice registers.

With the focus on artistic expertise and the development of methods that stimulate artistic practice a permanent interaction between artistic activities and traditional research methods forms the basis of my art-based research project.

In experimenting with the voice I have developed a technique to modify the sound of my falsetto so that it approaches a modal quality that corresponds to historic descriptions of the voce faringea. In cooperation with Johan Sundberg I have recorded and studied in research laboratories at the KTH in Stockholm samples of various registers in my voice - modal, falsetto and voce faringea - and have measured, compared and documented various physical parameters of the glottal functions, which provide clear information about specific sound characteristics of the different registers.

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# Evaluating 'Comfort' and Singer Task in Different Musical Genres: An acoustic and Perceptual Study of Female Singers of Western Lyric, Musical Theatre Contemporary Commercial Music (no. 197)

G. Kayes, G.F. Welch

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Female singers working in different musical genres make different sounds in different pitch ranges and perform in different acoustic environments. Vocal pedagogues and voice clinicians agree that in order for a professional career to be sustainable, singers need to be physiologically comfortable while performing. In Western Lyric singing this issue has traditionally been addressed using the fach system of voice categorisation, which enables singers and teachers to assess roles and tessiturae suitable for the singer's voice. However, these fach categories have limited relevance in Musical Theatre and Contemporary Commercial Music singing, where the musical writing and, in particular, the pitch range for female singers, is very different. Additionally, for genre authenticity in performance, it may not be suitable for some singers to sound vocally comfortable presenting a further challenge to pedagogical and clinical understanding of what is vocally safe and sustainable. To date, scientific study of singing voice has offered much information about Western Lyric singing, especially in male voice. More information is needed about the parameters of female voice use in Contemporary Commercial and Musical Theatre singing in order to assess what might be best practice within these genres. In this research, a novel methodology of 'Comfort Zone pitch histogram' was used provide a baseline measurement of singers' genre tasks. Such a measurement allows for a rounded approach to comparing singer capabilities between different musical genres and may contribute to both clinical and pedagogical understanding of different sung genres.

## Method

13 female singers aged between 20 and 44 years were recorded performing their full sung pitch range, a reading test, and song genre tasks. Each singer also reported a comfortable pitch-range within her full sung pitch range [Comfort Zone]. The song products were analysed using a 'Comfort Zone histogram', which calculates the relationship between singer mid-Comfort Zone and song Median F0, together with song F0 range and duration. Singers' song tasks were rated by 17 expert listeners according to 'perceived comfortable performance' [PCR%] using a Visual Analogue Scale; each singer similarly self-rated her song. Additionally judges and singers each provided a short commentary on what had informed their choice. All variables gathered from these data were further analysed in a series of statistical procedures to discover why some singers were rated as comfortable/uncomfortable, and to ascertain possible relationship between PCR%, singer Comfort Zone, song tessitura and singer genre. Results of the findings are presented together with Long Term Average Spectral analysis of sung vocal products that were found to be representative of their respective genre, and those that were at the extreme ends of the perceived 'comfortable performance' scale.

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# Influences on the Professional Aesthetic Judgement of Voice, Singing and Singers (no. 198)

A. Sol

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Aesthetic Criteriae

What is it that professional jury's (voice teachers, conductors, directors, accompanists, impresarios, other singers) judge when they hear a singer perform, audition or present him- or herself? Is it the voice, the personality, the technical skills? Is it the repertoire, reputation or experience? Or is it a combination of several such aspects? What part do feelings and personal taste play in the decision on which a singer is accepted or rejected at the labour market for singers or an educational institution? So many aspects from different scientific disciplines seem to come together in the consideration of the professional artistic/aesthetic valuation of singing. One of them being of course a healthy well attended voice. Yet it is obvious that this is not enough to make a career as a singer. Looks, type of voice, acting experience but also social and political connections, social and artistic personality and obedience and at the same time temperament will compensate each other in an unpredictable way.

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# Analysing Changing Vibrato Behaviour in Solo Voice Ensemble Singing

(no. 199)

H. Daffern, D. Howard

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Perceptually vibrato is known to be an important characteristic in choral singing, with conductors specifically directing singers in their use of vibrato when considering 'choral blend', tuning, expression and taste. Particularly in Renaissance and Baroque repertoire vibrato is conventionally used as an ornament, and current convention in vocal ensemble performance is to restrict the use of vibrato for musical affect at specific moments in the music, such as at the resolution of a suspension. Whilst vibrato in solo singing is well-researched, consideration of vibrato behaviour of individuals in an ensemble setting is still in its infancy. This is in part due to the difficulty of isolating the individual voices for analysis.

In order to construct a method for analysing vocal characteristics of individual singers within a group, a protocol was designed and pilot tested. Laryngograph and audio recordings were made of student vocal quartets from the University of York. The laryngograph data for each singer was analysed to extract fundamental frequency data. The fundamental frequency data was then used to analyse vibrato characteristics of the individual singers, considering in particular adapting vibrato for 'choral blend' and the use of vibrato as a musical ornament in suspensions. The perceptual relevance of the vibrato behaviour was assessed through a listening test. The results of vibrato characteristics of individual singers are considered alongside their perceptual relevance. The accuracy of the data is also considered alongside the implications of applying this protocol to analyse other vocal characteristics in choral singers.

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# Voice Quality and Vocal Track Activities' Evaluation in Various Styles of Singing (no. 200)

E. Sielska-Badurek, E. Osuch-Wójcikiewicz

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Nowadays there are many singing styles, including: classical singing, belting, pop, soul, gospel, jazz, rock, traditional singing, etc. Voice characteristics vary much between different styles of singing. Even less seasoned listener can distinguish rock from opera singing easily.

The aim of the study was to compare the activities of the vocal track and the resulting differences in the voice quality in a various vocal techniques.

In 2008-2012 we assessed comprehensively 72 singers. From this group we selected 7 vocalists who actively perform two or more styles of singing. In those singers we evaluated the voice quality. Using a flexible endoscope we performed pharynx and larynx activities' evaluation and we assessed in a palpation examination the abdominal, chest and neck's movements and tensions. The above evaluation we performed during different vocal techniques' singing by the each of our singers. Each of the vocalists used at least 2 singing techniques and each vocal technique was performed by at least 2 vocalists. Vocal techniques, which were involved in the investigation, there are: classical singing, belting, jazz and rock.

Assessing the voice quality we observed differences in: the colour of the sound, the degree of mixing registers, vibrato, the air added to the voice, intentional vocal breaks, nasality, etc. In the endoscopic examination there were assessed movements of the soft palate, pharyngeal walls, the base of the tongue, larynx, as well as the shape of the vestibule of the larynx (the movement of vestibular folds), the character of the glottis' closure and the piriform sinuses with simultaneous evaluation of voice quality. In addition, in the palpation examination, we distinguished differences in breathing patterns, larynx' position and vocal tract's movements and tensions.

The largest differences we observed between classical singing technique and growling.

Better understanding the voice track activities in different vocal techniques will help the whole vocal team.

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# Impact of Syllable Stress and Phonetic Context (no. 201)

J. Iwarsson, J. Fredsø

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

## Background

Intermittent aphonia is perceived as sudden interruptions of voicing in dysphonic voices. Unlike the perceptual constitution of total aphonia, these aphonic instances typically affect one syllable only and may reflect an increased stiffness of the vocal fold mucosa, requiring an increased phonatory subglottal pressure. Research in the perceptual and acoustical characteristics of intermittent aphonia is sparse. The aphonic instances have been described as unpredictable, but experiences from voice therapy indicate a close linkage to vocal and respiratory 'technique' as well as type of speech sound. A closer analysis of the phonetic distribution of the phenomenon in connected speech is lacking.

## Objectives

Based upon theoretical principles of vocal fold oscillation and phonetics, this study aims to investigate the hypothesis that occurrences of aphonic instances in dysphonic voices are not random, but related to syllable stress and phonetic context. The finding of a non-random appearance of aphonic instances would confirm clinical experience and increase our knowledge about underlying physiological mechanisms in intermittent aphonia. This will be relevant both to aetiology, diagnostic tools and treatment of this type of dysphonia.

## Methods

Recordings of 31 dysphonic subjects with intermittent aphonia reading a standard text were analysed. The standard text was phonetically transcribed and all vowels of the text were labeled and categorised with regard to syllable stress and character of the phoneme preceding the vowel. All aphonic vowels of the recordings were identified perceptually and the occurrence within each syllable category were analysed in percent. Four different hypotheses were formulated and analysed by the non-parametric Wilcoxon's signed-ranks test.

## Results

For three out of four hypotheses significant differences between the categories analysed were found. Thus aphonic vowels were shown to be significantly more common in unstressed syllables as opposed to stressed syllables, in vowels following an unvoiced phoneme as opposed to a voiced phoneme, and in vowels following two or more unvoiced phonemes as opposed to one unvoiced phoneme. No significant difference was found between vowels following aspirated stops /p,t,k/ as opposed to unaspirated stops /b,d,g/.

## Conclusion

The aphonic instances appearing in dysphonic voices with intermittent aphonia are not necessarily randomly distributed, but associated with certain factors of vocal fold production in connected speech. The fact that some syllables are more 'at risk' of being realised as aphonic is highly relevant to the choice and design of voice therapy. The language-specific limitations of the study are discussed as well as the practical generalization of the results to the clinical management of intermittent aphonia.

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# Acoustic Measures of Prosody in a Linguistic Context: Preliminary Reference Data Obtained Using Prosogram (no. 202)

W. Decoster, A. Holemans, Y. Jacobs, P. Mertens

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

Voice plays a central role in speech communication. First, vocal features provide information about the voice source and the resonance physiology. When problematic, therapy (voice therapy or medical treatment) can be established. But voice is also crucial in speech communication for the expression of emotions and linguistic content. This research focuses on the linguistic function of the voice (sometimes referred to as linguistic prosody).

Although perceptual evaluation is generally considered to be the gold standard for the assessment of speech communication in daily-life situations, an objective acoustic ground for this perceptual assessment would be highly desirable: acoustic measures may be used to document the treatment of prosody, they may facilitate the acquisition of foreign language, they help to differentiate between normality and pathology, etc.

The Prosogram software tool, developed by P. Mertens (Linguistics Department, KU Leuven), may be used to obtain acoustic measures of prosodic properties. It provides a semi-automatic transcription of prosody, based on a stylization of fundamental frequency simulating tonal perception of human listeners (Mertens 2004). Because the analysis performs a segmentation of the speech signal into syllabic nuclei, the obtained prosodic measures take into account the evolution of prosodic parameters over sequences of syllables. The tool is implemented in Praat (Boersma & Weenink 2009), a free open software package for acoustic analysis of speech. The methodology was presented at PEVOC8 in Dresden (2009).

This research project aims at defining reference values for prosodic properties calculated for speech samples. A speaking task was designed to elicit speech data while controlling as much as possible the prosody used by the speakers and minimizing free prosodic variation among the subjects. In this task, the subjects read aloud a narrative text composed of short sentences, each of which introduces a single new information element, while avoiding emotional prosody.

Subjects were young adults (male and female, age 17-27 years) living across two Flemish regions, that are interrelated with reference to regional variance in speech and prosody.

Results will be reported; methodology, limitations and strengths will be discussed.

Thanks to (1) prosodic measures taking into account pitch perception and (2) the (preliminary) reference values for prosodic properties, the research outcomes enable linguists, teachers, speech pathologists and other professionals in human oral communication to incorporate prosody in diagnosis, treatment and education in a more objective way. It also contributes to enhancing the efficiency and efficacy of interventions. We invite research centers represented at PEVOC10 to cooperate in future prosody research to increase the applicability of the results considering a variety of languages, pathologies, speech tasks etc.

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# Acoustic Method in the Assessment of Disordered Voices (no. 203)

S. Vaz Freitas, P. Melo Pestana, V. Almeida, F. Aníbal

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

## Introduction

The acoustic method benefits from the support of Engineering Signal Processing technologies, which provide functionality in terms of software and hardware that constitute the utilization standards of the equipment. Its use is more efficient, quick and non-invasive, facilitating the task of analysis and classification of voices (modified or not), during SLP treatment.

With this work, we aim to describe and analyze the consistency between assessments of a voice's database. The used software's were: one open source (PRAAT) and three commercialized (Multi Dimensional Voice Program - MDVP, Kay Elemetrics; VoiceStudio, Seegnal; Dr. Speech, Tiger Electronics).

## Materials and Methods

Ninety voices have been selected from a database. Of these, 20 were normal voices and 70 had some degree of disturbance. The 90 segmented voice samples were evaluated and classified according to the following acoustic parameters - MeanF0 (Hz), SD F0 (Hz), jitter (local) (%), Jitter (PPQ5) (%), Shimmer (local) (%), Shimmer (APQ5) (%), HNR - Harmonic-to-Noise Ratio (dB).

The analysis of acoustic measurements according to the software was made using the nonparametric Kruskal-Wallis test.

The results show that, for acoustic measurement "SDF0 (Hz)", it appears that: the software Voice Studio provides significantly superior values than the other, and Dr. Speech and Praat presented the lowest values. For "HNR (dB)", it was found that Dr. Speech attributes significantly superior measures than the other applications, and the software programs MDVP and Voice Studio had the lowest values. Regarding the "Jitter (local) %", Voice Studio presents significantly higher values, with Dr. Speech assessing the lowest ones. For "Jitter (PPQ5) %", Voice Studio presents measures significantly superior than the other, with the Praat obtaining the lowest. To "Shimmer (local) %", Voice Studio and MDVP had significantly superior measures, and Dr. Speech the lowest. Finally, for "shimmer (APQ5) %" Voice Studio and MDVP had values significantly bigger than Praat.

## Conclusion

We concluded that the software Voice Studio showed values significantly higher for all of the acoustic measures, except for HNR. This one was higher in Dr. Speech. Regarding MeanF0 (Hz) no significant differences were found according to the software programs ( $p > 0.05$ ). It should be noticed that measures depending of F0 extraction suffer interferences from the signal aperiodicity and must be carefully applied and interpreted, especially when studying disturbed voices, which are characterized by signal irregularities.

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# Acoustic Analysis Of Laughter In Children (no. 204)

L.S. Perepa

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Acoustics

## Introduction

Laughter is an audible expression or appearance of excitement, feeling of joy and happiness. Although, it is an integral and important part of human communication, yet a little is known about its acoustic features.

## Objectives

Knowledge in terms of acoustic features of child's laughter is limited, despite the fact that it is the most frequently occurring vocalization in social interaction and has positive effects. Hence the present study aims to focus on basic acoustic features of children's laughter.

## Methodology

30 boys and 30 girls in the age range of 3-5 years served as participants for the study. Their laughter was elicited by their mothers either tickling them or the child watching another child being tickled. The samples were recorded; analysed using PRAAT and the data obtained was subjected to statistical analysis using SPSS 17.0. Mean F0, max.F0, min F0, 5 formant frequencies and melodic contours were analysed.

## Results

No significant gender differences were found. The Formant frequencies coincided with vowel /a/ for both boys and girls (Savithri R. 2000). Melodic contours were mostly falling types, however other patterns were also observed.

## Conclusion

Research in terms of child's laughter continues to be limited. The study emphasises the need for further studies to understand the information conveyed by different types of laughter, clinical deviations and also the developmental process of individual differences in the production and use of such predominant involuntary vocalizations in communication behaviours. (Askenasy, 1987).

## Acknowledgement

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# The Acoustic Correlates of Persuasive Voice: A Cross-language Study (no. 205)

R. Signorello, D. Demolin

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

Rhetoricians, as politicians, address people to persuade them (e.g., Aristotele, trans. 1991). They combine their verbal and non-verbal behaviours to be perceived as charismatic (e.g., Signorello et al., 2012). Rhetorical speeches are usually organised in a sequence of propositions of increasing importance or force that reach the most intense moment at end, in unison with audience (a structure similar to the climax figure-of-speech but regarding the whole speech). The core question of this work is to investigate whether and how orators adapt the acoustic correlates of voice in rhetorical discourse, during which they are supposed to persuade, versus non rhetorical discourse, which final goal is not to persuade.

We plotted Speech Range Profiles (SRP) and computed acoustic values (F0, SPL, Harmonic-to-Noise Ratio, Jitter, Shimmer) of /a/ vowels from speeches of 3 politicians (Luigi de Magistris 'Italian', Nicolas Sarkozy 'French', and Luiz Inácio Lula da Silva 'Brazilian') given in different communicative contexts and addressed to different types of audience (informal interview 'INT', formal conference addressed to other politicians 'CON', and monologue addressed to followers 'MON'). SRPs clearly show an important difference in the voice extension in terms of low and high F0 and SPL values: during MON speakers use a high-range, during CON a middle-range and during INT a low-range extension of voice.

Simple linear regression analyses show trends in long-term acoustic parameters of voice and in their time-related variation: The Italian speaker increases F0 ( $r=.189$ ,  $p<.001$ ) and decreases SPL ( $r=.251$ ,  $p<.0001$ ) during INT; increases F0 ( $r=.224$ ,  $p<.0001$ ) and increases SPL ( $r=.174$ ,  $p<.0001$ ) during CON and increases F0 ( $r=.213$ ,  $p<.0001$ ) and decreases SPL ( $r=.142$ ,  $p<.0001$ ) during MON. The French speaker tends to keep F0 and SPL stable during INT, keeps F0 stable while decreases SPL ( $r=.108$ ,  $p<.01$ ) during CON, and decreases F0 ( $r=.074$ ,  $p<.01$ ) while tends to keep SPL stable during MON. The Brazilian speaker decreases F0 ( $r=.190$ ) and tends to keep SPL stable during INT, increases F0 ( $r=.135$ ) and tends to keep SPL stable during CON, increases F0 ( $r=.272$ ,  $p<.0001$ ) and SPL ( $r=.127$ ,  $p<.0001$ ) during MON.

Results show a cross-language trend in how orators use voice in different types of discourse, at least for the sample analysed. Politicians adopt different voice profiles with respect to the context and the goal of communication: MON and CON, i.e. formal discourse, are uttered with higher- and middle-ranged voice and this is, in our hypothesis, in order to persuade and to gain votes; instead INT are uttered with a low-range profile of voice because of the changing of the goal of communication, that is not to persuade. Additionally, orators during MON show what we suggest to call the "voice climax" strategy: a gradual and significant adjustment of the acoustic correlates of voice during discourse.

Aristotle (trans. 1991). Rhetoric. Acheron Press. Signorello, R., D'Errico, F., Poggi, I., and Demolin, D. (2012). How charisma is perceived from speech. A multidimensional approach. In IEEE Computer Society, editor, ASE/IEEE International Conference on Social Computing, pages 435–440, Amsterdam, The Netherlands.

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# The Evolution of Radio Voices (no. 206)

T. Sejr Hansen

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

Our voice is our primary means of communication. And most people have an opinion about how we speak – or how we should speak. Spoken Danish is often criticized of being too fast and too badly pronounced – not only among the young generation but also on national TV and radio. Danish appears to be degenerating much faster than ever before. But is that true? Analyzing the readings of the radio news where the ideal Danish is expected to be found might give an indication of the spoken language's condition. In my six months research of the Danish radio news from 1936 to 2010 I found that the changes in spoken Danish might not just be for the worse. The changes can also enforce the understanding of the news and thereby support democracy. But does that mean that we should allow all changes and welcome every new pronunciation?

After listening to hours of radio news broadcasts from the 1930's till today I analyzed six selected broadcasts thoroughly by use of five elements of prosody: articulation, clang, intonation, dynamics and speed. The broadcasts were then compared, and the development tendencies of the oral interpretation were assessed on basis of Fafner's and Ong's orality concepts. The broadcasts were analyzed using the software program Praat. The data showed that the speed has increased by about 30 %, the pauses are shorter and fewer and some syllables are no longer pronounced. But the graphs were not linear; the 40's appeared to be slower than the 40's and the 70's faster than the 2010s. Finally, in my thesis, I discussed whether spoken language should be evaluated based on the critic's personal aesthetic preferences, or whether it must be assessed on the utterance's expediency in relation to the utterance's situational conditions and function.

Basically I analyzed how we talk about talking and what ideals we hold. To some the preservation of an ideal of spoken language appears to be a goal in itself – to others the development is welcomed as a sign of evolution, enhanced presence and improved understanding.

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## Manuel Garcia II: The Beginning (no. 207)

S. Austin

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Manuel Garcia (1805-1906) is widely considered to be the pre-eminent voice teacher of the 19<sup>th</sup> C, whose influence is still realized in voice pedagogy today. Garcia is also appreciated as the father of otolaryngology; a result of fact that he is often credited with the invention of the laryngeal mirror in 1854. Garcia was a member of a well-known singing family whose patriarch, Manuel Garcia pere was a leading tenor at the Paris Opera at the beginning of the 19<sup>th</sup> C. Garcia's monumental Complete Treatise on the Art of Singing (Vol. 1 in 1847 & Vol. 2 in 1854) was the first comprehensive progressive pedagogical method for voice which also included a complete description of the anatomy and physiology of the mechanisms involved in singing. His descriptions of the phonatory, respiratory, and articulatory systems were quite accurate. Garcia was particularly insightful into the function of the human larynx. He offered a definition of vocal registers that is still the basis of those used today. He pointed to the different 'mechanical principles' and described the importance of full glottal closure and full participation of the body of the vocal folds to produce the chest register. He identified the vocal folds as the source of the several unique sounds that the voice is capable; the registers. He understood that the sound produced by the larynx is in itself unremarkable, but is quickly modified by the vocal tract to produce the human voice. He said that it was the pharynx that created the various timbres of the voice and the vowels – predicting what came to be commonly understood as the 'source-filter theory of speech production'. He described many details of laryngeal function as a result of his own careful observations using excised larynges that he obtained from his local butcher shop and later with his experiments using the laryngeal mirror. A presentation about Garcia is appropriate in light of the interdisciplinary focus of this conference. Garcia was a singer, voice teacher and voice scientist for the ages.

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# A Three-Dimensional Approach to Classify Soprano Voices (no. 208)

F.M.B. Lã, S. Cláudio, J. Sundberg

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Fächer is of paramount importance to classical singing pedagogy: it defines career choices and development in accordance to the singer's vocal and personal abilities. However, classifying voices is not always an easy task; it is subjective as it depends on a multitude of factors which include Fächer definitions, individual perceptions, aesthetic preferences, and professional experience. The current investigation aims to explore complementary methods of vocal classification, based on both subjective and objective evaluations.

Recordings of audio, electrolaryngograph, intraoral pressure and air flow signals were carried out with eleven sopranos using a combination of an electrolaryngograph microprocessor (Laryngograph) and an MS-110 computer interface (Glottal enterprises). Singers were asked to perform "O mio babbino caro" (while listening to the respective piano accompaniment in one head phone), sung with the lyrics and substituting the lyrics by the syllable /pae/. Additionally, a set of diminuendo repetitions of the syllable /pae/, sung at different pitches, was recorded.

Soundswell signal workstation (Hitech) was used to perform acoustical and voice source analysis. The former included long term average spectrum analyses of (i) alpha-ratio, (ii) equivalent sound level (Leq), (iii) mean spectrum peak and (iv) the dominance of the fundamental (H1-H2LTAS); the latter included (i) subglottal pressure (measured as an estimative of intraoral pressure during the /p/ occlusion), (ii) glottal resistance and (iii) collision and (iv) phonation threshold pressures (CTP and PTP, respectively). A listening test was carried out with nineteen classical singing teachers and professional singers of eight different nationalities. They were asked to rate, using an analogue visual scale, the singer's voice type, choosing within the extremes of the scale, i.e. soubrette/dramatic soprano. The listening test included replicated stimuli of all recorded singers singing the same excerpt of "O mio babbino caro".

