

## **Surgical Medialization with Silastic Implant for Unilateral Vocal Fold Immobility; 35 Years Experience**

Objective: Chart review of 483 patients with unilateral vocal fold immobility, comparing short and long term voice results for medialization vs combined medialization and reinnervation, managed by the author over a 35 year period.

Methods/design: Videostroboscopic evaluations were reviewed regarding preinterventional status and voice outcomes after surgery by speech and language pathologists.

### Results:

Medialization with Silastic implant

N= 351

Paralysis/Paresis = 217

Cricoarytenoid Joint Immobility = 124

Voice “normal” = 190

Voice “much better” = 144

Voice improved, but not satisfactory = 17

Combined reinnervation and Medialization with silastic implant

N=132

Paralysis/Paresis = 128

Voice “normal” = 116

Voice “much better” = 14

### Conclusions:

Vocal fold paralysis/immobility can be managed by adjustment of the cartilage skeleton, repositioning of the vocal fold(s) and/or reinnervation. Combined medialization and reinnervation has been effective in achieving better long term voice results in unilateral paralysis.

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## **Development of Patient Oriented Voice Disorder Management System**

**Objective:** Established the voice disorder management system is an evidence based, patient centered to improve care for individuals with voice disorder and provide support for their caregivers. The system is that productive, patient-centered interactions between informed patients and knowledgeable teams across the care continuum can lead to optimal outcomes and patient self-management support.

**Methods:** A novel computer based on Browser/Server mode is adopted in the system. It adopts Java Server Pages (JSP) technique and Tomcat of the runtime environments, SQL Server 2000 as backstage supporter's database .With the friendly mutual interfaces, it has applied to patient with help of the physicians in the out-patient. The data which we want includes basic information, previous history, symptoms and signs and inspection. The data will be organized into some questions in the web page. Then the choice of the questions will be saved into the database by the JDBC (Short for Java Database Connectivity)

**Results:** The patient orient voice management adopt of effective web application platforms and appropriate project management methodologies. The system is self-management support protocols, and delivery system to manage the individual needs of patients. The management system includes patient and clinician education, explicit evidence-based care plans, expert care availability, patient self-care, counseling, comprehensive patient tracking, calendaring features and monitoring of outcomes.

**Conclusions:** Patient oriented voice disorder management is implemented by the following multidisciplinary team members. Voice disorder management improves patient adherence to treatments and disease control compared with usual care and relies on patient education and reminders, and clinician education and feedback. Thus, the team offers services tailored to patients' needs and preferences rather than attempting to provide a specific treatment to all subjects regardless of their preferences or needs.

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## **Current Status of Intracordal Injection of Basic Fibroblast Growth Factor for Vocal Fold Scar and Atrophy**

**Introduction:** Basic fibroblast growth factor (bFGF) has a regenerative effect of dermis and epidermis with a strong angiogenetic effects. Basic FGF has also proved to increase production of hyaluronic acid from the vocal fold fibroblasts, which is suitable for regeneration of the vocal fold in case of vocal fold scar and atrophy. The present retrospective study reports the current status of bFGF injection therapy for the vocal fold.

**Materials and Methods:** Forty cases with vocal fold atrophy (24 cases) or scar (16 cases) have been treated with transcordal injection of bFGF. Injection was basically repeated 4 times with interval of 1 week between each injection. Follow up periods were 3-72 months (mean 15 months) in atrophy cases and 3-48 months (mean 14.8 months) in scar cases. Maximum phonatory time, voice handicap index (VHI)-10, and GRBAS scale were evaluated.

**Results:** MPT, VHI-10 and GRBAS were significantly improved in both atrophy and scar cases. The degree of improvement in each parameter shows no significant difference between atrophy and scar cases. When success is determined by the improvement of VHI-10 more than 5 (Gartner-Schmidt J, 2010), the success rate for atrophy and scar cases were 89% and 73%, respectively. Mild to severe hyperemia was observed in 10 of 24 cases in atrophy, and in 11 of 16 cases in scar. All of them were resolved within a few months. Recurrence of atrophy or scar occurred in 3 of 24 cases and 2 of 16 cases, respectively (12%). Recurrence occurs at 12-36 months in atrophy cases, and at 36-48 months in scar cases.

**Conclusion:** Intracordal bFGF injection was effective for both atrophy and scar cases, and no significant difference was observed in the degree of improvement between both groups. However success rate seemed to be higher in the atrophy cases. Recurrence occurs in 12% with no difference between both pathologies. More effective delivery system is now under research.

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## **Inter-Rater Reliability in Analysis of Laryngoscopic Features for Unilateral Vocal Fold Paresis**

### **Objective**

The diagnosis of paresis in patients with vocal fold motion impairment remains a challenge. In particular, laryngoscopy examination may result in significant disagreement in diagnosis among providers. We hypothesize that systematically evaluating for a standard set of clinical parameters will increase the diagnosis concordance among providers.

### **Methods**

Two laryngologists (rater 1) and two trainees (rater 2) rated laryngoscopic findings in 19 patients suspected of paresis. The diagnosis was confirmed with laryngeal EMG. A standard set of 27 ratings was used for each examination that included movement, laryngeal configuration and stroboscopy signs. A Kappa co-efficient was calculated for agreement in laryngoscopy findings and effectiveness in predicting the laterality of paresis.

### **Results**

A substantial agreement (kappa coefficient  $>0.61$ ) existed between the raters for vocal fold length, vocal fold thickness, bowing, and reduction in movement. A moderate agreement (kappa coefficient  $> 0.41$ ) existed between raters for pyriform opening and reduced kinesis. The senior author was accurately able to diagnose the side of paresis in 89.5% of cases for a kappa coefficient of 0.78, while the trainees correctly predicted the side of paresis in 63.1% for a kappa coefficient of 0.35. The raters agreed on the diagnosis in 73.7% of cases for a kappa coefficient of 0.50.

### **Conclusions**

Using a standard set of laryngoscopic findings improved the provider's ability to identify the laterality of vocal fold paresis and increased inter-rater reliability compared to other series.

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## The Ventriloquist: A Double Voice or a Double Language?

A voice from elsewhere, the ventriloquist: is the magician of the voice

Ventriloquist: a strange word indeed! In Greek, he's called *egastrimitos*: from *gaster*, stomach and *mythos*, speech - the spoken voice of the stomach. Yet who has ever seen stomach articulate words... His set lips give the illusion of a voice coming from elsewhere. to manipulate vowels and consonants, cheating is often necessary

The formation of vowels and consonants depends on the shape of the buccopharyngeal and respiratory tract. This contortionist of the larynx owes his talent to his fast neurological control over this zone, and to his lung capacity. The ventriloquist can't form all the vowels and consonants the same way, so how can he cheat?

Whereas Christian, the ventriloquist, smacks his lips together to voice consonants, Freddy, his puppet, can't benefit from this gesture. The most problematic consonants are *p, b, f* and *m*. These professionals find *c, d, g, k, n, q, s*, and *x* relatively straightforward, whereas articulating *r, t, v*, and *z* is a little trickier.

A genuine language evolves for the puppet: *barrier* becomes *varrier*. *Formidable* becomes *hormidable*. Your brain immediately corrects the fraudulent letter. When Freddy sings 'The singer from Mexico', he pronounces it *-Nexico*, but the auditory illusion is perfect, you hear 'Mexico'.

The ventriloquist learns what amounts to a second language. His reflex, when the puppet is speaking, is to replace certain consonants with others that are so close to the original ones that you don't notice the switch. We substitute the missing consonants instinctively, subconsciously. Our left brain will understand and decode words that aren't actually those pronounced by the ventriloquist.

What we understand is more important than what we hear: the auditory illusion is based on a readjustment on our part that can go as far as verbal anticipation.

### Two characters and two different languages.

The artist is at the height of his art when there's perfect harmony between his gestures and his *voices*. His right hand manipulates the puppet. He remains facing his public. His lips never move. His face, his eyes look surprised when the puppet talks. Christian cocks his head as if to better hear Freddy. And in a fraction of a second, the repartee is given.

This technical talent gives a perfect illusion of the two characters. The artist becomes 'a double voice'. This split-off in the cerebral integration of the voice is remarkable. This double voice exists only because it's supported by a double cerebral projection of the characters played.

The ventriloquist has created a trio: puppet - ventriloquist - spectator

All these ventriloquists that I've been able to observe have a common denominator: a perfect mastery of the two, even three, or four voices they use. The speed with which they switch from one to the other in their question and answer game is mind-blowing, just amazing.

Is there a dualism of the brain? Does Ventriloquism require an apprenticeship from childhood? Is there a physical or intellectual predisposition for it? Is it a gift, or a quest for one's inner self? The Ventriloquist is a multilingual interpreter,

The interpreter has controlled his brain in two different directions: for reception and for transmission, with extremely short latency. This faculty requires regular practice. These professionals' concentration is remarkable, and they translate into their mother tongue, of which they master perfectly the syntax and linguistic subtleties. Doesn't this come close to what the ventriloquist does? I must also point out that given the resonators required for this art of the voice and of magic, a good ventriloquist must have reached puberty. Today, this magician of the voice entertains us, yesterday, he was the representative of dark forces, he communicated with the dead who spoke through him, and he predicted the future. Hippocrates sketches an explanation of *egastrimitos*. Ventriloquism is the soul's voice uttered by an internal force.

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## The Ventriloquist: An Athlete of the Vocal Tract

A voice from elsewhere, the ventriloquist: is the magician of the voice  
 The same exhalation, whether it's Freddy or Christian  
 The vocal instrument, framework of the laryngeal acrobat  
 Freddy speaks. The laryngeal muscles, the lateral muscles of the soft palate and the uvula play a preponderant role. They tighten and give this part of the pharynx a tube-like appearance.

### Two techniques of ventriloquism

The near voice

When the ventriloquist uses his near voice, the puppet is close to him.

- It is produced by positioning the tongue in a particular way. When Christian speaks normally, his tongue is flat, the voicings pass over it, one could say, mostly flowing through the mouth and lips, partially through the nose.
- When the artists speaks in Ventriloquism, he inverses these forces by arching his tongue and rounding the base of the tongue, thus bringing it into contact with the uvula and the posterior part of the soft palate.
- The tongue is shaped like a dome at the back, in contact with the soft palate. The tip of the tongue is relatively low, two to three millimeters from the lower teeth.

Thus, the vibrations flow mostly through the nose and only partially through the mouth. This dual exit via the nose and mouth creates ambiguity in that the spectator can't tell very well where the sound is coming from, and this reinforces the sense of illusion. You can get an idea of this by pronouncing the letter *G*, as in *Gang*. This is why many puppets have a nasal voice. videofibroscopy is completed with three-dimensional radiology imagery. Thus, the work carried out with Doctors Albert Castro and Rodolphe Gombergh gives us a better understanding of the workings of the vocal apparatus of ventriloquists, and of its muscular, articular and osseous functions. Observing it with a scanner, we're at liberty to focus on any specific tissue.

- We catch the muscular contractions of the tongue and pharynx, of the soft palate and lips. We reveal the jointed agility of the membrane between the thyroid and the cricoid cartilages, between the cricoid and arytenoids, within that astonishing bony trampoline, the hyoid bone, from which the heads of the lingual muscles surge upwards.

Spectrography provides analyses of the different acoustic prints and the speed with which the ventriloquist switches from Freddy's head voice to Christian's chest voice. In a few fifteenths of a second, two distinct spectral identities are formed, and yet they're one and the same.

The ventriloquist's lung capacity is comparable to that of great singers or great tragedians.

Being able to switch rapidly to this alternative lingual position is something the ventriloquist has to practice over and over.

Good control of the lips also comes from regular practice. He rehearses mostly in front of a mirror. However, occasionally, if he's tired, he'll turn his head slightly to fake the consonants *b*, *p*, *f*, *m*, *v*. The vowels can only be produced by contorting the tongue and the buccopharyngeal muscles.

I had just understood one aspect of the enigma of how the ventriloquist forms words: he creates lips behind his lips.

The distant voice

His operational mode is different.

The distance voice makeup :

- He curls his tongue inside his mouth to enable the sound to echo.

- He creates a buzz, in other words a movement to and fro of the harmonics in his buccal cavity. The voice is damped. The vocal cords shorten, but are very rounded, and the timbre is relatively high-pitched.
- The pharyngeal muscles on each side of the larynx contract violently.
- The hyoid bone rises and is almost level with the mandible.
- The tongue is almost clamped to the roof of the mouth.
- The larynx tips forward. The frequency of the voice is variable, deep or high. It's like a breathy voice.
- Thanks to the tongue, the resonators are able to create a second resonance chamber inside the mouth, hence the echo. Due to this double resonance, the voice seems to come from elsewhere, from the depths of the abyss, from the ceiling, from the other side of the wall. The timbre is low and muffled.
- Here too, the ventriloquist creates lips behind his lips thanks to the shape he gives his tongue and to its position in relation to the soft palate and uvula.
- The contraction of the abdominal muscles is an important facilitator of his excellent control over the phonatory exhalation.

This magician of vibration makes us dream, yet his impressive agility has still not been entirely elucidated. This theatrical art and magic overtakes on our spirit into the intangible dimension of the illusion of harmony.

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## **Diagnostic Prevalence and Industry of Patients Presenting with Dysphonia in the United States**

**Background:** Dysphonia may result from a number of distinct acute or chronic laryngeal conditions. This study presents an overview of all key diagnoses affecting speech, their relative prevalence and the patient demographics, location and occupations for each key diagnostic category.

**Study Design:** US Retrospective claims database analysis.

**Methods:** The MarketScan Commercial and Medicare database were queried for this study. Patients presenting with ICD-9 diagnoses associated with dysphonia were grouped by main disease type (i.e., vocal fold paralysis, paresis, undefined dysphonia, acute and chronic laryngitis, malignant and benign laryngeal neoplasms, vocal fold polyps, laryngeal spasm, laryngeal edema and other vocal cord diseases). The total prevalence of each condition in 2012 was estimated using the MarketScan projection methodology and for each disease type, the patient demographics (age, gender), payer status and occupation were analyzed.

**Results:** Approximately 2.6 million patients presented with dysphonia due to one of the disease types evaluated herein. Laryngitis represented 60.5% of all cases (acute: 54.7%; chronic: 5.8%). The second largest category included patients with dysphonia only (21.1%). Laryngeal cancer only affected 4% of all patients (malignant: 2.7%, benign: 1.1%). Overall, the service industry employed 29% of all patients, followed by manufacturing (21%) and transportation industry (18%). These ratios were similar across all disease type except for malignant larynx neoplasm, which included 38% patients from manufacturing industry and only 16% from service industry.

**Conclusion:** Dysphonia due to laryngeal conditions affects nearly 1% of the US population. Service and manufacturing industry are strongly represented in this patient population. More research is required to understand the relative high prevalence of patients from manufacturing in the malignant neoplasm category.

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### **Correlation between Acoustic, Stroboscopic and Clinical Vocal Evaluation in Patients with Vestibular Pathology, Before and After Vestibular Rehabilitation**

The voice is a fundamental communication instrument in inter-human relations. The personal, professional and emotional success of an individual is connected with/ depends upon the ability to express one's self appropriately.

In order to have an optimal vocal performance, it is essential to have good postural alignment.

Maintenance of a normal body posture depends on having an adequate retrieval of information from the vestibular apparatus, the visual and proprioceptive systems, as well as the assimilation of this information by the central nervous system leading to creation and realization of an adequate musculoskeletal response. Although there are countless studies that correlate postural changes and changes in vocal quality, there has never been a study investigating correlation between balance disorders (vestibular, visual or proprioceptive changes) and voice.

**Objective:** Determine whether patients with balance disorders present with any clinical, acoustic or endoscopic vocal changes (even if asymptomatic or unperceived), and if correction of the balance impairment such as through the vestibular rehabilitation leads to improvement in vocal quality. **Study**

**Design:** Prospective, observational and longitudinal study. **Methods:** Analyze the vocal differences (clinical, stroboscopic, and acoustic vocal parameters) in a population of patients with vestibular dysfunction in three different periods (pre-treatment, post-treatment and 3 months post-treatment), diagnosed by videonystagmography with changes on the Computerized Dynamic Posturography (CDP), who have been treated with vestibular rehabilitation.

**Results:** In this moment there are 25 patients participating in the study, recruitment will end on December 31<sup>st</sup>. The study will be concluded in March 31<sup>st</sup>.

**Conclusions:** The verification of this hypothesis will have direct implications on clinical practice. If so, evaluation of patients with vocal pathology should include more objective global evaluation of posture and balance, using specific tests such as the videonystagmography and CDP.

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## Psychogenic Dysphonia versus Psychogenic Movement Disorders

In literature of the recent past, psychogenic dysphonia refers more to the term psychogenic aphonia (the loss of voice) than dysphonia, in the absence of apparent structural or neurological pathology. It is a disorder seen more often in women and is usually associated with significant life events and emotional difficulties that may lead to conflict over speaking. Psychogenic dysphonia has been a controversial diagnosis throughout most of the 20th century, like the diagnosis psychogenic movement disorders (PMD) and conversion disorders (CD) in the field of neurology and psychiatry. Modern neuroscience increasingly supports comprehensive biological models for the complex disorders PMD and CD by functional magnetic resonance imaging studies focused on the amygdala activity.

### Material:

This retrospective study set out to describe the profile of 530 patients with symptoms of psychogenic voice disorders and/or alterations like sudden loss of onset, restriction of the upper register and diminished dynamic. We saw all these patients in the period between October 1996 and September 2014. They were examined by videostroboscopy and a short psychotherapeutic anamnesis was done when we saw a long posterior glottal gap and supraglottic hyperfunctional activities in the videostroboscopy without signs of organic voice disorders. We recommended all these patients for a psychotherapeutic intervention and voice therapy.

### Discussion:

Sigmund Freud argued that in conversion disorder (CD) the affect attached to stressful memories is "repressed" and "converted" into physical symptoms. In the life events profile of our patient, we found childhood abuse-related posttraumatic stress disorder (PTSD), co-morbid depression, anxiety, disorders of personality, stress disorders a.o. During clinical examination the long posterior glottal gap and the supraglottic hyperfunctional activities were, in our experience, useful "red flags" for underlining the suspected diagnosis of psychogenic dysphonia and had a clear connection to a pathological life events profile. In the view of the modern neuroscience studies, the authors postulate that we can understand the psychogenic dysphonia more with the hypothesis and model of the neurobiological mechanism of psychogenic movement disorders (PMD) and conversion disorders (CD), as several animal studies and functional magnetic resonance imaging studies have shown. The authors will present some cases and the results of a group of patients after the psychodiagnostic examination and psychotherapy.

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**Office-Based Laser Assisted Posterior Cordotomy under Local Anaesthesia using Transnasal Flexible Laryngoscope for Bilateral Vocal Fold Paralysis**

Laser assisted Posterior cordotomy using microlaryngeal suspension laryngoscope under General anesthesia is a widely accepted technique for the surgical management of bilateral vocal fold paralysis. In certain situations where suspension laryngoscopy could not be negotiated and in patients with poor cardiopulmonary status who could not accept the risk of general anaesthesia an alternative procedure is essential. So we designed a novel technique of Office based laser assisted posterior cordotomy under local anaesthesia using transnasal flexible laryngoscope with working channel and Diode Laser. All the patients had comfortable airway and acceptable voice 2months after decannulation following this procedure.

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### **Botulinum Toxin- A for Treatment of Contact Granuloma**

**OBJECTIVE:** Contact granuloma has been associated with voice abuse, laryngopharyngeal reflux and habitual throat clearing. It has a high propensity for persistence and recurrence. Treatment options included voice therapy and anti-reflux measures. Surgical excision has been considered in patients who do not respond to medical management. In this research we aimed to present our experience with botulinum toxin injection only.

**METHOD:** Our series consisted of 22 patients, who underwent botulinum toxin injection only as an outpatient procedure to bilateral thyroarytenoid muscles in 2.5 to 5 Units. No other treatment was applied. The cases were followed up for at least 6 months ranging between 6-100 months with a mean of 28.

**RESULTS:** Seventeen cases (77%) were cured of their granuloma. Eleven of the cured cases had grade II, 4 cases had grade I and 2 patient had grade III granuloma.

**CONCLUSIONS:** Botulinum toxin A injection only is an efficient treatment modality in contact granuloma, especially for grade I-II cases.

**Keywords:** laryngeal granuloma, vocal cords, botulinum toxin-A, arytenoid cartilage

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### **Microtrapdoor Flap Technique for Treatment of Laryngeal Stenosis: Experience with 34 Cases**

**Aim:** Laryngeal stenosis is the most challenging disorder for the laryngologist to treat. Microtrapdoor flap technique was described in 1980's, however, it has not been popular since then. The reason may be the difficulty of the technique. In this study we will report our experience with microtrapdoor flap technique to treat laryngeal stenosis of 34 patients.

**Materials and Methods:** Twelve males and 22 females make up our study group. Their mean age is 43 with a range of 9 to 73 years. One patient had supraglottic stenosis and the others had glottis stenosis. Technique involved medially based triangular mucosa excision with CO2 laser and scar tissue excision deep to this triangle until below the lowermost level of stenosis. Mucosa of medial base of triangle is carefully preserved; it is cut in the middle vertically towards subglottis until below the stenosis. Anteriorly and posteriorly based mucosal flaps are obtained. These flaps are sutured with 6/0 vicryl to the apex of triangle. If necessary, the same technique is performed on the other side too. The patients are required to have at least one year postoperative follow-up.

**Results:** The etiology of laryngeal stenosis includes: 19 cases due to failed surgery for bilateral vocal fold paralysis; 7 cases due to microlaryngoscopy (3 laryngeal papilloma, 1 leukoplakia excision, 1 glottic cancer excision, 1 foreign body extraction, 1 biopsy from interarytenoid region); 4 cases due to prolonged intubation; 1 case due to laryngeal fracture, 1 case due to vertical laryngectomy, 1 case due to smoke inhalation (burn) and 1 case congenital or idiopathic.

Seventeen patients had tracheotomy. All seventeen of them were decannulated 2 months postoperatively. All 34 patients were dyspnea free on exertion one year postoperatively.

**Conclusions:** Microtrapdoor flap technique is a successful surgical option for treatment of laryngeal stenosis.

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## **Intralaryngeal Botulinum Toxin in Severe Vocal Cord Dysfunction**

### **Objective**

Vocal cord dysfunction (VCD) is a syndrome characterized by paroxysms of glottic obstruction due to true vocal cord adduction resulting in symptoms such as dyspnea and noisy breathing. Patients are usually treated with proton pump inhibitors, respiratory retraining and psychotherapy. The objective of the study is to describe the management of patients with severe VCD that do not respond to usual treatment.

### **Methods**

Retrospective study including patients with severe VCD despite standard treatment.

The diagnosis of VCD was made by symptoms (crisis of dyspnea) and confirmed by video laryngoscopy during an episode.

Variables studied were demographics, video endoscopic findings, laryngeal electromyography and received treatment.

### **Results:**

6 patients were included. Mean age was 43 years. 82% were women. All patients had episodes of dyspnea with stridor. Video endoscopic examination showed paradoxical vocal fold movement in all cases. Laryngeal electromyography ruled out neurogenic injury of laryngeal nerves.

Initial treatment was made with proton pump inhibitors, respiratory retraining and psychotherapy. All patients received botulinum toxin in the thyroarytenoid muscle after failure of previous treatments, followed by respiratory rehabilitation and psychotherapy.

Initial improvement of symptoms was achieved with one single dose of botulinum toxin in all cases. 2 patients needed a second one and 1 patient continued with severe crises that required a tracheostomy.

### **Conclusions:**

Botulinum toxin, along with respiratory training and psychotherapy, is useful for severe vocal cord dysfunction in most patients.

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## **Management of Thyroarytenoid Muscle Paralysis as Partial Recurrent Nerve Paresis**

**Purpose:**

To propose the diagnosis and management of thyroarytenoid muscle paralysis (TAMP) cases.

**Materials and Method:**

Eight cases of idiopathic TAMP, present for 2 years, are reported. Despite normal adduction and abduction of the vocal folds, apparent paralysis was seen in only the thyroarytenoid muscle. TAMP was confirmed by EMG, and movement of the arytenoid cartilage was evaluated using 3DCT and endoscopic findings.

**Results:**

Although two of the eight cases recovered with conservative treatment, TAMP persisted in five cases. Four vocal folds of those five patients were treated with hyaluronic acid injections. Surgical nerve-muscle pedicle flap transfer was performed in one case, resulting in good postoperative vocal function.

**Conclusions:**

Not a few TAMP cases were misdiagnosed as a voice mutation disorder or vocal fold atrophy etc. Physicians should continue to improve management and treatment of partial recurrent nerve paralysis.

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## **Laryngeal Disorders May Represent the First Symptoms of Serious Systemic Diseases**

**Objective:** Some patients represent their laryngeal disorders as the first symptoms of their serious systemic disorders. Although it is uncommon to see such cases in daily clinical practice, these diseases must not be overlooked. The purpose of this presentation is to warn all the multidisciplinary team members involved in laryngeal management, not to have the biased view to pay attention only in the larynges.

**Methods/Design:** Case reports.

**Results:** Case 1, 75 y.o., male, hypothyroidism (HT). He visited our institution with hoarseness, lack of energy, and poor concentration for 3 years. His arytenoids were edematous and his vocal quality was G2R2B1A0S0. Blood test represented serious HT. He was consulted to endocrinology division and hormone replacement therapy achieved the normal blood data in 2 months. His vocal and general condition showed complete recovery 9 months after diagnosis. Case 2, 30 y.o. male, myasthenia gravis (MG). He was consulted to our department with inarticulate vocalization and dysphagia for 8 months. Although his laryngo-pharyngeal findings were not severely disturbed at his first visit, velopharyngeal incompetence and tongue movement disorder became apparent during repeated evaluations performed by speech-language pathologists. He was consulted to neurology division and diagnosed as MG. Improvement of his laryngo-pharyngeal symptoms were observed after pyridostigmine and steroid medication 4 months after diagnosis. Case 3, 65 y.o., female, mucous membrane pemphigoid (MMP). She was consulted to our institution with erosive lesions in oro-pharyngo-laryngeal area for 1 year and 7 months. Multiple ulcerations were observed in the supraglottis, soft/hard palate, and gingiva at her first visit. She was consulted to dermatology division and diagnosed as MMP. Disappearance of the lesions was observed 5 months after diagnosis by combined medication of azathioprine, steroid, and cyclosporine.

**Conclusions:** Systemic diseases should always be kept in mind as one of the pathologies to induce laryngeal disorders for precise patient care.

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## Surgical Treatments for Spasmodic Dysphonia

### Objective

Type II thyroplasty (TPII) and thyroarytenoid muscle myectomy (TAM) are surgical treatments for adductor spasmodic dysphonia (adSD). In this study, we compared the efficacy between TPII and TAM.

### Methods

Sixty five patients treated surgically since March 2008 to November 2012 were included. TPII was performed on thirty cases and TAM on thirty five. We evaluated the efficacy using voice handicap index 10(VHI10) and perceptual voice evaluation "strangulation, interruption, tremor and breathiness" before surgery and six months after surgery.

### Results

Both surgeries improved VHI10 and perceptual voice evaluations with significant difference except breathiness. In preoperative severities there were no significant difference between the two treatments. Postoperative strangulation, interruption and tremor were better and breathiness was severer in TAM than TPII with significant difference. There was no significant difference in postoperative VHI10 between TPII and TAM.

### Conclusions

Although TAM is more effective to control spasmodic symptoms, it makes breathiness worse than TPII. Both are useful operations for adSD.

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## **Thyroplasty Implant Dimensions: Evaluation of a Predictive Model in Cadaver Larynges**

### **Objective**

Medialization thyroplasty is a frequently performed using silastic block implant prepared during surgery. In order to facilitate the best outcome for patients, it would be useful to have an accurate predictive model to detail the block dimensions. Ideally, this model would provide a reliable effective medialization of the affected vocal fold and reduce preparation time. A recently developed predictive model based on CT scan analysis of laryngeal anatomy and desired medialization position was developed. This model also accounts for vocal fold tissue compression in thyroplasty. The purpose of the study is to evaluate vocal fold medialization when using the predictive model to determine the block dimensions in excised cadaveric larynges.

### **Study Design:**

Cadaver model experimental

### **Methods:**

Ten excised cadaver larynges (5M, 5F) were subjected to helical CT scan before and after silastic block placement. Block dimensions were calculated based on a predictive formula from CT scan measures.

### **Results:**

The results show adequate medialization with an average predicted correction of 6.5 mm for women and 8 mm for male larynges in the study. However, it may be more appropriate to utilize this model with window positioned less than 8 mm posterior to the midline of the thyroid ala. When the model is applied to windows placed more posteriorly, the implant may be too short for mid fold correction.

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## **The Prevalence and Risk Factors for Kindergarten, Elementary and Middle School Teachers in Tianjin, China**

### **Objective**

The objective of this program was to investigate the prevalence and the risk factors of voice problems for teachers in Tianjin from a 47805 sample size study. This is the first time to report the risk factors and effects of teachers' voice problems in such large sample size in Tianjin (over 193 thousands teachers in Tianjin), China.

### **Method**

There are 47805 teachers involved in this study. A 47 questionnaires were collected, an integrated physical exam of ENT and the strobolaryngoscope were performed on the teachers. The living habits, working environment, teaching experience, phonation habits, teaching characteristics, health condition, voice symptoms, and physical discomfort were involved. Logistic regression was used to find risk factors and effects of voice problems for teachers.

### **Results**

The prevalence rate of voice disorder was high in teachers, and 69.4% subjects suffered from different kinds of voice diseases. According to the regression coefficients, OR, and 95% C.I. for OR, the teaching experience, class capacity, acid regurgitation, gender were the mainly risk factors for teachers' voice problems. The risk would be increased if the teaching experience raises 1.014 years, the class capacity raise 1.011 students, the acid regurgitation raise 0.818 level. The female teachers were more vulnerable to the voice diseases.

### **Conclusion**

These results imply the need for a preventive voice care program for teachers, including limitation of the class capacity, dietary habit changes and regular voice examinations.

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## Long Term Clinical Outcomes of Pulsed Dye Laser Treated Sulcus Vocalis

**Objective:** Sulcus vocalis is a condition caused by a groove at the free edges of the vocal folds. Previously we have reported the efficacy of treating sulcus vocalis with pulsed dye laser (PDL) and named the specific surgical procedure PDL glottoplasty. The aim of this study is to present the long term effects of PDL in the management of sulcus vocalis with special emphasis on the morphologic and voice outcomes.

**Study Design:** Prospective clinical research.

**Methods:** This study was conducted on 36 patients diagnosed with sulcus vocalis by videostroboscopy at the Gangnam Severance Hospital Otorhinolaryngology Department between August 2006 and December 2013. Energy delivery was fixed at 0.75 Joules (J) per pulse, and each vocal fold was administered 60 to 110 pulses (average 72.5 pulses) during each procedure. Aerodynamic, stroboscopic, and acoustic voice analyses were performed before and after the operation. All patients received continuous voice therapy or singing therapy starting from 3 months after the operation and all have been followed up for at least 12 months.

**Results:** Generally, the initially pathologic vocal folds showed decreased stiffness, resolution of previous scar formation and improved mucosal wave properties after treatment, resulting in improved vibration and dysphonia. In the objective voice analysis, most patients who underwent PDL glottoplasty showed improvement in several postoperative voice analysis indices. The differences between preoperative and some postoperative voice parameter indices were statistically significant.

**Conclusion:** PDL glottoplasty can be an effective and beneficial treatment option in the management of sulcus vocalis. Objective measurements of voice quality and normalization of vocal fold vibration and morphologic changes of scar formation improved after PDL treatment in most cases. Further studies with larger numbers of cases and longer follow-up periods would be required to establish this as a promising treatment method.

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## **Patient Experience with Laryngeal BOTOX for Spasmodic Dysphonia: An 18 Year Experience at the Cleveland Clinic Voice Center**

### **Objective:**

This paper will present a review of the Cleveland Clinic experience in the treatment of Spasmodic Dysphonia with laryngeal Botox injections over an 18 year period. A statistical analysis of the information will be accomplished in order to inform the expectations of caregivers and patients relative to the treatment of Spasmodic Dysphonia and thereby improve patient's informed consent for participation.

### **Methods/Design:**

For each patient injection, identical information related to patient experience was obtained, including the presence, onset and duration of side effects (voice and swallowing), the onset of benefits, a rating of best perceived level of benefit, the onset of the decline in benefits, and the timing of reaching pre-treatment baseline. The dose of Botox, and the rationale for changes in dosage were recorded. The protocol for injection was consistent as well, including participation of a PhD SLP, an RN, and an MD laryngologist. The database will be developed from the above information and will be studied via descriptive statistics to obtain useful long term patient experience.

### **Results:**

A 10-year prior pilot study on some of this information was published in the fall, 2014 Advances in Otolaryngology & Dentistry newsletter of the Cleveland Clinic Head & Neck Institute, and covered more than 1200 patient injections. Our patients enjoyed a more tolerable side effect profile, greater duration of benefits, and larger percentage who received benefits. The satisfaction expressed by our patients is consistent with the standard-of-care status of Botox injections.

### **Conclusions:**

These pilot study results changed the counseling we offered prospective patients with spasmodic dysphonia. We anticipate that including all patients from an 18 year experience will further refine expectations and therefore patient counseling. The expanded data base will facilitate a study of dosing trends over time, and differences among injectors. This study will fill the need for long term objective documentation of patient experience relative to the treatment of Spasmodic Dysphonia with laryngeal Botox.

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### **Surface EMG Differences Between Classical Singers and Belters**

**Objective:** The differing resonance strategies used by classical singers and belters would suggest different patterns of laryngeal muscle recruitment, but this has not been well characterized in the literature. This paper uses surface electromyography (sEMG) and transnasal laryngovideostroboscopy to evaluate significant differences in muscle recruitment between these 2 types of singers.

**Methods:** Healthy volunteers, both amateur and professional, with training as either a belter or a classical singer who sing predominantly in one or the other style are asked to sing music from their standard repertoire as well as standard exercises while connected to sEMG electrodes. The electrodes are placed over different muscles and transnasal laryngovideostroboscopy is recorded throughout the entire session.

**Results:** Preliminary results show a significant difference in muscle recruitment on sEMG with belters engaging their omohyoid muscle as they ascend into their upper register compared with classical singers who engage very little of their omohyoid. Conversely, the classical singers engage significantly more cricothyroid activity as they ascend while belters show very little. In the classical singers, the cricothyroid sEMG signal was synchronized with their vibrato.

