

3078

## Does Vocal Fold Tissue Possess Spatially Varying Mechanical Properties?

Kelleher, Jordan<sup>1</sup> Siegmund, Thomas<sup>1</sup> Chan, Roger W.<sup>2</sup>

1. *Purdue University, West Lafayette, IN, USA*; 2. *Department of Otolaryngology-Head and Neck Surgery and Graduate Program in Biomedical Engineering, Dallas, TX, USA*

To be able to understand phonation from a biomechanical perspective it is necessary that the stress-stretch response of vocal fold (VF) tissue is understood. Past studies have focused on the overall stress-stretch response of VF tissue.

We hypothesize that measurements of local stretch would reveal deeper insight into the mechanical response of VF tissue.

We conduct uniaxial tensile tests on VF tissue are attached to a mechanical testing apparatus through sutures at anterior and posterior ends. A random speckle pattern was applied to enable the use of a digital image correlation scheme for the determination of spatial distribution of stretch. Images of the VF tissue during deformation are obtained with a digital camera. Local cross sectional areas were determined from images assuming axisymmetric geometry. Beam models are employed for the prediction of fundamental frequency. Implications on transport through the VF are investigated using a poroelastic constitutive model.

We report detailed results for a typical VF tissue specimen, i.e. a human VF ligament. The stretch distribution was found to vary greatly with anterior-posterior position with the lowest stretch found at the mid-position. Accounting for both stretch distribution and cross section variation, it is found that the VF ligament tissue modulus possesses significant spatial variation, i.e.  $E=200$  kPa at VF anterior/posterior ends and  $E=1500$  kPa at the mid-position. Such stiffness variation would increase the fundamental frequency by 20% over that predicted for homogeneous modulus case. Results from simulation with a poroelastic tissue model will be used to discuss further implication on moisture transport processes in the VF structure.

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**3228**

## **The influence of de-cohesion on vocal fold deformation and stresses**

Siegmund, Thomas; Bhattacharya, Pinaki

*Purdue University, West Lafayette, IN, USA*

The mechanism of vocal fold vibration depends on a delicately balanced energy budget where several factors determine whether sufficient energy is delivered to the folds to sustain self-oscillation. However, past work has only considered the viscous dissipation in the fluid and the dissipation during the deformation of the tissue structure.

We investigate the role of cohesive contact between folds as an additional energy sink. In-vivo studies show that vocal folds impact each other many times during phonation processes. The adhesive characteristic of the contact is a strong function of surface properties, such as the degree of hydration or the presence of mucous, and can easily vary over a large range for even a single subject. The influence of such variations on the deformation characteristics are the subject of this study.

A 3D finite element model of a vocal fold structure is created, in which inner glottal surfaces can interact following a contact-cohesive traction-separation law. The traction separation law is characterized by a value of energy-to-separation and a value of separation strength. The vocal fold structure is pressure loaded, and dynamic motion brings parts of the inner glottal surfaces into contact. Following contact, separation occurs as a dissipative process described by the traction separation law.

In a dynamic analysis of the structure, we report the energy expended to de-cohere inner glottal surfaces as a fraction of the external work, and its relation to the dissipation in the tissue structure. The dependence of this loss on the cohesive properties with respect to bulk material properties is investigated parametrically.

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**Water mass transport within the larynx during inhalation**

Mongeau, Luc<sup>1</sup> Wang, Shuangdong<sup>1</sup> Sivasankar, Mahalakshmi<sup>2</sup>

*1. McGill University, Montreal, QC, Canada; 2. Purdue University, West Lafayette, IN, USA*

Superficial dehydration induced by poorly conditioned inhaled air may affect vocal fold tissue rheology. Vocal fold hydration level is an important factor regulating vocal fold vibration, voice quality, and vocal health. Despite this fact, there has been relatively little done to quantify and analyze convective water mass transport between vocal fold mucosa and the poorly hydrated air inhaled. This study describes a numerical study of airflow and water mass transport within the human larynx in order to quantify mass transport due to convection in the air stream in comparison to reported molecular conduction and other transport mechanisms. After careful validation, computational models of the larynx and the vocal tract were developed using the commercially available computational tool Fluent. Mesh refinement and time step sensitivity studies were first conducted. Simulation water transport results were compared to experimental data and simpler semi-empirical models for verification. A two dimensional model with a geometry similar to that of the larynx was then created and used for analysis. The influence of glottal width, inlet pressure and glottal angle was investigated. A general non-dimensional equation was utilized to obtain water mass flow as a function of flow velocity and other parameters. In general, assuming the inlet pressure or pressure drop with the range of value used in the paper and vocal fold surface is 1 cm in length, the net water transport rate from human larynx due to flow convection could be around 0.03 g/min. It is expected to be higher during human sports exercise or singing from analysis. Convective water transport was found to play a significant role in the regulation of hydration levels on the vocal fold tissue.

## Investigation of Electroglottographic Features by Means of High-Speed Videoendoscopy

Deliyski, Dimitar D.<sup>1</sup> Orlikoff, Robert F.<sup>2</sup> Golla, Maria E.<sup>1</sup> Moukalled, Habib J.<sup>1</sup>

*1. University of South Carolina, Columbia, SC, USA; 2. West Virginia University, Morgantown, WV, USA*

Because electroglottography (EGG) is sensitive to changes in vocal-fold contact area during phonation, it can be a valuable tool for both voice researchers and clinicians. Clinical observation and the application of various physical and mathematical models have been used to identify important EGG signal landmarks and to relate changes in signal morphology to specific aspects of laryngeal physiology. The continued refinement and applicability of high-speed videoendoscopy (HSV) allows the synchronization of the EGG signal with endoscopic images of the vocal folds. It is the purpose of this study to investigate variations of specific EGG features and relate them to HSV-observed changes in vibratory behavior.

Fourteen vocally-normal speakers (7 men and 7 women, between 22 and 29 years of age) were recorded using synchronous HSV (16,000 fps) with EGG (96,000Hz) as they produced the vowel /i/ sustained in eight different modes of phonation: habitual, high and low pitch, breathy and pressed phonation, glottal fry, tremor, and falsetto. Three different segments were selected from each of the 131 recorded HSV-EGG tokens, for a total of 393 samples. Based on current EGG models, 11 signal features were identified, grouped into four categories: 1) Cycle-phase related features; 2) Temporal features; 3) Noise-related features; and 4) Configuration-related features. The resulting data were compiled to compare differences related to the phonatory mode and the sex of the subject. Using custom-designed software with a specialized graphic user interface, the EGG signals were precisely aligned (11-microsecond accuracy) with multi-slice digital kymography. The classified EGG features were then related to specific vocal-fold vibratory characteristics. The results will be discussed in terms of how they may lead to a more meaningful interpretation of EGG signals.

## Cytochrome c Oxidase Deficiency in Human Posterior Cricothyroid Muscle

Tellis, Cari M.<sup>2</sup> Sciote, James J.<sup>3</sup> Rosen, Clark A.<sup>4</sup>

1. *Misericordia University, Dallas, PA, USA*; 2. *Misericordia University, University Park, PA, USA*; 3. *Temple University, Philadelphia, USA*; 4. *UPMC Voice Center, Pittsburgh, USA*; 5. *UPMC Voice Center, Pittsburgh, USA*

Mitochondrial alterations occur in skeletal muscle fibers throughout the normal aging process, resulting from increase accumulation of reactive oxide species. These result in respiratory chain abnormalities which decrease the oxidative capacity of muscle fibers, leading to decreased contractile force, sarcopenia or fiber necrosis. Of the respiratory chain enzyme subunits in the mitochondria, cytochrome c oxidase (COX) demonstrates the highest mutation rate. Intrinsic laryngeal muscles possesses some distinctive genotypic, phenotypic and physiologic properties. Their susceptibility to mitochondrial alterations resulting from biological processes which increase levels of oxidative stress may be one of these distinctive characteristics.

Results of the study determined the incidence of COX deficiency in human posterior cricothyroid (PCA) muscle fibers, in comparison to fibers from the human thyrohyoid (TH) muscle, an extrinsic laryngeal muscle which served as the "control" muscle. Ten PCA and 10 TH muscles were harvested post laryngectomy from 10 subjects ranging in age from 55-86 years. Using histochemical and immunohistochemical tissue section staining and standard morphometric analysis the difference in COX deficiency between type I and type II fibers within and between muscle types were compared.

COX negative fibers were identified in both the PCA and TH muscle. The PCA had ten times as many affected fibers as the TH muscle. There were significant differences in COX deficiency between muscle type and fiber type ( $p = .003$ ). Most of this effect however, was the result of elevated levels of COX deficiency in type I fibers from the PCA ( $p = .002$ ). In addition, this effect in the PCA type I fibers showed a strong positive correlation with increased age. Increased mitochondrial alterations, therefore, may occur in the PCA during normal aging.

## Phonetic labeling of dysphonia

Revis, Joana<sup>1</sup> GHIO, Alain<sup>2</sup> Giovanni, Antoine<sup>3</sup>

1. LAPEC, Fédération ORL, MARSEILLE, France; 2. LPL, Aix en Provence, France; 3. LAPEC, Fédération ORL, MARSEILLE, France

Despite of an intensive research focused on perceptual analysis, results remain uncertain and variable. Our goal was to reconsider perceptual methodology by proposing new approach based a phonetic method. Each phoneme was labeled according to five criteria : roughness, creakiness, breathiness, unvoiced and aspirated, scored as present or absent. The percentage of occurrence of each criteria was calculated considering the total number of phonemes produced by the subject. This allowed us to establish a qualitative profile of each patient's dysphonia. 80 subjects (20 normal and 60 dysphonic subjects) were recorded for the analysis of a ten syllable phrase. The voices were also submitted to the classical GRBAS perceptive analysis method by a jury of trained professionals. The labelling of the phonemes was performed by a trained speech therapist familiar with phonetic techniques. The results showed that our methodology was strongly correlated to the GRBAS scale and allowed a better characterization of dysphonia. This finding implies that perceptual judgments are directly proportional to the number of dyphonia-related events occurring during speech. With regard to linguistic factors, this study indicated that the frequency of abnormalities involving initial phonemes, median accented phonemes, and final phonemes was correlated with the prosodic curve. In the sentence analyzed in this study, the median accented phoneme also occurred in a phonetic context that promoted devocalization. Phonetic context has a strong influence on the occurrence of abnormalities. This new method gives an interesting perspective in dysphonia analysis since it appears to be at time more strict and reliable, and provides a detailed map of the dysphonic events during speech.

## Effect of Induced Effort/Strain on Voice

Awan, Shaheen N.<sup>1</sup> Tanna, Bhairavi D.<sup>2</sup>

1. *Bloomsburg University of PA, Bloomburg, PA, USA*; 2. *Supplemental Health Care, Cleveland, OH, USA*

The purpose of the study was to study the effects of induced effort on the voice by evaluating the effect of various exercise loads and intensities on the efficiency and function of the vocal mechanism. Subjects were required to perform a dumb bell lateral raise in a seated position at 20%, 50%, and 80% intensity levels of a previously ascertained single maximal lateral raise for one minute. During this task, subjects produced repetitions of the sustained vowel "ah" at comfortable pitch and loudness. Simultaneous recordings of electroglottographic (EGG) and acoustic waveforms were conducted. The weight lifting tasks were performed alternately with non-lifting/baseline recordings. Obtained data was analyzed in terms of glottal closed quotient and several acoustic parameters. In addition, voice samples were rated for perceived strain and severity.

Auditory-perceptual ratings indicated that sustained voice samples showed significant increases in strain and pitch in the workload phases as compared to baseline. EGG analysis revealed a significant increase in the glottal closed quotient in the weight lifting stages. Acoustic analysis was relatively unsuccessful in objectively documenting vocal effort, though a trend was observed for vocal effort/strain to be associated with increased fundamental frequency and decreased signal-to-noise ratios. The findings of this study provide objective data that substantiates previous speculations regarding the vocal characteristics of vocal effort/strain and provides incentive for future research with respect to the relationship between effort and voice production.

3192

## **Audibility of high frequency in voice**

Monson, Brian B.<sup>1</sup> Ternström, Sten<sup>2</sup>

*1. University of Arizona, Tucson, AZ, USA; 2. The Royal Institute of Technology, Stockholm, Sweden*

The human voice frequency spectrum above 5 kHz is often neglected in studies on the human voice. Perceptual studies involving this high-frequency range suggest that it may be of perceptual significance. Percepts possibly affected by this frequency range include speech intelligibility, talker discrimination, naturalness, and breathiness. To determine the validity of further research on this high-frequency range, a perceptual study was performed wherein listeners were required to discriminate between human voice stimuli that differed only in high-frequency content. High-frequency levels in human voice stimuli were manipulated to determine difference limens of discrimination, as well as thresholds of detection. Results will be presented that show the sensitivity of the human ear to the high-frequency content in voice. These results may impact any area where qualitative assessment of voice is necessary or important, including speech pathology, vocal pedagogy, voice synthesis, wide-band telephony, and the recording studio. Based on these results, methodology for future studies in this area will be recommended.



## **Thyroarytenoid and Cricothyroid Muscle Activity and Vocal Fold Adduction Patterns in Seven Female Commercial Singers during Production of Chest, Chestmix, and Headmix Registers**

Kochis Jennings, Karen A.<sup>1</sup> Finnegan, Eileen M.<sup>2</sup> Hoffman, Henry T.<sup>2</sup>

1. California State University, Northridge, Northridge, CA, USA; 2. University of Iowa, Iowa City, IA, USA

Although there have been numerous investigations of laryngeal muscle activity during phonation in the chest and falsetto registers, no research has been conducted examining laryngeal muscle activity during phonation in the chestmix register, a register used by many female commercial singers, particularly during the production of higher frequencies. The purpose of this study was to test the hypothesis that commercial singers produce chestmix by maintaining/increasing adduction of the vocal processes and by engaging the thyroarytenoid muscle to a greater degree than they would to produce a head register. Simultaneous recordings of thyroarytenoid and cricothyroid muscle activity, videonasendoscopy, and audio were obtained from seven female commercial singers (5 trained, 2 untrained) during sustained phonation and song phrases produced in chest, chestmix, headmix, and head registers. 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. Results from the study confirmed the hypothesis. 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. Cricothyroid activity was similar for chestmix, headmix, and head during production of lower frequencies, but greater for chestmix during production of higher frequencies.

## Acoustic and articulatory adjustments for singer's formant production: Spectral analysis, MRI and finite element modeling

Svec, Jan G.<sup>1</sup> Horacek, Jaromir<sup>2</sup> Vampola, Tomas<sup>3</sup> Herbst, Christian<sup>1</sup> Miller, Donald G.<sup>4</sup> Havlik, Radan<sup>5</sup> Krupa, Petr<sup>6</sup> Lejska, Mojmir<sup>5</sup>

*1. Palacky University Olomouc, Dept. Experimental Physics, Olomouc, Czech Republic; 2. Institute of Termomechanics, Academy of Sciences of the Czech Republic, Prague 8, Czech Republic; 3. Department of Mechanics, Biomechanics and Mechatronics, Czech Technical University Prague, Prague 2, Czech Republic; 4. EGGs for Singers, Roden, Netherlands; 5. Audio-Fon Centrum, Brno, Czech Republic; 6. Department of Medical Imaging, Masaryk University, Brno, Czech Republic*

Singer's formant, i.e., energy boost of the spectral components of voice around 3 kHz, has been recognized as an important factor for operatic singing. Latest modeling studies suggest that such energy boost can be achieved through various articulatory adjustments, but detailed in vivo data are needed. This study offers magnetic resonance (MR) images, acoustic and finite-element-modeling data from two male operatic singers who produced voice both in naïve and operatic singing quality at the same fundamental frequency on vowels [a] and [e]. In both the singers the MR images revealed a) lowered larynx, b) raised soft palate, c) flattened tongue, and d) straightened spine in operatic singing when compared to the naïve singing. Anatomical differences (e.g., epiglottis shape and position, overall shape and volume of the vocal tract) were found between the two singers. This was related to differences in formant frequencies and in the singer's formant cluster. Analysis of finite element models of the vocal tract created from the MR images revealed at least six acoustic eigenmodes, both longitudinal and transverse, that can contribute to the energy boost in the frequency region of 2-5 kHz. The data suggest that different anatomical dispositions in singers lead to different possibilities for optimizing voice quality. Recognizing these inter-individual differences can play an important role for the science-based singing voice pedagogy in future.

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## Subglottal pressure in communicative reading

Sundberg, Johan<sup>1</sup> Scherer, Ron<sup>2</sup> Hess, Markus<sup>3</sup> Müller, Frank<sup>3</sup>

*1. Dept of Speech Music Hearing, School of Computer Science and Communication, Stockholm, Sweden; 2. Bowling Green State University, Bowling Green, OH, USA; 3. Department of Voice, Speech and Hearing Disorders at the University Medical Center of Hamburg-Eppendorf, Hamburg, Germany*

While in singing subglottal pressure is varied with pitch and vocal loudness, it is often assumed to be relatively constant in speech. For example, Ohala showed that the variations of this pressure during speech can be attributed to articulatory downstream blockage of the airway, e.g., in fricative and stop consonant production. Fant and associates, on the other hand, examined continuous subglottal pressure during reading, and reported small variations associated with prosody. Abrahamson and Sundberg found substantial variations of subglottal pressure during actors' stage speech.

In the present investigation subglottal pressure was measured while a male subject read first with a loud and then with a neutral voice, as if he were telling a story to a large and then a small group of listeners, respectively. Simultaneous recordings were made of airflow (recorded by a Rothenberg mask system), subglottal pressure (picked up by a pressure transducer in the trachea introduced via tracheal puncture), and audio. Equivalent sound level differed by 6.4 dB. In loud compared to neutral reading, average subglottal pressure was almost twice as high, airflow about 30% higher, and F0 almost 4 semi-tones higher (7 and 13 cm H<sub>2</sub>O, 0.2 and 0.15 L/s, 160 and 130 Hz, respectively). Considerable variations of subglottal pressure were observed, some peaks coinciding with the occlusion for stop consonants, and others coinciding with peaks in the F0 curve. By contrast, the variations of flow during voiced sequences were mostly unrelated to subglottal pressure per se (adduction was not measured). The correlation between the log of pressure and flow was close to 0. On the other hand the correlation was 0.91 and 0.87 between the log of pressure and F0 in loud and neutral voice, respectively. The findings deviate considerably from the results of earlier investigations and indicate that the role of subglottal pressure in speech may differ considerably between subjects depending on style of speaking.

## **A Cross-System Study of the Geriatric Voice in Relation to an Open Mouth Approach**

Lin, Emily<sup>3</sup> Mautner, Helene<sup>3</sup> Maclagan, Margaret<sup>3</sup> Anderson, Tim<sup>1</sup>

*1. Christchurch Hospital, Christchurch, New Zealand; 2. Christchurch Hospital, Christchurch, New Zealand; 3. University of Canterbury, Christchurch, New Zealand*

An open mouth approach is commonly used in voice therapy for enhancing speech and voice production and relaxing the laryngeal musculature. The acoustic and physiological consequences of an open jaw posture, however, have not been clearly understood due to a paucity of cross-system studies taking the age effect into consideration. This study employed an infrared-light marker based facial tracking system along with a multi-channel recording setup to pursue this investigation. Subjects included 58 female and 28 male healthy adults, aged between 38 and 93 years old. Subjects sustained the vowel /a/ for approximately three seconds at a constant, habitual pitch in normal and open-jaw postures respectively. The extent of maximum jaw displacement was measured from the recorded facial tracking signals. Fundamental frequency, vocal stability, and the first two formant frequencies were derived from acoustic signals, and speed quotient (time ratio between the opening and closing phases) and contact quotient (the time ratio between the closed phase and the period) from electroglottographic signals. The Aerophone II system yielded mean flow rate for the same phonation task and airflow and air pressure measures for an additional /pa/ repetition task. Results from a series of parametric tests indicated that an open jaw posture was associated with a significant increase in mean flow rate, fundamental frequency, and intensity as well as an improvement in vibratory patterns and periodicity across all age groups. The general findings demonstrated the positive effect of an open mouth approach. Differences related to aging were also observed.

## VRP contour shape variations with voice pathology

Pabon, Peter<sup>1</sup> Hakkesteegt, Marieke<sup>2</sup>

*1. Royal Conservatory, The Hague, Utrecht University, Utrecht, Netherlands; 2. Erasmus University Medical Centre Rotterdam, Rotterdam, Netherlands*

It is generally acknowledged that the size of the Voice Range Profile is reduced, and that the VRP shape changes, when the voice function is disturbed due to voice pathology. Apart from incidental case reports, there is little systematic knowledge of how this reduction takes place, what the general alterations are, and if there are typical patterns or specific shapes that could link to distinct pathological or functional changes.

Sets of 120 VRPs of female voices and 80 VRPs of male voices, all with diverse voice pathology, are analyzed. The choice was to do a morphologic analysis without the premise that shape/size should link to any grading/typing of pathology. First, a grand total overlap map is created that provides a general overview of the progress of the area reduction process. The observed effect is best described as a two stage retreat from the falsetto register area, to a modal residual area that coincides with the area generally occupied by the speaking voice. Next, a pure morphological analysis is done by applying a Principal Component Analysis (PCA) on the contour variation in each data set. A PCA analysis can reveal any systematic patterns in the contour alterations. The output of this analysis is a group of characteristic VRP shape modifiers, graded by their relative impact. The group of shape modifiers found, forms at the same time the most efficient model to analyze, classify or synthesize VRP contours for that category.

Graphs will be presented that demonstrate the characteristic VRP contour changes. The application of the shape modifiers will be demonstrated and their potential status; their uniqueness and their possible physiological association will be discussed.

## Experimental aerodynamical and postural analyses of whispering voice

Lagier, Aude<sup>1</sup> Amy de la Breteque, Benoit<sup>1</sup> Yohann, Meynadier<sup>2</sup> Giovanni, Antoine<sup>1,2</sup>

1. CHU Timone, Marseille cedex 05, France; 2. Laboratoire Parole et Langage, UMR6057, Aix-en-Provence cedex 1, France

**Introduction:** Whispering voice is mainly featured by the absence of vibration and the lack of contact between the vocal folds. Previous studies described two different types: the quiet whispering voice (QWV) and the forced whispering voice (FWV) (Monoson & Zemlin, 1984). The latter corresponded to the intention to produce higher vocal loudness. We hypothesized that FWV would be closer to vocal hyperfunction (i.e. vocal effort): increase in subglottal pressure (SGP), typical modifications of body posture.

### Experiments:

Experiment 1 focused on SGP. Two subjects (who belong to the authors) were analyzed. A tracheal puncture allowed direct measurement of SGP while the subjects had to whisper “quietly” or “loudly”. The results showed a SGP at 11.4hPa and 14.3 hPa respectively during FWV since SGP in QWV were 3.2hPa and 5.3hPa. The results were consistent with the hypothesis.

Experiment 2 focused on body posture. The movements of twenty female subjects were assessed using a 3D numerical device based upon video detection and reconstruction (SMART<sup>®</sup> system). The task was to dictate, a series of numbers to a listener located 10 meters away from the subject, using speaking or whispering voice. The results showed that trunk movements were significantly higher than during speaking voice ( $Z=-3.92$ ,  $p<0.0001$ ). The description of the movements highlighted the close relation with the postural aspects of vocal effort.

**Conclusion:** FWV did share the SGP levels and postural characteristics of vocal effort. A clinical application of these results concerns the post-operative cares in phonosurgery. The use of FWV should be avoided in order to prevent the patient from acquiring and perpetuating the vocal effort behavior.

3221

## Morphometric Characteristics of the Vestibular Folds and Their Functional Significance

Kahane, Joel C.; Chorna, Lesya

*University of Memphis, Memphis, TN, USA*

There is a paucity of quantitative data on the vestibular folds (VsF). Renewed interest in the VsF relates to their contribution to dysphonia. This study provides quantitative data to characterize developmental-involuntional VsF changes and suggests a comprehensive description of their mechanics.

**Methods:** 400 histological sections of 20 human larynges, matched by decade (1st - 9th ) were studied via light microscopy. Images were digitally captured with bright field and stereo microscopes. Linear and area measurements were made along with descriptions of constituent morphology.

**Results:** 1. Thickness of the quadrangular membrane (QM) (epithelium and superficial lamina propria) was uniform (~10% of the area) along VsF length, consistent across ages, becoming fibrotic in old age. 2. Connective tissue (CT) was greatest in the mid-portion of VsF (40-45% of the total area) followed by posterior and anterior points of attachment. 3. Density/area of the mixed muco-serous glands (~ 50%) was slightly less in mid 1/3. 4. The densest CT area (~40%) was deep to the QM, had fimbriations surrounding nests of glandular tissue. In old age, these tissues became fibrotic and 5. increases in CT area accrued by addition of areolar tissue at the expense of involuting gland acini.

**Implications:** 1. CTs and glands were arranged in distinct regions within VsF. No muscle is intrinsic to VsF proper. 2. A "true" VsF ligament was not evident. 3. VsFs were reinforced in mid-region by dense CT, possibly serving to prevent sagging and mass loading of the true folds. 4. Increased thickness of CT contiguous to the arythenoids may serve to dampen vibration during phonation. 5. With increasing age, VsF may stiffen and become less active in glottal dynamics.

## Efficient Stroboscopic Evaluation

Kelley, Richard<sup>1</sup> Portnoy, Joel<sup>2</sup> Colton, Raymond<sup>2</sup> Paseman, Ashley<sup>3</sup> Lowell, Soren<sup>4</sup>

1. SUNY Syracuse, Syracuse, NY, USA; 2. SUNY, Syracuse, USA; 3. Vocal Pointe, Syracuse, USA; 4. Syracuse University, Syracuse, USA

Stroboscopic examination is a valuable tool for evaluation of persons with dysphonia. Interpretation of the exam by the clinician should be systematic. In the past various systems for rating several parameters or "signs" have been proposed. The results of a previous study supported the concept that a small set of rated stroboscopic parameters can be used to adequately represent the information gained from rating the original, more comprehensive sign protocol. Using only 3 stroboscopic signs (vocal fold amplitude, vibratory behavior and edge), a Vibration Score and Edge Score were calculated. These two scores differentiated various vocal pathology and provided a more efficient method of extracting valuable information from the stroboscopic exam.

In this prospective study, we enrolled 30 patients over 18 years old who had a diagnosis of a benign vocal fold lesion. Evaluation included stroboscopy which was rated only for vocal fold amplitude, edge and vibratory behavior parameters. These were used to determine Vibration Score and Edge Scores. Digital voice recording were also evaluated by subjective rating and a Voice Handicap survey was completed. We investigated the relationships between the stroboscopic Vibration and Edge Scores, VR-QOL, and subjective voice rating for each diagnosis.



## Comparison of Endoscopic vs. Electromyographic Evaluation of Vocal Fold Paresis

Divi, Venu; Geyer, Matthew

*Drexel University College of Medicine, Philadelphia, PA, USA*

Vocal fold paresis is responsible for a variety of vocal complaints and is a common finding on initial evaluation of the voice patient. This finding, at times very subtle, is diagnosed using repetitive phonatory tasks during flexible fiberoptic laryngoscopy on initial office evaluation. Paresis may be found to be unilateral, bilateral, or fluctuating. Laryngeal electromyography (LEMG) can be used to confirm the presence, location, and severity of the vocal fold paresis. In addition, LEMG can determine specifically which muscles are responsible for the vocal fold hypomobility. Given that the finding of paresis is at times difficult to determine visually, discrepancy can be seen between the endoscopic and electromyographic description of the vocal fold movement. This study is a retrospective analysis comparing findings of vocal fold paresis on endoscopic examination against LEMG findings to determine consistency of results between the two methods of evaluation. All patients with documented vocal fold paresis on initial otolaryngologic evaluation were subsequently sent for blinded LEMG evaluation by a neurologist. Comparison is made between the findings to determine accuracy of the examining physician in identifying paresis seen on LEMG. Analysis is also done to determine if accuracy is affected by increased severity of paresis as seen on LEMG or by seniority of the examining physician.

## Controlling Gender and Voice Intensity Effects in Acoustic Assessments

Brockmann, Meike<sup>1</sup> Drinnan, Michael J.<sup>2</sup> Carding, Paul N.<sup>3</sup>

1. Clinic for Otorhinolaryngology, Head and Neck Surgery; University Hospital Zurich, Zurich, Switzerland; 2. Critical Care Physics, Regional Medical Physics Department, Newcastle upon Tyne, United Kingdom; 3. Department of Speech, Voice and Swallowing, Newcastle upon Tyne, Great Britain

**Introduction:** Gender and voice intensity effects on jitter and shimmer have been widely documented and limit the clinical usefulness of these measures. The aim of this cross-sectional single cohort study was to compare these effects under a range of assessment protocols and to derive clinical guidelines.

**Methods:** Forty healthy adults (1:1 f:m) aged 20-40 years phonated a prolonged /a/ at: (a) subjective soft, normal and loud intensity; (b) prescribed intensities: 65, 75, 85 and 95dB (visual feedback); (c) prescribed intensities and fixed fundamental frequency (F0) (visual and auditory feedback). Gender and voice sound pressure level (SPL) effects were assessed with ANOVA.

**Results:** In soft, medium or loud phonations, men were always louder, but equally as loud as women at prescribed intensities. 85dB without fundamental frequency control was matched best. In all tasks jitter and shimmer were lowest at highest SPL. Gender differences were considerably smaller with control for SPL but not for pitch (table 1).

Assessment protocols	Produced mean	Produced mean	Mean jitter	Mean jitter	Mean shimmer	Mean shimmer
	SPL (dB) Women	SPL (dB) Men	(%) Women	(%) Men	(%) Women	(%) Men
Soft voice	61.3	64.2	0.52	0.75	4.15	4.67
Medium voice	72.2	73.3	0.32	0.42	2.22	2.56
Loud voice	88.5	92.0	0.24	0.20	1.38	1.43
65 dB	69.9	70.3	0.36	0.43	2.58	2.62
75 dB	77.5	76.8	0.25	0.30	1.90	1.90
85 dB	85.3	84.8	0.23	0.21	1.55	1.45
95 dB	92.8	93.2	0.19	0.19	1.02	1.30
65 dB and F0	70.4	70.7	0.33	0.43	2.40	2.47
75 dB and F0	76.8	77.2	0.30	0.29	1.86	1.95
85 dB and F0	83.7	83.9	0.24	0.26	1.40	1.77
95 dB and F0	89.6	90.6	0.21	0.26	1.29	1.73
Pooled confidence interval	0.94	0.94	0.1	0.1	0.5	0.6

**Discussion:** In clinical practice the effects of gender and habitually different voice intensities between individuals on jitter and shimmer can be minimised when patients control for their voice intensity by visual feedback and maintain 85 dB. Future work should investigate which patient groups are able to fulfil these requirements.

3092

## Properties of the subglottal acoustic wave in the range of the primary register transition

Miller, Donald G.<sup>1</sup> Schutte, Harm K.<sup>2</sup>

1. EGGs for Singers, Roden, Netherlands; 2. Groningen Voice Research Lab, Groningen, Netherlands

In typical speech phonation the phasing of the subglottal acoustic wave is set in relation to the maximum that occurs at the moment of glottal closing, with the form of the wave determined by the primary subglottal formant. In much of speech and singing the subglottal acoustic wave is unable to complete a full cycle before glottal opening renders the sub- and supra-glottal spaces acoustically coupled. The longer closed phases of some singing voices, however, allow an accurate measurement of the formant. In an ascending sung scale, the subglottal acoustic wave maintains a relatively constant formant frequency up to the point in the scale where the wave is no longer able to complete a cycle within the glottal closed phase. At this point the wave takes on a new form: the moment around which phasing is organized is now that of the maximum at glottal opening. What was the maximum at glottal closing is delayed until after glottal closing, half-way through the glottal cycle that begins at opening. The two maxima are properties of a standing wave at  $2 \times F_0$  that is forced on the subglottal cavity.

The present study considers the implications of this shift in the subglottal wave for the singing voice, paying particular attention to the fact that the shift occurs in a band of  $F_0$ s, 300-400 Hz, that mark the typical shift from the "chest" to the "head-falsetto" vibratory pattern of the vocal folds. The primary source of data is a series of direct dynamic measurements of sub- and supra-glottal pressures from broad-band pressure transducers mounted on a catheter passed through the posterior commissure of the glottis of professional (classical) singers.