A multiple regression step-wise analysis was run to assess relationships between vocal parameters and the listener's ratings. The results suggest the existence of a correlation between the listener's ratings (% of visual analogue scale -VAS) and both acoustical and physiological parameters ( $R^2 = 0.87$ ), namely Leq and PTP for the pitch B4. The listeners' ratings can be predicted according to the following equation (Eq. 1), where z stands for z-scores of the predictors (z-Leq and z-PTPB4), and Sn stands for # singer:

$$\%VAS \approx [z\text{-Leq} (S_n) * 0.716 + z\text{-PTPB4} (S_n) * 0.476] + 42.525 \text{ (Eq.1)}$$

This exploratory study proposes that perceptual voice assessments, commonly used to determine a singer's voice classification, can be complemented by both Leq and PTP facilitating a more objective evaluation of voice type. Implications for voice pedagogy will be discussed.

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# How to Avoid a Teachers Burn Out, and at the Same Time Improve the Students Learning Process. Placing of Responsibility in Singing Tuition (no. 209)

L.L. Skovgaard

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

Too many teachers suffer from stress and burn out. The pedagogy of Complete Vocal Technique emphasizes a specific focus on responsibility placing in a learning process that works for the benefit of the singer as well as the teacher.

The theoretical perspectives "The Reflective Practitioner: How Professionals Think in Action" (Donald A. Schön 1983), "Truth and Method" (Hans-Georg Gadamer 1960) and "Situated learning" (Jean Lave and Etienne Wenger 1991) provides a philosophy and method for teaching, where teachers are the facilitator of the students processes, providing tools and knowledge for the students to pick up.

An emphasis on reflection in action provides the possibility of being aware of own prejudice. A prejudice that tends to affect the process of the student, and this to the extend that the teachers often are working harder than the students. The learning process is then imbalanced, the students are learning less and the teachers are working more.

Inspired by the philosophical hermeneutics we work on understanding as an active process, which includes a specific focus on the dialogue in the communication with the singing students. A dialogue where there is a responsibility exchange. The ideal is for the singing teachers to get the experience to be responsible for facilitating the learning and for the singers to get the experience to take responsibility in the learning process. This has, as we experience it, a great impact on avoiding a teachers potential burn out as well as a positive impact on the singers learning process and motivation in singing tuition.

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# Comparison of Two Different Warm-up Strategies for Singing Voice (no. 210)

T. Altorjay, C. Csíkos, K. Osvay

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

There is an on-going debate in the scientific literature whether is it possible to activate the nasal cavities during singing vowels? Their use in forming the nasalised consonances like [n, m, ng] is evident. In some languages – like French, Portuguese – nasalised vowels are also used in everyday speech. On the one hand in classical European singing culture, called “bel canto” singers and singing teachers use the head-register, the head-resonance. Frequent advices are: “ring your voice into the mask”, “drive into your head” etc. They affirm the advantage of the activation of nasal cavities during singing and practice. On the other hand some investigators, specialists assert that the ringing in the mask is “only a feeling, not a real function”. In our paper we approached that contradiction from a practical point of view. We have composed two different, short warming-up exercises. One for activate the nasal cavities, another focusing on the mouth cavity. Two sessions have been organised for 11 female and 11 male participants. All the participants were the student of the Singing Department at the University of Szeged, in Hungary, with more than four year-long intensive singing education. We recorded all of the Hungarian vowels before and after the two types of warming-up exercises. We have chosen for every participant, according to her/his gender and voice-category suitable deep, middle and high tone. They had to sing every vowel at the three pitches, keeping them longer than one second. The recordings have been analysed with SIGVIEW 2.4. program, while the statistical data have been evaluated with SPSS20. We investigated the effects of the different warming-up strategies by means of sound volume and the overtone content. The result of the experiment suggested, that from the view-point of sound volume the mouth cavity activation is advantageous, even in some cases significant, from the aspect of overtone content is disadvantageous. The effect of the nasal cavity activation was unmatched.

**Keywords:** warming-up, sustained vowels, nasal cavities, mouth cavity

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# Is Control Breath Support the Basis of Vocal Technique? Connection Versus Support (no. 211)

C. Ormaechea

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

When looking through Internet about voice research, I discovered some comments by Dr. Harm K. Schutte at the PAS conference in 2002, where he declared that support was one of the most confusing terms in singing and the least understood. He suggested the idea that support probably had little to do with breathing control and much more to do with larynx reflexes which would relate it to the respiratory tract. He considered the possibility of investigating the subject seriously.

As a singing teacher I have concentrated in particular on demonstrating that the concept of breath support for teaching singing students is not only incorrect, but also harmful, and as I have developed a method which focuses specifically on the idea proposed by Dr.Schutte, I thought that it would be an opportunity for me, as well as a great honour, to present this work at the next meeting of the 10th Pan European Voice Conference.

In 1995, I developed a teaching system known as the Conexive Method of Singing with the help of the National Council for Culture in Venezuela, CONAC. At present I am living in Madrid where the method is used, with particular interest, for people who have difficult functioning problems in singing as well in dysphonic voice.

What is the "Conexive Method of Singing"?

The "Conexive Method of Singing" is a therapeutic educative system whose aim is to facilitate healthy voice production by recognising the original features of the sound process. Knowing and practicing the mechanism of primary voice production, that is, re-adopting the process of the voice production mechanism in the new-born, is for the method fundamental.

This recognition occurs by identifying what we have labeled as the conexive reflex and it refers to the automatic, involuntary response of the human being to the staccato vocalisation stimulus. We perceive this as a direct connection between the larynx and the diaphragm. This reflex is present in the scream and the cry of a new-born child that is, in pre-linguistic sounds, as well as in mammalian animals. The reflex becomes less evident as the child starts to talk. However, in singing it is possible to recuperate the reflex, which is the basis of all the techniques involved in the method.

Some principles of the method related to the breathing mechanic:

\*The useless of the control breathing techniques

\*We believe that the accepted idea that good vocal function depends directly on good breathing mechanics is erroneous. In fact we believe the opposite, that good breathing mechanics depend on good vocal function.

\*Good aerodynamic mechanism depends more on acoustics factors than in voluntary breath control.

\*We hope that the empirical research that we have done will provide novel insights into the cause of finding more functional and secure pedagogical and therapeutic methods for the voice problems.

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# ISFV, Inhaling Singing, a New Extended Technique by Françoise Vanhecke

(no. 212)

F. Vanhecke

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

The second half of the 20th and the 21st Century delivers music with liberty for use of the voice, which allows the use of "Inhaling" singing. Vocal sounds or even words can be produced while a singer is inhaling. This can create a strained or even humorous effect that has been mostly linked to folk, ethnic and rock music. During recent research on that inhaling technique, we discovered that there are several ways of interpreting and perceiving such sounds. To improve the technique, improvisation and sound painting are ways to discover that sound idiom. Inhaling singing requires confidence and knowledge of the vocal instrument as well as experience from the performer. Timbre modulation of the voice, using amplitude of in-breathing are performed with support of body movement. Inspiration and phonation are performed at the same time.

The acoustic analysis of the fundamental frequency produced while inhaling singing reveals that the sound we hear is not always what we expect we should see. The impact of supraglottis with arytenoide cartellages is correlated with the sopra glottis vibrators, the physiological cause. The vocal folds give various states of thickness and thinness and the intrinsic muscles are very active.

The acoustic analysis was performed using datasets from both male and female voices.

For the measurement and analysis we used spectrograms and an electroglottogram (EGG) from the Voce Vista software developed by Don Miller. A video-stroboscopy and a nasofibroscope are performed by connecting a camera in parallel with the audio data acquisition. A series of kymogramms show us that several co-vibrators are active. The study is practice based on: inhaling production of a single sustained freely chosen sound, inhaling glissando, inhaling singing on double tones, multiphonics, electronic sounds at different ranges of pitch and melody (tonal and atonal) using vibrato and non vibrato and dynamics on which the singer feels comfortable. Experimenting and exploring this Inhaling Singing on my own voice, I discovered more and more flexibility in the way of performing. With that new way of singing I manage now to sing a defined melody. The tessitura for the IS is until now situated in the high range of the female voice. Using that new kind of singing enables to switch immediately to other styles of singing.

Thus we can gain an insight in the optimum use of vowels required for reproduction. We found that quite some music scores and their vocal notations are not really well defined.

Scores and works by Tzvi Avni, Joan La Barbara, Irma Bilbao, Meyer Kupferman, Dieter Schnebel have been examined as well as 'Aria' by John Cage.

We also attempted to do specific notational proposals in our own compositional work.

Pathological and therapeutics aspects can be useful for clinical cases.

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# Identification of Epithelial Stem Cells in Human and Porcine Laryngeal

## Mucosa (no. 213)

G. Woodson, D. Crosby, D. Laugh

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Vocal Fold Healing

Vocal fold scar is a significant cause of voice disability. Current treatments do not satisfactorily restore the voice. Stem cell implantation has been proposed as a potential treatment. However, little is known about the role of endogenous stem cells in vocal fold healing. Recently, skin and intestinal cells expressing leucine-rich orphan G protein-coupled receptors (Lgr) have been described as multipotent adult stem cells. To determine whether these proteins are present in laryngeal epithelium, we harvested mucosa from porcine and murine vocal folds. Immunohistochemistry documented the presence of Lgr5 and Lgr6 markers. This was confirmed by PCR. This suggests that there are stem cells in laryngeal mucosa that play a role in vocal fold healing.

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# The Impact of Hormone Dysfunction on Voice *(no. 214)*

*J. Abitbol*

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Medicine

Not Available

# Bacteria, Bacteria Everywhere – But What Is in the Larynx? (no. 215)

G. Woodson, D. Crosby, D. Laugh

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

There is substantial evidence that bacteria are not by-standers in the larynx but are key players in mucosal immunity. Many species of bacteria have been found individually in patients with acute infective diseases but until now there has only been one description of the complete bacterial flora of the human larynx and its variation between individuals. This reported only those bacteria isolated by standard clinical techniques, which will fail to detect the majority of bacterial species. These bacteria, including parasitic and fastidious species, are only detectable by DNA-based techniques. Studies of the oral cavity have demonstrated that many such bacterial species are implicated in diseases of unknown etiology. Previous studies on the presence of *Helicobacter pylori* in the larynx have produced equivocal results. One study detected no *Helicobacter pylori*-like organisms in laryngeal samples using Giemsa and haematoxylin-eosin staining, whereas another study using similar techniques detected organisms resembling *Helicobacter*, but these bacteria could not be positively identified by immunohistochemistry. As *H. pylorus* has been found using more sensitive DNA-based techniques throughout the oral cavity examination of the larynx in this way is the only method likely to provide a definitive answer.

This presentation will review the evidence for bacteria in the larynx and its role in the development of chronic laryngitis and present active research being completed that is mapping the laryngeal microbiome.

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# Phonosurgical Training and Evaluation Methods (no. 216)

J. Jiang, T. Chen

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

Surgical intervention in the vocal folds is complicated by the small size and delicate structure of the tissue. Even small changes to the structure of this tissue can lead to disruption of its normal function, making restoration of vocal fold function a difficult task. The working model of laryngeal microsurgery is removing pathological tissue while not damaging surrounding healthy tissue in the constrained workspace of a direct laryngoscope, with an operating area no larger than 5 cm<sup>2</sup> using approximately 30 mm long micro instruments under a microscope. Despite these challenges, there is no suitable, objective method for quantifying performance of phonosurgical tasks or providing feedback. The ability to accurately evaluate performance of surgical tasks through an objective and quantifiable method is necessary for improvement of surgeon evaluation and training, clinical care, and research. In the apprenticeship model, patients bear the bulk of a trainee's learning curve. By contrast, surgeons with previous experience on simulators demonstrate greater skill and make fewer technical errors. Therefore, we employed motion analysis techniques to evaluate motion metrics during surgical simulations. Two motion analysis techniques were used, including microBIRD, a magnetic tracking technique, and VPITS, a video-based tracking technique. Both methods were able to distinguish between novice and expert, as well as quantify a learning curve. In addition, these motion tracking techniques were used to evaluate the effects of ergonomic factors, such as arm supports, on motion metrics. We conclude that using either microBIRD or VPITS, we can achieve objective evaluation, provide crucial feedback to trainees, and optimize the ergonomics of the surgical station.

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# Does Phonosurgery Change the Quality of Life for the Better? A Retrospective Study (no. 217)

F. Müller, A. Proescher

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Rehabilitation of the Voice

The VHI questionnaire is used in the Department of Voice, Speech and Hearing Disorders at the University Medical Center Hamburg-Eppendorf for all voice patients. When patients are designated for a phonosurgery, the VHI is assessed before and after surgery, providing an evaluation of the surgery in terms of quality of life. This study presents the data for a complete year and correlates VHI scores with gender, disease, surgery technique. For the majority of patients with complete pre- and post-operative VHI questionnaire the quality of life improved (44 out of 52). For the two biggest disease groups "vocal fold polyp" and "unilateral vocal fold palsy" the improvement was significant.

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# Micro-video-endoscopic Thyroplasty with Permacol: Our Experience over Ten Years (no. 218)

L. Warner, P. Jones, S. Jones

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Surgery

## Objectives

Unilateral vocal fold paralysis (UVFP) may result in severely impaired vocal function with a detrimental effect on quality of life. Herein we describe our experience of medialisation thyroplasty for UVFP using a micro-video-endoscopic approach for enhanced precision and safety with Permacol an acellular porcine dermal collagen implant.

## Methods

A retrospective review of medical case notes, specialist voice clinic and speech and language therapy notes of 49 patients who underwent micro-video-endoscopic thyroplasty at a UK teaching hospital Otolaryngology department between 2001 and 2011.

## Surgical Technique

Micro-video-endoscopic thyroplasty with Permacol<sup>®</sup> is performed under total intravenous anaesthesia with spontaneous respiration through a laryngeal mask which is adjusted to allow fiberoptic laryngoscopy through the mask. The thyroid cartilage is exposed using a short transverse incision from just beyond the midline to the posterior border and vertical separation and retraction of the infrahyoid muscles in the midline without division.

Permacol<sup>®</sup> thyroplasty uses a 3 to 4 millimetre window in the thyroid cartilage and Permacol<sup>®</sup> strips are positioned through this smaller window compared to conventional techniques.

In our micro-video-endoscopic technique, using a microscope and a 3 millimetre diamond burr a hole is drilled to form a 3 to 4 millimetre window in the thyroid cartilage through which strips of Permacol are inserted lateral to the inner perichondrium under microscopic visualisation. The whole depth of the vocal fold is moved towards the midline from the anterior commissure to the tip of the vocal process of arytenoid cartilage until the free edge is in the midline, using fiberoptic laryngoscopy to achieve accurate medialisation.

## Results

49 patients underwent micro-video-endoscopic medialisation thyroplasty with Permacol<sup>®</sup> under general anaesthesia, on a day-case basis. The median age was 65 years (range 27 to 94 years), 38.8% of patients were female. 70% of patients had a fully abducted vocal cord with a large glottic gap, the remaining had a moderate gap. UVFP was caused by malignancy in 61.2% of patients, surgery in 14.2%, anatomic abnormalities in 4% and 18.3% were idiopathic.

There were no immediate complications. Three minor complications occurred during follow up, including keyhole scarring in one patient and mild exercise induced stridor in two patients which did not require further intervention. Median follow up was 5 months with a range of 1 month to seven years.

At one month 85% of patients had an improved GRBAS score and 88% of patients an improved VOISS score. Post-operative mean VoiSS and GRBAS scores both demonstrated a significant improvement from pre-op (VoiSS 59.7 vs. 37.3  $p < 0.001$ ; GRBAS 9.9 vs. 5.6  $p < 0.001$ ).

Seven patients required revision surgery (14%). Four due to under medialisation and three likely due to re-absorption. No major complications were reported in our series and no cases of Permacol<sup>®</sup> extrusion occurred.

## Conclusions

Our results show significantly improved vocal outcomes with excellent patient satisfaction after micro-video-endoscopic Permacol<sup>®</sup> thyroplasty with low complication rates and no significant airway compromise. This is a safe and effective alternative to previously described methods.

**Keywords:** vocal cord paralysis, thyroplasty, laryngeal framework surgery, Permacol<sup>®</sup>



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# Management of Acute Voice Problems at the Salzburg Festival (no. 219)

J. Schlömicher-Thier, M. Weikert

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

When a high professional singer falls ill, a variety of individual factors arise. The decision to recast is made more difficult by responsibility towards the other members of the cast, anxiety on the part of the management, exertion of influence by the conductor and the director; recording contracts are tempting, and – last but not least – the audience wishes to see a radiant hero or heroine. As freelance artists, they may have a full diary of engagements in opera houses and at music festivals all over the world, and only air travel enables them to attend rehearsals in one place and concerts in another. But professional singers are subject to illness from the same causes as other people: acute viral and bacterial infection, allergies, faulty diet, environmental influences at work (on stage), side effects of medication, hormonal factors (especially for female singers), psychological strain due to family or social circumstances, personal crises, overwork, over-exertion in the course of working life. The medical specialist has to be aware of the possible causes and the heavy demands made on the singer in respect of physical strain, heightened sensitivity and expressive capability.

In these presentation the Authors will speak about the special way of Diagnostik, Intervention and Treatment of the professional Singers, when they got sudden and acute symptoms and will present an evaluation of 74 high professional male and female singers at the Salzburg Festival during 5 Festival seasons (2001 – 2005)

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# New Traumatic Lesion in Adolescent Female Singers (no. 220)

L. Halstead, D. McBroom

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

There is increasing pressure for prepubescent children to sing in the Pop/Rock/Belting styles and develop big, relatively heavy chest voices to survive in children's theater groups and competition choirs. As these young girls attempt to sustain these styles in their vocal performance throughout puberty, injuries can occur. This paper describes a new traumatic lesion seen in two adolescent female vocalists –herniation of the laryngeal ventricular mucosa onto the vocal folds. This problem is seen often in self-trained/undertrained adults singing in the gospel and pop/rock styles, but seems now to be occurring in adolescent girls active in theater troupes and choirs focusing on the Belting/Pop/Rock genres. This paper emphasizes the need for young vocalists to “cross train” in other vocal styles in order to repair injury to the larynx and, most importantly, highlights the need for the integration of cross training in other vocal styles into voice training to prevent injury and maximize their vocal potential.

Two adolescent girls, age 15 & 17, presented with this lesion and complained of pain while singing and loss of their top notes. Both have been praised for years for their big chest voices and mature sound. Both had very back focused speaking voices.

Multi-disciplinary treatment included: 1. Medical management by the laryngologist, 2. the singing voice specialist emphasizing yawn, loft resonance and reduced medial compression of the false vocal folds, building breath support. The belting repertoire was then reintroduced with modifications in technique. 3. The speech language pathologist focusing on flexibility, forward focus, and breath support.

Outcome: both singers have near complete resolution of their ventricular herniation and regained the full vocal range. Both continued singing in choirs and theater groups and are preparing for college auditions as vocal performance majors. Laryngeal examinations 12-16 months post treatment shows no change in the appearance of the ventricles, although one singer had returned to her old belting habits for several months and presented with recurrent pain with singing.

The importance of cross training in other vocal styles as it relates to improved breath support, increased vocal range and flexibility and elimination of repetitive task injury to the laryngeal musculature will be detailed.

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# Therapeutic Choices for Curing Dysodia? 3 Clinical Cases. FAURE MA1, (MD, F-Paris); PÉROUSE AR2, (MD, F-Lyon); COULOMBEAU B3, (MD-F-Lyon) (no. 221)

M.-A. Faure

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Clinical Issues

## Summary

Three clinical cases of objective laryngeal lesions illustrate a particular approach to the management of anatomical voice disorders. When confronted with a laryngeal disorder, talented artists often suffer a crisis of self-confidence which may drive them toward maladaptive compensations. Even if the therapeutical choice is phonosurgical, a phoniatric “artistic guidance” could be proposed as:

- Physical and mental training for a gentle inward flow of air by inhaling air
- Supple opposition to exhaling habits by speaking or singing for different durations
- Inner proprioceptive feeling reaching an equilibrium among the usual recommendations for improving voice intensity or an attractive “singing formant”
- Postural behavior in order to improve articulatory and musical legato when sharing their artistic talent, therefore avoiding some maladaptive compensations
- Alternative medicine

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# Phonetography: VRP – Measurements in the Phoniatician-, Logopede- or Voice Teacher's Office: How to Do? (no. 222)

M. Weikert, V. Siebertz, I. Franke, J. Schlömicher-Thier

- **Form:** Oral Presentation
- **Category:** Medicine
- **Topic:** Examination Techniques

What are the essentials for this tool of the practical point of view by ELS - related Voice evaluation

There will be performed a workshop of voice measurement according to the principles of ELS: the five parameters of Perception, Videostroboscopy, Acoustics, Aerodynamics/efficiency, Subjective rating by patient are mentioned, with the focus to Acoustics, Aerodynamics and to the demonstration of voice range profile measurement.

The authors will demonstrate the speaking shouting and singing voice profile Measurements with LingWAVES Phonetogram Plus Software/Forchheim., by PC working station Windows XP: with his phonetography and spectrography modules, (medical product class 1 (93/42/EEC), CE signed)

## The progress of the workshop

1. Short theoretical introduction
2. Demonstration of examples of voice assessments of the phoniatician and logopede area, with
3. The relevance of the VRP for semi - and high professional singers (Voicerange-Architecture, Dynamik - and Registerstruktur)
4. The main part with life- measurements, also of participants of the WS.

The WS invites ENT- doctors. Phoniaticians, Logopedes, Speech-pathologists, vocal-pedagogues, singing-teachers for an hands on training

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- **Form:** Workshop
- **Category:** Medicine
- **Topic:** Examination Techniques

This workshop will be devoted to the fundamentals of videokymographic imaging and to the application of videokymography in clinical practice. Videokymography (VKG) is a high-speed videolaryngoscopic examination method, which allows obtaining detailed information of the vibratory behavior of the vocal folds and surrounding tissues (1,4). In contrast to the standard stroboscoped laryngoscopic methods, which work properly only on regular voices and do not allow detecting irregularities, the high-speed imaging does not suffer from this limitation and allows detecting real vibration of the vocal folds. Videokymography differs from the other high-speed videolaryngoscopic methods in that it uses a special videokymographic camera which provides two images simultaneously – in the left half it shows the standard laryngoscopic image (50 or 60 images per second), in the right half it provides the kymographic image showing the vibratory behavior of a selected part of the vocal folds in high speed (7200 line images per second) (2). The high-speed kymographic images are available immediately making the method friendly for use in busy clinical practice. Research on videokymography in voice disorders identified over 30 vibratory features which reveal on various causes of vibration disorders of the vocal folds (3,4).

When applied in clinical practice, videokymography allows detailed diagnosis of vibration disorders of the vocal folds in small developing lesions, which are difficult to detect using other methods. It enables an early detection of cancerous tissue on the vocal folds. It is highly useful for detecting organic causes of damaged vocal fold tissue, which could otherwise be considered a functional disorder. It allows detecting tiny scarred areas and increased stiffness of the mucosa and of the submucosal tissues. The workshop will provide case examples of characteristic pathologic conditions, which were diagnosed thanks to videokymographic findings.

The work has been supported by the European Social Fund projects no. CZ.1.07/2.4.00/17.0009 and CZ.1.07/2.3.00/20.0057 in the Czech Republic.

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Jan G. Švec, Ph.D. is an internationally renowned Czech physicist performing basic research on production of human voice. He has worked as a research scientist at the Center for Communication Disorders (Medical Healthcom) in Prague, the Czech Republic, at the National Center for Voice and Speech in Denver, CO, USA and at the University of Groningen, the Netherlands. Currently he is at the Palacký University Olomouc, the Czech Republic and serves also as an associate research scientist at the Voice Centre Prague. He designed videokymography, the method for high-speed visualization of vocal-fold vibrations, which is used for advanced diagnosis of voice disorders. He collaborates with numerous research teams in Europe and USA and lectures world-wide. From 2004 to 2011 he served as the chairman of the Voice Committee of the International Association of Logopedics and Phoniatrics (IALP).