**Conclusion:** This early data suggests that omohyoid muscle activity is substantially higher in belters compared with classical singers and that sEMG may be an effective modality for detecting this difference. Understanding this muscular strategy may help singers who perform in all contemporary commercial musical styles to reduce potentially harmful compensatory strategies and reduce the potential for injury.

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### **Occupational Noise Exposure in College Level Teachers of Singing**

**Objective:** Occupational noise exposure has been well studied in different types of professional and amateur musicians. To date, no literature has looked at noise exposure among teachers of singing. Most voice studios are smaller rooms and well trained classical singers produce high sound pressure levels capable of being heard in large halls without amplification. This paper seeks to evaluate the noise exposure experienced in the studio setting by classical teachers of singing at the college level and to evaluate a potential health risk.

**Methods:** Full-time college-level teachers of singing are recruited and loaned a noise dosimeter to wear throughout their normal teaching day. These data are then analyzed for periods of unsafe noise exposure and overall exposure during a normal working day.

**Results:** Preliminary results have shown that while there are periods of exposure to high sound pressure levels in the studio, the overall daily dose approximates but does not reach unsafe levels of exposure.

**Conclusion:** While additional exposures incurred by these teachers while in teaching in the choral, rehearsal and performance settings are not included in this study, the close approximation of the overall daily studio noise exposure in our sample to unsafe levels may suggest that teachers who have studios with more powerful voices may benefit from taking precautions against chronic noise exposure.

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### **Surface EMG Differences in States of Vocal Fold Dehydration**

**Objective:** Recent studies have shown that vocal fold dehydration leads to differences in properties of the mucosal wave and quality of phonation. At this time, there is no literature examining how singers and speakers attempt to compensate during periods of vocal fold dehydration. This paper used surface electromyography (sEMG) to measure differences in extrinsic muscles of phonation between normal and dehydrated vocal folds.

**Methods:** Subjects are instructed to drink 1 liter of hypotonic solution 90 minutes prior to their sEMG session. During their session, they are asked to execute a sustained [a] vowel, arpeggios, and normal speech and singing while connected to sEMG electrodes placed over extrinsic laryngeal muscles. After these baseline measures are taken, the subjects breathe dried air for 20 minutes and repeat the same task. Before and after measures are compared using a paired t-test.

**Results:** Preliminary results after dehydration show increased mean activation and increased mean peak activation in thyrohyoid and omohyoid during the sustained [a] task. The spoken passage, arpeggios, and singing were not significantly different.

**Conclusion:** Extra-laryngeal muscles demonstrate increased activation during sustained vocalization in a state of vocal fold surface dehydration. This compensatory strategy may predispose to vocal fold injury during prolonged performance in the dehydrated state.

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### **Xylitol Lozenges for Vocal Fold Dehydration**

**Objective:** Vocal fold dehydration is a subject of much ongoing research, yet no literature has examined possible treatments. Xylitol is an over-the-counter mucolytic commonly used for xerostomia. This paper seeks to evaluate whether xylitol can improve vocal function in the context of vocal fold surface dehydration or systemic dehydration.

**Methods:** Healthy volunteer subjects undergo high speed laryngeal imaging and objective voice measures including subglottic pressure, peak to peak amplitude, and the voice parameters included on the KayPentax Multidimensional Voice program (MDVP). The measurements are taken after an overnight fast, and repeated after 20 minutes of xylitol disc hydration. During a separate session, after routine eating and drinking and 90 minutes after ingestion of 1L of isotonic solution, baseline hydrated objective voice measures and high speed imaging are collected. The measurements and imaging are then repeated after the subjects breathe dried air for 20 minutes and again after adding xylitol disc hydration for 20 minutes. Paired comparison t-tests are made for all measures.

**Results:** Preliminary results suggest that xylitol may improve objective measures of vocal function in the context of dehydration with a more pronounced effect on surface dehydration.

**Conclusion:** Xylitol may be an effective adjuvant to vocal therapy by mitigating the effects of dehydration and thereby improving overall vocal function.

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## **Correlational Study of Laryngopharyngeal Reflux Symptomology and the Voice Range Profile in Singers**

Laryngopharyngeal Reflux (LPR) is a prevalent health concern that has been a topic of debate among health care professionals for decades. Voice symptoms associated with (LPR) can be particularly debilitating for singers. Objective measures of the singing voice that correlate with LPR symptoms may improve the diagnosis and treatment of affected singers, but as of yet such measures have not been reported in the literature.

The voice range profile (VRP) has been shown to be sensitive to subtle changes in the singing voice, particularly when captured with spaced calibrated microphones such as in the Voice Profiler System from Alphonson medical systems. We hypothesize that LPR symptom severity may positively correlate with decreased pitch- and dynamic-range, a raised phonation threshold, and an increase in noise levels at high F0 and low sound pressure levels (SPL).

Participants (n=15) were avocational and vocational singers between 18 and 72 years of age recruited via snowball sampling. Inclusion was based on a mean Reflux Symptom Index (RSI) score  $\geq 13$ . Symptomology and acoustic data were collected over the course of six weeks in the Janette Ogg Voice Research Center of Shenandoah Conservatory. During these sessions self-reported perceptual measures were captured with the RSI and a Singer Specific Questionnaire (SSQ). Participants sang a standardized VRP protocol which was captured using the Voice Profiler System. This recording procedure was repeated per subject to test for intrasubject sensitivity and variability. Statistical analyses were performed to investigate possible correlations between LPR symptom severity and the acoustic measures of the voice.

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## **Improving Voice Patient Compliance with Follow-up: Identifying Deterrents**

*Objective:* Treatment for voice disorders may involve multiple modalities depending on the cause, and can include pharmacological, surgical, and behavioral modification approaches. However, even in multispecialty clinics, voice patients may be less likely to comply with follow-up when compared to patients seen for other ENT complaints. We investigated the factors contributing to noncompliance with follow-up in order to evaluate clinic procedures and improve voice patient follow-up and outcomes.

*Methods:* Eligible patients were identified from records of a multispecialty voice care clinic. Noncompliant patients were identified as those who had been instructed to follow-up but had not returned within the previous six months. Patients were telephoned to administer a brief survey about their experiences and the 4-item version of the Perceived Stress Scale (PSS-4).

*Results:* We identified 74 eligible patients, of whom 19 were reached and 13 provided responses. The majority of patients found office staff helpful, had reasons for treatment sufficiently explained, had opportunity to have questions answered, experienced only minor irritation from the scope or procedure, and felt their wait time was reasonable. The most frequently cited reason for discontinuing follow-up was financial (38.5%). Some patients (30.8%) did not like clinic location (downtown area), or felt follow-up would not be helpful (46.2%). Of the 11 patients receiving voice therapy, some did not appreciate benefit from (38.5%) or could not afford therapy (30.8%). The 31% who were noncompliant with voice exercises also reported greater perceived stress.

*Conclusions:* This study is the first step toward identifying factors that contribute to noncompliance in voice patients who are directed to follow-up in an outpatient clinic. Ease of clinic access and affordability appear to be substantial factors. Patient stress may also play a role in compliance. Emphasizing the importance of continuity of care and offering comprehensive approaches designed to help manage distress may improve patient adherence to voice care recommendations.

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## ***In Vivo* Vocal Fold Tissue Reconstruction using Micro-structured Hyaluronic acid-Gelatin Injectable Hydrogels**

**Objective:** The aim of the present study was to investigate long term effects of local injection with a hierarchically micro-structured hyaluronic acid-gelatin (HA-Ge) hydrogel for the prevention of scar formation after vocal fold surgical injury using a rat model.

**Method:** Vocal fold stripping was performed unilaterally in 33 Sprague-Dawley rats. They were divided into three treatment groups. A volume of 25  $\mu$ l Saline (placebo controls), HA bulk (HA-Bulk) or HA-Ge hydrogel was injected into their lamina propria (LP) five days post-surgery. The rats were sacrificed two months after the injection. Immunohistochemistry was performed to analyze the vocal folds for collagen type I, collagen type III, and elastin.

**Results:** Epithelium was slightly thinner in the injured vocal folds, compared to the uninjured controls. The relative elastin densities were greater in both the HA groups compared to the saline controls. For both saline and HA-Bulk treated groups, the collagen I levels were greater in the injured vocal folds compared to that of the uninjured ones, which indicated scar tissue formation. On contrary, collagen type I level was found to be similar between the injured and uninjured vocal folds for HA-Ge treated group. Collagen type III level decreased significantly in the saline controls. Excessive amounts of collagen type III were found in both HA groups.

**Conclusions:** Local HA-Ge injections might prevent scarring and improve the microstructure of the healing vocal fold tissue through elevating the relative density of elastin and collagen III, and decreasing that of collagen type I, compared to saline controls.

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### **Development of Vocal Tremor in the Adductor Spasmodic Dysphonia Population**

**Objective:** While spasmodic dysphonia is typically the most common hyperkinetic laryngeal movement disorder encountered, essential tremor is the most common movement disorder overall. The tremulous voice due to periodic contraction of antagonistic adductor-abductor muscles described in essential vocal tremor is used to differentiate the vocal disorder from spasmodic dysphonia. While previous studies have found that 15% of patients diagnosed with adductor spasmodic dysphonia (ADSD) present concomitantly with vocal tremor, the two pathologies have been viewed as distinct disorders. To date, no study has examined the development of essential vocal tremor within patients initially diagnosed with ADSD.

**Methods/Design:** 120 patients seen at the Emory Voice Center between 2003-2013 with an initial diagnosis of adductor spasmodic dysphonia were included in the study. A retrospective chart review was performed on all patients specifically looking at gender, age and progression of vocal disorder diagnosis. After reviewing physician and speech pathology clinical documentation, the most recent vocal disorder diagnosis was recorded. Patients with a final diagnosis of ADSD alone were compared to those with a final diagnosis of ADSD and vocal tremor.

**Results:** Between 2003 -2013, 120 patients were initially diagnosed with ADSD. Of the 120 patients initially diagnosed with ADSD, 8 (6.7%) developed vocal tremor throughout their clinical course. Of the patients developing vocal tremor, the average age was 67 years old (44-81) and 87.5% were female.

**Conclusion:** Of patients initially diagnosed with ADSD, 6.7% develop vocal tremor. The prevalence of vocal tremor in the ADSD population is higher than that found in the general population (0.4-5.6%). This finding demonstrates that ADSD and vocal tremor may in fact not be distinct clinical entities and may have an underlying associated pathology.

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## **The Effects of Hormonal Contraception on the Voice: A Systematic Review of the Literature**

**Objective:** Women of reproductive age commonly use hormonal contraceptives, the effects of which have been studied in reference to their effects on the vocal folds. It is essential that the practicing otolaryngologist is aware of this relationship in order to make recommendations on hormonal contraception as it relates to each individual patient's voice requirements.

**Methods/Design:** A comprehensive literature review of PubMed was completed. The terms "contraception", "vocal folds", "vocal cords", and "voice" were searched in various combinations. Acceptable articles that addressed the effects of contraception on the vocal folds were included.

**Results:** In total, sixteen articles were available for review. Hormonal contraception was historically believed to affect the voice negatively, however, recent studies using low-dose oral contraceptives show that they stabilize the voice. The caveat is that stabilization generally occurs only during sustained vowel production; connected speech is unaffected. Therefore, singers may be the only population that clinically experiences increased vocal stability as a result of taking hormonal contraceptives. Only low-dose combined oral contraceptives have been studied; other forms of hormonal contraception have not been evaluated as they relate to their effects on the voice. One study compared different types of low-dose combination oral contraceptives and found no difference in their effects on the voice. Great interstudy variability exists in the voice demands of patients, types of oral contraceptives, and acoustic measures tested.

**Conclusion:** Hormonal contraception has no clinically perceptible effects on the voice in non-singers. Singers may experience increased vocal stability with low-dose combined oral contraceptive use. Other forms of contraception have not yet been studied. Greater consistency in methodology is needed to increase reliability of the interpreted data.

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### **New Perspective on Psychosocial Distress in Patients with Dysphonia: the Moderating Role of Perceived Control**

Although an association between psychosocial distress and voice disorders has been observed, little is known about the relationship between distress and patient-reported voice handicap. Further, the psychological mechanisms underlying this relationship are poorly understood. Perceived control has been shown to play an important role in distress associated with other medical disorders. The objectives of this study were to 1) characterize the relationship between distress and patient-reported voice handicap and 2) examine the role of perceived control in this relationship.

**Methods:** Cross-sectional study in tertiary care academic voice clinic. Distress, voice handicap, and perceived control were measured using established assessment scales. Association was measured with Pearson's correlation coefficient; moderation was assessed using multiple hierarchical regression.

**Results:** 533 patients enrolled. 34% met criteria for clinically significant distress (e.g., depression, anxiety, and/or somatization). A weak association ( $r=0.13$ ,  $p=0.003$ ) was observed between severity of psychosocial distress and vocal handicap. Present perceived control was inversely associated with both distress ( $r=-0.41$ ,  $p<0.0001$ ) and voice handicap ( $r=-0.30$ ,  $p<0.0001$ ). The relationship between voice handicap and psychosocial distress was moderated by perceived control ( $b$  for interaction term  $-0.11$ ,  $p<0.01$ ); patients with low perceived control reported greatest distress in association with greater vocal handicap.

**Conclusions:** Severity of distress and vocal handicap were related, and their interaction was moderated by perceived control. Low perceived control was associated with the most distress and most vocal handicap; targeting this potential mechanism may facilitate new opportunities for improved care.

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## **The Efficacy of Injection Thyroplasty in the Management of Superior and Recurrent Laryngeal Nerve Paresis**

The diagnosis of Superior and Recurrent Laryngeal Nerve Paresis/Palsy remains elusive due to the variability of its clinical presentation. Patients complain of a wide range of vocal disabilities including vocal fatigue, inability to project and loss of vocal range on the basis of varying degrees of glottal insufficiency. To complicate matters, there are also different patterns of reinnervation which may be inadequate, incomplete and even dysfunctional (synkinesis). Therefore, paresis can often be difficult to diagnose and distinguish from innocent vocal fold asymmetry. The condition is often missed unless the clinician carries a high index of suspicion. A heightened awareness along with improved diagnostic ability with videostroboscopy and laryngeal electromyography has resulted in an increased pick up rate for this condition. Once the diagnosis has been confirmed, patients can be offered a treatment options like injection thyroplasty aimed at improving glottal incompetence. The objective was to establish if injection thyroplasty is effective in these patients.

An analysis was done on a pilot group of adult patients with recurrent and/or superior laryngeal nerve paresis who presented to the clinic over a period of 5 years. After obtaining a detailed history of the patient's presenting complaint, a thorough clinical examination was performed including both flexible and rigid endoscopic videostroboscopic examinations. Laryngeal EMG studies were then carried out on patients with suspected paresis to confirm the diagnosis and further define the exact nature and extent of the paresis. The patients included in the study went on to have injection thyroplasty with Radiesse Gel. The patients response to injection laryngoplasty was analysed by comparing pre and post treatment objective measures of vocal function including acoustic and aerodynamic measurements, as well as voice questionnaires (VHI, GCI & QLI).

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### **To Sing Or Not to Sing! When Is It Safe to perform and How Long Should Voice Rest Be?**

There is no clear scientifically based algorithm that outlines the exact contra-indications to singing with an injured larynx and each individual patient must be managed on the basis of their clinical presentation and their specific vocal demands and capabilities. This presentation attempts to identify some clear parameters that may be used in voice clinics internationally that would assist in the management of voice professionals who have sustained vocal injury and are desperate to get back on stage as soon as possible.

With a review of the main texts, current research on both this topic and on wound healing and a retrospective analysis of a group voice professional patients with varying degrees of vocal injury whose managements ranged from conservative medical interventions to surgical procedures, the author attempts to identify some clear outlines that may assist in the physician's decision making process regarding the ideal length of voice rest and when it is safe to perform.

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## Laboratory Evaluation of Vocal Fold Paresis and Paralysis

**Objective:** To determine the incidence of abnormal laboratory test results for a workup of vocal fold paresis or paralysis.

**Study Design:** Retrospective chart review

**Methods:** The charts of 268 adult patients who were diagnosed with vocal fold paresis or paralysis were reviewed. The data collected included demographics, white blood cell (WBC) count, hemoglobin (Hb), blood glucose (BG), thyroid stimulating hormone (TSH), anti-thyroid peroxidase antibody (anti-TPO), anti-thyroglobulin antibody (anti-TG), Lyme titers, anti-nuclear antibodies (ANA), rheumatoid factor (RF), and fluorescent treponemal antibody (FTA-Ab). National data on prevalence of abnormal values for some of these tests were obtained for comparison.

**Results:** After controlling for age and gender, WBC and Hb were found to have a significantly higher incidence of abnormal results in patients with vocal fold paresis/paralysis when compared to the general population. The difference was 10.3% for WBC ( $p < 0.001$ ) and 6.0% for Hb ( $p = 0.037$ ). Although TSH, anti-TPO, and anti-TG were more likely to be abnormal in the paresis/paralysis group, the difference was not statistically significant. Additionally, in our study group, a total of 5 Lyme titers were positive out of 260 subjects tested (1.92%). For 2013, the Centers for Disease Control (CDC) reported 35,000 cases of Lyme disease out of 316,130,000 people in the U.S. (0.01%). The ESR was abnormal in 27 of 259 subjects tested (10.4%) with a broad range for the estimated prevalence of ESR in healthy adults. In hospitalized patients, it can be elevated up to 53% of the time. The ANA was positive in 38 of 251 subjects (15.1%), with a prevalence ranging from 3% to 25% in healthy individuals. The RF was positive in 17 of 263 subjects (6.5%); in healthy older adults, the prevalence is estimated at 20%. The FTA Ab was positive in 3 of 250 subjects (1.2%) with a prevalence in the U.S. of 0.02% for 2012.

**Conclusions:** Vocal fold paresis and paralysis have numerous etiologies, and a comprehensive evaluation requires a variety of laboratory tests. This study has helped us to better understand the prevalence of abnormal laboratory results within this group in comparison with that of the general population. Further prospective studies are needed to determine the cost/benefit ratio of each of these tests and whether specific history and physical examination findings should be considered to help guide the diagnostic workup.

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## Vocal Fold Varices and Implications in Hemorrhage

### Objectives:

- 1) Determine the incidence of vocal fold hemorrhage in dysphonic patients being managed in a laryngology practice with a follow up period of >4 years.
- 2) Identify the risk factors associated with vocal fold hemorrhage
- 3) Develop a vocal fold varix grading system to better predict risk of vocal fold hemorrhage

**Study Design:** Retrospective chart review

**Methods:** Adult patients were selected if they were followed for more than 4 years for their voice complaints between January 2006 and June 2014. Data were collected from the patient's chart and from stroboscopy examination. Variables included age, gender, follow up duration, professional voice use status, history of vocal fold hemorrhage, hemorrhage diagnosed during the follow up period, laryngeal diagnoses, laryngeal surgeries, assignment of varix grade per vocal fold, use of blood thinning agents. A varix grading system was developed for this study: Grade 0= no varix; Grade 1= small straight vessel oriented parallel to the vocal fold edge; Grade 2= mildly dilated vessel and/or more tortuous path (ie perpendicular to the vocal fold edge); Grade 3= large, very dilated, coiled vessel.

**Results:** A total of 88 patients have been included in the study to date. Fifty percent are male and the mean age at first visit was 50 years. Fifty six percent are professional voice users. Nine percent of the patients had a history of vocal fold hemorrhage prior to their initial visit. The mean duration of follow up was 71 months. Forty-eight percent underwent vocal fold surgery. The overall incidence of hemorrhage in this group was 26%. The incidence of hemorrhage in patients without a previous history of hemorrhage was 21%. There were no hemorrhages in vocal folds assigned with a varix grade of 0. Fifteen percent of Grade 1 varices developed a hemorrhage. Twenty-eight percent of Grade 2 varices hemorrhaged, and Grade 3 varices had a 29% hemorrhage rate. There was no statistically significant difference in hemorrhage risk with blood thinning medications.

**Conclusions:** This study confirms the increased risk of vocal fold hemorrhage when a varix is present. Additionally, vocal fold varices assigned a grade 2 and 3 have an increased risk of hemorrhage when compared with grade 1 (nearly 30% vs 15%). Larger prospective studies are needed to investigate treatment outcomes when applying this grading system to surgical and non-surgical management of vocal fold varices.

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## **Why Arytenoid Adduction is a “Must” for UVFP? - Etiological Consideration of Jostle’s Sign Using 3DCT**

### **Objective:**

To detect the passive movement of paralyzed arytenoid (Jostle’s sign) in UVFP and to think about necessity of arytenoid adduction for voice surgery.

### **Methods:**

A total of 61 patients with UVFP who had undergone 3D CT imaging were included. Cricoid and arytenoid cartilage was imaged by 3D CT. We detected the movements of the paralyzed side when comparing inspiration and phonation. By comparing the MFR with the normal control group, we determined whether cases would worsen according to degree of the passive movement.

### **Results:**

In all cases, the paralyzed arytenoids were displaced cranially compared to the unaffected side. MFR worsened as the grade of the displacement became more severe.

### **Conclusions:**

The paralyzed arytenoid is not immobile and is subjected to passive movement during phonation. To attain a better postoperative voice, arytenoid adduction (AA) is necessary because only AA can reproduce natural adduction and resolve the passive movement.

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**Dysphonia as a Consequence of Preterm Birth: Is There an Effect on Voice Quality at School Age?**

**Objective:** Dysphonia following extreme preterm birth has been reported in the literature. Risk factors identified include: female gender, frequency of intubation, low birthweight and duration of ventilation. Yet, these factors are not limited to extreme preterm birth. This study sought to identify the incidence of dysphonia in very preterm children, at school age.

**Methods:** Children born at  $\leq 32$  weeks gestation and discharged from the NICU of the study centre were eligible for participation in this study. After excluding those children resident  $>200$ kms from the study centre and those with known disability likely to preclude successful assessment, the remainder were stratified according to gestational age and intubation frequency. Participants were then randomly selected and invited to undergo a clinical voice assessment, with a perceptual (Consensus Auditory-Perceptual Evaluation of Voice), acoustic (Acoustic Voice Quality Index) and quality of life (Pediatric Voice Handicap Index) component. Retrospective chart review was conducted to identify relevant medical and demographic information.

**Results:** Out of 391 children approached, 178 completed voice assessments. The incidence of dysphonia in this cohort was 62.6%. On univariable analysis, total number of intubations, maximum tube size and tube size to bodyweight ratio were significantly associated with voice difficulties, but only female gender, gestational age and duration of intubation were significant in the multivariable model.

**Conclusions:** Dysphonia is a potential long-term outcome of very preterm birth. Children born at earlier gestational ages and those intubated for longer periods were more likely to present with voice difficulties, as were females. These data suggest that dysphonia may be more common in preterm children than previously recognised.

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## Vitamin D Deficiency and Voice

**Objective:** To investigate the relationship between Low level of vitamin D, phonatory symptoms and acoustic findings.

**Methods/Design:** A total of 38 subjects presenting to the endocrinology clinic were enrolled in the study. These were divided into two groups; Nineteen with Vitamin D deficiency and 19 with normal Vitamin D level. Demographic data included age, gender, and history of smoking. All patients were asked about the presence or absence of dysphonia, degree of phonatory effort and vocal fatigue. Acoustic analysis and perceptual evaluation using the GRBAS were performed on all subjects.

**Results:** The mean age of the total group was 47.29 years  $\pm$ 13.52 years. Subjects with vitamin D deficiency (25(OH) D < 25ng/dl) had higher odds of having phonatory effort (OR: 4.8) and vocal fatigue (OR: 2.19) compared to subjects with normal Vitamin D level. Similarly, patients who were not on treatment were less likely to have phonatory effort (OR: 0.208) and Vocal Fatigue (0.457) compared to controls. However, the difference in the mean and frequency of phonatory effort, vocal fatigue and dysphonia was not statistically significant between the two groups. There was also no significant difference in the means of any of the acoustic variables and perceptual parameters among the two groups. With respect to the Voice handicap index-10 there was a borderline significant difference in the mean score between patients with low level of vitamin D compared to controls.

**Conclusion:** The results of this investigation indicate that patients with low level of vitamin D are more likely to have increase in phonatory effort and vocal fatigue compared to subjects with normal levels.

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## Laryngopharyngeal Reflux and Gluten Sensitivity

**Objective:** To evaluate the prevalence of gluten sensitivity in patients with laryngopharyngeal reflux (LPR) and the effects of a gluten free diet (GFD) on Reflux Symptom Index (RSI) and Reflux Finding Scores (RFS).

**Study Design:** Retrospective case series with data collection

**Methods:** Approximately 50 adult patients diagnosed with laryngopharyngeal reflux underwent a laboratory evaluation for celiac disease and wheat allergy, and some also pursued a GFD trial. The RSI and RFS were documented before and after GFD, and stroboscopy was performed on these patients also.

**Results:** When inquiring about gluten sensitivity in patients with dysphonia and LPR, it became evident that some patients had a strong history in support of gluten sensitivity, and many of them have followed a GFD already. Preliminary data have suggested that with a GFD in this population, symptoms commonly associated with LPR including excess mucous, throat clearing, globus pharyngeus, post nasal drip, and hoarseness improved more than with anti-secretory medications alone.

**Conclusion:** A growing amount of research in the last decade has demonstrated the effects of celiac disease on the esophagus including dysmotility and increased prevalence and severity of GERD. Although not as well studied, this may be the case for non-celiac gluten sensitivity (NCGS), a condition that may be present in as much as 6% of the population. With this in mind, it is conceivable that LPR in the gluten sensitive population requires a different approach to management with greater emphasis on GFD and less on anti-secretory medications. Our initial data and future studies will help to define the relationship between gluten sensitivity and LPR.

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## **Features of Unilateral Recurrent Nerve Adductor Branch Paralysis and the Need for Posterior Cric arytenoid Muscle Resection in Thyroplastic Surgery**

### **Purpose:**

To assess the pathological characteristics of unilateral recurrent nerve adductor branch paralysis (ABP), and to investigate the necessity for posterior cricoarytenoid muscle (PCAM) resection in thyroplastic surgery.

### **Materials and Methods:**

Four cases of ABP treated surgically are presented. ABP is a partial recurrent nerve paresis, and this type of paresis compromises the abductive function of the arytenoids. Adduction and abduction of paralytic arytenoids were determined by three dimensional computed tomography (3DCT).

### **Results:**

All cases were treated with arytenoid adduction combined with a type 1 thyroplasty. In the two cases treated with PCAM, the postoperative mean phonation time (MPT) improved from 3s to 30s. In the two cases with insufficient PCAM resection, the surgical outcomes were unsatisfactory.

### **Conclusions:**

Surgical treatment is necessary for ABP patients, and adequate resection of the PCAM is required for a satisfactory postoperative outcome. It is necessary to establish a standard management protocol for the treatment of ABP.

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### **Dysphonia: Associated Pathology and Objective Assessment**

**Objective:** Dysphonia is a common complaint. There is little evidence-based literature describing the etiologic pathology associated with dysphonia and treatment outcomes. The purpose of this study was to define the distribution of pathology associated with dysphonia and to evaluate treatment outcomes with objective and subjective measures via a prospective observational study.

**Methods/Design:** The charts of patients who presented for evaluation of dysphonia at a busy tertiary laryngology practice over the course of a 12 month period were reviewed. Patients completed a Voice Handicap Index at the initial evaluation and the physicians recorded changes in patients' presenting complaints, results of serial diagnostic evaluations, and treatment algorithms. The data was analyzed using Chi-square analysis and correlation statistics.

**Results:** There were 170 patients who presented for evaluation of "voice complaints". 110 of these were identified by the treating physician as having dysphonia as the primary complaint. The most common voice complaints were hoarseness, decreased range, and vocal fatigue. The most common primary diagnosis was vocal fold paresis. The most common secondary diagnoses contributing to the voice complaint, included reflux laryngitis and muscle tension dysphonia. Voice Handicap Indices ranged from 0 to 113, with a mean of 38. The most common medication recommended at the initial evaluation was a proton pump inhibitor, which was recommended in 92/110 (83.6%) patients. Surgery was recommended at the initial evaluation in 17 (15.5%) patients as an eventual treatment option and in 1 patient as the primary treatment option. Of the original 110 patients, only 35 came back for at least one follow-up visit within the first year of the initial presentation. Of these, 50% reported an improvement in their symptoms.

**Conclusions:** These results help to describe the distribution of pathology among patients with voice complaints and common treatment algorithms. This is the first study of its kind in the literature.

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### **Impact of Arytenoid Adduction for Unilateral Vocal Fold Paralysis**

**Aim:** We consider arytenoid adduction (AA) is necessary for every grade of UVFP because AA reproduce natural adduction of arytenoid. Aim of this study is to evaluate the voice outcomes of AA.

**Material and methods:** Sixty four patients with UVFP were treated between October 2009 and January 2013 in our institute. All patients underwent AA performed through fenestration of the thyroid ala combined with type I thyroplasty (fenestration approach: Tokashiki et al. Laryngoscope 2007). Key of this procedure is no release of the cricothyroid joint and the cricoarytenoid joint. In all cases, maximum phonation time (MPT) and mean airflow rate (MFR), pitch range and perceptual evaluation (GRBAS) were measured before and after the operation. This time we evaluated over one year result of patient's voice quality and complications.

**Results:** After surgery. 61 of the 64 patients achieved an MPT of over 10 s and an MFR of under 200 ml/s. There were no patients whose voice did not improved.

**Conclusions:** AA is considered to be necessary to obtain confirming results for every grade of UVFP, not only for severe patients.

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## **Laryngeal Hemangioma Presenting as a Laryngocele**

**Background:** Adult laryngeal hemangiomas are a rare entity first described in 1864. In the majority of cases a unilateral bluish-red lesion is noted in the supraglottis or glottis on endoscopy.

**Objective:** To report a case of laryngeal hemangioma that presented as a laryngocele.

**Methods:** Retrospective review of a unique case.

**Results and Conclusion:** We present a case of a 49 year old female with a past medical history significant for reflux who presented with hoarseness. On physical exam she was noted to have a large smooth flesh-colored polyp emanating from the right laryngeal ventricle. She was diagnosed with an internal laryngocele based on physical exam and imaging. The patient underwent CO2 laser excision of the laryngocele. Final pathology revealed mostly dilated vascular channels with unremarkable overlying respiratory mucosa consistent with a hemangioma. This is an extremely rare manifestation of a laryngeal hemangioma presenting as an internal laryngocele.

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### **Incidence and Effects of *Helicobacter Pylori* Infection in Patients with Abnormal Reflux Finding Scores**

Objectives: *H. pylori* is a gram negative bacterium that is associated with gastrointestinal pathologies. The relationship between *H. pylori* and laryngopharyngeal reflux (LPR), however, is less clear. Recently studies have started to investigate the possible relationship between *H. pylori* infections and LPR. The focus of this research project was to further analyze this relationship.

Study Design: Retrospective chart review

Methods: Charts and stroboscopy images were reviewed for subjects with prior *H. pylori* testing. Data was analyzed using standard statistical methods.

Results: There were 70 patients (mean age  $49.4 \pm 15$ , 30% males) with adequate data available for review. A variety of methods were utilized for *H. pylori* testing, and percentage of patient on proton pump inhibitor therapy was recorded (61.4% pre-*H. pylori* testing, 91.4% post-*H. pylori* testing). Values analyzed for the patients that were *H. pylori* positive (HPP) and *H. pylori* negative (HPN) included mean age (HPP  $56.6 \pm 16.7$ , HPN  $49.3 \pm 15$ ), male gender (HPP 22.2%, HPN 30.1%), mean pre-testing RFS (HPP  $11.1 \pm 1.2$ , HPN  $12.1 \pm 2.2$ ) and mean post-testing/treatment RFS (HPP  $10.6 \pm 1.4$ , HPN  $11.1 \pm 2.3$ ). Using a case-matched analysis for the *H. pylori* positive (HP+) patients, there was no evidence that treatment of *H. pylori* improved the reflux finding score (RFS).

Conclusions: The incidence of *H. pylori* is much lower than previously reported in non-US studies (12.9%). There appears to be no correlation between *H. pylori* treatment and change in RFS, but further prospective studies should be done to confirm these findings.

Word Count: 238

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## **Benign Vocal Cord Lesions in Azerbaijan Mugham Singers and Their Treatment**

**OBJECTIVE:** The goal of this study is to study the diagnosis and treatment of vocal cord benign lesions in Azerbaijan mugham singers.

**METHODS:** 94 professional mugham singers were examined and treatment in our clinic from 2009 to 2014 year. There were 22 women and 72 men with their ages ranged from 18 to 61 years. 58 persons were students of the conservatory and music colleges and 36 persons were professional singers and teachers of this educational institutions. All the patients were examined by laryngostroboscopy and acoustic analysis, in voice laboratory which was financed and established by Science Development Foundation under the President of the Republic of Azerbaijan. In 34 examined patients (21 man and 13 woman) was diagnosed benign vocal cord lesions. In 8 patients (2 man, 6 woman) was diagnosed bilateral vocal cord nodules, in 4 patients (3 man and 1 woman) Reinke odema, in two mans vocal cord polyps, in 9 patients vocal cord cysts (in three singers (1man and 2 woman) in right vocal cord and in 6 mans in left vocal cord), in 7 patients varicosis (5 man and 2 woman), and in four mans sulcus vocalis. In all patients lesions appeared by the using of the sound wrongly.

**RESULTS:** In all patients Vocal cord nodules were bilateral and fairly symmetric. Their stroboscopic pattern showed normal or minimal reduction of the mucosal wave activity during stroboscopy. And in all singers (except one woman with cystic bilateral nodules) these lesions disappeared in response to behavioral modification of voice use (voice therapy and voice rest).

In our hospital, the specific classification is used for the treatment of Reinke's edema, which has been applied in examined singers too. In all of them this disease was in the initial stage. And all patients were treated with voice therapy procedures.

Two patients with the vocal cord polyps, one woman with cystic noduls and 8 patients with vocal cord cysts were treated by phonomicrosurgery.

In 5 cases varix was found on the left vocal cord, in 1 case on the right vocal cord and in 1 case in both vocal cords. In four patients varice were on the superior surface and in the middle musculomembranous region of the vocal cord and one of them was on the medial surface of the vocal cord. All the patients presented hoarseness and poor performance during the singing. Treatment of the patients was performed with carbon dioxide laser cauterization.

All patients have resumed full vocal activities, and during the next nine months after operation nobody had a subsequent hemorrhage or vocal deterioration. It was significant improvement of the acoustic analysis (jitter, shimmer and harmonics/noise ratio) and laryngostroboscopy values after treatment.