## The possibilities and limitations of estimating subglottal pressure from intra-oral pressure in speech and singing

Lagier, Aude<sup>2</sup> Henrich, Nathalie<sup>1</sup> Amy de la Bretèque, Benoît<sup>2</sup> Giovanni, Antoine<sup>2</sup>

1. CNRS, DPC GIPSA-lab, Saint Martin d'Hères, France; 2. CHU La Timone Marseille, LPL, Aix-en-Provence, France

Subglottal pressure is a parameter of much importance in voice function. Yet, its direct measurement is challenging, because it requires a very invasive approach. It consists in placing a pressure transducer below the glottis by tracheal puncture between the cricoid cartilage and the trachea first ring. Other methods have been proposed, which estimate the subglottal pressure using less invasive approaches. The most common one is to estimate subglottal pressure from intra-oral pressure measured during the plosure of voiceless consonants. This approach has been validated in the case of normal speaking voice. However, few studies have explored its validity for soft or loud voice, for whisper or pressed voice, and in the case of singing.

This study explores the possibilities and limitations of estimating subglottal pressure from intra-oral pressure in speech and singing. Two subjects were recorded while uttering CV segments (plosive consonant followed by a vowel) with different voice qualities (normal, soft, loud, whisper, pressed). One of the subjects, who is a trained singer, sung sentences at several pitches covering his comfortable tessitura in the two main laryngeal mechanisms. Two recording sessions were conducted with a one-year time interval in between. Several methods for estimating subglottal pressure from intra-oral pressure signal are compared. A good agreement between estimates and direct measures is found in most cases. Soft phonations seem to be the worst situation for deriving subglottal pressure from intra-oral pressure measurements.

## Signature-Based Measurement of the Delay between Voice Signals

*Deliyski, Dimitar D.; Schwarz, Raphael*

*University of South Carolina, Columbia, SC, USA*

Relating intra-cycle landmarks of vocal-fold vibration to corresponding features of indirect voice signals is a question of high importance for basic science and clinical practice. The recent refinement of high-speed videoendoscopy (HSV) allowed for accurate synchronization of image data with sound-pressure, electroglottographic, oral-pressure, airflow and other voice-related signals. Synchronization is a necessary prerequisite for aligning these signals with high temporal precision. A remaining problem, however, is the inherent delay between the signals measured at the laryngeal level versus those measured inside or outside the vocal tract. Traditionally, these delays have been estimated based on distance and speed of sound. Recent findings cautioned us that actual delays may be significantly greater than estimated, sometimes exceeding a glottal cycle. Therefore, delays should be measured rather than estimated.

The purpose of this study was to develop a technique for accurate and reliable measurement of the delay between different types of voice signals. The technique relies on the premise that, although, different types of signals have inherently dissimilar waveforms due to differences in phase and spectral characteristics, they carry a common signature encoded in their fundamental frequency fluctuations. The method comprises a 3-stage high-precision autocorrelation-based frequency signature decoder applied on two synchronously-recorded voice signals, followed by statistical procedures for eliciting the actual delay. In order to assess the validity, accuracy and reliability of the technique, 180 pre-recorded acoustic samples from 20 vocally-normal speakers (10 men and 10 women) were re-recorded by two microphones of different types interspaced at 4 distances, using 1-cm increments, producing a total of 720 two-channel samples. The results demonstrate the proposed technique warrants and exceeds the required accuracy and reliability necessary for intra-cycle landmark alignment.

3072

## **Analysis and study on electroglottograph and acoustic parameters of Peking Opera Singers**

Wang, Jianqun<sup>1</sup> Zhang, Qian<sup>1</sup> Feng, Yulin<sup>2</sup> Shen, Xiaohui<sup>1</sup> Yu, Chenjie<sup>1</sup> Yang, Ye<sup>1</sup>

1. *The Affiliated Drum Tower Hospital of Nanjing University Medical School, E.N.T. Department, Nanjing University, Nanjing, China*; 2. *Institute of Acoustics, Nanjing University, Nanjing, China*

**Objective:** Analysis and study on electroglottograph and acoustic parameters of different roles in Peking Opera.

**Method:** Using Dr. Speech 3.0 software in the multi-media system to conduct synchronizing electroglottograph and acoustic test of vowels such as /æ , /a: /i: pronounced by 127 different roles aged between 20 and 62 and the result is compared with common people with healthy voice quality.

**Result:** The F0 of electroglottograph and acoustic test of vowels such as /æ , /a: /, /i: pronounced by different roles showed a remarkable difference. Other electroglottograph parameters such as Jitter, Shimmer, NEE, CQ, CQP and acoustic parameters such as Jitter, Shimmer, NEE all have their own parametric values. The parametric voice values of Peking Opera singers and common people are all within the normal range of DPSS.

**Conclusion:** The different roles in Peking Opera have their unique acoustic features and we can use Dr Speech 3.0 software to do objective test and evaluation of their voice parametric values and provide useful clinical value for vocal training and protection of Peking Opera singers.

**3242**

## **Measurement of Vocal Fatigue in Patients with Unilateral Vocal Fold Paralysis**

Edgar, Julia D.; Piccirillo, Jay F.; Paniello, Randal C.

*Washington University School of Medicine, Saint Louis, MO, USA*

Patients with unilateral vocal fold paralysis often complain of voice fatigue. These patients frequently indicate that their voice is stronger in the morning and that with use it weakens and becomes more breathy. The variability of voice quality throughout the day makes it more difficult for a physician to assess functional fatigue during a patient office visit. This study is an initial step to determine a viable means of assessing voice fatigue in this population in the physician's office. We have data from 10 patients with unilateral vocal fold paralysis. Data was collected at a single session prior to medialization thyroplasty and again at a single session 6 months post intervention.

Maximum phonation time fatiguability quotient (FQ) is a new measure. It is conceptually a measure of the compensatory effort of the non-paralyzed side. FQ is the ratio of the second maximum phonation time (MPT) measurement divided by the first, with a standardized amount of work in between (in this case three trials of maximum phonation followed by five minutes of loud reading). The quotient is 1.0 if there is no fatigue and 0.0 if no voice is produced at the second attempt.

In addition to completing the FQ protocol patients completed the voice-related quality of life measure (VRQOL). Data analysis is underway, including Cepstral analysis of sustained phonation. A control group will also be included.

3142

## **Dysphonia assessment using automatic classification system**

Revis, Joana<sup>2,3</sup> GHIO, Alain<sup>3</sup> Pouchoulin, Gilles<sup>1</sup> Giovanni, Antoine<sup>2</sup>

*1. LIA, Avignon, France; 2. LAPEC, Fédération ORL, MARSEILLE, France; 3. LPL, Aix en Provence, France*

This study addresses voice disorder assessment. After several years of research about perceptual analysis of dysphonia, our work is focused on the phonetic influence responsible to pathological events emergence. The phonetic labeling method allows a perceptual evaluation of each phoneme separately, but needs to be automated. This work proposes an original methodology involving an automatic classification system as well as knowledge of both pathological and machine learning experts. This methodology aims to bring a better understanding of phonetic phenomena related to dysphonia. Firstly, the automatic system was validated on a dysphonic corpus (80 female voices), rated following the GRBAS perceptual scale by an expert jury. Then, an automatic phonemic analysis underlined the significance of consonants and, more surprisingly, of voiceless consonants for the same classification task. Submitted to pathological experts, it appears that the onset of the vocal fold vibration could explain these findings. These observations led to a manual analysis of voiceless plosives, which highlighted a lengthening of VOT according to the dysphonia severity, validated by a preliminary statistical analysis.



### **Impact of Dysphonia on Quality of Life in the Pediatric Population.**

Verduyckt, Ingrid A.<sup>1,3</sup> Benderitter, Celine<sup>2</sup> Morsomme, Dominique<sup>1</sup> Jamart, Jacques<sup>1</sup> Remacle, Maec<sup>2</sup>  
1. UNIVERSITY HOSPITAL OF MONT GODINNE, YVOIR, Belgium; 2. CATHOLIC UNIVERSITY OF LOUVAIN LA NEUVE, LOUVAIN LA NEUVE, Belgium; 3. UNIVERSITY HOSPITAL OF SAINT-LUC, BRUSSELS, Belgium

The following study takes place in the framework of the development of a voice related quality of life instrument adapted to children.

The objective was to identify dysphonic children's complaints regarding their voice and its impact on physical, emotional and socio-functional aspects of life.

Semi-structured interviews were conducted with 25 dysphonic children with vocal complaint aged 6-13 (M=9.6) and 55 normophonic children aged 5-13 (M=8.5). A written questionnaire was addressed to the dysphonic children's parents.

Following a qualitative analysis of the interviews and the questionnaires, 24 main complaints were identified.

A chi square test was used to compare the dysphonic children's complaints with the normophonic's and a binomial test was used to evaluate the concordance of the dysphonic children's complaints with their mother's.

17 of the 24 identified complaints were significantly more expressed by dysphonic than by normophonic children: 5/10 physical, 5/7 socio-functional and 7/10 emotional ( $p < 0,05$ ).

3 of the 24 identified complaints show significant discordances between the mothers and the children: 1/10 physical (mothers < children), 2/10 emotional (children < mothers) ( $p < 0,05$ ).

We conclude that dysphonia has a negative impact on children's quality of life and that children from age 5 are capable of giving their opinion about voice related quality of life.

These results encourage us to think that the child's subjective evaluation should be considered prior to treatment decision.

## **The Diagnostic Value of the Voice Range Profile (VRP) in the Phoniatic Counseling of Professional Boy Singers at the Onset of the Voice Change in Puberty**

Fuchs, Michael<sup>1</sup> Heylen, Louis<sup>2</sup> De Bodt, Marc<sup>2</sup> Hentschel, Bettina<sup>3</sup> Wuyts, Floris L.<sup>4</sup> Meuret, Sylvia<sup>1</sup>

*1. University of Leipzig, Section of Phoniatics and Audiology, Leipzig, Germany; 2. Department of Neurosciences, University of Antwerp, Belgium; Faculty of Medicine, University of Gent, Belgium, Edegem, Belgium; 3. Institute for Medical Informatics, Statistics and Epidemiology, University of Leipzig, Germany, Leipzig, Germany; 4. University of Antwerp, BioMedical Physics, Antwerp, Belgium*

During the voice change due to swift laryngeal growth, the capacity and quality of the singing voice is temporarily limited, especially with boys. For members of professional boys' choirs with high artistic demands, this is a vulnerable phase in which the singing voice must be protected from overstrain. The goal of the study was to investigate what significance the VRP has for the diagnosis of the voice change.

With 36 boys of the Leipziger Thomanerchor, a total of 435 VRPs were conducted over 3.5 years at 3-month intervals, analysing 6 frequency parameters and the Voice Range Profile Index for Children (VRPIc). Using tests according to Friedman and Wilcoxon and a linear regression, the question of which modifications begin even before the onset of voice change (OVC) was pursued, in order to predict the time remaining before OVC.

The upper ( $P=0.002$ ) and the lower ( $P=0.008$ ) limits of the voice range showed a significant drop 3 months before OVC. The VRPIc is lowered by 0,58/month ( $P<0.001$ ) down to an average rating of -0.22 at the OVC. The size of the chest and falsetto registers showed no significant changes; the borderline between the two evinced a tendency to drop as early as 3 months before OVC.

It was shown for the first time that longitudinal VRP data are useful for accurate diagnosis of the OVC with boys and for predicting the time remaining, making it possible to avoid voice problems resulting from vocal overstrain. The results give the choir director valuable information to plan the pieces the children are to sing.

## Defining the Lived Experience of Elderly Adults with Voice Disorders

Etter, Nicole M.<sup>1</sup> Thomas, Lisa B.<sup>2</sup> Stemple, Joseph C.<sup>1</sup> Howell, Dana<sup>3</sup>

1. University of Kentucky, Lexington, KY, USA; 2. Marshall University, Huntington, WV, USA; 3. Eastern Kentucky University, Richmond, KY, USA

Recent evidence suggests that as many as 29% of individuals over the age of 64 suffer from a current voice disorder (1). This percentage is of note, as only 6.6% of individuals in the working age population (<65) report such a disorder (2). Further, studies of treatment-seeking populations indicate that individuals over age 65 account for more than one quarter of those seeking specialty care for a voice disorder (3). These findings suggest a possible increase in voice concerns in the elderly population. Continued study of this age group is needed to understand the impact on the aging adult's quality of life. The objective of this study was to define the lived experience of elderly adults with voice disorders. Information was gathered from interviews with treatment-seeking elderly adults. Information was analyzed qualitatively following the principles of phenomenological assessment (4). Data suggests elderly adults experience a strong emotional reaction to their voice problem and social and vocational limitations are present. The proposed paper will share results describing the life experience of elderly adults with voice disorders; the first step in developing a formal quality of life tool.

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## The effects of instructions on motor learning of a relaxed phonation task

Ma, Estella; Cheung, Ophelia

*Voice Research Laboratory, Division of Speech and Hearing Sciences, The University of Hong Kong, Hong Kong, Hong Kong*

Traditionally, it is believed that providing instructions to learners about how to perform a motor task is necessary to facilitate the learning process. However, evidence from the general motor learning literature suggests that provision of task instructions to learners may degrade their learning when compared to others who are not informed about the rules/strategies of the skill. The present study examined the effects of instructions on learning the “relaxed phonation” task in a group of vocally healthy individuals. It investigated whether providing learners with specific and detailed instructions about how to produce relaxed phonation would facilitate or degrade learning of the skill.

Twenty-six vocally healthy individuals were randomly assigned into two groups: INSTRUCTION group and NO-INSTRUCTION group. Participants in the INSTRUCTION group were provided with detailed instructions about how to phonate in a relaxed manner. They were introduced the chant-talk technique which has been demonstrated to be effective in reducing vocal hyperfunction. Participants in the NO-INSTRUCTION group were not introduced any information on how to phonate with relaxed mode. All participants practiced a reading aloud task. The muscle activities over perilaryngeal region during practice were measured using surface electromyography (EMG), which were then provided to participants as biofeedback. The participants were required to minimize the EMG waveform amplitude. A delayed retention test was conducted one week after training to evaluate motor learning.

Results revealed that for the NO-INSTRUCTION group, there was a significant decrease in EMG levels (hence, more relaxed) between baseline and delayed retention tests. However, similar improvement was not observed in the INSTRUCTION group. The results suggest that provision of task instructions can influence the way an individual learns a voice motor skill.

## **Application of Perceptual Motor Learning Principles to Auditory Training in the Perception of Voice Qualities**

Bergan, Christine C.

*Southern Illinois University Edwardsville-Assistant Professor, Collinsville, IL, USA*

Improving the reliability and validity of voice quality assessment strengthens the value of diagnosis of voice pathologies and the general habilitation of healthy voice production. The primary goal of this study was to investigate whether selected perceptual-motor learning principles incorporated into an auditory training paradigm would improve the reliability and validity of perceptual judgments of voice qualities.

Specifically, the principles of blocked vs. random presentation of stimuli and massed vs. spaced practice schedules were investigated. Forty subjects with no formal training in the perception of voice qualities were divided into five groups of 8 subjects each: Massed-Blocked, Massed-Random, Spaced-Blocked, Spaced-Random, and Placebo. All groups except Placebo completed a four-phase study, which included pre-tests, training, one-day retention and generalization tests, and 14-day retention and generalization tests. The Placebo group completed the pre- and post-tests only. Training was completed with an interactive computer program that provided feedback about accuracy of the subject's rating after every stimulus. Three types of stimuli were used in this study: Synthetic [a], Natural [a], and excerpts from the "rainbow" passage produced by natural voices with and without pathologies. All training was completed with the synthesized voices, and the natural [a] and natural rainbow passages served as a means to measure generalization of learning to a novel task.

All four types of training resulted in increased accuracy and decreased absolute error. This improvement was greater for the groups receiving training than for the placebo group. Magnitude of improvement varied with specific type of stimulus and voice quality. The massed-random training group demonstrated the greatest magnitude of improvement from pre- to short-term and long-term retention and generalization tests.

3119

## **Preliminary Investigation of the Global Voice Therapy Model**

Grillo, Elizabeth U.

*West Chester University, West Chester, PA, USA*

Four adult patients with voice disorders, who were referred for voice therapy, participated in the Global Voice Therapy Model (GVTM) one session a week for a total of 4-5 sessions. Each session lasted between 40-50 minutes. The GVTM, dedicated to improving generalization and maintenance of newly learned voice behaviors independent of a specific voice production technique, includes the following component parts: 1) stimulability testing to determine the voice production technique that facilitates the most improved vocal output, 2) bottom-up presentation of the improved vocal output by incrementally increasing utterance length and cognitive complexity until conversational speech is achieved and generalized across people, situations, and settings, 3) production and recognition of "new voice" (i.e., improved vocal output achieved in therapy) and "old voice" (i.e., poor vocal output before therapy) by auditory and kinesthetic feedback at all levels of utterance length and cognitive complexity and 4) additional methods to augment and support the improved vocal output, such as vocal hygiene strategies, laryngeal massage, abdominal breathing exercises, body stretching, and posture. Pre- and post-treatment clinical voice measures were recorded. The measures included acoustic and aerodynamic data, number of dysphonic events, perceptual rating scales of vocal quality and vocal fatigue, and a quality of life scale. Clinical research was warranted to investigate the potential effectiveness of the GVTM in treating adult patients with voice disorders. The ultimate goal of such investigation is to provide preliminary data for a future randomized clinical trial.

3141

### **Study of vocal therapy efficiency: comparison of two methods.**

Morsomme, Dominique J.<sup>1</sup> Martinot, Gisèle<sup>2</sup> Vliegen, Liz<sup>3</sup> Verduyck, Ingrid<sup>3</sup>

1. University of Louvain - University of Liège, Liège, Belgium; 2. CHU - ENT Dptmnt, Liège, Belgium; 3. Université Catholique de Louvain, Louvain-La-Neuve, Belgium

Our objective is to compare the efficiency of 2 methods of vocal therapy. Method A consists of exercises centred on the breath, the vibration and the resonance. Method B associates the principles of the muscular chains (Struyf) and the motor coordination (Piret-Béziers) with the eutonia of G. Alexander. 11 patients (mean age: 32.9) presenting a functional dysphonia or nodules of the vocal folds were distributed in both groups. We compared their results pre and post therapy (interval: 6 months) at subjective (GRB, VHI) and objective (acoustics and aerodynamics) measures.

We observe an improvement of the post therapeutic measures in both groups (VHI  $p < 0.005$ ; maximum intensity  $p < 0.05$ ; intensity range  $p < 0.05$ ; frequency range  $p < 0.05$  and maximum frequency  $p < 0.05$ ).

We observe an improvement of the post therapeutic measures for the group A for the grade and the roughness on a sustained [a] ( $p < 0.05$ ) and for the grade, the roughness and the breathiness on text reading ( $p < 0.05$ ).

Both methods are equivalent to improve the vocal quality of the dysphonic patients in this study.

## A trial of four tremor control techniques

Bonilha, Heather S.<sup>1</sup> Halstead, Lucinda<sup>2</sup>

1. University of South Carolina, Columbia, SC, USA; 2. Medical University of South Carolina, Charleston, SC, USA

Many patients with vocal fold tremor do not have success with medical or surgical intervention. These patients are often advised to have a trial of voice therapy in an attempt to alleviate some of the laryngeal strain associated with the disorder. Throughout the clinical and scientific literature, there have been some suggestions of behavioral modification techniques that reduce the notability of vocal tremor. Four of these techniques that we have focused on are: reduced loudness, increased breath support, increased pitch, and increased rate of speech. These techniques all revolve around the foundation of attempting to reduce the load on the thyroarytenoid muscles. Clinically, we have had some success with teaching patients these tremor control techniques for the short-term reduction of the notability of their vocal tremor. Due to this clinical success, we sought to investigate whether the results of these clinical control techniques could be experimentally-validated. Ten patients with vocal tremor participated in the study. We accomplished a repeated measure acoustic and perceptual study of the four voice control techniques, as well as a patient self-assessment of the effect of the control techniques. All patients achieved short-term reduction in vocal tremor with at least one of the control techniques. The best technique for each patient differed due to whether acoustic analysis, auditory-perceptual rating, or patient self-assessment was used as the test.



3201

## **Efficacy of therapy in puberphonia: an outcome evaluation research**

KUMAR, VIJAY

*Mysore University, Mysore, Karnataka, India*

**Introduction:** Voice is the essential part to one's speech and significant contributor of the personality. Puberphonia is a voice condition where young male continue to use the high pitch voice even after attain puberty. Clinically it has been observed that puberphonic subjects may show varying symptoms. Some of the puberphonic may have only monopitch [high pitch] while other equipped with diplophonic voice [low & high pitch].

**Aim:** Aim of the study was to assess effectiveness of various therapy techniques in various Puberphonic subjects.

**Method:** Six puberphonic age ranged 13 to 25 years were selected for the study. Perceptual and instrumental assessment reports were gathered for all subjects. It was surprisingly observed that one (Group I) out of six showed co-existence of two mean habitual frequency 128 Hz and 237 Hz. While others subjects (group II) expressed only unidimensional higher pitch. Traditional mode of therapy was tailored for both groups.

**Results:** As hypothesized both group responded adequately for the tailored rehabilitation programs. Group I was able to maintain his lower pitch consistently in various speaking conditions just after 3 sessions of therapy for various socio-academic environments. Groups II also showed significant improvement in habitual pitch while generalization was achieved.

**Conclusion:** Remarkable stable improvement for both groups justifies the role of symptom specific tailored therapy approach in Puberphonia. This study advocates the need for efficacy study in speech therapy. Outcome evaluation may help client while dealing insurance, medical legal or service concerns issues.

3030

### **Treatment of psychogenic dysphonia, using the visualisation method**

Niebuir-van der Ham, Aimée E.; Dikkers, Frederik G.

*University Medical Center Groningen, University of Groningen, Groningen, Netherlands*

Little has been published about a specific group of patients with non-organic voice disorders: psychogenic voice disorders. Here, the loss of voice is related neither to structural laryngeal lesions nor neurological disease. Stress and/or emotional factors seem to be related to this condition.

Various models are being used to treat psychogenic dysphonia. In 1986 Drost, in the Netherlands, developed the visualization method. Here we describe this method and our results.

Using a standardized protocol at the Voice Clinic of the University Medical Center Groningen, a third line referral hospital in the Netherlands, the voice is being diagnosed by a speech therapist and an otorhinolaryngologist. The patient records the subjective experience using VHI.

Treatment takes about 2½ hours and is performed by a qualified speech therapist. During this session efforts are undertaken to find out which factors played a role in starting the voice disorder. Then a short overview about the laryngeal structures that work together in voice and speech is presented to the patient. The idea of an organic failure is taken away and an explanation model for the voice disorder is presented. Consecutively the patient has to complete several voice tasks in mind. These tasks comprise of loudness, clearness and rate of speech. It is important to stress that these tasks are performed in silence, using the previous, normal, voice only in mind. The final step is to implement this thought experiment into normal speech.

In a period of 5 years 38 patients were diagnosed with psychogenic dysphonia. Thirty four (m-f: 11-23) were treated with the visualization method. Twenty five patients benefited by visualization. Visualization is a good and effective treatment for psychogenic dysphonia.

3024

## **The treatment of muscle tension dysphonia: comparison of two treatment techniques by means of an objective multiparameter approach**

Van Lierde, Kristiane M.; d'Haeseleer, Evelien; Sofie, Claeys

*university hospital Gent, gent, Belgium*

**Objectives/hypothesis:** the purpose of the present study is to measure the effectiveness of two treatment techniques - vocalisation with abdominal breath support and manual circumlaryngeal therapy- in patients with muscle tension dysphonia. Based on the results of previous reports a significant improvement of the objective overall vocal quality after manual circumlaryngeal therapy can be expected.

**Study Design:** crossover design

**Methods:** The vocal quality before and after the two treatment techniques was measured by means of the dysphonia severity index, which is designed to establish an objective and quantitative correlate of the perceived vocal quality. The dysphonia severity index is based on the weighted combination of the following set of voice measurements: maximum phonation time, highest frequency, lowest intensity and jitter.

**Results:** The repeated measures ANOVA revealed a significant difference between the objective overall vocal quality before and after MCT. No significant differences were measured between the objective overall vocal quality before and after vocalisation with abdominal breath support.

**Conclusion:** This study showed evidence that manual circumlaryngeal therapy is an effective treatment technique for patients with elevated laryngeal position, increased laryngeal muscle tension and muscle tension dysphonia. The treatment effectiveness was measurable with a multiparameter approach by means of the DSI value, reflecting the objective overall vocal quality. The precise way in which manual circumlaryngeal therapy has an effect on vocal quality has not been addressed in this experiment, but merits study. Further research into this topic could focus on EMG recordings in relation with vocal improvements with larger sample of subjects.

3140

## **Task-Dependent Supramarginal Cortical Activation During Phonatory Behaviors in Humans**

Joshi, Ashwini; Jiang, Yang; Stemple, Joseph C.; Andreatta, Richard D.

*University of Kentucky, Lexington, KY, USA*

Current theoretical models of speech production suggest an important role for comparative feedback between self-generated acoustic and somatosensory inputs during running speech. One cortical area that has been suggested to play such a role is the region in and around the temporo-parietal junction (Brodmann Area 40), a somatosensory association area in the inferior parietal cortex. Given that the laryngeal system functions as the source of acoustic energy during speech and vocalization, if BA 40 does play a role in negotiating self-generated acoustic inputs and movement-related somatosensation, one could expect this region to be differentially modulated during isolated phonatory behaviors as compared to running speech. To examine this prospect with functional magnetic resonance imaging (fMRI), a series of vocalization/speech tasks were designed in a hierarchical manner to reflect different levels of phonatory complexity. Subjects performed vocalization and speech tasks under three conditions: whisper, voiced and imagined. The purpose of this presentation is to demonstrate the relation between BA 40 activation and laryngeal activity during task production. Data from persons with normal voice showed different levels of BA 40 activation as a function of the level of laryngeal involvement during each of the speech/vocalization tasks. Bilateral activation was present during the tasks, with the "imagine" sentence production condition evoking the largest response in BA 40. Unlike the primary motor area (BA 4) that responded stronger to voice production than imagination, area 40 may be involved in coordinating imagined or actual voice production involving memory and sensory feedback.

## Acoustic Analysis of Detrimental and Beneficial Clearing Behaviors

Bonilha, Heather S.; Copen, Jennifer; Savidge, Maggie

*University of South Carolina, Columbia, SC, USA*

Non-productive cough and chronic throat clearing are often implicated in causing or maintaining laryngeal pathologies. Due to this implication, clinicians advise patients to stop coughing and throat clearing and to replace them with less harmful behaviors that also remove the urge-to-clear. The behaviors that clinicians advocate for have not been assessed to determine their less harmful status. Furthermore, it is necessary to evaluate the potentially harmful behaviors of coughing and throat clearing in relation to habitual and loud phonation. This study sought to compare the following behaviors: cough, throat clear, silent cough, soft throat clear, habitual phonation, and loud phonation. Thirty-five self-professed vocally-normal participants were recorded producing these behaviors via the Multi-Dimensional Voice Program (MDVP) Model 5105 (KayPENTAX) coupled with a condenser head-mount microphone AKG C420 held at a distance of 4 cm and an angle of 45-degrees from the participant's mouth in a sound proof booth. The behaviors were simultaneously measured for loudness via sound pressure level (SPL) meter. The results revealed that the less harmful techniques were produced at nearly 7 dB SPL less than the throat clear, 11 dB SPL less than the cough, and 14 dB SPL less than loud phonation. For 77% of the participants, the phonation samples recorded prior to the cough were softer than those recorded post-cough. The vocally-normal speakers were then grouped according to the level of acoustic perturbation in their habitual phonation. Participants with acoustic perturbation levels outside of normal limits had lower SPL on all tasks except coughing when compared to persons with normal acoustic perturbation levels. Overall, it appears that coughing and the acoustic characteristics of phonation have a multifaceted, degradatory relationship.

**Correlation between vibratory and perceptual measurement in resonant voice**

Chen, Fei; Lo, Gigi; Pang, Gary; Ma, Estella; Yiu, Edwin

*The University of Hong Kong, Hong Kong, Hong Kong*

Instrumentations and perceptual evaluation protocols have been used in studying the physiology and acoustics of resonant voice exercise used in voice therapy. However, the extent of vibratory resonance during resonant voice phonation is not well documented. The present study investigated the relationship between extent of skull resonance using quantitative measurement and the perceptual quantification of phonatory resonance. The study also examined the difference in skull vibration between the production of nasal and non-nasal voice stimuli after resonant voice training. 18 females and 18 males aged from 20 to 33 years with normal voice were given a session of resonant voice training. Vibration measurements using vibro-detector on the nasal bridge and forehead site during the production of voice stimuli were taken. The voice productions were also recorded and three speech pathologists with at least 2 years of experience in assessing and managing voice patients were asked to rate independently using an 11-point equal-appearing interval (EAI) scale to evaluate the amount of phonatory resonance. Results revealed that the correlation between skull vibration measurement and perceptual resonance rating was significant but low ( $r = .389, p < .0001$ ). Furthermore, the increase in vibration after resonant voice training is comparable between the nasal and non-nasal stimuli ( $p > 0.05$ ). Neither was the vibration in resonant voice significantly different ( $p > 0.05$ ) from that in strained voice. These results suggested that either perceptual voice evaluation or the vibratory measurement on the nasal bridge and forehead site is not a good indicator of resonant voice.

3025

### **The objective vocal quality, vocal risk factors, vocal complaints and corporal pain in female student teachers during the three years of study**

*Van Lierde, Kristiane M.; d'Haeseleer, Evelien; Claeys, Sofie  
university hospital Gent, gent, Belgium*

The purpose of the present study is to determine the objective vocal quality and the vocal characteristics (vocal risk factors, vocal and corporal complaints) in 143 female student during the three years of study. The objective vocal quality was measured by means of the Dysphonia Severity Index. Perceptual voice assessment, the Voice Handicap Index, questionnaires addressing vocal risks, vocal and corporal complaints during and/or after voice usage were performed. Student teachers have a normal perceptual and objective vocal quality corresponding with a DSI% of 76. The ANOVA revealed a significant increase of the objective vocal quality between the first and the third year of study. No psychosocial handicapping effect of the voice was observed, though there are some vocal complaints and almost all student teachers reported the presence of corporal pain during and/or after speaking. Especially sore throat and headache were mentioned as the most present corporal pain symptoms. Due to the decreased awareness and the multifactorial genesis of the potential vocal risk factors the student teachers are at risk for developing an occupational dysphonia during their teaching career. Since teaching is a high-risk profession for the development of voice problems the incorporation of a direct vocal training technique to increase vocal endurance during teaching together with a vocal hygiene program, dietetics and a stress management training program during the three years of study is needed to prevent occupational dysphonia.

## **Effects of electromyographic terminal feedback on motor learning of the relaxed phonation task**

*Wong, Amy; Ma, Estella; Yiu, Edwin*

*Voice Research Laboratory, The University of Hong Kong, Hong Kong, Hong Kong*

The present study investigated the effects of terminal feedback on the learning of relaxed phonation using a motor learning paradigm. Twelve dysphonic participants were evenly and randomly assigned to two groups of conditions: with terminal feedback and without terminal feedback. During training, all participants were asked to read aloud sentence stimuli with four Chinese characters. Participants in the terminal feedback group received surface electromyographic (sEMG) biofeedback from the thyrohyoid site after reading every two sentences. Participants in the 'no feedback' group did not receive any feedback throughout the training sessions. A delayed retention test was conducted one week after training to evaluate motor learning.

Results showed that motor learning was achieved in the 'no feedback' group, as demonstrated by a greater reduction of sEMG levels at the thyrohyoid site, comparing to the terminal feedback group. In order to assess how the participants perceived their learning, Voice Activity and Participation Profile (VAPP) (Ma & Yiu, 2001) was used. A great reduction in the Total VAPP scores during the pre- and post-treatment measurements was obtained from participants in the terminal feedback group. However, an increase in the Total VAPP scores was observed in the 'no feedback' group. The results indicated that participants' perception towards their learning was affected by the amount of feedback they received during therapy and their perceptions did not necessarily parallel the actual benefits of the therapy.