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Jitka Vydrová, MD, finished her studies at the 1st Faculty of Medicine at Charles University in 1982. After graduation she worked at the ENT department (clinic) and got two board certifications in otolaryngology.

She has been working as the director of the health centre Medico in Prague 4. She has been also the senior consultant of the ENT department there. In 2008 she established the Voice and Hearing Centre Prague, a diagnostic and therapeutic centre for voice and hearing disorders, focusing on voice professionals, especially on singers and actors. She organizes special classes in vocal use (A School for the Voice and Speakers). She has been a member of many juries in different singing competitions and contests. She is the president of the non-profit organization Voice and Hearing Centre o.p.s. This organization supports young singers and awards prizes for notable singing achievements and performances.

She has been teaching voice care and physiology at the conservatory in Prague since 2000. She also gives lectures in phonetics and voice physiology at the Academy of Performing Arts in Prague. Since 2000 she has been a board member of the Czech Society of Otolaryngology and Head and Neck Surgery. She often lectures about voice at various Czech and international conferences. She has written a textbook about voice care and physiology for conservatories. Moreover, she is the author of the book "Advice on singing." Every year, she organizes a conference on "Artistic Voice".

# Videokymography (VKG) in Clinical Practice (no. 224)

F. de Jong

- **Form:** Workshop
- **Category:** Medicine
- **Topic:** Examination Techniques

Examination of glottal closure and the vibratory pattern of the vocal folds is of key-importance in diagnostics of voice disorders. Laryngostroboscopy enables the visualization of vocal fold vibration but yields illusionary recordings by picking up moments of subsequent mucosal waves. Therefore, reliable interpretation of vocal fold vibration by stroboscopy is only possible if perturbation of frequency and intensity is limited. However, in voice pathology this is often not the case. This asks for real-time examination of vocal fold vibration. VKG is applied for several decades. The latest version of the videokymograph by Cymo<sup>®</sup> displays simultaneously two images on the screen. At the left side, an overview of the vocal folds is shown with a line that indicates the level of VKG recording. At the right side this line is written in time with a speed of 7200/sec. By slight movement of the endoscope, the line of examination can be moved over the vocal folds. The images can be recorded digitally, directly applied or used for further processing. In this way vocal fold vibration of the vocal folds can be easily examined in a real-time mode. The nature of the recordings makes exact analysis of glottal closure, propagation of the upper and lower margins, small left-right phase differences, and fast alterations of frequency and intensity possible. Practical issues are the relatively short period necessary for recording and independence of the periodicity of the acoustic signal. This new-generation videokymograph provides a simple, quick tool to investigate vocal fold vibration and the author is of the opinion that VKG in this way is a reliable tool and can even replace laryngostroboscopy in routine clinical vocal fold examination.

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Felix de Jong is a phoniatician who holds a professorship in Leuven, Belgium



## Artistry - What Is It and How to Teach It? (no. 225)

V. Laaksonen

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

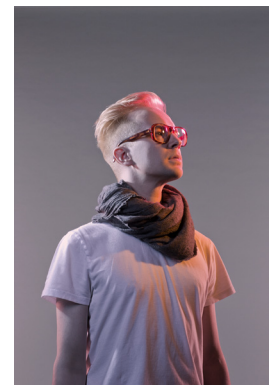
The focus of teaching singing is often in technique, style and performance. They are all important and practical parts of singing. They are also subjects that are relatively easy to describe by words. However, artistry and artistic thinking are more difficult to define and thus perhaps more difficult to teach. What does artistry mean in singing and is it different from musicianship?

This workshop will try to answer this question. It will present artistry and artistic thinking from different perspectives based on music pedagogy, philosophy and interviews of both vocal artists and voice teachers. Some specific methods how to make artistic thinking integral part of teaching will be presented. We will also examine why teaching can sometimes slow down or prevent singer's artistic growth and how to avoid this.

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Ville Laaksonen is singer, voice teacher and artistry coach from Finland. He has studied voice and pedagogy at the Sibelius Academy and Complete Vocal Institute. He is one of the first and most experienced authorized Complete Vocal Technique teachers in Finland. Nowadays he runs a popular voice studio in Helsinki and works with best-selling artists and beginners with same passion. As a singer Laaksonen has worked in musicals, with bands such as Nightwish and performed in international shows on TV.



More information: [www.villelaaksonen.com](http://www.villelaaksonen.com) & [www.cvtteachers.com](http://www.cvtteachers.com)

## Breathing and Singing (no. 226)

J. Marková-Krystlíková

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

The correct breathing techniques influence us all our lives. For a vocalist this is the absolute basis of correct vocal technique and expression. It is crucial to expose children to correct breathing techniques, in an engaging way, from as early as possible, in order to help their learning of song and even learning of speech and pronunciation. This opera soloist and experienced teacher, member of the Voice Center, has lectured on this theme all over the world and has a rich history working with children. She is also the director of the Prague Children's Opera.

This lecture will also include an active portion, including examples with children. It is designed for educators, medical professionals, and vocalists.

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Jiřina Marková-Krystlíková has led these Master Classes in many countries, and you now have the opportunity to study these composers in the Czech Republic and directly immerse yourselves in their cultural heritage.



# Psychoacoustics of Dysphonic Voice Quality: Methods and Concepts (no. 227)

D.A. Eddins, R. Shrivastav

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Psychoacoustics
- Invited Lecture

A comprehensive framework is necessary to understand of the relationship between vocal acoustics and the perception of voice quality and to translate that knowledge to practice. Through interdisciplinary collaboration we combine theory and procedures grounded in over a century of psychoacoustic, speech science and signal processing research to develop such a framework. Here we model dysphonic voice quality perception using the same fundamental principles that govern the encoding of auditory input in the human auditory pathways (auditory physiology) and processes that govern the sensation and perception of these inputs (psychoacoustics).

In the first of two papers, key psychoacoustic concepts and procedures are highlighted to show how these are important for the study of dysphonic voice quality. A review of related science illustrates that voice quality perception is analogous to sound quality perception in many theoretical and practical ways. Thus, general principles that govern the perception of the loudness, pitch, and quality of all sounds can be applied to voiced speech sounds. Voice quality encompasses a multidimensional set of perceptual attributes associated with the vocal acoustic signal. Analogous to most other percepts, voice quality can be subdivided into multiple constituent dimensions which possibly interact. Parallels between the basic sound quality attributes of tonality, roughness, and sharpness will be related to qualities commonly associated with voice, including breathiness, roughness, and strain. Similarly, we will illustrate how the methods used to understand the principles of the perception of sound quality in general can be adopted for the study of dysphonic voice quality. Each of these methods has benefits and costs that need to be assessed separately when considering measurement techniques that may be optimal for laboratory use versus clinical use. To facilitate comparison of methods across judges (listeners), talkers (patients), and samples (sustained vowels, running speech), the concept of measurement scales will be discussed. The general success of these principles is evident in applications such as MP3 coding, loudness meters or telephony codecs. The second paper in this series will illustrate how these psychoacoustics concepts can be used to quantify voice quality perception and, when combined with knowledge of auditory physiology, can be predicted using models of auditory perceptual processing. The perception of breathiness in vowels is best described by models that include pitch strength and masked loudness. Roughness perception is best described by modeling the internal representation of waveform amplitude modulation. Strain in vowels appears to be influenced by changes to the spectral shape. Pitch plays an important role in all three models. Models for VQ perception based on such methods are successful in predicting breathiness and roughness with high accuracy ( $r > 0.91$ ).

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# Psychoacoustics of Dysphonic Voice Quality: Implementation and Outcomes (no. 228)

R. Shrivastav, D.A. Eddins

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Psychoacoustics
- Invited Lecture

A comprehensive framework is necessary to understand of the relationship between vocal acoustics and the perception of voice quality and to translate that knowledge to practice. Through interdisciplinary collaboration we combine theory and procedures grounded in over a century of psychoacoustic, speech science and signal processing research to develop such a framework. Here we model dysphonic voice quality perception using the same fundamental principles that govern the encoding of auditory input in the human auditory pathways (auditory physiology) and processes that govern the sensation and perception of these inputs (psychoacoustics).

In the first of two papers, key psychoacoustic concepts and procedures are highlighted to show how these are important for the study of dysphonic voice quality. A review of related science illustrates that voice quality perception is analogous to sound quality perception in many theoretical and practical ways. Thus, general principles that govern the perception of the loudness, pitch, and quality of all sounds can be applied to voiced speech sounds. Voice quality encompasses a multidimensional set of perceptual attributes associated with the vocal acoustic signal. Analogous to most other percepts, voice quality can be subdivided into multiple constituent dimensions which possibly interact. Parallels between the basic sound quality attributes of tonality, roughness, and sharpness will be related to qualities commonly associated with voice, including breathiness, roughness, and strain. Similarly, we will illustrate how the methods used to understand the principles of the perception of sound quality in general can be adopted for the study of dysphonic voice quality. Each of these methods has benefits and costs that need to be assessed separately when considering measurement techniques that may be optimal for laboratory use versus clinical use. To facilitate comparison of methods across judges (listeners), talkers (patients), and samples (sustained vowels, running speech), the concept of measurement scales will be discussed. The general success of these principles is evident in applications such as MP3 coding, loudness meters or telephony codecs. The second paper in this series will illustrate how these psychoacoustics concepts can be used to quantify voice quality perception and, when combined with knowledge of auditory physiology, can be predicted using models of auditory perceptual processing. The perception of breathiness in vowels is best described by models that include pitch strength and masked loudness. Roughness perception is best described by modeling the internal representation of waveform amplitude modulation. Strain in vowels appears to be influenced by changes to the spectral shape. Pitch plays an important role in all three models. Models for VQ perception based on such methods are successful in predicting breathiness and roughness with high accuracy ( $r > 0.91$ ).

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# Relationships Between Glottal Flow Parameters and the Perception of the Voice Quality (no. 229)

G.L. Salomão

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Psychoacoustics

A better understanding of the aerodynamic characteristics of the voice, such as the ones represented by glottal flow waveform parameters, has been considered valuable to better assess voice quality. However, there is still uncertainty regarding which parameters would best reflect significant differences between perceived voice qualities. The purpose of this study is to investigate the relationship between glottal flow parameters and the perception of the voice quality. Thirteen vocally healthy male choir singers, with various levels of experience, skill, and degree of singing training, were asked to sing ascending and descending chromatic scales of the vowel [a], in a comfortable pitch range and vocal loudness. They were encouraged to sing the ascending scale in modal register, extending it as far as possible, and the descending scale in falsetto, extending it as far as possible. Analyses of 104 glottograms of vowels with the same pitch, extracted from the pitch range where both scales overlapped, were carried out regarding the following parameters: period length (T0) and fundamental frequency (F0); duration of the closed phase (Tcl) and closed quotient (Qclosed); peak-to-peak airflow amplitude (AC amplitude); maximum flow declination rate (MFDR); amplitude quotient (i.e. the ratio between the AC amplitude and MFDR) and its corresponding normalized amplitude quotient (NAQ); level difference between the two lowest partials in the spectrum (H1 – H2). A panel of 16 voice experts classified the voices as being produced in modal or in falsetto register. A correlation analysis was carried out between the listening test classification and each of the flow glottogram parameters. Tones with a high value of Qclosed and low values of H1–H2 and of NAQ were typically associated with a high number of votes perceived as modal voices, and vice versa. NAQ showed the strongest correlation with the perceived voice quality ( $r=0.830$ ). In addition, a stepwise multiple regression analysis was carried out of the relationships between the number of votes for modal voices and the various flow glottogram parameters. The results showed that the Qclosed was the strongest predictor of the number of votes for modal voices, followed by H1–H2, MFDR and AC amplitude. Finally, a cluster analysis of the flow glottogram parameters showed five clusters in a continuum along the range of values for each of the parameters. Voices were unanimously associated to one or the other voice categories when their corresponding clusters of parameters were found at the extremes of this continuum, suggesting that: 1. different glottal flow parameters can be varied continuously and combined differently; 2. specific combinations or clusters of aerodynamics characteristics are likely to be associated with different perceived voice qualities; 3. a perceived voice quality seems to be easier to be classified the further apart the clusters appear on the continuum, and vice-versa.

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# Audio Perceptual Evaluation of Portuguese Voice Disorders: Inter and Intra Raters Reliability (no. 230)

S. Vaz Freitas, P. Melo Pestana, A. Ferreira

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Measurement

## Introduction

The audio perceptual assessment is based on the professional classification of a vocal sample produced by the speaker, associated (or not) with voice complaints. Generally, the requested tests conjugate sustained vowels, running speech, among others which are recorded on audio and/or video (preferably) for further analysis, reports, demonstrations (to the patients) and compare with future assessments. For some authors the audio perceptual evaluation of pathological voices is the gold standard of the entire assessment of dysphonia and, by far, the one that is most used to describe the voice in the clinical context: given its quickness, efficiency and the few resources involved on the attainment of results (reduced cost). The aim of this research was to describe the results of the audio perceptual evaluation, made by ten experts, of a 100 voices' database, with 10% of repetitions. A statistical analysis will be presented with references to the results of the intra and inter rater reliability.

## Materials and Methods

Data analysis was drawn in two stages. Initially, depending on the nature of the variables, descriptive statistics were described. The classification of the GRBAS' parameters was obtained for each one of the ten experts, for the 90 voice samples. The intra class correlation coefficient (ICCC) was used to determine the inter raters' reliability. For the 10 repeated voices the intra rater reliability was measured with a dispersion analysis.

## Results

The average classification of the 10 experts for each one of the GRBAS' parameters differ in a statistically significant way ( $p$  values  $<0.05$ ). The values of the correlations, with confidence intervals of 95%, between the average scores given by experts for all the components of the GRBAS scale lies, in general, between 0.838 and 0.966. With values greater than 0.8 we conclude that there is a good reliability of the parameters of the used scale. It should be noticed that the first three parameters of the scale (G, R and B) have the higher inter rater reliability. Differences were statistically significant ( $p <0.05$ ) for Experts 1, 6, 9 and 10 who evaluated the same voice in a significantly different way. Two assessments were compared using the 10 "original" and "repetitions" ( $p$  value  $<0.05$ ) - which means a poor intra rater reliability.

## Conclusion

All the experts had similar evaluation criteria for the assessment of the five parameters of the GRBAS scale (the values of the confidence intervals at 95% of the experts average ratings of the GRB were above 0,8). However, its quantification is not statistically similar. The A (Asthenia) and S (strain) have a lower reliability. Most of experts do not reveal statistically significant differences between the values assigned to the GRB parameters, for the ten "original" voices and its "repetitions" ( $p > 0.05$ ). The reliability of the audio perceptual assessment relies on several factors, but it can be faced as a very advantageous tool in the context of a voice lab.

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# The Relationship of Glottal Area and Glottal Flow to Voice Quality (no. 231)

J. Kreiman, R. Samlan, G. Chen, B. Gerratt, Z. Zhang

- **Form:** Oral Presentation
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

The assumption that specific aspects of vocal fold vibration alter voice quality underlies many descriptions of voice quality and clinical decisions about disordered voice. Characteristics of vibration are often inferred from the shapes and associated spectra of the glottal area waveforms extracted from high-speed video of vocal fold vibration. Identically-named features of vibration have been inferred from the glottal flow waveforms recovered through inverse filtering and their spectra. However, these waveforms differ from one another. Interaction of the time-varying glottal area with vocal tract pressures is thought to cause a delay in the glottal flow peak relative to the peak of the glottal area, causing a less symmetric glottal flow waveform with a steeper closing slope [Ishizaka & Flanagan, Bell System Tech J 51:1233-1268, 1972; Rothenberg, JASA 53:1632-1645, 1973]. The acoustic and perceptual consequences of these differences in pulse shape are not fully understood. Waveforms, spectra, and voice quality of the area and flow signals were studied using simultaneously-collected laryngeal high-speed videoendoscopy and audio recordings of three different voice qualities from nine subjects. The video recordings were collected at 10,000 frames per second and glottal area waveforms extracted using GlotAnTools (Version 5) [Erlangen, Germany]. The audio recordings were inverse filtered and copy synthesized using the UCLA voice synthesizer to obtain glottal flow waveforms and their spectra. Glottal area waveforms were measured to obtain maximum area declination rates and alternating-current to open quotient ratios [Chen et al., JASA 133:1656-1666, 2013]. Maximum flow declination rate was measured from the glottal flow. Four slope components were measured from the spectra of both the glottal area and glottal flow waveforms (H1-H2, H2-H4, H4-harmonic closest to 2000 Hz, and 2000 Hz-5000 Hz). Measures from area and flow waveforms were compared and their relationships to perceived voice quality were assessed. [Research supported by NIH grant DC01797 and NSF Grant No. IIS-1018863]

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# A Comprehensive Investigation of the Performance Strategies in a Professional Impersonator (no. 232)

J. Revis, C. De Looze, S. Dufour, J. Abitbol, A. Giovanni

- **Form:** Workshop
- **Category:** Basic Science
- **Topic:** Occupational Voice

We present a series of three experiments about the fascinating ability of vocal flexibility and perceptive skills of the most popular French impersonator:

## 1. Vocal flexibility

### Objective

The objective of this initial feasibility study was to describe vocal flexibility in one of the best French impersonator. Our hypothesis is that linguistic features such as melodic curve and rhythm are mandatory for a great imitation performance.

### Method

We used a political speech by our former President Jacques Chirac, who we have chosen for his specific and recognizable voice. After transcription, we asked the impersonator to do several readings in his natural voice and in a spontaneous imitation task. Using Praat, we have compared 3 recordings: Chirac's, the impersonator's natural voice and the imitation performance (pitch: F0, melodic curve; rhythm: duration, pauses).

### Results

Results showed significant modifications in the impersonator's prosody, especially concerning the duration of pauses ( $p < 0.001$ ).

### Conclusion

The professional impersonator's imitation strategy lies on the reproduction of linguistic features. He manages to get out of his own discursive habits by changing the intonation curve and flow of speech, up to be confused with the target.

## 2. Prosodic adaptation strategies during voice imitation

### Objective

Voice imitation lies on two strategies: the convergence is the ability to reproduce global characteristics and the synchrony is the ability to reproduce instant variations. Our hypothesis is that a professional impersonator uses both strategies whereas naive subjects limit themselves to convergence.

### Method

4 control subjects and a professional impersonator have produced several readings of a Jacques Chirac's political speech: natural voice and spontaneous imitation for all participants, and imitation after listening to Chirac's recording for control speakers. Using Praat, we have compared the different performances.

### Results

Results showed pitch and rhythm convergence in naive speakers, whereas professional impersonator used only rhythm convergence but also pitch and rhythm synchrony.

### Conclusion

The professional impersonator's uses both convergence and synchrony. He eliminates what seems negligible to him, and selects and reinforces what he considers as a fundamental characteristic of the target.

## 3. Perceptual skills

### Objective

Process of imitation includes not only an incredible ability to reproduce vocal characteristics of a target speaker, but also to select them. Our aim is to compare the perceptual abilities between a professional impersonator and control auditors. Our method was inspired by Dupoux's (1997), who showed that French native speakers are "deaf" to Spanish accent contrasts between words. Our hypothesis was that control auditors would show difficulties to discriminate Spanish accent, whereas the professional impersonator would be sensitive to any contrast.

### Method

40 French native speakers and 1 professional impersonator have been asked to listen to 576 triplets of Spanish non-words in an ABX discrimination task involving an accent contrast, a phoneme contrast, or a redundant contrast with both variations.

### Results

The professional impersonator's performance was not significantly different from the group, but one of the 2 bests.

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Joana Revis is a speech pathologist but also a linguist (PhD). She works as a teacher and a researcher at the Laboratoire Parole et Langage (CNRS). Her research topic is voice perception. She works since 4 years with the most famous french impersonator, trying to understand how imitation is possible and the impact of the vocal and prosodic characteristics on our ability to recognize familiar voices. She's also developing a research plan about the forensic implications of voice. She is the author of a book about voice which will be available in october, about everything we can learn about someone by listening to his voice (De Boeck Editions).

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Jean Abitbol is a very famous french phoniatician/ENT surgeon (Md). He also published the books "Odyssey of the Voice" and "Performers Voice and Fatigue" (Plural Publishing).

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Antoine Giovanni is a laryngologist (Md-PhD). He also leads a research group in the Laboratoire Parole et Langage (CNRS).

# Chest and Falsetto, Belt and Mix: Closed Quotient and Formant Tuning as Key Factors in Distinguishing Classical and Popular Styles of Singing (no. 233)

D. Miller

- **Form:** Workshop
- **Category:** Basic Science
- **Topic:** Singing Voice

Even in university programs for training singers, teachers of singing are increasingly confronted with the question of properly preparing singers, for example those in musical theater, who will be singing with amplification and are thus not obliged to produce high-intensity sound in order to be heard. Using non-invasive feedback in real time from microphone and electroglottograph (EGG) signals, options are considered for producing healthy and natural singing sound, considering especially the position of the first two formants in relation to the lower harmonics in the range D4 to F5 (ca. 300-750 Hz). The additional factor of closed quotient is revealed as a critical factor with respect to register.

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Donald Miller, who designed and developed the software program VoceVista (Visual Feedback for Instruction in Singing), began his career as an opera singer and voice teacher. After several years as an opera singer in Europe, he took a position in the USA teaching at the Syracuse University School of Music, while continuing an active career as a bass-baritone in regional opera.

His interest in the relevance of voice science to the singing voice grew in the late 70's, and in 1984 he spent a semester in Groningen, the Netherlands, on a project with Harm K. Schutte and the late Prof. Janwillem van den Berg. In 1987 he moved permanently to Groningen to devote himself to research on the acoustics and physiology of the singing voice as an associate of the Groningen Voice Research Lab. This work has resulted in a number of scientific publications together with Prof. Schutte, as well as a doctoral monograph, *Registers in Singing*, published in 2000. His book on the practical application of spectrographic and physiological signals to voice pedagogy, *Resonance in Singing: Voice Building through Acoustic Feedback*, became available in July, 2008, at [www.voiceinsideview.com](http://www.voiceinsideview.com).

An important result of his work in Groningen has been the program VoceVista (visible voice -- see [www.vocevista.com](http://www.vocevista.com) and [www.eggforsingers.eu](http://www.eggforsingers.eu)). VoceVista was introduced in 1996, when personal computers became powerful enough to perform real-time spectrum analysis. Since then it has been regularly updated and further perfected and is now in use in voice labs and facilities for training singers world-wide, particularly in university voice training programs.

# Voice and Trauma, a New Vision in Etiology and Therapy of Voice Disorders

(no. 234)

H. Grooten-Bresser

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Treatment Methods

New insights in trauma, based on neuro-physiology, lead to understanding mechanisms in behavioral regulation and social engagement behavior. Trauma, according to these insights, disrupts the functioning of the autonomic nerve-system. Trauma is seen as an incompleated defense-system. Traumasymptoms are to a large extent generated by the vagus nerve. Interesting is that different stages in trauma have special voice features and that vocal cords, as we know, are innervated by the vagus nerve as well.

These insights have been integrated in body-oriented trauma-therapies, such as Somatic Experience developed by Peter Levine. Levine shows that trauma is no disorder or disease, but an injury caused by fright, helplessness or loss, ending in a neurological state that can stay for years.

Hyper- and hypotonicity in voice are recognized as associated with different stages in trauma and appear to vanish in trauma-therapy. The original defense respons and high arousal can be released and the autonomic nerve-system can turn back to his original state.

The author is an experienced speech- and voice-therapist. The last 2 years she applies body-oriented trauma therapy in the treatment of clients with severe voice-, swallowing- and breathing complaints. This leads to more understanding of "untreatable" clients, as they are called in the Netherlands.

A practice based report on applying insights of trauma therapy in voice therapy.