**CONCLUSIONS:** Benign vocal cord lesions in mugham singers appeared by the using of the sound wrongly. These lesions were found on 34 of the 94 examined singers. All the patients presented hoarseness and poor performance during the singing. The surgical procedure performed in 16 patients, and 18 were treated by the conservative and voice therapy procedures. Treatment methods in all cases were effective.

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**BS1**

### **Case Study Longitudinal Voice Change in English Cathedral Girl Choristers**

The English Cathedral tradition of regularly sung services is a millennia-old practice in the UK. The upper (usually termed ‘treble’) musical line was originally sung by both boy and girl choristers in medieval times, but then become a predominately all male convention. However, since 1990, choirs of girl choristers have been added in the majority of cathedrals and often sing alternate services. We have been recording girl choristers at Wells Cathedral in Somerset at approximately six month intervals since 1999, and for many of them there is a considerable amount of longitudinal data. The data are stereo recordings of speech pressure (microphone) and electrolaryngograph signals for a series of spoken and sung tokens including a read passage, VCV (vowel-consonant-vowel) tokens, a sung scale and a short sung piece of music. In this paper, we will report on longitudinal voice changes including variation in fundamental frequency mean values and ranges, average spectra and tuning acuity.

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## **On the Epilarynx Dimensions for Voice Classification**

The epilarynx for any individual has dimensions that are unique to that person, and they have a direct impact on the overall acoustic output spectrum during speech and singing. In particular, it is the relationship between the dimensions of the epilarynx and those of the main vocal tract that accounts for the acoustic output from a vocal tract in regard to that individual's sung voice classification, for example soprano, mezzo soprano, alto, tenor, baritone or bass. This paper will present data for male and female professional opera singers based on vocal tract shape measurements taken in a magnetic resonance imaging (MRI) that have enabled practical three dimensional finite element simulations of their vocal tract transfer functions to be rendered. These outputs have been compared with those from acoustic tube models and theoretical analyses to model the nature of the acoustic contribution of the epilarynx in the context of the singer's formant cluster. The relative dimensions of the vocal tract and the epilarynx of an individual are shown to account for the voice classification that best suits a particular singer.

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## What Do Professional Opera Singers Change if They Try to Change Singers` Fach?

**Introduction:** Vocal categories such as soprano, mezzo-soprano, alto, tenor, baritone or bass might imply that singers within such a category fulfill comparable requirements. In fact, there are strong differences within such vocal categories related to the singers` Fach. In this respect, such a contrast can be observed between the lyrical and the dramatic way of singing or singers` repertoire, respectively. However, the differences between a lyrical and a dramatic way of singing are not understood in detail.

**Material and Methods:** 15 professional opera singers of different categories and Fachs were asked to sing a scale one time in what the subjects considered “lyrical singing” and another time in what the singers considered “dramatic singing”. The vocal tract profiles were recorded using dynamic Real-time MRI. Furthermore, from the dual optical microphone system the audio signal was recorded during the experiment. After digitally removing the scanner noise, the audio signal was analyzed concerning SPL and vibrato.

**Results:** The data show that there are different strategies associated with the dramatic way of singing. These strategies were either observed as single phenomenon or in combination. In contrast to lyrical singing, dramatical singing was associated with an increase of sound pressure level, of vibrato amplitude and/or elongation of the vocal tract by means of lowering the vertical larynx position.

**Conclusions:** There is no uniform physiological strategy among opera singers by which dramatic singing could be defined.

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### **Vocology: A Quarter-Century in the Making**

Vocology, the science and practice of voice habilitation, is taking shape as a discipline. From its early years of conceptualization around 1990, vocology has steadily grown as a special emphasis area in departments that offer voice education. It has been recognized that requirements for vocalization in ordinary speech communication do not fully address the capabilities of the larynx to produce sound over wide ranges of pitch, loudness, and sound quality. The broader study of human and animal sound making, which includes non-speech (singing, laughing, calling, humming, crying) and highly dramatic and expressive speech, has led to new habilitative approaches, professional goals, associations, and aspirations for specialty certification in voice.

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### **An Oral Pressure Conversion Ratio as a Predictor of Vocal Efficiency**

Voice production is an inefficient process in terms of energy expended versus acoustic energy produced. A traditional measure, glottal efficiency, relates acoustic power radiated from the mouth to aerodynamic power produced in the trachea. This efficiency ranges between 0.001 % and 1.0 %. It involves the lung pressure utilized, and hence would appear to be a useful effort measure. Difficulty in measurement of lung pressure and tracheal airflow, however, has impeded clinical application of glottal efficiency. This paper reviews the theoretical and methodological issues regarding glottal efficiency and proposes a simplified measurement technique that has the potential for wide application due to cost and ease of use in clinics and vocal studios.

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## Generation of Subharmonic Tonal Sound within a Synthetic Larynx Model as Known in Diplophonia

**Objective:** As already reported in a previous study, geometric boundary conditions have a significant influence on the supraglottal flow field and the sound generation. Besides the harmonic series of the oscillation frequency of the vocal folds, additional subharmonic tonal peaks were detected in the sound spectrum which are characteristic for diplophonia. The largest amplitudes of the subharmonic peaks were observed for the smallest lateral diameter of the supraglottal channel. By removing the supraglottal channel, the subharmonics vanished. These peaks were intercalated exactly at half distance between two harmonics.

**Methods:** To study the influence of supraglottal flow boundary conditions on the phonation process, a synthetic larynx model was applied. It includes single or multi-layer silicone models of vocal folds showing flow-induced oscillations in the physiological frequency range. The lateral diameter of the supraglottal channel is adjustable and synthetic models of the ventricular folds can optionally be inserted. Measurement signals like hydrodynamic and acoustic pressure, flow velocity and structural motion were recorded synchronously.

**Results and Conclusion:** Our current investigations of the supraglottal flow field revealed an additional small peak at half of the oscillation frequency in the static pressure spectrum which marks the first peak of the subharmonic series. This first peak was not visible in the sound spectrum. The location at half of the oscillation frequency indicates that its generation is attributed to a cycle-to-cycle variation of the supraglottal flow field. This corresponds to the fluctuating location of the glottal jet as flow visualization experiments showed. Since the structural oscillation pattern of the synthetic vocal folds was symmetrical, we suggest that the subharmonic series originated from cyclic variations of the glottal jet due to the surrounding turbulent flow field whose transient and spatial distribution is mainly defined by the geometrical boundary conditions.

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## **Simultaneous Analysis of the Pitch-Shift Reflex (PSR) during Phonation and Speech with EEG and High-Speed Videoendoscopy (HSE)**

**Objective:** The analysis of the processes underlying auditory feedback during phonation and speech by the pitch-shift reflex (PSR) is of scientific and clinical interest. The PSR is the adjustment of the pitch during phonation/speech in response to a spontaneous pitch change of the auditory feedback. With this study the auditory as well kinesthetic feedback mechanisms are investigated during phonation and speech via perturbed auditory feedback analyzing the acoustic-, EEG- and HSE-signal.

**Methods:** 20 healthy subjects underwent transnasal HSE (8000fps) during sustained phonation [a] and articulation of the disyllabic word [‘mama]. While phonating or articulating, the auditory feedback was pitched up for 700 cents, lasting 300ms. Voice response pitch changes, event-related potentials and voice onset parameters from the video signal were determined and analyzed. Statistical analysis was applied to compare feedback mechanisms during pitched and un-pitched condition and phonation paradigm vs. speech paradigm.

**Results and conclusion:** We will present the results of response latency and magnitude of the PSR for the EEG- and acoustic (auditory feedback) as glottal parameters and perturbation measures like cycle periodicity and symmetry of the HSE-signal. Furthermore, the onset will be analyzed with regard to the kinesthetic feedback. Results will be discussed and correlated to existing studies concerning the pitch-shift reflex and both feedback mechanisms (auditory/kinesthetic).

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## **Larynx under Ultra-High Subglottal Pressure: Measure of Contact Force Between Vocal Folds in Excised Human Larynges**

**Objective:** Based on the clinical concepts of vocal abuse and phonotraumatism, this study aimed at analyzing the contact pressure between vocal folds driven by very high (extra-physiological) subglottal pressures.

**Material and methods:** 7 human excised larynges were set on the experimental test-bench. The vocal fold adduction was constant, using concomitant arytenoid adduction and membranous vocal fold medialization with Montgomery implants. The subglottal pressure (SGP) lied from 0 to 200hPa. The contact pressure was measured with a pressure sensor placed between the vocal folds, the tracheal airflow and subglottal pressure were measured 1 cm under the glottis, the electroglottography (EGG) was recorded, as well as the audio signal (microphone distance: 15cm from the larynx).

**Results:** At the phonation threshold, contact pressure appeared at the same time as the first activity of EGG, before the onset of the glottal cycle, then rapidly increased until a plateau. The maximal values of the contact pressure were very variable between the larynges (range: 0,7-12kPa). This contact pressure was not proportional to the subglottal pressure.

**Discussion:** The SGP is commonly used as a vocal abuse indicator. These results with a given glottal configuration question its role as the main factor of phonotrauma in vocal abuse.

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### Formant Tuning and Feedback in the Male Passaggio

It has been suggested that traversing the male (secondo) passaggio requires two important adjustments. When singing up the scale, first of all, the second harmonic (H2) needs to pass over the first formant (F1). After that, the timbre of the voice takes on a different, slightly 'darker' quality. This is the pitch where, in singer's jargon, the voice 'turns over.' Above the passaggio, in the optimal arrangement the second formant (F2) is then tuned to one of the higher harmonics, or, sometimes alternatively, the singer's formant cluster induces a dominant resonance in the approximate range 2.4 to 3.4 kHz. These two adjustments together produce the typical sound of the classical male upper voice. We have investigated the mechanisms underlying these adjustments, using the VoceVista software, to record EGG and microphone signals of the singers, and inverse filtering, using the Sopran/DeCap software, to reveal the shape of the glottal airflow pulses. The results indicate that:

Tuning of the first formant to the second harmonic affects the shape of the glottal airflow pulses through non-linear feedback. Inverse filtering reveals that if H2 is below F1, the pulses are skewed to the right; if H2 is above F1, the pulses are more symmetrical. This could explain the change in timbre as the voice turns over. We will show that the difference in pulse shape is caused by the changing phase relation between the supraglottic pressure wave and the glottal airflow pulse as H2 passes F1.

The tuning of the second formant appears to have a negligible effect on the shape of the airflow pulses. Its most salient effect on the sound is the enhancement of one of the higher harmonics. The more precisely F2 is tuned to one of these harmonics, the higher its amplitude.

Successful second formant tuning not only depends on precise tuning, but also on the closed quotient (CQ). Certain values of the CQ turn out to be more favorable for F2 tuning than others. We have investigated the nature of this dependency and offer here an explanation of the phenomenon: F2 tuning turns out to be most effective if the glottis stays closed into the final cycle of the dominant enhanced harmonic.

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### **Listeners Hear Who Is Singing: The Role of Familiarity**

**Objective/Hypothesis:** Previous research has shown that listeners are unable to identify who is singing across pitch when the voices are unfamiliar. This is likely because a singer's timbre changes with the adjustments necessary to produce sound at different pitches. However, familiarity with a singer's voice may provide additional information that may enable listeners to identify the singer. This study seeks to answer the question, "Does familiarity with a singer increase the accuracy of singer identification across pitch?"

**Study Design:** Repeated measures factorial design.

**Methods:** This study employs 2 tasks, a training task, and a forced choice experimental task where listeners hear two different singers producing "ah" at the identical pitch and an unknown singer producing "ah" at a different pitch and must identify which singer is the unknown singer. Stimuli recorded from 2 baritones, 2 tenors, 2 mezzo-sopranos, and 2 sopranos across a 1.5 octave range.

In the training task, listeners will be allowed to listen to all of the stimuli produced by each voice as many times as they like until they believe they can identify the voices by singer number at which time they will proceed to the a test procedure where they will listen to all the stimuli produced by each singer and must identify the singer by the singer number. When they are able to identify all the male and female voices they will proceed to experimental task.

For the experimental task, all possible pairs of male and female singers were constructed for the lowest pitch and for the highest pitch. The unknown singer was varied across the remaining pitches. Listeners hear two different singers producing "ah" at the identical pitch and an unknown singer producing "ah" at a different pitch and must identify which of the 2 singers is the unknown singer.

**Results/Conclusions:** Data from this study will be compared to data collected in a previous study with the identical method, but where the listeners were not previously familiar with the singers' voices. It is anticipated that familiarity will improve the ability to identify singers across pitch.

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## **Automatic Measurements of Formant Frequency and Aperiodicity of Vibrato Vowels**

### Objective

Automatic methods are frequently used in voice research for measuring formant frequencies and aperiodicity. Such methods have been developed primarily for the analysis of speech. Their accuracy when applied to singing has not been tested in detail.

### Design

In this experiment we used the MADDE synthesizer to generate vowel sounds with well-defined formant frequencies. The vowel sounds were provided with vibrato of varied rate and extent and were analyzed by inverse filtering as well as two automatic methods.

### Method

First the sounds were analyzed by inverse filtering, which showed expected voice source waveforms. Then, they were analyzed by means of the PRAAT and the Wavesurfer software with respect to formant frequencies, jitter, shimmer and harmonic-to-noise ratio.

### Results

The results showed that the measured formant frequency values failed to remain constant, but rather varied in pace with the vibrato. Also the measured jitter and harmonic-to-noise ratio values varied with vibrato, systematically decreasing with vibrato rate and vibrato extent. The shimmer values, by contrast, varied unsystematically with the two vibrato parameters.

In addition, some natural tones, sung with vibrato by professional operatic singers were analyzed using the same automatic methods and also by inverse filtering and produced the similar discrepancies.

### Conclusions

Vibrato may cause errors in formant frequencies when measured by automatic analysing software. This result is not surprising, given that the analysis software were designed for speech. However, they are relevant when automatic methods are used for measuring formant frequencies and aperiodicity of vowels sung with vibrato.

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## Towards Objective Voice Assessment: The Diplophonia Diagram

**Objectives:** Diplophonia is a common and often misinterpreted symptom of disordered voice and needs objectification. It was hypothesized that diplophonia is produced by two distinct oscillators, which yields a profound physiological interpretation. Based on that hypothesis, an audio signal processing algorithm for the detection of diplophonia is proposed, tested and validated. Its performance is compared to the clinical standard parameter Degree of Subharmonics (DSH).

**Study design:** Prospective.

**Methods:** 50 dysphonic (28 diplophonic and 22 dysphonic without diplophonia) and 30 euphonic subjects were included in the study. From each subject up to five sustained phonations were recorded during rigid telescopic high-speed video laryngoscopy. 185 phonations were split up into 285 segments of distinct voice qualities. In accordance to the clinical group allocation, the considered segmental voice qualities were 1) diplophonic, 2) hoarse without diplophonia and 3) euphonic. To analyse the segments, an analysis-by-synthesis procedure was proposed. The Diplophonia Diagram is a scatter plot that relates the one-oscillator synthesis quality SQ1 to the two-oscillators synthesis quality SQ2. Multinomial logistic regression was used to distinguish diplophonic from non-diplophonic segments in the Diplophonia Diagram.

**Results:** Diplophonic segments could be well distinguished from non-diplophonic segments in the Diplophonia Diagram, because two-oscillators synthesis is more appropriate to imitate diplophonic signals than one-oscillator synthesis. Detection of diplophonia using the Diplophonia Diagram clearly outperforms the DSH by means of positive likelihood ratios (56.8 versus 3.6).

**Conclusions:** The diagnostic accuracy of the newly proposed method for detecting diplophonia is superior to the DSH approach, which should be taken into account for future clinical and scientific work.

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## Comparison of Vibratory Onset and Offset Measurement Protocols Using High-Speed Videendoscopy

**Motivation:** Voice onset has been studied extensively by means of acoustic and electroglottographic measurements. Kinematic measurements of onset using high-speed videendoscopy (HSV) vary and have often been performed with a relatively small sample size.

**Objective:** To compare three different methods for quantifying vibratory onset and offset; automated approaches taken from Mergell et al. (1998), Kunduk et al. (2013), and a novel semi-automated approach using glottal area waveform measurements of amplitude periodicity and open quotient.

**Methods:** HSV recordings were acquired from 68 (male:26, female:42) vocally healthy (21-45yrs) adults for production of /hi.hi.hi.hi/ at typical pitch and loudness. One middle production of /hi/ was segmented for analysis. Onset time was measured using Mergell et al. (1998) and Kunduk et al. (2013) protocols. A semi-automated glottal area waveform measurement of vibratory onset time was used for comparison and is defined as the time from first oscillation to a determined threshold of amplitude periodicity representing sustained phonation. Vibratory offset time was measured from an automated protocol presented in Kunduk et al. (2013) and a semi-automated measurement defined as the time corresponding to a deviation in open quotient to the cessation of oscillation.

**Results:** The means and standard error for each onset and offset measurement will be presented for male and female populations in milliseconds and number of cycles. The automated methods will be evaluated for the male and female onset samples based on a Pearson's product moment correlation with the semi-automated protocol.

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## **Interaction of Roughness and Breathiness in the Perception of Dysphonic Voices**

**Introduction:** It is known that many abnormally rough voices are also abnormally breathy but the potential interaction between the two percepts has not been formally quantified. The two voice quality (VQ) dimensions often co-occur, however it is not clear how changes along one dimension may alter the perception on another dimension. Knowledge of such interactions is essential for developing models of dysphonic VQ perception that can accurately predict VQ judgments for natural voices.

**Objective:** To quantify the degree to which co-occurrence of breathiness and roughness influence the perception of each VQ dimensions in vowel /a/. These results will allow extension of current models of dysphonic VQ perception to a broader range of dysphonic voices.

**Methods:** Four synthetic vowels, 2 male and 2 female, were generated using a Klatt-synthesizer with the LF source model. These were modeled after natural adult talkers. Two continua were generated from each talker. The breathiness continua altered breathiness by systematically increasing the aspiration noise level and the open quotient in 7 equal steps. The roughness continua were created by modulating the waveform amplitude at a frequency of 25 Hz and with 7 different modulation depths. A total of 196 stimuli were created (4 talkers X 7 breathiness level X 7 roughness levels). Ten listeners evaluated breathiness and roughness for each of these items using a single-variable matching task. VQ judgments for stimuli that varied along a single VQ dimension were compared to those for stimuli that co-varied along two voice quality dimensions.

**Results:** Preliminary data shows that listeners are capable of reliably judging VQ for stimuli that vary along a single voice quality dimension as well as stimuli that co-vary in two dimensions. The magnitude and direction of interaction between the two VQ dimensions will be quantified upon completion of all data collection.

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### **Vocal Fold Left-Right Vibratory Phase Asymmetry in Children with and without Bilateral Lesions**

**Objectives:** The objective of this study was to provide initial data on the measurable left-right vibratory differences of vocal fold relative phase asymmetry in children with and without vocal fold lesions.

**Methods/design:** In a prospective study, 10 participants (5 healthy; 5 with lesions) between the ages of 5 and 10 were examined using rigid monochrome high-speed videoendoscopy (HSV) at the rate of 8,000 frames per second. Participants were asked to sustain phonation at their normal pitch and loudness. Using custom software for dynamically linking HSV to digital kymography, objective measures of left-right vocal fold relative phase asymmetry were obtained at three positions along the vocal folds.

**Results:** The study tested the hypothesis that left-right relative phase asymmetry would be greater in children with bilateral lesions compared to those with no lesions. Within the group with lesions, additional attention was given to provide a description of the differences between the various types of lesions. The specific findings will be discussed.

**Conclusions:** Results of this study provide quantitative data on vocal fold left-right vibratory phase asymmetry in children with and without benign bilateral lesions, which can be the basis for the development of objective clinical measurements. Further studies are warranted to develop specific quantitative techniques for differentiating vocal fold nodules from cysts with contralateral lesions. Although nodules and cysts appear endoscopically very similar, the preliminary findings suggest differences in their vibratory phase asymmetries.

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## Vocal Effort and Intelligibility : A Preliminary Study with Aerodynamic Measurements during Production of Consonants

Production of voice during vocal effort has been studied mainly in terms of the subglottic pressure and derivative formulas during the production of vowels. The study of the production of consonants seems essential to integrate vocal effort in the general framework of hyperarticulation proposed by Lindblom : the use of a "loud" or "clear" voice is accompanied by an increase in various indices of speech intelligibility, especially the contrast between voiced and unvoiced consonants which is the subject of this work.

However, indirect methods are inapplicable here and we conducted a pilot study using the principle of transtracheal direct measurement of subglottic pressure on the lead author of the study. We studied on the same speaker during the same session, 8 successive productions of a series of non-words including the contrast f / v in 12 different vowel contexts and 4 categories of speech (threshold, modal , clear, loud). The productions were performed randomly. Our goal was to show that there was in loud voice and clear voice an enhancement of the voicing contrast manifested by the increase in the difference of transglottal gradient (TGP) between voiced and unvoiced consonants. SGP, OAF, IOP, Fo, Int, spectrum has been recorded simultaneously using the EVA® device (SQ-Lab, France)

Our results are fully consistent with our hypothesis. For sample, on non-word /avafa/ , difference between /f/ and /v/ in TGP is 1.2 hPa at threshold, 2.5 hPa in modal voice, 4 hPa in clear voice and 9 hPa in loud voice. Other results are consistent as well.

These results demonstrate that the use of a "clear" voice (that aims to improve intelligibility in certain circumstances) is based on a more energetic process than the modal voice comparable to the loud voice. They confirm that vocal effort must be integrated into a unified approach of speech production and cannot be considered independently. These preliminary results should be confirmed by studies on various normal and pathological subjects.

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## **Comparison of Videostroboscopy to Stroboscopy Derived from High-Speed Videoendoscopy for Evaluating Patients with Vocal Fold Mass Lesions**

**Objective:** Videostroboscopy, the clinical staple for diagnosing and monitoring voice disorders, relies on an indirect signal, acoustic or electroglottographic, to predict the next phase of the glottal cycle to be sampled. As a result, for patients with even a moderate level of dysphonia, this sampling methodology can result in an uninterpretable asynchronous image sequence. Simulated stroboscopy, a derivative from high-speed videoendoscopy, extracts the phase of the glottal cycle directly from the glottis in the high-speed image sequence. It is expected that the direct sampling principle of simulated stroboscopy may result in more accurate stroboscopic synchronization. The purpose of this study is to determine the clinical efficacy of simulated stroboscopy relative to traditional videostroboscopy to assess vocal-fold vibratory function in individuals with and without mass lesions.

**Methods:** Twenty-eight patients with vocal fold mass lesions and 17 vocally-healthy controls were recorded producing sustained phonation using both videostroboscopy and high-speed videoendoscopy. Simulated stroboscopy samples were derived from the original high-speed recordings. Three experienced clinicians rated amplitude, mucosal wave, left-right phase asymmetry, glottal edge and synchronicity for both traditional videostroboscopy and simulated stroboscopy. Acoustic signal types and visual-perceptual ratings were compared to determine which technique better facilitates visualization of vibratory function in normal controls and patients with mass lesions.

**Results:** Preliminary results found that despite similar acoustic signal types, simulated stroboscopy produced more reliable ratings than traditional videostroboscopy. Additionally, raters indicated that they could not rate vibratory features in twice as many videostroboscopy samples than simulated stroboscopy samples.

**Conclusion:** Stroboscopic techniques based on extracting the phase directly from the glottal cycle rather than predicting the phase from an indirect acoustic signal provide better synchronization, improving clinical evaluation.

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**Non-Linear Source-Filter Interactions: The Effect of the Speed of Pitch Change on the Stability of  $F_0$  in the Vicinity of  $F_1$**

**Objective:**

To determine the extent to which the speed of pitch change influences the occurrence and duration of irregular vocal fold oscillation during the time in which the fundamental frequency is in the vicinity of the first formant.

**Methods:**

20 (10 male, 10 female) subjects participated in this study. Subjects were asked to produce a pitch glide, from low to high and back, while phonating through tubes of varying lengths. Subjects were asked to vary their  $F_0$  from the bottom of their range to at least 500Hz for males and 700Hz for females in order to ensure that the  $F_0$  would surpass  $F_1$ . The tubes served to artificially lengthen the vocal tract, thus varying the formant frequencies randomly and prohibiting the subjects from predicting the location of a formant and adjusting vocal tract configurations accordingly. Subjects were asked to produce the pitch glides twice, once slowly and once quickly (pitch-change rates were prescribed and demonstrated at 150 Hz/s and 300 Hz/s respectively). The signal from a microphone positioned at the end of the tube was used to produce a spectrogram of the pitch glide and formant frequencies were measured from this signal.

**Results:**

Overall, it appeared that the faster an individual's  $F_0$  approached the vicinity of  $F_1$ , the less likely they were to successfully negotiate that pitch region, resulting in an instability in phonation. Additionally, the pitch location of any instabilities appeared to vary predictably with changes in the vocal tract length.

**Conclusions:**

While some instabilities can likely be attributed to source or tissue unsteadiness and not associated with source-filter interaction, these results lend support to the claim that the filter can influence the stability of the vibratory pattern of the sound source.

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## Maximum Divergence Angle and Glottal Efficiency in Musical Theater and Opera Singers

**OBJECTIVE:** During the closing phase of vocal fold vibration, the fold can take on a divergent shape where the superior aspect of the glottis is larger than the inferior aspect. Experiments on excised canine larynges suggest that increasing the maximum divergence angle (MDA) will cause an increase in glottal efficiency (GE). For this project, GE is defined as acoustic intensity (in SPL) over subglottal pressure. The objective of this project was to ascertain and compare the MDA during different singing styles via visualization techniques. **METHODS/DESIGN:** Five opera and three musical theater singers (ages 22-35) performed a series of vocal tasks at two pitches (C#3 133.59 Hz and C#4 277.18 Hz) for three levels of loudness (soft, baseline, loud), while undergoing flexible distal chip videostroboscopy. Aerodynamic and acoustic information for each vocal task was recorded separately using the Phonatory Aerodynamic System (PAS) to verify the efficacy of vocal tasks. The flexible endoscopic evaluations were edited to include samples of the different pitches and levels of loudness. MDA was qualitatively measured via visual-perceptual judgments of repeated comparison tests, by a blinded rater asked to select the video in which the subject demonstrated the greatest MDA. Visual-perceptual judgments were assessed via contingency table, describing all instances in which soft and loud tasks were compared. **RESULTS:** For tasks performed at C#3, the loud task was selected as having the greatest MDA in 100% of the opera subjects and 57.14% of MT subjects. For tasks performed at C#4, the loud task was selected in 100% of comparisons across all subjects. **CONCLUSION:** This prospective study reveals novel human subject evidence that MDA may correlate with GE. Future studies will further explore the implications of MDA with respect to GE and laryngeal mechanics.

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**Vibrato-like Strain Modulations as a Mechanism to Reduce Stress Relaxation in Laryngeal Tissues**

Vocal fold tissues in animal and human species undergo deformation processes at several types of loading rates: a slow strain involved in vocal fold posturing (on the order of 1 Hz or so), cyclic and faster posturing often found in speech tasks or vocal embellishment (1–10 Hz), and shear strain associated with vocal fold vibration during phonation (100 Hz and higher). Relevant to these deformation patterns are the viscous properties of laryngeal tissues, which exhibit non-linear stress relaxation and recovery. In the current study, a large strain time-dependent constitutive model of human vocal fold tissue is used to investigate effects of phonatory posturing cyclic strain in the range of 1 Hz to 10 Hz. Tissue data for two subjects are considered and used to contrast the potential effects of age. Results suggest that modulation frequency and extent (amplitude), as well as the amount of vocal fold overall strain, all affect the change in stress relaxation with modulation added. Generally, the vocal fold cover reduces the rate of relaxation while the opposite is true for the vocal ligament. Further, higher modulation frequencies appear to reduce the rate of relaxation, primarily affecting the ligament. The potential benefits of cyclic strain, often found in vibrato (around 5 Hz modulation) and intonational inflection, are discussed in terms of vocal effort and vocal pitch maintenance. Additionally, elderly tissue appears to not exhibit these benefits to modulation. The exacerbating effect such modulations may have on certain voice disorders, such as muscle tension dysphonia, are explored.

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## Acoustic Clarity and Vocal Comfort in Speech

**Introduction:** Talkers have long been studied in their speech accommodation strategies in noise. Vocal effort and comfort within noisy situations have also been studied. However, few studies have been conducted on (I) the perception of acoustic environments, and (II) the effect of acoustic environments on speech production.

**Objective:** We hypothesize that if the clarity (C50) of a room is increased, the speakers' vocal comfort and vocal control in that room will be increased. Additionally, we hypothesize that a trained vocalist will be more aware of changes in C50.

**Methods:** In this study, 20 vocalists (10 trained and 10 untrained) performed vocal tasks while being exposed to a range of room acoustic conditions. In each environment, the subject performed a vocal task in two styles: comfortable conversational style and loud classroom style. After each task, the subject completed a series of questions addressing perception of vocal comfort, vocal control, and vocal fatigue. In addition to the style, the clarity (C50) in the position of the talker was changed by means of two plexiglass reflective panels. Two noise levels were used: background noise, and artificial child babble noise generated by a loud speaker (60 dBA). The presence or absence of the panels does not change the reverberation time of the room but it does change the clarity (C50), which is based on early reflections. Room acoustics were assessed.

**Results:** In this study, when panels were present, talkers perceived the room as being more comfortable to speak in. Additionally, in the noise condition, comfort and control tended to increase when the panels were present. The difference between trained and untrained speakers was measured. The results indicate that even while keeping room parameters (reverberation time) the same, reflective surfaces may be optimized by teachers in classrooms or performers on stage to increase perceived voice comfort.

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### **Assessing Age-Related Laryngeal Changes with High-Resolution MRI**

**Objective:** Glottal insufficiency, a typical endoscopic finding in the aging larynx, is often attributed to bowing of the vocal folds caused by muscle atrophy. Atrophic laryngeal muscle changes likely occur in three dimensions and may impact vocal fold vibration not only by creating a glottal gap, but also by changing the inferior glottal angle, thereby affecting aerodynamic forces needed for self-sustained vocal fold oscillation. Endoscopic examination of the larynx is limited, however, to a superior two-dimensional view. The objective of this study was to develop a novel, 3D, in vivo imaging technique for assessing age-related changes in the larynx using high-resolution magnetic resonance imaging (MRI).

**Methods/Design:** Image sequences were collected from a total of 20 individuals (10 males and 10 females) evenly distributed between two age groups: young adults (20-29 years old) and older adults (60-69 years old). Using a 3T MRI system, high-resolution static 3D MR images of the larynx were collected with a spatial resolution of 0.5x0.5x1 mm and T1 weighting (TE/TR = 10/ 805 ms). Using cartilaginous landmarks, image sequences were rotated to a standardized orientation and three-dimensional laryngeal morphological measures were made using a semi-automated procedure.

**Results:** Initial analyses demonstrate this imaging method provides adequate contrast and resolution to distinguish soft tissue from the cartilages of the larynx in young and older adult males and older adult females. However, cartilages in the images from the young adult females were not able to be reliably discriminated from the surrounding soft tissue. Within the male group, older adults had a greater subglottal angle than young adults (Wilcoxon rank sum test,  $W = 24$ ,  $p = 0.016$ ). Older adults also had a larger mean vocal fold cross-sectional area than young adults, although this difference disappeared when standardizing for neck width.

**Conclusions:** This novel imaging methodology allows for in vivo, repeatable, three-dimensional measurements of laryngeal morphology at resolutions higher than previously reported. In addition to the cross-sectional age-related changes seen in our current results, this method will allow us to more fully understand how age and interventions impact laryngeal morphology through future longitudinal studies.

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## Effect of Training on Visual-Perceptual Nasolaryngoscopy Ratings of Tremor

**Objective/Background:** Visual-perceptual ratings of laryngoscopy examinations show variable reliability, particularly for dynamic measures. Multiple methods to improve reliability of auditory-perceptual voice ratings have been reported, whereas little research has addressed methods to improve visual-perceptual laryngoscopy ratings. While the degree of tremor during vocal fold vibration can be quantified from the acoustic signal, visual-perceptual ratings are needed to assess tremor in surrounding structures. A validated visual-perceptual tremor rating scale for oropharyngeal and laryngeal structures was developed to improve standardization of ratings (Bove et al., 2006). In that study, high intra-rater reliability and moderate to high inter-rater reliability was found for a group of raters who had helped to develop the scale. The purpose of this study was to determine whether a training program was effective in improving inter-rater and intra-rater reliability for visual-perceptual tremor ratings.

**Methods/Design:** Ratings were performed by voice specialists who had not previously used the Vocal Tremor Scoring System. The training program included anchor samples (digital video-recordings) for the oropharyngeal and laryngeal anatomic regions and severity levels to be rated. Written definitions, review and discussion of the anchor stimuli, and group and individual practice ratings with the anchor stimuli as referents were components of the training program, which did not include any of the experimental stimuli. Prior to training, ratings were performed individually for the experimental dataset, which consisted of nasolaryngoscopy recordings for 10 patients with essential voice tremor. Ratings for the experimental stimuli were performed twice (for computing intra-rater reliability), in two randomly ordered blocks. The ratings were performed again after implementation of the training program.

**Results and Conclusions:** Inter-rater and intra-rater correlation coefficients will be presented, with comparison of the pre- and post-training time points. The clinical and research applications of a visual-perceptual training program will be discussed.

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## **Glottal Adduction and Subglottal Pressure in Singing**

Previous research suggests that independent variation of vocal loudness and glottal configuration (type and degree of vocal fold adduction) does not occur in untrained speech production. This study investigated whether these factors can be varied independently in trained singing, and how changes of subglottal pressure are related to changes of average glottal airflow, voice source properties and sound level under these conditions.

A classically trained baritone produced sustained phonations on the endoscopic vowel [i:] at pitch D4 (approx. 294 Hz), exclusively varying either (a) vocal register; (b) phonation type (from “breathy” to “pressed” via cartilaginous adduction); or (c) vocal loudness, while keeping the others constant. Phonation was documented by simultaneous recording of videokymographic, electroglottographic, airflow and voice source data, and by percutaneous measurement of relative subglottal pressure.

Register shifts were clearly marked in the EGG wavegram display. As compared with chest register, falsetto was produced with greater pulse amplitude of the glottal flow, H1-H2, mean airflow, and with lower MFDR, subglottal pressure, and sound pressure. Shifts of phonation type (breathy/flow/neutral/pressed) induced comparable systematic changes. Increase of vocal loudness resulted in increased subglottal pressure, average flow, sound pressure, MFDR, glottal flow pulse amplitude and H1-H2.