In summary, motor learning was evidenced in the 'no feedback group', which supported the hypothesis that provision of few or no terminal feedback would be more beneficial to motor learning as there was no concentration of attention focus on the laryngeal area with the absence of feedback.



3038

## **An EGG Study on Voices of Mandarin, Tibetan, Yi and Mongolian**

Kong, Jiangping

*Phonetics lab, Peking University, Beijing, China*

This paper is concerned with the voice study of Mandarin, Tibetan, Yi and Mongolian through parameters of F0, speed quotient and open quotient extracted from EGG signals of sustained vowels by the EGG program of Kay.

In this study, sustained vowel /a/ and its EGG signal are recorded twice simultaneously from 100 speakers, 50 males and 50 females, for each language, and each sample is about 2 or 3 seconds long. There are 800 samples altogether. F0, speed quotient and open quotient are extracted from each sample. There are more than 20,000×3 parameters for each language. These parameters are analyzed statistically and the average F0, speed quotient and open quotient are obtained. In addition, the standard deviations are calculated and numbers of these parameters involved in calculation are given.

According to these parameters, some conclusions have been drawn. They are: 1) F0 of female speaker in each language is larger than that of male speaker; 2) speed quotients of male voice are larger than those of female voice in Mandarin, Yi language and Mongolian, but the speed quotient of male voice is smaller than that of female voice in Tibetan; 3) the open quotient of male voice is larger than that of female voice in Yi language, a little bit larger in Mandarin, almost the same in Mongolian and smaller in Tibetan. In general, the study shows that the voices of the 4 languages are different in pitch, speed quotient and open quotient, and the phonations of languages which use different phonation types in their speech communication do influence their vocal habit and vibration of vocal folds physiologically.

## Comparison of Voice-Use Profiles in Elementary Classroom and Music Teachers

Morrow, Sharon L.<sup>1</sup> Connor, Nadine P.<sup>2</sup>

1. Westminster Choir College, Princeton, NJ, USA; 2. University of Wisconsin - Madison, Madison, WI, USA

Teachers represent the largest group of occupational voice users and they have voice related problems at a rate of over twice that found in the general population. Among teachers, the subgroup of music teachers are roughly four times more likely than classroom teachers to develop voice-related problems. While it has been suggested that music teachers might use their voices at high intensities and durations in the course of their work, voice-use profiles that measure the amount and intensity of vocal use, defined as vocal load, have not been measured directly in music teachers during the work day, nor compared with these same voice-use parameters in classroom teachers. In this study, total phonation time, fundamental frequency ( $F_0$ ), and sound pressure level (SPL) were measured directly using a KayPENTAX Ambulatory Phonation Monitor. Vocal load was calculated by distance dose as defined by Svéc, Titze & Poppolo (2003) which factors total phonation time,  $F_0$ , and SPL. Twelve participants ( $n = 7$  elementary music teachers and  $n = 5$  elementary classroom teachers) were monitored for one work week to determine average vocal load for these two groups of teachers. Significant differences in total phonation time ( $p < 0.01$ ) and distance dose ( $p < 0.01$ ) were found between the two groups. These results suggest that typical vocal loads in music teachers may be substantially higher than those experienced by classroom teachers. Reduction in vocal load may have clinical implications for the preservation of vocal health in music teachers.

**3144**

### **Voice disorders and social consequences**

Revis, Joana<sup>1</sup> Privat, Nathalie<sup>1</sup> Giovanni, Antoine<sup>2</sup>

*1. LAPEC, Fédération ORL, MARSEILLE, France; 2. LAPEC, Fédération ORL, MARSEILLE, France*

In our society, based on communication, dysphonia becomes a handicap which can be responsible of work discrimination. Actually, several commercial services are provided by phone only, and voice quality is mandatory for the employees. This work aim was to determine the social picture relayed by dysphonia. Our hypothesis was that dysphonia sounds pejorative compared to normal voice. 40 voice samples (30 dysphonic and 10 normal) were presented randomly to a perceptual jury of 20 naïve listener. The task was for each of them to fill a questionnaire, designed specifically to describe the speaker's look and personality. 20 items were evaluated, divided into 4 categories : health, temperament, appearance, and way of life. The results showed significant differences between normal subjects and dysphonic patients. For instance, the pathological voices were depicted as more tired, introverted, sloppy than normal voices, and less trustable. No significant differences were found according to the severity of voice disorders. This work is presently continued and has strong consequences on patient's management and voice therapy.

## **An Exploratory Study of Muscle Fatigue and Delayed Onset Muscle Soreness After Transcutaneous Electrical Stimulation to the Neck**

Fowler, Linda P.<sup>1</sup> Ingalls, Christopher<sup>1</sup> Gorham-Rowan, Mary<sup>2</sup>

1. Georgia State University, Atlanta, GA, USA; 2. Valdosta State University, Valdosta, GA, USA

Transcutaneous electrical stimulation (TES) is a staple in skeletal muscle rehabilitation. Recently, applying TES to cranial muscles has become a popular complement to traditional dysphagia rehabilitation regimens. Many SLPs using TES have made anecdotal reports of perceptual voice changes in their patients and have begun using it to treat a variety of voice disorders. Based on these anecdotal reports, Fowler et al., 2005 studied whether measurable changes in F0 and vocal loudness could be found in normal subjects after an hour of TES. Non-significant, but measurable increases were found in the group averages for both parameters. Additionally, some subjects reported neck fatigue immediately after TES and neck soreness 24 hours later. These findings were similar to results from vocal loading studies (Gelfer et al., 1991; Buekers et al., 1995; Vilkman et al., 1999). Skeletal muscles fatigue more rapidly from TES than from normal contractions (Marsolais et al., 1988; Riener, 1999). Accordingly, treatment guidelines for the application of TES to skeletal muscles have been established to prevent fatigue. No studies have investigated the fatigability of neck muscles from TES.

Six normal subjects, three males and three females participated in this study. Subjects engaged in standardized speech tasks during pre-treatment voice recordings, timed intervals throughout an hour of TES treatment and post treatment recordings. Fo and dB measurements were made from the pre and post treatment recordings. Subjects also marked a 100 mm visual analog scale to indicate the level of muscle soreness they felt prior to TES treatment and at timed intervals after the treatment. Analysis of data is currently in progress.

## Patient Factors Related to Voice Therapy Attendance and Outcomes

Smith, Bonnie E.<sup>1,2</sup> Kempster, Gail B.<sup>1</sup> Sims, Steven H.<sup>1</sup>

1. Assistant Professor, Department of Otolaryngology--Head & Neck Surgery, University of Illinois at Chicago, Chicago, IL, USA; 2. Private Practice, Port Charlotte, FL, USA

Limited information is available concerning factors that may be associated with attendance and outcomes among patients referred for voice therapy. The purpose of this study was to determine whether patient-related factors could be identified which distinguished patients who attended voice therapy and had positive voice change from those who did not. This retrospective study included reviewing medical record information for 100 patients seen at a major urban, academic medical center over a one year period. The attendance/outcomes of voice therapy for the patients in this study resulted in their division into 5 groups, including those who 1) were successfully discharged from therapy; 2) attended a few sessions, had voices that improved to normal or were near normal and then stopped attending therapy; 3) attended many sessions with some voice gain; 4) failed to improve despite attending voice therapy; or 5) failed to attend voice therapy as recommended. Outcomes for Groups 1-3 (53% of patients) were considered successful (positive voice change) while outcomes for Groups 4 and 5 (47% of patients) were considered unsuccessful. A high percentage of patients, those in Group 5, essentially did not attend therapy (44%). Patients having successful outcomes were more likely to be younger, employed, with fewer laryngeal diagnoses, medical problems, a less severe voice disorder and lower Voice Handicap Index (VHI) scores at the start of therapy. The data suggest that patients with more complex laryngeal diagnoses, more severe voice diagnoses, occupational issues, more health issues and higher VHI scores at the time of the initial voice evaluation may be at greater risk for failing to attend voice therapy sessions. Suggestions for improving voice therapy attendance and success rates are discussed.

## Content development in Voice-Related Patient-Reported Outcomes Measures

Branski, Ryan C.<sup>1</sup> Cukier-Blaj, Sabrina<sup>2,3</sup> Pusic, Andrea<sup>4</sup> Cano, Stefan J.<sup>5</sup> Klassen, Ann<sup>6</sup> Mener, David<sup>1</sup> Patel, Snehal<sup>1</sup> Kraus, Dennis H.<sup>1</sup>

*1. Memorial Sloan-Kettering Cancer Center, New York, NY, United States; 2. Integrated Acoustic Analysis and Cognition Laboratory, Sao Paulo, Brazil; 3. Cefac Health & Education, Sao Paulo, Brazil; 4. Memorial Sloan-Kettering Cancer Center, New York, NY, United States; 5. University College London, London, Great Britain; 6. McMaster University, Hamilton, ON, Canada*

**Objectives/Hypothesis:** To review existing patient reported outcomes measures (PROM) used in dysphonic populations in order to assess the procedures employed in their development and the extent to which these meet current development standards for content generation and psychometric evaluation.

**Study Design:** Systematic review.

**Methods:** A systematic review of Medline, CINAHL, and HAPI databases was completed using voice, quality of life (QOL), and PROMs as keywords. We identified all patient-reported or parent-reported questionnaires measuring QOL associated with voice disorders from the review findings. Questionnaires were appraised for adherence to international guidelines for the development and evaluation of PROMs as outlined by the Scientific Advisory Committee of the Medical Outcome Trust.

**Results:** Nine PROMs fulfilled the inclusion criteria. The quality of these questionnaires was variable with regard to instrument development and none met all of the current, recommended criteria. Of the nine questionnaires, the Voice Symptom Scale underwent the most rigorous development process. Furthermore, many instruments have been augmented to allow for proxy administration, failing to address QOL-related issues specific to the target population.

**Conclusions:** Instrument development is often overlooked when attempting to quantify patient reported outcomes in dysphonic patients. Careful instrument development procedures are required to ensure that PROMs are valid, reliable, and responsive. Our review suggests that the deficits in psychometric properties of the current voice-related PROMs may be, at least in part, due to deficits in the development process. Furthermore, these data suggest the potential utility of a novel PROM adhering to rigorous international standards to better ensure that clinicians appreciate the variables most relevant to patients with voice disorders and address some of the psychometric shortcomings of the currently employed questionnaires.

3231

## **Singing outside of the box: development of a singing voice therapy program to maximize skill transfer**

Roth, MM, MA, CCC-SLP, Douglas F.<sup>1,2</sup> Gartner-Schmidt, Jackie<sup>2</sup> Smith, DO, Libby<sup>2</sup>

1. University of Pittsburgh, Pittsburgh, PA, USA; 2. UPMC Voice Center, Pittsburgh, PA, USA

A key challenge in voice therapy has been facilitating the transfer of patients' new vocal skills from the therapy room into their everyday situations and environments. Motor learning principles have indicated that the ability to generalize new skills depend on the similarity between the conditions during training and those in the transfer situation. In general, transfer across tasks is quite small and depends on the similarity between the tasks and conditions during therapy and those of the target environment. This fact poses a particular challenge for singing voice therapy in which the majority of training is spent in a small therapy room with no more than piano accompaniment. For a professional singer who must transfer these skills to a large environment, often in competition with a number of potentially loud instruments, in front of an audience and in a heightened emotional state, it is not surprising that patients can have difficulty transferring new skills to performance.

To address these difficulties, a treatment program was developed for an internationally touring rock singer that closely approximated the conditions of her performance venues during therapy. The program was conducted over the course of a single week in a local performing arts venue. During the sessions, her sound engineer played a multi-track recording from a prior live performance at realistic concert levels and she performed using her typical high energy dancing and singing. This paper will describe the various techniques used during therapy to facilitate the transfer of newly trained skills from therapy to performance. Following therapy the singer went from needing to cancel a large number of performances to having no canceled performances four months after therapy.

3150

## **Comparing the Vocal Dose of University Students from Vocal Performance, Music Education and Musical Theater**

Gaskill, Christopher S.; Cowgill, Jennifer G.

*The University of Alabama, Tuscaloosa, AL, USA*

University students training for vocal music careers face varying demands regarding the typical vocal dose experienced throughout their undergraduate training. It is reasonable to expect that they may often experience vocal doses much higher than might be considered safe or desirable. It is unclear how well students can meet these vocal challenges. The purpose of this study is to gather preliminary data regarding the typical vocal dose of university undergraduate students majoring in vocal performance, musical theater, and music education. 2 students, 1 male and 1 female, at the freshman or sophomore level in each of these three programs will wear a vocal dosimeter for 5 days. Prior to and following the data collection period, videostroboscopy of the larynx and basic acoustic and perceptual voice analyses will be performed. The dosimeter will collect data regarding accumulated vocal dose as a function of intensity and fundamental frequency. The students will also log singing activities and time spent in social activities, with information regarding type of singing, environmental factors, and self-perception of vocal quality and fatigue. The students will also perform vocal probe activities at regular intervals throughout the day to assess pitch range and the ability to produce soft, high-pitched phonation. The dosimetry and pre- and post-dosimetry voice evaluation data will be summarized in order to compare the vocal doses and basic vocal function of the students between the three programs of study. Implications for ways to insure students' vocal health will be presented, along with suggestions for future research and for structuring training curricula to provide the best training possible without potential compromise of students' vocal health.



3137

## **Voice Characteristics of Female Physical Education Student Teachers across their First Semester of Student Teaching**

Grillo, Elizabeth U.; Fugowski, Justine

*West Chester University, West Chester, PA, USA*

Based on the high prevalence of voice disorders in the teaching profession and the societal and economic impact, a prevention paradigm beginning with student teachers should be implemented to minimize the likelihood of developing a voice disorder. With the goal of developing such a prevention paradigm, the voice characteristics of student teachers were evaluated. The participants consisted of seven female physical education student teachers at West Chester University. The present study required the student teachers to participate in the collection of subjective and objective voice data at three time points in the semester; 1) baseline, prior to the beginning of the semester of student teaching, 2) middle of the semester of student teaching, and 3) end of the semester of student teaching. The subjective voice data included: CAPE-V, VHI, vocal quality rating scale completed by the participant, vocal fatigue rating scale completed by the participant, and end of the semester questionnaire completed by the participant. The objective voice data included: acoustic measures of fundamental frequency, jitter measures, shimmer measures, dB SPL, NHR, semitone pitch range, and aerodynamic measures of laryngeal resistance, MPT, and the s/z ratio. Results will be discussed in relation to the following specific research questions:

- 1) Will the subjective and objective measures of female physical education student teachers change over their first semester of student teaching?
- 2) Are the female physical education student teachers' subjective voice characteristics consistent with their objective voice characteristics?
- 3) Do the female physical education student teachers feel that their voice is negatively affecting their ability to teach?

3074

## Voice Amplification as a Means of Reducing Vocal Load in Elementary Music Teachers

Morrow, Sharon L.<sup>1</sup> Connor, Nadine P.<sup>2</sup>

1. Westminster Choir College, Princeton, NJ, USA; 2. University of Wisconsin - Madison, Madison, WI, USA

Music teachers are more than 8 times more likely to have voice-related problems than the general public, and more than 4 times more likely than other similar high-risk occupational voice users such as classroom teachers. Music teachers may have different and more extensive vocal needs than classroom teachers, as evidenced by our prior study in which music teachers were found to have significantly greater vocal loads during a full work week than classroom teachers, as measured using a KayPENTAX Ambulatory Phonation Monitor (APM). While research with classroom teachers has shown that voice amplification can reduce vocal intensity in classroom teachers, thus decreasing vocal load, there have not been similar investigations with elementary music teachers who rely on high intensities and durations of voice-use during their work day. In this study, vocal load was measured directly using an APM. Seven music teachers were monitored for one work week using an APM to determine vocal load by means of distance dose (a function of total phonation time, sound pressure level [SPL], and fundamental frequency [ $F_0$ ]), and were then monitored with the APM for a second week while using a voice amplification unit (Asyst Chatter Vox). Significant decreases in mean vocal intensity ( $p < 0.01$ ) of 8 dB were found using amplification, along with a significant decrease in distance dose ( $p < 0.01$ ). These data suggest that voice amplification may be an effective intervention for the potentially damaging vocal loads experienced by elementary music teachers.

3098

## **The Effect of Voice Amplification on Occupational Vocal Dose in Elementary School Teachers**

Gaskill, Christopher S.

*The University of Alabama, Tuscaloosa, AL, USA*

The primary purpose of this study is the collection of pilot data regarding the effect of a personal voice amplifier (Chattervox) on the accumulated occupational vocal dose in elementary school teachers. There will be two phases: 1. Elementary school teachers in a local school system will complete the Voice-Related Quality of Life (VR-QOL). The VR-QOL will be used to identify teachers with and without vocal problems. 2. Two participants will then be recruited, one with a low VR-QOL score (indicating no vocal problems), and one teacher with a high VR-QOL score (indicating the presence of vocal problems). This phase will employ a single-subject ABA design, with each phase lasting 1 week, for a total of 3 weeks. Each teacher will wear a vocal dosimeter during work hours each weekday for 1 week (5 work days), for the baseline phase. For the the treatment (B) phase, each teacher will continue to wear the vocal dosimeter, along with a personal voice amplifier for the duration of each workday for 1 week. Finally, both teachers will wear the vocal dosimeter for 1 more week, without the voice amplifier. Data regarding the accumulated vocal dose for each teacher, which includes frequency, intensity, and duration of voicing, will be collected for all three phases of the study. The teachers will also be instructed to perform certain vocal tasks at set intervals throughout the day for the purpose of obtaining daily baseline and comparison measures, and to rate their voices according to set parameters of vocal fatigue. Comparisons regarding the dosimetry and ratings data will be made between amplified and unamplified conditions, and between the two teachers.

**Effect of the Number of Anchors on Voice Rating Reliability**

Awan, Shaheen N.; Childs, Ashley B.

*Bloomsburg University of PA, Bloomsburg, PA, USA*

The purpose of this study was to evaluate the effect of the number of perceptual anchors on the reliability of voice quality judgments. Several studies have supported the idea that variability in auditory-perceptual ratings of voice may be reduced by replacing the varied internal standards of listeners with referenced anchors for the different vocal qualities. The external standards used in this study were auditory in nature. A total of five conditions were tested (No Anchors, One Anchor, Four Anchors, Seven Anchors, and Ten Anchors), each including 11 subjects instructed to perceptually rate seventy-two voice samples comprised of normal, breathy, hoarse, and rough qualities. Within each voice quality category, three of each severity (mild, moderate, and severe) were represented.

The results of this study indicated that the Ten Anchor condition resulted in a significantly stronger mean interrater correlation than the Four and Seven Anchor groups, but no significant difference existed when compared to the No Anchor and One Anchor groups. A trend was observed for improved mean interrater correlations in the Ten Anchor group. No significant differences between the groups for mean intrarater correlation or mean intrarater agreement existed. Results also indicated a significant decrease in anchor use following the presentation of the first 18 samples within the rating task, a trend for a decrease in the use of the Normal anchor, and increased use of the Hoarse anchors. Implications will be discussed.

## The Influence of Clinical Terminology on Self-Efficacy for Voice

Gillespie, Amanda L.<sup>1</sup> Verdolini Abbott, Katherine<sup>2</sup>

1. University of Pittsburgh, ASHA, Sewickley, PA, United States; 2. University of Pittsburgh, Pittsburgh, PA, United States

**Purpose:** (1) to obtain initial evidence around the question of whether clinical language (specifically language referencing vocal “abuse and misuse”) has the potential to harm self-efficacy for voice, which hypothetically may compromise patient compliance with treatment; and (2) to determine the number of subjects required for a future large-scale study.

**Methods:** Fourteen teachers with self-reported voice disorders of unknown etiology participated in the study. Subjects were randomly assigned to one of two 15-min standardized, video-taped educational exposures. One exposure described the origins of common voice problems in teachers in terms of vocal “abuse/misuse”. The other exposure described the problems in terms of “phonotraumatic behaviors and muscular tension”. Before and immediately after exposures, subjects completed a visual analogue scale, the Voice Self-Efficacy Questionnaire, that was specially designed for the study, which assessed situation-neutral self-efficacy for voice.

**Results:** Psychometric evaluation of the tool indicated strong intra-rater and test-retest reliability ( $r > .99$ ;  $r > .78$  respectively). More conceptually interesting, binomial tests indicated that the responses to self-efficacy questions reliably increased pre- to post exposure in the “phonotrauma/muscle tension” group (20/28 responses;  $p < .05$ ), whereas no reliable change in scores was seen in the “abuse/misuse” group (13/28 responses decreased; 11/28 responses increased; 4/28 responses were unchanged; non-significant).

**Conclusions:** Results provide preliminary support for the hypothesis that clinical exposure to “abuse/misuse” language may harm patients’ self-efficacy by compromising expected increases in self-efficacy following patient education. Effect sizes based on the present data indicate that at least 20 subjects per group (N=40 total) would be required to assess the effects of the noted terminology on voice-related self-efficacy shifts parametrically, using a similar experimental design.

3217

## **Individuals high on introversion are at risk for muscle tension voice disorders as tested with a stress reactivity protocol**

Dietrich, Maria<sup>3</sup> Verdolini Abbott, Katherine<sup>1</sup>

1. University of Pittsburgh, Pittsburgh, PA, USA; 2. University of Kentucky, Lexington, KY, USA; 3. University of Kentucky, Lexington, KY, USA

The theory of the dispositional bases of vocal nodules and functional dysphonia (Roy & Bless, 2000) represents an important step toward the understanding of the relation between personality and voice disorders. However, experimental tests of this theory are widely lacking.

In this study, female healthy and vocally normal participants between the ages of 18-35 years were divided into two groups, introverts (n=27) and extraverts (n=27), based on results on the Eysenck Personality Questionnaire- Revised (EPQ-R). Both groups underwent a stress reactivity protocol, which involved a simulated public speaking stressor in addition to baseline speech, rest, and recovery phases. Outcomes were extralaryngeal surface electromyography (submental, infrahyoid, and anterior tibialis musculature); vocal effort, voice fundamental frequency (F0) and intensity; and systolic blood pressure (SBP), state negative affect, rumination, and fear of public speaking.

Introverts had significantly higher scores on vocal handicap, depression, and fear of public speaking as compared to extraverts. The stress reactivity protocol was effective and significantly increased SBP, negative affect, and rumination in all participants. Introverts had significantly greater infrahyoid muscle activity and numerically higher submental muscle activity throughout the protocol and perceptions of vocal effort increased significantly greater during stressor exposure in introverts than extraverts. In parallel, voice F0 and intensity decreased during stressor exposure for both groups.

This psychobiological study is the second test of the trait theory of voice disorders (see van Mersbergen et al., 2008) and the first to focus on stress reactivity. Results indicated that introverts have a disposition towards increased extralaryngeal muscle activity and vocal effort, which is magnified under conditions of psychological stress and most evident in individuals who score high on both introversion and neuroticism.

## Psychometry of patients with vocal nodules

Giovanni, Antoine<sup>1</sup> AKL, Leslie<sup>2</sup> Magalon, David<sup>1</sup>

1. *Lab Parole et Langage, marseille, France*; 2. *Université St-Georges, Beyrouth, Lebanon*

Vocal misuse and consecutive phonotrauma appears to be a major etiologic factor in vocal nodules. Individual sensitivity to phonotrauma remains difficult to handle but psychological factors seem very important etiologic factors among many others. This study was undertaken to gain better insight into the personality traits of patients with vocal nodules. 21 female patients were involved in the study and answer the psychometric test called Temperament and Character Inventory (TCI). This psychometric test distinguishes temperament (ie. inborn characteristics) and character (ie. traits maturing during development).

The results compared our patients' scores to the general population. Temperament items highlighted: a significantly higher novelty seeking dimension, significantly lower harm avoidance, no significant difference for the reward dependence dimension. Character items showed significantly higher score for cooperativeness, whereas self-directedness and self-transcendence were not significantly different of the general population. These results are consistent and specify knowledge from previous studies: women with vocal nodules are likely to have an extraverted and hyperfunctionnal temperament and a strong social implication.

Clinical implications are discussed mainly the tracks for future research concerning observance of speech therapy and means to improve it.

3160

## Not just sound II: an investigation of singer patients self-perceptions mapped into the voice range profile

Lamarche, Anick M.<sup>2</sup> Morsomme, Dominique<sup>3,4</sup> Ternström, Sten<sup>2</sup>

1. Kungliga Tekniska Högskolan, Speech Music and Hearing Department, Stockholm, Sweden; 2. KTH, CSC, Speech, Music and Hearing department, Stockholm, Sweden; 3. Université de Louvain, Unité d'ORL, d'audiophonologie et de logopédie, Louvain-la-Neuve, Belgium; 4. Cliniques Saint Luc, Centre d'Audio-Phonologie Saint Luc, Bruxelles, Belgium

**Purpose:** In aiming at higher specificity in clinical evaluations of the singing voice, singer perceptions were included and tested in conjunction with the voice range profile.

**Method:** The use of a commercial phonetograph supplemented by a hand-held response button was clinically tested with 13 subjects presenting voice complaints. Singer-patients were asked to press a button to indicate sensations of vocal discomfort or instability during phonation. Each press was registered at the actual position in the voice range profile (VRP) so as to mark areas of difficulty. Consistency of button press behavior was assessed with a method developed previously.

**Results:** In spite of their voice complaints, subjects did not press the button as much as healthy singers. Like healthy singers, the singer-patient group demonstrated consistent behavior but tended to press the button in completely different areas of the VRP space. The location of the presses was dominantly in the interior of the VRP and concentrated to a small fundamental frequency range. An extensive discussion examines carefully the reasons for such outcomes.

**Conclusion:** The button augmented VRP could be a well needed resource for clinicians but requires further development and work.



3117

## Does Knowledge of Diagnosis Affect Auditory-Perceptual Judgments of Dysphonia?

Eadie, Tanya<sup>1</sup> Sroka, Alicia<sup>1</sup> Wright, Derek<sup>1</sup> Merati, Albert L.<sup>2</sup>

1. University of Washington, Seattle, WA, USA; 2. University of Washington Medical Center, Seattle, WA, USA

**Objectives/Hypothesis:** Auditory-perceptual judgments of dysphonia often are performed by speech-language pathologists after they have received medical diagnoses from the referring laryngologist. However, it is unknown whether knowledge of this information a priori biases speech-language pathologists in their judgments of voice severity. Further, it is unknown whether such information differentially affects clinicians with varied experience levels. Therefore, the objective of this study is to determine whether knowledge of medical diagnosis and listener experience affect auditory-perceptual judgments of voice quality.

**Study Design:** Experimental.

**Methods:** Twenty-six speakers with dysphonia and 4 normal controls provided speech recordings. Twenty novice and 10 experienced clinician-listeners are currently participating in evaluating speech samples for roughness and breathiness using visual analog scales. In one condition, the samples are presented in conjunction with medical diagnostic information; in the second condition, no information is presented. The order of conditions is randomized across listeners.

**Results:** Group means of roughness and breathiness judgments made by novice and experienced listeners will be calculated across conditions. Differences will be determined using two mixed-model ANOVAs. It is hypothesized that there will be an interaction between experience level and knowledge of diagnostic information. Specifically, it is expected that knowledge of diagnosis will increase the severity of novice clinicians' judgments, but not experienced clinicians' judgments of voice quality. Post hoc analyses will determine whether results relate to specific diagnoses or dysphonic severity.

**Conclusions:** Results will reveal whether diagnostic information may be a source of bias that needs consideration before speech-language pathologists with different experience levels evaluate dysphonia.

**3034**

**The objective vocal quality, vocal risk factors, vocal complaints and corporal pain in Dutch female students training to be speech language pathologists during the four years of study.**

Claeys, Sofie; dHaeseleer, Evelien ; VanHoutte, Evelien; Kristiane, Van Lierde M.  
*university hospital Gent, Gent, Belgium*

The purpose of the present study is to determine the objective vocal quality and the vocal characteristics (vocal risk factors, vocal and corporal complaints) in 197 female student speech language pathologists during the four years of study. The objective vocal quality was measured by means of the Dysphonia Severity Index. Perceptual voice assessment, the Voice Handicap Index, questionnaires addressing vocal risks, vocal and corporal complaints during and/or after voice usage were performed. Student speech language pathologists have a borderline vocal quality corresponding with a DSI% of 68. The ANOVA revealed no significant increase of the objective vocal quality between the first bachelor year and the master year. No psychosocial handicapping effect of the voice was observed, though there are some vocal complaints and 93% of the student speech language pathologists reported the presence of corporal pain during and/or after speaking. Especially sore throat and headache were mentioned as the most present corporal pain symptoms. Due to multifactorial genesis of the potential vocal risk factors the student speech language are at risk for developing voice disorders during their vocal career. Since the vocal demand of speech language pathologists requires special skills the incorporation of master classes (with direct vocal training techniques to increase vocal quality and vocal endurance) in each year of study is needed to increase the vocal quality.

**Vocal characteristics of patients with paradoxical vocal fold motion (PVFM)**

Song, Phillip C.; Lambert, Lindsey; Cathie, Baliff; Yusuf, Konuk

*Massachusetts Eye and Ear Infirmary, Boston, MA, USA*

**Background and Aim:** Paradoxical vocal fold motion (PVFM) disorder and vocal cord dysfunction (VCD) describes a spectrum of episodic respiratory problems which originate from movement problems of the larynx. Over the past several years, recent literature has linked PVFM to other laryngeal disorders such as chronic cough, recurrent or superior laryngeal nerve neuropathy, and laryngopharyngeal reflux. Disordered voice has been associated with PVFM in numerous studies. We systematically evaluated the voice data from our pool of patients diagnosed with PVFM.

**Method:** Retrospective data was generated from a database of recorded laryngeal exams of a tertiary laryngology referral center.

**Results:** From 1994 to 2006, 10,273 laryngeal examinations were recorded and archived within the database. 10 patients with primary, nonorganic PVFM were identified and had a complete set of acoustic data for analysis. There were 9 females and 1 male. 9 of the 10 were judged by the examiner as being hoarse, with increased tension and strain. Objective data showed elevated perturbation measurements (jitter and shimmer) in 9 out of 10, increased subglottic air pressure in 5 out of 10. There was evidence of increased supraglottic compression in 9 out of 10.

**Conclusion:** Concomitant voice disturbances and abnormal objective acoustic data, especially in perturbation measures are present in many patients with paradoxical vocal fold motion disorder. The tendency is towards increased muscle tension and supraglottic hyperfunction.

**The twisted truth about arytenoid adduction asymmetry**

Bonilha, Heather S.<sup>1</sup> Deliyski, Dimitar<sup>1</sup> O'Shields, Maureen<sup>1</sup> Gerlach, Terri T.<sup>2</sup>

1. University of South Carolina, Columbia, United States; 2. Charlotte Eye Ear Nose & Throat Associates, P.A., Charlotte, NC, USA

The posture of the arytenoid cartilages has a direct effect on vocal fold position. Often the asymmetry of the arytenoid complex in the adducted position is considered when evaluating a patient for a voice disorder. This study sought to determine if there were differences in the asymmetry of the arytenoid adduction posture in persons with and without voice disorders. This is a retrospective case-control study that investigated three aspects of arytenoid adduction asymmetry: corniculate asymmetry, cuneiform asymmetry, and the asymmetry of the angle of the aryepiglottic fold. These three aspects were judged from still frames of the arytenoids in the adducted position extracted from stroboscopy recordings of 52 vocally-normal speakers and 54 persons with voice disorders. Asymmetry of the arytenoids in the adducted position was prevalent in both normophonic and dysphonic speakers. Persons with voice disorders had more right-sided than left-sided asymmetries compared to persons without voice disorders. The lack of strong differences in the prevalence of arytenoid asymmetries in the adducted position between normophonic and dysphonic speakers suggests that caution should be exercised when using these asymmetries as an indicator of or related to a voice disorders. Further study should assess the finding of more right than left sided asymmetries in persons with voice disorders. A logical future extension of this work will be to compare arytenoid adduction asymmetries with vocal fold vibratory asymmetries.

**3185**

### **Problems of Professional voices in Latvia**

More, Anna

*Phoniatriy Consultant, Riga, Latvia*

As the Republic of Latvia is situated on the coast of the Baltic Sea, the climate is rather damp and smog and great moisture is in the air. These are the reasons of frequent voice problems for adults and children.