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# Prevalence of Hoarseness in School-aged Children and Some Background Factors (no. 235)

E. Kallvik, E. Lindström, S. Holmqvist, J. Lindman, S. Simberg

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Child's Voice

Dysphonia is an increasing health problem and combined with an increase of voice demanding professions, this might be a substantial problem in the future when the children of today become part of the working population. In studies from the past 20 years, the reported prevalence of dysphonia in children has been varying depending on the method used in the study. The purpose of the present study was to determine the prevalence of hoarseness in children attending first or second grade of primary school. A second purpose was to explore possible background factors for hoarseness in children.

The participants were 217 children, 103 girls and 114 boys, aged 6 to 10 years with a mean age of 8 years. The children attended ten different schools in the West and South of Finland. The data was collected through questionnaires filled in by the parents and the teachers of the children and through voice recordings. Besides answering questions on background factors, the parents and the teachers also rated the children's voices. The recorded voice samples were perceptually evaluated by eight trained listeners and intra and inter rater reliability was calculated for them. Additionally, inter rater reliability was calculated for the ratings by the trained listeners, the parents and the teachers.

Both the intra and inter rater reliability for the trained listeners were quite high and significant. The prevalence of hoarseness for the whole group was about 12 %. Some possible background factors for hoarseness in children were identified.

The results will be presented and discussed. The results from the present study indicate that more attention should be paid to hoarseness in children. Additionally, background factors should be further explored.

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# Variations of Subglottal Pressure in Voice Exercises Using Flow-resistance in Normal Voice (no. 236)

C. Robieux, C. Galant, T. Legou, A. Giovanni

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

## Introduction

Several exercises in voice therapy are based on the use of semi-occluded tract (SOT) to create a flow-resistance and increase the intra-oral pressure (IOP), thus increase the subglottal pressure (SGP). Different types of SOT do exist and were considered as tools allowing the use of different SGP. The purpose of this study was to verify how much the SGP could be increased in the different voice exercises, and classify these exercises, in normal subjects.

## Method

Two female volunteers were asked to produce 3 trials of a vowel /a/, pronounced at four semi-tones (F2, A3, C#3, and E3), at usual intensity, and at the phonation threshold. They were also asked to produce 3 trials of voice exercises (using vowels, nasal consonants, lip trills, fricatives, and straws) at each semi-tone. The instructions were to start by blowing, and then produce a sound without interrupting or modifying the airflow. Phonation threshold pressure (PTP), usual SGP, and SGP for voice production in voice exercises were measured.

## Results

SGP involved for production of the vowels /i/ and /u/, the nasal consonants /n/ and /m/, and the phonation in a 8mm-diameter straw, were lower than usual SGP but, except for /i/ and /n/, their order varied between subjects. SGP involved for production of the fricative /v/, the lip trills, and the phonation in a 2mm-diameter straw, were higher than usual SGP. SGP involved for production of fricative /ʒ/ is lower than usual SGP in the first subject, and higher in the second subject. SGP involved for production of phonation in a 5mm-diameter straw is higher than usual SGP in the second subject, and close to usual SGP in the first subject.

## Discussion

In these 2 control subjects, voice exercises using SOT involve variable SGP. Some exercises allow the use of a lower SGP than usual; some others allow the use of higher SGP than usual. Some results are not consistent between subjects. It suggests that individual parameters must be considering. For vowels, nasal consonants, and fricatives, articulatory differences could be invoked. Instead, for phonation in straws, which have predetermined flow-resistance, it could be linked to the laryngeal resistance: we hypothesized that a flow-resistance higher than laryngeal resistance allows a higher SGP than usual.

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# Transglottal Pressure Gradient in Voice Exercises Using Flow-resistance in Normal Voice (no. 237)

C. Robieux, C. Galant, T. Legou, A. Giovanni

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

## Introduction

Several exercises in voice therapy are based on the use of semi-occluded tract (SOT) to increase the intra-oral pressure (IOP), thus separate the vocal folds during the phonation and avoid injury. The purpose of this study was to verify if the vocal folds were really protected in voice exercises using a SOT by comparing the transglottal pressure gradient (TGPG) involved in voice exercises, and the phonation threshold pressure (PTP), in normal subjects.

## Method

Two female volunteers were asked to produce 3 trials of a vowel /a/, pronounced at four semi-tones (F2, A3, C#3, and E3), at usual intensity, and at the phonation threshold. They were also asked to produce 3 trials of voice exercises (using vowels, nasal consonants, lip trills, fricatives, and straws) at each semi-tone. The instructions were to start by blowing, and then produce a sound without interrupting or modifying the airflow. Phonation threshold pressure (PTP), and SGP and IOP for the production of voice exercises were measured. Transglottal pressure gradient (TGPG) was calculated as the difference between SGP and IOP.

## Results

TGPG involved for the production of voice exercises were ranged from 2hPa to 5hPa that corresponds to PTP values measured in the 2 subjects, and to normative PTP values related in the literature. Some TGPG values were higher than 5hPa at E3, and one TGPG value was higher than 5hPa at C#3 in the first subject. In the second subject, TGPG involved for production of the fricative /ʒ/ was close to TGPG involved in phonation at usual intensity.

## Discussion

In these 2 control subjects, most of the voice exercises using a SOT involve low TGPG, near to the usual PTP, without conscious control of intensity. The higher TGPG values observed in this study could correspond to higher vocal fold stiffness for the production of higher vibration frequency. The higher TGPG values observed could also correspond, in the second subject, to a lack of flow-resistance due to individual articulatory parameters. Considering our results, voice therapy using flow-resistance seems safe for the vocal folds.

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# The Effectiveness of the Integrative Voice Therapy Regarding ICF (no. 238)

E. Haupt

- **Form:** Oral Presentation
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

The ICF, International Classification of Functioning, Disability and Health, provides a unique and standard language to describe functioning and disabilities across range of communication disorders (Ma et al.2007). It is also globally standard for the evaluation of voice therapy in the four key components of ICF. This study examines the effectiveness of the Integrative Voice Therapy by Evemarie Haupt regarding the objectives of the ICF. A survey of about 50 randomized patients was conducted by patients questionnaire. The results show an improvement in all areas required by the ICF, Thus, the analysis indicates a high degree of effectiveness of this holistic method concerning the objectives of the ICF.

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## Establishing an Interdisciplinary Voice Pedagogy Curriculum (no. 239)

J. Ogg, G. Johnson, S. Maines

- **Form:** Workshop
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

Nearly two decades ago, the Van Lawrence award was bestowed upon Dr. Janette Ogg, Professor Emerita of Voice & Voice Pedagogy at Shenandoah Conservatory (Virginia USA), for her concept of an interdisciplinary Voice Pedagogy course. A unique aspect of this class set it apart—from its inception, it was taught by a team of experts in their fields of Physical Therapy, Respiratory Therapy, Anatomy and Physiology, Speech-Language Pathology, Voice Acoustics, and Otolaryngology. Subsequently, this seminal concept was realized more completely with Shenandoah's establishment of both Master and Doctoral degree programs in Voice Pedagogy. These programs continue to evolve in response to the ever-growing field of Voice Science.

The purpose of this workshop is to offer a prototype for institutions interested in establishing an interdisciplinary Voice Pedagogy program or refining an existing one. It will consist of a brief overview of the successful Shenandoah course and degree programs followed by a round-table panel discussion led by Dr. Ogg and two of her former students. The essence of the workshop will be on discerning a means of building a program by utilizing existing resources and/or creating new ones. During the discussion segment, participants will have an opportunity to brainstorm with members of the panel regarding their visions, goals, and concerns about developing successful interdisciplinary Voice Pedagogy courses and curricula.

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Janette Ogg, D. M., Professor Emerita of Voice and Voice Pedagogy at Shenandoah Conservatory, Winchester, VA (USA), has had an extensive international career as a performer, teacher, and researcher. Among her numerous achievements and prestigious awards, she is especially gratified by the 2011 dedication of the Shenandoah Conservatory Janette E. Ogg Voice Research Center, named in her honor for her contributions to ongoing research in the fields of Voice Science and Voice Pedagogy. During her 35-year tenure at Shenandoah, Dr. Ogg established and taught the first multidisciplinary class in 1987. In 1994, she received the coveted Van Lawrence Fellowship from the Voice Foundation and the National Association of Teachers of Singing for her contributions to the interdisciplinary approach to teaching Voice Pedagogy. Her vision and passion of realizing a terminal degree in Voice Pedagogy came to fruition from this groundbreaking class. It led to the creation of the MM in 1998 and the DMA in 2008, respectively. Her former students are not only actively performing in professional opera, theatre, television, film, nationally and internationally, but also are serving as voice teachers, choral directors, administrators in higher education, and researchers. They are published and actively present their research at major conferences—research that reflects the nature of the multidisciplinary approach.

As a performer, Dr. Ogg has appeared in opera, concert, chamber music, musical theatre, radio and educational television in the USA, Canada, Europe with International Music Festivals of Austria, Germany, Czech Republic, Hungary, Poland, Italy, Banff Festival of the Arts.

She holds a Doctor of Music degree in Vocal Performance from Florida State University, a Master of Music degree in Vocal Performance from the University of North Carolina, and a Bachelor of Arts in Speech and Drama from Asbury College.



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## Voice Pedagogy: What Do We Need? (no. 240)

B. Gill

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy
- Invited Keynote Lecture

**Panel Discussion with:** Janice Chapman, Norma Enns, Brian Gill, Christian Herbst, and Jeannie LoVetri  
**Moderator:** Brian Gill

Within the area of voice, vocal pedagogy is at the crossroads of science and practice. Many questions still remain in this relatively new area of study and while exciting advancements have been made, there are still myriad questions left unanswered. This panel discussion will feature five prominent vocal pedagogues from around the world who will briefly present their opinions on what vocal pedagogy needs in order to move forward. Each panelist will have approximately five minutes to present their ideas. This will be followed by an open discussion guided by questions from the moderator as well as questions from the audience. Some of the topics covered will include: developing a common vocabulary, contemporary styles, ideas for further research, areas of agreement and disagreement between voice teachers, singing in the community, how to get important information regarding healthy voice use to the masses, and interdisciplinary voice care.

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Brian Gill (tenor), D.M.A., Certificate in Vocology, 2011 Van L. Lawrence Fellowship Winner awarded by The Voice Foundation/NATS, is Music Associate Professor/Director of Vocal Pedagogy at the NYU Steinhardt School. He has performed numerous operatic and musical theater roles, concerts, and recitals in the US and abroad. In addition to NYU, Professor Gill has taught at Eastern Kentucky University, Pace University, The University of Kentucky at Lexington (graduate assistant, voice and diction) and the University of Colorado at Boulder in the Continuing Education program. A sought-after master clinician/guest lecturer, Professor Gill has taught/presented for The New York Singing Teachers' Association, US Army Soldier's Chorus, South Carolina Governor's School, Quisisana Regional Theater, NYU's department of Communicative Sciences and Disorders, The New York Voice Study Group, The Fall Voice Conference, The Voice Foundation, The National Center for Voice and Speech, The Acoustical Society of America, Physiology and Acoustics of Singing conference, Pan-European Voice Conference, and OPERA America. Abroad, Professor Gill has taught in France, Portugal, Sweden, and South Korea. His students perform throughout the United States and abroad, including The Metropolitan Opera, New York City Opera, English National Opera, Sante Fe Opera, Chicago Lyric Opera, Dallas Opera, Opera Royal de Wallonie, The Royal Opera House, LA Opera, On and Off Broadway, in Broadway national and international tours, The Soldier's Chorus, and many regional theaters in the US and abroad. Professor Gill has published in Voice Prints, Logopedics, Phoniatrics, Vocology, and The Journal of Voice.

# Voice Pedagogy: What Do We Need? (no. 241)

J. Chapman

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy
- Invited Keynote Lecture

How do we help the retired or retiring professional singer become a competent singing teacher? In the UK, this problem is largely not addressed – unlike other university departments, the teaching of singing is not subject to external assessment, and within music colleges and universities there is sometimes a haphazard approach to physiological and scientific information. My experience in the UK suggests that while this transition is generally a sensitive and difficult one, it is particularly problematic for very famous singers. I would like to propose a targeted resource, with multi-disciplinary input, (e.g. a website) to address this problem.

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## Keynote Panel: Voice Pedagogy (no. 242)

N. Enns

- **Form:** Oral Presentation
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy
- Invited Keynote Lecture

The future of vocal pedagogy lies in balancing traditional models, images and methods with the knowledge given us by the ongoing research community and the possibilities offered by new technological possibilities. Interdisciplinary co-operation is absolutely essential to the continuous development of appropriate vocal pedagogy strategies for the 21st century. Research must go beyond supporting things singing teachers already know, it must also be extended to a much broader cross-section of examinees. Teamwork between the medical and therapeutic disciplines, the teacher and the singer-patient must improve. New research into stylistic and language issues, specific pedagogies for various target groups, and better, more comfortable examination procedures must follow the many helpful developments to date.

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# Applicability of Kymography in the Evaluation of Glottal Insufficiency (no. p1)

E. Niebudek-Bogusz, M. Just, M. Tyc, M. Zacirka, M. Śliwińska-Kowalska

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Analysis of Voice and Speech

Documentation of diagnosed glottal insufficiency with one or two frames from a videostroboscopic sequence may lead to controversies, mainly because of subjective selection of the frames shown in the documentation. Reliable documentation of glottal insufficiency should clearly present motion of select parts of vocal folds. This can be achieved with kymography. However, a single kymographic section is not necessary representative for the overall condition of vocal folds, as the glottal insufficiency may only appear on a part of folds, and the selection of the place of kymographic section is still subjective.

The aim of this paper is to propose a documentation standard for glottal insufficiency using automatically generated set of kymographic sections from a specially processed videostroboscopic sequence. In contrary to video sequences recorded with high speed cameras, videostroboscopic sequences suffer from unwanted movements of laryngoscope tip during their relatively long recording. In addition, both kinds of slow motion sequences, stroboscopic and high-speed, require proper centering, rotating and cropping of the image. During this image processing, the often "shaky" videostroboscopic image is stabilized as well. First, two frames are selected from the slow motion sequence, which present the best both closure and opening of vocal folds. Then, the range of clearly visible vocal folds is marked. Finally, the software automatically generates a fixed number (8 frames as example) of kymographic section from equally spaced points in the marked visible range. Such a set of images should be easily verifiable for a qualified specialist. The presented system can be easily extended with a semi-automatic numeric parameterization of glottal insufficiency. To conclude, this tool seems to be an effective complement to examination of voice disorders.

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# Can Singing Teachers Trained in a Pedagogic Method (Complete Vocal Technique) Reliably Identify Elements of Sung Sound Examples? (no. p16)

J. McGlashan, M. Sayles, H. Kjelin, C. Sadolin

- **Form:** Poster
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

**Aim**  
To test the reliability of the Complete Vocal Technique (CVT)<sup>1</sup> pedagogic method in identifying sound elements from sound samples from different vocal genres

**Method**  
22 singing teachers with a median of 4.5yrs (range 2-25yrs) teaching experience were asked to listen to 11 short sound samples of different contemporary and classical songs. They were asked to describe each the sounds in terms that could be used in pedagogy to describe each element of the song. The results were compared to compared to those agreed by consensus of an expert panel of CVT teachers.

**Results**  
The first sound sample, for example, consisted of 12 elements with the last identified as having 3 sound qualities:

Element	Don't dream of women 'cause they only bring you down													
Descriptor	C	C	C	C	OD	C	C	OD	OD	C	C	C	Dis	Vib
(n=22)	16	19	19	20	10	15	16	21	17	18	16	10	20	7
%	72.7	86.4	86.4	90.9	45.5	68.2	72.7	95.5	77.3	81.8	72.7	45.5	90.9	31.8

(C= curbing, OD= Overdrive, Dis=Distortion, Vib= Vibrato)

The average agreement across the sound sample was 72.7% for the twenty-two singing teachers.

**Conclusion**  
The terminology used in the CVT pedagogical method when applied to sung sound samples appears to be used with a high level of agreement in CVT trained teachers.

1. <http://completevocalinstitute.com/>

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# Associations Between OXTR and AVPR1A Gene Polymorphisms and Self-reported Vocal Symptoms *(no. p31)*

S. Holmqvist, L. Westberg, A. Johansson, P. Santtila, E. Lindström, S. Simberg

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Occupational Voice

Most research regarding the etiology of voice disorders focuses on environmental risk factors and the genome as a contributing factor is relatively unexplored. However, several studies have suggested a genetic predisposition for vocal symptoms and vocal pathologies. Twin studies have shown that 35% of the variability in dysphonia between individuals is explained by genetic effects with the rest (65%) being explained by nonshared environmental effects. These results indicated genetic effects on voice, providing reason to further explore the role of genetics in the occurrence of vocal symptoms. One type of variation in the DNA sequence is called a single nucleotide polymorphism (SNP) and can account for differences in appearance, how we develop diseases or how we respond to drugs. Stress is a well known risk factor in the etiology of vocal symptoms and the oxytocin and vasopressin genes have been associated with social behaviour and stress. In the present study we wanted to explore the association between OXTR and AVPR1A polymorphisms and vocal symptoms reported by a population based sample of Finnish men and women (N=657). The sample consisted of 219 men and 438 women born between 1965 and 1989, who had completed a questionnaire including items regarding the occurrence of six vocal symptoms. The participants were a subset of the second data collection of the Genetics of Sex and Aggression sample where DNA and hormone samples were obtained. Effects of the OXTR and AVPR1A polymorphisms on the occurrence of vocal symptoms were calculated using the Generalized Estimated Equations (GEE) method, which takes into account the dependent structure of family data and therefore all family members could be included in the analyses. The 6 vocal symptoms were formed into a composite variable used in the statistical analyses. The preliminary analyses showed main effects of three of the OXTR SNPs and one of the AVPR1A SNPs on the occurrence of vocal symptoms. The effect of these genes and their polymorphism needs to be further explored.

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# Voice Quality in Acquired Immunodeficiency Syndrome (AIDS): Some Perceptual and Acoustic Findings *(no. p46)*

Z. Camargo, V. Medina, L.C. Rusilo, J.C. Gorinchteyn

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Acoustics

Studies indicate the prevalence of speech and voice disorders in patients with acquired immunodeficiency syndrome (AIDS). Yet, the correspondences between perceived voice quality and acoustic correlates in that population have not been described. There are about 222,551 people with AIDS in São Paulo, and it remains unclear what are the effects of long-term antiretroviral drugs. On describing the correlates between perceived voice quality and acoustic correlates, this work is thought to bring about some insights on the singularities of patients with AIDS. The studied group was composed by 20 subjects with AIDS (10 female and 10 male), aging between 50 and 60 years-old, with lipodystrophy (lipid abnormalities), who were cared for in the AIDS Service for Elderly Patients and who had been under antiretroviral therapy (between two and nine years). The control group was composed by 9 subjects, same age, 05 female and 04 male, with lipid abnormalities without AIDS (ethics committee: 71/2011). The corpus was composed by semi-spontaneous speech samples and repetitions of 03 key-sentences designed for perceptual evaluation by VPAS. From the acoustic point of view, data were submitted to ExpressionEvaluator script (Barbosa, 2009), running in PRAAT software, which automatically extracts measures related to  $f_0$ ,  $f_0$  1st. derivate, intensity, spectral slope and LTAS. Preliminary statistical treatment was carried out in order to define basis for results presentation. Among the sociophonetic factors studied, gender was found to be the most influential variable and was considered in the multivariate statistical approach (discriminant analysis, linear regression, logistic regression and canonic correlation). The results showed a significant prevalence of supralaryngeal voice quality settings for the studied group: tongue body (retracted and lowered), pharyngeal constriction and supralaryngeal vocal tract hyperfunction, which had the discriminatory power of detecting studied (98.68%) and control (98.31%) samples (correlation factor -  $R^2$ : 85.4%). These findings were related to laryngeal settings, such as harsh and creaky voices and breathiness. Acoustic measures showed a lower correlation factor ( $R^2$ : 36.5%) in detecting the studied (77.37%) and control (77.53%) samples. For the sake of corresponding acoustic measures and perceived voice qualities,  $f_0$  (specially for female), and spectral slope and LTAS (specially for male) were relevant. The time under medication was found to be another influential variable in perceptual analysis ( $R^2$ : 63.30%). The tendency towards supralaryngeal and tension voice quality settings may be related to the reports of specific effects of lipodystrophy on vocal tract and also upper airway infections due to opportunistic infections and demand an effort in developing investigations to continue to address these issues and designing strategies to prevent some disturbances in long-term follow-up of AIDS patients.

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# Applicability of Cepstral Analysis in the Diagnosing of Benign Vocal Fold Masses *(no. p2)*

E. Niebudek-Bogusz, J. Grygiel, P. Strumiłło, E. Woźnicka, M. Śliwińska-Kowalska

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Acoustics

## Background

Recently it has been stressed that voice production is subjected to the nonlinear processes, which cause aperiodic glottis vibrations. These vibrations cannot be always characterized by means of conventional acoustic parameters, such as measurements of frequency and amplitude perturbations. Thus, special attention is paid recently to nonlinear acoustic methods.

## Aim

The aim of this study was to assess the applicability of nonlinear analysis, including evaluation of mel cepstral coefficients (MFCC), in the diagnosing of occupational voice disorders.

## Material and methods

The study involved 275 voice samples of pathologic voice (sustained vowel "a" and four standardised sentences) registered in female teachers with the benign vocal fold masses (vocal nodules and polyps) and 200 voice samples of normal voices from control group females. The mean age of patients and controls was similar: 45 vs. 43 years. Voice samples were analyzed with the evaluation of MFCC.

## Results

Classification of MFCC by the Sammon Mapping and Support Vector Machines yielded a considerable accuracy of the test. Voice pathologies were detected among 475 registered voice samples: for vowel "a" at 86% sensitivity and 91% specificity, and for the examined sentences the corresponding values varied between 86% and 100% respectively. Consequently it is expected, that the first twelve MFCC will be significant enough to assess voice pathologies. Concluding, nonlinear voice analysis with application of mel cepstral coefficients could be an useful and objective tool for confirming benign lesions of glottis.

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# Effects of a Two Day Workshop on Complete Vocal Technique on Ability to Describe the Voice Qualities in the Singing Voice *(no. p17)*

J. McGlashan, M. Sayles, H. Kjelin, C. Sadolin

- **Form:** Poster
- **Category:** Voice Pedagogy
- **Topic:** Voice Pedagogy

Eleven participants in a two day workshop on the Complete Vocal Technique (CVT) pedagogic method of singing were asked to describe 11 singing voice samples from a variety of genres before starting the workshop (Test 1) and at the end of the second day (Test 2). The participants were from a variety of backgrounds including singing teachers, singers, speech therapists and other voice professionals. The results of Test 1 showed a non-structured approach with variety of descriptive terms used with little consistency. The results of Test 2 showed that the participants used the new terminology introduced in CVT in a more structured way which reflected improved abilities to analyse the singing voice qualities of the sound elements in the samples.

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# Basilar Membrane Excitation Patterns of Rough Sounds Simulated by Means of an Auditory Model *(no. p32)*

V. Vencovský, M. Frič

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Modelling/Simulation

Pure tone can be characterized to sound rough when it is amplitude or frequency modulated. Perception of roughness can also occur when two pure tones differing little in frequency are presented simultaneously. Hydrodynamical cochlear model simulating the basilar membrane response to sound stimulation is used to get the impression about the basilar membrane excitation patterns caused by rough signals. The model was designed to simulate the real behavior of the cochlea in small mammals, specifically magnitude and phase characteristics of cochlear filters obtained during physiological experiments. Model parameters were then adjusted to simulate the human cochlea. Since it is not possible to conduct *in vivo* experiments in human cochlea, the model was verified by means of psychophysical experiments. The model can much better than other types of cochlear models (e.g. widely used filterbank models) predict masking experiments with complex sound signals. Perception of roughness is often being associated with a situation when more spectral components falls into the same cochlear filter which is the case of complex sound signals used in the masking experiments. The hydrodynamical cochlear model was thus chosen to simulate the basilar membrane excitation patterns in response to rough sounds.