When changing either vocal register or phonation type, subglottal pressure and mean airflow showed an inverse relationship, i.e. variation of glottal flow resistance. The direct relation between subglottal pressure and flow when varying only vocal loudness demonstrated independent control of vocal loudness and glottal configuration. Achieving such independent control of phonatory control parameters would be an important target in vocal pedagogy and in voice therapy. [1]

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## Electroglottography and Direct Measurement of Vocal Fold Contact Area – a High-Speed Video Update

**Objective.** Electroglottography (EGG) is a popular non-invasive method that purports to measure changes in relative vocal fold contact area (VFCA) during phonation. Despite its broad application, the putative direct relation between the EGG waveform and the VFCA has to date only been formally tested in a single study (Scherer et al., 1988), suggesting an approximately linear relationship between VFCA and the EGG signal magnitude. However, in that study flow-induced vocal fold vibration was not investigated. A rigorous empirical evaluation of EGG as a measure of relative vocal fold contact area under proper physiological conditions is therefore still needed.

**Methods/Design.** In order to address this issue, three red deer larynges were phonated in an excised hemi-larynx preparation utilizing a conducting glass plate. The time varying contact between the vocal fold and the glass plate was assessed by high-speed video recordings made in the sagittal plane at 6000 fps, synchronized to the EGG signal ( $\pm 0.167$  ms).

**Results and Conclusions.** In the contacting phase, the EGG waveform systematically preceded the measured VFCA. The average difference between the normalized [0..1] VFCA and EGG data in the three larynges was 0.180 ( $\pm 0.156$ ), 0.075 ( $\pm 0.115$ ) and 0.168 ( $\pm 0.184$ ) in the contacting phase, and 0.159 ( $\pm 0.112$ ), -0.003 ( $\pm 0.029$ ) and 0.004 ( $\pm 0.032$ ) in the de-contacting phase. In the de-contacting phase, there was thus a good agreement between VFCA and the EGG waveform in two out of three larynges. Disagreements between the VFCA and EGG waveforms could have been caused by errors in data normalization, electrode placement, anisotropic conductance properties of the vocal folds, and possible effects of electroglottograph hardware circuitry. Pending further research to clarify the issue, quantitative EGG data should be interpreted cautiously, allowing for potential errors.

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## Pitch Diadochokinesis in Individuals with Parkinson's Disease: A Novel Maximum Performance Task

**Introduction:** Vocal impairments are considered one of the earliest and most frequent characteristics of speech disorders in individuals with Parkinson's disease (PD). Vocal impairments can be characterized using acoustic correlates such as voice quality, fundamental frequency ( $f_0$ ) statistics, and perturbation. Sustained phonations of vowel /a/ have been predominantly used to extract these voicing measures in PD discrimination experiments. Although production of sustained vowels is a fairly easy speech task, maximum performance tasks are arguably better because they overcome compensatory mechanisms in older adults with and without PD. Hence, investigation of laryngeal coordination through a maximum performance task is particularly motivating because simple vowel phonations may not be sufficient to identify the subtle voicing deficits present in early stages of the disease.

**Objective:** The goal of this experiment was to explore a novel maximum performance task or pitch diadochokinesis in individuals with Parkinson's disease (PD) and age-matched controls. It was hypothesized that individuals with PD will show shorter pitch rise slope and variability compared to age-matched controls with this task.

**Methods:** Eight individuals with a clinical diagnosis of idiopathic PD and 8 age-matched controls participated in this study. Participants were instructed to rapidly transition between a chosen comfortable high and low pitch and were also instructed to complete the task as a pitch glide for approximately 5 seconds. A custom-designed MATLAB algorithm was developed to measure (a) the pitch glide range, i.e. the difference between the maximum and minimum pitch produced by the subject; (b) rise/fall time, i.e. the amount of time taken by the subject to complete the pitch glide range. These two measures were then used to compute (c) rise/fall slopes. The rise/fall slope equals the pitch glide range divided by the rise/fall time.

**Results:** Preliminary findings suggest that rise range and slope of the pitch contour during the pitch glide task can significantly differentiate individuals with PD from controls with an overall accuracy of 70%. The reduction in rise slope measures indicate that PD patients are unable to transition between low and high pitches as quickly as age matched controls. Results will be discussed based on physiological underpinnings.

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### **Effects of Laryngeal Adjustments on Vocal Intensity: Evidence from Simulation and Experiment**

Although vocal intensity increase in humans is often accompanied by laryngeal adjustments to increase the glottal resistance, the effects of laryngeal adjustments on vocal intensity still remain unclear. In this talk, we present data regarding the influence of laryngeal adjustments on vocal intensity from numerical simulations, physical vocal fold model experiments, and in vivo canine experiments. In all models, vocal intensity was found to decrease with increasing vocal fold adduction (or reducing prephonatory glottal width) in both simulations and physical model experiments, or increasing activation of the cricothyroid and thyroarytenoid muscles in the in vivo canine experiments. In general, the effect of laryngeal adjustments on vocal intensity was much smaller than that of the subglottal pressure. These results showed that, although laryngeal adjustments are often observed with vocal intensity increase, they do not increase vocal intensity by themselves. It is hypothesized that, as vocal intensity increases, laryngeal adjustments are made to maintain sufficient glottal closure and conserve airflow against increasing subglottal pressure. [Work supported by NIH]

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### **Divergent or Convergent Glottal Angles: Which Gives Greater Flow?**

**Objective:**

During phonation the glottis alters between convergent and divergent angles. For the same angle value, diameter, and transglottal pressure, which angle, divergent or convergent, results in greater flow?

**Methods/Design:**

The symmetric glottal angles of the physical static model M5 were used. Characteristics (life-size) of the model were: axial glottal length 0.30 cm; angles of 5, 10, 20, and 40 degrees; diameters of 0.005, 0.01, 0.02, 0.04, 0.08, 0.16, and 0.32 cm; transglottal pressures from 1 to 25 cm H<sub>2</sub>O; resulting in flows from 2.7 to 1536 cc/s and Reynolds number from 29.4 to 13,058.

**Results:**

(1) For diameters of 0.04, 0.08 and 0.16 cm, the divergent angle always gave more flow than the convergent angle (about 5-25%); (2) for the smallest (0.005 cm) and largest diameter (0.32 cm), the divergent angles always gave less flow (10-30%); (3) for diameters of 0.01 and 0.02 cm, flow was greater for divergent 5 and 10 degrees, and less for divergent 20 and 40 degrees.

**Conclusions:**

These results suggest that the divergent glottal angle will increase the glottal flow for midrange glottal diameters (skewing the glottal flow further "to the right"?), and create less flow at very small diameters (increasing energy in the higher harmonics?).

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## Control of the Glottal Configuration in *Ex Vivo* Human Models

**Objective:** this study aimed at quantifying the effect of muscular control on glottal configuration in excised human larynges. The two parts of the study are adduction control and tension control of the vocal folds.

**Material and methods:** All larynges were excised from autopsic subjects, without any laryngeal lesion at examination. 10 larynges were studied in the adduction part. Adduction was obtained by arytenoid approximation and/or by membranous vocal fold medialization, and the glottis area was measured in each situation. 10 other larynges were studied in the tension part, and crico-thyroid angle and vocal fold length variations were correlated with the crico-thyroid approximation from 0 to 25mm.

**Results:** The adduction part showed that the glottal area was decreased from 41,2mm<sup>2</sup> mean without adduction, 10,2 mm<sup>2</sup> with arytenoid adduction, 9,2mm<sup>2</sup> with membranous vocal fold medialization, up to 1,1mm<sup>2</sup> mean with the combination of arytenoid and membranous adduction. The tension part showed that the length of vocal folds increased (+1,3mm mean) and the crico-thyroid angle decreased (-9,62° mean) with crico-thyroid approximation.

**Conclusion:** this study gives better insight to the action of the intrinsic laryngeal muscles: lateral crico-arytenoid (ie. arytenoid adduction) , thyro-arytenoid (ie. membranous vocal fold medialization), crico-thyroid (ie. vocal fold extension). It will also be the basis for further studies of phonation based on excised human larynges using experimental test-bench.

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**Gender Differences in Speech: Correlating Pulmonary Function with Symptoms of Vocal Fatigue among Occupational Voice Users**

**Objective:**

To determine if there is a relationship between chronic voice fatigue and the pulmonary function of individuals who work in occupations that require a lot of talking and whether that relationship is stronger for females or males.

**Methods:**

123 public school teachers (97 female, 26 male) were recruited to participate in this study: an occupation identified as requiring frequent and prolonged voice use. Subjects completed a series of questionnaires about their voice use and voice comfort. Following the questionnaires, they underwent a three-part assessment consisting of (1) a pulmonary function test, (2) a phonation threshold test, and (3) a vocal acoustical assessment. Whenever possible, the research was conducted at the subjects' work environment. Scores from one of the questionnaires (the vocal fatigue index - VFI) were tabulated and examined in relation to spirometry measures (FET, FVC, and FEV), and acoustical measures. Simple correlations were drawn and higher-order statistical analysis was conducted to determine the strength of any apparent relationships.

**Results:**

Among teachers whose VFI scores provided the strongest indication of voice fatigue, a relationship does appear between VFI scores and individual spirometry measures. This relationship also appears to be stronger among female participants than males.

**Conclusions:**

A relationship between spirometry measures and the occurrence of voice fatigue suggests that underlying issues with an individual's pulmonary function may predispose her/him, to experiencing symptoms of chronic fatigue. Females may be particularly at risk.

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## The Cepstral Peak of Periodic and Quasi-periodic Signals

The cepstral peak is a popular method for quantifying voice quality and has been shown to be sensitive to breathiness and overall severity of dysphonia. While the cepstral peak has been used to quantify the degree of periodicity of voice signals, the factors that affect the cepstral peak are less well understood. For the most fundamental periodic signal (a pulse train), the cepstral peak depends on the analysis window type (e.g., rectangular, Hann, Hamming) and length relative to the fundamental period of the pulse train as well as the phase between the window onset and the first pulse within the window. For filtered pulse trains (i.e., periodic signals with amplitude variation), signal discontinuities at window edges have a profound impact on the cepstral peak which may be mitigated by using zero-tapering windows (e.g., Hann, Blackman). Using a Hann window, cepstral peak diminishes slightly due to pulse train filtering for a broad range of speech-like transfer functions. The cepstral peak of a low-pass filtered pulse train decreases in proportion to the relative bandwidth of the pass band, indicating that the cepstral peak is not a property of the acoustic signal but rather a measure of a discrete-time representation of the acoustic signal with implicit reliance on sampling rate. Periodicity is “broken” when period-by-period variation occurs either by additive noise, amplitude and period variation, spectral changes, or some other biologically relevant alteration, all of which decrease the cepstral peak. The effects of various period-by-period variations on the cepstral peak were measured and compared to that of periodic signals with the goal of designing a cepstral peak estimator that is sensitive to quasi-periodicity, specific to the type of periodic-breaking alteration, and robust to variations in confounding signal characteristics (e.g., fundamental frequency, level).

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### **Bruxism and Vocal Constriction in Singers: A Pilot Study**

**Objective:** Vocal pedagogy often discusses the need for a relaxed jaw in singing to ensure vocal freedom. This study investigated the relationship between bruxism and vocal hyper-function to see if residual tensions accumulated from nighttime teeth grinding can associate with vocal constriction.

**Method:** A correlational study was performed comparing jaw clenching times to various estimates of vocal hyper-function such as electroglottographic closed quotients, audible evaluations of vocal strain, EGG waveform analysis, and harmonic to noise ratio. Jaw-clenching times were recorded using an EMG device worn by test subjects over a span of three nights. This data was compared to closed quotients measured on low (Eb3 or Eb4), middle (Bb3 or Bb4), and high (Eb3 or Eb5) pitches sung on /Λ/ vowels in the octaves appropriate to the test subject's vocal fach. Blind to the jaw-clenching times, university voice science professors listened to the audio samples taken from the EGG measurements and rated them on a numerical scale for audible levels of vocal strain.

**Results:** There was a positive correlation between jaw-clenching times, closed quotients, and strain ratings for every pitch range in both men and women. Test subjects with longer average jaw clenching times tended to sing with higher closed quotients and were scored with higher audible vocal strain. Furthermore, evaluation of the EGG waveforms of male test subjects with high strain ratings revealed saw-tooth like patterns often associated with pressed phonation. Harmonic to noise ratios also showed a positive correlation with jaw clenching times. However, due to the small sample size of only four men and four women in this pilot study, these correlations generally did not have statistical significance.

**Conclusion:** The consistent pattern of positive correlations throughout the experiment suggests that a relationship worthy of further investigation may exist between bruxism and vocal hyper-function. Once statistical significance has been established with a larger sample size, experiments to determine causation could be conducted by gradually reducing habitual jaw clenching times in test subjects through biofeedback therapy.

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### **The Use of the Subliminal Implicit Learning Paradigm in Voice Motor Learning**

Background: Implicit motor learning is referred to the passive accumulation of task-relevant knowledge at an unconscious level. Subliminal learning, a form of implicit learning, utilizes unconscious thresholds to influence behavior in a way that subjects are unaware of the subliminal adaptation in response to the stimuli presented. A Just Noticeable Difference (JND) is the smallest detectable threshold that an individual can detect between two sensory stimuli at above chance level. In order to set up the condition for subliminal learning, it is necessary to first identify the JND in visual stimuli.

Aim: The aims of this study were to examine the JND of visual stimuli.

Methods: The JND of 30 subjects (mean age=25.11years) were identified by means of a visual discrimination task of subtle differences between multiple visual stimuli. Visual stimuli were presented in a graph form (two lines at the X and Y-axis) and the changing visual stimulus represented as a line in the middle. Subjects were asked to indicate accurately as possible whether the position of the middle line had changed or not indicating 'higher' or 'lower' for each trial.

Results: Results revealed that subjects were unable to discriminate small subtle differences when the visual stimuli (middle line) changed within 1% visual displacement compared to a standard height, but they were able to discriminate visual changes when the visual stimulus increased above 1.5% displacement (equivalent to 4.5cm differences) of the standard height. When presented with large alteration of the visual stimuli they presented higher level of confidence, suggesting a certainty in their identification of the transforming stimuli. Results from this study provides us with the JND value for setting up further experimental studies on subliminal implicit learning for voice motor learning.

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**Comparison of Predictable Formant-Harmonic Interactions with the  
Historic Pedagogic Locations of the Male Zona di Passaggio**

Predictable, changing interactions between the lower harmonics of the voice source and the first formant of the vocal tract can provide an acoustic explanation of the historically understood location of the events of the *zona di passaggio*. Ten specific formant-harmonic intersections correlate with the male *zona di passaggio*, (with its *primo* and *secondo passaggi*), as understood in the international Italian school and reported by R. Miller (1986), necessitating specific pedagogic strategies that differ by vowel. This paper will compare the locations of these events, illustrate them by means of voice synthesis (*Madde*, Granqvist), and describe how and why pedagogic strategy must vary by the vowel's first formant location.

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## **An Examination of the Demographics of a SVS Practice in a Large Metropolitan City**

This study is a follow-up of a demographics study presented four years ago by the Sound Singing Institute at the Voice Foundation Symposium in regard to this specific practice's population. All of the information reported was gathered at the initial evaluation. An excel spreadsheet was created into which the data were entered and then tabulated. While the categories in entirety include (1) age, (2) gender, (3) singer type, (4) genre, (5) group, (6) diagnoses, (7) post surgery, (8) post cancer treatment, (9) medical condition, (10) referral source, and (11) occupation, this presentation will elucidate categories 1-6 and 10-11.

The categories for this database grew over time and some of the categories were difficult to synthesize. For instance, in regard to genres, while the researchers realize that only "commercial" and "classical" could have been written, the most popular genres were also specifically outlined. Also the diagnoses category contains both medical diagnoses and patient reported symptoms of the vocal apparatus.

Primary referrals were from ENT's in Houston as well as others in and outside of the state of Texas. It is the current practice of the SSI that a referral must have a medical examination. It is preferred that the patient have a video examination to present at the initial evaluation with the SVS as pictures only show if pathology is present and do not show muscular function.

As outlined in "Preparing the Singing Voice Specialist Revisited," as the need for qualified and well trained singing voice specialists grows a means for appropriate preparation is required. Perhaps the examination of a SVS practice in a major metropolitan city will help to illuminate the breadth and type of preparation needed. This is especially relevant since there are programs of training underway.

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### **A Preliminary Study on the Effects of Different Consonant-Vowel Combinations on Airflow in Classically Trained Sopranos\***

Perceptual and acoustic analyses were completed to investigate the possible effects of different consonant-vowel combinations on airflow in classically trained sopranos. Eight (N=8) graduate level sopranos were asked to indicate their voice teachers' preferences of vowels, consonants and consonant-vowel combinations, as well as their own, which they often use in their vocal exercises. After this pre-experimental procedure, all participants were asked to sing a researcher-selected vocalise in their low-medium (D4-A4) and medium-high (A4-E5) ranges, using different consonant-vowel combinations. KayPENTAX Phonatory Aerodynamic System Model 6600 was used for collection of data throughout the experimental procedures. Numerical data was collected on vital breath capacity, phonation time, expiratory volume, and mean expiratory airflow. For collection of perceptual data, all participants were asked to specify the consonant-vowel combinations they felt particularly comfortable and uncomfortable with when vocalizing in their low-medium (D Major) and medium-high (A Major) ranges throughout the experiment. The purpose of this study was to investigate the effects of consonants /b/, /d/, /g/, /r/, /z/, and /m/ on airflow in the low-medium and medium-high ranges of classically trained soprano voices, when paired with the vowels /i/, /e/, /a/, /o/, /u/. Results of the perceptual and acoustic analyses did not display any distinctive patterns or commonalities among the eight participants.

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\*This research study was designed and completed at the Presser Voice Laboratory at Westminster Choir College in Princeton, NJ.

## **The Evolution of the Female Broadway Belt Voice: Implications for Teachers and Singers**

**Background** - In a little over a decade, the range of the female belt voice has changed more drastically than in the previous seven decades due to the rapid increase of the rock/pop musical. Traditionally, the belt range extended to C5, but in current rock/pop Broadway productions, females are often required to belt up to an F5. This higher extension of the belt voice beyond C5 is a significant change, and female musical theater singers need effective strategies to produce these higher belt notes.

**Objective** - The intent of this study is to gain a clear understanding of the techniques and strategies used to successfully teach and produce the higher range of the female musical theater belt voice.

**Method** - The study is a qualitative design composed of two data collection methods: interviews with four nationally recognized master musical theater voice teachers and 17 of their female belt students, and observations of the master teachers working with these students in their private studios.

**Results** - There was much consensus among the teachers and singers on the strategies and sound of the higher belt range, such as incorporating more head voice involvement with closed, narrow vowels, and maintaining a bright, speech-like quality. Singers report that they produce high belt notes with more of a mix vocal approach. Teachers suggest that female voice type may determine the extent of a singer's ability in this high belt range.

**Conclusions** - The high belt will be narrow, based on closed vowels, mixing in some degree of head voice function, with very little use of vibrato. Although this study has revealed some guidelines for the female musical theater high belt and similar strategies among master teachers, voice teachers should be aware of the variability of their female musical theater voice students.

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### **Applying Exercise Science Principles to Voice Pedagogy: Skill Acquisition and Vocal Literature Selection**

**Objective:** Although there is a large body of literature that applies exercise principles to athletic goals (running marathons, training specific skill acquisitions, etc.), there is relatively little research currently being done that applies these same principles to musical endeavors. This presentation will summarize recent research in exercise science principles. These principles will then be directly applied to specific warm-up regimes (skill acquisition) and literature selection for singers.

**Methods/Design:** The presentation will begin with a discussion of skill acquisition from the exercise physiology perspective. Current research supports the concept that muscles will do what they are trained to do. This will segue to a description of common skill acquisition warm-ups that are generally used in voice training and rehabilitation, including tone/resonance development, flexibility, power, and range. Assessment methods and rubrics that hone in on the individual singer's abilities in these areas (such as range, tessitura, flexibility, resonance, etc.) will be discussed. The presentation will conclude with a discussion of how one can use this objective data to assign specific repertoire from the standard body of vocal literature. Thus, the specific areas of skill acquisition are reinforced through appropriate repertoire selection.

**Results and Conclusion:** Consideration of exercise science principles, particularly in the area of muscle training and skill acquisition is an invaluable tool when assigning vocal warm-ups and repertoire. Integrating these principals into one's teaching and voice training in shorter performance intervals directly encourages successful outcomes in longer and more involved performance endeavors.

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## **A Pilot Study: Investigating Formant Tuning in Girl Choristers Through Wide-Band Excitation**

Formant tuning is a technique seen in professional female adult singers, whereby the singer modifies the shape of their vocal tract in order to increase the acoustic power output by improving the efficiency of the vocal source and vocal tract.

It has been seen that formant tuning is employed over a smaller pitch range by less experienced singers, and they are also less likely to tune higher formants. This study aims to determine if experienced young singers are using formant tuning techniques, by investigating the extent of formant tuning in girl choristers.

Wide-band excitation at the subject's mouth during singing was used to measure the vocal tract resonances of 3 girl choristers. Formant values in sung vowels were compared to the average values in speech, to find evidence of formant tuning in sung vowels at high pitches, and determine if similar formant tuning techniques are used by female choristers as by professional adult classical singers.

It is expected that some evidence of formant tuning will be seen in the choristers, and further work may focus on determining when formant tuning is developed, and in developing tools to help young singers learn to formant tune effectively.

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## **The Impact of Cool-Down Exercises: A Subjective Study of Singers' and Listeners' Perceptions**

A previous study on the efficacy of vocal cool-down exercises through aerodynamic and acoustic measures yielded inconclusive results due to various circumstances. However, the small subjective survey provided evidence that further study was warranted. Therefore, the objective of this research was to significantly expand the subjective measures, including the addition of an expert listener portion, to evaluate whether there were discernible differences in either singer or listener perception from pre (no vocal cool-downs) to post (after using cool-downs) test.

This paper presents the results from the single subject crossover design study. Twenty classically trained collegiate level female singers documented self-ratings through the EASE Survey, Singing Voice Handicap Index (SVHI), Daily Self-Perceptual Questionnaire and End of the Study Questionnaire used for evaluation. During a two-week period, singers replicated a daily 60-minute voice load through vocalizes and arias. A cool-down protocol was then utilized during one week of the study and during the second week singers did not use the cool-down exercises. Randomized paired recordings of the two weeks were assessed by four expert listeners both with and without the cool-down protocol. Perceptual judgments were made with regards to voice condition through a series of questions.

The data from the SVHI, EASE and Perceptual Questionnaires show a majority of participants (up to 75 percent) perceived a positive impact from using cool-down exercises. Most interesting were the singers' positive comments about the cool-down exercises' impact on both their speaking and singing voices. The more knowledgeable the singer with regard to voice pedagogy, the more pronounced the impact and awareness from using the cool-down exercises. Although expert listeners were positive they could accurately discern the cool-down weeks from the non-cool down weeks, their accuracy was only approximately 50 percent.

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## **The Effects of Two Warm-up Procedures on the Acoustic and Perceptual Measures of Choral Sound**

Numerous choral pedagogues recommend beginning a choir rehearsal with a warm-up that combines physical and vocal warm up procedures. The purpose of this study was to assess with intact choirs ( $N = 4$ ) the potential effects of two different choral warm-up procedures (strictly physical or strictly vocal) on the acoustic and perceptual measures of choral sound. Choristers followed one of two videotaped warm up sessions (A or B) at the beginning of their regular choir rehearsal. Warm-Up A featured a choir conductor leading the choir in a physical only, no phonation warm up and Warm-Up B presented the same conductor leading the choir in a vocal only, no physical activity, warm up. Immediately following the warm-up video, each choir recorded the same unison folk song. Data were acquired during six data collection sessions across an eight-week period. Digital audio recordings of the choral performances were used for analyses of long-term average spectra (LTAS), intonation, and amplitude. Expert listeners evaluated differences between each set of recordings and singer surveys provided singer perceptions regarding their singing ability under each warm up condition. Results will be discussed in terms of differences in choral sound between Warm Up Conditions A and B as determined by LTAS, pitch analysis, expert listener results and singer perceptions.

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### **Working 9 to 5: Impact of Non-performance Voice Use on Singers' Vocal Health**

Employment across the range of vocal artistry is notoriously episodic and unpredictable. Few performers make their living reliably from their art-form alone. Driven by a need for steady income in professions which have spasmodic job options and where pay rates rarely recognize the years of training, experience and skill maintenance required to attain mastery in their artistic field, there often is a socio-economic imperative for singers to seek additional work – to have a ‘day job’.

Existing studies relating to occupational voice health, across a range of employment were reviewed in order to contextualise this investigation. Research relating to voice health and voice stress within a cohort (N=102) of professional contemporary gig singers (Bartlett, 2011) defined the type, frequency and duration of work outside their professional singing employment. Qualitatively-moderated responses were used to evaluate the impact of these ‘day jobs’ on the singers’ vocal health.

Findings from the study present strong indicators that the source of many voice problems for professional singers lies in unrecognised abuse or misuse of their everyday work-related speaking voice use rather than their performance style choices. This is informing knowledge for all voice care professionals who work with singers.

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## The Impact of Aerobic Exercise on Vocal Warm-up for Singing

**Objective:** There are many variations of warming up for singing, primarily focusing on vocalizing. In contrast, this study was designed to explore the potential benefit of aerobic exercise on voice production. It was hypothesized that following aerobic exercise, the singer would demonstrate increased sound pressure level (SPL), increased pre-phonatory inspiration, and increased airflow during voicing. Our goal was to test the hypothesis in as natural a context as possible, embedded in singing the national anthem of the United States.

**Methods/Design:** Twenty-two students in an academic vocal performance program participated (16 graduate; 6 undergraduate). There were 11 sopranos, one mezzo-soprano, five tenors, three baritones, and two bass/baritones. All participants completed the Physical Activity Readiness Questionnaire (PAR-Q), and indicated they were safe to exercise. NASA Physical Activity Ratings were obtained, where 0 indicates an avoidance of walking and exertion, and 10 indicates running over 25 miles per week or 12 hours in comparable physical activity. Participants' activity levels ranged from 2 to 8, with an average of 6.8, indicating that the majority of the participants were in good physical condition. Physiological data during singing were acquired before and after a 30-minute treadmill workout in the singer's aerobic heart range. In full voice, participants sang the first seven notes of the Star Spangled Banner on "pah", repeating the seventh note at 1.5 syllables per second following an inhalation. Inspiratory and expiratory airflow and intra-oral pressure data were captured with a face mask covering the nose and mouth, and a pressure sensing tube positioned behind the lips.

**Results:** Five students produced sound pressure levels (SPL) more than 1 dB softer when singing following aerobic exercise. This was considered reflective of fatigue, and the remaining analysis focused on the 17 singers who increased SPL following exercise. Paired t-tests were performed to assess differences pre and post exercise. Mean SPL increased from 105.1 to 106.2 dB SPL, significant at  $p = .01$  ( $df = 16, t = 2.44$ ). Mean airflow during voicing increased from 261 cc/s to 302 cc/sec., significant at  $p = .02$  ( $df = 16, t = 2.63$ ). Mean airflow was essentially unchanged in the participants who decreased SPL. Across groups, there was essentially no change in the magnitude of inspiration prior to the sung repeated syllables. There was also considerable variability among participants, precluding some potentially significant differences, particularly in vocal efficiency.

**Conclusions:** The results of this study demonstrate the benefit of aerobic exercise to prepare a singer to perform. With aerobic exercise, singers significantly increased SPL, and more importantly, did so primarily by significantly increasing airflow during voicing. The lack of increase in pre-phonatory inspiration is attributed to the singer's use of a catch breath, and the potential for many to have continued singing without a second inspiration. This study highlights the potential benefit of a more holistic approach to warming up for vocal performance.

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## **Stress Factors Contributing to Self-Reported Symptoms of Vocal Hoarseness and Vocal Fatigue**

Numerous factors can contribute to one experiencing unpleasant vocal symptoms.

Indeed, one's general health, dietary and vocal habits can always have an impact. Research shows that among the contributing factors to poor general health, some significant ones can be psychological. Felitti and colleagues (1998) discussed how childhood adverse experiences predicted several health conditions in adulthood.

In the present study, the authors aim at investigating if some psychological factors, including childhood trauma, appear to contribute to self-reported vocal symptoms. 82 participants between the ages of 18 and 71 took part in this online preliminary study. They were administered four questionnaires to assess childhood trauma, attachment in adulthood, anxiety, shame, guilt, pride and detachment/unconcern. Also, participants responded to numerous questions regarding their vocal health history, vocal habits, general health and dietary habits.

In the analyses, those who reported having experienced vocal hoarseness and vocal fatigue in the past had significantly higher levels of childhood trauma. The same results were obtained for vocal hoarseness and levels of avoidant attachment, detachment and denial of trauma. Participants who reported seeing an ENT and receiving a diagnosis were grouped together and found to have marginally higher ( $p = .05$ ) levels of detachment.

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### **Perception of Non-Vibrato Sung Tones**

Singers are often asked to sing with a non-vibrato production. However, the term non-vibrato is problematic in that it is not possible for a human to sing a tone without fundamental frequency variation. Whether a singer achieves a quality of tone that is perceived as non-vibrato is an aurally subjective matter. The specific aim of this study was to determine when a tone is perceived as non-vibrato by a population of singers, voice teachers, choir directors, and speech pathologists. Utilizing voice samples that exhibit a variety of vibrato rates and extents, the investigator sought to determine:

- (1) If there is a threshold for the perception of non-vibrato tone with regards to vibrato extent;
- (2) If given similar vibrato extent, does vibrato rate affect the perceptual threshold of non-vibrato tone;
- (3) If there are differences in the perceptual threshold of non-vibrato tone across the different professions of the research subjects.

Participants responded to an online survey featuring forty randomized samples of soprano voices singing [a] with a variety of vibrato rates and extents. Some samples were repeated to test subject response reliability. Results indicate that a clear perceptual threshold exists with regards to vibrato extent. Substantial differences were found across the four groups.

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### Registration Strategies of Professional Operatic Mezzo-Sopranos

Singing operatic and oratorio mezzo-soprano roles involves substantial skill in negotiation of the Mode 1-2, transition, or *primo passaggio*, under a variety of conditions. Stylistic demands and the mezzo-soprano operatic vocal range often require this registration event to be perceptibly camouflaged and sung with sufficient amplitude and resonance to be heard over an orchestra. Revered 19<sup>th</sup> century pedagogue Manuel Garcia II instructed singers to employ a “glottal pinch” at the transition to increase glottal closure, suggesting that success was dependent upon favorable voice source behavior. Can evidence of this approach be seen in today’s operatic professionals? This study examined “best practices” from mezzo-sopranos who have recently sung with Level I opera companies or orchestras with an annual budget of at least \$10 million. To noninvasively examine voice source behavior in an environment that is physically conducive to normally produced operatic singing, measures derived from electroglottography and inverse filtering were examined to observe and document voice source characteristics as these singers negotiated the *primo passaggio*. Subjects were asked to sing ascending and descending chromatic scales using different vowels as they would in an operatic performance. The point, or zone, of transition from Mode 1 to Mode II (and the reverse) was determined in each sample to identify any differences in technical approach based upon vowel or scale direction. Preliminary results suggest that successful singers have a variety of techniques at their disposal to negotiate the *primo passaggio*. Future research will be extended to work with professional sopranos and singing voice students.

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## **Group-Singing Music Therapy Protocol as an Adjunct Treatment for Parkinson's Disease**

Over one million Americans live with Parkinson's Disease (PD) and 60,000 new cases are diagnosed each year. Speech-motor problems in PD occur when dopaminergic neurons die or become impaired. Primary symptoms include resting tremor, slowness, rigidity, postural instability, reduced speech intelligibility, depression, fear and anxiety, all to the detriment of quality of life (QOL).

Speech intelligibility problems reduce effective communication and can contribute to social withdrawal, a growing sense of isolation, and strain in maintaining relationships. Typical PD speech symptoms include breathiness, roughness, reduced prosody, ability to sustain tones, and a reduced ability to follow internal feedback as to how loud the person with PD should be speaking. Many patients benefit from (and current literature supports) the inclusion of a Singing Voice Specialist (SVS) and a Board-Certified Music Therapist as part of a multidisciplinary care team. We hypothesize that choir singing will favorably impact speech intelligibility and quality of life measures in people living with PD.

PD participants (n=12) will be recruited from the general geriatric population. Inclusion criteria will be health sufficient to engage in singing and cognition sufficient to give consent. Participants will engage in eight weekly 50-minute group-singing sessions that will focus on posture, respiration, phonation and articulation. The singing protocol will include 15 minutes of vocal warm-up exercises (VWUE), 30 minutes of vigorous singing with guitar accompaniment, and five minutes of vocal cool-down vocal exercises. Participants' caregivers will be invited to sing in the choir, though their data will not be collected or included in this study. Participants' speech will be examined before and after the 8-week period. Acoustic measures will include intensity, duration, and perturbatory measures. Self-reported voice and QOL measures will be solicited via the Voice Handicap Index (VHI-10).

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### **The Factor of the Closed Quotient in Male Operatic Singing above Passaggio**

For pitches above (second) passaggio in male operatic singing, and especially for exposed "money notes," spectrum analysis of professional subjects as well as of the recorded literature shows that elite singers characteristically choose resonance strategies that exploit a dominant harmonic enhanced by the second formant, the singer's formant cluster, or a combination of the two. In order for these strategies to be fully effective, we will show that a relatively large closed quotient (generally >65%) is required. The closed quotients are monitored by the EGG signal in the software VoceVista, together with inverse filtering in the software DeCap/Sopran. Means of achieving the elevated closed quotients not directly related to high subglottic pressure will be discussed.

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## How Know-That Becomes Know-How: New Research in Motor Learning Theory

With rapid advances in neuroscience, the gulf that once separated mind and body is eroding rapidly. Yet current learning theories and their terminology still reflect a fundamental division between the mind and the body: i.e. *declarative* versus *procedural* learning, or *propositional knowledge* versus *tacit knowledge*. This dichotomy has its roots in the ancient world, when Greek philosophers used the word *epistêmê* to mean knowledge and the term *technê* to mean “craft.” Thus, knowledge is understood as a product of the mind (thought) whereas craft is a product of the body (activity). In philosophy, this dichotomy is known as simply “know-that” and “know how.”