The author has provided assistance concerning voice problems at the Latvian Cultural Academy and Latvian State Academy of Music, combining activities of a phoniatrist and the family doctor as well. The phoniatrist assists students and singers' voice studies during their classes. The phoniatrist accompanies professional collectives in their tours abroad, ensures help before and after the performances.

The author is an expert of her profession and is frequently consulting professionals and people who have voice problems.

The Latvian nation since ancient times has been a 'singing nation'. The famous Latvian Song festival is held since 1837 every 4 years, and the last festival took place in 2008. In these song festivals participate thousands of singers from whole country, even from the most distant districts.

Latvian Opera singers are also well known, and after independence was regained in 1991, many Latvian singers work abroad. Two Latvian soloists Majja Kovalevska and Elina Garanča sing the Metropolitan Opera in the USA.

The presentation will conclude with information about the products for treatment created in Latvian pharmacy factories.

## Extreme phonation in Heavy metal singers

Thomas, James P.<sup>1</sup> Linck, Frizzi L.<sup>2</sup> Cross, Melissa<sup>3</sup>

1. *voicedoctor.net, Portland, OR, USA*; 2. *Weill Cornell Medical College, New York, NY, USA*; 3. *melissacross.com, New York, NY, USA*

Three, self described 'heavy metal singers' without vocal complaints were examined for their techniques in creating three distinct 'screams' common in heavy metal vocal technique.

On spectral analysis, there were several notable findings. Each one of the three 'screams' was characterized by a-periodicity/noise in the sound spectrum, independent of voicing of scream. Each one of the three 'screams' presented with amplification of certain frequency regions in the sound spectrum independent of vowels phonated.

On laryngoscopy, benign mucosal changes were evident in all three subjects on the vocal cords, despite the lack of vocal complaints. From a perspective of a healthy "classical singer's vocal cord", the mucosal changes would be described as moderate to severe pathological changes, yet the changes to the vocal cord mucosa in these subjects might not even be described as vocal limitations and may indeed be both a product of this musical style as well as enhance the sought after sound quality of this musical genre. There was a distinct shaping of the pharynx for each scream as well as posturing of the larynx ranging from flaccid to tight vocal cords

It appears that a desired vocal product of this musical genre is presence of aperiodicity/noise during phonation/singing. There are three distinct types of heavy metal 'screams'. Two unvoiced screams and one voiced scream. The two unvoiced screams are characterized by a specific 'extreme phonation singer's formant region'/'heavy-metal formant region'; scream 1 presents with amplified frequencies between 500Hz-1400Hz, scream 3 presents with amplified frequencies between 400Hz-1200Hz. The voiced scream 2 is characterized by attenuated F0, distinct overtones of F0 as well as aperiodicity/noise.

## **A Longitudinal Examination Potential Vocal Injury in Musical Theater Performers**

LeBorgne, Wendy D.<sup>1</sup> Korovin, Gwen<sup>2</sup>

*1. Blaine Block Institute for Voice Analysis & Rehabilitation; The Professional Voice Center of Greater Cincinnati; The University of Cincinnati-College Conservatory of Music, Dayton, OH, USA; 2. Private Practice, New York, NY, USA*

Musical theater performers have been shown to potentially be at increased risk of vocal injury due to the physical and vocal demands required of these vocal athletes. Sports medicine, exercise science, exercise physiology, and dance medicine have long established guidelines for injury prevention and management in pre-professional and professional athletes and dancers (Demorest and Landry, 2004, Caine, Maffulli, and Caine, 2008, Emery, 2005, McGuine, 2006, Chen, Chang, Lin, Hong, Huang, Chou, 2005, Hogan and Gross, 2003). Additionally, extensive research pertaining to injury prevention, epidemiology studies, sports psychology, training techniques, nutrition, and many other topic related to training and maintaining elite athletes have been published. However, research into whether an elite musical theater performer is at an increased risk for vocal injury has yet to be established.

This presentation will introduce case studies of musical theater performers who were originally screened for "wellness" while in a pre-professional collegiate training program and have subsequently been re-examined after establishing a professional performing career in musical theater either on Broadway or with a National Tour of a Broadway production

3105

## **Cross-sectional and Longitudinal Risk Assessment Analysis for Hyperfunctional Voice Disorders**

Ho, Elaine M.; Yiu, Edwin M.

*The University of Hong Kong, Hong Kong, Hong Kong*

Voice disorder is one of the most common communication disorders. Yet, it is not distributed randomly in the population, certain population groups are at higher risks of developing voice disorders. It is generally agreed that the development of voice disorders involves a multifactorial genesis. Many studies have shown that vocal loading, physiological and psycho-emotional factors are significant indicators in the development of voice problems. The present project adopted the risk assessment model based on the probabilistic approach for voice disorders. Such approach takes into account different conditions that would affect the voice status of an individual.

The present project aimed to investigate the risk indicators and factors that are involved with hyperfunctional voice disorders using the Voice Risk Calculator - a self-reported questionnaire that assesses the different risk indicators for the development of voice problems. Findings from two studies will be reported. Study 1 was a cross-sectional study involving 30 dysphonic and 30 non-dysphonic subjects. Study 2 was a longitudinal study involving 5 non-dysphonic teachers and they were followed during the first year of their teaching. Results showed that specific conditions concerning vocal loading, physiological and psycho-emotional risk indicators positively correlated with the prevalence of dysphonia. It is contended that with the identified risk indicators of voice disorders, specific methods and strategies for preventive, diagnostic and intervention programs can be developed to eliminate or reduce these conditions (Beck, 1990; Page & Beck, 1997).



## Laryngeal Behaviour in Whisped Voice: a study using high speed imaging

Crevier-Buchman, Lise<sup>1</sup> Vaissiere, Jacqueline<sup>2</sup> Henrich, Nathalie<sup>3</sup> Vincent, Coralie<sup>2</sup> Hans, Stephane<sup>1</sup> Brasnu, Daniel<sup>1</sup>

1. Service ORL, Hopital Europeen Georges Pompidou, Université ParisV, Laboratoire de Phonetique et de Phonologie LPP-CNRS-UMR7018, Paris, France; 2. Laboratoire de Phonetique et de Phonologie, LPP-CNRS-UMR7018, Paris, France; 3. GIPSA-lab, Département Parole et Cognition, Saint Martin d'Hères CEDEX, France

**Introduction:** Whispered voice is characterized by the lack of voicing and the presence of friction noise except during the closed phase of plosives. However, segmental contrasts such as voicing tend to be preserved in whispered speech. Acoustic and perceptual studies have showed that formant frequencies and intensity were some of the phonetic parameters that allows the listeners to distinguish the voicing feature between normal and whispered modes.

The aim of our study is to compare the laryngeal behaviour of whispered voice at the level of the glottis and of the supraglottic region using high speed imaging in 2 situations, voiced and unvoiced consonants and vowel production.

**Methods:** Our preliminary study consists in measuring the glottic area and the supra glottic involvement during syllables VCV and CVC with V = /i/ and C = labial fricatives /f/ and /v/ as uttered by 3 male and 3 female subjects. We used a fiberscope (Pentax) and a rigid scope using the High Speed Camera Weinberger "SpeedCam Lite" (500 i/sec) and the Wolf Endocam (4000i/sec).

**Results:** When whispering, the supraglottic constriction varies with the voicing feature of the consonant. Whispered segments have an anterior-posterior and a transversal compression between the arytenoids, the aryepiglottic folds and the base of the epiglottis.

**Conclusions:** The paper discusses how far the voiced and the unvoiced consonants and the vowels uttered with a lack of vibrations of the vocal folds accompanied with an open glottis, and is there too a supraglottic constriction (aryepiglottic constriction mechanism).

**3089**

### **Improving Immune Function, Fact or Fiction**

Asher, Benjamin F.

*none, New York, NY, USA*

Upper respiratory infections are dreaded by the professional singer and speaker. Remedies for prevention abound. The literature on echinacea has been disappointing at best. But numerous other lesser known supplements and herbs have purported immune boosting effects. There is a substantial body of evidence in the mainstream medical literature establishing the efficacy of probiotics, arabinogalactans, elderberry, propolis, butterbur, euphorbium, and various Chinese herbal preparations in improving immune and respiratory function. This paper will present the evidence as well as discuss the author's experience with the use of these products in the professional voice patient.

3211

## **Paradoxical Vocal Cord Dysfunction, Paradoxical Vocal Fold Movement, Irritable Larynx Syndrome, and Chronic Cough Revisited**

Andrianopoulos, Mary V.; Whitmal, III, Nathaniel A.; Klasner, Estelle

*University of Massachusetts-Amherst, Amherst, MA, USA*

The etiology, diagnosis and treatment of upper airway conditions such as Paradoxical Vocal Cord Dysfunction (PVCD), Paradoxical Vocal Fold Movement (PVFM), Irritable Larynx Syndrome (ILS), and Chronic Cough (CC) have been studied extensively over the past two decades. As a result, this syndrome complex, once believed to be primarily psychogenic in origin, is currently viewed differently by many clinicians and physicians. Current empirical investigations suggest possible sensory and motor dysfunction at various levels within central and peripheral nervous systems with underlying medical, neurophysiological, and biomechanical triggers, as well as evidence of psycho-social-emotional manifestations.

The purpose of this retrospective study is to analyze published empirical evidence to provide an historical perspective of the theories/phenomenon of the symptom complexes PVCD, PVFM, ILS, and CC. This investigation presents a new conceptual model of these conditions with basis in three areas: underlying etiologies, clinical and co-morbid symptoms and pre-existing conditions; and the efficacy of various medical and behavioral symptomatic therapies for remediation. In addition, psychometric and meta-analytical general variance based models are applied to determine rate differences and hypotheses underlying each condition based on: a) sample size; b) effect size and statistical effects; c) reliability; d) validity; and e) outcomes of medical and/or behavioral management of these conditions.

**Aerodynamic Voice Assessment Before and After Thyroidectomy**

Solomon, Nancy P.; Horst, Leah B.; Makashay, Matthew J.; Gurevich-Uvena, Joyce

*Walter Reed Army Medical Center, Washington, DC, USA*

Aerodynamic assessment of voice is a useful adjunct to the clinical armamentarium for certain disorders. In this study, 87 patients were evaluated up to four times, as part of a prospective longitudinal clinical trial to determine the incidence of negative voice outcomes after thyroidectomy. In addition, 18 patients who underwent non-neck surgeries were tested as a control group. Laryngeal airway resistance (R<sub>law</sub>) and phonation threshold pressure (PTP) were determined at comfortable and high pitches (30% and 80% of the pitch range). Data from subjects whose pitch ranges decreased by > 20% were eliminated from analysis. As expected, R<sub>law</sub> and PTP were significantly greater for the higher pitched production. No systematic differences in R<sub>law</sub> were detected as a short- or long-term outcome of thyroid surgery. PTP decreased slightly, but significantly, over time for the control group, and for the first post-operative evaluation for the thyroidectomy patients. The reductions in PTP may be attributable to a learning effect. Another possible explanation for the thyroidectomy group's result is that the tasks may not have been produced at comparable pitches because of post-operative reductions in pitch range. PTP generally increases as pitch increases, so performance at a lower pitch could have affected the results in the observed direction. This study would have been strengthened by including a repeated-baseline assessment to account for learning effects and normal variability across time. [The views expressed are those of the authors and do not reflect the official policy of the Department of the Army, the Department of Defense or the US Government.]

**3247**

## **Evaluation of vocal therapy for treatment of vocal fold nodules**

Franco, Ramon A.; Bruch, Jean

*Harvard Medical School, Boston, MA, USA*

**Objective:** To determine whether vocal therapy used as the primary modality for treatment of vocal fold nodules resulted in subjective improvement in voice and resolution of nodules

**Study Design and Setting:** Retrospective chart review. The Voice and Speech/Language Pathology data base at the Massachusetts Eye and Ear Infirmary was searched for all patients with a diagnosis of "nodules" and "vocal nodules", yielding 863 potential candidates. Review of records, including patient charts, videostrobic testing, and acoustic/aerodynamic analysis, yielded a total of 137 patients eligible for inclusion. Inclusion criteria consisted of: diagnosis of bilateral vocal fold nodules, completion of course of voice therapy following diagnosis; and pre- and post-therapy video or photodocumentation of laryngeal exam. Exclusion criteria included: age under 15 years, co-existing neurological diagnosis (such as spasmodic dysphonia, vocal fold immobility, or muscular dystrophy), or presence of additional laryngeal pathology such as polyps or granuloma. Patients were also stratified with respect to gender, smoking, presence of GERD/LPR, and history of vocal abuse.

**Results:** The majority of patients in the study noted subjective improvement in voice following vocal therapy for vocal fold nodules. Review of pre- and post-therapy laryngeal examination revealed lack of resolution of vocal fold nodules in the majority of patients.

**Conclusion:** Voice therapy for treatment of bilateral vocal fold nodules results in subjective improvement in voice and vocal function, however does not result in resolution of the nodules as noted on physical examination.

3230

## **The Effects of a Large Scale Head and Neck Cancer Screening of an At Risk Population**

Hapner, Edie R.<sup>1</sup> Wise, Justin<sup>2</sup>

1. Emory Voice Center, Atlanta, GA, USA; 2. Georgia State University, Atlanta, GA, USA

The purpose of this study was to examine the incidence of abnormal findings in a large scale screening for head and neck cancer in an at-risk population. Participants were screened for oral and laryngeal cancers during seven race events. Screenings were completed by Otolaryngologists or Oral Surgeons. Over 1000 participants completed the screenings. 41% of the participants were female and 59% males. Results indicated that significantly more males evidenced abnormal findings than would be expected by chance and that significantly fewer females evidenced abnormal findings than would be expected by chance. Independent Samples t Tests indicated that those individuals who evidenced abnormal findings were significantly older than those participants who did not evidence abnormal findings. Logistic regression analyses indicated that the only significant predictor ( $p < .05$ ) of the presence of abnormal findings was tobacco use. Specifically, for every pack of cigarettes smoked per day, an individual was 1.95 times more likely to evidence abnormal findings even after controlling for alcohol use, family history of cancer, personal history of head and neck cancer, gender, age, and occupation.

Little is known about the impact of large scale oral, head and neck cancer screenings in changing at risk behaviors. Mechanisms to reduce or eliminate at risk behaviors like smoking and the use of smokeless tobacco face ever decreasing availability of funds to support programs. This study provides evidence that head and neck cancer screenings at community events that attract high risk populations are effective at identifying those individuals who require follow up with a physician.

## **How I do it: A new technique for phonosurgery in patients with difficult laryngeal exposure**

Cui, Xi D.

*Affiliated Hashan Hospital of Fudan University, Shanghai, China*

In patients with obesity or neck and oropharyngeal anatomic anomalies, difficult laryngeal exposure is not a rare problem encountered during microlaryngosurgery. In such cases conventional direct laryngoscopy usually cannot be performed, and although alternative procedures such as surgeons with the aid of a flexible bronchoscope or a 70° nasal endoscope have previously been introduced no consensus has been reached on which is the optimal method. In this article we try to describe a novel technique utilizing GlideScope® Video Laryngoscope and a series of curved endolaryngeal instruments for treatment of vocal fold lesions in patients with difficult laryngeal exposure. GlideScope® Video Laryngoscopes offer significant benefits to Anesthesiology by providing a consistently clear view of the patient's airway, enabling quick intubation even in difficult airways, but its usage in phonosurgery has not been reported. This method was used to treat 3 patients successfully in whom conventional suspension laryngoscopic microlaryngosurgeries cannot be performed, during which the difficult degree of manipulation, the visibility range and the time length of operation were evaluated. All the 3 patients were successfully performed the phonosurgery to remove the lesions of the vocal folds using the GlideScope® Video Laryngoscope and curved laryngeal instruments. We accomplished the surgery with excellent visualization and without any complications although a little inconveniently because of the narrow operation space. In conclusion this GlideScope® Video Laryngoscope provided excellent laryngeal exposure in 3 patients with difficult laryngeal exposure using conventional suspension laryngoscopy combined with curved laryngeal surgical instruments, we can easily remove the lesions of the vocal folds. The further clinical use of this laryngeal operation system needs design developments.

3040

## Post-operative hoarseness in the general surgery patient undergoing general anesthesia

Sariego, Jack

*Temple University School of Medicine, Philadelphia, PA, USA*

**Background:** Hoarseness following general anesthesia with intubation is not an uncommon complaint among patients undergoing general surgical procedures. The current study was undertaken to examine the incidence and predictors of postoperative hoarseness and to assess its duration.

**Methods:** A prospective study was performed of consecutive patients who underwent general anesthesia with intubation at a single institution. Only patients extubated immediately post-operatively were included. Patients were evaluated in the Recovery Room and hoarseness-subjective or objective-was documented. Follow-up phone calls (outpatients) or interviews (inpatients) were performed on the third post-operative day.

**Results:** A total of 210 consecutive patients were included in the study: 145 were intubated with endotracheal tubes (ETT) and 65 with LMAs. The incidence of hoarseness was not statistically significant between the two groups: 9.6% (14/145) in the ETT group vs. 7.7% (5/65) in the LMA group. There was no statistically significant difference between hoarse and non-hoarse patients with respect to: average ASA classification (2.1 vs 2.2); average age (50.2 vs 51.0 years); male:female ratio (0.46 vs 0.50). All 19 hoarse patients had complete resolution by follow-up phone call or interview 72 hours post-op.

**Conclusions:** Though self-limited, postoperative hoarseness is not an insignificant complaint among patients undergoing general anesthesia. There are no good predictors of hoarseness, and the use of the LMA does not prevent this complication. The surgeon must be aware of this problem, since it is a major concern for the patient. Furthermore, any hoarseness that does not resolve shortly post-operatively necessitates further ENT evaluation.



3091

## **New surgical technique for mucosal bridge of vocal fold : sandwich mucosal flap surgery**

Kim, Hyung-Tae

*AAO-HNS, The Korean society of Otolaryngology-HNS, The Korean society of Logopedics and Phoniatics, Seoul, Korea, Republic of (South Korea)*

**Objective:** A mucosal bridge of the vocal fold has been often underestimated by conventional diagnostic visualization workup. It has been usually diagnosed as a vocal fold swelling, ruptured submucosal cyst, or sulcus vocalis. The purpose of this study is to evaluate the efficacy of the new diagnostic tool, ultra high-speed video system and to estimate the result of the new surgical technique, sandwich mucosal flap surgery in patients who have a mucosal bridge of vocal fold.

**Materials & Methods:** Retrospective study of 6 patients who were diagnosed the mucosal bridge of vocal fold by ultra high-speed video system and underwent the sandwich mucosal flap surgery between 2005 and 2007 has been done. The patients had the associated benign lesions such as ruptured submucosal cyst, sulcus vocalis, and laryngeal polyposis. The subjective and perceptual assessment, aerodynamic and acoustic assessment and videostroboscopic assessment were evaluated before and after surgery at 2nd, 6th months. The statistical analysis was done with Wilcoxon Signed Ranks test.

**Results:** In subjective assessment, voice handicap index was significantly improved from 20.9 to 16.4. In aerodynamic assessment, subglottic pressure and maximum phonation time were decreased. Acoustic assessment for fundamental frequency, jitter, shimmer and noise-to-harmonic ration demonstrated a significant improvement ( $P < 0.05$ ). All cases showed improved the amplitude and regularity of mucosal wave in videostroboscopic evaluation.

There have not been the troublesome complications.

**Conclusion:** This clinical study suggested that ultra high-speed video system could be considered an accurate diagnostic tool for mucosal bridge of vocal fold, and that the sandwich mucosal flap surgery are useful treatment method that reserve the mucosal wave of vocal fold and voice quality.

## **A double-blind, placebo-controlled study on the effectiveness of a Chinese herbal medicine decoction in treating chronic laryngitis**

Chung, Olivia, Suk Ying; Xue, Steve; Yiu, Edwin

*The University of Hong Kong, Hong Kong, Hong Kong*

Herbal medicine is often employed as either a primary, an alternative or adjunctive therapy in treating voice disorders in China. The principles of traditional Chinese medicine (TCM) lie in the equilibrium of yin (water) and yang (fire) concept and the removal of phlegm and stagnant blood in the body.

A number of Chinese herbal medicine decoctions or formulae have been reported to be effective in treating dysphonia. Yang Yin Qing Fei (nourishment of fluid to clear dryness and heat in the lung) decoction is a popular formula used to treat chronic pharyngeal and laryngeal inflammatory diseases. It consists of eight individual herbs, *Rehmannia glutinosa*, *Ophiopogon japonicus*, *Scrophularia ningpoensis*, *Paeonia suffruticosa*, *Fritillariae Cirrhosae*, *Glycyrrhiza uralensis*, *Mentha haplocalyx* and *Paeonia lactiflora*. There is however relatively little specific information on how the decoction brings about the improvement. Indeed, there exists virtually no study that employed a randomized control design with objective outcome measures to investigate efficacy of this decoction in treating chronic laryngeal inflammatory diseases.

This study employed a randomized-control style to investigate the effectiveness of Yang Yin Qing Fei decoction in treating dysphonia in chronic laryngitis. Subjects with chronic laryngitis were randomly allocated into one of the two groups: (a) herbal medicine and vocal hygiene and (b) placebo treatment and vocal hygiene. The outcome measures used included (a) voice range profile (phonetogram), (b) voice activity and participation profile (VAPP, Ma & Yiu, 2001) (c) sentence recording for perceptual voice evaluation, (d) stroboscopy, and (e) subjective evaluation of symptoms.

Preliminary results showed that the group that received both the Chinese herbal medicine decoction and the vocal hygiene improved better in their vocal function than the placebo group of subjects.

3044

## Effect of Fasting on Voice in Males

Hamdan, Abdul-latif<sup>1</sup> Ashkar, Jihad<sup>1</sup> Sibai, Abla<sup>1</sup> Tanbouzi Husseini, Sami<sup>1</sup> Oubari, Dima<sup>2</sup>

1. American University of Beirut, Beirut, Lebanon; 2. Specialty Voice Center, Beirut, Lebanon

**Purpose of the study:** To study the effect of fasting between fourteen and sixteen hours on voice.

**Study design:** A prospective study on male subjects.

**Material and Method:** A total of 26 healthy male subjects were recruited for the study. The age varied between 22 and 50 years with a mean of 28. Exclusion criteria included hoarseness at the time of presentation, history of recent upper respiratory tract infection or microlaryngeal surgery. Subjects were evaluated while fasting and non fasting. Each subject was asked about changes in voice quality, vocal fatigue and the ease of phonation. This was followed by an acoustic analysis and laryngeal video-stroboscopy.

**Results:** The incidence of vocal fatigue was higher while fasting compared to non fasting ( p value 1.00). Phonatory effort was significantly affected (p value<0.001). Fifty percent of the subjects had an increase in their phonatory effort. There was a significant increase in Noise to harmonic ratio ( p value 0.001) and a significant decrease in both the habitual pitch and the Voice Turbulence Index ( p value 0.018 and 0.045 respectively). There were no laryngeal video-stroboscopic changes.

**Conclusion:** Fasting in males results in vocal fatigue and an increase in phonatory effort. These phonatory changes can be secondary to dehydration and or the overall neuromuscular fatiguability.

## The relative contribution of different voice qualities to perceived age

Harnsberger, James D.; Brown, Jr., W. S.; Shrivastav, Rahul

University of Florida, Gainesville, FL, USA

**Objective/Hypothesis:** To specify a set of acoustic cues to vocal aging and to establish their perceptual relevance.

**Study Design:** Perceptual testing

**Methods:** An experiment was conducted to estimate the contribution of voice quality to perceived age in age estimation experiments using: 1) natural, pathological stimuli and 2) 150 normal old, middle-aged, and young voices. The disordered samples included single sentences from 231 talkers (Kay Elemetrics database), which were judged by 20 listeners. The normal samples were sentences judged by 160 listeners. The pathological stimuli represented natural occurrences of a significant degree of a voice quality of interest, such as hoarseness, breathiness, or tremor. For each voice quality, the discrepancy between the chronologic age of the speakers and their mean perceived age was taken as the degree to which a voice quality of interest shifted perceived age older.

**Results:** Listeners in rating normal voices underestimated chronologic age by six years, although chronologic and perceived age were strongly correlated ( $r=0.95^{**}$ ). In contrast, disordered voices were overestimated in age by three years. More specifically, voice disorders that usually result in breathiness shift the perceived age of a speaker older by an average of nine years. For hoarseness and tremor, +12 to +13 year mean shifts were observed. These shifts were comparable to those elicited in previous work using resynthesized stimuli to simulate target voice qualities of interest.

**Conclusions:** Voice quality plays an important role in the perception of age from speech, and the use of pathological voice samples can provide valuable insights into the normal aging process.

## **Gastro Esophageal Reflux Disorder - Lifestyle, Symptomatology & Voice Profile: Findings from India.**

*Boominathan, Prakash; Kumar A, Ravi; GS, Purushothaman  
Sri Ramachandra University, Porur, Chennai Tamil Nadu 600 116, India*

Boominathan et al (2008) study reported effects of lifestyle on vocal health in Indian singers, teachers, politicians and vendors. GERD in voice clinic practice (ENT & SLP) is on a steady rise in India. The treatment protocol in vogue is initially a change in lifestyle with or without medical therapy. This study profiled life style patterns, laryngeal signs & symptoms, and voice in 30 individuals who were clinically diagnosed (laryngoscopy & pH monitoring) with GERD. In this study highest frequency of GERD was found during the fourth decade of life. More than 70% of the subjects were non-vegetarians, coffee 'lovers', and consumed high fat laden food rich with Indian spices and 16% were overweight. Meal timings, stress levels, voice use and sleep habits were dependent on nature of work. 94% of the subjects were in sedentary, 'high-stress' related jobs, hence poor habits. 90% of the subjects showed posterior pharyngeal wall erythema, interarytenoid edema and granular pharyngitis. Common symptoms reported were burning sensation in the throat, brash, throat pain, dry cough and voice change. Perceptual analysis revealed low pitched phonation, grade and breathiness (moderate to severe) as the most deviant parameter. MDVP findings showed deviant frequency and perturbation measures. The present study documents possible causes and identify significant factors contributing to development of GERD that pertains to this geographical location, culture, food habits and ethnic group. These findings will be useful while treating individuals with GERD.

### Reference

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## **The effects of surface electrical stimulation on neck muscles in voicing and swallowing**

Lai, Sin Yi Sindy; Ma, Estella; Yiu, Edwin

*The UNIVERSITY OF HONG KONG, HONG KONG, Hong Kong*

Numerous studies have been reported on the therapeutic effectiveness of surface electrical stimulation (ES) in voicing and swallowing (Bulow, Speyer, Baijens, Woisard & Ekberg, 2008; Ludlow, Humberg, Saxon, Poletto, Sonies & Crujido, 2007). However, controversial argument on its effectiveness is still ongoing. Humbert and colleagues (2007) found the use of surface ES only facilitated vocal fold closure to a small degree in healthy adults. Some studies reported that laryngeal elevation was facilitated in dysphagic patients (Bulow et al., 2008; Shaw, Sechtem, Searl, Keller, Rawi & Dowdy, 2007) while others found lowering of larynx position during the use of surface ES (Humbert, Poletto, Saxon, Kearney, Crujido, Wright-Harp et al., 2006; Ludlow et al., 2007).

In this study, the effects of surface ES on laryngeal movement during voicing and swallowing were investigated in 15 normal healthy individuals and 5 individuals with unilateral vocal fold paralysis. Surface ES was given over the extrinsic laryngeal muscles to determine if the laryngeal movement would be altered. According to the International Classification of Functioning, Disability and Health (ICF) framework (World Health Organization, 2001), assessments on i) acoustic, perceptual and aerodynamic aspects of voice quality; ii) voice range profile; iii) laryngeal imaging; iv) swallowing ability; and v) larynx position are used at the impairment level. Measurements of functional impacts included the Voice Activity and Participation Profile (VAPP) (Ma & Yiu, 2001) and the M.D. Anderson Dysphagia Inventory (MDADI) (Chen, Frankowski, Bishop-Leone, Hebery, Leyk, Lewin & Goepfert, 2001). Each subject received one-hour surface ES once a week for five consecutive weeks. Preliminary data revealed that the application of surface ES facilitated the laryngeal movement and the laryngeal position during voicing and swallowing.

3106

## Combined therapy of surgical excision, laser vaporization and Cidofovir Injection for the treatment of recurrent respiratory papillomatosis in an adult cohort

Claeys, Sofie e.<sup>1</sup> Van houtte, evelyne<sup>1</sup> van lierde, kristiane<sup>2</sup>

1. ent specialist, ghent, Belgium; 2. Voice Clinic University Hospital Ghent, Ghent, Belgium

**Objective:** To evaluate the efficacy of the repeated combination of intralesional cidofovir, surgical debulking and CO2 laser vaporization as therapy for recurrent laryngeal papillomatosis in an adult cohort.

**Patients:** Five adult patients with biopsy-proven laryngeal papilloma who received Cidofovir injections at the ENT department in a period of 5 years (2004-2008) were included in the study. All patients were priorly treated only by cold steel resection and no disease control was obtained before. Every patient was treated repeatedly with a combined intervention: surgical debulking, laser ablation and Cidofovir injections. Interventions were performed on a as-needed basis and treatment was repeated as long as papillomas were observed at videostroboscopy.

**Results:** One of five patients showed a complete remission of RRP after six injections over a follow-up period of 18 months. The diagnosis of RRP in this patient was established only two years ago and RRP was limited to the glottis subsite. In the other four patients, a controlled disease state was obtained. Disease duration in this group ranged from 3 to 30 years and disease spread was more extended (supra-glottis, glottis and subglottis subsites). After treatment(s), the disease degraded from multifocal exophytic papilloma to unifocal sessile papilloma in all four patients. Mucosal wave was preserved in every patients and no other side effects could be noted.

**Conclusions:** Cidofovir therapy in combination with surgical debulking and laser vaporization was an effective treatment in adults allowing papillomatosis to be controlled without any observed side effects. Full remission was only obtained in one patient but disease control was obtained in all five. Factors influencing the efficacy of the cidofovir treatment e.g. age at onset, duration of the disease, clinical stage are discussed.

## **Phon microsurgical Plus Photoangiolytic Pulsed Laser Treatment of Recurrent Glottic Keratinizing Precancerous Dysplasia**

Gallivan, Gregory J.

*See Biography, Springfield, MA, USA*

The objective of phon microsurgical excision of precancerous keratinizing glottic dysplasia with atypia, in which 15 - 55% of cases will result in frank invasive squamous cell carcinoma, is to maximally preserve the mucosal layered microstructure, to allow optimal phonatory mucosal vibration, while effectively eradicating the disease. When there is recurrence after microflap and CO<sub>2</sub> laser phon microsurgical techniques, including Reinke's space infusion for hydrodissection, precise tangential microflap dissection around the curving vocal fold just deep to the epithelial basement membrane in the superficial aspect of the superficial lamina propria (SLP) and selective dissection between the vocal ligament and the vocalis muscle, further effort must be made to choose a treatment modality that preserves good voice function while it controls the disease. The concept of aberrant microvascularity and intralesional tumor angiogenesis was described in the late 1960's and early 1970's. Angiolytic lasers, including 532 nm pulsed potassium titanyl phosphate (KTP) were introduced in the late 1990's to effectively manage vocal fold dysplasia. Their accepted mechanism of action facilitates precise microflap resection of glottic dysplasia by selective photoangiolysis of the subepithelial microcirculation and preserves histopathological architecture with minimal collateral thermal damage to the perivascular SLP. The hybrid approach of microflap dissection plus angiolysis is illustrated by the case of a 46-year-old former heavy smoker with an intractable chronic cough. Recurrence five months after initial microflap and CO<sub>2</sub> laser resection of severe keratinizing dysplasia of the right vocal fold required the addition of photoangiolytic pulsed KTP laser treatment.



3113

## **Voice feminization in case of gender reassignment: effects of Wendler glottoplasty**

Morsomme, Dominique J.<sup>1</sup> Remacle, Marc<sup>1,2</sup>

*1. University of Louvain, Bruxelles, Belgium; 2. University Hospital of Mont-Godinne, Yvoir, Belgium*

Voice feminization in case of male to female gender reassignment remains a challenge. The Wendler glottoplasty is a technique proposed to increase the fundamental frequency and consists in creating a controlled glottic web encompassing the anterior 1/3 of the vocal folds. .