The model output was first obtain in response to two 60 dB SPL pure tones with gradually increasing frequency difference from 10 Hz to 140 Hz, lower tone fixed at 400 Hz. Strong amplitude modulation is visible in the excitation patterns up to 60 Hz frequency difference. Decomposition of the excitation patterns into two components and decrease of amplitude modulation depth is then obvious for higher frequency differences.

The second signal was composed of three harmonic components. Frequency of individual harmonics was 200, 400 and 600 Hz and levels 60, 40 and 30 dB SPL respectively. 300 Hz pure tone was added to the complex tone in order to cause a perception of roughness. Level of the pure tone was increased from 20 dB to 60 dB SPL. Excitation patterns without the pure tone show three separated vibrating regions on the basilar membrane. Each of them corresponds to one of the harmonics. Added signal causes pattern with 100 Hz period in the region between the first and second harmonic. This is accompanied by a perception of roughness.

The model was finally used to obtain excitation patterns of speech signals with and without roughness. Speech signals were recorded during videokymographical examination when the subjects were asked to produce sustained vowels. Continuous signals contained passages with roughness and passages without roughness. Diplophonia was examined as a cause of the roughness. Amplitude modulation can be again visible in the basilar membrane excitation patterns of rough signals. Disordered voices also causes irregular patterns in parts were more harmonic components fall into one cochlear filter.

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# Acoustic and Perceptual Correlates of Voice: Trends Between Short and Long-term Analysis *(no. p47)*

Z. Camargo, R. Moraes Queiroz, L.C. Rusilo, S. Madureira

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Acoustics

A great number of factors influencing voice quality patterns have not been addressed in studies focusing acoustic-perceptual correlations. Furthermore, there are few studies describing the correspondences between short and long-term acoustic correlates of voice quality. The present study aims at investigating the correspondences of some short-term (H1-H2) and long-term acoustic measures (f0 and f0 1st. derivate (df0), intensity, spectral slope (SpSl) and long-term average spectrum (LTAS) frequency standard-deviation) and their power to predict laryngeal and tension voice qualities based on the application of statistical methodological procedures. The corpus was composed by semi-spontaneous speech samples and 05 repetitions of 3 key-sentences samples, recorded in a sound proof room by 29 subjects (11 male and 18 female). Automatic measures (f0 and df0, intensity, SpSl and LTAS) were extracted by means of the ExpressionEvaluator script (Barbosa, 2009). The same samples were perceptually evaluated, using the Vocal Profile Analysis Scheme for Brazilian Portuguese: BP-VPAS (Camargo, Madureira, 2008). Short-term measures (H1-H2) of the vowel [a] in stressed and pre-stressed syllables of the key words in the selected sentences were extracted. The short and long-term acoustic measures and voice quality settings judgments were statistically analyzed in order to investigate the validity of each acoustic parameter to predict voice quality settings related to neutral and non-neutral laryngeal and tension settings groups (discriminant analysis, canonic correlation and linear regression). The results showed the segregatory power of long-term acoustic measures to predict neutral (79.12%) and non-neutral (74.95%) laryngeal and tension settings. The relevant measures to detect neutral setting (modal voice) were f0 e df0, with segregatory power of 82.42%. On the other hand, for the non-neutral settings in laryngeal and tension domains, the combination of SpSl and LTAS measures was influential, with segregatory power of 65.87%, especially for laryngeal hyperfunction and raised larynx settings. Although differences have been found between neutral and non-neutral settings (exceptions for creaky voice and laryngeal hypofunction for male and creaky voice for female), the correlation between H1-H2 measures and voice quality settings was not relevant (R2: 20% for male and 2.9% for female samples). H1-H2 did better in differentiating speaker's gender (73.43% for female and 66.57% for male). The results reinforce the relevance of long-term analysis for voice evaluation, especially to establish acoustic-perceptual correlations and the demand for improve systems of non-modal vocal fold vibratory patterns recognition.

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# Voice Disorders among Education Professionals in Portugal: Prevalence, Risk Factors, Occupational and Economic Impact *(no. p3)*

C. Martins, J. Figueiredo, L. Metello, A. Araújo

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Occupational Voice

Education Professionals (EP) are the Voice Professionals with the highest prevalence of voice disorders (VD) and several studies have focused their reality. The objective of this study was to assess the prevalence of VD in EP in Portugal verifying its impact in their professional performance and its related economic impact.

A cross-sectional quantitative and descriptive study was carried out in a sample of 279 EP with a mean age of  $39.62 \pm 9,6$  years, using an online survey.

Approximately 55.4% of the EP revealed some type of VD. The most frequent symptoms were: dry throat (56.1%), need for throat clearing (50.2%) and extra effort to speak (45.2%). Associations ( $p < 0.05$ ) were found between VD and several intrinsic factors such as: gender, gabbler and anxious profile, level of tiredness, habit of screaming, presence of some pathological conditions and stressful working environment.

Voice quality was described to be affected by the work shift ( $p = 0.000$ ) and 40.0% of the EP showed an occupational limitation due to VD. The absenteeism of these professionals was 25.9%, with an annual average of 1.5 days. It was also showed a positive moderate to strong correlation between the VD's frequency and professional performance (understanding of the message, peer relationships, avoidance of interaction with others and professional image). National costs of approximately 4.5 million euros per year were estimated for education professionals, considering the impact of VD.

The impact of VD in EP was shown to be an important issue, either in individual and institutional performances, but also in the country's economy. There is urgent to define occupational voice health measures in Portugal in order to prevent VD and to improve economic and functional performance of all the involved parties.

**Keywords:** Professional Voice, Voice Disorders, Education Professionals, Prevalence, Occupational Impact, Economic Impact

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# The Closure of the Posterior Glottis: True or a Geometric Condition? (no. p18)

C. Storck, M. Hofer, B. Neumayer, S. Stollberger, B. Gogos

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Imaging

## Background

During laryngoscopy, the posterior glottis is open often in female larynges while in male larynges the posterior glottis seems to be closed. The aim of this study was to analyse the glottal closure during phonation by means of three-dimensionally rendered cadaver larynges.

## Material and Methods

23 cadaver larynges were examined with Magnetic Resonance Tomography (MRT) and MIMICS® 3D-imaging software (15m, 8w) in phonation position of the vocal folds. The mucosal thickness, the posterior glottal dome and the distance of the vocal processes were measured.

## Results

Only in one male larynx, the posterior glottis was completely closed. In all other larynges a small window was still open. The mucosal thickness on vocal fold level was thicker in male larynges (3.2mm) than in female larynges (2.6mm).

## Conclusions

Our analysis showed, that the posterior glottis is open nearly in all larynges. The assumption, that the posterior glottis is closed during laryngoscopy seems to be caused by the anterior inclination of the larynx, the arytenoid cartilages and the interarytenoid bar respectively.

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# EGG and Acoustic Differences Between Emotionally Loaded Vowels Produced With Mono and Varying Pitch *(no. p33)*

T. Waaramaa

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

Vocal emotions are known to be communicated mainly through fundamental frequency (F0) and sound pressure level (SPL). The aim of the present study was to investigate which vocal parameters are used to convey emotions instead of F0 if the pitch is predetermined as in singing, and whether different EGG threshold levels differentiate between emotions, valence (on an axis negative-neutral-positive), activity level or gender.

Protracted emotionally loaded vowels [a:], [i:], [u:] produced by professional actors (n2) and actresses (n2) with mono (n96) and varying pitch (n96) expressing eight emotional states were studied for acoustic parameters F0, SPL, filter characteristics, duration and alpha ratio measured by Praat Software. Contact quotient (CQEGG) was calculated from the EGG signal with VoceVista program using 35%, 55% and 80% threshold levels.

When genders were studied together, One-Way ANOVA test showed significant differences between mono-pitched and freely varying vowels for F0, F3, F4, CQ 35%, CQ 55%, CQ 80%, duration, SPL and alpha ratio. Valence differed significantly for F0, F3 and F4, and activity level for the three threshold levels measured. When genders were compared, they differed significantly for all the parameters measured except for SPL and alpha ratio.

In the mono-pitched expressions, voice source characteristics, reflected in CQEGG threshold levels 55% and 80%, tended to be related to the activity level in males. Females tended to communicate valence and emotions by the vocal tract settings, reflected in F4.

When the pitch was varied freely the vowels produced showed significant differences in emotions for F0 and SPL in both genders. In males, valence differed significantly for F0 and CQ 35% threshold level which was smaller in positive than in negative valence. In females, valence differed significantly for F0 and F3 which was highest in positive valence. Emotions differed significantly in females for CQ 80% threshold level being smaller in positive emotions than in the negative emotions. Valence seemed to be expressed by varying F0 and either voice source characteristics (males) or filter characteristics (females), independently of SPL.

Emotional expressions tended to vary between vowels produced with mono or varying pitch. Gender differences were found for all three threshold levels measured. When the pitch was predetermined males seemed to use voice source characteristics and females vocal tract settings to modify their expressions for activity or valence/emotions. In the varying pitch utterances valence tended to be expressed on the threshold level CQ 35% in males, and emotions in females on the threshold level CQ 80% and also by F3. Greater opening time of the glottis indicates more hypofunctional voice quality in females, which may raise the third and fourth formant frequencies. The interplay between different threshold levels and formant frequencies warrants further study.

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# Choir Singing Therapy: Voice Outcomes from a Feasibility Study (SPICCATO) of People with Parkinson's Disease and Stroke (no. p48)

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- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

Singing has been suggested as a therapy for people with Parkinson's Disease (PD) to improve breathing, posture, intonation and loudness, and for people with non-fluent aphasia, as it could help to 'rewire' the brain to improve language recall. Recent small-scale controlled studies have provided limited evidence that singing in a choir can improve voice/speech, respiration, quality of life, health and wellbeing in people with neurological disease. No study has examined outcomes for a mixed choir for people with different neurological conditions. This feasibility study aimed to assess the stability, practicality and acceptability of voice measures outcomes, and to investigate relative improvements in vocal function to determine the feasibility of conducting a clinical trial using mixed methods to evaluate the therapeutic role of singing and choir participation for people with stroke and PD. Fourteen CeleBRation Choir members have been assessed: 8 Stroke (3 females/5 males) and 6 PD (2 females/ 4 males), mean age 63 years (SD 12.5), at three measurement points: Baseline (before 12-week block of choir sessions), Midway (after 6 weeks choir sessions) and Final (after 12 weeks choir). Voice measures included sound pressure level (SPL), maximum phonation time (MPT), auditory perceptual and acoustic analyses (sustained vowel, connected speech and pitch range), and self-assessment questionnaires. Mean F0 showed a statistically significant gender effect for all tasks, as expected ( $p \leq 0.001$ ). Overall the stroke group had higher mean F0 than PD. Mean F0 was more consistent over repeated assessments than other voice measures. Semitone range showed a statistical trend for improvement over time ( $p = 0.079$ ) for the pitch range task. The stroke group improved at the final assessment. The PD group showed a consistent semitone range over time, with consistently high values. Comparisons across tasks showed that, for Mean F0, the reading task appears to be the most consistent over time. Reading produced the highest semitone range (25–27 semitones) across tasks. SPL (Lceq) measures were sensitive to change across MPT /ah/ repetitions; the third (last) repetition produced significantly higher sound levels than the first two. The overall effect of time on QASD (Questionnaire for Acquired Speech Disorders) and difference for final versus initial VRQOL (Voice-Related Quality of Life) were significant. A randomised controlled trial has been planned to establish whether choral singing therapy in a mixed neurological choir is beneficial for voice/speech and language, and psychosocially for people with PD and after stroke.

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# Artistic Voice Professionals: Prevalence, Risk Factors, Medical Seek and Occupational Impact *(no. p4)*

C. Martins, J. Figueiredo, L. Metello, A. Araújo

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Occupational Voice

Singers and actors are artistic voice professionals (AVP), a group with high voice demand and dependence. Even minor voice disorders (VD) may produce important consequences in their performances. The objective of this study was to assess the prevalence of VD in AVP in Portugal verifying its association with several risk factors and its impact in their professional performance.

A cross-sectional quantitative and descriptive study was carried out in a sample of 41 AVP with a mean age of  $31.24 \pm 8.6$  years, using an online survey.

Approximately 38.1% of the AVP revealed some type of VD. The most frequent symptoms were: dry throat (48.7%), need for throat clearing (42.5%) and difficulty to produce low and high pitched sounds (35.2%). Associations (p

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# Epidemiological Findings from a National Survey of Voice Problems in New Zealand Teachers *(no. p19)*

S. Leão, J. Oates, S. Purdy, D. Scott, R. Morton

- **Form:** Poster
- **Category:** Voice Pedagogy
- **Topic:** Other

Epidemiological studies of specific populations are essential to underpin prevention and treatment programs. Although teachers' voices have been widely studied in other parts of the world, this study provides the first prevalence data for voice disorders in New Zealand (NZ) teachers. Of 2339 teachers from all NZ regions who accessed the survey, 1888 provided sufficient data to be included. Prevalence data were estimated for three time-frames: 32% (teaching career), 24% (year), and 13% (current). Primary teachers ( $p < 0.001$  /  $OR = 1.74$ ), females ( $p = 0.008$  /  $OR = 1.63$ ) and those aged 51-60 years ( $p = 0.01$  /  $OR = 1.45$ ) were more likely to report voice problems. Mild voice problems were reported by 52%; moderate (37%), and severe (11%). Recovery time varied: 70% (<1 week), 23% (1 to 4 weeks), and 7% reported chronic problems (>4 weeks). Teachers with more severe problems took longer to recover, in the expected direction. During the 12-month period, approximately 64% of teachers kept working, 28% stayed away from work from 1 to 3 days due to a vocal problem, and 9% stayed away for more than 3 days. The most frequently reported symptoms were throat discomfort, voice quality alterations, vocal fatigue and singing difficulties. Less than 8% of teachers had attended voice training or a vocal care program during teaching training or since qualifying as a teacher. Of teachers who reported voice problems, only 22.5% consulted a health practitioner. Only 38% of teachers with chronic voice problems visited an otolaryngologist. This research revealed that voice problems are a concerning problem among NZ teachers and that there is limited awareness among teachers about their vocal health and available specialized health support for these problems.

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# Perception of Emotional Nonsense Sentences in Egypt, Estonia, Finland, Russia, Sweden and the USA (no. p34)

T. Waaramaa

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Perception of Vocal Emotions

The focus of the present study was on the perception of emotions and valence (on an axis positivity-neutrality-negativity) from nonsense vocal samples, and if the perception was dependent on culture, language or gender. Listening tests for 300 participants were conducted on location in six countries: Egypt, Estonia, Finland, Russia, Sweden and the USA.

Emotional nonsense sentences (n32) were produced by Finnish professional actors (n2) and actresses (n2) expressing eight emotions: anger, disgust, fear, interest, joy, sadness, surprise, and a neutral emotional state. The two-sentence nonsense utterances were measured for F0, SPL, alpha ratio, duration and syllable duration of each expression in order to study possible rhythmic differences between the emotional expressions. The calculations were conducted with Praat Software, and statistical analyses by SPSS 19. In the perception tests the listeners used headphones and answered orally which of the eight emotions they perceived. The tests were conducted one by one with the listeners. Cultural differences occurred in the testing procedure concerning the level of privacy or quietness. A translator was needed in Egypt and Russia.

The mean duration of the nonsense sentences was 9652 ms. Sentence duration varied significantly negatively between sadness and anger ( $p = 0.039$ ), the mean of the syllable duration between sadness and surprise ( $p = 0.026$ ) being shorter in surprise. Standard deviation calculated from the syllable durations differed significantly between genders ( $p = 0.006$ ) being greater in females than in males for all the emotions expressed except neutrality. A positive correlation was found between SPL and alpha ratio ( $r = 0.470$ ).

Cronbach's alpha was 0.876 for the perception of the emotions. Valence was perceived with 88% accuracy. No gender differences were found in the perception test. The sentences were perceived significantly differently between Finland and Egypt, Russia, Sweden and the USA, and between Estonia and Russia ( $p < 0.05$ ). Excluding neutrality, sadness followed by disgust and interest were the most frequently chosen emotions for an answer, and joy most rarely. Anger and disgust as well as surprise and interest were frequently confused. However, anger was perceived as interest fairly often.

The results showed significant differences in perception accuracy between Finnish and the listeners in the other countries, excluding Estonia. Hence it was concluded that the language background may have an effect on the perception of the emotional content of the speech even without actual words. The perception may be based on familiarity with the speech prosody, and in Estonia on the linguistic relationship between the Estonian and Finnish languages. The cultural similarity between Finland and Sweden did not seem to affect the perception as much as the language background.

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# Glottal Incompetence: Proposal of an Evidence Based Therapy (no. p49)

P. Melo Pestana, S. Vaz Freitas

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Treatment Methods

## Introduction

The glottal incompetence is a term that, despite being regarded as general, it reflects the dysfunction of the vocal folds on voice and swallowing.

An incompetent glottis, as the name suggests, results in an asthenic voice, at first. After the onset of the disorder, patients can develop compensations, even involuntary ones, intending to bring the voice to a normal state. The lack of literature to assist the clinical decision making in these areas, especially concerning glottal incompetence, is big. Often, the solution to glottal incompetence depends on a surgery. The costs, the impact and the consequences of surgery can be, sometimes superior than the Speech Therapy intervention.

With this work we intend to provide a tool to support therapeutic decision-making when facing a case of glottal incompetence.

They can be denominated as: paralysis and paresis of the vocal folds, atrophy or presbylarynx, loss of soft tissue or scars, or the combination of these conditions. The intervention adopted by the Speech Therapist is customized to each case. The main determinants of the therapeutic goals are the laryngeal findings and, as a consequence, to the authors divided into two categories: glottal incompetence and glottal insufficiency.

## Materials and Methods

It was elaborated a scheme (Conceptual Classification of Glottal Closure Disorders) that aims to categorize incomplete glottal closure into glottal incompetence and glottal insufficiency. This scheme contains inclusion criteria as well as the most common clinical symptoms.

In addition, it presents an original flowchart supported in literature review and an applied/tested therapy program that was implemented in real cases from a Central Hospital ENT Service.

The need for intervention depends on the affection of, at least, one glottal function that depends on the complete glottis adduction. So, it could be a vocal or swallowing and breathing problem. In the flowchart, the intervention is defined by priorities.

In cases where the intervention has been successful, the patient must be discontinued or in a follow-up program to control the laryngeal characteristics and its consequences to the treated functions. If the results are unsatisfactory, the SLP must rethink the therapy and the reasons of the failure. The intervention should continue until one or more of the following criteria are achieved: 1) normal voice / similar to premorbid quality, 2) enough, but changed, voice enabling the social and professional integration of the patient, 3) recovery of complaints and symptoms relating to respiratory and sphincteric functions.

## Conclusion

In conclusion, we designed a model based on theory and practice that supports therapeutic decisions about cases with glottal incompetence.

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# Developing Voice Perceptive Assessment Competences Using RASATI Scale: An Experiment with Speech Therapy Students *(no. p5)*

I. Moura, V. Pinto, A. Araújo

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Examination Techniques

## Introduction

Voice quality perceptive assessment is a fundamental practice for Speech Language Therapists (SLT). This analysis complements voice assessment procedures and continuously guides therapeutic processes. This is a complementary measure also for other health professionals as well as for singing and acting voice users. Although voice quality is considered a subjective voice parameter, there are several scales that objectify the assessment within and among listeners, using different voice parameters and measuring systems. A commonly used scale in Portuguese expression countries is RASATI, an adapted version of GRBAS, including parameters as: R – rouquidão (roughness); A – aspereza (harshness); S – soprosidade (breathiness); A – astenia (asthenia); T – tensão (strain); I – instabilidade (instability). Previous studies identified that several factors, as professional education, listener's experience or listening conditions, have influence on the assessment's reliability. Previous research carried out different experiments using SLT students and non-professional listeners. Using different training methods different results were reached, but they all conclude that auditory training is a fundamental method to increase assessment reliability. This study aims to analyze the effects of an auditory training program for SLT students, using RASATI scale.

## Method

A sample of 23 SLT students was used in a quasi-experimental study. This study started in the first contact with voice quality scales for voice samples' analysis. Students were divided in two independent groups and exposed in different moments to an auditory training protocol designed to develop voice quality assessment abilities. The protocol was applied in different consecutive weeks for each group, so they became each other control. Audio samples of 15 normal and disordered voices were used for listening tests using RASATI in 4 different moments: a) before the training, b) immediately after the training, c) one week after and d) two months after the training. Results were compared with standard measures obtained from a 3 experienced STL panel, using the same scale.

## Conclusions

Results show that the training modified and standardized students' assessment decisions in all voice parameters. However, over time classification returned to high dispersion measures in all parameters. This reveals that a single moment training may not be enough to produce long term effects. Roughness and instability were the parameters with lower influence of time and training process. The experiment produced an approximation of students to professional SLT assessments for all parameters except asthenia. Perceptual auditory training seems to potentiate students' assessment skills, although it may need a continuous and oriented process to ensure better results and reliable assessments of voice quality.

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# Phonatory Characteristics of Male Fado Singers: An Exploratory Study (no. p20)

F.M.B. Lã, J. Sundberg

- **Form:** Poster
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Fado is the most traditional Portuguese music genre, recognised as Portuguese intangible cultural heritage by UNESCO in 2011.

The origins of this particular musical genre are still subject of several on-going debates. Despite the inconclusive discussions, one might agree that Fado is an urban singing style originated in the middle 19th century, in economically deprived neighbourhoods of Lisbon. Since then, Fado spread out to other cities of Portugal, such as Coimbra, sprouting into slightly different styles. For example, the Fado/Canção from Coimbra is sung outdoors by male singers only, with the guitars tuned one tone lower than the ones accompanying Fado from Lisbon. Despite descriptions of sound quality of Fado singing exist in the literature, these are mainly subjective and do not include acoustical and physiological analyses of the Fado singer's voice.

Three singers of Fado/Canção from Coimbra were recorded. Singers were asked to perform a representative Fado/Canção sung with the lyrics and substituting the lyrics by the syllable /pae/. Recordings used a combination of a Digital Laryngograph Microprocessor and the Glottal Enterprises MS-110 computer interface to allow simultaneous recordings of (a) audio, (b) electrolaryngograph, (c) oral pressure and (d) flow signals.

Data analyses consisted of both acoustical and voice source parameters. The former included: (i) Equivalent Sound Level (Leq); (ii) Long-term Average Spectrum (LTAS); (iii) alpha ratio ( $\alpha$ ); and (iv) estimate of F0 dominance from the LTAS curve (H1-H2)LTAS. The voice source analyses were carried out using the custom made Decap software (Svante Granqvist, KTH). It allowed calculations of: (i) maximum flow declination rate (MFDR); (ii) normalized amplitude quotient (NAQ); (iii) level difference between the first and second partials of the source spectrum H1-H2; and (iv) closed quotient (Qclosed).

The LTAS slope was found to be steep in the region above 1kHz;  $\alpha$  presented low values ( $\alpha$ Mean = -7,14). These may suggest that high glottal adduction and a high subglottal pressure do not constitute characteristics of this singing style. With respect to the lower portion of the spectrum, the second harmonic was on average always dominant in relation for the first one (H1-H2(LTAS) = -0,8 dB).

As expected in outdoors singing, and despite the use of voice amplification, Leq was high (Leq = 91,69 dB). NAQ values were also high. As this parameter is inversely related to perceived level of pressedness, it seems that Fado/Canção from Coimbra can be perceived as a non pressed singing style. Moreover, the high values of MFDR suggest that, overall, this style of singing show signs of vocal efficiency.