In psychology, the foundational principles of motor learning theory are based on this dichotomy; while these principles account for simple motor tasks and gross motor skills, until recently, they have not adequately accounted for complex or fine-motor activities, like fine singing, instrument-playing or dance. Singers, instrumentalists and dancers must have knowledge of basic information before they can effect that knowledge in its physical form: they must first know-that in order to know-how. Where they obtain this know-that is from a coach, who provides “feedback.” According to motor learning researchers, “feedback” is second only to practice in facilitating motor learning, with feedback grouped into two categories: *augmented* (i.e. verbal instruction from a coach) and *sensory* (what the learner’s own nerve endings are relaying). Given that the successful transference of vocal technique or therapeutic tasks ultimately hinges on the ability of the teacher, coach or therapist to impart efficacious feedback, I will present the most recent research in motor learning theory, with an emphasis on the conundrum surrounding how the brain processes verbal feedback (“know-that”) for muscular tasks (“know-how”), with a particular emphasis on higher-order complex motor tasks such as singing.

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## **Singer's Dystonia: The Singing Voice Specialist's Participation in Diagnosis and Singing Voice Habilitation - A Case Study**

### **Objective:**

The Singing Voice Specialist (SVS) is an integral participant in the diagnosis and treatment of Singer's Dystonia--a neurological condition characterized by voice breaks and laryngeal spasms during singing that are reproducible and pitch-and/or-task-specific, that will include either abductor spasms on voiceless consonants or adductor spasms on sustained vowels in singing, and that are unresponsive to diligent singing technique work, medical treatment, and voice rest. Diagnosis is confirmed by a positive finding in medical and laryngeal exams by the physician assisted by the SVS, in evaluation of the singing voice by the SVS, in the spectrographic analysis by the Speech Language Pathologist, and in the laryngeal EMG. Treatment may include medical intervention, Botox injections, and retraining by the SVS.

### **Methods/Design:**

Focusing primarily on the case of a professional baritone/dancer performing 8 shows weekly in a professional variety show, this paper will first explain the participation of the SVS in the diagnostic evaluation of this singer, which calls on the expertise of the SVS to eliminate the possibilities of poor technique and passaggio problems and to help to isolate the recurring task-or-pitch specific problem caused by the dystonic spasms. Exercises and listening skills implemented in this evaluation will be detailed.

Additionally, the habilitation, behavioral management, and retraining of the singer's technique and performance tasks by the SVS will be discussed, including vocal exercises, strategies for adjusting to the dystonic spasms' behavioral limitations, ways to modify repertoire, changing of keys in songs to minimize dystonic breaks, providing psychological support required for optimal performance, and handling the singer's, managers', and colleagues' reactions to the "new normal" for the Singer's Dystonia patient.

### **Results and Conclusion:**

The SVS is integrally involved in both the diagnostic and treatment phases for Singer's Dystonia, helping the singer to better manage their singing tasks and to minimize the troubling spasms.

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## **The Relationship of Vital Breath Capacity and Efficient Breath Use in Varying Degrees of Exhalation and Phonation in Classically Trained Singers**

The purpose of this study is to explore the relationship between singers' vital breath capacities and their efficiency of breath use in various degrees of exhalation (non-phonatory) and phonation. Four areas of breath use are examined: vital capacity, /s/ semi-occluded sustained exhalation, /z/ semi-occluded phonation, and a sustained single pitch with the single vowel /i/ in non-occluded phonation. Participants ( $N = 20$ ; men,  $n = 8$ ; women,  $n = 12$ ) are first and second year graduate students at a major, Northeastern conservatory, all in their 20s or early 30s, with their primary performance emphasis in voice. Measurement tools include the s/z ratio protocol, the KayPENTAX Phonatory Aerodynamic System (vital capacity and phonated airflow), and a background questionnaire. Results are discussed in light of voice pedagogy for breath management in singing, the size of singers' vital capacity and the quality of breath use (both acoustic and perceptual), as well as by sex, age, years of study, and voice health history. Future considerations include physical attributes such as body size, rib cage diameter, BMI, and neck circumference.

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## Perceptual Salience of Amplitude and Frequency Modulation in Vocal Vibrato

### Objective

Research in acoustic analysis of vocal vibrato and related vibrato synthesis suggests that amplitude modulation (AM) arises chiefly as a secondary phenomenon resulting from resonance tract variation related to the oscillations in frequency (FM) produced by performers. The purpose of this study was to investigate the perceptual salience of modulations with AM only, FM only, and AM/FM-combined examples. Vocal and instrumental musician listeners judged the quality of processed vibrato tones of a male and female singer.

### Method

Two professional singers, one female (soprano) and one male (baritone), sang the first 12 measures of *Ave Maria* (Bach/Gounod). The singers produced two versions: one with their normal full use of natural vibrato, and a second utilizing straight tone without any vibrato. We recorded multiple examples of each version. A panel of music graduate students then identified the best examples. We processed the sound files using ProTools (Avid) and created experimental stimuli using the MondoMod plug-in (Waves Systems Ltd.). Four stimuli were produced, the original singer vibrato version and three modifications of the straight tone version: Examples with AM only added, FM only added, and both AM and FM added. Listeners were music majors attending a large music school, and comprised 20 vocalists and 20 instrumentalists. Participants were presented two practice examples and judged 12 pairs of examples (6 for each voice) using the method of paired comparisons. Listeners were asked to judge which member of each pair was most representative of characteristic vocal vibrato and to give sound quality judgments on a 7-point rating scale.

### Results

Results were discussed in terms of previous research concerning acoustic analysis and synthesis of vocal vibrato. Limitations of the study, implications for singers and voice studio teachers, and directions for future research were also presented.

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## **Assessments of Voice Use and Voice Quality Among College/University Singing Students Ages 18-24 Through Ambulatory Monitoring with an Unfiltered Accelerometer Signal**

Voices are still developing during the first years of collegiate study. Yet the multiple social and performance demands placed on college/university singers could put their voices at risk. While previous vocal dose studies have analyzed the duration, intensity and frequency (in Hz) of voice use among college/university singing students through ambulatory monitoring, no studies to date have incorporated the simultaneous acquisition of these measures with acoustic voice quality measures so that they could be directly compared for the same voicing period. Such data could be helpful in developing a greater understanding of how young singers use their voices as well as potential correlations between vocal dose and acoustic changes in voice quality.

The purpose of this study was to assess the voice use and voice quality of college/university singing students ( $N = 19$ ), ages 18-24 years through measurements of vocal dose and voice quality, collected over three full days of ambulatory monitoring, with an unfiltered neck accelerometer signal acquired with the Sonovox AB VoxLog™ portable voice analyzer collar. Vocal dose metrics included phonation percentage, dose time, cycle dose, and distance dose. Voice quality measures included fundamental frequency ( $F_0$ ), perceived pitch ( $P_0$ ), LTAS slope, dB SPL, alpha ratio, dB SPL 1-3 kHz, pitch strength, shimmer, jitter, and harmonic-to-noise ratio.

Major findings from more than 800 hours of recording indicated that among these students (a) higher vocal doses correlated significantly with greater voice amplitude, more vocal clarity and less perturbation; and (b) there were significant differences in voice quality between non-singing, solo singing and choral singing, with solo singing having the highest mean  $F_0$ , dB SPL and voice clarity and least perturbation and with non-singing periods having the largest daily vocal dose.

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**The Effects of Choir Spacing and Choir Formation on Long-Term Average Spectra (LTAS)  
Acquired from a Female, SSAA Choir**

Vocal methods literature treats choir spacing and choir formation as time-efficient, nonverbal strategies to change the quality of a choir's sound. Choir spacing refers to how closely singers stand in relation to each other in performance. A choir formation is a positioning of singers solely according to the scored voice parts they sing.

Since 1960, a host of perceptual preference studies has examined these two strategies. Only recently, however, have separate lines of investigation tested the effects of choir spacing (e.g., Daugherty, et al., 2013, Daugherty, 2014) and the effects of choir formation (e.g., Morris, et al., 2007; Daugherty, 2014) on the long-term average spectra (LTAS) of choir sound. The purpose of the present study was to compare the effects of three inter-singer spacing conditions (close, lateral, circumambient) and two choir formations (sectional formation, mixed formation) on LTAS data acquired from a female, SSAA choir as it sang a largely homophonic motet. Among the controls instituted: (a) videotaped conducting to insure consistency of tempo and the same conductor behaviors during the sung trials, (b) random assignment of singers to consistent row positions within the choir, (c) maintenance of the same distance from the front row of the choir to the microphone locations in all trials, and (d) a randomly ordered performance sequence of the choir spacing and choir formation variables. Results were discussed in terms of optimum singing efficiency, vocal/choral pedagogy, and the logics informing choir spacing and choir formation schemata.

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## Noise Doses Acquired by University Singing Voice Instructors during Voice Lessons Taught Across One Week in Intimate Studio Venues

This investigation examined noise doses acquired by 14 voice instructors (9 females, 5 males) during lessons ( $N = 40$ ) taught across 1 week in small, University-assigned practice room venues (58 - 63 sq ft) re-purposed as voice teaching studios. Participants wore factory calibrated Etymotic Personal Noise Dosimeters (Model ER-200D) set to NIOSH measurement recommendations. In addition, 1 male and 1 female instructor wore dosimeters during waking hours for a full day inclusive of teaching and non-teaching times. Among primary results: (a) cumulative noise doses acquired by instructors teaching 1 of 15 single, 1-hr voice lessons ranged from 7% - 76% of daily allowable dose ( $M = 33\%$ ), with  $L_{eq}$  levels from 82.82 - 93.69 dBA ( $M = 88.16$  dBA); (b) for 6, contiguous 2-hr teaching periods recorded (12 lessons, each period in the same room), cumulative noise doses ranged from 23% - 210% of daily allowable dose ( $M = 86.67\%$ ), with  $L_{eq}$  levels from 84.81 - 94.24 dBA ( $M = 89.13$  dBA); (c) for 2, contiguous 3-hr teaching periods recorded (6 lessons), instructor acquired cumulative noise doses ranged from 28% - 81% of daily allowable dose ( $M = 55\%$ ), with  $L_{eq}$  levels from 84.06 - 88.50 dBA ( $M = 86.28$  dBA); (d) 1 instructor who taught 4 contiguous lessons in the same room acquired 290% of her daily allowable noise dose, with a mean  $L_{eq}$  level of 92.53 dBA; (e) 3 instructors who taught non-contiguous lessons on the same day in the same room acquired between 48% and 314% of daily allowable noise dose; and (f) the 2 instructors who wore dosimeters across a full day of activities acquired 1100% (male) and 1500% (female) of NIOSH allowable noise doses. These results were discussed in terms of noise-induced hearing loss among voice teachers and directions for future research.

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## Acoustic Clarity and Vocal Comfort for Singers

Abstract:

**Introduction:** Talkers have long been studied in their speech accommodation strategies in noise.

However, few studies have been conducted on (I) the perception of acoustic environments, and (II) the effect of acoustic environments on speech and singing.

**Objective:** We hypothesize that if the acoustic clarity of a room is increased, singers' vocal comfort and vocal control will be increased. Additionally, we hypothesize that a trained singer will be more aware of changes in clarity.

**Methods:** In this study, 20 singers (10 amateur and 10 professional singers) performed vocal tasks in different acoustic conditions. In each condition, the subject performed several vocal tasks: scales and arpeggios (over two octaves), and sustained notes and filato (at three different fundamental frequencies). All tasks except the filato were performed with different dynamics: mezzo forte and forte. Additionally, subjects were instructed to sing an extract from the American National Anthem accompanied by a musical track emitted at different power levels. After each condition, the subject responded to questions regarding perception of vocal comfort, control, and fatigue, and their perception of the clarity of their own voice. Room acoustic clarity was manipulated: in some conditions, two plexiglass reflective panels were placed at different distances from the subject.

**Results:** The results indicate that when a panel was present, singers tended to perceive the room as being more pleasant to sing in (i.e., comfort and control tended to increase). The effect of experience on self-reported comfort, control, and fatigue is discussed. Assessments of the Lombard Effect for singers are presented. We propose the optimal time interval for the early reflections, that is, reflections that increase the support for singers. The results indicate that even when the reverberation time is constant, reflective surfaces may be added or modified to increase the singer's perceived voice comfort.

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## Spectrum Effect of Different Degrees of Nasalization

### Objectives

According to the experience of many teachers of singing, a slight degree of velo-pharyngeal opening (VPO) can improve tone quality considerably. The present study aimed at documenting spectrum effects of different degrees of VPO.

### Design

Experimental study based on measurements collected from eight singer-subjects who sang vowel sequences on different pitches. Three degrees of nasalization were studied, *None*, *Some*, and *Much*. They were aurally monitored during the recording by co-author BG, experienced teacher of singing. Nasal and oral airflow were recorded by means of a Glottal Enterprises divided flow. In addition to the flow signals, audio and EGG were recorded on separate tracks in wav files. Acoustic effects were analyzed in terms of long-term-average spectra (LTAS) and effects on vocal fold vibration in terms of EGG waveform. Quantitative information on the degree of nasalization will be derived from the flow signals.

### Results

On average across subjects, the *Some* condition showed the highest overall sound pressure level while the *Much* condition showed the lowest.

There was, overall, less acoustic energy for the *Much* condition in the low frequency range, up to 660Hz, than for the *None* and *Some* conditions.

Averaged across subjects, the high frequency energy was the greatest in the *Some* condition, less for the *Much* condition, and the least for *None* condition. No effects could be observed in the EGG skewing.

### Conclusions

A small degree of nasalization seems to have some positive effects on the spectrum, increasing the sound pressure level of the radiated sound and enhancing the high frequency components and thus the spectrum balance.

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**The Effects of Two Singing Styles (Classical and Belt) on Measures of Head Position, Jaw Opening, and Long-Term Average Spectra of Female Voice Majors: An Exploratory Study**

Classical vocal pedagogy textbooks advise singers to maintain a neutral head position with the chin level with the ground while singing (e.g., McKinney, 1994). However, contemporary commercial music (CCM) voice pedagogues sometimes advocate employing an elevated head posture to achieve an optimal timbre for musical theatre singing (e.g., Barnes-Burroughs, Watts, Brown, & LoVetri, 2005). The purpose of this exploratory study was to investigate potential differences in measurements of head position (determined from postural markers adhered to the Nasion, Tragus, and a line to represent the Vertical Plane), jaw opening, and long-term average spectra (LTAS) of female voice majors ( $N = 10$ ), with demonstrated experience in both classical and belt styles of singing, as they performed the same piece of vocal literature in two styles (classical and belt). Results were discussed in terms of (a) head position, jaw opening, and LTAS differences between the two singing styles (classical and belt), (b) potential modifications of head position and jaw opening for singing in classical versus belt styles, and (c) directions for future research.

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## **Singing through the Smoke: A Survey of the Use of Theatrical Fog and Haze in Major US Opera Companies**

Opera performers face a myriad of unique challenges in their working environment. Coordinating artistic singing, stagecraft and acting, while wearing heavy woolen costumes under warm stage lighting requires a unique skillset. One common stage effect singers may experience in their careers is the use of theatrical fog and haze, created by atomizing fine particles (often mineral oil or propylene glycol). Health concerns of performing in stage fog have been raised for musical theater and pop/rock singers, but the risks to operatic singers are not well understood.

The respiratory behavior of opera singers, characterized by vigorous inspiratory and expiratory activity, may increase their susceptibility to lipid pneumonia, asthma, and vocal fold pathologies. This study will obtain current statistics on the use of stage fog by major opera companies to better understand the potential hazards to professional singers.

An online survey study will be conducted to determine the prevalence of stage fog use in operatic productions and the compounds most frequently used for these effects. Technical staff of opera companies will be invited by email and/or telephone to participate. Subsequent opportunity for individual commentary and follow-up will be offered and conducted depending on the availability of participants. Results from this study may have implications for the voice care community and their care for these highly specialized singers.

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## **The Functional Basis of Squall: Stroboscopic and Perceptual Findings**

The term “squall” refers to a pitched yell commonly found in American black gospel singing. Its use is generally restricted to moments of high emotional intensity, and it is a desired stylistic component of American black gospel singing. The functional and pedagogical basis of squall is not well understood.

This study examined the function of the vocal mechanism during squall. Three professional gospel artists who were self-reported users of squall production were recruited. Participants performed a set of prescribed singing tasks using squall and non-squall singing. Stroboscopy with high definition digital imaging was performed to examine the vocal fold vibratory pattern and pharyngeal configuration employed during squall and non-squall singing tasks.

Videostroboscopic recordings (both squall and non-squall) were rated by three speech language pathologists and laryngologists. Raters evaluated: the ventricular fold participation, compression of the arytenoid cartilages, aryepiglottic constriction, and vocal fold visibility. Medio-lateral and antero-posterior compression of was also examined.

Audio recordings of the participants’ singing were evaluated perceptually by three raters with expertise in Black Gospel singing. Perceptual measures included: timbre, intensity, ring, perceived constriction, distortion, and roughness. Statistical analyses were conducted to determine if correlations between the perceptual and stroboscopic findings could be observed. These correlations may have pedagogical implications for the care and training of singers of Black Gospel music.

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**Perceptions of Experienced Singers Performing the Same Sung Material in a Recital Hall and in a Practice Room with Digitally-Produced Active Acoustics**

The purpose of this study was to examine perceptive measures of solo singers ( $N = 30$ ;  $n = 20$  females,  $n = 10$  males) performing in a counterbalanced venue order the same series of vocalises and songs in a recital hall and in an individual practice room designed with adjustable digitally-produced active acoustics to determine if participants could perceive a difference between singing in a recital hall and singing in a room with digital active acoustics set to 4 simulated conditions (practice room, large recital hall, large auditorium, and arena). After each recording period participants completed a questionnaire that solicited perceptions of loudness, singing effort, and venue acoustics. Participants were also given an opportunity to comment freely. Results indicated participants readily perceived differences between these venue conditions, particularly with respect to reported singing effort. Participants preferred singing in the recital hall rather than in the digitally simulated environments.

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## **The Effect of Amplification on Vocal Load in Pop/Rock Singers**

Contemporary Commercial Music singers perform in highly amplified situations. Anecdotal evidences suggests that these performers sing hyper-functionally when their aural feedback is insufficient. While several studies have investigated the impact of amplification on teachers in the classroom, there have been no investigations of the impact of amplification on singers' vocal load. The purpose of this study is to determine whether or not Contemporary Commercial Music singers can reduce vocal load by using vocal monitors.

Five men and five women will be assigned selections from pop/rock repertoire. Each singer will then perform the example in two conditions: amplified accompaniment without vocal monitoring, and amplified accompaniment with vocal monitoring. One powered floor monitor will be used to play the accompaniment track and a second powered floor monitor will be used for vocal monitoring using a Shure SM-58 dynamic microphone. Vocal load will be captured using a VoxLog necklace accelerometer. Statistical analysis will be used to determine whether or not there are any significant changes in these measurements amongst the various conditions.

The results of this study may have ramifications for those who train pop/rock singers as well as those who rehabilitate singers in clinical settings.

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### **Immediate Voice Improvement Following “Clear Speech” Instruction: A New Addition to the Voice Evaluation**

Purpose: “Clear speech” is a traditional strategy used across communication science disciplines to improve intelligibility. “Clear speech” results in decreased speaking rate, increased pauses, syllable durations, fundamental frequency, and vocal intensity. It is unknown if “clear speech” instructions can elicit similar acoustic, as well as aerodynamic improvements in individuals with voice disorders. The purpose of the current study was to determine if patients with voice disorders could achieve voice improvement immediately following instructions to use “clear speech.”

Methods:  $N = 113$  patients with voice problems (76F, 37M) completed voice recordings of a standard reading passage using the Phonatory Aerodynamic System 6600 first using their normal (dysphonic) voice, and again following instructions to use “clear speech.” Acoustic, aerodynamic, and speech breathing analyses of both recordings were conducted by raters blinded to the experimental hypotheses.

Results: Increases (improvements) following the “clear speech” instruction in average fundamental frequency ( $p < .001$ ), average vocal intensity ( $p < .001$ ), average airflow ( $p < .001$ ), total breaths taken ( $p < .001$ ), total reading time ( $p < .001$ ), and breaths/second ( $p < .001$ ).

Conclusions: “Clear speech” instructions can elicit immediate voice change in people with voice disorders. “Clear speech” may be a useful tool to assess stimulability for behavioral voice change at the time of initial evaluation, and may assist in determination of appropriate patient referrals for behavioral voice intervention.

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## Acoustic and Aerodynamic Impacts of Pregnancy on the Classically Trained Soprano Voice

**Objective:** To determine if pregnancy alters acoustic or aerodynamic characteristics of the classically trained soprano voice during the third trimester of pregnancy, through one year post partum. Data will be presented within the context of hormonal and physiological changes with pregnancy.

**Methods:** The subject was a healthy thirty-five year old non-smoking soprano, who had been singing professionally for fifteen years.

Data were acquired during the following weeks of pregnancy: 28, 30, 34, 36 and 39 weeks. Two acquisitions were obtained during postpartum: 10 weeks postpartum, and 12 months postpartum.

Phonatory tasks included softest and full voice syllable train production, as well as full voice singing of portions of an aria. To assess agility and pitch matching accuracy, the singer produced three trials of the same 24-note chromatic task as quickly as possible beginning on B-flat 4. The tasks were repeated in the same order for each day of acquisition. Respiratory measures were vital capacity, and oxygen saturation during aria singing. Acoustic measures included agility, pitch accuracy in semitones, vibrato rate, and perturbation measures. Aerodynamic measures were phonatory threshold pressure, airflow during voicing, estimated subglottal pressure, sound pressure level, laryngeal resistance, and voicing efficiency. Self-perceived evaluations were also recorded through use of the Singing Handicap Index and the Vocal Handicap Index.

**Results:** Respiratory data showed a very minor drop in vital capacity during pregnancy, which was restored at 10 weeks postpartum. Oxygen saturation results indicated normal health for the subject, with no decline during aria singing over time. Agility decreased slightly in the 10 week postpartum reading as compared to the pregnancy readings. Pitch accuracy was slightly affected, as the semitone distance from the target frequency increased to 1.36 Hz above the target frequency in week 39 (from 0.07 Hz in week 28, and 0.03 at 12 months postpartum). Phonatory threshold pressure increased from 3.3 cm/H<sub>2</sub>O to 4.9 cm/H<sub>2</sub>O. Laryngeal valving efficiency increased from 579.0 ppm at 28 weeks, to 3051.0 ppm in week 39, with a marked increase from week 36, at 922.0 ppm. The increase was attributable to physiological preparation for birth, as the baby was born five days after the week 39 recording.

**Conclusion:** Acoustic and aerodynamic levels remained within healthy limits throughout pregnancy. Laryngeal valving efficiency peaked in week 39 of pregnancy, coinciding with the body's increasingly high hormonal output immediately prior to childbirth. Acoustically, pitch accuracy and agility were not markedly affected by pregnancy. Although singers may experience some changes in acoustic and aerodynamic function during the third trimester of pregnancy, pre-pregnancy vocal functioning may begin to return as early as ten weeks postpartum.

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### **Sleight of Hand: Effects of Conducting Gesture on Choral Sound**

Choral pedagogues have long touted the efficacy of any movement of the conductor's hand to illicit desired choral sound. While conducting experts might have us believe that a conductor's "sleight of hand" enables them to manipulate an ensemble to their will, there is disagreement about which gestures prove the most effective. Recommendations include height of gesture, vertical gesture, and direction of palm. Recent research investigated these claims in terms of specific conductor hand gestures and movements.

This presentation examines the results of multiple choral conductor gesture studies. These investigations of hand shape, direction of gesture, and height of conductor gesture indicate that the hand movements of the choral conductor affect choral sound. The timbre, intonation, and perceptions of singers can be altered with the slightest hand movement. Each study investigated the effects of varying non-verbal conducting behaviors on acoustical (LTAS) and perceptual (pitch analyses, singer survey, expert listening panel) measures of the conglomerate vocal sound of established choirs. Results of these studies will be discussed in terms of possible effects of nonverbal conductor behaviors on vocal health and choral sound, and what these data may suggest for future research.

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**Male Singing During Pubertal Voice Change: A National Survey of Male Enrollments and Selected Program Components in Middle School/Junior High School Choral Programs**

The purpose of this study was to survey nationally a stratified random sample ( $N = 2500$ ) of middle school/junior high school choral teachers who belong either to the National Association for Music Education (NAfME) or the Texas Music Educators Association (TMEA), in order to (a) ascertain the status of male enrollments in school choral classes, (b) obtain a snapshot of respondents' demographic characteristics, (c) describe selected (omit this word: design) components of these choral programs, (d) solicit teacher perceptions of obstacles to recruitment and retention of young male singers, and (e) explore possible relationships between each of these factors. The results were discussed in terms of (omit this word: effective) choral program components and demographic factors that may encourage or discourage male singing at a time when pubertal voice change may be most prevalent, limitations of the study, and suggestions for future research.

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**The Effect of Three Spacing Conditions and Three Venue Conditions on Acoustic and Perceptual Measurements of a Male Barbershop Quartet**

This investigation examined the effects of three inter-singer spacing conditions (accustomed, closer, more lateral) on LTAS, intonation, and questionnaire data acquired from a male, TTBB quartet singing the same homophonic, Barbershop-style song in three different venues (rehearsal hall, church sanctuary, auditorium). Among the controls instituted: (a) observation of a projected, prerecorded, silent video of the quartet performing the song as it customarily does to ensure consistency of tempo and interpretive behaviors during all sung trials; (b) maintenance of the same quartet to microphone distance in all trials and locations; and (c) a counterbalanced performance sequences of the two spacing conditions. Results were discussed in terms of male barbershop quartet performance practices, optimal vocal efficiency, and suggestions for future research.

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## **The Effects of Varied Conductor Background Colors on the LTAS, Intonation, and Perceptions of Three SATB Choirs**

Various studies in multiple disciplines have assessed the effects of color on human behavior and perception. Some studies in music have suggested positive correlations between colors and particular musical sounds, yet these studies to date have relied primarily on subjective data in largely uncontrolled circumstances. This investigation tested the effects of observing a videotaped conductor framed by 3 different background colors on the timbre (LTAS), intonation (pitch analyses, one-third octave band analyses), and perceptions (questionnaire) of performances by 3 SATB choirs who sang the same, largely homophonic motet in the same venue. The conducting stimuli, presented in a counterbalanced order, employed the same video footage of the conductor to ensure no variation in conductor behaviors among the sung trials, with the varied background colors inserted post-production via green screen technology. Consistent choir to microphone distances were maintained in all sung trials, and each choir stood in the same choir formation with the same spacing between and among singers. With IRB approval, participants were not apprised beforehand of the specific independent variable of interest. Results were discussed in terms of possible effects of visual, environmental stimuli upon singing and suggestions for future research.

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## Effects of two Conductor Final Release Gestures on Perceptions of Choral Sound

Choral conducting pedagogues often advocate for a clear final release gesture. Previous research has indicated that choristers may imitate certain conductor gestures (Daugherty & Brunkan, 2013; Manternach, 2012a, 2012b) while other studies have revealed possible increased singer muscle activity while viewing fist ed conductor gestures (Fuelberth, 2003a, 2003b, 2004; Manternach, in review). In a pilot study, individuals ( $N = 33$ ) sang a short melody while following a pre-recorded conductor who displayed either an open palm inhalation gesture or a fist ed gesture at the final release or “cutoff.” Expert listeners reported differences in the singers’ sound in 82% of the paired excerpts. Singers most frequent self-reported response to the gestures was a change in their vocal production. No research to date, however, has examined the effects of varied conductor “cutoff” gestures on the final sound of a choral ensemble. Such information could be beneficial to conductors who wish to evoke efficient vocal production at the final release. This investigation was designed to examine perceptions of singers’ vocal sound during a final release when cued by two conductor gestures. Research questions investigated were: (1) Will choral singers report differences in the conductor gestures, ~~vocal~~ choral sound, or vocal production during two conductor final release gestures (open palm inhalation gesture, fist ed gesture) (2) Will expert listeners report differences in choral sound during the final release gestures?

Intact choral groups ( $N = 5$ ) performed a short melody while watching a life-sized pre-recorded conductor. On each repetition’s final note, the conductor displayed either an open palm inhalation gesture or a fist ed gesture. Ensembles viewed each gesture one time in a random order. Expert listeners ( $N = 20$ ) evaluated each choir’s final sung notes, selected their preference between the paired excerpts, and noted specific differences in choral sound at the final release. (N.B. Data collection is in progress.)

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### **Sing Out, Luisa Miller! Belting for the Crossover Singer**

**Objective:** This poster presentation illustrates female classical voice, super-belt voice, and belt-blend voice from the same sounds source, through the use of Voce Vista software with electroglottography and spectral analysis.

**Methods:** The three most common sounds used in female crossover vocal technique will be defined: classical, super-belt, and belt blend. Classical uses a head register with cricothyroid (CT) dominance; super-belt uses the classical upper register with manipulated (spread) resonance; and belt-blend is produced through a cooperative use of the CT and thyroaretenoid (TA) muscles, resulting in the speech-like belt heard in contemporary musical theatre. Three singers will be used. Employing Voce Vista and electroglottography, each singer will demonstrate classical, super-belt, and belt-blend on the same pitch pattern or musical phrase. Glottal quotients and harmonic tracking via spectrogram will be presented and compared.

#### **Results and Conclusions:**

In today's dynamic world of vocal music, classical singers are being asked to produce cabaret, jazz, musical theater, and other contemporary-commercial style performances in order to reach a larger audience. For many, this means performing repertoire without having had any stylistically specific training. While many "crossover" and maintain an essentially classical sound, the result is not always authentic. Well-trained classical singers have all the tools to belt in a healthy way, but misinformation still abounds. Super-belt will be highlighted as a compromise for those with hesitations about belting, and will be presented as way to produce a sound without diverging from the classical registers and corresponding muscle dominance. Pedagogical tools and resources will be recommended.

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## **Hormones and the Female Voice: An Exploration of the Female Hormonal Cycle from Puberty to Menopause and How it Affects the Vocal Apparatus**

This paper examines the female hormonal cycle throughout a woman's life and its effects on the singing voice. Unfortunately, data on the female hormonal cycle and its effects on the voice are not yet widely covered in most standard vocal pedagogy books. Information on the subject is often relegated to a small section, and usually describes only the symptoms. The human larynx is directly influenced by the lifelong cyclical hormonal fluctuations. A woman's monthly cycle, which lasts from puberty to menopause, causes changes in hormone concentrations that can affect a woman's physical and emotional states. These effects are also seen in the vocal tract. This paper examines the effects on the singing voice. It will provide a brief overview of the steroid hormones: estrogen, progesterone, and androgen. These three hormones are responsible for the development and maturation of primary and secondary sexual characteristics. Additionally, this paper will provide information regarding the benefits and drawbacks of oral contraceptive pills (OCPs). OCPs contain synthetic hormones that mimic the body's own natural hormones, maintaining constant levels of estrogen and progesterone throughout the menstrual cycle, preventing ovulation. By blocking changes in the body's hormonal levels, OCPs have proven highly effective as a voice stabilizing agent. The changes to the voice during pregnancy will be examined. The increased hormonal concentrations associated with pregnancy act upon the reproductive organs, muscles, bone, cerebral cortex, and mucosa, as well as the larynx. This paper will also explore what happens to the voice throughout the stages of menopause. The treatment options, specifically hormone replacement therapy, will be discussed, as well as alternative treatment methods. Lastly, this paper will share information gathered from a survey of singers regarding their own experiences with PMS and PMVS, OCPs, pregnancy, and menopause.

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## **Impact of Vagal Nerve Stimulation on Objective Vocal Quality, A Pilot Study.**

**Objective/hypothesis:** The main purpose of this study was to determine the impact of vagal nerve stimulation on the subjective and objective vocal quality using the Dysphonia Severity Index. It was hypothesized that the objective vocal quality and other vocal characteristics are disordered in comparison with an age and gender matched control group. In addition the acoustic vocal parameters were compared during three conditions: at rest, during normal and raised stimulation. A significant relation between the amount of stimulation and the presence of disturbed acoustic parameters was hypothesized.

**Study design:** Pilot study

**Methods:** Subjective (auditory perceptual evaluation, Voice Handicap Index) and objective (aerodynamic, vocal range, acoustic measurements and determination of the Dysphonia Severity Index) were used to determine the vocal quality in 13 subjects with vagal nerve stimulation in three different conditions: at rest, during normal and raised stimulation.

**Results:** The subjects with vagal nerve stimulation had a disordered perceptual vocal quality mainly characterized by the presence of a moderate roughness and slight breathiness and the objective vocal quality by means of the DSI value is -2.4. During stimulation and especially during raised stimulation the fundamental frequency is significantly increased. However the subjects experienced no psychosocial handicapping effect of the vocal quality on the QOL

**Conclusion:** Subjects with vagal nerve stimulation have typical vocal characteristics. ENT specialists and voice therapist must be aware of the presence of this vocal pattern at rest and during normal and raised stimulation. Especially professional voice users and elite vocal performers must be informed before implantation.

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## Voice Risk Assessment: Assessing Risks for Voice Problems

**Background:** Voice problem has a prevalence rate of 6%. Yet, this prevalence rate is not distributed randomly in the population and certain population groups are more prone to developing voice problems. Multiple factors are involved in the development of voice disorders. The three major factors commonly cited are related to the 1) vocal loading, 2) physiological and 3) psycho-emotional areas.

**Objective:** This study aimed to investigate the risk factors and indicators that are involved with hyperfunctional voice disorders using a self-reported questionnaire. The questionnaire was validated to become the “Voice Risk Calculator” which could be used to determine the different risks that an individual might be prone to in developing voice problems.

**Methodology:** Forty non-dysphonic subjects and 120 dysphonic subjects with different severity levels were recruited from a university voice clinic. They aged between 20 to 60 years old. They were given a questionnaire with 40 items covering the vocal loading, physiological and psycho-emotional areas to complete. Subjects also completed a voice range profile, aerodynamic evaluation, and the Voice Activity and Participation Profile.

**Results:** The findings showed that 23 questionnaire items related to vocal loading, physiological and psycho-emotional areas can reliably (>90%) distinguish between dysphonic and non-dysphonic subjects. Stepwise multiple regression also showed that as few as 5 items of the questionnaire could be used to reliably predict the presence of voice problems.

**Conclusion:** It is contended that with the identified risk indicators of voice problems, specific methods and strategies for preventive, diagnostic and intervention programs can then be developed to eliminate or reduce these conditions.

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### **Improving Vocal Function Using Qigong - Myth or Fact?**

**Background:** Qigong, or Life Energy Cultivation, is a practice of breathing, meditation and martial arts to achieved a balanced life energy. There is a general sceptism about qigong as it is often presented or promoted with a mythical flavor. Indeed, the term “Qigong” was first introduced only about 50 years ago but the practice of Life Energy Cultivation can be traced back to more than a century. This paper will introduce a “Phonatory Qigong” exercise which has been practiced in Chinese monasteries for centuries. This specific qigong method aims at improving vocal function through practicing voicing exercise together with a series of martial arts.