Our retrospective study includes 15 patients (mean: 42.5 years) with a mean follow-up of 7.5 months. The voice assessment was based on videolaryngostroboscopy, aerodynamic and acoustic measurements.

The fundamental frequency increased significantly from 150Hz to 194 hz,  $p < 0.01$ ; ESGP (Estimated Subglottic Pressure) augmented from 8.1 to 12 cmH<sub>2</sub>O ( $p < 0.01$ ) and the jitter from 1.4 to 2.7 ( $p = 0.05$ ). The glottoplasty according to Wendler can contribute to the voice feminization but at the cost of an increased voice effort.

**Posterior glottic closure: Type I thyroplasty versus arytenoid adduction**

Yavari, Aida<sup>1</sup> Menaldi-Jackson, Cristina<sup>2</sup> Johns, Michael M.<sup>3</sup> Rubin, Adam D.<sup>2</sup>

*1. Kansas City University of Medicine and Biosciences, Santa Maria, CA, USA; 2. Lakeshore Professional Voice Center, Lakeshore Ear, Nose and Throat Center, St. Clair Shores, MI, USA; 3. Director, Emory Voice Center, Atlanta, GA, USA*

The goal of laryngeal framework surgery in patients with unilateral vocal fold paralysis is to improve glottic closure by medializing the paralyzed vocal fold. Type I thyroplasty is the most commonly performed procedure. Arytenoid adduction is sometimes performed in conjunction with thyroplasty. One of the main rationales for performing an arytenoid adduction is to improve closure of the posterior glottis. The purpose of this study is to evaluate if arytenoid adduction yields better posterior glottic closure than thyroplasty alone. Blinded reviewers will evaluate pre and postoperative videostroboscopic examinations of 3 groups of subjects with vocal fold paralysis. The 3 groups include subjects treated with Type 1 thyroplasty using a silastic implant, Type 1 thyroplasty using a Gore-tex implant, and Type 1 thyroplasty with arytenoid adduction. Posterior glottic closure will be rated on a visual analogue scale. Improvement in posterior glottic closure will be compared amongst the 3 groups of subjects. Results and clinical implications will be discussed.

3093

## Laryngeal neuromuscular identification for surgical treatment of spasmodic dysphonia

Mora Rivas, Elena <sup>1</sup> Cobeta Marco, Ignacio <sup>1</sup> Marañillo Alcaide, Eva <sup>1</sup>

1. Hospital Universitario Ramón y Cajal, Madrid, Spain; 2. Press Dress, Madrid, Spain

**Introduction:** The gold standard management of adductor spasmodic dysphonia is the botulinum toxin injection. Long term treatments have been investigated with a few studies supporting them. We present our investigation for a surgical treatment that consists on combine neurectomy of the intralaryngeal recurrent nerve with miectomy of thyroarytenoid and lateral cricoarytenoid muscles.

**Study Design:** A prospective study that consists of three parts: in the first one we dissect human larynges from necropsies, in the second one we study larynges obtained just after laryngectomy, and in the third one, not yet started, we will perform the surgery in patients.

**Methods:** Fifteen formalized larynges and two fresh larynges are studied. A posterior thyroplasty is made and, under surgical microscope, a dissection of the intralaryngeal recurrent nerve and its terminal branches is proceed. The thyroarytenoid and lateral crycoarytenoid muscles and the vascular branches of inferior laryngeal artery and vein are also examined.

**Results:** The window on the posterior and inferior region of the thyroid cartilage wing that is necessary to find the structures must have a medium size of 8x10 mm and has to be placed from the thyroid edges: 13 mm from the midline, 6 mm from the posterior edge, 11 mm from the superior and 3 mm from the inferior one. The vascular branches are in 35% of the cases anterior and external related to the recurrent nerve. Two branches exist in general for the thyroarytenoid muscle and one for the lateral cricoarytenoid.

**Conclusion:** The great variability in nerve and vascular patterns related to the intralaryngeal recurrent braches support this study dissection just to elaborate a correct surgery protocol.

**3152**

## **It Takes a Team: Management of Voice Disorders in Singers**

Scarce, Leda

*Duke Voice Care Center, Raleigh, NC, USA*

This presentation will define the distinct and collaborative roles of voice professionals and how their collective talents, knowledge and skills are integrated to achieve optimal rehabilitation of voice injuries in singers.

### **Key Concepts:**

- **Voice Teacher:** Builds singing technique in a healthy instrument. Often at the frontline for identification of a voice disorder in a singer. Can help ensure that voice care is obtained quickly. Often collaborates with singing voice specialist during rehabilitation.
- **Laryngologist:** Otolaryngologist who has specialized training in medical and surgical management of voice disorders. A laryngologist who works with singers must also be familiar with the special needs of singers and understand the professional and academic implications of voice disorders, as well as how all aspects of medical treatment may impact the singing voice.
- **Speech Pathologist:** Provides evaluation and behavioral management of the speaking voice.
- **Singing Voice Specialist:** Speech pathologist with extensive background in performance and vocal pedagogy, or a vocal pedagogue with additional training in voice disorders and voice rehabilitation. A Singing Voice Specialist who is also a Speech Pathologist is uniquely skilled to provide behavioral management of all aspects of the voice-speaking and singing-concurrently and comprehensively to restore lost function, resolve the injury and prevent future injuries.
- **No single member of this team has adequate skills to address all aspects of a voice disorder and independently facilitate the recovery of the singer. All members of the team must collaborate to make appropriate recommendations for voice use and vocal pacing, identify medical and behavioral contributing factors, and design an exercise regimen to maintain vocal strength and flexibility to promote healing and avoid further injury.**

3135

## **MTD as viewed by Voice Teacher and Speech Pathologist: Collaboration and Conquest**

Goffi-Fynn, Jeanne C.<sup>1</sup> Carroll, Linda<sup>2</sup>

1. Teachers College, Columbia University, New York, NY, USA; 2. Children's Hospital of Philadelphia, New York, NY, USA

In this study, we will look at the roles and issues addressed by a voice teacher and speech pathologist in order to retrain a singer diagnosed with MTD (muscular tension dysphonia). We will discuss the general traits of MTD:

- High breathing patterns (clavicular, thoracic)
- Patients: Increased subglottic pressure
- Patients: Elevated vertical laryngeal position
- Posterior glottic chink
- Hyperadduction of false vocal folds
- Chest-voice dominant phonation (excessive thyro-arytenoid function)
- Reduced coordination of registers
- "Bottom"up approach to voice

including also psychological/personality aspects. Tracing the singer's journey from the initial doctor's appointment and diagnosis of MTD, the singer will be followed first in therapy with the speech pathologist and continuing on with the voice teacher. An individual singer will be viewed to provide examples in the retraining of a singer and their self-perception. Presentation will include excerpts from therapy/lessons, and interviews with singer followed by general concepts and recommendations.

**3146**

**The effect of breath management on perceived acoustic quality**

Fitzmaurice, Catherine

*University of Delaware, New York, NY, USA*

“Survival” and “intentional” breathing use the same respiratory mechanism, but are differently innervated and have different effects on vocal quality. Acoustic distortion caused by muscle tension can be alleviated through specific breath management techniques that address both “survival” and “intentional” breathing.

## The Singing Power Ratio and Timbre-Related Acoustic Analysis of Singing Vowels and Musical Instruments

Lin, Emily; Jayakody, Dona; Looi, Valerie

*University of Canterbury, Christchurch, New Zealand*

Singing Power Ratio (SPR) is the ratio between the highest intensity peak from the 2-4 KHz range and that from the 0-2 KHz range. The SPR analysis of human voice has been found useful for gauging a singer's "formant tuning" technique, a technique useful for projecting voice over the orchestra sound energy, which is often found lower around the 3 kHz frequency region. To assess how different pitch levels, vowels, and musical instruments may pose different levels of demand on "formant tuning", this study compared the vowel production (/i, e, a, o, u/) of a trained singer with notes played by a selection of commonly used musical instruments. The musical instruments included: wood wind (flute, oboe), brass (trumpet), string (violin, cello, guitar), and keyboard (piano). Eighteen notes, from C4 to F5, were obtained from each instrument. The energy of each recorded signal was normalized. A 300-ms segment taken from the middle section of a note was submitted to spectral analysis to yield SPR and other timbre-related spectral measures. One-way Repeated Measures Analysis of Variances were performed. The SPR values for wood wind, brass, keyboard, and back vowels (/a, o, u/) were found to be the lowest, followed in order by string and front vowels (/i, e/), indicating that front vowels might have the advantage of being heard over most musical instruments. The SPR values were found to be independent of pitch for all musical instruments except for violin, which showed a positive relationship between SPR and pitch. For the high vowels (/i, u/), SPR decreased as pitch increased, suggesting that these vowels might demand more "formant tuning" for projection as the target pitch is raised.

**3155**

## **The Anatomy and Physiology of Five Non-Classical Vocal Postures**

Scearce, Leda

*Duke Voice Care Center, Raleigh, NC, USA*

### **Educational Objectives:**

Upon completion of this course, participants will:

- 1) Understand laryngeal and vocal tract mechanics and basic technical strategies for safe singing relative to a variety of vocal techniques used by pop singers.
- 2) Identify factors in assessing risk of vocal injury and the nature of vocal injuries associated with different postures, and guidelines for voice rehabilitation for singers who use these vocal postures.

Course description, relevance and purpose:

Vocal styles vary by a number of physiological characteristics including primary muscle activation (thyroarytenoid vs. cricothyroid), subglottic pressure, degree of glottic closure, vocal fold thickness, larynx height, degree and location of muscular compression, tongue position, lip position, etc. Particular configurations of these aspects comprise different vocal techniques, which can be conceptualized as vocal "postures" and are associated with particular vocal sounds. Many discreet vocal postures can be identified.

This presentation will examine five vocal postures that are prevalent in non-classical singing styles. The five postures are labeled by resulting sound quality characteristics: "brassy," "twangy," "squeezed," "booming," and "whispy." This is not an examination of style, but rather an exploration of how these different vocal postures are utilized across and within multiple styles of non-classical singing.

Singers who perform in these styles often move rapidly from one of these vocal postures to another, and often use many different postures in the same song and even the same musical phrase.

These different vocal postures have differing implications for pedagogical decision making, risk of vocal injury and vocal rehabilitation and so it is important for voice teachers and vocal healthcare providers who work with non-classical styles to understand the physiology of vocal postures such as those outlined above.



## **Analysis of Five Musical Theater Belting Substyles**

Popeil, Lisa S.<sup>1</sup> Sundberg, Johan<sup>2</sup> Thalen, Margareta<sup>3</sup>

*1. Voiceworks, Sherman Oaks, CA, USA; 2. Dept of Speech Music Hearing, School of Computer Science and, Stockholm, Sweden; 3. University College of Music Education, Stockholm, Sweden*

Analysis of five musical theater belting substyles was performed using a variety of investigative modalities including frequency analysis, EGG, sub-glottal pressure and an evaluation by a panel of expert listeners. The goal of the study is to quantify timbral and perceptual characteristics of five commonly heard musical theater belting vocal styles: heavy belt, nasal belt, ringy belt, brassy belt and speech-like belt and comparing these to the characteristics found in traditional classical voice production.

3187

## **The Alexander Technique as an asset to vocal therapy as measured through standard voice science methods:**

Rootberg, Ruth; Johnson, Molly B.; Andrianopoulos, Mary V.

*University of Massachusetts-Amherst, Hadley, MA, USA*

**Objectives/Hypotheses:** This investigation addressed the following research questions: 1) Does hands-on teaching and verbal instruction of the Alexander Technique (AT) facilitate an immediate effect on voice production and vocal quality?; 2) What are the short-term learning effects and impact of Alexander Technique on voice production and vocal function?; 3) What are the long-term beneficial effects and generalization of Alexander Technique on voice production and vocal function?; 4) How many lessons or individual instructions are necessary to produce positive outcome effects?

**Methods:** An ABA research design consisting of 2 healthy controls and 2 experimental participants with voice problems due to muscle tension was utilized. All participants underwent the standardized baseline testing (baseline A) and then were subjected to hands-on Alexander Technique instruction for 20 to 30 minutes. Post-AT data were obtained (baseline B) and compared to pre-treatment data (baseline A). The protocol was repeated a third time, hands-off of the AT and post-treatment data were obtained (baseline C) and compared to baselines A and B. The next phase included 8 sessions of private lessons among the 2 experimental participants with muscle tension voice problems. All participants underwent follow-up testing (baseline D) once the 2 experimental participants completed AT instruction. The 2 healthy controls did not receive any remediation during between baselines C and D.

**Results:** Pre-testing to post-testing measurements revealed that the experimental

participants exhibited a positive and statistically significant change in vocal quality compared to the controls between baseline A and post-treatment baseline D measurements.

**Conclusions:** This study demonstrates the beneficial effects of AT on individuals with voice impairment. Further research is suggested to establish evidence-based practice regarding the beneficial effects of AT on vocal quality.

3158

## Effects of 14 to 15 hours of dietary hydration gap on voice qualities in normals

D, Vikas M.; Kumar, Vijay

Mysore University, Mysore (Karnataka), India

**Introduction:** This study is based on the assumption that dehydrating factors dry out mucosal lining and put an increased strain on the phonatory apparatus (Sunderberg, 1986). By all this it has been suggested that there may be link between low fluid intake and occurrence of voice disorders (Lawrence, 1981; Sataloff, 1987).

**Aim:** Aim of the study was to assess quantitative and perceptual changes because of hydration delay on voice production, if any.

**Method:** Data was obtained for nineteen normal healthy participants (10 female and 9 males) of age range twenty to fifty years who participated in study for phonation of /a/, /i/, /u/, /s/, /z/, and for reading and conversation tasks. Fourteen hours hydration gap was considered. Instrumental and perceptual analysis was done.

**Results:** No statistically significant change was observed for fundamental frequency, loudness, voice breaks across pre and post hydration conditions. While rear numerical changes were present for within group subjects. Perceptual analysis of quality related parameters revealed minor changes for both male and female groups across dehydration and rehydration conditions. In males those changes were in roughness and breathiness while female showed changes only in breathiness.

**Conclusion:** Effect of hydration gap was not observed influential and remarkable on acoustic parameters may be because of the gap duration was not sufficient to influence overall water balance system of human body. In this study degree of dehydration has little or no effect on voice parameters although role of water intake and its influence on general health cannot be tunneled.

3175

## **An Acoustic and Aerodynamic Study of Diatonic Scale Singing in a Professional Female Soprano**

Tan, Haidee Lynn C.; Scherer, Ronald C.; Schoonmaker Rodgers, Jane  
*Bowling Green State University, Bowling Green, OH, USA*

The purpose of this study was to describe acoustic and aerodynamic characteristics of diatonic scale singing in a professional female soprano. The classically trained singer sang ascending-descending ninth scales (F# Major) on /a/ at slow, moderately slow, moderately fast, fast, and fastest tempi. Tempo was controlled to determine differences between scales sung at a comfortable tempo versus an uncomfortable tempo. The slow, moderately fast, and fastest tempi were designated as comfortable because they are typically performed with integer multiple vibrato cycles per note. The moderately slow and fast tempi were designated as uncomfortable because the note durations do not match integer multiples of the singer's typical vibrato cycle period. Results revealed the following: 1) average F0 vibrato extent and average airflow vibrato extent decreased with tempo increase, 2) mean note intensity was greatest at the highest notes and lowest at the lowest notes, 3) airflow was maximum at the lowest notes and least at the highest notes of the scale. Distinctive trends were not observed between the comfortable and uncomfortable tempi. However, scales sung at comfortable tempi demonstrated greater regularity in the number of vibrato cycles per note than scales sung at uncomfortable tempi. Higher airflows of lower notes than higher notes suggest greater laryngeal flow resistance (up to about a factor of 4) and greater glottal adduction at the higher notes. It is hypothesized that F0 and airflow vibrato extent decreased with tempo increase because the singer applied a control strategy of less variation of subglottal pressure, cricothyroid contraction, and glottal adduction. The airflow vibrato characteristics are novel results for describing classical singing.

**Effect of Breathing and Vocal Function Exercises (Adapted) in the Practice Regimen of Trained Carnatic (South Indian Classical) Singers - a Pilot Investigation.**

Boominathan, Prakash; Ravi, Shruthi; Chandrashekhar, Divya  
*Sri Ramachandra University, Porur, Chennai Tamil Nadu 600 116, India*

Breathing for singing and pitch control is emphasized in training for Carnatic singing. However, there are no prescribed (specific) techniques and exercises in the traditional training regimens for the same. Boominathan et al (2004) reported excessive voice use, poor vocal hygiene and inadequate breath support in 60% of Carnatic singers while singing. This study reports the effects of vocal hygiene, yogic breathing exercises and vocal function exercises (adapted from Stemple, 2005) in the regular practice regimens of three trained Carnatic singers. Respiratory measures [Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV) & Flow (FEF), ratio of FEV/FVC, Inspiratory Capacity (IC), Vital Capacity (VC), Maximal Expiratory Pressure (MEP) & MPT], acoustic measures in phonation and various singing tasks [Fo, lo, perturbation & phrase duration] and self evaluation were used to compare effects of 30 days training. The training was provided individually and the practice was closely monitored through daily checklist and regular follow-up once a week. The results revealed overall improvement in all respiratory measures and a statistically significant increase in FEV1/ FVC ( $p=0.01$ ). The acoustic analysis revealed an increase in frequency range (approx. 3 - 6 ST), however, this increase was not statistically significant ( $p=0.13$ ). A significant increase ( $p=0.03$ ) in dynamic range (14.75 dB) was attributed to the physiological improvement in coordination between respiratory and phonatory systems. All subjects reported improvements in their voices such as ability to sustain notes for longer durations, increased phrase duration, increased singing range and improved breath support for singing. These findings are encouraging as substantial improvements were obtained on all outcome measures. Though the study objectives were met, interpretation is limited to the subjects in this study.

## **The Suitability of Melodic Contour Mapping Technology for legato training in the Undergraduate Choral and Solo Collegiate Classical Singer**

Barnes-Burroughs, Kathryn; Kramer-Erxleben, Deanna; Lucero, Oliver; Hughes, Thomas; Boulware, Marcie; McNeil, Kathy; Arnold, Sue; Dolter, Gerald T.; Carter, Susan; Coberly, Rebecca; Meixner, Micah L.; von Schwedler, Erika; Lan, William Y.

*The Texas Tech Voice Alliance - Texas Tech University, Lubbock, TX, USA*

The purpose of this study is to investigate the pedagogical suitability of using computer-generated notational melodic contour mapping systems (MCMS) during legato training of the undergraduate collegiate choral singer, while becoming a college-level classical solo singer - this, in response to many young singers who find themselves "holding" tones in choral environments, without connection between the notes.

During a pilot study, it was concluded that more MCMS training for experimental subjects was needed. Our current study investigates the possible improvement of solo legato classical singing with MCMS training. 20 female college singers, between the ages of 17 and 22 who were currently taking voice lessons and simultaneously participated in choral groups, have been evaluated while singing the children's song "Mary had a little lamb" on the vowel [a], a cappella, and in the key of C major beginning on E4. Three conditions were investigated: (a) singing while reading traditional notation; (b) singing while reading traditional notation and a simultaneous MCMS display, and asked to sing "a more legato line" - this, after brief training with MCMS; (c) singing again with traditional notation alone. An equivalent control group has also been tested using traditional notation only.

Through blind perceptual screening, six university-appointed master voice teachers rated each pre- and post-training sample for legato singing in both groups. Based on descriptive analyses of results, discussion focuses on the perception of sustained legato singing as it may be affected by training with MCMS.

3004

## **Vocal Knowledge of Pre-Service Music Performers, Educators, and Therapists in University Music Degree Programs**

Daugherty, James F.<sup>1</sup> Bowers, Judy<sup>2</sup> Okerlund, David<sup>2</sup>

*1. The University of Kansas, Lawrence, KS, United States; 2. Florida State University, Tallahassee, FL, USA*

Career educators have been documented as a group at risk for vocal overuse and/or damage, but less is known about voice use consequences for music teachers and music therapists, who add singing to already heavy speaking demands faced by professionals across disciplines. Informal observations and self-reports of vocal problems among music professionals suggest one key issue may be personal decision-making, possibly based on incomplete or inaccurate knowledge of vocal anatomy, physiology, and acoustics. Moreover, the potential exists that music teachers and conductors entering the profession with inaccurate or incomplete voice knowledge may impact the health and optimal efficiency of the human voices with whom they work.

The purpose of this study was to assess the status and accuracy of voice knowledge among students (N=412) enrolled in selected vocal ensembles and courses in music education, vocal performance, voice pedagogy, music therapy, and choral conducting at two major universities in the United States. Participants completed a voice knowledge questionnaire. Part one contained statements (N=21) asserting various facts, both true and false, about vocal anatomy, physiology, and acoustics. Participants responded True, False, or Don't Know to each question. In part two, participants wrote free responses to a situational question eliciting what they deemed the three most important facts about how the voice works. Results were disaggregated by sex, student status (undergraduate, master's, doctoral), major, years of choral ensemble singing experience, years of private voice study, and prior coursework in music education, choral conducting, voice pedagogy, and vocal performance. Implications for the structure and content of university curricula designed for those preparing to work with singers in a professional capacity as music teachers, conductors, or therapists were discussed.

## Voice Teacher Survey: Teaching Someone with a Diagnosed Vocal Pathology

Weekly, Edrie M.<sup>1,8,11</sup> Korovin, Gwen S.<sup>2,3,4</sup> Asbury, Amy J.<sup>1,5,6</sup> Maines, Sarah<sup>1,7</sup> LoVetri, Jeannette L.<sup>9,10</sup>

1. Shenandoah University and Conservatory of Music, Associate Professor of Voice, Winchester, VA, USA; 2. The Gould Center for Care of the Voice, New York City, NY, USA; 3. Attending Physician, Lenox Hill Hospital, New York City, USA; 4. Clinical Assistant Professor, New York University School of Medicine, Attending Physician, New York City, NY, USA; 5. Blue Ridge Community and Technical College, Liberal Arts Division, Winchester, USA; 6. Winchester Musica Viva, Executive Director, Winchester, USA; 7. Adjunct Voice faculty, Trinity University, Washington, D.C., USA; 8. Contemporary Commercial Music Vocal Pedagogy Institute, Co-Founder and Associate Professor of Voice, Winchester, USA; 9. The Voice Workshop, Director, New York City, USA; 10. Contemporary Commercial Music Vocal Pedagogy Institute, Co-Founder, Winchester, USA; 11. National Association of Teachers of Singing, Fairfax, USA

In order for today's vocal pedagogues to provide quality training, they must familiarize themselves with several disciplines, including voice science and voice medicine. It is increasingly common for singers with vocal pathologies to receive treatment from voice care teams. These teams may include laryngologists, speech language pathologists, singing voice specialists, voice scientists, and psychologists, among other professionals. In this modern array of professionals guiding the rehabilitation of singers, where do voice teachers fit in and what are their practices? The aim of this study was to investigate current studio practices related to retraining someone with a diagnosed vocal pathology.

Researchers designed a survey to identify these studio practices as well as the personal medical history and demographics of professionals attending a conference on contemporary commercial music vocal pedagogy. Sixty-six voice teachers and professional singers of various vocal styles completed the survey. Respondents answered questions about their comfort level and studio practices regarding teaching a new student who has a diagnosed laryngeal pathology, is recovering from vocal fold surgery, or is recovering from a vocal injury.

Findings of the survey indicate the majority of teachers have received some form of instruction in vocal health issues, enabling them to interpret written reports from physicians. Respondents indicated that they maintain relationships with physicians and speech language pathologists and that they send students who are recovering from surgery or injury back to these professionals for check-in visits. Seventy-eight percent of teachers surveyed felt they were able to recognize vocal fold health issues solely from hearing the student sing. Results related to specific studio practices in retraining an injured or recovering voice will be discussed.



3245

## **Current Perceptions on the Effect of Vocal Warm Up Exercises: A National Survey of Classical Singing Pedagogues and Students.**

Meyer, David; Zeine, Lina; Bone, Amber

*Western Washington University, Bellingham, WA, USA*

Vocal Warm Up Exercises (VWUE) are considered essential for healthy singing technique. Their effect, though universally valued, is little understood. Quantifying the effects of VWUE remains an elusive goal. Perceptually, VWUE are believed to have significant effects on the singing voice.

Investigators at Western Washington University developed and assessed an online survey of classical singing pedagogues and their students. The survey was distributed nationally within the United States to determine what VWUE are meant to accomplish in classical singing, as taught in the collegiate music programs. Subjects were asked to rank perceived effects associated with VWUE, and respond to questions using a calibrated judgment scales.

Discussion focuses on descriptive survey results and analyses, including agreement and disagreement between classical singing pedagogues and their students. It is hoped that the results will guide further scientific inquiry into quantifying the perceptual effects of VWUE, and lead to the development of measurements that are clinically useful in the singing voice studio.

3041

## Technology Based Distance Education in the Vocal Studio

Broadwater, Kimberly J.<sup>1</sup> Buchanan, Mary L.<sup>2</sup>

1. Mississippi Valley State University, Itta bena, MS, USA; 2. Delta State University, Cleveland, MS, USA

**Introduction:** Technology-based equipment for teaching via distance education has been available for many years to teachers in the voice studio. However, it has only been within the past few years that this equipment has become more affordable and accessible. Additionally, instructional materials concerning the use of technology for the voice studio are now being widely published. However, is the technology available adequate?

**Method:** Measurements of singing quality using technology-based equipment in the voice studio was calculated. Two "base sites" were used to evaluate the use of telephone, web, and video conferencing in the voice studio. One site hosted the data acquisition equipment with the second site providing a singing source. Acoustic data was collected using each technology variable listed. The data collector, singing source, and observers completed a survey to evaluate effectiveness. Additionally, acoustic data was measured (Fo, jitter, shimmer, and HNR).

3216

## Vibrato parameters in professional singers

*Garcia-Lopez, Isabel; Peñarrocha, Julio; Perez-Ortin, Magdalena; Carrasco, Alejandra; Gavilan, Javier  
Otolaryngologist, Madrid, Spain*

**Objective:** To establish differences in vibrato rate and extent between registers in professional singers.

**Study Design and Methods:** Prospective case review.

### Methods and Materials:

Recordings of 28 professional singers, 15 females and 13 males (15 sopranos, 2 mezzosopranos, 7 tenors, 4 baritons and 2 counter-tenors) were performed in order to collect a long sustained vowel sample in different registers: low, medium and high at a medium loudness.

The vibrato rate and extent were calculated for each register and comparisons were conducted relating to F0 in low, medium and high register for each voice type.

**Results:** Vibrato rate tends to be higher in females and in lower pitches. The greater variation among singers was found in the higher pitch.

Vibrato extent was correlated with F0, with an increasing of the extent associated with higher pitches in absolute terms. But the opposite applies when transformed in semitones (relative increase), that is lower tones tend to vary in a wider range than higher pitches.

Key Words:

Vibrato, singing voice, registers

**3244**

## **The Effect of Vocal Warm Up Exercises on the *Messa di Voce* - a Pilot Study.**

Meyer, David; Zeine, Lina; Bone, Amber

*Western Washington University, Bellingham, WA, USA*

Vocal Warm Up Exercises (VWUE) are considered essential for healthy singing technique. Their effect, though universally valued, is little understood. Measurements of the singing voice that are clinically useful are elusive. Short-term changes in the singing voice may be perceptually significant, but show no statistically significant acoustic or aerodynamic change. In this study we will examine the acoustic changes of Vocal Warm Up Exercises on the *Messa di Voce* (MDV).

The MDV is universally considered a very advanced vocal technique in which a single pitch is sung with gradual crescendo and decrescendo. This requires an extremely high level of vocal coordination, particularly in the decrescendo phase.

It is hypothesized that Vocal Warm Up Exercises will increase:

MDV dynamic range

MDV pitch stability

MDV duration

MDV crescendo/decescendo phase symmetry.

Six undergraduate voice majors between 20-22 years of age will be selected and instructed in proper MDV technique. 32 samples per subject will be gathered over four days: two samples per session prior to VWUE, and two post VWUE. Subjects will be given a set list of VWUE to perform as prescribed by their voice instructors. Subjects will also be instructed to restrain from vocally demanding tasks for at least four hours prior to sample collection, and to refrain from any singing whatsoever to insure their voices would not be "warmed up."

192 samples will be examined acoustically to determine if any of the hypothesized effects of VWUE on MDV are supported by statistically significant data.

Independent variable: the subjects' use of VWUE prior to MDV.

The dependant variables: MDV dynamic range, pitch stability, MDV duration, and crescendo//decescendo phase symmetry.

Controlled variable: Time of day and vocal load prior to sample acquisition.

3235

## **Acoustic and Perceptual Dissimilarity Within and Between Voice Category in Classically Trained Female Voices**

Erickson, Molly

*University of Tennessee, Knoxville, TN, USA*

Dissimilarity has long been used to test perceptual dimensions of timbre difference in auditory stimuli. Most studies focus on the perception of instrumental timbre or pathological vocal timbre. A handful of studies have reported on the perceptual dissimilarity of major voice categories (soprano, mezzo soprano, tenor, baritone). None have focused on within voice category perceptual distinctions such as dramatic and lyric voice quality. This study seeks to examine the perceptual dissimilarity of timbre, both between and within voice category using stimuli produced by classically trained female singers. The perceptual stimuli were produced by 12 female singers recorded singing the vowel "ah" at three pitches, C4, G4, and F5. Six of the singers were unambiguously classified as soprano, with 3 being classified as lyric and 3 being classified as dramatic. The remaining six singers were unambiguously classified as mezzo soprano with 3 being classified as lyric and 3 being classified as dramatic. At each pitch, the 12 sung stimuli were combined in all possible pairs for a total of 66 paired stimuli at each pitch, for a total of 198 stimulus pairs. The paired stimuli are being presented to 50 inexperienced listeners who are being instructed to rate quality differences in the pair using a visual analog dissimilarity scale. Multidimensional scaling procedures using both INDSCAL and ALSCAL will be used to determine the perceptual dimensions used to categorize the stimuli. These dimensions will be correlated with acoustic measures in an attempt to identify which, if any, spectral cues lead to categorization of category and sub-category voice types. Acoustic measures include: H1-H2, spectral centroid, and frequency vibrato rate and extent.

## **Acoustic, Aerodynamic, and Self-Perceived Vocal Capability in the Operatic Voice Following a Systematic Vocal Exercise Program**

Ensslen, Anyasia J.<sup>1</sup> Stemple, Joseph C.<sup>1</sup> Patel, Rita<sup>1</sup> Croake, Daniel J.<sup>1</sup> Thomas, Lisa B.<sup>2</sup> Banks, Caroline<sup>2</sup>

1. *University of Kentucky, Lexington, KY, USA*; 2. *Marshall University, Huntington, WV, USA*

This study examined the effects of a systematic vocal exercise program (Vocal Function Exercises) on acoustic and aerodynamic measures and self-perceived vocal capabilities of opera students. In a previous study, these exercises demonstrated significant changes in the measured areas of voice range profiles. This study is an expansion of our previous research by including selected aerodynamic measures as well as a qualitative assessment of vocal change. The project was conducted as a joint effort between the Division of Communication Sciences and Disorders and the School of Music at the University of Kentucky and the Division of Communication Disorders at Marshall University.

Short term use of Vocal Function Exercises (4-6 weeks) has previously been shown to enhance voice capabilities in normal speakers, graduate opera singers, and teachers with voice disorders. This project was unique in that it measured the physiologic range of exceptional voices prior to and following the 10 week exercise program and compared those results to the same measures in a peer control group. Four dependent variables were employed: (1) measured area of the Voice Range Profile; (2) measured Dysphonia Severity Index; (3) phonation threshold pressure; and (4) laryngeal airway resistance. In addition, a subject interview probing self-perceived vocal change was conducted post-treatment. This final variable added a qualitative component to the analysis. Results and implications for the trained singer will be discussed.