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# Analysis of Vocal Fold Vibrations Using High-speed Digital Imaging in Patients with Vocal Fold Paralysis (no. p35)

A. Yamauchi, H. Imagawa, H. Yokonishi, K.-I. Sakakibara, R. Ueha, Y. Nito, N. Tayama, T. Yamasoba

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Imaging

## Backgrounds

Patients with vocal fold paralysis frequently demonstrate severe dysphonia, resulting in poor synchronization with laryngostroboscopy.

## Materials and Methods

In the present study, the authors conducted a retrospective study using high-speed digital imaging (HSDI) to clarify the vibratory characteristics of 106 patients with vocal fold paralysis (males, 66; females, 40; and the mean age, 64) in comparison with 46 vocally healthy subjects (males, 17; females, 29; and the mean age, 32). HSDIs of speaking fundamental frequency of patients with vocal fold paralysis and vocally healthy subjects were recorded at 4500 fps, and images were assessed qualitatively with a rating form for HSDI, and quantitatively with laryngotopography, multi-line kymography and glottal area analysis.

## Results

In patients with vocal fold paralysis, HSDI was not feasible in 18% due to supraglottic hyperactivity while videostroboscopy was not feasible in 55% due to supraglottic hyperactivity and poor synchronization. With an HSDI assessment form, vocal fold paralysis patients more frequently revealed asymmetry, glottal gap, lateral phase difference, and quasi-periodicity than vocally healthy subjects. With laryngotopography, quasi-periodicity was pointed out in 31% of vocal fold paralysis patients, among which a frequency ratio of 2:3 was predominant; and lateral phase difference was significantly higher in vocal fold paralysis patients. With multi-line kymography, vocal fold paralysis patients revealed significantly higher open quotient. Analysis of glottal area revealed significantly higher glottal gap, higher maximum glottal area, smaller glottal area difference and smaller supraglottic area. Desynchronized patients demonstrated significantly poorer HSDI parameters than synchronized patients. Furthermore, with multivariate analysis, open quotient in multiline kymography revealed significant correlations with MPT, MFR, and HNR, and supraglottic area revealed significant correlations with MFR and HNR.

## Conclusions

With the use of HSDI, vibratory characteristics of vocal fold paralysis patients were qualitatively and quantitatively described. Multiple HSDI analysis methods utilized in the present study are considered to be effective in the assessment of severity of dysphonia.

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# Evaluation of Dysphonic Severity for Cantonese-speaking School-age Children: A Multi-parametric Approach *(no. p50)*

E.P.-M. Ma, Y. Lam

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Child's Voice

## Background

Currently, there is a lack of pediatric normative database on how Cantonese dysphonic children manifest differently from vocally healthy Cantonese children in terms of vocal functions. Data reported in the literature on English-speaking children cannot be directly applied to Cantonese-speaking children because Cantonese is a tone language and English is a non-tone language. Voice measures can manifest differently between tone and non-tone languages.

## Objective

The aim of the present study was to evaluate the dysphonic severity for Cantonese-speaking school-age children using a multi-parametric approach.

## Methods

Thirty dysphonic children with laryngeal pathologies and 30 controls with normal voices participated in the study. All children were native Cantonese speakers and were aged from 6 to 12 years. Each child undertook several voice recordings for perceptual, acoustic perturbation, voice range profile (phonetogram) and aerodynamic evaluation.

## Results

The dysphonic group demonstrated significantly more severe voice quality ( $p < 0.001$ ) than the control group. The dysphonic group also demonstrated significantly smaller voice range profile area ( $p < 0.001$ ), shorter maximum phonation time ( $p < 0.001$ ), significantly higher level of jitter and shimmer values (both  $p < 0.01$ ) than the control group.

## Conclusions

The study provides a preliminary database of vocal functions in Cantonese-speaking children.

## Acknowledgement

This study was supported by a grant from the Hong Kong Research Grant Council General Research Fund (HKU 774110M).

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# Electrostimulation of Immobile Vocal Cord - Methodology in our Modification *(no. p6)*

J. Traboulsi, V. Štípková, M. Perníčková, T. Vaverková, J. Astl

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Rehabilitation of the Voice

Electrotherapy is part of physical therapy, in which the therapeutic effect of different forms of energy is used. Impulstherapy is a part of electrotherapy that utilizes therapeutic effect of precisely shaped current pulses. Since 2010 we added this method as an adjunct therapy for patients with iatrogenic and idiopathic vocal cord paresis. We have tried to modify the methodology to suit our conditions and at the same time, if possible, reaching a maximal therapeutic effect. Based on past experience we consider this method as a suitable supplement therapy in the above-mentioned group of patients. The optimum appears to us to use it in conjunction with voice therapy. It is well tolerated for patients and significantly contributes to the psychological component of treatment.

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## Resonance of Singing Voice (no. p21)

K.A. Jačková-Kadlecová, M. Frič

- **Form:** Poster
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

The aim of the presentation is to outline the problems of interpretation of the term resonance of the voice and share the experiences of the authors with the complex classification of the type of resonance of the voice. The origin and modification of the human voice from a point of view of acoustic properties is influenced by resonant cavities above and below the vocal cords. The shape, size and structure of the resonant cavities are the real sources of voice timbre. In the vocal pedagogy as resonant spaces are also other areas (volumes) considered as sources affecting the resulting timbre. As resonant spaces the areas starting from the cranial bone until the abdominal cavity are considered. Resonance is described as a physical phenomenon in which occur vibrations due to the vocal cords and finally amplification of the sound using resonance cavities.

Important is, that the vocal system, resonant cavities, articulator etc. create final sound - the human voice. This sound includes even more acoustic properties that are unique to each individual. In practice, the resonance is associated especially with properties such as capacity, sonority and timbre of voice.

Resonance of voice is often classified as given by chest, head, and mixed (according to the prevailing subjective feeling vibration in the chest or head). Our aim was to determine if this criterion of the types of resonance is really objective. Quality of vocal resonance and timbre are always considered in a whole. Other aspects such as art and aesthetics, emotionality, etc. are also included.

The resonance and voice timbre are also closely related to vocal registers and modes. Usually the type of resonance is mainly associated with a pitch, thus with using a specific voice register etc.

We assumed that even an experienced singer will not be able to perform separately the different types of resonance of particular tones in the chest and head register. Therefore, the aim of objective listening tests were to compare the mutual consistency used in distinguishing subjective opinion of a resonance between the evaluator and the subject under the test and among the evaluators themselves.

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# Vocal Fold Atrophy Patients in a Japanese Tertiary Medical Institute: Demographics and Treatment (no. p36)

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- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Rehabilitation of the Voice

Japan is facing an unprecedented expansion of the 65-and-older subpopulation, and patients with presbylarynx, age-related vocal fold atrophy, are rapidly increasing. Reports on treatment of vocal fold atrophy were, however, limited in number.

In the present study, the authors conducted a retrospective study to investigate the demographics and treatment on patients with vocal fold atrophy at the Voice Outpatient Clinic of the Department of Otolaryngology of the University of Tokyo Hospital, a tertiary medical institute in Japan.

At the authors' department, 37.0% of newly referred patients were aged 65 and over between 2006 and 2012. Patients with the diagnosis of vocal fold atrophy during this period were 128, 91 of which were 65-and-older (presbylarynx). Of 128 vocal fold atrophy patients, 85 chose no further treatment; 32 underwent collagen injection laryngoplasty; 5 underwent lipoinjection laryngoplasty; 4 underwent voice therapy; 1 underwent injection laryngoplasty and voice therapy; and 1 underwent thyroplasty type 1. Post-treatment follow-up period was 6.1 months on average. Thirty-one of 38 patients treated with injection laryngoplasty revealed subjective voice improvement. Questionnaire scores on dysphonia (VHI-10 and VRQOL) also revealed significant post-therapeutic improvement. In objective parameters, MPT, and MFR revealed significant post-therapeutic improvement. There existed, however, no significant differences in the ratio of patients with good synchronization with laryngostroboscopy, APQ, PPQ, and HNR. While lipoinjection was selected in more dysphonic patients preoperatively than collagen injection, the post-therapeutic results of both groups were statistically equivalent. There were no age- or gender-related differences in the therapeutic effect of injection laryngoplasty.

Although injection laryngoplasty augmenting the body of vocal fold was effective in the improvement of glottal incompetence, therapeutic effect on roughness was limited. Further application of voice therapy which improves the breath support and laryngeal coordination, and implementation of treatment targeted at the cover of vocal will be essential.

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# Identifying Voice Problems in School-age Children: A Comparison Between Teacher, Parent and Speech Pathologist Reports *(no. p51)*

E.P.-M. Ma, A.H.-S. Cheung

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Child's Voice

## Background

Voice problems are common in children with high prevalence figures reported in the literature. A reliable referral source of voice cases is one of the important factors that determine whether children with voice disorders can receive appropriate and timely voice evaluation and therapy. Unfortunately, due to limitation of clinical resources, it is difficult for speech pathologist to screen every child for voice disorder. If parents and teachers, who have plenty of opportunities to observe and interact with the child, possess the ability to accurately detect abnormal voice quality and identify voice disordered cases that requires referral for further voice evaluation, they can partner with speech pathologists in voice screening for their children.

## Objective

To evaluate untrained parents' and teachers' ability to detect voice problems in children by comparing their judgments with speech pathologists' judgments.

## Method

Parents and teachers of 64 grade one students in Hong Kong completed a screening questionnaire for each of their own child or student. They were asked to rate perceptual overall voice severity of the child's voice on a 6-point equal-appearing interval scale with 0 as "no problem at all" and 5 as "extremely severe". They were also asked to make a decision of referral for further evaluation of the child's voice condition. Four practicing speech pathologists, who did not know the students, made their own judgments using the same questionnaire based on recorded connected voice samples of the students.

## Results

Results revealed poor correlations and agreements in ratings between parents and speech pathologists, as well as between teachers and speech pathologists.

## Conclusions

The results suggest that parents and teachers may not reliably identify dysphonia among their children. Training may need to be provided for parents and teachers before fully involving them in screening for voice problems in school-age children.

## Acknowledgement

This study was supported by a grant from the Hong Kong Research Grant Council General Research Fund (HKU 774110M).

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# Videostrobokymography of the Vocal Fold in Cases of Reinke Edema (no. p7)

A. Szkielkowska, P. Krasnodebska, B. Miaskiewicz, H. Skarzynski

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Examination Techniques

## Background

F.Reinke described a space in the vocal folds, which is known as the superficial lamina propria (Hirano). Excessive chronic swelling and disturbed structure of this space leads to Reinke's edema. According to the severity of the disease, Yonekawa proposed in 1988 a three-degree classification. Videostrobokymography (VSK) is an effective tool for a quantitative analysis of vibratory patterns of the vocal folds. It can be successfully applied in patients with normal voice and various benign vocal fold lesions. VSK describes glottal function with objective parameters – open (OQ) and closed (CQ) quotients.

## Aim

The purpose of this study was to compare the OQ and CQ of the glottal chink, measured with VSK of patients with normal voice and with Reinke edema. A secondary aim was to test if there was a relation between these parameters and the location and severity of the edema as classified on the Yonekawa scale.

## Material and Methods

87 patients were enrolled in the study. Using VSK recording, parameters were measured from the anterior, medial, and posterior third of the vocal folds. Videostrobolaryngoscopic recordings were made during sustained phonation of the vowel [e:]. Yonekawa's classification was used to classify the edema. A student t-test was used for statistical analysis and significant differences in the ratio of OQ and CQ between the control group and patients with Reinke edema were tested. The level of statistical significance was set at p

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## Voice Education of Teachers (no. p22)

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- **Form:** Poster
- **Category:** Voice Pedagogy
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All teachers are voice professionals. In spite that this area is not a usual part of their university training. Since 2007 students of Faculty of Education WBU have the opportunity to put subjects focused on voice education on their curriculum. Currently the voice training of students is enriched and improved through the project CZ.1.07/2.4.00/17.0009 "New methods and technologies for education, diagnosis, therapy and rehabilitation of the human voice - connecting basic research in voice physiology with university education and stays at specialized health institute." Project is run by Medical Healthcom L.t.d. in partnership with Palacký University in Olomouc in the period 2011 - 2014, Faculty of Education WBU in Pilsen is cooperating subject.

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## Multidimensional Structure of Dysphonia (no. p37)

A. Bonetti

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Measurement

The aim of this research was to determine the relations between the results of objective voice analysis, perceptive voice analysis, and the results of self-assessment of vocal problems in persons with dysphonia, in order to examine the possibility to express and grade the influence of voice disorder on its acoustic features, perceived quality and social efficiency with one general measure based on unique set of variables. Thirty eight subjects (males and females) with diagnosed dysphonia participated in the research, as well as 30 control subjects, all between 20 and 64 years of age.

Self-assessment was made by using the VHI. Objective voice analysis (19 variables) included analysis of sustained phonations of the vowel /a/ with MDVP (Key Elemetrics Co.) Perceptive voice assessment (3 variables) was carried out by two clinically experienced SLPs.

The results of canonical analysis revealed significant relations between three different types of voice assessment. With the goal to investigate the possibility to rang the subjects by the severity of their vocal problems (mild, moderate or severe), tacsonomic analysis was used. This included 11 of original variables (5 self-assessment variables, 5 acoustic variables, and one perceptive variable) with most prominent canonical coefficients. Tacsonomic analysis showed that the subjects could be grouped into 3 separated clusters in a meaningful manner, without regard to the diagnosis.

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# Injection Medialization Laryngoplasty with Collagen as the First Step Treatment for Posterior Glottic Gap in Unilateral Vocal Fold Paralysis (no. p52)

T. Goto

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Treatment Methods

## Introduction

Injection medialization laryngoplasty with collagen (IMLC) has been reported as an effective means to improve glottal closure, and trans oral collagen injection can be easily accomplished in outpatients surgery. To compensate the posterior glottic gap (PGG) in unilateral vocal fold paralysis (UVFP), arytenoid adduction or intracordal injection therapy is indicated. Though injection laryngoplasty is generally said to be insufficient for the larger PGG, we often see the disappearance of PGG after IMLC even if the paralyzed vocal fold was fixed in the intermediate position. The aim of this study is to evaluate the effect and the limitation of IMLC for PGG in UVFP and prove this procedure is appropriate.

## Methods

We retrospectively reviewed medical record of 30 patients suffering from UVFP with PGG who started IMLC under local anesthesia as the first step treatment from February, 2006 to June, 2010. They were either in too poor general conditions to be treated invasively or did not wish to be hospitalized to treat hoarseness. Collagen was orally injected into the middle portion of the vocal fold to compensate the atrophy. In addition, we injected it into lateral side of the vocal process in order to adduct the arytenoid.

## Results

12 cases are in the intermediate vocal fold fixation (intermediate group) and 18 cases are in the paramedian vocal fold fixation (paramedian group). The mean times of collagen injection was 3.9. The number of patients whose PGG disappeared was 8 (66%) in intermediate group and 14 (77%) in paramedian group respectively. The average maximum phonation time (MPT) increased from 4.5 to 8.5 seconds and the average mean flow rate (MFR) decreased from 438.3 to 292.4ml/s. They were improved significantly.

## Conclusions

By devising the injection position of collagen, PGG can disappear in about 60 – 70 % of cases. Based on this experience, we recommend IMLC under local anesthesia as the first step treatment for PGG in UVFP unless the patients wish to be treated by other treatments such as arytenoid adduction. And if the hoarseness does not improve after IMLC, we choose arytenoid adduction as the second step.

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# An Unresolved Case of Familial Aphonia (no. p8)

J. Dršata, K. Smatanová, V. Chrobok

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Clinical Issues

## Introduction

Dysgenesis of arytenoid or other laryngeal cartilages are classified as rare conditions and can possibly be life threatening. We report a case of aphonia within members of one family, and a focus on their quality of life. To our best knowledge, very minimal has been written about these conditions in the literature.

## Case description

A 37 year old Caucasian male presented to our ENT clinic with his 1.5 year old daughter. His main complaint was his daughter's inability to produce voice since birth. There was not known any factor causing their disability, no history of swallowing or breathing difficulties and both had no significant past medical history and did not take any medication. Examinations of the father by a Neurologist, Psychologist and Physician were normal. Aphonia did not affect their quality of life. His mother had aphonia since birth, but she was dead by the time of appointment. On examination, the father was aphonic, with no stridor or respiratory distress. Results: Flexible laryngoscopy revealed undeveloped arytenoids cartilages bilaterally with possible dysgenesis of cricoid cartilage. Vocal cords were in complete abduction with no visible movement. Maximum phonation time was 6 seconds aphonic voice. Result of VHI (Czech version) was F- 8%, E- 15%, P- 0 %. Further investigations were refused by the patient as his quality of life was not affected.

## Discussion

Dysplasia of laryngeal cartilage is a rare condition and we ought to investigate as ENT surgeons. However, our focus is to respect patient's wish and offer him a safety net by regular appointments and a possibility of fast tracking admission in case of emergency.

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# Voice Disorders in Elementary and Secondary School Teachers: Some Reflections on Acoustic and Perceptual Profiles (no. p23)

Z. Camargo, M.F. Bonfim de Lima Silva, L.C. Rusilo, S. Madureira

- **Form:** Poster
- **Category:** Voice Pedagogy
- **Topic:** Occupational Voice

Despite the great amount of works describing teacher's voice disorders, few studies have addressed the detailed description of voice quality and vocal dynamics. Acoustic and perceptual analysis procedures can be thought as useful tools to investigate such variables. This research aimed at investigating acoustic and perceptual correlates of voice quality and vocal dynamics of teachers from a public school (elementary and secondary education). The running speech samples from 25 female teachers with voice complaints and laryngeal disorders were collected at school. The perceptual analysis was based on the VPAS performed by five experienced judges (voice quality settings and vocal dynamics elements). The recorded corpus was also analyzed by means of the ExpressionEvaluator script (Barbosa, 2009), which extracted  $f_0$ , intensity, spectral slope-SS and LTAS measures. Data were analyzed by means of agglomerative hierarchical cluster analysis-AHCA, canonic correlation-CC, linear regression-LR and discriminant analysis-DA, taking into account perceptual, acoustic, laryngeal disorders, age, number of teaching-years and weekly workload-hours variables (Ethics Committee n.º 298/2008). The prevalent voice quality settings were laryngeal and supralaryngeal hyperfunction, harsh voice, raised larynx, closed jaw, pharyngeal constriction, raised tongue body and breathiness. From the vocal dynamics analysis, data indicated inadequate breath support, low pitch variability, high mean habitual pitch and loudness, fast speech rate and high loudness variability. In AHCA, tendencies towards clustering spectral slope (mean and SD) and LTAS in one group and  $f_0$  (median and 99,5% quantile) measures in other were found. DA revealed that laryngeal disorders were influential in terms of discriminating time teaching (76%) and weekly workload (80%). VPAS data also showed influence in discriminating the weekly workload (45%). CC showed the relevance of spectral slope and  $f_0$  measures in acoustic-perceptual correlations: SS (skewness) and breathiness (40%), harsh voice (32,4%), high habitual pitch (28,8%) and supralaryngeal hyperfunction (25,7%); SS (mean) and high habitual loudness (29,5%), laryngeal hyperfunction (29,5%) and harsh voice (29,5%); SS (SD) and pharyngeal constriction (28,5%) and high habitual loudness (27,2%);  $f_0$  (99,5% quantile) and harsh voice (26%);  $f_0$  (median) and inadequate breath support (25,3%);  $f_0$  (interquartile semi-amplitude) and inadequate breath support (21,1%). LR reinforced the relevance of acoustic measures- $f_0$  (median:58,6%) and spectral slope (skewness: 43% and mean:39,2%) - and perceptual data (harsh voice: 48,3%, fast speech rate: 46,7%, retracted tongue body: 40,6%, breathiness: 40,1% and pharyngeal constriction:38,7%) in relation to laryngeal disorders. These findings reinforce the multidimensional aspect of voice and the importance of acoustic and perceptual profiles to provide a detailed description of teacher's vocal behavior.

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# Voice Mutation in the Indian Population (no. p53)

R.K. Balasubramaniam, J.S. Bhat

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Child's Voice

## Introduction

Early pubertal development and an increased incidence of sexual precocity have been noticed in children. These observations are raising the issues of timing of puberty in relation to ethnic, geographical, and socioeconomic background, as these changes influence vocal mutation (Parent, Teilmann, Juul, Skakkebaek, Toppari, & Bourguignon, 2003). However, voice mutation in Indian population is not well understood. Hence the present study was attempted to identify the age of vocal mutation in Indian population.

## Method

120 participants were divided into four groups in the age range of 12-16 years with one year interval. All the voice samples were directly recorded into the praat software(version 5. 1. 43) at 44.1 kHz sampling frequency during the phonation of /a/ at the most comfortable pitch and loudness. Fundamental frequency was extracted from the sustained phonation in all the age groups. One way ANOVA was performed to compare the significant difference between the mean of all the groups in both the genders separately, followed by bonferronis post hoc test.

## Results

The results of one way ANOVA did not reveal any significant main effect of the group ( $F=1.319$ ;  $P>0.05$ ) and gender ( $F=1.478$ ;  $p>0.05$ ) indicating that vocal changes had not taken place in males even at 16 years of age whereas vocal mutation was attained at the age of 14 years in females.

## Conclusion

The present study investigated the age at which the vocal mutation occurs during adolescence in the Indian population and the results revealed that vocal mutation was not attained even at the age of 16 years in males as measured through fundamental frequency. However, vocal mutation was attained at 14 years in females. Further studies are required to correlate the general physical development, puberty and vocal mutation in the Indian population with larger samples.

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# What Happens in the Pharynx and Larynx, After Singing Teachers' Instructions, During a Singing Lesson? (no. p9)

E. Sielska-Badurek, E. Osuch-Wójcikiewicz

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Singing Voice

In order to achieve the desired voice quality singing teachers and some voice therapists link to the imagination of the singer. They often use phrases, like: sing the sound or the phrase "closer", "with an open throat", "palate lift" or "lower the larynx".

The aim of the study was an evaluation of changes in activities at the level of the pharynx and larynx when singing a vocal phrase, after teacher's comments.

In the study took a part 30 healthy singers - professionals and amateurs. Each of the vocalist chose a short, comfortable vocal phrase and sung it 19 times after instructions like: sing more quietly, louder, "closer", with vibrato, "with an open throat", "lifted palate", "lowered larynx", etc. During the examination, we assessed the activities at the level of the nasopharynx, oropharynx, laryngopharynx and larynx due to a flexible endoscope.

Amateur singers only in a small percentage could introduce changes in the activities of the pharynx and larynx after our instructions. Professional singers introduced a variety of changes, but not necessarily corresponding to the instructions of the examiner.

Various vocalists react differently to instructions while studying singing and voice rehabilitation. Some of them even acquire a completely different effect. This might depend on their vocal tract's awareness, as well as on the learned activities that were adapted to teacher's instructions.

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# Difference in Head Position for High Notes in Successful Classical and Non-classical Male Singers (no. p24)

P. Amarante Andrade, J.G. Švec

- **Form:** Poster
- **Category:** Voice Pedagogy
- **Topic:** Singing Voice

Good posture is considered essential for various human activities; voice production is not an exception. Since the initial understanding of singing voice, body posture has attracted a great deal of attention from voice professionals. Many studies have been devoted to better understanding of the relationship between body posture and voice. This study aims at investigating the differences in head position for high notes between successful classical and non-classical male singers. We hypothesise a higher chin elevation for pop singers whilst performing high notes when compared to classical singers. Method: 74 pictures of different well-known singers were captured during live performances on YouTube. 39 western classical and 35 popular male singers producing notes between A4 and E5 were analysed and scored with regards to head posture. A 10 cm visual analogue scale (VAS) was implemented for transversal and rotational head positioning. The data was analysed by 4 raters who were instructed with regards to the measurement procedures. A series of Spearman correlation tests was employed to assess inter-evaluator consistency for the VAS scoring. A Two-sample Kolmogorov-Smirnov test was implemented to assess the differences in head position between singing techniques. Results: Statistically significant differences for VAS scores between classical and pop singers were found for the transverse and rotational head positioning. However no strong correlation was found among raters for transversal head positioning. On the other hand, rater's scoring for rotational head positioning showed a strong Spearman's correlation scores ( $Rho > 0.83$ ). Discussion: The results showed a significant difference in head position for high notes between singing techniques. Classical singers tend to maintain a neutral head position and pop singers produce high notes with different head positions. A larger spread data distribution for pop singers VAS analysis indicates a variety of possible head positions employed by this group for high notes. In contrast, a narrower data distribution for classical singers was found, suggesting a limited possibility of head positions for high notes. Conclusion: This study of successful classical and pop male singers head position for high notes showed that these groups use different head positions while performing high notes. These different head positions are expected to play an important role in voice production by means of extrinsic muscles adjustments, which is reflected on the distinct singing techniques for each group.