**Objective:** This paper will review the “Phonatory Qigong Exercise” based on six practice words.

**Methodology:** Literature review was conducted by searching through the classical Chinese medicine literature. The Phonatory Qigong Exercise has been termed the “Six-Word Qigong Verses”.

**Results:** Literature review found the first documnetation of “Six-Word Qigong Verses” can be dated back to 1600 years ago. It has been practiced as a standard daily exercise in Chinese Tao Monasteries for centuries. Contemporary Qigong experts agreed on the choice of the “six words” that are to be used in the exercise. The six practice words are: xu, he, hu, si, chui, and xi. It is claimed tha the martial art exercise combined with phonation of these sixw words promote and cultivate general life energy.

**Conclusion:** Despite the popularity of this Phonatory Qiging Exercise and extensive classical Chinese medicine literature write about the usefulness of the exercise, there is no scientific validation of the method. Given its close resemblance of other vocal exercises used

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## The Use of Glottal Fry in Spontaneous Speech of Young and Middle-Aged American Women

Over the past few years, glottal fry has become more prevalent in normal populations and especially in the speech of young American women.

**Objective:** To compare vocal fry use in spontaneous speech of young and middle-aged American women. Data was collected was spontaneous speech which was analyzed perceptually and acoustically. Vocal fry was more prevalent in younger than in middle-aged women.

**Methods:** Subjects were 40 American women; 20 aged 18-25, and 20 aged 35-50. Participants were asked to describe all the steps involved in making a peanut butter and jelly sandwich and in doing laundry. Analyses performed: Acoustical analysis and sentence position of vocal fry occurrences. The acoustic parameters analyzed were: mean, minimum and maximum F0, glottal fry/minute ratio, and the sentence position of glottal fry. Glottal fry/minute ratio was obtained by dividing the number of glottal fry occurrences in a sample and dividing by the total sample duration and was averaged by group. Sentence position of glottal fry was obtained by averaging the number of occurrences in each position for each group.

**Results:** Values of minimum fundamental frequency clearly show that there was vocal fry in their spontaneous speech samples. The mean minimum F0 was 74.9 (SD=4.3) for the younger women and 73.10 (SD=6.6) for the middle-aged women ( $p=0.305$ ). The mean maximum F0 was 452.1 (SD=65.0) for the younger women and 457.9 (SD=69.2) for the middle-aged women ( $p=0.785$ ). Younger women tended to exhibit more glottal fry in the middle of the sentence in spontaneous speech than middle-aged women. The mean glottal fry for the medial position was 7.1 (SD=5.5) for the younger women and 4.9 (SD= 5.0) for the middle-aged women ( $p=0.205$ ). The mean glottal fry for the final position was 5.5 (SD= 4.1) for the younger women and 4.5 (SD= 4.1) for the middle-aged women ( $p=0.446$ ). The mean glottal fry/minute ratio for young women was 14.55 (SD=6.4), while the mean glottal fry/minute ratio for middle-aged women was 11.55 (SD=7.0) ( $p=0.168$ ). This study showed that all participants had at least one episode of glottal fry in their spontaneous speech sample (the lowest glottal fry/minute ratio was 1 for young women and 2 for middle-aged women).

**Conclusions:** Both groups presented with vocal fry in their spontaneous speech, showing that vocal fry is becoming more prevalent and is influencing not only the way young adult women speak, but also the way middle-aged women speak.

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### **Characteristics of Voice Use Among Clergy**

Clergy are professional voice users yet, to date, we have no evidence base indicating prevalence or characteristics of voice disorders. For this study, a survey was conducted from a random sample of the approximately 4200 churches in the Chicago area. 10% of the potential group was sent questionnaires, asking detailed questions about voice use in worship services and other pastoral duties. Analysis was done by denomination, size of congregation, characteristics of worship service, and other variables. From this information, educational efforts in prevention of voice disorders in this at-risk population can be designed.

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**Suitable Duration of Voice Rest after Vocal Fold Surgery:  
Randomized Controlled Clinical Study**

**Objectives:** Voice rest is commonly recommended after phonosurgery to prevent worsening of the injury of the vocal fold, and possibly to promote better wound healing. However, appropriate duration of voice rest is not known and it is even controversial if voice rest is needed or if voice rest leads to better wound healing. Recently early intervention with voice therapy is also recommended to improve wound healing. The purpose of this study is to examine the suitable duration of voice rest after phonosurgery.

**Methods:** This study was approved by the institutional review boards at Kyoto University. A single-centre, prospective, randomised controlled trial was carried out for patients with leukoplakia, carcinoma in situ, vocal fold polyp, Reinke's edema and cyst who underwent phonosurgery. Enrolled participants were randomly assigned to voice rest for 3 post-operative days (Group "3 days") or voice rest for 7 post-operative days ("7 days"). Randomization was performed within each pathology. Both groups received voice therapy for 6 weeks following each voice rest period. GRBAS, stroboscopic examination, aerodynamic assessment, acoustic analysis and voice handicap index (VHI)-10 were performed at 1,3,6 months after surgery. Stroboscopic examination evaluated normalized mucosal wave amplitude (NMWA). The above parameters were compared between both groups.

**Results:** 21 patients were assessed (Group "3 days" n=13, Group "7 days" n=8). At one month postoperatively, Group "3 days" showed significantly better improvements than group "7 days" in GRBAS, jitter, shimmer, and VHI-10. At three and six months postoperatively, Group "3 days" showed significantly better improvements than group "7 days" in NMWA.

**Conclusions:** The data suggests that 3 days voice rest followed by voice therapy may lead to better wound healing of the vocal fold as compared to 7 days voice rest. The appropriate mechanical stimuli in the early stage of wound healing of vocal fold may lead to favorable functional recovery.

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### **Effectiveness of a New Intensive Short-Term Voice Treatment: a Pre-Experimental Single Subject Design**

**Objective:** The purpose of this study was to investigate the effectiveness of an intensive short-term voice treatment in a patient with chronic, functional dysphonia for whom the traditional model (with two 30-minute sessions a week during several months to years) of voice treatment was not successful.

**Methods:** A pre-experimental single subject design was used. The treatment lasted for four consecutive days at a frequency of one and a half hours a day. Different voice techniques performed by a trained speech therapist were used. A voice evaluation consisting of both objective (aerodynamic measurement, Voice Range Profile, acoustic analysis, and Dysphonia Severity Index) and subjective (auditory perceptual evaluation using the GRBASI rating scale of Hirano) measurements was carried out before the introduction of the intensive treatment and after each therapy day. The psychosocial impact of the voice problems were examined before and after the treatment using the Voice Handicap Index.

**Results:** Both the results of the objective and subjective measurements showed a positive evolution of the voice quality after the introduction of the intensive short-term voice treatment, whereas the results of the self-assessment didn't confirm this progress.

**Conclusions:** It can be assumed that the improvement in voice quality was due to the introduction of the intensive short-term voice treatment. This pre-experimental single subject research is therefore a useful first step prior to experimental studies to confirm the presumed causal links. Further research is needed to determine why the psychosocial impact of the voice problems of the patient did not change after therapy.

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## Examination of Warm-Ups in Undergraduate Student Singers

**Background/Objective:** Vocal warm-ups are considered important to help safely prepare the vocal folds for the technical requirements necessary for singing. However, warm-ups are not consistently emphasized in all singing settings, and this may be due to the lack of objective evidence regarding their effectiveness. The objective impact of vocal warm-ups on the intensity and frequency range of the singing voice was examined in this study.

**Methods:** Twenty undergraduate students enrolled in a music-related university degree program participated in this study. The students were assigned to one of two interventions (vocal warm-ups or voice rest). Each student completed a voice questionnaire and the Singing Voice Handicap Index-10 (SVHI-10) to reveal patterns related to warm-ups, singing, and speaking. A pre- and post-intervention Voice Range Profile (VRP) was conducted to measure the frequency and intensity range.

**Results:** Nearly all of the participants practiced warm-ups on a routine basis. The most common warm-ups were breathing, stretching, legato arpeggios, 5-note scales, glissandos, and 1-octave scales. No significant differences in the mean frequency range were noted in either intervention group. The voice rest group demonstrated a statistically significant lower mean intensity range in their post-intervention VRP. Although not statistically significant, 35% of the participants had abnormal scores on their SVHI-10.

**Conclusions:** In this study, singers who practiced one session of vocal warm-ups did not improve frequency range but did have a higher mean intensity range than controls in the voice rest group. One session of warm-ups is not sufficient to elicit significant changes in vocal range. Rather, differences in vocal range are more likely to occur over time while practicing warm-ups, developing proper singing techniques, and implementing good vocal hygiene and care. In addition, warm-ups should be practiced more routinely in all settings.

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**Show or Tell: Modeling and Instruction in Acquiring a Novel Voice Task**

**Objective:** Modeling and instruction are frequent components of both traditional and technology-assisted voice therapy, and are used to help people acquire vocal tasks. This study aims to investigate if the provision of a model with or without instruction is sufficient for the acquisition and short-term retention of a complex voice task. **Method:** 30 speech pathology students were randomly assigned to 2 conditions and trained to produce a vocal siren over 40 trials. One group received a model and verbal instruction, while the other group only received a model. The production of sirens was analysed for phonation time, vocal intensity, cepstral peak prominence (CPP), peak-to-peak time, and root-mean-square error (RMSE). **Results:** The model only group showed significant change in vocal siren performance on intensity and CPP, while the model and instruction group changed significantly on phonation time, intensity, CPP and peak-to-peak time. Nevertheless, both groups did not successfully reproduce the model's siren performance during the experiment. The groups also did not retain performance of the task one day later. In addition, an interaction effect was found for vocal intensity. **Conclusion:** Providing verbal instruction with a model is more beneficial than providing a model only in the acquisition of a complex voice task, especially in early pre-practice. However, both these conditions are not sufficient for acquisition and short-term retention. Other elements of the principles of motor learning pre-practice schema (e.g. feedback, perceptual training) may be required to help participants develop an internal reference of correctness. These results suggest that exclusive use of non-interactive computer programs and mobile apps may not be effective for early acquisition of complex vocal tasks.

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### **Group Voice Therapy: Increasing Efficiency, Reducing Wait Times and Improving Outcomes**

The objective of this pilot project was to demonstrate the benefits of utilizing group voice treatment for clients in the Winnipeg Health Region. Although limited, there is literature to suggest that group therapy is not inferior to individual treatment and that there may be psychosocial and clinical advantages to group therapy (Law et. al, 2011).

In the 15 months preceding October 2012 wait lists had escalated from 159 to 250 clients, and wait times had risen from 29 to 46 weeks. To address these challenges a hybrid approach to voice therapy was adopted that included group and individual treatment.

Productivity was maximized by increasing services offered in a group format and decreasing individual treatment options. Wait lists were consolidated and treatment protocols were standardized. A mixed client demographic for groups was utilized.

Within one year the median wait dropped to 7 weeks. Of the 192 patients recommended for group treatment, 127 registered and attended at least one session. Average number of group attendances was 3.5 sessions, out of a possible of 4. Client satisfaction surveys indicated 83% of attendees were satisfied with group treatment. Two percent were unsatisfied and 15% were somewhat satisfied or did not respond. Mean CAPE-V scores decreased from 28.7 to 12.6 and mean VHI-10 scores decreased from 18.8 to 11.8.

This pilot study suggests that models which include group voice treatment appear to be effective and there may be advantages of offering treatment in a group format. A limitation was that the project design did not allow for meaningful comparison to other treatment models. More rigorous research is needed to fully determine the potential of group therapy for different client demographics, as well as to study the impact of intensity and duration on group models.

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**Quality of Life Measures in Patients with Voice Disorders: A Prospective, Longitudinal Study**

**Objective:** Our study evaluated longitudinal outcomes of two quality of life scales, the Short Form Health Survey (SF-12v2) and Voice Handicap Index (VHI), for patients with voice disorders.

**Methods:** Two-hundred forty-two consented patients from the UW Voice and Swallow Clinics Outcomes Database with dysphonia completed the SF12v2 and VHI at their clinic visit from November 2012 to April 2014. Longitudinal surveys were sent at 3, 6 and 12 months after each patient's last visit to the clinic. Student's t-tests and Fisher's exact tests were completed to look at differences between patients who received voice treatment (behavioral or medical) or no treatment based on patient-level variables -- age, sex, socioeconomic factors, smoking history and presence of comorbidities. Mean scores of the SF12v2 and VHI at each time point were compared using repeated measures ANOVA.

**Results:** There were no differences in patient-level variables between the treatment and non-treatment groups ( $p < .05$ ). There were no differences in SF12v2 mean scores over time ( $p < .05$ ). Overall VHI and physical, functional and emotional subscale mean scores were improved from baseline to three ( $p < .01$ ), six ( $p < .01$ ), and twelve ( $p < .01$ ) months. There were no significant differences in VHI mean scores between 3, 6 and 12 month surveys ( $p < .05$ ). There were no significant differences in SF12v2 or VHI mean scores in patients who received behavioral and/or medical treatment compared to those who did not ( $p < .05$ ).

**Conclusions:** Our results suggest without significant changes in mental or physical health, patients with dysphonia reported an improvement in vocal outcomes three months after their last visit to the voice clinic. In addition, these outcomes remained unchanged at six and twelve months post-clinic visit.

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### **Perioperative Voice Therapy Outcomes for Benign Vocal Fold Lesions**

**Objective:** To examine the effect of timing of voice therapy (preoperative counseling, preoperative therapy and postoperative therapy) on outcomes measured by a patient self-reported scale, the Voice Handicap Index (VHI), and objective acoustic measures (jitter %, DSI, NHR).

**Study Design:** University of Wisconsin Voice and Swallowing Outcomes Database

**Setting:** Tertiary care clinics.

**Subjects:** 10 preoperative counseling participants (5 male, 5 female); 12 preoperative therapy participants (2 male, 10 female); 9 postoperative therapy only participants (4 male, 5 female).

**Methods:** Mean changes in VHI total scores, DSI, jitter, and NHR scores were compared between pre-counseling, preoperative therapy, and postoperative therapy groups, using unpaired t-tests. A Fisher's Exact test was completed to examine demographic differences between treatment groups.

**Results:** Despite lack of statistically significant changes in acoustic measures, the perioperative therapy group demonstrated statistically significant decreases from pre-therapy vs. post-therapy VHI total scores ( $p = 0.0001$ ). No significant differences in age or sex were measured between treatment groups; however a significant difference in diagnosis (i.e. type of lesion) was indicated ( $p=0.0084$ ).

**Conclusions:** Patients receiving a multi-session course of voice therapy prior to surgery coupled with postoperative therapy demonstrate greater gains in their subjective view of vocal function and quality as measured by the VHI compared with patients receiving preoperative counseling and postoperative therapy only.

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## **Prevention of Laryngeal Contractures After Ingestion and Inhalation Injuries: Can Voice Therapy Help?**

**Objective:** Inhalation and ingestion burn injuries may result in a number of long term complications including dysphagia, dysphonia and laryngeal contracture formation. Laryngeal contractures may evidence as posterior cricoid stenosis, aryepiglottic fold contracture, and laryngeal webbing. Laryngeal contractures may lead to long term communicative impairment, respiratory compromise and challenging intubation. There is currently no non-surgical therapy described within the literature that is designed to prevent or treat laryngeal contractures. Therefore, the aim of this study was to devise and implement a laryngeal range of movement exercise program to aid in the prevention and treatment of laryngeal contracture formation post burn.

**Methods/Design:** Utilising knowledge of exercise based contracture prevention principles for burn injury, active range of movement exercises designed to stretch the larynx were trialled on a series of patients considered at high risk for laryngeal contractures. The exercise regime implemented focussed on adduction, abduction, and lengthening of the vocal folds that oppose the directional force of contractures that most commonly occur in the larynx.

**Results:** Outcomes to date have been promising with patients. However, laryngeal contractures may develop and persist post injury despite voice therapies being encouraged. Consequences of medical and surgical management and decreased patient compliance were highlighted as factors that may potentially exacerbate laryngeal sequelae and persistent dysphonia.

**Conclusions:** Voice therapy may play a key role in the prevention and treatment of laryngeal contractures and subsequent airway and voice disorders.

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### Coping Strategies in Voice Disorders

**Purpose:** to examine coping strategies of individuals with voice disorders and to study the relationships between the type of coping, vocal complaint, and type of voice disorder (organic vs. functional).  
**Methods:** 58 individuals, aged between 19 and 90 years (mean=44.6), 41 with voice disorders (mean age=46.4) and 17 vocally healthy individuals (mean age=40.1) completed the following analyses: an identification and characterization questionnaire, vocal complaint report (vocal quality, fatigue and strain, presence of air in the voice, vocal range reduction, frequency deviation, volume deviation and discomfort), and VDCQ. **Results:** The groups studied were similar in regards to age ( $p=0.443$ ) and sex ( $p=0.670$ ). The groups presented with significantly different VDCQ scores ( $p<0.001$ ), the mean score was 45.2 (SD=22.6) for the individuals with voice disorders and 2.2 (SD=6.1) for the vocally healthy individuals. The group with voice disorders was characterized as using more problem-focused strategies (65.9%) in comparison to emotion-focused strategies (29.3%) ( $p<0.001$ ). They also reported more vocal quality deviation complaint (65.9%), followed by volume deviation (14.6%) and fatigue and strain (12.25%) ( $p=0.001$ ). The use of coping strategies was similar regardless whether the individual presented with a functional or organic voice disorder ( $p=0.652$ ). There were no differences between males and females in regards to the VDCQ scores ( $p=0.588$ ), the type of coping strategies ( $p=0.217$ ) and vocal complaint ( $p=0.051$ ) for both groups. No significant correlation was found between the type of coping strategy and the following variables: voice disorder ( $r_s = -.098$ ;  $p=0.542$ ), vocal complaint ( $r_s = -.216$ ;  $p=0.175$ ), VDCQ score ( $r_s = .116$ ;  $p=0.469$ ). **Conclusions:** these initial findings show that the population with voice disorder examined in this study uses more problem-focused coping strategies to deal with their voice problems, regardless of the type of both voice complaint and voice disorder.

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**Effects of Adventitious Vocal Trauma: Relative Fundamental Frequency and Listener Perception**

**Objective:** The objective of this study was to examine, both acoustically and perceptually, vocal changes following an acute period of high voice use.

**Methods/Design:** Participants from a university club women's volleyball team (N=12) were recorded one week prior (Pre) and one week following (Post) the 10-week spring volleyball season. For comparison, six control speakers were recorded over the same period. All speakers read four sentences and the acoustic recordings were analyzed for the relative fundamental frequency (RFF) and utilized in an auditory-perceptual experiment. The onset cycle 1 and offset cycle 10 RFF values were used as acoustic measures given their previously noted associations with listener perceptions of strain and vocal effort. Eight naïve listeners participated in a visual sort and rank perceptual task, in which they rated both overall severity and vocal strain.

**Results:** Perceptual results revealed no significant differences between ratings of overall severity or vocal strain between the Pre and Post recordings. Onset cycle 1 RFF values were significantly lower ( $p = 0.04$ ) in the Post recordings of the volleyball participants compared to Pre recordings, but there was no significant difference ( $p = 0.20$ ) in offset cycle 10 RFF values. Receiver operating characteristic analyses indicated moderate sensitivity and specificity of onset cycle 1 RFF for discrimination between the volleyball and control participants. Qualitatively, when examining the RFF values from the control participants, there were minimal changes from Pre to Post for both onset cycle 1 and offset cycle 10.

**Conclusion:** Onset cycle 1 RFF may be effective for detecting changes in vocal health over an acute period of high voice use before perceptual changes in vocal quality are noted. This is important as high voice users are at risk for developing functional voice disorders.

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## Voice Production Across Different Levels of Vital Capacity and Intensity

Healthy subjects breathe in deeper to produce louder voice. Patients with voice disorders exhibit discrepancy in this relationship. The goal of this research is to study voice production across three levels of vital capacity i.e., *high, normal, and low*. The participants will be instructed to perform *soft, normal, loud* intensity levels across these levels of vital capacity. Voice measures will be compared across these three levels of support.

### Objective

Milstein and Watson (2004) summarized the relationship of lung volume initiation for speech and its effects on speech production. Results indicated that the subjects varied vocal intensity across the three levels. Lowell et al (2008) studied respiratory and laryngeal function in 18 teachers, nine with voice problems and nine without. Their results indicated a significant difference in respiratory maneuvers during speaking tasks. Gillespie et al (2013) analyzed ninety female subjects with voice disorders. The results showed significant increase in lung pressure and airflow in these patients. These studies did not control vocal intensity. This research project intends to compare voice characteristics across different levels of vital capacities and intensities.

### Protocol

Vocally healthy subjects were instructed to prolong the vowel /a/ and produce an “all voiced” sentence at three different levels of vocal intensity across three levels of vital capacity (high, normal, and low). Data collection is still in progress. Acoustic, aerodynamic, kinematic, and visual analysis will be used for this study. The effect of percentage of vital capacity and vocal intensity on voice measures will be compared.

### Results

Based on the current data, several measures of voice changed with the percentage of vital capacity used for speech at specific levels of vocal intensity.

### Conclusion

This project will highlight the use of lung volume initiation during assessment and therapy.

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## **Listeners' Perception of Gender after Raising Vowel Formant Frequencies in a Male Speaker**

Current clinical practice in voice therapy for male-to-female (MtF) transgender clients focuses on raising modal frequency to a level that can be representative of either male or female, termed "gender neutral". However, listening studies have revealed that raising pitch alone is not sufficient to change gender perception. One possible explanation is that the vowel formant frequencies ( $F_1$ - $F_3$ ) have remained in a male range. A few studies have confirmed that through therapy, MtF transgender clients can raise their vowel formant frequencies by altering tongue position and lip posture. However there is no consensus regarding which formant and at what frequency range listeners change their gender perception.

The purpose of this study was to identify which formant(s)  $F_1$ - $F_3$  and frequency level(s) are most influential in listeners' perception of gender neutral or feminine voice, by systematically manipulating the formant frequencies from 200ms vowel samples of a biological male voice. Using a customized Matlab program, vowel samples were manipulated by isolating each formant using a corresponding band pass filter designed with cutoff frequencies matching the specified frequency range, modifying the isolated formant, and then combining the modified and unmodified components of the sample. Individual and combined vowel formant frequencies  $F_1$ - $F_3$  were increased in 20% increments until the male vowel formants matched those typical of a female. Samples were randomized and recorded onto a DVD and played for listeners to perceptually categorize each sample as male, female, or gender neutral.

Results of this study will indicate the formant(s) and the frequency range(s) that are associated with a perceptual shift in gender identification. These results could have clinical implications in creating speech treatment goals for MtF transgendered individuals that will result in a more successful transition.

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## Respiratory Measures of Musical Theater Singers and Non-singers

### Background

The purpose of this project is to determine whether respiratory patterns differ significantly between musical theater singers, classical singers, and non-singers. As preliminary data, we are reporting aerodynamic measures in musical theater students and non-singers. The research has been approved by the IRB at East Carolina University. Data from eight female subjects, four in each group, are reported.

### Subjects

Subjects in the musical theater group were currently enrolled in the musical theater program at East Carolina University and had received at least one semester of voice lessons in that program while the non-singer group never received formal private voice lessons. Subjects were females within the age range 18-39 years, not pregnant, non-smokers, with no history of vocal or respiratory pathology.

### Methods

The subjects were assessed for their aerodynamic capacities using the KayPENTAX Phonatory Aerodynamic System (PAS). The protocols of vital capacity, maximum sustained phonation, comfortable sustained phonation, variation in sound pressure level and voicing efficiency were administered. The subjects completed three trials of each protocol and an average of the three trials was computed. Mann-Whitney U tests were carried out as part of statistical treatment of the non-parametric data.

### Results

Results of this preliminary data showed significant differences only in measures of maximum phonation time ( $p = 0.029$ ) and peak expiratory airflow ( $p = 0.029$ ). Interestingly, we did not find significant differences in laryngeal resistance and aerodynamic power in the voicing efficiency protocol. As we continue our research including more subjects and a third group of classical singers, we expect to identify more differences between the groups and solidify the patterns revealed in the preliminary data.

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## **Validation of the Cepstral Spectral Index of Dysphonia (CSID) as a Screening Tool for Voice Disorders: Development of Proposed Clinical Cutoff Scores**

**Objectives:** The purposes of this study were to (1) evaluate the performance of the Cepstral Spectral Index of Dysphonia (CSID - a multivariate estimate of dysphonia severity) as a potential screening tool for voice disorder identification, and (2) develop potential clinical cutoff scores for the classification of voice disordered cases vs. non-case controls. Voice disordered cases vs. controls were initially defined via three reference standards: (1) auditory-perceptual judgment; (2) Voice Handicap Index (VHI) score; and (3) laryngoscopic description. Ability to effectively classify cases vs. controls using the CSID was evaluated via a combination of logistic regression and ROC analyses.

**Methodology:** Subjects were 332 males and females (116 males, 216 females) comprised of subjects who presented to a physician with a voice-related complaint and a group of non-voice related control subjects. Each subject provided a VHI 30-item score, underwent laryngoscopic evaluation, and provided speech/voice samples including the 2nd & 3rd sentences of The Rainbow Passage. Speech samples were analyzed using the Analysis of Dysphonia in Speech and Voice (ADSV) program (KayPENTAX, Montvale, NJ). Cepstral and spectral measures were combined into a previously reported CSID multivariate formula for Rainbow Passage samples (i.e., the CSID<sub>R</sub>).

**Results:** The ability of the CSID<sub>R</sub> to discriminate between cases and controls was represented by the “area under the ROC-curve” (AUC). ROC classification of dysphonia cases vs. controls resulted in a strong AUC = 0.85. A range of possible cutoff scores was determined that not only achieved the best balance between sensitivity and specificity, but also provided more conservative cutoffs vs. liberal cutoff threshold scores for screening purposes that resulted in high sensitivity while maintaining a reasonable degree of specificity. Weaker but adequate AUC's = 0.75 and 0.73 were observed for the classification of voice handicapped and laryngoscopic positive cases vs. non-cases, respectively. Logistic regression analyses indicated that subject age may be a significant covariate in the prediction of dysphonic and voice handicapped cases vs. controls.

**Conclusions:** Cepstral and spectral measures incorporated into the CSID<sub>R</sub> can provide accurate classification of voice disordered cases vs. controls, particularly when auditory-perceptual judgment is used as the reference standard. While users often focus on a cutoff score that achieves a balance between sensitivity and specificity, this cutoff does not necessarily address the desired purpose of the examiner (e.g., more liberal cutoffs for screening purposes vs. conservative cutoffs when cost or risk of further evaluation is deemed to be high). Discussion of the potential clinical application of these results and reasons for differences in classification accuracy based upon case vs. control definition will be provided.

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**Voice Outcomes Following Behavioral Voice Therapy in Children with Bilateral Vocal Fold Lesions**

**Objective:** The objective of this study is to examine voice outcomes in children with bilateral vocal fold lesions who have completed 8 weeks of behavioral voice therapy

**Methods/Design:** All children enrolled in this study were evaluated at a hospital-based pediatric voice center. Criteria for enrollment included diagnosis of bilateral vocal fold lesions on laryngeal exam and a recommendation for behavioral voice therapy by the evaluation team. Of the 65 children who were initially enrolled, a total of 38 (14 females; 24 males; age range = 5 to 12 years) children initiated a course of voice therapy at the base hospital location or a satellite location. Baseline evaluation of all children enrolled included instrumental measures, perceptual analysis utilizing the Consensus Auditory Perceptual Analysis of Voice (CAPE-V), and the pediatric Voice Handicap Index (pVHI). The behavioral therapy program was driven by the needs of the child but most participants began with vocal hygiene education, and then continued with vocal function exercises, and resonant therapy. After the completion of 8-weeks of therapy, a repeat of the perceptual analysis was completed from recorded speech samples and parents were asked to complete a second pVHI. Some children continued in therapy beyond this 8-week period, but data collection ended at the end of the pre-established time frame.

**Results/Conclusions:** Data collection for this study is completed at this point and analysis of the current data will examine the magnitude of change in the CAPE-V subscores (e.g., overall severity, roughness) and pVHI total and subscale scores following 8-weeks of behavioral therapy. The analysis will also include correlations between the magnitude of change in CAPE-V and pVHI measures with adherence to recommended therapy and completion of home-based exercises. These correlations should provide helpful insights to care providers and for patient education.

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### **Physiology and Health of Male-to-Female Transgender Speaker's Voices**

Male-to-female (MTF) transgender speakers who want to be perceived as female are typically instructed to elevate fundamental frequency, use forward oral resonance, and increase the breathy quality of their voice. Considering the anatomical constraints of a larynx post-testosterone, acquiring and habituating such a voice can be challenging. The physiological phenomena underlying this voice change remain relatively unexplored. However, female-like fundamental frequency and open quotients in MTF speakers perceptually judged to be female suggest that changes are made at the larynx. Concern has also been expressed that techniques used by the MTF speakers for making these changes have the potential to produce voice problems. Endoscopy is a good tool for examining degree of closure, which relates to possible breathiness and larger open quotient as well as presence of supraglottic compression, especially anterior-to-posterior (A-P), which has been associated with patients having misuse voice disorders. Because endoscopy is not a common medical procedure for MTF, acoustic and/or aerodynamic measures that correspond to elements of those exams would be beneficial. Airflow, Cepstral Peak Prominence, Low/High Frequency Ratio were thought to relate to degree of closure, and Phonation Threshold Pressure, Relative Fundamental Frequency, and patient effort ratings were thought to relate to presence of supraglottic compression. Eleven MTF speakers participated, ranging in age (32-64 years), years presenting as female full-time (3-17), and history of voice feminization therapy (0-4 years). None reported history of a voice disorder. Feminine-sounding voices were found to exhibit posterior glottal gaps, high airflow rate, low CPP, and high L/H Ratio. The majority exhibited some degree of A-P compression in spite of no reported vocal effort, and the corresponding measures of PTP and RFF also suggested increased vocal fold tension. These aerodynamic and acoustic measures may prove useful for practicing clinicians monitoring male-to-female vocal femininity as well as health.

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### Discourse Analysis of the Prepractice Phase of Voice Therapy

**Objective:** A preliminary study of clinicians' behaviours during the acquisition phase of voice therapy has found more 'talking' behaviours than 'doing' behaviours and differences in types of verbal information used by experienced and student clinicians. A discourse analysis tool such as Exchange Structure Analysis (ESA) may be useful in describing these differences more specifically for the purposes of student learning. This study aims to investigate how experienced and student clinicians differ in the way they interact with clients in the initial stages of voice therapy, where clients are generally at a low skill level.

**Methods/Design:** Four experienced voice clinicians and five final-year speech pathology students taught a standardised patient to produce a vocal siren. The interactional exchanges used by the participants were analysed and compared using ESA. These interactional exchanges were also compared to the participants' behaviours.

**Results:** Both clinician groups used *information-giving* and *action-requesting* moves more often than any other exchange structure moves. Experienced clinicians used significantly less *action-requesting* and *offer-of-action* moves than student clinicians. A trend existed whereby experienced clinicians used relatively more *teaching exchange* moves. Mapping of clinical behaviours onto the exchange structure moves was helpful in describing some of the 'talking' behaviours that could not be adequately covered by behavioural analysis.

**Conclusion:** This study found preliminary evidence that clinicians generally adopt a more directive approach in the initial stages of voice therapy, which appears consistent with the role of a therapist. The use of *action-requesting*, *offer-of-action* and *teaching exchange* moves appears to be associated with the level of clinical experience. This has implications for student learning. Our findings also suggest that ESA may be useful as an adjunct to the behavioural framework when understanding the teaching of a complex motor skill.

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### **Meta-perception of Attitude Judgment in Individuals with Voice Problems**

**Objective:** The aim of the present study was to examine the meta-perception of attitude judgment (in the domains of personality, physical appearance, social characteristics) in individuals with voice problems.

**Method:** Twenty-two (11 vocally healthy and 11 voice-disordered) individuals participated in the study. Each participant rated his/her self-perceived severity of voice problems. To evaluate their meta-perception, each participant was asked to give attitude ratings in response to the question “How do you think other people rated their attitudes toward you?”. Attitude judgments were made using a semantic differential scale with 22 bipolar adjective pairs. The 22 bipolar adjective pairs were intended to cover non-speech characteristics of the individual’s personality, physical appearance and social characteristics.

**Results and Discussion:** Results showed that the dysphonic group gave significantly more negative rating ( $p<0.01$ ) in their self-perceived severity of voice quality than the vocally healthy group. The dysphonic group also had significantly more negative meta-perception ( $p<0.01$ ) than that of the vocally healthy group. Findings suggest that individuals with voice problems have a negative self-image, and negative attitude towards themselves.

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## **Identification of Biological and Health-Related Indicators of Vocal Decline in Aging**

**Objective:** To establish health-related and biological indicators related to vocal decline in a non-treatment seeking elderly population of subjects.

**Methods/Design:** Fifty-one local volunteers between the ages of 60-85 were assigned to one of two groups based on the presence or absence of vocal fold atrophy and bowing consistent with presbylaryngeus and vocal quality consistent with presbyphonia. Group assignment was made by two certified speech-language pathologists with expertise in voice. All subjects were evaluated on outcome measures of select aging health-related and biological indicators as well as traditional vocal function assessments. Health-related and biological indicators under investigation included: anthropometric measures, inflammatory markers, physical strength measures, gait and balance ability, respiratory function, and physical activity level. Vocal functions were assessed with selected measures from the five domains of vocal assessment: visio-perceptual, aerodynamic, acoustic, auditory-perceptual, and self-reported voice quality of life.

**Results:** A diagnosis of presbylaryngeus was significantly correlated with health-related and biological indicators of body weight, total lean body mass, gait and balance ability, physical activity level, and the inflammatory marker C-reactive protein. Vocal measures significantly correlated to these indicators included: auditory-perceptual, reflux symptoms and cepstral spectral index of dysphonia.

**Conclusions:** Correlations between several study measures and presbylaryngeus were noted. Future data from this study will be directed toward developing novel screening tools enabling prediction of and specific treatments for delaying or rehabilitating vocal decline in the elderly.

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### **Influence of Voice Focus on Oral-Nasal Balance in Speech**

The concept of focus is used in vocal paedagogy to describe the relationship between vocal tract length and vocal resonance. A forward focus with a forward tongue carriage and a raised larynx results in a flat voice quality while a backward tongue carriage and a lowered larynx add pharyngeal resonance to the voice. It is unknown whether the vocal focus also affects oral-nasal balance in speech. The differences in pharyngeal length and setting could affect transpalatal nasality through the soft palate. This would be of particular interest for the speech therapy of speakers with disorders of oral-nasal balance, such as hypernasality.