3170

## A novel matching task for measurement of voice quality

Shrivastav, Rahul<sup>1</sup> Eddins, David A.<sup>2</sup>

1. University of Florida, Gainesville, FL, USA; 2. University of Rochester, Rochester, NY, USA

**Objective:** To develop a technique for perceptual measurement of voice quality that would provide data with known measurement properties (i.e. ratio or interval data) and be free of biases such as range and frequency effects. This would allow comparison of data across multiple experiments or laboratories.

**Study Design:** Synthetic and natural voices were submitted to three different perceptual tasks -rating scale, magnitude estimation and a newly developed matching task. The matching task required listeners to compare the breathiness/roughness of each test stimulus (standard) to a sawtooth+noise (S+N) signal. Listeners manipulated the "breathiness" of the S+N signal by varying its signal-to-noise ratio (SNR) and manipulated "roughness" by varying the depth of a 40 Hz amplitude modulation added to this signal. The SNR/modulation depth of the S+N signal at which it was perceived to be equally breathy/rough to the standard was then used as a measure of the breathiness/roughness in the standard. The data obtained in the matching task was compared to that obtained from rating scale and magnitude estimation tasks.

**Results:** Results show that the matching task was sensitive to changes in breathiness and roughness. Listeners performed the matching task with a high degree of inter- and intra-listener reliability. Comparison of matching data to rating scale and magnitude estimation tasks suggests that the matching task provides perceptual measurement with ratio-level scale properties.

**Conclusions:** The matching task is a simple to use method for perceptual evaluation of voice quality. It avoids limitations of the rating and magnitude estimation tasks thereby making it highly suitable for laboratory research on voice quality.

### **Does Real-Time Visual Feedback Enhance Aspects of Choral Performance?**

Nix, John P.; Simmons, Amy ; Muttwill, Amy M.

*University of Texas San Antonio, San Antonio, TX, USA*

The authors have previously examined the preferences of singers in a SSAA choir with regard to the use of real-time displays of purported spectra in rehearsals. The current study examines whether or not real-time feedback of acoustic parameters has a positive or negative effect upon selected aspects of performance. The authors used the software program VoceVista in a series of simulated performances of a women-only (SSAA) chorus of undergraduate music majors and non-majors (n=19). The real-time display of acoustic parameters of the choir's sound was projected onto a screen during some of the performances so that singers in the choir could see a videotaped image of the director and the real-time display simultaneously. Following each trial, singers rated the ensemble, balance, blend and overall quality of their performance on a 10 cm visual analog scale. Post performance, members from the choir (n=12) and other expert musicians (n=24) listened to blinded recorded excerpts of the simulated performances. Listeners rated each excerpt for ensemble, balance, blend and overall quality, again using the visual analog scale. Performer and listener responses were evaluated for significance. Spectrograms and long term average spectra of recorded excerpts were examined for differences between trials with and without feedback. Results will be discussed and recommendations for future studies will be given



**3215**

**Indian Carnatic Singers : Training , Performance characteristics and vocal habits**

Duvvuru, Sirisha; Erickson, Molly

*University of Tennessee, Knoxville, TN, USA*

In classical Carnatic singing, there exists no discipline of vocal pedagogy. Training of Carnatic singers is highly individual and depends on the mentor's singing style. Singers are not trained in technique or in healthy vocal habits, but rather in expression, scales, pitch and rhythm. The goal of the present study is to document the training, performance strategies and vocal habits of Carnatic classical singers. A 54-question survey is currently being administered to Carnatic classical singers performing throughout the southeastern United States. Thirty questionnaires will be obtained. All participants must have studied Carnatic singing for at least 15 years and have given one full length concert. The questionnaire consists of several sections related to training, performance characteristics, and vocal habits.

## Speaking Voice Norms of Classical Singers

Altman, Sarah M.; Obert, Kerrie B.

*The Ohio State University, Columbus, OH, USA*

The aim of this study is to collect a small database of acoustic voice norms of classically trained singers (defined as having had four or more years of private voice instruction) using standardized equipment. Baseline voice norms measured include average pitch, average intensity, pitch range, intensity range, jitter, shimmer, noise to harmonic ratio, s/z ratio, laryngeal ddk, and maximum phonation time. These norms will be gathered by recording the voices of healthy classically trained singers ranging in age from 18-39. These measures will be gathered easily using a microphone connected to a computer software program. The recorded segments will then be analyzed by The Voice Evaluation Suite (VES) by Vocal Innovations. The total time involved in this study is approximately forty-five minutes per subject including screening time (hearing screening, health questionnaire and voice recording).

This study's results will be compared to a similar multi-institutional study of non-singers and is likely to produce valid and reliable acoustic norms of classically trained singers with no associated risks or discomforts to the subjects. We expect to be finished collecting and comparing data by spring of 2009 and will include our results in our poster.

Establishing a normative voice database for classically trained singers separate from a database for non-singers is essential to reliably distinguish between healthy and disordered classically trained voices. It is our hope that our rigorous scientific design will provide a standard that voice clinics throughout the world can use to treat classically trained singers.

**3178**

**Vocal Fatigue in primary school teachers in Indian scenario.**

B.P, Abhishek; Thottungal, Santhosh S.; N.P, Nataraja

*University of mysore, mysore, India*

Vocal fatigue in school teachers has been extensively studied. Studies in Indian conditions are not available. The Indian condition has been considered different because of the number of students in a classroom (average of more than 60), the classroom acoustics, noise in the surroundings and use of blackboard and chalk (inhalation of chalk dust while writing or cleaning the black board).

The vocal fatigue in 30 primary school teachers in a typical Indian condition; another 30 teachers from schools that do not have the above said characteristics of an Indian school has been studied.. Vocal fatigue has been measured by analyzing the voice samples recorded before and after the day's work (a teacher on an average teaches 5-6 hours a day) in the typical Indian conditions and around 2-3 hours a day in other schools that have been considered.

The voice samples were recorded before and after the day's work of the teacher starting from Monday through Saturday (Saturday being half day) and also on Monday morning of the following week that is after voice rest from Saturday afternoon to the following Monday morning (voice rest has been defined as not using the voice for teaching purposes however using for their day to day activities.)

The effect of duration of voice rest i.e. evening of the working day to the morning of the following day and also from Saturday afternoon to the following Monday morning, was also noted. The acoustic analysis, to obtain the voice parameters which reflect vocal fatigue, of all the voice samples have been carried out. The results have been discussed in the light of available literature.

**Voice Characteristics in Indian Adult Males after Vocal Loading Task.**

Boominathan, Prakash; Rajendran, Anitha; Gnanavel, Dinesh

*Sri Ramachandra University, Porur, Chennai Tamil Nadu 600 116, India*

Vocal loading refers to excessive use of voice. This study reported effects of vocal loading and resulting complaints of voice fatigue/ change, recovery pattern and endurance in 20 healthy adult Indian males (18-25 years). A controlled prolonged loud (70-80 dB SPL) reading up to one hour was taken as a vocal loading task. Perceptual (GRBAS), acoustic analysis (MDVP) and self analysis were used to quantify changes in voice pre and post (5, 10, 15, 20 minutes & 24 hours time interval) vocal loading. All subjects were under strict vocal hygiene and partial voice rest regimen during the 24-hour period post vocal loading task. Recovery of vocal function was inferred using paired t test and repeated ANOVA of pre and post vocal loading measurements. All subjects reported initial signs of fatigue ('throat tightness' & 'out of breath') after 25 minutes of loud reading. The mean total reading time was 35 minutes (SD: 4.34). None were able to read for an hour. Perceptually, all had a hoarse and breathy voice quality immediately after vocal loading (Spearman coefficient: 0.37). MPT reduced between 4 and 8 seconds ( $p: 0.00$ ) and mean s/z ratio was increased to 1.23 (SD: 0.08,  $p: 0.00$ ) in the immediate post-test. Significant increase in frequency and amplitude perturbation measures were noticed in the immediate post recording. Acoustic parameters (jitter, shimmer & noise related) showed recovery to near pre-test values in the post 20 minutes analysis. Voice parameters recovered completely after acute physiologic change due to vocal loading 24 hours later. These findings can be applied to understand vocal endurance, susceptibility to vocal fatigue and physiological changes due to vocal loading in Indian adult males.

**3148**

**Dare we? Singing lessons for the very young.**

Brown, Karie L.

*Teacher's College, Columbia University; Marble Collegiate Church, New York, NY, USA*

Traditionally, teachers of classical singing technique have been reluctant to teach young children, presumably for fear that strenuous use prior to voice migration will damage fragile young voices. The problem with this position is that children DO use their voices during childhood, often more strenuously than they will during adolescence and beyond. Furthermore, many young children want to study singing. Early childhood methods such as Suzuki have made instrumental study possible for very young children, but those who wish to study singing often have no good options.

This reluctance may stem from a lack of understanding of the abilities and limitations of children's voices, on the part of studio voice teachers and school choral directors, who are often the first singing teachers children encounter. When public school music teachers in the United States rate the effectiveness of their undergraduate training, preparation for teaching beginning singers is one of the lowest-rated areas. College-level vocal pedagogy courses generally focus only on the adult voice. Even voice researchers seem unaware that an understanding of healthy singing in childhood is sorely needed, for the body of research into the adult singing voice far outweighs the research available to those who wish to learn about the singing voice during childhood.

Through a review of available literature, action research carried out with a group of very young singers, and interviews with professionals who work with young singers, this presentation proposes a model of voice study uniquely suited to the needs of the very young. Normative development of the vocal apparatus during childhood, the learning environment, and possible goals of a program of vocal study for very young children are all addressed.

## Correlation between voice handicap index (VHI) and acoustic aerodynamic analysis after phonosurgery

Cheng, Jeffrey; Woo, Peak; Thompson, Chandler; Carroll, Linda; Ivey, Chandra; Mortensen, Melissa  
Mount Sinai Medical Center, New York, NY, USA

**Objective:** Evaluate and compare patient improvement after phonosurgery using a subjective and objective measurement tool. Investigate whether professional voice patients are more subjectively affected by their voice dysfunction than non-professional voice users.

**Study design:** A prospective cohort.

**Methods:** A non-randomized, prospective study, which enrolled twenty-three patients, was performed in an academic, tertiary-care referral center. Preoperative Voice Handicap Index (VHI) questionnaires and acoustic/aerodynamic testing was completed prior to undergoing phonosurgery for non-neoplastic vocal fold pathology. Postoperative VHI and acoustic/aerodynamic testing was collected six weeks postoperatively. Statistical analysis was performed comparing the subjective and objective changes pre- and postoperatively to see if there was a correlation between the VHI change and voice laboratory measurements.

**Results:** The VHI changes significantly in both groups ( $p = 0.002$ ) after phonosurgery. Objective measurements failed to show significant change in this cohort, whereas the VHI scale was more sensitive. Professional voice patients seem to have greater change in their VHI score after phonosurgery than non-professional voice patients. Objective voice laboratory measurements of voice do not correlate well with subjective evaluation of voice dysfunction.

**Conclusion:** Phonosurgery has been demonstrated to effectively improve some vocal cord pathologies, and the VHI has been shown to be a useful instrument to help monitor treatment efficacy. Acoustic/aerodynamic voice laboratory measurements do not significantly correlate with VHI scores, which provides further evidence of the inability of integrating subjective and objective voice disability measurements to make meaningful interpretations. Professional voice patients are more subjectively affected by their voice disability, so it is useful to stratify these patients with voice dysfunction and monitor their treatment responses with more specialized and sensitive indices, like the Singer's Voice Handicap Index (SVHI).

3188

## **Physical model of voice production with physiologically based tension control, bulging effects and acoustic loading**

Cook, Douglas D.; Zanartu, Matias

*Purdue University, West Lafayette, IN, USA*

A physical model of the vocal folds has been constructed for exploring some of the primary mechanisms of human phonation. The model consists of two-layer silicone vocal folds with a tension control scheme mimicking the effects of the crico-thyroid muscle. Adduction and bulging effects are modeled using pressure lateral to the vocal folds. The subglottal system was designed to match typical acoustic resonances of the trachea and lungs, and the supraglottal tract is deformable to allow various acoustic loading conditions. Instrumentation includes microphones to capture the transglottal pressure drop, flow meter to measure mean flow rate, as well as microphones in the lung chamber and at the exit of the supraglottal tract. High speed video of the synthetic vocal folds, and measurements of the dynamic changes in the flow rate are also possible. The model will be used for experimentation (see below), and as an educational laboratory in the Department of Speech, Language and Hearing Sciences at Purdue University.

One novel aspect of this model is its ability to produce changes in pitch, loudness, and vocal tract formants. Preliminary experiments with this model were designed to explore the nonlinear relations between air flow, tissue motion, and acoustic loading effects. The interactions between acoustic loading and sound source as well as the acoustic coupling between tracts were examined. Future experiments using the model will be oriented toward the exploration of inverse filtering of the oral volumetric flow rate. Overall, this physical model of voice production promises to be a valuable teaching and research tool.

**Cross linguistic comparison of VOT in Dravidian speakers**

E, Pragathi; Rao, Trupthi; Kumar, Vijay

*University Of Mysore, Mysore, India*

Cross-linguistic differences in VOT have been investigated extensively in the literature but, studies pertaining to that in Indian languages are less explored. Dravidian language is a Family of 23 languages spoken principally in South Asia by more than 210 million people. The four major Dravidian languages of southern India are Telugu, Tamil, Kannada, and Malayalam which have independent scripts and long documented histories. In light of these aspects an effort has been made to compare the VOT in four Dravidian languages (Kannada, Tamil, Telugu and Malayalam). Subjects have been selected on the basis of their age, gender, native language, second language and education. 48 subjects in the age range of 20 to 30yrs participated in the study. They were categorized into group A, group B, group C and group D whose native languages were Kannada, Tamil, Telugu and Malayalam respectively. Each group consisted of 12 subjects (6 males and 6 females). All the subjects were given a task to read the standard "Rainbow passage", as English was considered as the common second language for all the subjects. Objective analyses of all the recorded voice samples were carried out. The language and gender variations have been considered for the analysis and the results have been discussed. Positive outcome of the study can be used in quantifying the acceptable VOT range in second language which is possibly influenced by native Dravidian language. Further extension of the study can help us to find out speech patterns in different aprosodic or dysarthric speech in bilingual and in multi-lingual concerns.



3174

### **A survey of exercise habits in college-aged vocal performance majors: A preliminary study.**

Emerich, Kate A.; Scheaffer, Katie

*University of Denver, Lamont School of Music, Denver, CO, USA*

The standards for operatic performers have changed significantly over the past decade. Opera is now considered as much a visual art as it is a display of virtuosic singing. The ramifications of this shift in the opera world is significant, evidenced by well-known divas losing opera contracts because of their physical size, an increase in incidence of gastric bypass procedures in opera singers, and opera directors making casting decisions based on physical appearance as much as vocal talent. Music conservatories historically are responsible for preparing young singers for the professional world, but the focus has been on teaching proper singing technique, language diction and languages, appropriate repertoire, music theory and history, and vocal pedagogy. Teaching singers how to look their best through physical exercise and/or diet and nutrition has not made its way onto the curriculum. The motivating question for this study is: Should the curriculum in the music conservatory shift to include education/emphasis on physical fitness secondary to the importance of appearance in the performance world? To assess the basic need for this education, it was first necessary to determine exercise habits of current vocal performance majors.

**Methods:** A survey of regular aerobic and core strengthening exercise was conducted at the Lamont School of Music at the University of Denver. A confidential questionnaire was given to all vocal performance majors regarding the type and frequency of exercise they participated in on a regular basis. 35 students completed the questionnaire.

**Results:** 8 students (23%) exercised 3 or more times a week. 13 students (37%) did not exercise. None of the students exercised daily. 40% of the students exercised 1-2 times a week.

3060

## Voice Disorders and its Symptoms in Primary School Teachers

Fahaam, Maryam M.; Jalilevand, Nahid; toraby nejad, farhad  
*none, shyras, Iran (Islamic Republic of)*

**Introduction:** Risk of voice disorders increases in voice professional users like teachers due to used voice for sustained moments; but it seems that they get accustomed to this fact!

**Methods:** We asked from 398 primary school teachers to say us if they feel any voice problems and experience any of 9 explored symptoms to them. Voice samples is gathered by reading a same passage, continues vowel /a/ and counting 1-20 in their usual voice. 3 expert voice pathologists and VOCAL ASSESSMENT SOFTWARE assessed voice samples to determine the disordered samples. Then compare the rate of teachers who felt voice problems with the rate of whom diagnosed as really having voice disorders.

**Results:** The rate of teachers with voice disorders (68.09%) is more than who felt voice problems (24.37%) and this deference is significant ( $p < .05$ ). the most complaints were hoarseness and vocal fatigue. According to the vocal assessment software 68 sever hoarseness, 72 harshness and 229 sever breathiness is seen in the samples. Only 17.83% of samples who felt voice problems are diagnosed as having voice disorders and only 14.46% of samples were intact; it means that they didn't have any complaint and also show no signs of voice disorders in 2 assessments. As increased working years the risk of voice disorders increased too.

**Discussion:** incidence of voice disorders in teachers is higher than normal, but unfortunately most of them are not aware of their disorders and adapted to it. Because of overusing voice as their job's expediency it is very important to alert them from the torts of teaching by a disordered voice in vocal folds and other laryngeal structures. Utilize voice hygiene may help them to have more healthy voice.

## Description of dynamic of the vocal folds in functional voice disorders

Fernández-Baillo, Roberto; Gómez Vilda, Pedro

*Laboratorio De Comunicación Oral. Universidad Politécnica De Madrid, Boadilla del Monte (Madrid), Spain*

The study of the functional disorders is one of the bigger difficulties found by the clinical voice analysis. We can find many classification systems of the voice pathologic and all of them are distinguishing four principal groups: hypofunctional, hyperfunctional, pubertal voice and psychological disorders. Present work is focused in the study the functional alterations classed as hypofunctional and hyperfunctional, with the objective to describe the dynamic mechanisms of the vocal folds developed in each of these kinds of phonations which allow to get data to a correct distinguishing in relation to non-pathological voice. Preliminary results were gotten using records from 20 subjects with non-pathological voice and 20 with functional pathology (10 hypofunctional and 10 hyperfunctional). The normal and functional alteration condition was based on the results obtained from the assessment, image and voice capture after a medical and phoniatric study. The distinguishing of the subjects with functional disorders inside their correct group was based on criteria related to the glottal closure. The software Glottex, a tool based on a method of inverse filtering that allows to get the glottal source and biomechanical parameters related to the masses and stiffness, was used for the processing of the signal voice. In this work the results show a clear distinguishing between the most of the subjects in relation to the non-pathological or functional condition. The results show that the rate of amplitude between open-close and the starting point of the open phase are decisive. The data allows offer a new classification system of the functional voice disorders where each group of functional disorders (hypofunctional and hyperfunctional) including several subclasses which are given decisive information for the voice treatment.

## Effects of voice hydration on voice performance

Franca, Maria Claudia; Simpson, Kenneth O.; Garrison, Jamie M.

*Southern Illinois University, Carbondale, IL, USA*

Low fluid intake may be associated with poor vocal performance (Sataloff, 1987; Verdolini, Titze, & Fennel, 1994). The relation of body hydration on vocal performance was investigated in this study. The hypothesis was that vocal quality is associated with levels of hydration, specifically that limited hydration is associated with poor vocal quality while adequate hydration is associated with good vocal quality.

The independent variable in this study was hydration. The participants agreed to refrain from consuming liquids, then drink only water at the prescribed time and amount. The effects of different levels of hydration on objective measures of voice quality were explored. There were two dependent variables: jitter and shimmer, measures of perturbation of the voice. Voice production was collected by using vowels samples analyzed by the MDVP mode of the VisiPitch 3950.

On the day of assessment, pre-test data (i.e. dehydration condition) was collected from participants of both control and experimental groups. The participants in the experimental group then drank 1 liter of water in 20 minutes. Participants in the control group abstained of ingestion and food of liquids prior to posttest (i.e. rehydration condition). The posttest was conducted 90 minutes after beginning water ingestion.

There was significant statistical difference for shimmer measures, an indication that hydration may improve vocal performance. The findings could have utility for proposing adequate body system hydration as a prevention approach to avoid voice disorders.

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**3248**

**Hypopharyngeal Pharyngoplasty: A case series**

Franco, Ramon A.; Andrus, Jenni; Quesnel, Alicia

*Harvard Medical School, Boston, MA, USA*

Hypopharyngeal Pharyngoplasty is a surgical procedure that allows for resection of the pyriform sinus to improve swallowing function in those patients with recurrent laryngeal nerve injury. Unilateral vocal fold paralysis can be associated with a dilated ipsilateral pyriform sinus that requires the patient to perform a head turn and chin tuck to swallow well. The hypopharyngeal pharyngoplasty procedure was performed in 12 patients.

3012

## Does singing activity influence sexual maturation?

Fuchs, Michael<sup>1</sup> Gelbrich, Goetz<sup>2</sup>

1. University of Leipzig, Section of Phoniatics and Audiology, Leipzig, Germany; 2. Coordination Center for Clinical Trials Leipzig (KKSL), Leipzig, Germany

**Background:** The mechanisms of the onset of pubertal development are not fully understood so far. Any information about variables correlated with puberty may therefore be useful to generate hypotheses on the pathways of the onset of puberty.

**Methods:** We performed a cross-sectional case-control study with the primary goal to examine the relationships between singing activity of children and vocal parameters during the pubertal mutation of the voice. Eighty-seven children with regular singing activity under professional conduct and 97 children without singing activity beyond usual music lessons at school were included. Participants were aged 10.5 to 16 years. Subjects completed a questionnaire about their sociodemographic environment and underwent assessment of vocal parameters and physical examination including Tanner stages of pubertal development.

**Results:** Pubertal development was significantly more advanced in singers compared to age and gender matched non-singers ( $P=0.011$ ). The adjusted mean difference of Tanner stages was 0.62 (95% CI: 0.14 to 1.11). In addition, possessing siblings was an independent predictor of less advanced puberty ( $P=0.034$ ; difference -0.54 Tanner stages, 95% CI: -1.04 to -0.04).

**Discussion:** Regular singing activity seems to be associated with earlier onset of pubertal development. Relationships between singing activity might be considered to be explanatory. Influences of the social environment may be discussed as well. However, the true reason remains unknown so far. Further hypotheses and empirical investigations may be helpful to understand the matter.

## The impact of posture change on glottic closure and acoustic measures

Gilman, Marina

*Emory Voice Center, Atlanta, GA, USA*

It is common knowledge that posture is essential to good voice use, whether singing or speaking. Yet there are few studies showing how posture impacts vocal fold function in speaking or singing. Fishman BV and Shipp T (1970), Jones (1972), Kooijman et al (2005), Giovanni, Aki, and Ouaknine.

(2008) have shown that postural shifts increase tension not only in the extrinsic laryngeal muscles, but also postural muscles impacting respiratory function and vocal production as measured by increased perceived effort, spectrographic analysis, the Voice Handicap Index and Dysphonia Severity Index.

Subtle changes in musculo-skeletal organization impact vocal production. Since we talk and sing in a variety of positions, sitting, standing, slouching, lying down, etc. it is important that optimal head/neck/spine relationships be maintained no matter what the position. A well-organized neuro-musculo-skeletal system has maximal flexibility. However, when the system is not organized small changes in posture can result in poor vocal production.

This study examines the impact of postural shifts, glottal closure (EGG) and perceived vocal effort. The postural parameters examined are a neutral position, that is, the subjects habitual position in sitting; the head in an exaggerated forward and exaggerated backwards position in sitting; knees locked and then knees soft in standing.

Preliminary evidence indicates changes in EGG % closed quotient, % standard deviation or configuration of the glottal cycle in at least some positions from the presumed neutral. There was no one position in which these changes consistently occurred. Rather, each individual had his/her own configuration depending on their personal organization. It is postulated that individual muscle-skeletal organization determines which positions create the greatest shifts in vocal fold movement.

**3210**

### **Subglottic pressure in oriental singing**

Giovanni, Antoine<sup>1</sup> AKL, Leslie<sup>2</sup> Amy de la Bretèque, Benoit<sup>1</sup>

*1. Lab Parole et Langage, marseille, France; 2. Université St-Georges, Beyrouth, Lebanon*

Ornaments in oriental singing are notes added to the skeletal of the melody in order to obtain a prettier musical effect. Ornaments can be of different types but always joined to the vowels and never to the consonants. They can be ascendant or descendant. Since there is very few scientific data on these productions, we are heading for the description of the laryngeal behaviour during singing. The first step was to study subglottic pressure during the ornaments production.

The study presented is a preliminary study in which the singing voice with ornaments was performed by one of the authors. Subglottic pressure was assessed with a transducer (EVA system) and a tracheal transcutaneous catheter (catheter was inserted between cricoid cartilage and first tracheal ring). Subglottic pressure was compared in a steady vowel (flat without ornaments, with and without classic vibrato) at different  $F_0$  and intensity levels and in the same notes with ornaments of different types.

Our first results show a mean higher subglottic pressure in the vowels with ornaments as compared to vowels without, according to the different levels of intensity. The most important findings are that some kinds of ornaments close to the "tremolo" are made of rapid variation of subglottic pressure and are completely different from what was observed in classic occidental style vibrato.

During presentation, some samples of these oriental ornaments will be performed by the authors



3223

## **A Longitudinal Look at Vocal Development**

Goffi-Fynn, Jeanne C.<sup>1</sup> McCann, Lori<sup>2</sup> Brown, Karie<sup>1</sup> DeMaris, Amanda<sup>1</sup> McRoy, Danielle<sup>1</sup>

*1. Teachers College, Columbia University, New York, NY, USA; 2. Montclair State University, Montclair, NJ, USA*

In our qualitative study, we have selected singers at various ages to better understand practical manifestations in the theory of the singing voice and how to teach it. Beginning with a group of very young singers, we compare the literature and look for areas of convergence and divergence in our work with the participants. Vocal issues addressed will include range, voice quality, breath coordination, and vocal maturity issues. We will also investigate the learning environment and issues related to education, musical issues (including repertoire), and psychological attitudes in the voice studio. Our study includes young musicians (ages five and six), an adolescent (age 14), a freshman voice major (age 19), an adult beginner, and a young professional. Data collection includes videotaping of lessons, interviews with participants (and parents), and journals and self-reflections from participants.

## **Effect of surface electrical stimulation on voice in patients with muscle tension dysphonia: Pilot data**

Gorham-Rowan, Mary<sup>1</sup> Morris, Richard<sup>2</sup> Fowler, Linda<sup>3</sup> Hapner, Edie<sup>4</sup>

*1. Valdosta State University, Valdosta, GA, USA; 2. Florida State University, Tallahassee, FL, USA; 3. Georgia State University, Atlanta, GA, USA; 4. Emory Voice Center, Atlanta, GA, USA*

The use of transcutaneous electrical stimulation (TES) has become a popular therapy for treating dysphagia. Anecdotal reports suggest that patients exhibit improvements in voice and swallowing following TES. Although evidence indicates that TES does not affect vocal fold function (Gorham-Rowan et al., 2007; Humbert et al., 2008), measurable changes in fundamental frequency and vocal loudness have been documented (Fowler et al., 2005). These changes presumably occur as a result of extrinsic muscle stimulation (Ludlow et al., 2007). This study was completed to determine if TES would be a useful therapeutic tool for individuals with muscle tension dysphonia (MTD).

Three women with MTD participated in the study. Two of the women had not received prior voice therapy; the third participant had received two sessions of therapy. Prior to TES, the participants engaged in 10-15 minutes of oral resonance therapy and easy conversation. TES was then administered for 10-15 minutes using VitalStim<sup>®</sup>; electrodes were placed on either side of the thyroid lamina. The level of stimulation was set at the minimum level of motor stimulation, defined as the level at which participants first reported a "grabbing" sensation. The participants were instructed not to react to laryngeal lowering by attempting to pull the larynx up.

Voice recordings were obtained at the beginning of the therapy session, as well as pre- and post-TES. Two of the participants demonstrated measurable changes in fundamental frequency and loudness level. All three participants stated that it was easier to phonate following TES. Although these results suggest that TES may provide some benefit, further research is warranted to determine the extent to which it may be used as a therapeutic tool for voice disorders.

**3016**

### **Medialization Thyroplasty Using Silastic Implant**

Gulia, Joginder S.

*Pt B.D. Sharma University of Health Sciences , Rhotak, India*

Thyroplasty type-I has become treatment of choice in un-recovering unilateral vocal fold palsy, which the authors performed in 15 patients. Vocal fold palsy showed propensity for males (60%) and for left side in 67% cases. It was idiopathic in 67% of cases. Hand carved silastic implant was used and all the patients had statistically significant ( $p < 0.001$ ) improvement in voice immediately and after three months of surgery. There was no extrusion of implant and none required revision.

## Reliability and Validity of the Transgender Self-Evaluation Questionnaire

Hancock, Adrienne B.; Owen, Kelly ; Siegfriedt, Linda L.; Brundage, Shelley B.

*George Washington University, Washington, DC, USA*

Although absent from the literature, changes in voice are often accompanied by transgender (TG) patients' reports of changes in self-image and well-being. The Transgender Self-Evaluation Questionnaire (TSEQ; Davies, 2006) is a non-standardized questionnaire designed to quantify the TG patient's perceived emotional, physical, and functional impact of her voice. Although premise and instructions are similar to the Voice Handicap Index (VHI), the content of the TSEQ includes questions unique to TG experiences. The TSEQ's current value is limited because development procedures and normative data have not been published. But because the TSEQ form is published in suggested TG guidelines (Davies & Goldstein, 2006) and the seminal book on the issue (Adler, 2006), providers are using the TSEQ to fill the gap in transgender voice services.

Thirty transgender individuals will complete the TSEQ, the VHI, and the Voice-Related Quality of Life scale; they will rate their self-perceived overall femininity and provide a speech sample that will be acoustically analyzed and perceptually rated by themselves and by 25 naïve listeners for femininity and likeability. The TSEQ will be completed again two weeks later. Descriptive data and Pearson-product moment correlations will be reported and discussed in terms of the TSEQ's validity and test-retest reliability.

Crucial to the development of treatments for TG clients seeking to change their voice and communication is identifying valid and reliable measures for the psychosocial change, particularly for a population relatively new to our scope of practice. Next, defining the relationship between the traditional acoustic and perceptual measures (i.e., aspects of the signal) and the psychosocial indices of the client will guide development of evidence-based practice combining empirical evidence, clinician expertise, and patient values.

**Clinical versus Laboratory Ratings of Voice using the CAPE-V**

Horst, Leah B.; Solomon, Nancy P.

*Walter Reed Army Medical Center, Washington, DC, USA*

Perceptual ratings of voice may differ between clinical and research environments. In a prospective clinical trial, 85 patients were evaluated by one of two speech-language pathologists (SLPs) using the CAPE-V before and three times after thyroidectomy over a 6-month period. Subsequently, their voice recordings were played over headphones in quasi-randomized order (blocked by speaker) to 3 experienced SLPs, including the clinical raters. Listeners were blinded to patient identity and recording session, and were provided with auditory anchors for "moderate" dysphonia. Each SLP who provided clinical ratings demonstrated moderately strong correlations with her ratings of the same voices under laboratory conditions ( $r = .78$  and  $.69$  for overall severity), but the clinical ratings tended to be higher (more severe). Intraclass correlations across the three SLPs for laboratory ratings were moderate ( $r = .66$  for overall severity). Correlations between the median of the three laboratory ratings and the clinical ratings were moderate as well ( $r = .77$  for overall severity). As with the individual raters, clinical ratings were higher than laboratory ratings, implicating clinical bias. Another possible contributor to the difference may have been the influence of the auditory anchor in the laboratory. These findings highlight the potential for clinical bias and emphasize the need for standardized procedures of auditory-perceptual evaluation of voice in the clinic. [The views expressed are those of the authors and do not reflect the official policy of the Department of the Army, the Department of Defense or the US Government.]