## Acknowledgements

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# Perceived Stress in Employed and Non-employed Persons with Voice Disorders *(no. p39)*

B. Barsties, Y. Maryn

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Occupational Voice

## Background

Stress is often hypothesized to have a negative influence on voice production and vocal characteristics and could therefore play a causal role in developing voice disorders. However, the relation between work-related stress and phonation is unclear.

The present study therefore investigated perceived stress in employed person with the background of professional voice users (EP) as well as non-employed person (NEP). All of them present voice disorders.

## Method

Fifty-three adults (forty EP, thirteen NEP) with diagnosis of primary functional or secondary organic voice disorders took part in this study. All subjects underwent a clinical multidimensional voice assessment at the ENT department of the Sint-Jan General Hospital in Bruges, Belgium.

The independent variable perceived stress was measured with the Perceived Stress Questionnaire (PSQ). This questionnaire has four subscales (i.e., Worries, Tension, Joy and Demands) and tallies a total score. Abnormal stress is measured with a z-score  $\geq 1$  above the norm of the PSQ.

The dependent voice-related variables were the Acoustic Voice Quality Index (AVQI), the Dysphonia Severity Index (DSI) and the Voice Handicap Index (VHI).

## Results

No significant differences in AVQI, DSI and VHI were found between the two groups.

The EP group showed higher scores on the Worries, Tension and Joy PSQ subscales and the total PSQ outcome, but only for the Demands subscale this difference was significant ( $p=0.018$ ). Abnormal stress in both groups was low and varied between 8% and 30% in all subscales of the PSQ.

Furthermore, no significant differences in stress level appeared between the MTD subjects and the subjects with benign vocal fold lesions.

## Conclusion

The stress levels found in this study are comparable to those in voice-related literature in relation with stress and voice disorders.

Only the Demands subscale differed between professional voice users and non-employed persons.

The other PSQ subscores and total score showed no significant difference. These findings led to the main conclusion that stress has only low impact in developing voice disorders.

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# Resonance Exercises – Influence on Voice Quality in Voice Professionals

(no. p54)

E. Dvořáková, M. Frič, J. Vydrová

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

The aim of the study was to verify rehabilitative and re-educational effect of resonance exercises in voice professionals. It is a part of a larger research in voice re-education and therapy, conducted in cooperation with Voice Center Prague, MARC HAMU and KDV DAMU. (The results of the on-going research with more subjects will be published in future).

The group comprised of 5 voice professionals (4 women and 1 man), whose average age was 29.8. The therapy lasted 5 weeks, its frequency 1x60min weekly, plus individual daily training with recordings 10 – 15 min, respiratory exercises as needed, recorded in a training diary. The subjects were carefully selected out of the actors of the Y Theatre, students of pedagogical branches at KVD DAMU Praha and professional speakers. The common reasons for inclusion in the project were voice problems: voice fatigue, throat constriction and strain during louder speech or singing, husky and short of breath voice accompanied by hoarseness.

## Methods

Preliminary and final foniatic examinations including laryngostroboscopy, videokymography and examination of the voice field of speaking and singing voice (XION system), Czech version of VHI questionnaire, an objective questionnaire of perceptive voice assessment by a therapist. Acoustic methods – analysis of voice field and other acoustic parameters – RealVoiceLab programme in real time (speaking and singing tasks), sonography – spectrogram of vocals, segmental acoustic analysis of MDVP and spectral MDA parameters, electroglottographic record, listening tests – perceptual voice assessment.

Minor defects found on vocal chords in 3 subjects, in 2 more serious defects: vocal cord mucus, tapering thickening, uneven vocal chords, vocal cord insufficiency. Recommendation: Helicid, Loseprazol, voice and respiratory therapy. Therapeutic method based on assessment and analyses: a) respiratory exercises, diaphragmatic breathing, breath support training, b) resonance exercises: choice of voice position for exercising, tonal range and difficulty. Therapist devised an exercise plan including a recording, adapted the range and difficulty of exercises according to pace of learning the tasks and fixation of habits. Therapist kept checking the connection of head and chest resonance, following voice quality in vocal register transitions, the measure of resonance and tonal support. With vocal range increasing, therapist transposed the vocal exercises to higher and lower pitches.

Preliminary results show an improvement in voice quality of all the subjects, namely their vocal range, dynamics, timbre – increase in brightness glitter and carrying capacity, lowering of shortness of breath, fatigue, and increase in vocal range. In spectral analysis of vocals, an increase in higher harmonic components of the spectrum (aliquots) and strengthening of higher formants is presumed.

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# Long-term Voice Results in Patients after Augmentation of Hyaluronic Acid to the Vocal Fold *(no. p10)*

B. Miaskiewicz, A. Szkielkowska, H. Skarzyński

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Surgery

## Aim

To assess the quality of voice of patients who were treated with the surgical method of hyaluronic acid injection into the vocal fold in the long-term follow up

## Material

The material included 30 patients suffering from dysphonia, who were referred for injection laryngoplasty, meaning augmentation of the hyaluronic acid into the vocal fold.

The group consisted of six patients with glottic insufficiency and atrophy of vocal fold in the course of functional dysphonia, five of the patients suffered from presbyphonia, three of them had scar and vocal fold atrophy, three patients had sulcus vocalis, and thirteen patients suffered from unilateral vocal fold paralysis.

## Method

Patients included in the study underwent laryngological and phoniatic examination. Preoperative and postoperative examination were based on videostroboscopy with assessment of glottic closure, quality of vocal fold vibration: symmetry, regularity, amplitude, mucosal wave, and differences in the position of vocal folds. Patients' voice was assessed using the subjective GRBAS scale as well as objective evaluation provided by Multidimensional Voice Program was applied.

The microsurgical procedures were performed under general anesthesia applying suspension laryngoscopy. For the injection Surgiderm 24 XP hyaluronic acid was used. The program of care over patients after hyaluronic acid augmentation provided by our institution included series of voice rehabilitation that have been conducted for 3 months after operation (1 visit per week).

Follow-up examinations including perceptive voice assessment (GRBAS), videostroboscopy and acoustic measurements of patients' voices were conducted 12, 18 and 24 months after injection.

## Results

Perceptual voice quality (as assessed by the GRBAS scale) in patients with dysphonia was improved. Analysis of single parameters showed that the best results were obtained within the G-parameter (grade) and B-parameter (breathiness) and the results were stable in long term follow up periods.

Multidimensional Voice Analysis showed significant statistical improvement within the group of frequency, amplitude and noise parameters. The differences in value between following observation periods were not statistically significant. Stabilisation of the noise parameter indexes confirmed improvement of vocal fold adduction and reduction of glottic gap after hyaluronic acid injection.

## Conclusions

1. Injection of the hyaluronic acid into the vocal fold improves significantly phonatory functions of the larynx and quality of voice in patients suffering from glottic insufficiency
2. Best results are observed in patients with unilateral vocal fold paralysis
3. The long-term follow up confirms that hyaluronic acid injection to the vocal fold is an easy, effective and fast method restoring good quality voice.

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## Vocal Arts Medicine in China (no. p25)

L. Han

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Treatment Methods

The development of Vocal Arts Medicine in China has always related to the communication and cooperation among the singing teachers, ENT doctors and voice therapists. Mr. Xiang Shen, a famous vocal coach and tenor, Mr. Baofu Feng, a dedicated otolaryngologist, Mr. Junqing lin(M.D.), a pediatrician and excellent baritone were the most outstanding representatives and contributors to these three different fields in China.

Vocal Arts Medicine has been well developed in the Central conservatory of Music (CCOM) of China. "Singing mechanism and voice care" has been a compulsory course for the vocal students for the past 10 years. The specialist in Vocal Arts Medicine has been a member of the committee for vocal students' selection, voice classification, voice therapy and voice care for 30 years. A great number of clinical voice examination and identification reports are provided to the singing teachers every year. These reports can help the singing teachers to understand why the vocal student's voice is hoarse, and if it is organic or functional? Why his or her voice is hard to classify, and does it a match or not? Why he or she cannot reach certain tones and if it is physiological?

We believe that Vocal Arts Medicine is an interdisciplinary Voice Medicine branch, and must be based on ENT clinical anatomy and physiology. Through medical examination, acoustic analysis, objective assessment of the speaking and singing voice, we could determine the physiological, acoustic and pathological characteristics of different singing styles and causes of voice disorder, which could help us to select the most efficient treatment and prevention methods. Except recommending vocal rest or correcting their fault methods, we usually use Western medicine or TCM to drip on their reddened, swollen vocal cords. We think that this is the most direct administration route.

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# Hoarseness Assessment: Selection of Acoustical Parameters for Analysis of Sustained Vowel /a/ Phonation (no. p40)

A. Stráník, R. Čmejla, J. Vokřál

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

Acoustic measures have been developed to help quantify voice characteristics. The advantage of having such measures is that, if reliable and reproducible, they can be used as a means of following changes in voice over time and in comparing the efficacy of treatment regimens aimed at improving dysphonia.

The aim of this experiment is to select acoustic parameters which can differentiate voice according to breathiness, roughness and overall voice performance. A database recorded by the Department of Phoniatics, 1st Faculty of Medicine, Charles University and General Faculty Hospital was used for this purpose. This database was created from the 1970'-s to the 1990'-s as a common part of voice examination for healthy and pathological voices as well. All records were performed using professional recording equipment and situated in a soundproof booth with the level of ambient noise lower than 18 dB SPL.

A total number of 469 sustained phonations of the vowel /a/ were selected from the database and evaluated by means of a modified GRBAS scale by five experts from the Department of Phoniatics. The GRBAS scale modification involves merging parameters A (Asthenic) and S (Strained) into parameter T (Tension). Whereas parameters G (Grade), R (Roughness) and B (Breathiness) can assume values from 0 (without pathology) to 3 (extreme pathology), parameter T can assume values from -2 to +2, where negative values indicate an asthenic voice, and positive values indicate a strained voice. Each expert made two assessments of every recording with at least two-week time delay. Every record was analyzed with the following parameters: BACD (Bayesian Autoregressive Changepoint Detector), BRI (Breathiness Index), CPP (Cepstral Peak Prominence), GNE (Glottal-to-Noise Excitation Ratio), GVA (Generalized Variogram Analysis), H1A (ratio of 1st and 2nd harmonic amplitude), HLR (High to Low Energy Ratio), HNR (Harmonics-to-Noise Ratio), HT (spectral tilts between 1st and 2nd harmonic), LSP (Line Spectral Pairs), RPK (value of Pearson's correlation maximum between 3.3 and 16.7 ms i.e. 60 and 300 Hz), SD (Spectral Deformation), SPS (Signal Periodicity Strength), SR (Spectral Rolloff) and fundamental frequency estimations in the frequency, cepstral and time (autocorrelation) domains. All of the above-mentioned parameters were implemented in MATLAB.

Our results show that it is possible to select parameters which can distinguish different degrees of hoarseness by means of the GRB scale. Parameter T seems not be distinguishable from sustained phonation. According to Spearman's correlation coefficients, the following parameters were selected: HNR, RPK, GNE, CPP and  $f_0$  estimated from cepstrum.

Kappa statistic was used to compare subjective and objective assessment. Whereas subjective assessment reach  $KG_s=0.41$ ,  $KR_s=0.35$  and  $KB_s=0.41$ , objective assessment by means of acoustic signal analysis reaches  $KG_o=0.51$ ,  $KR_o=0.49$  and  $KB_o=0.55$ .

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# Voice Disorder Induced Handicap in Female Professional Voice Users Before and After an Intervention (no. p55)

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- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Occupational Voice

## Background

The amount of voice problems has increased with the amount of “vocal occupations” [1]. One of the largest groups among voice patients is female teachers [2, 3].

## Aim

To study the psycho-social handicap due to voice disorder in professional voice users before and 1-2 years after an intervention.

## Subjects and methods

The study group comprised 39 females (mean 46 yrs) with occupational voice problems. All the subjects underwent a phoniatic examination followed by vocal rehabilitation (e.g., voice therapy and information on vocal hygiene and ergonomics). The subjects completed Voice Handicap Index (VHI) [4] and Voice Activity and Participation Profile [5] questionnaires before and 1-2 years after the intervention. 36 female teachers (mean 43 yrs) with no voice problems served as controls. The groups were comparable for age, smoking habits, talkativeness and basic illnesses.

## Results

Before the intervention, the patient experienced a moderate psycho-social mean handicap in VHI compared to the control group with little or no handicap ( $p < 0.001$ ). 1-2 years after, the patients' psycho-social mean handicap was mild only ( $p < 0.001$ ). Despite the decrease, the patients' handicap scores were greater than in the controls. Before the intervention, the voice problem had a relatively large effect on patients' work compared to the controls with no effect. After 1-2 years, the effect in the patients had decreased. The amount of sick leaves in the patient group was remarkably lower than earlier.

## Discussion

The effects of the intervention lasted for at least 1-2 years. Possibly, the patients learned to take better care of their voices. This may have reduced the sick leaves as well.

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# Office-based Laryngoscopy - Tips and Tricks in Performing Special Maneuvers (no. p11)

S. Fleischer, M. Hess

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Examination Techniques

Office-based laryngoscopy is a common routine procedure. The development of new technical equipment such as high definition cameras, flexible tip-chip endoscopes or NBI nowadays allows for much more precise examination than a few years ago. Nevertheless, without the optimal handling of the equipment it is not possible to maximally benefit from the newest technology.

We describe special maneuvers in rigid as well as in flexible endoscopy such as uncommon positioning of the tip of the endoscope, examining the subglottal region and the trachea with a "dipping-maneuver", scoping the esophagus (TNE). Tips and tricks useful for gaining quite astonishing 'insights' within office-based endoscopy will be demonstrated.

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# First PIRL (Picosecond-Infrared-Laser) Ablation Results at Human Vocal Folds - A Preliminary Assessment of a Future Phonomicrosurgical Device

(no. p26)

D. Hildebrandt, F. Müller, M. Hess

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Surgery

## Introduction

A new Picosecond-Infrared-Laser (PIRL) provides a novel effect of tissue ablation that enables incisions without significant damages to adjacent tissues.

## Method

At the vocal folds of 15 cadaver larynges we conducted cutting tests with a PIRL prototype, a standard scalpel and a conventional CO<sub>2</sub> laser. Histology and environmental scanning electron microscopy (ESEM) analyses were performed to point out the differences.

## Results

Incisions of the PIRL showed largely no lateral destructions, but straight bordered margins. There were no carbonization and scarcely visible coagulation (mean value of maximal lateral expansions < 10 µm).

## Conclusion

These abilities make the PIRL promising for future phonomicrosurgical applications, because it is going to combine advantages of the contact-free laser surgery with an accuracy level as known by professional interventions with the 'cold' instruments. Our Poster will demonstrate this new laser technique, show methods of the comparison and also discuss the state of the current research.

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# EGG and Acoustic Analyses from Different Length Voice Samples Compared to Perceptual, Laryngeal and Self-evaluation *(no. p41)*

E. Kankare, D. Liu, A. Väisänen, A.-M. Laukkanen, A. Geneid

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Analysis of Voice and Speech

Vocal loading consists of various environmental and individual elements. As one of the individual elements, pressed voice quality can be taxing to voice user especially when the phonation time per day is long. Contact quotient (CQ) measured from electroglottogram (EGG) has been reported to be higher in pressed phonation. Results of the earlier studies have raised a question about the sufficient length of the voice material in EGG analyses.

The aim of this study was to examine if one word is enough in EGG analyses to detect difference in perceptual and self-evaluation of voice.

EGG and acoustic signals were recorded from text reading of seventy female kindergarten teachers. CQEGG and the velocity of increasing contact area, reflected in maximum peak of the first derivative of amplitude normalized EGG signal (MDEGG), were examined in one stressed word in the middle of text reading and in two sentences with 21 words from the same text passage. All nine Finnish vowels were included in the two sentence sample. CQ was calculated with threshold level (CQ 25%, 35%, 50%), derivative (CQDEGG) and hybrid (EGG3:7) methods. Fundamental frequency (F0) was calculated from EGG signal, and equivalent sound level (Leq) from calibrated acoustic signal. Breathy-pressed continuum in phonation was perceptually evaluated from both lengths of voice samples by five voice trainers. Laryngeal examination was made by a phoniatician with a videolaryngoscopy. Self-evaluation was made with Voice Activity and Participation Profile (VAPP).

From EGG parameters only MDEGG differed significantly between voice samples. Nearly all CQ values correlated negatively with F0. MDEGG did not have F0 correlation. In one word no correlation was found between EGG parameters and VAPP, perceived pressedness or laryngeal classification. In two sentences MDEGG was the only EGG parameter to correlate with perceived pressedness. Perceived pressedness correlated moderately also with Leq and F0. Laryngeal examination correlated with SPL. VAPP correlated with F0.

The results indicate that longer sample in EGG analyses detects perceptual difference better than one word. Since MDEGG, unlike CQ, did not have a negative correlation with F0 either, it is worth studying further as an indicator of impact stress. High F0 and intensity seem to be stronger vocal loading factors than pressed voice quality.

This study has been supported by the Academy of Finland (grants No. 1128095 and 134868).

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# Phonating into Resonance Tubes with the Free End in Water – Effects on the Vertical Laryngeal Position and Subglottal Pressure - a Pilot Study *(no. p56)*

G. Wistbacka, J. Sundberg, S. Holmqvist, J. Smedberg, S. Simberg

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

Phonating into glass tubes, so called resonance tubes, into a bowl of water has been used as a voice therapy method for several decades in Finland, producing good clinical results in patients with different voice disorders, e.g., hyperfunction and vocal nodules. However, the physiological effects of using the tubes are not yet fully understood. The vertical laryngeal position seems to have a great impact on voice production. It has been established that various phonatory and respiratory tasks affect the vertical laryngeal position and a low position of the larynx seems to promote a healthy use of the voice. The aim of the present pilot study was to investigate possible changes in the vertical laryngeal position and subglottal pressure when phonating into resonance tubes of two different lengths with the end in the air and emerged in water.

The data was collected on two participants, one female and one male, who were familiar using resonance tubes. The laryngeal position and electroglottographic signal was recorded using a two-channel electroglottograph (Glottal Enterprises MC2-1) and the oral (subglottal) pressure with a pressure transducer (Glottal Enterprises MSIF-2) attached to a thin plastic tub (ID 4 mm) which the subject held in the corner of the mouth. The audio signal was recorded using a head-worn AKG B 29L-microphone. Data was collected using the SoundSwell software program. Calibration of larynx height was realized by sliding the EGG electrodes up and down on the neck while the subject sustained an /a/ vowel. The participants were initially asked to phonate into a 26 cm long tube and secondly into a 28 cm long tube. Recordings were made with the tube ending in air, and 2 and 6 cm under the water surface and also while varying this depth during phonation.

Phonation into resonance tubes with the free end in water distinctly lowered the vertical laryngeal position for both participants. When using the longer resonance tube the effects on the laryngeal position were greater. Both the EGG-signal and the subglottal pressure showed amplitude modulation when phonating into the tubes in water, compared to normal phonation or phonation with the resonance tube end in air.

The results indicate that phonation into the tube with the end in water leads to a lowering of the larynx position. When the tube end was deeper in the water the oral pressure increased and the laryngeal position was lower. Since patients with hyperfunctional voices tend to have a high laryngeal position, this could explain why the method is so effective in treating this kind of voice patients.

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# Recording of Breathing Movements by Pneumography (no. p12)

O. Dlouhá, J. Vokřál, J. Sedlák

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Examination Techniques

## Introduction

In our Dept. of Phoniatics of the First Faculty of Medicine, Charles University and General University Hospital, there is long-time tradition of voice and speech fluency disorders treatment. In this study we are interested especially in noninvasive method of recording breathing movements during voice and speech production. We record the investigation of relationships between parameters that describe inspiratory and expiratory phase of respiration and the typical features of voice or speech disorder. Abdominal breathing is the most natural form of breathing.

## Method

Pneumograph is used to record movements of the chest and abdominal walls. The recordings also include information about patient's voice during phonation and speaking. There are evaluated: respiratory rate, ratio between inspiration and expiration, relationship between chest and abdominal wall movement, detection of pathological phenomena. There are several tasks which are performed during measurement: normal breathing, deep breathing, prolonged phonation of vowel /a/, talking, reading, and singing.

The sampled signals are transmitted to PC software via USB bus, which makes it possible to show the curves from signals in real-time. The real-time visualization is necessary, because the measuring sensors have to be correctly set up before the measuring process. On-line visualization allows a record control during measurement. The application includes buttons which provide controlling of the recording and inserting information tags on activity during the measurement. In addition, data archiving and printing functions are integrated into the software.

The instrument is based on 32-bit microprocessor ATMEL AT91SAM7S64. The selected type of microprocessor contains all the required peripherals and it is easily accessible on the market. The inputs of the device are connected to a pair of strain gauges (SS5LB Biopac) and a microphone. A piezoresistive mechanism is used inside of the SS5LB Biopac sensors. An electret microphone, which is commonly used in computer technology, is used to record the voice. In appropriate conditions, the sensor should not restrict the test subject, because doing so it would affect the measured signal. The sensor sensitivity is sufficient to register observed pathological phenomena such as hard voice beginnings.

## Results

Results will be presented in graphs of recordings as examples of individual voice disorders and of stuttering. Our experiences with this investigation are a positive contribution to diagnostics. This method helps to evaluate the results of voice and speech therapy.

## Acknowledgements

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# Relationship of Open Quotients in Different Definition to Acoustic Property, Phonation Types, F0, and Intensity (no. p42)

H. Yokonishi, H. Imagawa, K.-I. Sakakibara, A. Yamauchi, T. Nito, T. Yamasoba, N. Tayama

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Examination Techniques

## Introduction

We have analyzed the modes of vocal fold vibration to clarify the relationship between auditory impression of pathological speech and vocal fold vibration using high-speed digital imaging (HSDI) so far. And, this time, we have discussed various calculation methods about open quotient (Oq) from HSDI films and Electroglottography (EGG).

## Methods

In previous studies, Oq was calculated as a scalar quantity from one-dimensional data, such as an EGG waveform (Oq-dEGG or Contact Quotient) or a glottal area function (Oq-area0), and there was a problem that could have multiple definitions of opened or closed points. In this study, we invented following features obtained from the positional information of the vocal fold free edge in relation to the antero-posterior direction of the glottis from HSDI. Data were analyzed using a custom MATLAB program (2011a Student Version; The Mathworks, Inc., Natick, MA). 1. Oq-mean (mean of open quotient of the free edge); 2. Oq-mean<sup>+</sup> (mean of positive open quotient of the free edge). In order to compare relationship between acoustic parameter and these Oqs, H1\*-H2\* between the first two harmonics of the acoustic signal spectrum after a formant-based correction was calculated as acoustic parameter for each phonation. On the other hand, Each Oq was treated as objective variable, and log<sub>2</sub>(F0[Hz]) (instead of fundamental frequency), intensity (difference from intensity in G3, normal intensity of each subject), falsetto(0 or 1), breathy(0 or 1), pressed(0 or 1) were treated as explanatory variables. Multivariate linear regression analysis was performed.