To date, 9 female speakers have been recorded reading test sentences with and without nasal consonants with normal, forward and backward focus. The oral-nasal balance of their speech production was assessed using a KayPentax Nasometer 6450. The preliminary data analysis demonstrated that nasalance scores tended to numerically decrease with a backward speaking focus and to increase with a forward speaking focus. However, the differences were not statistically significant in an analysis of variance.

Voice focus appears to have a minor but measureable effect on oral-nasal balance in speech. In future research, it will be investigated if this effect is more pronounced in speakers with oral-nasal balance disorders.

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### Flow Vibrato in Western Classical Singers

*Background:* Fundamental frequency (F0) vibrato is characterized predominantly by frequency extent and rate. There may be a “flow vibrato” that is associated with F0 vibrato, and also have the characteristics of extent (airflow) and rate. Studying both flow vibrato and F0 vibrato together may have both basic and pedagogical importance in understanding how vibrato is produced.

*Objectives:* To describe the characteristics of flow vibrato (extent and rate), and to describe the relationship between the flow vibrato and F0 vibrato (phase and rate).

*Method:* Four professional singers volunteered and were asked to phonate smooth /p:a:p:a:p:/ sequences to measure the airflow using a circumferentially vented mask associated with the Glottal Enterprises aerodynamic system. Three loudness levels (L1, L2, L3-piano, mezzoforte, and forte), and three pitches (P1, P2, P3-lower modal, upper modal, and high) were used. The singers were asked to sing with their performance technique. The flow vibrato signal was downsampled to match the 10 ms intervals of the F0 signal obtained using Praat.

*Results:* Flow vibrato was present for all singers. Greater extent of flow was seen for the higher modal pitch compared to the lower modal pitch across the loudness levels among all the singers (overall extent for pitch 1 mean=36.8 cc/s, pitch 2 mean=81.5cc/s;  $p<0.01$ ). No statistical difference was found across the pitches. The rate of flow vibrato and F0 vibrato was seen to have a moderately strong correlation ( $r = 0.78$ ). The phase for the flow vibrato tended to be ahead of the F0 vibrato and overall the F0.

*Conclusion:* Both F0 vibrato and flow vibrato tend to be synchronous with each other, and predominantly flow leads F0 in phase. Flow vibrato extent is higher for higher modal pitches but appears independent of loudness. The mechanisms that create flow vibrato need to be determined.

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## **Recording and Analysis Decisions when Estimating Subglottal Pressure from Oral Pressure**

**Objective:** To understand recording methodology and analysis techniques when estimating subglottal pressure via intraoral pressure.

**Methods/Design:** A literature-based standard production technique was used that required the participant to produce /p:i:p:i:./ syllables smoothly at approximately 1.5 syllables per second, with the added target of having a rectangular shaped (flat plateau) oral pressure pulse. For comparison purposes, pressure pulse shapes were generated using the following non-standard experimental tasks: (1) performing the task without training, (2) increasing syllable rate, (3) using a voiced /b/ instead of a voiceless /p/ initial syllable, (4) adding a lip or velar leak, and (5) using a two syllable production (“peeper”) instead of a single syllable production. Except for the untrained condition, each single exhalation recording included the standard production technique and the experimental production technique to allow for comparison between the estimates of subglottal pressure from the standard and the atypical production.

**Results:** Seemingly accurate estimates were able to be made from (a) the standard production technique, (b) the voiced initial consonant /b/ productions, and (c) the two-syllable word productions. The conditions that resulted in a flow leak or a lack of time to equilibrate air pressure did not appear to provide accurate estimates of subglottal pressure from oral pressure. While accurate estimates of subglottal pressure tend to be associated with rectangular shaped oral pressure pulses, inaccurate estimates of subglottal pressure can be associated with a variety of shapes of oral pressure pulses with consistently lower pressure values than the standard production technique.

**Conclusions:** Estimates of subglottal pressure from oral pressure appear to be accurate when three conditions are met: (1) the lips come fully together, (2) there is pressure equilibration, and (3) there is a continuation of pressure equilibration. Visualization of the oral air flow signal aids in making decisions about airway equilibration during the consonant.

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## **The Relationship between Psychological Stress Reactivity and Laryngeal Airway Resistance in Prospective Student Teachers**

### Objective

The objectives of the study are to determine (1) the effect of imposed social-evaluative stress on laryngeal airway resistance (LAR) during voice production in vocally healthy prospective student teachers and participants from the general population, and (2) if stress responders, as defined by salivary cortisol responses, show greater LAR reactivity to stressor exposure than non-responders.

### Methods

Twenty-four vocally healthy female prospective student teachers ages 21-35 years will participate in the study. The participants' laryngeal function will be assessed first without stressor exposure and then with stressor exposure. The stressor will consist of public speaking under social-evaluative conditions. The primary outcome measure is LAR (ratio of subglottic pressure and airflow). Participants will complete the vocal efficiency protocol for LAR data collection both with comfortable pitch and loudness and with slightly elevated loudness during each experimental phase. During the stress phase, the participant will be interrupted after one minute of public speaking so that data can be collected. Additional outcome measures are heart rate, respiration, perceived fear ratings, salivary cortisol, and personality traits.

### Results

The Institutional Review Board of the University of Missouri approved the study and screenings have begun. The hypothesis is that exposure to a stressor will increase LAR. Further, it is hypothesized that stress responders will show greater elevations in LAR during stressor exposure than non-responders.

### Conclusions

The data will be used to evaluate if stressor-induced elevations in LAR may serve as a marker for risk for voice problems in occupational voice users. Further, psychobiological profiles based on cortisol and personality will help to refine voice disorders screening tools. The long-term goal is to test psychobiological voice screening methods of student teachers to facilitate personalized prevention.

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### **The Relationship of Vital Breath Capacity and Efficient Breath Use in Varying Degrees of Exhalation and Phonation in Classically Trained Singers**

The purpose of this study is to explore the relationship between singers' vital breath capacities and their efficiency of breath use in various degrees of exhalation (non-phonatory) and phonation. Four areas of breath use are examined: vital capacity, /s/ semi-occluded sustained exhalation, /z/ semi-occluded phonation, and a sustained single pitch with the single vowel /i/ in non-occluded phonation. Participants ( $N = 20$ ; men,  $n = 8$ ; women,  $n = 12$ ) are first and second year graduate students at a major, Northeastern conservatory, all in their 20s or early 30s, with their primary performance emphasis in voice. Measurement tools include the s/z ratio protocol, the KayPENTAX Phonatory Aerodynamic System (vital capacity and phonated airflow), and a background questionnaire. Results are discussed in light of voice pedagogy for breath management in singing, the size of singers' vital capacity and the quality of breath use (both acoustic and perceptual), as well as by sex, age, years of study, and voice health history. Future considerations include physical attributes such as body size, rib cage diameter, BMI, and neck circumference.

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## Pitch and Pitch Strength as Outcome Measures for Voice Treatment

Introduction: Measurement of treatment outcome is critical for all kinds of voice treatment, whether surgical, behavioral, or pharmacological. Measures of treatment outcomes typically include visual (e.g. stroboscopic data), auditory (e.g. CAPE-V), and objective correlates of vocal fold vibratory characteristics, typically using acoustic signals (e.g. HNR, CPP) or patient self-reported questionnaires (e.g. VHI, VRQOL). Subjective measures, such as assessment of videostroboscopic images and auditory perception are subject to high variability. Most acoustic measures of voice are only valid for signals where some degree of periodicity can be assumed. However, this assumption is often invalid for dysphonic voices where signal periodicity is suspect. Furthermore, many of these measures are meaningless in isolation for diagnostic purposes, although might be useful in following treatment outcomes.

Objective: We evaluate a recently developed algorithm (Auditory-SWIPE') to estimate pitch and pitch strength for dysphonic voices. While fundamental frequency ( $f_0$ ) is a physical attribute of a signal, the pitch is its psychophysical correlate. As such, the perception of pitch can extend to most signals irrespective of their periodicity.

Methods: This study involves post-hoc analyses of 30 subjects representing a wide range of dysphonic speakers who were evaluated and treated for voice problems at a major voice center. All subjects were recorded before and after surgical/behavioral treatment for voice disorders. Pitch and pitch strength for each speaker were computed with the Auditory-SWIPE' algorithm.

Results: Estimates of pitch and pitch strength will be compared against  $f_0$  measures and subjective judgments of quality. Pre- and post-treatment data will be compared to determine whether pitch estimates may track treatment outcomes for dysphonic voices, across a wide range of underlying diagnoses.

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### Voice Clinic Related Anxiety: Use of the Spielberger State-Trait Anxiety Inventory

**Introduction:** There is a well established association between patients with voice disorders and psychopathology, including anxiety and depression. Psychological disorders may be causal of, or consequential to voice pathology, and the relationship is complex (Caputo Rosen, 2007). Pre-operative anxiety state has been extensively measured, and is well recognized (Goldberger, 2011), but anxiety in the outpatient Voice-Clinic setting has not yet been addressed. We set out to examine both baseline and situation anxiety levels amongst our patients in voice clinic outpatients.

**Methods:** We administered the Spielberger State-Trait anxiety inventory (STAI-Y) to all patients attending a consultant's weekly voice clinic over a one month period in our institution; this is an extensively validated tool which measures a patient's general anxiety level (their 'trait' anxiety) through questions 1-20 and the anxiety levels at a particular moment in time (their 'state' anxiety) via questions 21-40. Patients filled in these forms during the waiting period for outpatients. This was registered as a departmental audit, which formed part of our voice service evaluation.

**Results:** 50 STAI questionnaires were successfully completed; each was analysed using the STAI key; the higher the scores, the higher the anxiety level. Patients had an age range of 19-91, and male to female ratio of 1:1.5. Females had a mean state score of 37.5 (SD 13.2, range 20-69), and trait score of 37.5 (SD 11.2, range 20-54); males had a mean state score of 32.8 (SD 11.6, range 20-50) and trait score of 34.6 (SD 7.9, range 22-48). No significant difference was found on subgroup analysis using student's t-test; between males and females, nor when scores were divided between age groups. Scores were consistent with published results for STAI-Y published normative values for working aged adults, with females in this group having mean state score of 35.2 (SD 10.6) and trait score of 34.8 (SD 9.2); and males with mean state scores of 35.7 (SD 10.4) and trait scores of 34.9 (SD 9.1). It has been suggested that those achieving state scores of greater than 39-40 have clinically significant anxiety levels; 39 % of females (11/28) achieved this score; with 3 recording a score of over 50; 32 % of males (7/22) had scores over the 40 mark threshold

**Discussion:** Anxiety is defined as feeling of tension, worry and apprehension, associated with physical symptoms, particularly the autonomic nervous system and with general symptoms such as inability to concentrate (ICD-10 Classification). Pre-operative anxiety is well recognised (Goldberger, 2011) and may consequently affect a patient's ability to retain information, and as such affect the process of informed consent.

Patients with psychiatric disorders and psychological disturbance are well known to manifest with vocal dysfunction; one study has quoted 80 % of all patients to have a psychogenic background to their voice disorder (Brodniz, 1971). Professional voice users are particularly vulnerable to the psychological impact of vocal dysfunction. Caputo Rosen, 2007, has built upon established personality theory to account for this; she postulates that professional voice users may view their voice as inseparable to their sense of identity. Therefore, when voice is lost, they experience an acute loss of personal identity and self-esteem, with consequent psychological distress, such as anxiety or depression, manifesting.

In our analysis, we identified that over 30 % of our patients were experiencing clinically significant anxiety levels in outpatients. Further research to identify characteristics of this subgroup is required. Sataloff, 2014, has recommended criteria for determination of voice impairment by occupational voice requirement. As a further study, we plan to prospectively correlate levels of anxiety with occupational use using these criteria. Identification of patients at risk from anxiety will allow health care professionals to focus management strategies, and thus may help to improve outcomes.

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### **Conversation Training Therapy: Development of a New Voice Therapy Program**

Purpose: Patients complain about voice use in conversation, yet conversational voice is often targeted last in traditional voice therapy programs, if at all. The purpose of the current study was to incorporate input from expert voice-specialized speech-language pathologists (SLP) and patients with voice disorders in the development of a theoretically-based voice therapy program that targets conversational voice use in the first session, and throughout all sessions.

Design: Prospective, multiple-category clinical interview.

Methods: A voice therapy program, Conversation Training Therapy (CTT), was created by the investigators based on patient's perception of voice therapy gleaned from 45 patient surveys as part of a prior investigation. The CTT program was then presented individually to  $N = 5$  SLPs specialized in voice with over 10 years' experience from around the nation. Feedback was solicited via clinical interviews with a blinded interviewer. The responses were reviewed and categorized thematically. Items with the greatest overlap took priority for inclusion in the CTT program.

Results. CTT is the first voice therapy program to be developed by a multitude of experienced voice-specialized clinical SLPs and patients with voice disorders. CTT differs from traditional voice therapy because it targets voice techniques in conversation *in the first session and throughout all sessions*. CTT is rooted in theories of motor learning, which encourage skill learning and generalization.

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**Preventive Voice Care for Professional Voice Users and the Extended Voice Team: The University of Miami Vocal Health Collaborative**

Preventive vocal health is essential for professional voice users. Often, extended voice team members such as voice teachers, speech coaches, yoga instructors and others only become involved with a voice center during the rehabilitative process, rather than the habilitative process. The Vocal Health Collaborative at the University of Miami is a partnership among the Miller School of Medicine Department of Otolaryngology, Frost School of Music Department of Vocal Performance and other university departments interested in vocal health. This program is focused on promoting preventive vocal care and cultivating important relationships among extended voice team members. Goals include increasing awareness regarding vocal health, further developing and educating an effective extended voice team, and pursuing meaningful research in the areas of vocal health, vocal pedagogy and singing voice rehabilitation. Related programming is varied and consists of incoming student vocal health screenings, clinical graduate observation internships, a Performing Voice Transitional Rehabilitation service, a Faculty Workgroup on Vocal Health, World Voice Day activities and community education. Faculty members involved in the collaborative attend quarterly meetings to support maintenance of appropriate education in the field of voice disorders, voice science, vocal health, vocal pedagogy and performing arts. The members in turn promote preventive voice care and vocal health among the student and general population and work together as a team to help diagnose and rehabilitate singers to their fullest potential.

This presentation will address the design of the University of Miami Vocal Health Collaborative and outline current and proposed programming. By sharing this model, we hope to take part in the ongoing conversation within our field regarding improvements in preventive voice care and cultivation of the extended voice team.

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### Vocal Characteristics of Russian-English Bilinguals: Preliminary Findings

**PURPOSE:** To investigate differences in the vocal characteristics of Russian-English bilingual individuals in their native and second language. Eleven (11) individuals (mean age=42.8), 5 males (mean age=36.8) and 6 females (mean age=47.8), participated in the study. They are all emigrants to the US (mean age of immigration: 18.4) and have completed at least an elementary school equivalent in their native country. Only participants that were proficient in speaking, understanding, reading and writing were included. Participants completed a self-assessment questionnaire that investigates how they perceive their communication characteristics in each language. They were also asked to watch two different 30-second video-clips and describe one of them in Russian and the other in English. The videos were presented randomly to the participants. Voice samples were analyzed acoustically by means of Praat software. The acoustic parameters extracted were: Mean, minimum and maximum F0, F0 variability (Hz and semitones), duration, and speech rate (words/minute). **RESULTS:** There were no significant differences in how the individuals perceive their communication characteristics in both languages (all  $p > 0.050$ ). No statistical differences were found in any of the pitch-related measures (mean F0  $p = 0.114$ , minimum F0  $p = 0.462$ , maximum F0  $p = 0.324$ , F0 variability-Hz  $p = 0.325$ , semitones  $p = 0.368$ ). Individuals had faster speech rate in English than in Russian (143 words/min vs. 95.9 words/min,  $p = 0.008$ ). Duration was similar in both languages (English=21.0 sec; Russian=22.7 sec;  $p = 0.397$ ). Correlations were found between age and gender with some of the self-perception questions. **CONCLUSIONS:** These preliminary results show that Russian-English bilingual individuals have similar pitch-related characteristics and diverse temporal characteristics of speech when speaking both languages.

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### **Discussion of Voice Services and Treatment by Transgender Individuals in Online Forums**

**Background:** The internet has been a boon to the transgender community. It allows members of the community to connect, share information, and engage in activism. (Shapiro, 2008) Online forums are a popular option and one frequent topic of discussion on these forums is voice, particularly changing one's voice as part of transitioning. Voice therapy for this purpose is available through speech-language pathologists, but even cursory internet searching quickly reveals that voice treatment resources and how-to guides are shared between members of the transgender community as well.

**Objective:** The purpose of this study is to better understand the concerns and issues transgender individuals experience when seeking to change gender characteristics of their voices to inform clinical practice and clinician-patient interactions.

**Methods:** Eight publically available online forums on transgenderism were identified: six English language and two German language forums. All forums included threads that discussed member's voice in relation to transitioning. Relevant threads were identified using the following keywords: voice, voice therapy, speech therapy, Stimme, Logopädie, and Sprachtherapie. Open coding analysis was used to identify common themes that emerged from the data, following accepted procedures in qualitative methods (Denzin & Lincoln, 2000; Morse & Richards, 2002).

**Results:** Preliminary results indicate that transgender individuals seek advice from peers because peer can empathize with and relate to the challenges of transitioning. Individuals may also have difficulty finding professionals to work with or be turned down for services from providers. Financial barriers are also frequently cited, as well as reluctance to take on what is perceived to be a significant time commitment. Discussions revealed many concerns related to voice, including (to name a few) sounding like the wrong gender during vegetative sounds (coughs, sneezes, etc.), the effect of HRT on voice, effecting voice change without HRT, and the use of binders causing breathing problems and/or heartburn. Knowledge of these issues and concerns provide insights to clinicians who have transgender clients or may have them in the future and can help build better clinician-patient working relationships.

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## **Human Vocalization Patterns When Communicating with Cats**

Domestic cats are beloved animals by many people. Cat owners often find comfort in petting a cat and amusement with some cat antics. Communication with a cat contrasts with dog communication, partly because of directives frequently given to a dog but ignored by a cat. Prior study on dogs revealed higher SF0 for human communication with both small dogs and large dogs. This study compares rate of speech and shift of fundamental frequency (SF0) among 10 adult males and 10 adult females communicating and petting a cat vs. normal baseline measures. The impact of speech rate and SF0 shift for communication with domestic companions is important to consider when treating dysphonic patients.

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### **Proposed Self-assessment Protocols for Professional Speaking Voice**

**Purpose:** The self-assessment protocols are important tools to epidemiologic survey in consulting services in SLP. However, the more specific professional vocal use, more necessary to understand the self-perception of the subjects in different population. Thus, not always the general clinical protocols are sensible to identify the impact of dysphonia in the life of a professional singer, actor, TV-presenter, reporter, operator of tele-services or teacher. **Objective:** To present two new self-assessment protocols for professional voice. One for TV journalists and one for tele-services. **Methods:** For TV journalists, it was presented the Self-assessment questionnaire of Communication Quality TV with 16 questions. For tele-services professionals it was proposed a Self-perception Questionnaire of Communication with the Customer with 21 questions. Both of them with 6 points scale. **Results:** The self-assessment questionnaires are able to help professionals to understand their communication behavior by phone or on TV. They also can be used to aid them to better explain their expectations on professional improvement. Thus, they allow the consulting SLP service and the TV direction to understand the communication skills and personal expectation of tele-operator, reporters, anchors, narrator and sports broadcaster. Those questionnaires have been already applied for more than four years in consulting services. The methodology has presented good results. **Conclusions:** The protocols allow a deeply perception and improve the self-knowledge of professional's communication. They also contribute to develop strategies to individual SLP therapy sessions like the longitudinal comparison of the questionnaire answers.

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### **Improving Agreement Between Graduate Students and Experts for CAPE-V Measures**

To rate perceptual features of voice reliably one must have internal standards of vocal qualities, usually developed from years of experience. The purpose of this study is to determine if feedback and practice can improve agreement between students and voice professionals rating voice samples using the CAPE-V. This study includes two phases; in the first, nine voice professionals will rate 68 voice samples using the CAPE-V (sustained /a/ and /i/, CAPE-V sentences, and spontaneous speech sample). The 40 samples that are rated with the most agreement among professionals will be used for phase two. In the second phase, 45 graduate students will be recruited and randomly placed in one of three groups. All groups will take a pre-test and a post-test one week later. The Feedback group will listen to samples and will be given feedback of the range of ratings from the professionals before they take the post-test. The Practice group will also listen to samples after the pre-test, but with no feedback. The Control group will only take the pre-test and the post-test. It is anticipated that the Feedback group will rate voice samples with better agreement with the voice experts in a post-test than the Practice group and the Control group. It is also expected that the Practice group will have greater agreement with the voice experts than the Control group. This could provide a model for training new voice clinicians with limited voice experience to use the CAPE-V reliably.

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## Perceptual and Objective Measures of Boychoir Voices

### Objective

The purpose of this presentation is to provide initial data from a longitudinal study that is examining acoustic, aerodynamic, vocal fold vibration patterns, and perceptual voice changes that occur as boys who sing progress through puberty. Choral singing activities are one of the primary vocal outlets for young boys and the understanding of both the physiologic and perceptual changes are necessary for optimal vocal training during this tenuous time-frame. The few studies that document pubescent vocal development in this population do not include all the relevant measures of voice and vocal production. Additionally, the manner in which data has been collected and evaluated varies by clinical site and has not been consistently documented in previous studies. Research questions from this project will examine the effect of puberty on the delineated vocal parameters.

### Methods

The planned target enrollment for this study is 45 subjects, ages 7 to 9 years, from the Cincinnati Boychoir and are classified in Cooksey Stage 1 (Pre-pubertal Unchanged Voice: Range = 220–698 Hz). Data collection will include the following measures: Acoustics (Voice Range Profile, Long Term Average Spectrum); Aerodynamic (Average Airflow, Estimated Subglottal Pressure); Endoscopic Laryngeal Imaging, including high speed imaging (4 frequencies; 3 vocal slides); Perceptual Analysis (Rating Singing Samples for Timbre and Voice Breaks); and Pubertal Development Scale (Self-Ratings by Parent). These subjects will continue to be evaluated each time they mature into the next Cooksey Voice Classification (Mid-voice I, Mid-voice II, Mid-voice IIA, New-voice, Emerging Adult Voice).

### Results/Conclusions

Descriptive statistics and visual inspection of data trends will be used to analyze the acoustic, aerodynamic, laryngeal endoscopic, perceptual, and pubertal development data. Initial findings will be reported for at least 20 subjects. This study will expand the limited data on physiologic and acoustic changes that occur as boys who sing progress through puberty.

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### Perceptual Error Identification of Human and Synthesized Voices

**Objective:** Verify the ability of voice specialists (VS), general speech language pathologist (SLP) and laymen to discriminate human and synthesized voice samples.

**Methods/Design:** 70 subjects (20 VS, 20 SLP, 30 laymen) preformed a listening task to classify 54 voices: 18 human samples and 18 synthesized vowels, male and female (9 each), with different type and degree of deviation, total of 36 voices. Repetition of 50% was used to verify intrarater reliability. Voice disorders were simulated by perturbations of vocal frequency (roughness); additive noise (breathiness) and by increasing tension and decreasing separation of the vocal folds and increasing pulmonary pressure (strain). Human voices were collected from the database of a vocal clinic. **Results:** Intrarater reliability was high (72.22%). The average amount of error considering all groups was 37.77% (13.6/36), 31.94% (11.5/36) for VS, 39.30% (14.15/36) for SLP and 40.83% (14.7/36) for laymen. The three voices that had greater perceptual confusion were human male with severe breathiness, synthesized female with mild breathiness and human female with severe roughness. For the VS group: human male with moderate roughness, human male with moderate strain and with severe breathiness, and human female with severe roughness. For the SLP group: synthesized female with mild breathiness, human male with severe breathiness, and synthesized male with mild strain. For the laymen group: human male with severe breathiness, human female with severe roughness and breathiness, synthesized male with severe breathiness, and synthesized female with mild breathiness. **Conclusions:** The quality of synthesized samples was very high. Human voices with moderate to severe deviation and synthesized voices with mild deviation had greater perceptual confusion. VS presented a lower amount of error which allows us to infer that auditory training assists on vocal analysis tasks.

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## Reliability and Validity of Aerodynamic Measures in Healthy Voice Users

An utterance that more closely matches connected speech is needed to elicit aerodynamic investigations of voice. Repeated /pi/s were compared with a repeated phrase to determine reliability and validity of aerodynamic measures in healthy voice users.

The current study addresses a critical barrier in the assessment and treatment of patients with voice disorders; the lack of reliable and valid clinical voice outcome measures. What is needed is a clinical voice outcome measure that is not subjective in nature, maintains reliability and validity across gender and age and across different types of voice disorders, reflects voice production in connected speech, and captures change in voice from pre- to post-treatment. Recognizing what is needed to advance the field; the study investigated the reliability and validity of laryngeal resistance (LR; subglottic pressure divided by average airflow, Smitheran & Hixon, 1981) captured by repeated /pi/s and a repeated phrase using KayPentax's Phonatory Aerodynamic System (PAS, Montvale, NJ).

Preliminary work identified LR as a potential, reliable, and valid coordinative measure of the voice production system (e.g., Grillo et al., 2009; Grillo & Verdolini, 2008; Grillo, et al., 2010). The preliminary studies also suggest a potential for LR in capturing voice production changes from pre- to post-voice treatment based on the success of distinguishing three voice qualities that are found in patients with voice disorders; breathy, normal, and pressed. There are key questions that remain to continue such investigation involving LR: (1) Will a short phrase elicit valid and reliable LR data, in healthy adult voice users across gender and age? (2) Will LR demonstrate changes in voice from pre- to post-voice treatment in adult patients with voice disorders? Question one is addressed in the current study. Question two will be addressed in future studies.

**Participants:** Participants were 20 males and females between the ages of 20-40 in good vocal health on the day of testing.

**Equipment:** The equipment involved the PAS, available for purchase through KayPentax.

**Procedures:** Following informed consent, participants completed screening procedures. Screening involved an interview eliciting a voice sample to assess the voice quality of the potential participants and the participants' history related to type of voice use, occupation, gender, age, race, and ethnicity. The equipment involved placing a mask firmly over the mouth and nose to ensure a good seal, and positioning the plastic tubing connected to the pressure transducer intraorally, avoiding blockage of the tube by the tongue. Following typical clinical procedures for cleaning of aerodynamic instrumentation, the entire inside of the airflow mask was cleaned by a surface disinfectant before every new participant and each participant received a new intraoral pressure tube. Participants produced two types of utterances into the PAS with the constraint that each trial for both utterances was repeated after a five minute break to assess reliability of LR. For the first type of utterance, participants were instructed to produce a consonant-vowel syllable string (/pi pi pi pi pi/), repeated three times in a comfortable  $F_0$  and intensity, at a rate of 88 beats per minute as indicated by the metronome. For the second type of utterance, participants were instructed to produce the following phrase "Pooh, pay Pia pea pie," repeated three times in a comfortable  $F_0$  and intensity, at a rate of 88 beats per minute, as indicated by the metronome.

**Anticipated Findings:** For reliability, LR values during the /pi/s and the phrase for both will demonstrate a strong correlation ( $>.70$ ) across repetitions of each trial at time points 1 and 2. For validity, LR values will demonstrate a strong correlation for both the /pi/s and the phrase.

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## Ambulatory Voice Monitoring of a Muslim Imam During Ramadan

**Objective:** Religious leaders comprise a significant population of voice users with high vocal demands and may be at increased risk of developing voice disorders. It is hypothesized that the quantitative characterization of the occupational voice use of religious leaders may lead to a better understanding of the role of vocal behavior in voice use-related disorders. The purpose of this study is to monitor the voice use of a Muslim imam during the month of Ramadan when vocal demands are especially elevated due to the chanting of extended prayer cycles.

**Methods:** An adult male imam wore an accelerometer-based ambulatory voice monitor for 12 days throughout the month of Ramadan when Muslims fast during the daytime (abstaining from both solid food and liquid) and attend extended prayer services after sunset. Vocal dose measures were computed before, during, and after prayer services to quantify the differing vocal demands during daytime and nighttime activities. In addition, acoustic, aerodynamic, and endoscopic descriptions were obtained from laboratory recordings during the first and last weeks of the month.

**Results:** Initial results indicated phonation time as high as 50% during prayer chanting periods lasting approximately two hours. This vocal load is similar to or higher than vocal doses reported for teachers and vocalists during periods of occupation-related voice use. Sound pressure level, fundamental frequency, phonation time, cycle dose, and distance dose were elevated during prayer chanting compared with daytime vocal dose levels. Whereas vowel perturbation measures were within normative ranges, subglottal pressure and vocal efficiency ratios yielded abnormal values at the end of the month, suggesting increased vocal effort and/or fatigue due to extended periods of vocal demands.

**Conclusions:** This study provides a preliminary framework for future investigations into the quantification of voice use by religious leaders who experience periods of extensive voice use.

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## **Effects of a Cognitively Demanding Task on Spectral-Cepstral Acoustic Features of Voice in Healthy Young Adults**

**Objective:** The purpose of this study was to determine the effect of a cognitively demanding task on voice quality in healthy adults, using spectral and cepstral measures as objective measures of voice quality.

**Methods:** Sixteen healthy young adults (eight female) read 16 sentences. Sentences contained embedded 'Stroop' tasks, in which participants were asked to say the ink color of the word instead of the word text. Sentences were presented in two conditions: congruent and incongruent. In the incongruent Stroop condition, ink color differed from the text shown (e.g., the word 'red' in blue ink), which represented an increase in cognitive load relative to the congruent Stroop condition, in which ink color and word text were the same.

**Results:** Two-way mixed models analyses of variance on the cepstral peak prominence (CPP) and the low-to-high spectral energy ratio (L/H ratio) indicated statistically significant main effects of Stroop condition (congruent or incongruent). The incongruent task was associated with higher CPP and lower L/H ratios.

**Conclusions:** Healthy young adults show changes in voice quality in continuous speech produced with higher cognitive loads. These effects may be a result of heightened autonomic arousal, which has been shown to produce destabilizing effects in other speech motor systems. Future work will incorporate additional acoustic measures and perceptual measures of vocal quality and will extend this work to individuals with voice disorders.

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## Acoustic Assessment of the Voices of Children Using Nonlinear Analysis: Proposal for Assessment and Vocal Monitoring

**Objective:** To analyze the accuracy of recurrence measurements, both isolated and combined, to assess the intensity of vocal disorders in children. **Method:** A total of 93 children of both sexes (48 girls and 45 boys), aged between 3 and 10 years, participated. The vocal-deviation intensity was evaluated by the consensus of three speech therapists from the pronunciation of vowel /ε/ using the visual-analog scale. In the acoustic analysis, eight recurrence-plot characteristics were evaluated, extracted with neighborhood radius values that maintained the recurrence rate at 1%, 2%, 3%, 4%, and 5%. The classification was performed using quadratic discriminant analysis applied for individual and combined measurements. The performance was evaluated by measuring the accuracy, which related the cases correctly classified to all the analyzed cases. **Results:** In the classification cases concerning individual measure performance, the trapping time and maximum length of the diagonal lines showed the best classification potential to discriminate between healthy and disturbed voices, with accuracy rates above 80%. In the healthy and mild-deviation cases, the *TREND* measure was also relevant. For the mild- versus moderate-deviation classification, the best performance was obtained by the *TREND* measure (85.00% ± 7.64%). A gain was obtained in the classification rate when the measures of recurrence were combined, reaching an accuracy of 95.00% ± 5.00%, for discriminating between healthy voices and those with mild deviation. **Conclusions:** The measures of recurrence, either alone or combined, may be useful in detecting healthy and disturbed voices and in differentiating the intensity of vocal disorders in children.

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**Acoustical Bases for the Perception of Vibrato as a Model of Vocal Tremor**

Vocal tremor involves atypical modulation of the fundamental frequency (F0) and intensity of the voice. Previous research on vocal tremor has focused on measuring the modulation rate and extent of the F0 and intensity without characterizing other modulations present in the acoustic signal (i.e., modulation of the harmonics). Characteristics of the voice source and vocal tract filter are known to affect the amplitude of the harmonics and could potentially be manipulated to reduce the perception of vocal tremor. The aims of this study were: 1) to determine if trained singers producing vibrato with F0 modulation (to simulate vocal tremor) could volitionally modify characteristics of the voice source (i.e., F0, vocal quality) and vocal tract filter (i.e., vowel) to reduce listeners' perception of the magnitude of modulation of voice, and 2) to determine the acoustical characteristics that were associated with differences in perception of the magnitude of modulation of voice. Results revealed that listeners perceived a higher magnitude of voice modulation when voice samples had a pressed quality rather than breathy vocal quality, but not a higher mean F0 or vocal tract shape that enhanced the higher harmonics (/i/). Based on regression analyses, listeners' judgments were predicted by modulation information present in both low and high frequency bands. These findings indicate that production of a breathy voice might be a useful compensatory strategy for reducing the perceptual severity of vocal tremor affecting the larynx. [Work supported by NIH F31-DC012697 and NIH R01-DC011275]

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### **Effectiveness of Vocal Health Workshops for Teachers**

**Aim:** To verify the effectiveness of health voice workshops, provided by students of the Speech Pathology course at the FOB-USP Brazil. **Method:** Twenty-seven teachers, 24 females and 3 males, age range 25-65 years (mean 44,  $\pm 4,2$  yrs), from three public schools, attended the Voice Workshops, with 6 six meetings, 60 minutes each one, in May and June, 2014. The protocols Screening Index for Voice Disorder (SIVD), V-RQOL (Voice-Related Quality Of Life), VHI (Vocal Handicap Index), and VAPP (Vocal Activity and Participation Profile) were applied pre and post Workshop, and a satisfaction questionnaire. **Results:** After the Voice Workshops there was a 5 points average reduction at the SIVD total scores. The Wilcoxon test found significant statistical difference between pre and post workshop for SIVD total score ( $p < 0.0001$ ), and for 10 symptoms concerning the vocal disorder ( $p < 0.05$ ). The scores of protocols V-RQOL, VHI and VAPP obtained by the teachers both prior to and after workshops showed good quality of life, with no significant difference in the comparison of scores pre and post voice workshops ( $p > 0,05$ ). The individual analysis of the scores of the protocols, according to the classification as to their quality of life (good, intermediate and poor), obtained prior to and after Voice Workshop, pointed to a decrease in the number of teachers who presented poor and intermediate quality of life, following the Voice Workshops. The responses to the satisfaction questionnaire showed that the voice workshops was well thought by most teachers who reported improvement in their professional performance, a decrease in their vocal effort and their intention to comply with the guidelines and vocal exercises, following the Voice Workshops. **Conclusion:** Voice workshops led to a decrease in the number of teachers who presented poor and intermediate quality of life, and improved their professional performance with a decreased vocal effort.