## **Perceptual and acoustical parameters of Kannada speech sounds in people with maxillary implant prosthesis**

*Jaivikas, HH; Tarun Thomas, K; Rao, T.A. Subba; Mysore Narasimha, Ajay  
Mangalore University, Mangalore, India*

A major portion of speech articulation takes place within the oral cavity and any alteration to the structures or absence (e.g. teeth) will adversely affect speech. The study, attempts to add specific details of Kannada speaking subjects who is fitted with denture. It highlights the importance of team work by the dentist and the speech language pathologist while treating the patients with dentures. 22 edentulous patients above 60years of age participated. Dentures were constructed for each of them using standard norms. The trial dentures were duplicated three times incorporating a certain change in the positioning of the maxillary incisors and thickness of the palatal plate while keeping the other factors same. It was found that perceptually speech of subjects with regular dentures was most intelligible after two weeks of use compared to other types of dentures. The F0 and aspiration time increased immediately after insertion but decreased with use. Labial inclination of maxillary incisors produced greater effect on speech compared to retroclined position. The familiarity of tongue to dentures produced better diadacokinetic rates. Results reveal that the implantation of maxillary prosthesis has altered the individual's F0 and its harmonics, thereby causing the speech to be distorted. It was also observed that any structural change in the prosthesis like alteration in the position of incisors had a strong influence on speech and also speech distortion alters with the thickness of the denture palatal plate and increase rapidly with 1mm of thickness. Despite significant effects, the phonetic aspects of denture fitting is not getting due importance compared to attention given to esthetics. The proclined position of incisor is more difficult to improve than the retroclined position.

3219

## Structural Heterogeneity of the Vestibular Folds

Kahane, Joel C.

*The University of Memphis, Memphis, TN, USA*

Vestibular folds (VsF) are prominent structures in the endolarynx and play roles in protective closure of the airway, occasionally becoming involved in disordered voicing. Surprisingly, they are described without attention to the heterogeneity of their structure. Recently, renewed interest in VsF surrounds their role in dysphonia and pulse register phonation. The present study grew out of observations of VsF histology, which suggested the need for more discriminative description of their structure.

**Methods:** 400 histologic sections of 20 human laryngeals, matched by decade (1st- 9th ) were studied via light microscopy. Detailed mapping of 5 distinct regions of the VsF were made along its anterior-posterior course. Data were analyzed with regard to age and sex differences.

**Results:** The VsF were found to be structurally complex having similar morphology across ages and sexes. VsF were found to have a unique architecture which included regional specialization and no intrinsic muscle (m.ventricularis) or ventricular ligament, as classically described. Each fold contained: 1. a well-defined lamina propria (quadrangular membrane) which supported squamous or respiratory epithelium; 2. Dense fibro-elastic connective tissue (CT) forming a lattice for glands and ducts. This was fimbriated, having its fibers separated by glands. 3. The so-called ligament was interrupted by glandular tissue and was not composed of linear arrays of fibers; 4. A glandular region composed of compound muco-serous glands comprised much of the VsF; 5. Loose CT (areolar) was found between the glandular region and paraventricular muscle. This muscle is part of m.thyroarytenoid and not intrinsic to the VsF. It is located in the wall of the ventricle.

Morphologic data will be illustrated and annotated. Functional implications will be discussed.

## Correction of Asymmetric Vocal Fold Vibration Patterns with Collagen Injection - Analysis by Videokymography and Laryngotopography

Kimura, Miwako<sup>1,5</sup> Imagawa, Hiroshi<sup>2</sup> Sakakibara, Ken-ichi<sup>4</sup> Nito, Takaharu<sup>2</sup> Tayama, Niro<sup>5,2</sup> Chan, Roger W.<sup>1</sup>

1. Univ. of Texas Southwestern Medical Center, Dallas, TX, USA; 2. The University of Tokyo Hospital, Tokyo, Japan; 3. Health Science University of Hokkaido, Hokkaido, Japan; 4. Health Sciences University of Hokkaido, Hokkaido, Japan; 5. International Medical Center of Japan, Tokyo, Japan

**Objective/Hypothesis:** The clinical diagnosis and assessment of voice disorders have generally been performed by videostroboscopic methods. However, videostroboscopy is not capable of the imaging and analysis of irregular vocal fold vibration commonly observed for vocal fold paralysis. There is much interest in the studies of asymmetric, irregular vocal fold vibration for both clinical and research purposes. This study used the high-speed digital imaging techniques of videokymography and laryngotopography to evaluate the effect of collagen injection on irregular vocal fold vibration patterns in vocal fold paralysis.

**Study Design:** Prospective experimental study with control.

**Methods:** Ten patients with unilateral vocal fold paralysis underwent high-speed digital imaging before and after transoral injections of bovine atelocollagen. High-speed digital image analysis of vocal fold vibration was performed, with kymograms and laryngotopographs developed for analysis of the vocal fold vibration.

**Results:** Kymographic analysis revealed two vibratory frequencies from the contralateral vocal folds in six patients before collagen injections. The distinct vibratory frequencies became the same after injections for all six patients. Differences in vibratory amplitude were observed in the other patients before collagen injections, with improvements observed after injections.

**Conclusions:** Differences in vibratory frequencies or amplitudes observed before collagen injections indicated asymmetry and a lack of entrainment between the vocal folds. Results of this study showed that the surgical procedure of collagen injection could improve the functional symmetry of vocal fold vibration in unilateral vocal fold paralysis.



3181

## **Phonation in a straw. Experimental in vivo measurement of subglottic pressure with EVA@ device**

Amy de La Breteque, Benoît; Ghio, Alain; Akl, Leslie; Leuchter, Igor; Giovanni, Antoine

*CNRS, Aix-en-Provence, France*

**Introduction:** We used vocal reeducation techniques based on exercises with a straw for more than 20 years. It seems to allow a gentle vibration of the vocal cords as well as a progression of the cordal adduction force proportional to resistance due to the straw. Our aim is to study the intraoral and subglottic pressures (IOP and SGP) and the modalities of the glottic vibration during these exercises.

**Method:** The subject is a male vocal professional, with no voice pathology. The subglottic pressure was recorded by a probe placed between the first and the second tracheal ring and the intraoral pressure by a probe placed in the mouth. The voice is produced after a short expiration time, to obtain a sufficient and stable air flow, controlled with the hand at the extremity of the straw. Eight models of straw with different calibre and length were tested. The data were collected with the EVA@device and analysed with the Phonedit software (Sq-Lab, Aix en Provence).

**Results:** A pressure gradient exists between the SGP and the IOP, varying with the voice frequency, and close to the phonation pressure threshold. The pressures are bigger when the straw calibre is small, the straw long and the frequency high. The vocal cord contact is differed when the straw is long.

**Conclusion:** The phonation exercises with the straw require an output airflow control and thus allows an optimal adaptation of the SGP and vocal coaptation without risk for the free border of the vocal cords.

**Clinical outcomes of hydration intervention on vocal function: a meta-analysis**

Leydon, Ciara<sup>1</sup> Sivasankar, Mahalakshmi<sup>2</sup>

1. Brooklyn College, Brooklyn, NY, United States; 2. Purdue University, West Lafayette, IN, United States

Vocal fold hydration is purported to promote optimal biomechanical characteristics of vocal fold mucosa, increase efficiency of vocal fold oscillation, and promote normal voice quality. Maintaining adequate vocal fold hydration is considered an important component of vocal hygiene protocols. However, reviews of outcomes of studies assessing the benefits of vocal hydration on vocal fold function have revealed conflicting results. The purpose of this work was to determine the magnitude and consistency of the effects of hydration intervention on vocal fold function across studies. Specifically, we completed a comprehensive meta-analysis of the effects of superficial and systemic vocal fold hydration on phonation threshold pressure (PTP), a measure of efficiency of voice production. Thirty-nine studies examining the effects of hydration on vocal function were found. Of these studies, 14 examined the effects of hydration on PTP. Nine articles met the criteria for inclusion in the analysis. Our results revealed that, overall, hydration treatment demonstrated a tendency to reduce phonatory effort, however, this decrease did not reach significance at the 95% confidence level. The magnitude of the effects of hydration intervention varied across studies. Assessment of two factors that may have contributed to the variability in findings across tasks, pitch level of the speaking task and vocal health of participants, revealed a trend for a greater overall effect size for high pitch speaking tasks and for healthy participants. Evaluation of others factors that may account for differences in reported effects of treatment, including study design and the amount and type of intervention, is warranted to understand the variability in outcomes across studies and to guide best practice for protecting and rehabilitating vocal function.

**3203**

### **Voice range profile in Indian tonal languages**

Mathur, Nikhil; M, Deepthi; M.S., Deepa ; N.P., Nataraja

*University of Mysore, Mysore, India*

Linguistic aspects of tonal language in India has been a major area of interest in the last few decades. However the influence of voice range profile in tonal dialect has been less investigated. In addition comparison of frequency and intensity data in tonal speakers as compared to that of non tonal speakers could provide more reliable data for assessment and treatment of voice disorders in these speakers. An attempt has been made to investigate frequency and intensity range of the tonal dialect ( Mizo and Manipuri) and a comparison has been done between these languages, with non-tonal languages( kannada and Tamil) and across gender. 40 native speakers ( 20 Mizo,20 manipuri;10 males and 10 females in each group) were selected as subjects for the study.7 Swaras of Indain classical music and sustaining the vowel /a/ were used for collecting voice sample. Objective evaluation was done and the parameters assessed were glottal fry, falsetto, frequency range, soft voice, loud voice and intensity range. Additionally CAPE-V scale is been used for the perceptual evaluation of the voice sample .The results along with systematic objective reports will be discussed for these languages.

**3206**

**Distribution of F0 and pitch range in reading and conversation task among Indian tonal language**

Mathur, Nikhil; M, Deepthi; M.S., Deepa ; N.P., Nataraja

*University of Mysore, Mysore, India*

A handful study exists on tonal languages in India. However the distribution of F0 and pitch range during conversation and reading task has not been extensively studied. Hence an attempt is been made to study the F0 and pitch range in Indian tonal languages. Selected for the study were 20 Mizo and 20 Manipuri tonal dialect speakers; 10 males and 10 females in each group. Subjects were instructed to read a standard passage ( Rainbow Passage) and were involved in conversation in English. Additionally subjects were asked to read passage in Mizo and Manipuri languages respective of the groups. They were involved in conversation within the group members. These Voice samples were analyzed objectively and samples were compared within and between tonal and non tonal languages, and across gender. The results will be discussed in the light of existing literature.

3246

## **Are All Breathing Strategies Equal? An Acoustic Examination of “High” and “Low” Breathing Techniques for Singing.**

Meyer, David; Zeine, Lina; Bone, Amber

*Western Washington University, Bellingham, WA, USA*

Singing voice pedagogies universally stress the importance of proper breath management for healthy singing. Methodologies for teaching breathing differ: “low” (abdominal/diaphragmatic “down-and-out” breathing) vs. “high” (chest/intercostal “up--and-in” breathing). Titze and Hixon suggest that both strategies may be equally useful for the singing voice. In this study we will examine singing samples utilizing both breathing strategies in an attempt to determine their relative efficacies.

6 healthy male subjects (age 18-22) with no history of asthma were instructed in “low” (down-and-out) and “high” (up-and-in) breathing techniques. Subjects performed a 10 second sustained singing task in which pitch and dynamic levels were kept constant.

20 samples sung with each breathing technique were examined acoustically. Abdominal wall movement was measured in centimeters of change of abdominal circumference. The abdominal wall movement was correlated with the subjects’ MPT, pitch, and frequency stability measures for each sample.

Independent variable: the subjects’ abdominal wall movement. The dependant variables: MPT, pitch, and intensity stability. Controlled variable: Body type (ectomorph vs. endomorph) - 3 subjects in each type were selected.

Working assumptions include the following:

Increased MPT values = healthier phonation.

More stable pitch and intensity = healthier singing respiration.

“down-and-out” abdominal/diaphragmatic breathing requires large abdominal wall movement.

“up-and-in” high chest breathing requires little to no abdominal wall movement.

Abdominal wall stability = little/no change in abdominal circumference measurement.

3197

## Effect of vocal usage in vendors

M.R, Devika; N, Sreedevi; U, Navitha; Joy, Sweety

*University Of Mysore, Mysore, India*

**Introduction:** Vending has been a profession since time immemorial. Studies show that the largest concentration of vendors are in the age group 16-35 years. It indicates that vending involves enormous physical labor. There are a total of 10 million street vendors in India and 2.5% of the urban population is indulged in street vending. Vending is one such profession which demands extensive usage of voice. Vendors are invariably prone to develop voice problems due to invariable vocal abuse and misuse. There are very limited studies which throw light upon this population of voice users. This preliminary study intended to investigate the effect of vocal usage in vendors.

The purpose of this study was to analyze the vocal quality of professional voice users (vendors) both perceptually and acoustically after their vocal usage of minimum 10 hours.

**Method:** The group consists of 30 male vendors who were selected based on the years of experience of working as vendors. (Minimum of 8 yrs). All the subjects were asked to phonate /a/, /i/, /u/ in two different periods (before and after occupational voice usage of minimum of 10 hours). The samples recorded were analyzed for extracting the perturbation and temporal parameters using CSL 4500 and Multi-dimensional Voice Program software. The perceptual ratings of the voice samples were also carried out by five postgraduate students using voice profile given by Wilson.

The readings of all parameters showed deviation from the normative data and statistical analysis of the parameters was done and the results showed significant difference before and after voice usage for samples in all the eight measures of MDVP. Results will be discussed in the light of the existing literature.

**3194**

### **Comfortable effort level in adults and children**

Narra, Manjunath<sup>1</sup> N.P, Nataraja<sup>3</sup>

*1. student, Mysore, IN, India; 2. university of mysore, mysore, IN, India; 3. Proffesor, Mysore- 25, IN, India*

The variability in comfortable effort level has been evidenced to be controlling speech output in terms of vocal intensity, fundamental frequency and utterance rate as it was studied in adults (Brown, 1976;1995;1997) and in young children (Brown, Shrivastav,2007) separately. However, no such data are available for comparison between adults and children. The present study was conducted to compare the comfortable effort level for phonatory and speech task across five successive days for adults and children. The phonation and speech samples of adults (20 males and 20 females) in the age range of 18 to 23 years and children (20 males and 20 females) in the age range of 4 to 9 years were recorded. For each subject one sample on each of the five successive days were recorded. The only instruction to the speaker was to repeat the utterances at a comfortable effort level. The recorded samples have been analysed to obtain the frequency related measures and intensity related measures. Statistical analysis to note the differences between the adults and children in terms of comfortable effort level for frequency and intensity related measures have been carried out. The results were discussed with reference to the literature.

## Analysis of voice in wind instrument players

Narra, Manjunath<sup>1</sup> Jacob, Chinnu<sup>2</sup> Venugopal, Anju<sup>2</sup> M.S, Soumya<sup>2</sup> N.P, Nataraja<sup>3</sup>

1. student, university of mysore, Mysore, IN, India; 2. student, university of mysore, Mysore- 25, India; 3. Proffesor, University of Mysore, Mysore- 25, IN, India

Wind instrument players are specific group of individuals who present intensive use of vocal tract associated with blowing the instruments (Eckley, 2006). Weikert (1999) has reported that larynx participates actively while wind instrument playing by regulating the airflow and excessive constriction of neck muscles cause laryngeal dysfunction, thus wind instrument players are prone to vocal deterioration and fatigue followed by performance. The present study was undertaken to study the vocal characteristics of wind instrument players. The voice and speech samples from 20 adult male wind instrument players in age range of 20-40years with experience varying from 15-34years and 20 normal individuals with same age range were obtained. The samples were analyzed, to obtain the frequency, jitter and shimmer, harmonic to noise ratio related measures, maximum phonation duration, S/Z ratio and maximum sustained blowing. Statistical analysis was carried out to compare the values of acoustic and temporal characteristics of WIP and normal subjects. The results showed that there was a significant difference for Jitter, Shimmer, harmonic to noise ratio between WIP and normal subjects. There was no significant difference between WIP and normal subjects for frequency related parameters. There was a significant difference, in terms of maximum phonation duration, S/Z ratio and maximum sustained blowing in wind instrumental players when compared with normal population, the WIP showing higher values. Thus the study indicates that playing wind instrument over a period of time may lead to vocal fatigue and voice disorder.



## Laryngopharyngeal reflux and voice: The relationship between objective evaluations and quality of life measures

Nishizawa, Noriko K.<sup>1</sup> Oridate, Nobuhiko<sup>2</sup> Takeda, Hiroshi<sup>3</sup> Mesuda, Yasushi<sup>2</sup> Imagawa, Hiroshi<sup>4</sup> Fukuda, Satoshi<sup>2</sup>

*1. Department of Communication Disorders, School of Psychological Sciences, Health Sciences University of Hokkaido, Sapporo, Japan; 2. Department of Otolaryngology, Head and Neck Surgery, Hokkaido University Graduate School of Medicine, Sapporo, Japan; 3. Division of Pharmasciences, Faculty of Pharmaceutical Sciences, Hokkaido University, Sapporo, Japan; 4. Department of Otorhinolaryngology and Head and Neck Surgery, University of Tokyo, Tokyo, Japan; 5. Department of Otorhinolaryngology and Head and Neck Surgery, University of Tokyo, Tokyo, Japan*

**Background:** A voice problem is one of the most common laryngeal symptoms in patients with laryngopharyngeal reflux (LPR). Some studies have noted that objective signs may be poorly correlated to subjective symptoms in patients with LPR; it is not known whether, in patients with LPR, the frequent complaints of voice problems are truly associated with objectively detectable voice disorder.

**Objective:** To evaluate and compare objective voice ratings, scores and voice-related QOL in patients complaining of voice disorder with and without LPR.

**Methods:** Seventy-two patients complaining of voice symptoms were divided into two groups; the LPR group, comprised of 36 patients with clinically diagnosed LPR, and the control group, consisting of 36 patients without diagnostic criteria of LPR. Symptoms and signs at the first visit were compared between the two groups. Voice related QOL was evaluated using the voice handicap index-10 (VHI-10), objective perceptual voice rating was made using the GRBAS score, and acoustic parameters, PPQ, APQ, and NNEa, were calculated for the sustained vowel /e/.

**Results:** No significant inter-group differences were observed in mean scores for total VHI-10. The mean for the G parameter of the GRBAS score and acoustic parameters were found to be significantly higher in the control than in the LPR group. Correlations between the G parameter and acoustic parameters were significant in both groups. The correlation between G parameter and total VHI-10 was found to be significant in the control group, but not in the LPR group.

**Conclusions:** In patients with LPR, voice related QOL did not correlate with objective ratings. Therefore, the complaints of voice problems in LPR patients might not result from any objectively detectable voice abnormality itself.

## Comparing Self Perceptions to Subjective and Objective Measures of Femininity in Transgender Speakers

Owen, Kelly<sup>2</sup> Hancock, Adrienne B.<sup>1</sup> Siegfriedt, Linda L.<sup>1</sup> Brundage, Shelley B.<sup>3</sup>

1. *George Washington University, Washington, DC, USA*; 2. *George Washington University, Washington, DC, USA*; 3. *George Washington University, Washington, DC, USA*

Vocal feminization assessment and treatment knowledge is limited due to paucity of empirical research and relevant clinical experience. Currently literature recommends acoustic changes in the voice, such as pitch and second formant frequency change (Coleman 1970, Dacakis 2000, Gelfer and Schofield 2000, Gelfer 1999). However, the relationship between speaker and listener perceptions, important for social validity of vocal feminization treatment, remains unclear.

This study explores potential perceptual measures to use in assessment and treatment for vocal feminization of TG clients. More specifically, we compare listeners' perceptions of speech femininity to speaker's perception and fundamental frequency. Twenty-five second audio excerpts from picture descriptions by 30 male-to-female TG speakers living 100% of the time as female and 10 non-TG speakers were organized for ratings. Twenty-five naïve listeners in the Washington D.C. area rated the femininity and likeability of each sample. Transgender speakers self-rated their overall femininity, speech femininity and likeability of their voice. Data regarding the speaker's age, duration of vocal feminization treatment and transition process, Voice Handicap Index and the Transgender Self-Evaluation Questionnaire were also collected.

At this time, data collection is ongoing. Descriptive data and Pearson-product moment correlations will be reported. It is expected that TG speakers' self-ratings of overall and speech femininity will have a strong positive correlation to the listener's perception of speech femininity and a medium positive correlation to acoustic measures. We expand McNeill, Wilson, Clark, and Deakin's 2007 findings by enlarging the sample size and addressing American gender schema. This research may increase the importance of patients' self perceptions in voice feminization treatment, and expand standard treatment beyond acoustic goals to address constructs of femininity in verbal and nonverbal communication techniques.

**3007**

## **Effects of Nasalance on the Acoustic Properties of the Tenor Passaggio and Head Voice**

Perna, Nicholas

*West Virginia University, Morgantown, WV, United States*

This study aims to measure the effect that nasality has on the acoustical properties of the tenor passaggio and head voice. Not to be confused with forward resonance, nasality here will be defined as nasalance, the reading of a Nasometer, or the percentage of nasal and oral airflow during phonation. A previous study by Peer Birch et. al. has shown that professional tenors used higher percentages of nasalance through their passaggio. They hypothesized that tenors used nasalance to make slight timbral adjustments as they ascended through passaggio. Other well respected authors including Richard Miller and William McIver have claimed that teaching registration issues is the most important component of training young tenors. It seemed logical to measure the acoustic effects of nasalance on formant tuning in the tenor passaggio and head voice.

Eight professional operatic tenors participated as subjects performing numerous vocal exercises (e. g. scales, arpeggios) that demonstrated various registration events. These examples were recorded and analyzed using a Nasometer and Voce Vista Pro Software. Tenors did generally show an increase of nasalance during an ascending B-flat major scale on the vowels [i] and [u]. Perhaps the most revealing result was that six of seven tenors showed at least a 5-10% increase in nasalance on the note after their primary register transition on the vowel of [a]. It is suggested that this phenomenon receive further empirical scrutiny, because, if true, pedagogues could use nasalance as a tool for helping a tenor ascend through his passaggio.

**3115**

**Vocally Mature at Age Nine.....A "Field Report" on Children's Voices**

Pomfret, Bonnie

*Salve Regina University, Rehoboth, MA, USA*

Traditional activities for the pre-mutational voice included group singing in school and places of worship - folk and children's songs, - easy hymns and songs, responsories, accompanied by piano, guitar, or organ. Individual lessons were offered only to the most talented; others were redirected to instrumental music until the voice had changed by age 14-16 or even later.

Current practices in children's singing activities include middle-school "musicals" and group singing of music that is based on adult's pop music. Music for worship has moved away from traditional hymnody to "praise team" and contemporary Christian idioms based on adult pop sound, accompanied by amplified instruments or amplified digital media. The highest demand for voice lessons in most community schools and private studios is in the 9-14 age group. Talent shows on popular media, such as American Idol, America's Got Talent, further promote the adult pop music sound.

These developments would indicate that a review of the vocal health issues for the pre-mutational voice is in order. Children who are performing need voice training. Children who are subject to greater vocal demands are likely to need voice care.

Further actions may be necessary to help our youth maintain healthy voices as children attempt activities which are vocally demanding. These may include, but are not limited to, the development of a set of "healthy practice" guidelines for the child's voice, and the development of methods and appropriate materials for children who take voice lessons.

## Frequency characteristics in animal species typically used in laryngeal research

Riley, Jennifer L.<sup>1</sup> Carroll, Linda M.<sup>2</sup> Riley, William D.<sup>3</sup>

1. *Elias Howe School, New York, NY, USA*; 2. *Children's Hospital of Philadelphia, New York, NY, USA*; 3. *William Riley Studios, New York, NY, USA*

New treatment options are explored in the animal model prior to translation of techniques to humans. Despite the necessity of laryngeal research using bench and in vivo animal specimens, little is known of the frequency characteristics of animals prior to treatment. This study examines frequency characteristics of a domestic dog, cat, rabbit and guinea pig across several vocalization events. Laboratory species do not typically have pre-treatment recordings, and would not be expected to have the extent of F0 range due to environmental and behavioral limitations. Baseline description of frequency ranges in animals should improve interpretation and description of post-treatment acoustic characteristics in the live laboratory animal.

## **Yodelling - acoustic and physiologic properties**

Schlömicher-Thier, Josef<sup>1</sup> Miller, Donald G.<sup>2</sup> Noe, Hubert<sup>1</sup> Herbst, Christian T.<sup>3</sup>

*1. Austrian Voice Institute, Neumarkt, Austria; 2. EGGs for Singers, Roden, Netherlands; 3. Laboratory of Biophysics, Dept. Experimental Physics, Palacký University, Olomouc, Czech Republic*

Yodelling is sustained phonation with nonsensical combinations of vowels and consonants. It is characterized by drastic timbral changes, caused by (a) abrupt changes of laryngeal mechanism (chest vs. falsetto registers); and (b) typical choice of vowels. The register transitions coincide with relatively large intervallic leaps.

The goal of this study was to better understand physiologic and acoustic properties of yodelling. In particular, the relationship between voice source characteristics and the vocal tract was investigated. Two yodellers (one female, one male), originating from the Austrian regions of Salzburg and Styria, were examined by means of flexible video-endoscopy, electroglottography and recording of acoustic data.

Preliminary results suggest that formant tuning plays an important role in yodelling. It is hypothesized that yodellers intuitively choose certain combinations of fundamental frequency and vowel, in order to facilitate the abrupt changes of laryngeal mechanism that are typical for yodelling.

## **One year follow-up of the LAX VOX tube aided short voice therapy in the light of Voice Activation and Participation Profiles and a symptom questionnaire**

Sihvo, Marketta<sup>1</sup> Isotalo, Elina<sup>1</sup> Luukkaala, Tiina <sup>2</sup> Sukanen, Outi <sup>3</sup> Kleemola, Leenamaija<sup>2</sup>

*1. Phoniatic Department at Tampere University Hospital, Tampere, Finland; 2. Tampere University Hospital, Research Unit and Tampere School of Public Health, University of Tampere, Tampere, Finland; 3. Department of Finnish, Information Studies and Logopedics, University of Oulu, Oulu, Finland*

The benefit of voice therapy was studied questioning the patients about their opinions, in order to test essential aspects in conveying information of endurable voice production and personal voice care to patients. Dysphonic patients seek help and are motivated to accept the basic knowledge and a few exercises that keep them capable to work in speaking professions, and speak in occupational and social situations. A short biofeedback aided intervention was designed, basing on pedagogic knowledge. The outcome was studied in a clinical follow-up project. - The present study is focused on the 35 dysphonic patients who attended three to five therapy sessions and two follow-up meetings. The course of the sessions was similar to all; the training was aided with a feedback tool, a flexible 35 cm long LAX VOX tube, tipped into water. The participants filled in the Voice Activity and Participation Profile and a symptom questionnaire: pre- and post therapy, after six months and one year from the last therapy session.

The most common and strongest symptoms, voice fatigue, voice loss, hoarseness, need for throat clearing and laryngeal sensations were statistically significantly alleviated, and the voice dependent quality of life was statistically improved in many aspects. This study confirms that even three intensive sessions on voice care help motivated persons like professional speakers, to take care of their vocal health.

## **Correlation between clinician-based (GRBAS) and patient-based (VHI) documentation of voice in theologians**

Stephen, Sareena; Sunny, Vijitha; Rao, Suba; George, Sherin A.

*University Of Mangalore, Mangalore, India*

In the professional set up the theologians are often the victims of the vocal abuse because of their vocally taxing job. They may have to use their voice for long hours for preaching in the church, speaking loudly and changing tone continuously. Theologians, singers, actors etc are professions who use their voice vocationally which may involve misuse and abuse (James, 2003).

Perceptual assessment is the foundation of voice assessment and approaches for documenting perceived voice qualities have evolved from descriptive approaches to more concise coding systems. Many are designed for well-trained, experienced voice professionals while others are intended for untrained patient use.

If the clinician's perception of voice quality is like the patient's it may be assumed that rating of voice quality does not depend on the experience of producing it. However if it is the case that the experience of production influences the patients' perception, we may expect the clinician's ratings of quality to differ from those of the patients'. To compare and contrast clinician based (GRBAS) and patient based (VHI) documentation of voice quality in theologians. Voice sample were recorded from 10 theologians with age range of 35-55yrs with experience of 20-30yrs. Samples were taken before mass and after mass (pre and post). The voice samples were rated by five licensed SLP. The samples were presented to the clinicians in two different randomized order. The voice sample set for analysis was selected based on a) Conversational speech and b) The MPD to assess on the GRBAS scale. And the results were discussed in the light of the existing literature.



3035

## Mucosal Bridge

Tan, Melin; Pitman, Michael

*New York Eye and Ear Infirmary, New York, NY, USA*

**Introduction:** We present a patient with a novel finding of bilateral mucosal bridges, bilateral type 3 trans-vocal fold sulcus vocali and a vocal fold polyp. While sulci and mucosal bridges occasionally occur in the vocal folds, it is rare to find multiples of these lesions in a single patient and it is an even rarer when occurring with a vocal fold polyp. To our knowledge this is the first description of a vocal fold polyp in combination with multiple vocal fold bridges and multiple type 3 sulcus vocali in a single patient

**Objective:** To verbally describe and visually present the diagnosis and treatment of a patient with an intracordal polyp as well as bilateral mucosal bridges and bilateral type 3 sulcus vocali that completely traverse the mass of the vocal folds in a cranial-caudal direction.

**Methods:** Presentation of a set of high definition intra-operative photos displaying the extent of the vocal fold lesions and the resection of the intracordal polyp.

**Results:** This patient presented with only 6 months of significant dysphonia. It was felt the recent change in voice was due to the polyp and not the bridges or sulci. Considering the patient's presentation and the noted morbidity of resection of mucosal bridges and sulci, only the polyp was excised. Postoperatively the patient's voice returned to his acceptable mild baseline dysphonia and the benefit has persisted 6 months postoperatively.

**Conclusion:** The combination of bilateral mucosal bridges, bilateral type 3 sulcus vocali and an intracordal polyp in one patient is rare if not novel. Treatment of the polyp alone returned the patient's voice to his life-long baseline of mild dysphonia.

## Teachers' Knowledge of Issues Related to the Care of the Voice

Tellis, Cari M.<sup>2</sup> Bauman, Laura<sup>2</sup> Sofranko, Jessica<sup>2</sup>

*1. Misericordia University, University Park, PA, USA; 2. Misericordia University, Dallas, USA*

Teachers have an increased risk for developing voice disorders. There is a lack of research, however, concerning whether teachers have received education about the physiology and care of their voice. This education may reduce their risk of developing voice disorders. Based on pilot testing, a comprehensive 24-question survey was distributed to teachers. This survey examined whether teachers were aware of issues related to vocal care and vocal hygiene. Results of over 200 surveys indicated that the majority of teachers have not been instructed in the care and use of their voices but believe it is necessary to maintain proper voice use for teaching. Because these teachers are not aware of how to take care of their voices, they do not use aspects of vocal use and vocal health in their teaching. Most of the teachers who responded believe it would be beneficial to them to learn about issues related to vocal use, care, and hygiene. Many teachers who responded to the survey have also missed several days of work because of a voice related issue. Responses to this survey will hopefully contribute to an increased awareness of the need for teachers to learn how to care for their voices. This foundational knowledge about the voice may help to decrease the number of teachers who develop voice disorders.

3173

### **What Do Professional Voice Users Learn About Vocal Use, Care, and Hygiene Before Entering the Profession?**

Tellis, Cari M.; Bauman, Laura; Sofranko, Jessica

*Misericordia University, Dallas, USA*

Professional voice users, particularly teachers, have been found to have an increased risk for developing voice disorders (Roy, Merrill, Thibeault, Parsa, Gray, & Smith, 2004; Williams, 2003). There is a lack of research, however, concerning whether students entering speaking intensive occupations have received education about the physiology and care of their voice before joining the profession. This type of education may provide these students with a foundation in proper vocal use, care and hygiene thus reducing their risk of voice disorders. The purpose of this study was to determine whether university and college professors who teach speech communication, presentation skills, drama, or education include aspects of vocal use, care and vocal hygiene within their courses. A survey was distributed to communications, theater/drama, and education professors across the country. This survey examined whether these professors were aware of issues related to vocal care and vocal hygiene, if they included aspects of vocal care and proper vocal use in their courses, and if they believed that it was beneficial to their student population to include aspects of vocal care and use in their courses. Results of the survey indicated that 80% of respondents believe it is important to teach aspects of vocal use, care, and hygiene in their courses, however, only 30% indicated that they have enough knowledge about these aspects to include them in their course syllabi. The number of professional voice users who develop voice disorders may decrease if these individuals receive this foundational knowledge about vocal care and vocal health before entering the profession.