Data were collected from six healthy male volunteers, and HSDI films were recorded at different phonation types, pitches and intensities, at 4500 fps, with a rigid endoscope, and with the duration of 1.86 seconds. The types of phonation included modal phonation at seven different pitches, falsetto at four difference pitches, breathy phonation at four different pitches and pressed phonation at two different pitches, and each phonations were performed at three different intensity (weak, normal, and strong). The sound was recorded with the microphone located 30cm anterior to the mouth.

## Results and Discussion

Oq-mean<sup>+</sup> and Oq-mean have a relatively strong correlation between acoustic properties, and can describe changes in phonation types, simultaneously, which reflect the state of open and close in each part of vocal fold, so those two parameters, especially Oq-mean<sup>+</sup>, are considered to be more usable than other Oqs.

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# Laryngeal and Pharyngeal Activity During Semi-occluded Vocal Tract Postures in Subjects Diagnosed With Hyperfunctional Dysphonia (no. p57)

M. Guzman, C. Castro, A. Testart, D. Muñoz

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Rehabilitation of the Voice

High vertical laryngeal position (VLP), pharyngeal constriction, and anterior-posterior (A-P) laryngeal compression are common features associated with hyperfunctional voice disorders. The present study aimed to observe the effect on these variables of different semi-occluded vocal tract postures in twenty subjects diagnosed with non-organic hyperfunctional dysphonia. During observation with flexible endoscope, each participant was asked to produce eight different semi-occluded exercises: lip trills, hand-over-mouth, phonation into four different tubes, and tube phonation into the water using two different depth levels. Participants were required to produce each exercise at three loudness levels: habitual, soft, and loud. To determine the VLP, A-P compression, and pharyngeal width, a human evaluation tests with three blinded laryngologists was conducted. Judges rated the three endoscopic variables using a 5-point scale. An intraclass correlation coefficient to assess intra and inter-rater agreement was performed. A multivariate linear regression model considering VLP, pharyngeal width, and A-P laryngeal compression as outcomes; and phonatory tasks and intensity levels as predictive variables was carried out. Correlation analysis between variables was also conducted. Results indicate that all variables differed significantly ( $p < 0.0001$ ). Therefore, VLP, A-P constriction and pharyngeal width changed differently throughout the eight semi-occluded postures. All semi-occluded techniques produced a lower VLP, narrower aryepiglottic opening and a wider pharynx than resting position. More prominent changes were obtained during tube submerged under the water and long-narrow tube into the air. VLP significantly correlated with pharyngeal width ( $\rho=0.578$ ;  $p<0.0001$ ) and A-P laryngeal compression ( $\rho=0.3364$ ;  $p<0.0001$ ). Moreover, pharyngeal width significantly correlated with A-P laryngeal compression ( $\rho=0.18$ ;  $p=0.001$ ).

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# Case Report on Histamine Bronchial Challenge Causing Vocal Fold Oedema

(no. p13)

M. Ansaranta, A. Geneid, P. Kauppi, P. Malmberg, P. Alku, E. Vilkmann

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Clinical Issues

A histamine bronchial challenge test is used to demonstrate nonspecific airway hyperreactivity in symptomatic patients having cough, shortness of breath or wheezing. Many patients report temporary voice change after the challenge, but the mechanism of this reaction has not been adequately described.

We are analyzing the effects of a histamine challenge test on voice and vocal tract. The broader study (N = 30) involves assessing the voice and throat symptoms, laryngeal examination using videolaryngoscopy and recordings of speech pressure signals and their use in glottal inverse filtering analysis. Here, we report laryngoscopy findings in two patients.

Two subjects (66-year old male and 64-year old female) were participants of the larger study of the effects of histamine challenge on voice and vocal tract. Subjects reported increased voice and throat symptoms after the histamine challenge. Videolaryngoscope revealed oedema of the vocal folds after the histamine challenge. Such oedema might explain the voice change reported by the subjects. To our knowledge, this is the first time such a laryngeal mucosal reaction during the challenge test is described.

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# Influence of Intentional Vocal Setting on Impression of Male Speakers (no. p28)

P. Lukkarila, A.-M. Laukkanen, I. Ilomäki, P. Palo

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Personality Assessment

In everyday life we attribute certain personality characteristics to other people based on their voice quality. Even though they may not coincide with true attributes of speaker, vocal stereotyping plays an important role especially when no supporting visual aid is available. In previously reported results on Finnish speaking females certain voice qualities tended to be associated with specific personality traits.

This study investigates the effects of seven different voice qualities on the listeners' impressions of Finnish speaking males. We also compare the results on male voices to those on four female voices reported earlier.

Four male subjects recorded the same short passage of speech in Finnish, first with their habitual speaking voice, then with forward and backward placement, pressed, breathy, creaky, nasalized and denasalized voice. The approved samples (n=25) were played in a mixed order to same fifty Finnish-speaking listeners who evaluated female voices in an earlier study. Using a seven-point polarized scale with 18 personality traits the listeners were asked to report all immediate or nearly immediate speaker impressions they received from the samples. The results were compared to the evaluations of the habitual speaking voices.

When speaking with forward placement, male speakers were considered to be more feminine, unpleasant and less plausible. With the tongue placed back in the mouth they were also considered less pleasant and less credible. Speakers using pressed voice were considered to be unpleasant and less credible. Breathiness triggered impressions of lesser credibility and unpleasantness, emotionality, submissiveness and cautiousness. Few statistically significant differences in personality assessments between genders were found. Female voices raised more negative assessments than male voices.

The results obtained for the immediate impressions partially support results reported in other languages and cultures. The forward placement of the tongue raises the formant frequencies, (especially F2). Voice containing high formant frequencies may appear to have a higher pitch than F0 would indicate. Breathiness indicates lesser muscular tension in the laryngeal region. When large body size and physical power often are considered to be desired male features, higher pitch or lax phonation can be considered undesirable characteristics for men. Backward placement and pressed voice raised negative connotations both in male and female voices. Pressed voice may evoke connotation to expression of anger and be interpreted as aggressiveness. In facial attractiveness studies of the digitally "averaged" faces have been found more attractive. The results of the present study may support to "pleasantness as average hypotheses" as both forward and backward placement of the tongue evoked negative assessments.

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# Text Delivery in Classical and Musical Theatre Singing. An Empirical Investigation of Differences in Phoneme Duration and Intensity in Sung Text Between Classical and Musical Theatre Genres (no. p43)

A. Leatherland

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Singing Voice

Pedagogues agree that the delivery of sung text will necessarily differ between singers in the Classical and Musical theatre genres (Balog 2005, Melton 2007, and Kayes 2004). Musical Theatre singers must give priority to text as their impetus is one of acting. Classical singers on the other hand must sing text without destroying the vocal line, their main concern being to serve the music (Potter 2006, Chapman 2006). The delivery of sung text could therefore be genre-specific. Thus, singers wishing to cross genre authentically might benefit from learning to sing text in a genre-appropriate way. In recent years real time visual computer feedback (RVF) has been used to help solo and choral singers with pitch control, vibrato, resonance and onset (Callaghan et al 2004, Welch et al 2005, Nix et al 2007, Wilson et al 2008). If clear genre-specific differences in sung phonemes were first identified and measured, RVF use might also facilitate the teaching/learning of sung text delivery.

To this end, the purpose of this study was to investigate empirically whether phoneme intensity and duration differ in the delivery of sung text in Classical and Musical Theatre genres. The results will inform a future RVF study in the singing studio.

## Method

Recordings were made of twelve male and female singers aged 18-25 from the Classical (n=6) and Musical Theatre (n=6) genres. Each performed a Musical Theatre song (Anyone Can Whistle, Sondheim) and one of two Classical songs from the "Beggars' Opera" (Gay, adapted Britten); "If the Heart of a Man" (males) and "When My Hero in Court Appears" (females). The songs were chosen to be accessible to all the singers. Ten randomly selected words from each recording were analysed using Praat spectrographic software, determining the duration and relative intensity of every phoneme. Minitab 16 software was used for statistical procedures: Inter-genre comparisons of phoneme intensity and duration were made for the Musical Theatre song, including an investigation of the effect of consonant word position and type. These results were then compared intra-genre to those of the Classical song.

## Results

Results demonstrated that Musical Theatre singers tended towards a "speech-like" delivery for the Musical Theatre song with significantly longer consonants than Classical singers, who exploited vowels to sustain tone. The Musical Theatre singers also used relatively more intense consonants. For the Classical song all singers changed their approach to phoneme duration but not to phoneme intensity. Results indicate therefore that phoneme duration and in particular, phoneme intensity are genre-specific. As such, both of these features could contribute to performance authenticity. The identified features are clearly detectable using a spectrographic display and pending further study could be taught using RVF to help singers cross genre authentically.

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# Does Obesity Cause Precocious Pubertal Voice Changes? (no. p58)

J.S. Bhat, R.K. Balasubramaniam

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Voice Therapy

## Introduction

The recent secular trends in pubertal maturation seem to coincide with the increasing prevalence of overweight and obesity and have raised considerable queries as to whether the early maturation is due to the obesity epidemic. Also, it is generally observed that obese children develop vocal mutation after the age of 17 years in the Indian children. Hence, the present study was attempted to verify the hypothesis that overweight/obesity does affect the vocal mutation. Also it would be of interest to know if underweight children have normal occurrence of vocal mutation.

## Method

30 Male participants in the age range of 14-17 years were classified into three groups based on the BMI which include underweight, normal weight, and overweight/obese. All the voice samples were recorded into the praat software at 44.1 kHz sampling frequency during the phonation of /a/ at the most comfortable pitch and loudness. Fundamental frequency was extracted from these recordings of sustained phonation. One way ANOVA was performed to compare the significant difference between the mean of all the groups.

## Results

The results of the present study revealed significant main effect of the group ( $F=5.732$ ;  $P$

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# The Effects of Vocal Training on Vocal Handicap and Some Acoustic Parameters in Voice Patients. A Pilot Study (no. p14)

J. Vintturi, S. Metsistö

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Rehabilitation of the Voice

## Introduction

Self evaluation of a patient's handicap is a useful tool when assessing voice disorder [1]. 46 female teachers received vocal hygiene instructions either with or without vocal training [2]. In both groups, Voice Handicap Index [3] improved, especially in the training group. Jitter and shimmer decreased in both groups. The mean speaking fundamental frequency (F0) and shimmer values (9 F, 9 M) increased in female student actors' voices after 12 months of training [4].

## Subjects and methods

The study group comprised 15 non-smokers (11 F, mean 45 yrs; 4 M, mean 50 yrs) with functional dysphonia (N=13), a narrow glottal gap (N=1) or mild laryngitis (N=1). The subjects attended a 1-year rehabilitation course for voice professionals with mild vocal symptoms. The 3 periods of 5-12 days consisted of lessons and group sessions (physical exercise, relaxation and vocal ergonomics) with individual vocal training. A broad variety of vocal exercises were applied.

The subjects completed Vocal Activity and Participation Profile (VAPP [5]) and read aloud a text in a quiet office room before and after the rehabilitation. The reading was recorded @ 6 cm. A sample of 'a' was analyzed for F0, sound pressure level (SPL), jitter and shimmer values (N=13). The data (F and M together) were analyzed using Wilcoxon Signed Ranks Test for paired samples.

## Results

VAPP scores decreased during the rehabilitation. In 15/28 of the questions, the change was statistically significant. F0 and SPL increased statistically significantly. An opposite trend could be seen in jitter and shimmer.

## Discussion

The effects on VAPP seemed positive, although the low number of the subjects has to be kept in mind. The increase in F0 and SPL can be considered beneficial in patients suffering from hoarseness and low endurance of the voice. Because no controls were recruited in this pilot study, one can't be sure if the changes were due to the vocal training or some other factor.

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# Inspiratory Muscle Training in Exercise Induced Inspiratory Symptoms (no. p29)

A. Sandnes, T. Andersen, M. Hilland, J.-H. Heimdal, T. Halvorsen, O.D. Røksund

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Treatment Methods

## Introduction

Exercise induced laryngeal obstruction (EILO) is not uncommon in young and otherwise healthy people and often confused with exercise induced asthma. The evidence base for conservative treatment is limited but case reports suggest effects from inspiratory muscle training (IMT).

## Objectives

To visualize laryngeal response pattern(s) to controlled training with IMT, and evaluate IMT used in patients with EIS after a six-week training programme.

## Methods

Twenty volunteers (age 21-28), were examined with video recorded continuous transnasal flexible laryngoscopy during IMT training using Respifit S<sup>®</sup>. The resistance was set to 100% and 60-80% of the maximal attainable inspiratory mouth pressure (P<sub>Imax</sub>). Four patients, (age 15-16) with severe EIS were given a six-week standardized IMT training program and examined before and after with continuous laryngoscopy in a maximum cardiopulmonary treadmill exercise test (CLE-test) with laryngeal movements scored by a senior laryngologist. Outcome were changes in CLE-test scores, subjective scores of severity, P<sub>Imax</sub> and running distance.

## Results

IMT resistance set to 60-80% of P<sub>Imax</sub> was preferable to 100% and gave laryngeal abduction in most healthy subjects. All 4 patients reported subjective improvements in symptoms and increased P<sub>Imax</sub> after the training period. Patient 1 and 2 became completely symptom-free, with increased peakVO<sub>2</sub> and minute ventilation. Effects were less apparent in patients 3 and 4, one of whom later treated with surgery.

## Conclusion

IMT may be effective in selected patients with EIS. Heterogeneous responses in healthy as well as in patients underscore the need for individualized and preferably laryngoscopically guided therapy.

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# The "In Plane" Visualization of the Breathing Movements of Chest and Abdomen Wall *(no. p44)*

M. Frič, P. Dlask, V. Vencovský

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Breathing

The standard image processing tools were used for the evaluation of the breathing movements in deep breathing. SpeedSence 9060 camera, resolution 1280x800 pixs, 25 frames/s was used for "in plane" recording (opposite to the chest and abdomen). Firstly the images of the video sequence were sharpened by means of a Laplacian filter in order to highlight surface patterns (the shirt with checked pattern). Sharpened consecutive images were analyzed by the cross-correlation tool of DANTEC Dynamic Studio (segments 64x64 pixs). Resulted matrices of moving vectors for given breathing maneuver were analyzed in MATLAB and their average, maximal and standard deviation values were displayed for interpretation of movement. The sum of consecutive movement vectors displays whole trajectory of body parts.

## Results

Cross correlation of images at the beginning and end of movement shows overall movement vectors but analysis of consecutive images refers to the dynamics of breathing movement as the trajectory and speed of different parts of body.

The results show the dominant horizontal movement of abdominal wall in the place of navel in the case of deep breathing with prevalence of abdominal movement. The dynamics of the movement reveals the quick sternal downward movement at the beginning and widening of lower rib cage part at the end of inhalation.

The deep pectoral breathing shows the main horizontal movement in the lower lateral part of the rib cage and whole chest vertical movement. Dynamics of the chest demonstrate the hysteretic movement.

The combined deep breathing reveals combination of the above mentioned movements.

The image analysis of video recordings of breathing movements could be a useful tool for description of breathing patterns in speech and singing.

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# Is Laser Acupuncture as Effective as Traditional Acupuncture in Treating Benign Vocal Pathologies? *(no. p59)*

E. Yiu, K. Chan, E.P.-M. Ma, M. Shek, L.Y. Tsang

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Treatment Methods

## Objective

Traditional acupuncture has been shown to be effective in treating benign vocal pathologies. However, some individuals are not able to tolerate needle puncturing in traditional acupuncture, laser acupuncture has been promoted by traditional Chinese medicine practitioners as an alternative means to deliver the effect of traditional acupuncture (Radmayr et al, 2001 and Gottschling et al, 2008). This study aimed to determine whether laser acupuncture is effective in stimulating the acupoints for treating vocal nodules and improving vocal functions.

## Methods

A total of 79 dysphonic subjects with benign vocal pathologies and a mean age of 36.25 years (SD = 11.34 years) were randomly assigned to a group which either received traditional acupuncture, genuine laser acupuncture, or placebo laser acupuncture on Renyin (St 9), Lianquan (CV 23), Lieque (Lu 7), Zhaohai (Ki 6) and Hegu (LI 4). Laser acupuncture used laser with 500mW output and 808nm wavelength. The intervention involved 12 sessions over a 6-week period. Acoustic measurement using voice range profile, voice-related quality of life measurement, and laryngoscopic evaluations were conducted to measure changes over time.

## Results

Subjects receiving traditional acupuncture showed significant improvements in their vocal function (highest fundamental frequency produced), quality of life (Voice Activity and Participation Profile), and size of the vocal nodules following acupuncture treatment when compared to the laser acupuncture and placebo laser acupuncture groups. The latter two groups of subjects demonstrated no significant improvement in the vocal function or vocal pathologies over time.

## Conclusions

Laser acupuncture was not able to demonstrate significant effectiveness in treating benign vocal pathologies as traditional acupuncture.

## Acknowledgement

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# Verification of Ambulatory Phonation Monitor with High Speed Digital Imaging *(no. p15)*

M. Kimura

- **Form:** Poster
- **Category:** Medicine
- **Topic:** Analysis of Voice and Speech

## Objectives

To determine the validity of the data of ambulatory phonation monitor (APM) with high speed digital imaging (HSDI).

## Methods

The APM is a portable instrument to track key phonatory information. It uses an accelerometer placed on the front of the neck to sense phonation-related skin vibration as a basis for estimating phonation duration, fundamental frequency and sound pressure level. In this study, both APM and HSDI were applied to diplophonia of the three unilateral vocal fold paralysis patients. HSDI was analyzed by kymography and laryngotopography.

## Results

Kymographic and laryngotopographic analysis of high speed digital images revealed two different frequencies between right and left vocal folds vibration, when the subjects showed diplophonia. Although the APM data also showed several different peak of the fundamental frequency histogram, the frequency values did not match to the laryngotopographic data. When the subjects didn't show diplophonia, the vocal fold frequencies of HSDI revealed similar value from the APM.

## Conclusion

These findings showed the data of ambulatory phonation monitor could be appropriate if the vocal fold vibration was regular. These preliminary data suggested that the ambulatory phonation monitor could not reflect the irregular vibration of vocal fold.

**Keywords:** ambulatory phonation monitor, high speed digital imaging, vocal fold vibration, fundamental frequency

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# Isolating the Effects of Strain on Voice Quality Perception (no. p30)

L.M. Kopf, R. Shrivastav, D.A. Eddins

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Psychoacoustics

Strain is one of three dimensions (breathiness, roughness, strain) that are used to describe dysphonic voice quality. No widely-accepted objective standards to quantify strain exist, and strain is often quantified using a rating scale. Unfortunately, most voices that exhibit strain also show some degree of breathiness and/or roughness. In a pilot experiment (Kopf et al., 2012), we observed that untrained listeners were unable to reliably judge the magnitude of strain independent of other co-occurring changes in the vocal signal. This makes it difficult to understand the acoustic-perceptual relationships to describe or objectively quantify the perception of strain. To address this limitation, ten listeners were recruited to provide subjective ratings of voice quality on all three dimensions (breathy, rough, strain) for /a/ vowels from talkers with disordered voices (KayElemetrics Database) using a separate 7-point scale for each rating. Similar to prior experiments, a rating of "1" represented lowest magnitude and "7" represented the highest magnitude of the target voice quality (e.g., Patel et al., 2011). For each stimulus, five ratings were made by each listener, and these five ratings were averaged to find each listener's average judgment of each voice quality dimension for a given voice (as described by Shrivastav et al., 2005). Partial correlations between average subjective ratings of strain and a battery of acoustic measures were calculated to identify the acoustic variables that may lead to the perception of strain while controlling for breathiness and roughness. The acoustic measures included: 1st-4th spectral moments, skewness, kurtosis; these were computed from linear and Bark scale spectra as well as cochlear excitation patterns and specific loudness curves computed using an auditory processing front-end. The results from the current experiment will be used to design models to explain the perception of strain.

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# The Influence of Acoustic Shields on Voice Measurements (no. p45)

M. Deutschl, M. Guštar, Z. Otčenášek, J.G. Švec

- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Acoustics

Acoustical shields are commonly used in recording industry in order to eliminate the undesirable wall reflections in the room and the noise from outdoors. The goal of this study was to find out how much the shield influences the direct and the reflected acoustic signals and to determine whether it can be used for voice measurements. Two different reflection filters manufactured by the companies sE Electronics and a Vicoustic were measured. The measurement was realized in an anechoic chamber using an active loudspeaker and a measurement microphone. The measurements were done without the filter, with the filter placed behind the microphone and with the filter placed in front of the microphone and compared. The results reveal that the SE Electronic filter attenuates the sound coming from the back by 10 dB per decade, acting as a low pass filter with the critical frequency of 700 Hz. Simultaneously, it changes the spectral properties of the direct signal by up to  $\pm 12$  dB causing the so called "coloration" of the sound. The second filter (Viscoustics) attenuates the sound coming from the back by 7 dB/decade, acting as a low-pass filter with the critical frequency of 900 Hz. Simultaneously, it changes the spectral properties of the direct signal by up to  $\pm 3$  dB. Both reflection filters behave like a comb filter due to the interference between the incoming and the reflected signal. Since they considerably modify the direct signal, changing its spectrum, the setup with the reflection filters is not recommended for voice measurements.

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# Cepstral Analysis of Voice During Menstruation (no. p60)

K.V. Phadke, J.S. Bhat, R.K. Balasubramaniam

- **Form:** Poster
- **Category:** Voice Therapy
- **Topic:** Analysis of Voice and Speech

## Introduction

The female larynx is subjected to changes throughout the life span, starting at puberty, followed by reproductive years with menstrual cycle and then with the attainment of menopause. Research in the past on vocal changes during menstrual cycle has been equivocal, with some reporting comparable results during cycle (Regishia, 2004; Meurer, Garcez, Corleta & Capp, 2009), where as some others indicating reduced voice quality during the menstruation (Mareen et al., 2008), and changes in VOT (Whiteside, Hadson, and Cowell, 2004). The magnitude of frequency perturbation change associated with time of ovulation has been suggested by Maureen et al (2009). Hence, in this study, it is hypothesized that cepstral measures predict changes in voice during menstruation as this measure relates to harmonic organization and is aimed at characterizing the voice changes during menstruation using cepstral analysis.

## Method

15 female subjects with normal speech, language and hearing without any history/complaints of vocal, respiratory and neurological problems were recruited in the present study. None of the subjects had any history of oral or injectable contraceptives usage, hormonal medication or hormonal therapy. Each subject was instructed to take a deep breath and phonate vowel /a/ for as long as possible at a comfortable pitch and loudness, followed by narration in a sound treated room. Phonation and narration sample were recorded using SpeechTool 1.65 software for cepstral analysis of the samples. This tool uses the Hillenbrand algorithm for the calculation of cepstral measures such as CPP (cepstral peak prominence and mean F0) for both the samples. The sample was collected in two sittings, once during the 3rd day of menstrual cycle and then post menstruation. The obtained scores were subjected to statistical analysis using SPSS software, version 11.0 with paired t- test.

## Results

The mean CPP value was 11.85 for phonation task and 11.56 for narration task during menstruation and 14.08 and 14.58 for phonation and narration task respectively post menstruation. Significant difference in mean values of CPP were observed for both phonation and narration tasks at  $p < 0.05$ . The decreased CPP values suggest decrease in the degree of harmonic organization. The possible reasons for such a decrease may be due to the decrease in estrogen level and increase in progesterone level which makes the vocal fold tissues more permeable and allows the fluid to retain within the lamina propria leading to poor vocal fold vibratory patterns. So the ovarian hormones seem to have effects on the voice production.

## Conclusion

The present study investigated the cepstral characteristics of voice in females during menstruation. Results revealed a decrease in the CPP value in females during menstruation in comparison to the voice samples of same individuals post menstruation. Thus it was concluded that the cepstral measures are effective in indicating the changes in voice during menstruation.

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