**3177**

**A survey about the oriental concepts used in Carnatic school of music.**

Thottungal, Santhosh S.; Niranjan, Avanthi; N.P, Nataraja

*University of mysore, mysore, India*

A survey about the oriental concepts used by the Carnatic School of music has been carried out using a questionnaire . seven teachers who are involved in training students in the Carnatic style of music, for more that 20 yrs were interviewed. The result indicated that the importance is placed on breathing techniques, body posture during singing, practice, identifying the basal pitch and voice rest during the training period.

Further the voice samples of 15 male and 15 female singers who had training under these teachers were recorded and analyzed along with a group of 30 controlled subjects (who did not have any training in singing), to find out the possible differences in the voice parameters, that is to find out the effect of training, on voice. The results have been discussed in the light of available literature.

3009

## **The Voice Handicap Index: A Translation and Cultural Adaptation to Puerto Rican Spanish Dialect and its Validation**

Villanueva-Reyes, Albert

*University of Puerto Rico, Medical Sciences Campus, Bayamón, PR, Puerto Rico*

The purpose of the present project is to translate, culturally adapt, and validate a Spanish language version of the Voice Handicap Index, a statistically robust instrument to quantify the psychosocial consequences of voice disorders. This work is of great importance for public health in Puerto Rico, since there exists a great need for a psychometrically robust voice disability/handicap inventory in the Spanish language spoken in Puerto Rico that could be used with patients that exhibit a variety of voice disorders in Puerto Rico and in United States. If a questionnaire or instrument is to be used in another country in a different language, translation and cultural adaptation are required. For the translation and adaptation of the Voice Handicap Index to Puerto Rican Spanish dialect, the cross-cultural adaptation process recommended by the American Academy of Orthopaedic Surgeons will be followed. Two forward translations to Spanish will be made of the original version of the Voice Handicap Index by two bilingual translators whose native language is Spanish. To assure that the translated version accurately reflects the item content of the original version, the instrument will be translated back into the English language. An expert committee will work on internal consistency reliability, will consolidate all the versions and components of the instrument, and will develop the pre-final version of the instrument for field testing. The validation process will consist of pre-testing and testing procedures followed by appropriate statistical analysis (Pearson product-moment correlation coefficient and Cronbach's alpha coefficient). Students will collaborate with the PI with pre-testing and testing procedures. Outcomes of this work are relevant to mission proposed by The Voice Foundation. Preliminary findings will be discussed.

**3017**

## **Descriptive study on voice parameters for Spanish-speaking adults**

Villanueva-Reyes, Albert

*University of Puerto Rico, Medical Sciences Campus, Bayamón, PR, Puerto Rico*

The aim of this study is to establish normative references for standard acoustic and physiologic voice measures collected from vocally healthy Spanish-speaking adults that can be used as a baseline to determine clinical relevance in diagnosing and treating voice disorders. Such baseline voice norms include average pitch, average intensity (loudness), pitch range, intensity range, and maximum phonation time. Establishing a normative voice database using our rigorous scientific design will provide a standard that voice clinics in Puerto Rico and throughout the United States wherever Hispanic populations are served, can use to reliably distinguish between healthy and disordered voices.

A total of 90 subjects with a healthy voice quality, 30 in each age group (15 males, 15 females), will be recruited for the proposed study. The three different age groups will be divided as follows: group A = 18 to 39 years; group B = 40 to 59 years; group C = 60 years or older. All participants will be speakers of Spanish and pass a pure-tone hearing screening as well as a voice screening. All recordings and analysis will be performed using The Voice Evaluation Suite™ (VES), by Vocal Innovations™, a program that automates collection, analysis, storage, and retrieval of significant voice measures. Standard statistical methods (means and standard deviations) will be used to analyze the acoustic data. Preliminary findings will be discussed and compared with previous studies with English-speaking groups.

## Stability, practice and stimuli selection in healthy adult voices

Vogel, Adam P.<sup>1</sup> Maruff, Paul<sup>1</sup> Fletcher, Janet<sup>2</sup>

1. *Centre for Neuroscience, University of Melbourne, Melbourne, VIC, Australia*; 2. *Linguistics and Applied Linguistics, University of Melbourne, Melbourne, VIC, Australia*

Obtaining true baseline measures of vocal functioning is essential for evaluating the impact of treatment, monitoring changes in disease state or capturing accurate single time-point recordings. Nevertheless, little research has systematically evaluated the effect of repeated vocal production. Due to the dynamic forces that underlie vocal production, acquiring acoustic data that is free from biological and technical error can be difficult. The current abstract details two experiments investigating the role of practice, stimuli selection and time of recording on the voice. The first study required 18 healthy adults to provide a combination of automated speech tasks (days of the week, counting from 1 to 20), a read passage (grandfather passage), extemporaneous speech, an alternating motion rate task (/papa/) and a sustained vowel task /a:/ five times in succession. This process was then repeated in a separate experiment requiring 18 healthy adult participants to complete the same speech battery every two hours over the course of an eight hour day (9 am - 5 pm). Broad measures of timing and frequency were derived from the acoustic data and measures of reliability (pearsons r) were calculated to highlight the stimuli and acoustic measures that remained stable over the course of five consecutive productions in both experiments. Aspects of timing (e.g., number of pauses) and frequency (e.g., f0) appeared to be consistent during both experiments, whereas measures of formant stability (e.g., F1 standard deviation) varied greatly from one recording to the next. These findings question a number of assumptions relating to vocal stability over short time periods and offer greater insight into the dynamic nature of the human voice.

## **Perceptual Profiles and Rating scales: Exploring the relationship between profile information and its implications for voice therapy**

Wallace, Samantha J.

*Ealing Hospital, London, UK*

In clinical voice work it is generally accepted that formal perceptual analysis of voice is an effective tool, allowing us to evaluate and organize auditory information. The variety and scope of profiles and descriptive terms continues to cause much debate. In the UK GRBAS(1,5) has been agreed as the minimum perceptual assessment tool for use by medical and SLT staff, and is widely used in North America.

This study aims to investigate the correlation between baseline assessments routinely administered in a hospital SLT voice therapy team, using the Voice Skills Perceptual Profile (VSPP),<sup>3</sup> Vocal Handicap Index (VHI),<sup>4</sup> and GRBAS as pre and post therapy measures. 10 Patients were recruited from a caseload over a one year period. Patients presented with a variety of laryngeal and vocal disorder diagnoses, excluding cases presenting with potential or known laryngeal carcinoma.

The 3 rating scale were administered at initial assessment and end of treatment. Data collected from the 10 patients was analysed to determine if there was any correlation between the scales. Each scheme were then investigated and compared to explore how they might-or might not-direct a pathway for practical voice therapy.

1 Hirano (1981)

2 Dejonkere et al (1993, 1996)

3 Christina Shewell (2005) Shewell C. (2009) *Voice Work: Art and Science in Changing Voices*. Oxford: Wiley-Blackwell(in press)

4 Jacobson et al (1997)

5 Carding P., Carlson E., Epstein R., Mathieson L. and Shewell C. (2001). Evaluation of Voice Quality. *International Journal of Language and Communication Disorders*. 36, 127-134.



3008

## Adaptation and Validation of the Mandarin Chinese Voice Handicap Index-10 in Taiwan

Wang, Nan Mai F.<sup>1</sup> Huang, Kuo You<sup>1</sup> Su, Mao-Chang<sup>1,2</sup> Hsin, Chung-Ham<sup>2</sup>

1. CHUNG SHAN MEDICAL UNIVERSITY, Taichung City, Taiwan (Republic of China); 2. Chung Shan Hospital, Taichung city, Taiwan (Republic of China)

**Objectives/Hypothesis:** The Voice Handicap Index-10 (VHI-10) is one of the most psychometrically robust, well-studied, and efficient instruments among the various instruments for measuring self-perception of voice related quality of life. However, the psychometric properties of the Mandarin Chinese version of VHI-10 remains untested. This study aimed to investigate such properties of the Mandarin Chinese version of the VHI-10 in Taiwan.

**Study Design:** Psychometric analysis of the Mandarin Chinese VHI-10 was performed among voice disordered and normal control subjects to reach validation of the Mandarin Chinese version VHI-10.

**Methods:** The original VHI-10 was translated into Mandarin Chinese and was performed by 176 patients with voice disorders and 70 normal control subjects. 32 patients were retested within three weeks. Results : Results showed that test reliability ( $\alpha=.861$ ), test-retest correlation ( $r=.720$ ;  $p .001$ ) and significant item-total correlation for Mandarin Chinese VHI-10. Mandarin Chinese version could be used to distinguish different dysphonic groups and between voice disordered and non-disordered subjects. Test-retest reliability and internal consistency were also found among the Mandarin Chinese VHI-10.

**Conclusions:** the Mandarin Chinese VHI-10 is a powerful and applicable instrument to quantify patients' perception of their voice handicap in Taiwan.

## Characterization of Elastic Fiber Distribution in the Mouse Vocal Fold

Watts, Christopher R.<sup>1</sup> Marler, Jeffrey A.<sup>2</sup> Urban, Zsolt<sup>3</sup>

1. Texas Christian University, Fort Worth, TX, USA; 2. James Madison University, Harrisonburg, VA, USA; 3. Washington University School of Medicine, St. Louis, MO, USA

Mice are excellent animal models for use in translational research due to the similarity of the mouse and human genetic codes, the similarity of numerous biological systems and structures, the ease of genetic manipulation, fast rate of development, and ease of care. While similarities between the gross morphology of mice and human thyroarytenoid structure have been noted, until recently no mouse model for studying vocal fold proteomic structure had been validated. In 2007 Abdelkafy published findings demonstrating similarities between the mouse and human vocal folds with relation to the distribution of collagen and hyaluronic acid, and the changes which take place in these substances during aging. The purpose of this study was to further investigate the relatedness of the mouse and human vocal folds in order to build on the argument for their use in translational research of the proteomic environment within vocal fold tissue.

We stained 5 young (4 weeks) and 5 mature (15 weeks) male and female murine vocal folds for elastin, in addition to collagen. We asked the following questions: (1) Are elastic fibers present within the vocal fold tissue of mice, and if true, (2) Is the distribution of elastic fibers within mouse vocal folds similar to that of humans? We will present data which verifies that elastic fibers are present in mouse vocal folds although their distribution is different from that in human vocal folds (a similar finding in other animal models). We will also present arguments to account for these differences and further argue for the beneficial use of the mouse to study the characteristics of vocal fold histological structure in normal, genetically altered, and medically treated vocal folds.

## Effect of Voice Disorders on Adolescents' Physical/Social Concerns & Career Decisions

Weinrich, Barbara D.<sup>1,2</sup> Brehm, Susan B.<sup>2</sup> Pack, Megan<sup>1</sup> Kelchner, Lisa N.<sup>3</sup> de Alarcon, Alessandro<sup>4</sup>

1. Miami University, Oxford, OH, USA; 2. University of Cincinnati, Cincinnati, OH, USA; 3. Cincinnati Children's Hospital Medical Center, Cincinnati, USA; 4. Cincinnati Children's Hospital Medical Center/University of Cincinnati, Cincinnati, USA

**Objectives:** The purpose of this study was to identify how airway reconstruction and voice characteristic differences affected the physical/educational/social concerns of adolescents, as well as their career decisions.

**Methods:** Experimental participants, ages 14-18 years, were randomly selected from the Cincinnati Children's Hospital Medical Center otolaryngology airway reconstruction surgery database of 200 patients, and determined to meet inclusion criteria (minimum one year post-laryngotracheal reconstruction (LTR) with voice disorder and ability to perform a telephone survey). Control participants were recruited from a local high school. They had no history of LTR or voice disorder, and were educational grade and gender matched with experimental participants. Before the participants were interviewed, appropriate permission by the guardians and assent by the participants was given to the interviewer.

**Results/Conclusions:** There were 32 participants (16 experimental; 16 control), with 20 males and 12 females, in high school grades 9 through 12. Responses to the 31 survey questions were recorded for participants and summed for each group. A two-sample t-test was used to compare mean score values between experimental and control groups in the areas of physical/educational concerns, social concerns, career decisions, and overall voice rating. Analysis revealed a significant difference between the experimental and control groups in the areas of physical/educational concerns ( $t=-4.56$ ,  $p=0.00$ ), social concerns ( $t=-3.81$ ,  $p=0.002$ ), and overall voice rating ( $t=-2.45$ ,  $p=0.21$ ). There was marginal difference between groups in the area of career decisions ( $t=-1.75$ ,  $p=0.092$ ). The lack of significant difference in career decisions could be due to the fact that, as teenagers, they had not yet formulated thoughts regarding career options or did not perceive that their voice would impact their ability to perform specific career choices.

## **An acoustic-perceptual study of voice tremor**

Wingate, Judith M.; Chheda, Neil; Shrivastav, Rahul

*University of Florida, Gainesville, FL, USA*

The purpose of the study was to examine essential vocal tremor perceptually to determine how much tremor must be present in order for listeners to detect it and how a change in the fundamental frequency variation relates to perceived tremor.

Essential vocal tremor is described as an intention tremor of the vocal folds which causes fluctuations in fundamental frequency and intensity that correspond to an unsteady voice (Warrick et al, 2000; Dromey et al, 2002). The primary treatment for vocal tremor is Botox which has been shown to be somewhat beneficial (Adler et al, 2004). The overall goal of treatment is to minimize the perceived tremor in voice. However, since the acoustic signal is non-linearly related to the perception of pitch, intensity and quality of the voice, it is possible that success of treatment may be better defined by the perceived tremor in the voice, rather than the actual variation in fundamental frequency and/or intensity. This study sought to determine how much reduction must occur in the acoustic variations in fundamental frequency for listeners to perceive significant changes in tremor .

Voice recordings of persons with vocal tremor were subjected to systematic reduction in tremor amplitude and frequency through the use of speech re-synthesis algorithms. The resulting output was rated by listeners for overall severity of voice quality and overall severity of vocal tremor. A comparison of the perceptual ratings was made to perceived changes in vocal quality following Botox injection.

**3163**

**Laryngeal tremor: association with other movement disorders**

Wolraich, David; Marchis-Crisan, Cristina; Khella, Sami; Mirza, Natasha

*University of Pennsylvania, Philadelphia, PA, USA*

Tremor is the involuntary skeletal muscle contraction that leads to an oscillatory movement. It can affect a single muscle (thyroarytenoid) or groups of muscles. Laryngeal Tremor (LT) has been associated with benign essential tremors, but to date, there is limited epidemiologic information regarding LT and its association with other movement disorders. We performed a retrospective chart review of 24 patients with the diagnosis of LT seen in a voice disorders clinic over a 3 year period. Of the patients who presented with LT, almost 80% had an associated movement disorder. Of these patients, 25 % had generalized tremor, and 33% had head and neck tremors including orofacial dystonias. Otolaryngologists may be the first to evaluate a patient for tremors. It is important to consider other movement disorders when examining patients with LT as a full neurologic assessment and treatment of other tremors may be beneficial.

**3059**

## **A study on the vocal mechanism of the sentence focus in Mandarin Chinese**

Yoon, Kiduk; Kong, Jiangping

*Dep. of Chinese language and literature, Peking University, Beijing, China*

There has been much acoustic study on the language prosody, but relatively little research has been conducted on the vocal mechanism of the natural speech prosody.

Our investigation considers the vocal mechanism variation of the sentence focus which plays a big role in the natural speech prosody system of Mandarin Chinese, the unique tone language.

We use one sentence in which a target syllable is placed each at focus and non-focus position, and have participants read naturally. We get 2 channel recordings, one for speech sound and the other for EGG signal. To analyze the vocal mechanism, parameters of F0 and OQ measured from GCI (Glottal Closing Instance) and GOI (Glottal Opening Instance) on the DEGG signal are extracted. Other parameters of prosody features, including intensity and duration of speech sound, are also measured, and all these parameters are classified and compared into two groups according to the existence of focus.

The result shows that at the focused syllables, the overall variation range of F0 and OQ are higher than those of the unfocused. Also, the EGG signal of focused syllables shows the various types of combination and transition among the 5 typical vocal registers used in real speech, such as high tone, breathy, modal, pressed and vocal fry.

These results call attention to the relationship between the vocal mechanism and the various constituents of the natural speech prosody in need of further investigation.

**Vocal characteristics of Japanese Noh singing voice**

Yoshinaga, Ikuyo<sup>1</sup> Kong, Jiangping<sup>1</sup>

*1. Department of Chinese language and literature, Peking University, Beijing, China; 2. Peking Univ, Beijing, China*

This study focuses on vocal characteristics of Noh, which is one of the Japanese traditional theatrical performances. To reveal the voice mechanism of Noh's phonation type, acoustical and electroglottography (EGG) signals of singing and speech are recorded. 2 males and 2 females of Noh professional singers of the Hosho school are involved in this recording. Recording covers a range over an octave, starting at about F#2 (92Hz) for male and E3 (164Hz) for female subjects. For acoustical analysis, Long-term average spectrum (LTAS) of speech signal and source signal measured by LPC inverse filtering are used. Open quotient (OQ) parameter is extracted from EGG signal using Kay real time EGG. The result of acoustical analysis shows that more energy concentrates on the singer's formant region in singing voice. The LTAS of source signal also shows more energy at high frequency range in singing voice. The EGG analysis shows OQ of singing voice is lower than that of speech. These results support Noh's singing voice is produced by pressed phonation type. Furthermore, EGG signals with double or multiple peaks are commonly observed in singing voice. To analyze these particular signals, we define its contacting and de-contacting events by means of DEGG.

3006

## **An Investigation into the Prevalence of Voice Strain in Chinese University Teachers**

Zhou, Gang; Niu, Xiaochun

*School of Foreign Languages, Dalian University of Technology, Dalian City, China*

Vocal disorders are very common occupation-related disease in teachers, though they have never been given enough attention in China. Teachers are among those individuals at greatest risk of developing vocal problems. This risk has been attributed to the factors such as vocal abuse and misuse due to the vocal demands of teaching, the poor acoustic environments in which teachers work, environmental conditions of school facilities, the lack of vocal education and training, length of career, types of teaching, and even factors related to the individual's emotional state, such as stress and anxiety.

The aim of the present study is to assess the prevalence of voice problems in the general population of Chinese university teachers, and explore whether their voice problems affect their daily life, their social life and their work. A voice strain and voice handicap index questionnaire was administered to university instructors of English (N = 156) in six Chinese universities. Results indicate that voice strain is prevalent among Chinese university instructors. The respondents' self-perceptions reveal that voice strain is significantly correlated with their job and their daily activities. The findings demonstrate consistently that teachers experience self-reported voice problems at a high rate. But results reveal that gender and different age cohorts do not affect teachers' self-perceptions of voice problems. The findings also reveal that voice strain is prevalent among Chinese university instructors, and they believe that they have to drink water when they lecture, and that taking breaks during lectures of more than an hour helps reduce their voice strain.

Key words: voice strain; vocal disorder; factor analysis; multiple regression; MANOVA



**3241**

**Employing motor learning principles in the studio to maximize the effectiveness of traditional training techniques**

Roth, MM, MA, CCC-SLP, Douglas F.

*University of Pittsburgh, Pittsburgh, PA, USA*

The transfer of vocal skills learned in the studio to performance on the stage is sometimes elusive or not as rapid as desired. When skills demonstrated one week during a lesson are not observed in subsequent weeks, it is often assumed that the student has not maintained an adequate practice regimen. While this is certainly often true, this lack of skill retention can also be seen in students who practice regularly. We as teachers can further facilitate the retention and transfer of our students skills by framing our instructional techniques around the principles of motor learning.

This workshop will be an interactive demonstration of the application of the motor learning principles to any number of pedagogical techniques which are regularly used in the teaching of singing. Attendees are encouraged to participate . The workshop will focus on how the instructions and feedback used in the studio can be shaped and reworded in a way that complies with the principles of motor learning.

**3109**

### **Functional Therapy Options for Vocal Fold Bowing**

Michael, Deirdre D.

*University of Minnesota, Minneapolis, MN, USA*

Otolaryngologists often refer to vocal fold bowing as “presbyphonia,” telling a patient that the condition is a natural consequence of aging, even for active voice users in their 50’s and 60’s. They may offer vocal fold augmentation procedures to close the glottic gap. Speech-language pathologists, on the other hand, are likely to view vocal fold bowing as a functional problem, and recommend speech therapy. However, they may view the disorder as a form of “hypofunction,” when the underlying cause of the disorder may actually be “hyperfunction.” In this voice specialty clinic, patients are seen who have been treated unsuccessfully for bowing, with functional therapy and/or vocal fold injections. It is often clear that the unsuccessful treatment used a single technique or approach. A multi-pronged approach, using a variety of exercises to differentially relax or strengthen extrinsic and intrinsic laryngeal muscles, can often provide greatly improved voice quality. An approach used frequently in this clinic is to use singing-mode exercises to find a more balanced modal register, or “chest voice” production. Even patients with no experience singing can use these exercises successfully. Collagen injections may be used to aid the functional treatment.

This workshop will explore a wide variety of exercises and techniques, often seemingly contradictory, that can be used successfully in treating patients with vocal fold bowing. The use of register-adjustment exercises will be especially highlighted. This session will be interactive, so that other clinicians can share their favorite techniques and strategies. Criteria for use of collagen will also be discussed.

**3225**

### **Balancing consonant and vowel effort in reducing dysphonia**

Carroll, Linda M.

*Children's Hospital of Philadelphia, New York, NY, USA*

Dysphonic patients have distinct awareness of reduced vocal function and increased effort with achieving adequate phonation. Speech requires coordination of consonants and vowels, often at rapid rates. During singing tasks, increased attention is often paid to the quality of vowels. Many dysphonic patients demonstrate discoordination of the CV events of phonation. Speech pathologists generally focus on tonal placement of vowels but ignore the significant impact of consonant tonal placement. Increased attention to consonant placement and acoustics can improve phonatory demands of the vowels, and permit improved quality of sound. Increased attention to consonant energy can also help unload the laryngeal demands during vowel production, allowing transfer of acoustic energy from consonants to vowels. Improved balance of consonant and vowel energy can reduce dysphonia and improve clarity of voice for both speaking and singing

**3226**

## **The Mellow Sound of Black Gospel Singing: Another View**

High, Ronald H.

*Benedict College, Columbia, SC, USA*

Black gospel singing has become widespread since its origin at the hands of Thomas A. Dorsey, the "Father of Gospel Music" and the composer of "Precious Lord, Take My Hand." Listeners of this music have associated this style of singing with a fusion of blues, jazz, R&B, and even hip-hop elements. In terms of the vocalism that many black gospel singers use, one can often notice a pushed and throaty production, which can result in hyperfunction that may be detrimental to the instrument. Evidence of this overuse of the voice manifests itself in the vibrato rate, hoarseness, and visible tension in the neck, face, and other parts of the body. Reasons for these apparent problems are, perhaps, due to the fact that gospel singers want to capture the soulful expression of this genre of music-making in an effort to inspire audiences and relate the gospel message in song.

This presentation will consist of a discussion of vocal techniques and performance practices of selected singers of black gospel music, who demonstrate the "mellow sound" of this genre, yet remain true to the authentic style. The lecturer will give a brief overview of gospel music history and discuss how vocal styles emerged, developed, and changed to meet the demands of the times, including the venturing out of gospel music from the black church to secular venues, the commercializing of gospel music, the promoting of gospel music through the recording industry, and the globalizing of the genre. Time will be allotted for audience participation in singing a gospel song. The lecturer will also make pedagogical recommendations for the teaching of gospel singing in the academic setting.

## **Assessment and Management of Collegiate-Level Musical Theater Vocal Injuries**

Rosenberg, Marci D.<sup>1</sup> LeBorgne, Wendy D.<sup>2,3</sup>

*1. University of Michigan; Vocal Health Center, Ann Arbor, MI, USA; 2. The Blaine Block Institute for Voice Analysis and Rehabilitation, Dayton, OH, USA; 3. The Professional Voice Center of Greater Cincinnati, Cincinnati, OH, USA*

The incidence of vocal injury during a rigorous vocal training program is extremely high due to the physiological demands placed on student vocal athletes during a typical four-year pre-professional training period. Management of these voices requires a unique skill set. This includes an understanding of the nature and rigors of both the pre-professional training process, and of the symptoms and injuries commonly seen in these patients. Additionally, clinicians must have knowledge and experience working with this specialized population to facilitate expedient rehabilitation of vocal injury. The University of Michigan and The University of Cincinnati-College Conservatory of Music produce some of the most hired musical theater performers of any undergraduate program in the nation. This workshop will provide a collaborative effort from both institutions on the role of the voice pathologist for musical theater vocal injuries. Participants will be exposed to topics relevant to this population including include common vocal injuries in collegiate musical theater performers, assessment of injury impact on performance, and strategies for both remediation and transition back into performance.

**3102**

**Applying Theatre Voice Training Techniques to Voice Therapy**

DeVore, Kate

*Total Voice, Inc., Chicago, IL, USA*

Many theatre voice training approaches are based on principles and modalities that are relevant for voice therapy. This workshop will focus specifically on two of those elements: experiential training and emphasizing the body-voice connection. Experiential training, or learning by doing as opposed to talking about something, is a key principle in both theatre voice training and therapeutic voice training. The body-voice connection includes awareness of kinesthetic sensations; exercises focusing on this type of mindful awareness can be helpful for voice clinicians. Drawing on work influenced by Arthur Lessac and other eminent theatre voice trainers, the workshop will explore exercises and paradigms that are directly applicable to voice therapy.

(Please note, in case you have seen another submission by me, I originally submitted a different topic, to be presented by myself and Starr Cookman. But she discovered a conflict so I am withdrawing that one and submitting this one myself. Thanks!)

3238

## **What Do I Do With a Voice Like That?: An Ears-On Approach to Teaching the Countertenor Voice**

White, Jay

*DePauw University, Greencastle, IN, USA*

Although people in the United States are hearing performances of countertenors, many still find the unique sound and character difficult to understand. While voice professionals are typically familiar with the Fach, many of them have had little experience in discerning what a “good” countertenor sound is, how to develop such a sound, and, to put it plainly, knowing where to begin when dealing with this unique voice type. It is my belief that the fundamental physical production of respiration, phonation, and resonance to achieve a healthy, classical sound applies to every voice. It is my hope that through proper application of these principles, all in attendance will hear that a countertenor, while rare, is simply a voice responding to good vocal guidance just as any other. In this 45-minute workshop, after conducting a coaching with a countertenor myself, I will guide two teachers of voice through a modified master class scenario with two countertenor students. We will begin with a brief, 5-minute introduction followed by the first singer’s performance. During this 10-minute coaching, I will point out the necessary things to listen for in determining a viable countertenor sound and guide the singer through some exercises based on what I have heard. The remaining two countertenors and two master teachers will then have 10-minutes each to work with each other. During their coachings, I will provide feedback, if necessary, to help ensure a positive educational experience for each participant. We will conclude the workshop with a 10-minute Question and Answer period.

A copy of this abstract was sent to Peggy Baroody along with a additional details.

**3207**

**Body Mapping: Practical Applications in the Singing Studio**

Hoover, Sarah A.

*NATS, NYSTA, Voice Foundation, Pi Kappa Lambda, Mu Phi Epsilon , Cold Spring Harbor, NY, USA*

This workshop will introduce the discipline of Body Mapping and demonstrate how it can be applied to the teaching of singing. Performers hindered by poor movement quality, insufficient body awareness, and excess physical tension cannot perform expressively or master technical challenges and may be subject to performance-related injury. Neuroscience offers singing teachers an important key for unlocking these potentially career-threatening problems: the discovery and exploration of body maps in the brain which govern sensory awareness and movement. These highly adaptable maps are subject to change in response to injury, experience, training, and practice. The discipline of Body Mapping - the study and refinement of these body maps - provides singers with the resources to clarify misconceptions that may result in physical problems. This hands-on demonstration will relate technical problems commonly encountered in the singing studio to underlying erroneous or incomplete conceptions of the body's functional anatomy and suggest Body Mapping strategies for use in the studio.



**3076**

## **LAX VOX Tube - A Tool for Care, Cure and Education**

Sihvo, Marketta<sup>2</sup> Denizoglu, Ilter<sup>1</sup>

*1. Alsancak Hospital ENT Dept. Voice Clinic, Izmir, Turkey; 2. Phoniatic Dept of Tampere University Hospital, Tampere, Finland*

The aim of voice therapy is to find the best way to produce voice within the patient's anatomic and physiologic capabilities. Among numerous methods, Sihvo's Lax Vox Method (LV) 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.

The procedure automatically balances the functions included in voice production. It also gives biofeedback and creates holistic cognition of the vocalizing process. The main mechanism of the LV technique is the altering of the vocal tract inertance due to positive supraglottal pressure and artificial elongation of the vocal tract. The 'domino effect' goes with lowering the larynx and proper abdomodiaphragmatic respiration.

The LV technique suits all speakers and singers desiring to learn vocal ergonomics and voice care. It is a useful therapy for various functional and organic voice disorders such as muscle tension dysphonia, vocal fold nodules, habitual and psychogenic dysphonia or aphonia, unilateral vocal fold paralysis, and presbyphonia. It is also an effective method for pre- and post-operative voice therapy.

The aim of this workshop is to perform live practice with the participants after the theoretical explanations so that they can experience the effects of this easy tool, and use it to trigger the healing process in any voice patient or voice trainer.

**3020**

**Common Denominators between Dance Techniques and Voice Training for the Actor**

Melton, Joan S.

*retired/self employed, New York, NY, United States*

In 2007-08, voice-movement specialist Joan Melton and London-based physiotherapist Jane Grey conducted pilot studies, using ultrasound imaging, to determine the specifics of abdominal muscle activity in efficient breath management for a variety of vocal tasks. Subjects ranged from singing teachers to West End performers to non-performers. In the second stage of this project, the research team is focusing on common denominators between dance techniques and voice training for the actor, with special emphasis on musical theatre performance.

In this participatory workshop, attendees will be invited to experience a range of vocal activities while engaging in physical movement that relates directly to dance. In addition, they will have the opportunity to observe visual documents from the presenter's research.

Participants should wear comfortable clothing that will allow them to move easily.

**3090**

**Trigger points, myofascial release, and the voice, a practical introduction**

Asher, Benjamin F.

*none, New York, NY, USA*

Myofascial pain and trigger points are a cause of vocal dysfunction. This workshop will be a practicum to teach voice professionals what to look for in evaluating their students/clients/patients. Physical examination of the neck muscles and rudimentary palpatory skills will be taught to gain an understanding trigger points and how to diagnose them.

**3032**

**Applications of Semi-Occluded Vocal Tract Postures in the Singing Studio**

Nix, John P.

*University of Texas San Antonio, San Antonio, TX, USA*

Semi-occluded vocal tract postures play a prominent role in many types of voice therapy. Several of these postures can be readily applied to singing voice training. The author's presentation will discuss the physiological, acoustical and pedagogical benefits of these postures, and will include ample time for demonstration and participation by workshop attendees.

**3071**

## **Crossover from Classical to Musical Theatre**

Weekly, Edrie M.

*Shenandoah University and Conservatory of Music; Contemporary Commercial Music Vocal Pedagogy Institute, Fairfax, VA, USA*

It has been quite difficult to become a successful crossover singer. For a singer to be successful, they would need to cross train the vocal production muscles creating laryngeal flexibility while maintaining good vocal health.

Opera singers have performed or recorded contemporary styles many times over the past 50 years. Sometimes it has been successful and at other times has failed due to classically trained singers trying to incorrectly emulate the style or sound. Opera diva, Eileen Farrell is one who successfully crossed over in her blues recording as well as Julia Migenes Johnson in her recording of Man of La Mancha.

It is also important to recognize there are and have been classical composers who have written music to be sung with different vocal qualities. For example, in *Così fan tutte* Mozart composed the role of Despina to disguise her voice twice, virtually allowing the singer to produce three different vocal sounds. Contemporary classical composers such as Stewart Wallace have written operas that included jazz and musical theatre belt singing.

This workshop will examine specific techniques and exercises for developing the crossover voice in a "hands on" experience. The audience will listen to excerpts of successful and unsuccessful crossover recordings. This interactive workshop will invite classically trained volunteers from the audience who would like to crossover to musical theatre singing.