**Key-words:** Voice; Health Action; Faculty.

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### **Vocal and Lifestyle Habits of Music Majors**

**Objective:** This study was designed to investigate the vocal and lifestyle habits of music majors in order to understand the effects of substantial voice usage and associated routine behaviors in this population.

**Method:** Forty university students majoring in music, with age ranging from 18 to 36 years, responded to questions related to their lifestyle habits as well as feelings and attitudes regarding their voice usage.

Twenty-one participants were female and nineteen were male, all pursuing college degrees in music, and majoring in the following categories: 18 Musical Theatre, 10 Classical Voice, 8 Music Business, 3 Music Education, and 1 Voice Performance. This study involved the use of the Singing Voice Handicap Index (SVHI) and self-reported data regarding demographics and voice usage using the Singing Voice Profile (SVQ), created for this study.

**Results:** Although the results did not reveal statistically significant differences among majors, outcomes indicated notable aspects related to habits that may negatively affect the voice. For example, a higher consumption of caffeinated drinks was verified among participants in the Musical Theatre group. Overall, the results showed significant relationships between consumption of caffeinated soda and frequency of hoarseness, voice loss, and hoarseness after singing. Outcomes also demonstrated significant correlations between not being able to perform because of voice problems and hoarseness, undesired voice variation, fatigue from singing, and no rest after using the voice for a prolonged period of time. Additionally, SVHI results indicated higher scores for emotional and physical aspects among Musical Theatre majors.

**Conclusions:** The results of this study suggest that both vocal and lifestyle habits could have an impact on the quality of voice. Inappropriate use of voice may affect the quality of voice performance for music majors. This research yields promising preliminary data regarding the effects of vocal and lifestyle habits on the voice.

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### Voice Quality in Future Musical Actors

Musical performers are a special group of elite vocal performers with a high vocal load as they combine singing, acting and physical performance (dancing). As they are absolutely depending on their vocal quality and vocal capacities for their studies and their future profession, an optimal voice coaching is very important. The purpose of this study was to determine the voice quality of future elite vocal performers (musical performers). Secondly, voice quality between first and second year students of the bachelor program Musical was compared.

Thirty-one Musical students (7 men and 24 women) with a mean age of 20 years participated to the study. To determine the voice quality objective (aerodynamic measurements, voice range profile, acoustic analysis and Dysphonia Severity Index) and subjective (videolaryngostroboscopy, Voice Handicap Index and Singing Voice Handicap Index) voice measurements were performed.

The mean DSI in male and female Musical students was respectively 3.9 and 5.6, both corresponding with an overall good vocal quality. The results of the VHI showed no important psychosocial impact on the speaking voice. However, the sVHI scores were higher than the VHI scores in both male and female Musical students. Despite the overall good vocal quality, videolaryngostroboscopy revealed a high presence of organic and functional voice disorders. No differences were found between the first and second year students.

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### Vocal Evaluation of Children with Congenital Hypothyroidism

Objective: evaluate vocal characteristics of a group of children with CH and their association with clinical, laboratory and therapeutic profile. Methods/Design: Observational, analytical, cross-sectional study. Two-hundred pre pubertal children, aged 3 to 12 y-old, were enrolled: 100 with CH (Study Group, SG) and 100 without CH (Control Group, CG). The following parameters were evaluated: 1) History – identification, complaints and interfering variables; 2) Perceptual and acoustic voice evaluation- samples of sustained vowel and connected speech, analyzed subjectively by a group of four speech therapists, voice specialists, and objectively by computer program; 3) Vocal Self-Assessment - scores on the instrument " Pediatric Voice Related Quality of Life Survey " (PVRQoL), 4) Laryngological Evaluation - presence or absence of laryngeal lesion and data of glottal closure; 6) Medical records (SG) - CH etiology, age at onset of treatment, severity of disease at diagnosis, quality of treatment in the first three years of life, and thyroid function of the day of examination. Results: SG and CG were different according to gender ( $p < 0.001$ ) and similar in age ( $p = 0.91$ ). In perceptual assessment, 62.6% of SG children passed whereas 37.4% failed in the voice screening, however not different of CG ( $p = 0.45$ ). Both groups had mean/median acoustic measurements within normal limits, with no differences between them. The mean PVRQoL of the SG ( $99.3 \pm 2.4$ ) and CG ( $99.5 \pm 1.7$ ) were not different ( $p = 1.00$ ) and correspond to the values reported by individuals without voice complaints. In laryngeal examination both SG (16.7%) and CG (15%) had vocal fold lesions ( $p = 1.00$ ). There was not association between voice/larynx characteristics and medical endocrinological data. Conclusion: CH children with early diagnosis and adequate treatment have the same vocal and laryngeal characteristics of children without this disease.

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### Nonlinear Acoustic Voice Analysis After Partial Laryngectomy

Dysphonia is the main surgical sequel in patients who underwent vertical partial laryngectomy (VPL) with the presence of intense glottal noise which makes more difficult conventional acoustic analysis. Therefore the nonlinear analysis, dynamic theory of nonlinear systems applied to nonlinear time series, has recently been adopted as a new approach to acoustic analysis of voice. **Objective:** apply to ANL by L- IS scale on acoustic voice analysis of patients underwent VPL. **Method:** 31 voices of patients underwent VPL called patient group (PG) and 31 voices of individuals without vocal or laryngeal disorder were analyzed called control group (CG). Two-dimensional graphs generated from the voice signals the both groups were evaluated based on the technique of VDVP through the rating scale L-IS for the three parameters: number of loops (L), irregularity (I) and spacing (S). For the correlation of data from nonlinear analysis with the perceptual evaluation, the voices of the PG were evaluated by GRBAS scale. **Results:** significant correlation ( $p < 0.05$ ) between the three parameters of the L-IS scale for the total sample analysis PG and CG. The results of the L-IS scale for the majority of PG patients were characterized by: zero for number of loops; 6 degree for both irregularity and spacing of the traces. The PG had most of their voices evaluated with 3 degree of dysphonia in GRBAS. There was a statistically significant correlation ( $p < 0.05$ ) between L-IS and GRBAS parameters: “L” with the overall grade of dysphonia (G) and breathiness (B) and “I” with breathiness (B). **Conclusion:** the method of ANL by L-IS scale, is efficient for evaluating the voices of patients underwent VPL.

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### **Efficiency and Cutoff Values of the Voice Activity and Participation Profile – VAPP for Non-Teachers and Teachers**

**Purpose:** To identify characteristics of efficiency and cutoff values of the dimensions of the Voice Activity and Participation Profile – VAPP protocol that discriminate dysphonic and vocally healthy subjects; to verify if the cutoff values remain the same for a sample of teachers. **Methods:** Features of efficiency and cutoff values of VAPP data of 171 subjects were analyzed by Receiver Operating Characteristic – ROC curve: 90 teachers (60 dysphonic and 30 vocally healthy, with similar mean age,  $p=0.418$ ) and 81 individuals non-teachers (48 dysphonic and 33 vocally healthy, with similar mean age,  $p=0.934$ ). **Results:** The area under the ROC curve - AUC and the cutoff values of the total score of VAPP for discriminating individuals with and without dysphonia are different for non-teachers and teachers. Non-teachers had AUC = 0.986 ( $p<0.001$ ) and 4.5 points in the total score of VAPP (sensitivity = 95.8%, specificity = 90.9%); teachers had AUC = 0.872 ( $p<0.001$ ) and 14.6 points of cutoff of the total score (sensitivity = 91.7%, specificity = 75.9%). **Conclusion:** The cutoff values of VAPP are different for non-teachers and teachers, higher for teachers, however, with greater sensitivity and specificity for non-teachers individuals and can be used for screening of large populations at risk for voice disorders.

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## **Vocal Tract Discomfort Symptoms in Patients with Different Voice Disorders**

**Objective:** To analyze the symptoms of vocal tract discomfort in patients with different voice disorders. **Study design:** This study was descriptive, observational, and cross-sectional. **Methods:** A total of 210 subjects with vocal complaints and prior medical assessment were divided into five groups according to diagnosis: no laryngeal lesion, lesion to membranous portion, voice disorder of neurological origin, glottal closure without organic cause, and voice disorder secondary to gastroesophageal reflux. All participants responded to the vocal tract discomfort scale at the time of assessment. **Results:** Patients had a mean of  $4.01 \pm 0.70$  symptoms, with sore throat being the most commonly reported. Compared to patients in other groups, patients with lesions in the membranous portion of the vocal folds and those with voice disorder due to gastroesophageal reflux showed an increased number of symptoms. Voice disorders of reflux were shown to result in a higher frequency of sore throat and lump in the throat than in those with neurological etiology. The intensity of the lump in the throat was higher in patients with reflux than in patients with neurological voice disorders. **Conclusion:** There was a difference between the number, frequency, and intensity of symptoms of vocal tract discomfort based on the type of voice disorder.

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## **The Effects of Aerobic Exercise Intensity on Electroglottographic and Acoustic Measures of the Voice**

**Purpose:** Exercise tasks have been associated with disruptions of respiratory and phonatory function that may lead to the development of voice and associated disorders. The purpose of this study was to investigate the effects of a typical aerobic running task at varying exercise intensities on pre vs. post characteristics of the voice.

**Methods:** Participants consisted of 16 females and 16 males (Total N = 32) between 18 and 30 years of age. Each participant initially completed a  $VO_{2\text{ max}}$  test to determine their individualized workload intensities. Approximately 1-8 days following the  $VO_{2\text{ max}}$  test, participants engaged in two, 15-minute treadmill running tasks at varying intensities (50% and 80% of participants'  $VO_{2\text{ max}}$  scores).

Electroglottographic (EGG) signals were obtained during vowel production to be analyzed for measures of contact quotient (CQ). In addition, acoustic measures of the voice including Cepstral Peak Prominence (CPP dB) and several other spectral or cepstral based measures were obtained for the sustained vowel productions.

**Results:** Exercise tasks resulted in a significant increase in vocal frequency for all participants, and resulted in a significant reduction in Cepstral Peak Prominence (CPP) in females. Measures of CQ and other acoustic variables showed nonsignificant group effects by exercise. However, single-subject analyses focusing on measures of CQ indicated that 7 of the 32 individual participants (21.9%) showed extreme reactions to exercise (CQ's below the 10<sup>th</sup> percentile or greater than the 90<sup>th</sup> percentile post-exercise). Four of the subjects showed evidence of substantially reduced vocal fold contact and 3 of the subjects showed evidence of substantially increased vocal fold contact immediately post-exercise as compared to their pre-exercise baseline measures.

**Discussion:** Reduced vocal fold contact during voicing immediately post-exercise may reflect increased respiratory demand and maintenance of a minimally obstructed airway. In addition, hypoadduction during voicing may also be consistent with signs of possible paradoxical vocal fold movement (PVFM). In contrast, increased vocal fold contact during voicing immediately post-exercise may be consistent with the development of hyperfunctional voice disorders often associated with exercise-related vocal abuse/misuse. These results indicate that EGG may serve as a helpful, noninvasive diagnostic tool for identifying individuals with exercise-induced reactions at the laryngeal level. Complete methods and results will be provided.

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## **Efficacy of Long-Term Use of Vocal Cool Downs as Analyzed through Aerodynamic Measurements**

**Objectives:** Initial investigation regarding the efficacy of vocal cool-down exercises after rigorous singing reveals some benefits, particularly in follow-up data collection 12-24 hours later (Gottliebson et al., 2011). Exercise physiology literature suggests that use of physical cool-down exercises is effective in facilitating the body's return to homeostasis and in providing protection for restoring muscles to pre-conditioning function. Such knowledge creates the opportunity for further discovery regarding the potential benefits of vocal cool-down exercises for the laryngeal mechanism and its efficiency during and after active, professional voice use. The purpose of the present study is to examine the efficacy of vocal cool downs after rigorous voice use when incorporated into the singer's daily regimen for six weeks by measuring phonation threshold pressure (PTP) and perceived phonatory effort (PPE).

**Methods:** Baseline measures of PTP and PPE have been collected. Study participants in the treatment group have received instructions for performing the cool-down exercise protocol daily for six weeks. Control group participants will follow their usual daily regimen for six weeks. Follow-up measures will be collected, as scheduled, in late November, early December 2014. Participants include six singers enrolled in the undergraduate program of the Music Department of Miami University, Oxford, Ohio.

**Results:** It is hypothesized that PTP measures will decrease at the 10%, 20%, and 80% levels of the pitch range following implementation of the treatment protocol. Furthermore, it is estimated that measures of the control group will reveal no change in PTP values at the 10%, 20%, and 80% levels of the pitch range. It is expected that PPE values will also decrease with use of the cool-down protocol, as the perception of effort will positively correlate with aerodynamic measures. It is anticipated that PPE values of the control group participants will not change.

**Conclusions:** If the null hypothesis is rejected, the data will support the conclusion that vocal cool down exercises used daily after rigorous singing is beneficial to the overall health and efficiency of the laryngeal mechanism, as observed through decreased PTP values and decreased PPE ratings. These findings would further support established conclusions regarding the use of cool-down exercises in facilitating carryover of resonant voice use into conversational speech (Gottliebson, et al., 2011).

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## **The Multidimensional Efficacy of Voice Rehabilitation in Patients Treated with Radiotherapy for Advanced Head and Neck Cancer**

**Objective:** our study aims to evaluate the efficacy of voice rehabilitation for advanced head and neck cancer patients after having undergone radiation therapy. **Methods:** Prospective cohort study, randomized, descriptive, inter-institutional. Twenty patients irradiated for advanced cancer of the oropharynx, larynx and hypopharynx were assessed 1,2 and 3 months after radiotherapy (ENT evaluation, perceptual and acoustic analysis and quality of life questionnaire in voice - Voice Handicap Index, VHI30). Ten patients were randomized to structured voice rehabilitation with a speech language pathologist 1 month after completion of radiotherapy (G1) and 10 to 2 months after completion of treatment (G2). Vocal rehabilitation was performed individually twice/week. **Results:** Most patients were male (60%), mean age of 59 y.o. in G1 and 64 y.o. in G2. The most prevalent tumor site was oropharynx (50%), followed by the larynx (40%) and hypopharynx (10%). No laryngological change after voice therapy was observed in both groups. G1 showed significant better vocal quality (90%), acoustic improvements and better voice handicap index on functional, organic and emotional domains and total score. G2, regarding the same period without voice therapy, presented worse perceptual voice evaluation on 66% of the patients, improvement on VTI, and worse values for PPQ, shimmer%, APQ, vAm, NHR and DUV, improvement on voice handicap index on functional and total score and worse results for organic domain and emotional domains. **Conclusion:** Voice rehabilitation is efficacious regarding voice function and quality of life. Voice rehabilitation is recommended for advanced head and neck cancer patients after radiation therapy, particularly early after the end of the treatment.

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### **Does Vibratory Motion Change Following Exposure to Low Humidity Challenge? A Multidimensional Voice Measurements Study**

**Objective:** To examine the effects of superficial dehydration resulting from exposure to low ambient humidity on vocal fold vibrations in vocally healthy adults using multimodality voice measurements. **Methods:** Spatial (speed quotient) and temporal (vibratory onset time, jitter %) measures of vocal fold oscillations, CAPE-V perceptual judgments of vocal instability, and phonation threshold pressure (PTP) were obtained from 10 young adults (21-29 years, male = 4, female = 6) before and after a 60 minute exposure to oral breathing of low ambient humidity air. Vocal fold oscillations were captured using high-speed video imaging at 4000 frames per second. PTP was obtained on /pi/ for 5 syllable trains consisting of 7 repetitions at 1.5 syllables per second. Since voice measurements vary with pitch and loudness, measurements of vocal fold oscillations and phonation threshold pressure were obtained at 10 percentage pitch levels. Pre and post challenge differences were subjected to a repeated measures multivariate analysis of variance. Findings were considered significant for  $p \leq 0.05$ .

**Results:** Statistical significance was achieved for the main effect of time ( $F [5, 5] = 6.689, p = 0.029$ , partial  $\eta^2 = .870$ ), suggesting a change in the voice measurements following exposure to low humidity ambient air. Post hoc analysis revealed significant difference ( $t (9) = 3.907, p = 0.004$ ) in the spatial measure of speed quotient before ( $1.492 \pm 0.161$ ) and after the challenge ( $1.276 \pm 0.14$ ). Statistical significance was not obtained in measures of jitter %, vibratory onset, phonation threshold pressure, and vocal instability.

**Conclusions:** Superficial laryngeal dehydration resulting from exposure to oral breathing of low ambient humidity air resulted in a change in the shape of the glottal area waveform, suggesting possible changes in the viscoelastic properties of the vocal folds.

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### **Mapping of Vocal Risk in Choir Amateur**

**Objective:** To verify the existence of vocal risk in amateur choir singers. **Methods:** 526 amateur choristers volunteers, 186 males and 340 females, average age of 42.07 years old from various choirs of Sao Paulo answered to four instruments: Voice Symptom Scale (VoiSS), Modern Singing Handicap Index (MSHI), List of Vocal Symptoms and Sign (LSS) and Generalized Anxiety Disorder Scale (GAD-7). Participants were screened according to the cut-off value of the VoiSS protocol into: pass group and failure group. The subjects were also classified according to the number of vocal signs and symptoms (less than 1.7 symptoms - no risk) and (1.7 or more symptoms - risk). Four groups were created: failed in both protocols, failed only in VoiSS protocol, failed only in LSS and no risk in both protocols. **Results:** A high number of singers failed in both questionnaires (n=169; 32.1%); considering only the VoiSS, n=102 singers failed (19.4%); only the LSS, 54 failed (10.3%) and the no risk group was formed by 201 participants (38.2%). The failure group presented a mean total score of score of 26.34 for the VoiSS; moreover, the MSHI total score for this group was 20.97, with greater deviation in the defect subscale, followed by disability and handicap; finally, the anxiety level was characterized as mild. For the pass group, the VoiSS mean total score was 8.27, the MSHI was 6.11 and the level of anxiety was minimal. **Conclusions:** Choir amateur singers can present a high number of vocal symptoms. The use of self-assessment instruments may assist the music conductor to screen the singers that need further evaluation. Anxiety can be higher when vocal symptoms are present. The combined use of the two protocols, one general and one more specific to singing aspect can enhance the possibility to identify individuals with potential problems.

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**Effect on Acoustic Parameters after Eight Voice Therapy Sessions Using a Flexible Resonance Tube in Patients with Functional Dysphonia**

**Objective:** To analyze the acoustic parameters pre and post prolonged and exclusive use of flexible resonance tube therapy in adults with functional dysphonia.

**Method:** Participated 8 women and 2 men with functional dysphonia who received eight voice therapy sessions using exclusively flexible resonance tube. The following acoustic parameters were analyzed using the Praat software: mean fundamental frequency (F0), jitter, shimmer, harmonic-to-noise ratio, H1-H2 (the amplitude difference between the first two harmonics), spectral emphasis. The task used for the analysis was a sustained /a/ vowel and measurements were taken from three distinct places of the vowel. Voice recordings were taken for pre (at the first session) and post-test (at the end of the eighth session) purpose. Paired t-test ( $p < 0.05$ ) was used to compare the means of the parameters pre and post-treatment.

**Results:** A comparative analysis of the acoustic parameters showed increase in F0 for the male group ( $p < 0.001$ ) and an increasing tendency for the female group ( $p = 0.06$ ). Jitter decreased after therapy ( $p = 0.04$ ). The other measurements were all close to the typical range for subjects without voice disorders. The effect of exclusive and prolonged use of the flexible resonance tube in subjects with functional dysphonia seems to be related, with improved stability of the frequency of glottal cycles and increased number of glottic cycle per second (higher F0). The results demonstrated a more significant effect on the men than women, but further studies with a larger number of men in the subject group are recommended.

**Conclusion:** The effect of prolonged and exclusive use of flexible tube in patients with functional dysphonia seems to be related to the stabilization of glottal cycles of vocal fold vibration.

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**Effect of TENS and Laryngeal Manual Therapy in the Larynx of Dysphonic Women: Clinical Trial**

Objective: to compare the effects of Transcutaneous Electrical Nerve Stimulation (TENS) and Laryngeal Manual Therapy (LMT) in vocal folds diadochokinesis (VFDDK) and laryngeal aspects in dysphonic women. Methods: 20 women with bilateral vocal nodules divided by drawing lots into: 1.LMT; 2. TENS; both groups received 12 sessions of treatment, by the same therapist. The patients were evaluated in three phases: 1. initial – without treatment; 2. after six weeks without treatment; 3. after six weeks with treatment. The registration of the VFDDK was realized by repetition of vowels /a/ and / i/; analysis was performed by the program *Motor Speech Profile Advanced (Kay Pentax)*. The laryngeal images were realized by the transnasal fiber optic laryngoscopy. The TENS application consisted of bilateral electrodes on the trapezius muscle and submandibular area (frequency of 10 Hz, high intensity). The LMT consisted of massage on the sternocleidomastoid muscle, larynx and kneading of the supralaryngeal area. The laryngeal images were randomized, paired and sent to the three judges (double-blind). Data were analyzed using the sign tests. The VFDDK of the three evaluations were compared by the paired t test. Results: There were no significant changes in the phase without treatment. After TENS there was improvement: anteroposterior ( $p=0.031$ ) and medial constriction ( $p=0.008$ ); vocal fold lesion ( $p=0.016$ ) and glottal adduction ( $p=0.016$ ). After LMT, VFDDK (vowel /i/) was observed decrease of the standard deviation period, coefficient variation of period and coefficient variation of peak intensity. There were no changes of the parameters vocal folds DDK after TENS. Conclusion: TENS application provided improvement of the laryngeal configuration in relation to supraglottic constriction, glottal adduction and vocal fold lesion when compared to LMT. However, the greater regularity of movements during VFDDK after LMT in dysphonic women, emphasizes the balance of phonatory function provided by the relaxation of the laryngeal muscles.

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Alcione Ghedini Brasolotto, PhD, Professor, Speech-Language Pathology and Audiology Department, Bauru School of Dentistry, University of São Paulo - FOB/USP, Bauru, São Paulo, Brazil

### **A Survey of Voice Usage among Religious Ministers**

**Objective:** This preliminary investigation was designed to examine indications of occupational voice problems in religious ministers. Further objectives of this study include identification of frequency and duration of symptoms associated with vocal strain in this population, as well as their level of basic knowledge regarding vocal health.

**Method:** Eight religious ministers from the Southern Illinois area of the U.S. contributed data to the study. All participants were male native English speakers, reportedly associated with diverse religious denominations under Christianity. The 16- question survey used in this study focused on the conditions of the ministers' vocal health in different times and periods of occupational voice usage. Information connected with situations prior, during, and after service was obtained, in order to determine when symptoms of a voice disorder or vocal strain were most prevalent. Participants also responded questions related to their knowledge of occupational vocal demands, vocal hygiene, and vocal health.

**Results:** Outcomes demonstrated indications of vocal strain associated with voice usage in this population. For example, approximately 40% of the participants have lost their voice completely during a sermon on an average of two times a month, 40% reported feeling a sore throat when preaching, more than two times a month, and 25% described feeling a sore throat every two weeks. Additionally, 40% reported frequently feeling symptoms of vocal fatigue and sore throat at the end of the day. On the other hand, approximately 90% of the ministers reported using amplification during service.

**Conclusions:** These introductory results suggest that religious ministers may be affected by vocal strain in association with occupational activities. Further research will include expanding the sample size and demographic region of the pastors. This data will be helpful in forming additional research projects about vocal demands of religious ministers in future studies.

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## Vocal Characteristics Related to Aging and Stroke

**Objective:** Comparing the perceptive-auditory characteristics of voice and laryngeal motor control in elderly patients with stroke, in elderly without neurological diseases and in young adults at determining the variables, which differentiate the elderly with and without damage. **Methods:** The study included 321 subjects: 25 elderly with stroke and 116 elderly with no neurological changes, aged 62 and 82 years, and 180 adults between 18 and 49 years. The analogical visual scale was used to perform the perceptive auditory assessment of voice quality and the Motor Speech Profile Advanced (KayPentax) was used to assess the laryngeal diadochokinesis. The results were compared by analysis of variance and Tukey test; the accuracy, sensitivity and specificity to differentiate the elderly with and without involvement by stroke were calculated by the ROC curve ( $p < 0.05$ ). **Results:** The parameters overall degree of vocal deviation, roughness, breathiness, slurred voice, standard deviation of the period, coefficient of variation of period, perturbation of period, coefficient variation of peak intensity of laryngeal diadochokinesis were higher for the stroke group than for the elderly group; overall degree of vocal deviation, roughness, breathiness, strain, vocal instability were higher, while the speed of diadochokinesis, were lower for the elderly group than for the younger group. The overall degree of vocal deviation of the sustained vowel, overall degree of vocal deviation, breathiness and slurred voice of connected speech, standard deviation of diadochokinesis period and the perturbation of diadochokinesis period of vowel "a" differentiated the stroke group from the elderly group with greater sensitivity than specificity, while the roughness of the sustained vowel and connected speech had greater specificity. **Conclusion:** Some vocal characteristics during phonation in elderly patients with stroke are related to aging, and others, to stroke; slurred voice was the parameter that best differentiated the stroke and elderly groups.

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## **An iOS-based Cepstral Peak Prominence App: Usability and Feasibility for Patient Practice of Voice Therapy Technique**

### **Background and Purpose:**

In voice therapy sessions, patients can commonly demonstrate vocal improvement by using a technique prescribed by the voice clinician. However, patients report difficulty replicating this technique independently without clinician assistance between sessions. Because overall voice quality is correlated with Cepstral Peak Prominence (CPP) values, CPP has the potential to assist patients in self-evaluating the accuracy of their voice production technique. Therefore, we developed a patient-centered, iOS-based software application ("app") that calculates CPP on iPods, iPhones and iPads. The purpose of this study was to examine its usability and effect on patient self-efficacy for practice.

### **Methods:**

Fourteen individuals with a wide range of voice disorders practiced resonant voice technique without and with the use of mobile CPP results; they subsequently evaluated their self-efficacy for practice on the Readiness Ruler, and assessed app usability with the System Usability Scale and a brief semi-structured interview.

### **Results:**

System Usability Scale scores were above average for mobile apps. Participants rated their self-efficacy for practice significantly higher with than without the app. Furthermore, CPP values were significantly higher when patients produced voice using resonant voice technique than when using their habitual voice production mechanics, and CPP scores again significantly higher when patients interacted with the CPP app to "beat" their score. Qualitative data showed that patients "liked having a number" to put to their voice quality improvement, and experienced a gamification effect: they enjoyed finding ways to optimize voice technique with the goal to beat their own CPP scores.

### **Conclusion:**

Mobile CPP holds potential to assist patients in self-evaluating voice practice, and in motivating adherence through self-efficacy and gamification effects.

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## Preparing Youth for a Lifetime of Singing

Preparing youth for a lifetime of singing, whether as a career or hobby, is a daunting task. A teacher cannot see into the future, cannot know if the child or teen will sing predominantly in classical, jazz, gospel, rock, country, or barbershop. Maybe they will join an early music choir, or a church that only performs contemporary Christian music. Maybe they will sing for a cover band, or support their own children by joining their kids in a community musical theater production. Or maybe that one person will try all of these things and never pick a favorite.

How can we prepare a young student for singing in any or all of these genres?

It starts with studying the basic physical mechanics of singing in many styles, and it starts by giving them permission to perform in any genre. Then we proceed to train the whole voice and the brain; to ensure the singer has access to all style options.

We give a student a vocal foundation that allows for all contingencies. However, it is apparently not an idea that is embraced by all voice teachers. A striking example came last winter when a young woman whom I had taught from age 12 to 18 told me about the first conversation she had with her first voice teacher other than me. In that conversation with her new teacher, the teacher said “Since you’ve had voice lessons since you were 12, you must know most of the Italian art songs.” The student was able to respond, “No, I only studied two of them. And I’ve been in four musicals. I had a scat solo in my last jazz choir show. I can belt an E-flat 5, and I soloed “Wade in the Water” in gospel style for my church in July.”

We cannot assume that any student is going to follow a traditional route to success, whether that tradition is focused on jazz, musical theater, classical forms, or another genre. And it is crucial that we not force them down a path of our choosing. Preparing youth for a lifetime of singing means empowering students to be smart singers – healthy singers.

Nancy’s presentation focuses on children ages 6 – 16. She discusses considerations of physiology, resonance, breathing, lesson breakdowns, and expectations for different ages. The presentation will require a piano and 3 children or teens, ranging in age from 6 – 14, to participate in the exercises.

Nancy Bos, Nancy Bos Vocal Studio, Bellevue, WA

### **Breath and Support in Estill Voice Training: Let it Go!**

Estill Voice Training™ (EVT) is a system for analyzing and producing voice quality. Developed from Jo Estill’s research and pedagogic insights, the system features Figures for Voice Control™, unique exercises that refine motor control for 13 elements of power, source, and filter. EVT principles apply to everyday speaking, performance, teaching, and rehabilitation. This workshop will highlight how select Figures relate to the Estill precept of allowing the breath to “free-vary” with changes in the true vocal folds and vocal tract. Performers, Teachers and Therapists alike are challenged to “support” the tone without “pressing” or “pushing”. The objective of this workshop is to demonstrate how Figures enable us to generate powerful voices without overpowering the delicate tissues of the true vocal folds. Workshop participants will have the opportunity to produce the Estill Voice Training™ Figure options, explore the kinesthetic connections between brain and anatomy, and apply physiological insights to common problems encountered in the singing studio and voice therapy. Participants are encouraged to volunteer their own voices, teaching and/or therapy challenges during the session.

Mary McDonald Klimek, MM, MS-CCC/SLP, Vice-President and Estill Voice Training Course Instructor, Estill Voice International, LLC

Kimberly M. Steinhauer, PhD, President and Estill Voice Training Course Instructor, Estill Voice International, LLC

### **Bel Canto / Can Belto: Enhancing Vocalism by Concurrent Training in Classical and Musical Theatre Styles**

Penn State voice faculty colleagues Mary Saunders–Barton and Norman Spivey have spent many years collaborating, observing and learning from one other. They have built on their interests in musical theatre and classical singing by working together with students, offering joint coursework, and overseeing the MFA in Voice Pedagogy for Musical Theatre—the first academic program of its kind. In this workshop, Saunders–Barton and Spivey will bring students from their program to demonstrate effective development as flexible singing–actors—pursuing optimum vocalism in both musical theatre and classical styles.

Norman Spivey, DMA, Professor of Voice, Penn State University, President NATS, 233 Music Building, Penn State, University Park, PA 16802

Mary Saunders-Barton, MA, Penn State University, 209 Theatre Building, University Park, PA 16802

### **Stand Up Straight and Breathe!**

**Objective:** To offer an opportunity to review concepts regarding the need to emphasize optimal static and active body posture for professional voicing. Basic vocal hygiene includes posture utilized prior to initiation of the inhale as well as during speech or singing, therefore aspects of professional voice usage are highlighted.

**Method:** Introductory remarks will be followed by hands-on experience and subsequent reasoning. This participatory workshop draws on past and current research as well as on an integrative perspective of diverse disciplines in occupational voice care, by combining voice teaching and speech-pathology knowledge. Complementary self-examination provides further insight into proprioceptive feelings, signaling the need of considerations beyond the basic voice mechanism in order to secure ideal voice performance and preservation.

**Results:** There is an increasing trend of interest in understanding anatomic and physiologic aspects as well as tangible considerations in recommendations to maintain ideal body alignment for voice usage. This paradigm signalizes that interdisciplinary attention is warranted to secure the general agreement that optimal use of body posture can facilitate phonation.

**Conclusions:** An analysis of voicing efficacy associated with various postural alignments and orientations should be driven by background knowledge and practical experiences. This workshop involves concepts in posture and voicing using a dynamic approach including applied observation and participation.

Jeanine F. Wagner, DMA, MM, MS, Professor Emerita, School of Music, Southern Illinois University Carbondale

Maria Claudia Franca, Ph.D., CCC-SLP, Associate Professor, Communication Disorders and Sciences, Rehabilitation Institute, Southern Illinois University Carbondale

**The Acoustic Landmarks of the Male Passaggio:  
Why and How Strategies Must Vary by Vowel**

Awareness of the acoustic registration events caused by changing interactions between the lower harmonics of the voice source and the first formant of the vocal tract can assist in working out a smooth, comfortable transition through the *zona di passaggio* into the upper range of the male voice. In order to establish a stable tube length and open throated *chiaroscuro* timbre, all harmonics other than H1 should be allowed to pass through F1 without formant tracking. Ten specific formant-harmonic intersections correlate with the historically identified male *zona di passaggio*, necessitating specific pedagogic strategies that differ by vowel. This workshop will demonstrate—via audience volunteers—how knowledge of the locations of these events, and of the passive vowel modifications that accompany them, can form an objective basis for a coherent acoustic approach to training male range.

At the end of the workshop, participants will:

1. Be familiar with all of the formant-harmonic interactions that occur within the male *zona di passaggio*
2. Understand why and how they necessarily differ by vowel

Learn pedagogic techniques used in implementing an acoustic approach to male *passaggio* training.

Kenneth Bozeman, M.M., Frank C. Shattuck Professor of Music, Lawrence University, 711 E. Boldt Way, Appleton, WI 54911

**Primary Muscle Tension Dysphonia/Aphonia:  
Guiding a Patient with No Voice back to Normal Voice**

The term “primary muscle tension dysphonia/aphonia”(MTD/A) is currently used to refer to patients presenting with absent voice or severely limited ability to voice, without an underlying vocal fold pathology sufficient to explain the severity of the dysphonia/aphonia. Patients with these symptoms have been diagnosed historically with “hysterical aphonia” or “functional aphonia.” There are multiple methods for re-engaging the voice of a patient with primary MTD/A described in the literature dating as far back as the early 1900s. Speech-language pathologists generally have good success in treating primary MTD/A with a multitude of different treatment approaches. Recent news stories have increased public awareness of SLP involvement in returning patients’ lost voices, and patients who are savvy health consumers will expect quick results.

The aim of this workshop is to increase clinician confidence in the ability to quickly bring back the voice of a patient with primary MTD/A. We will begin with hands-on exploration of the breathing and muscular tension patterns of multiple types of primary MTD/A to gain a sense of how the aberrant voices are produced. We will then practice multiple techniques to eliminate hyperfunction and restore voicing, including variations on circumlaryngeal massage, vegetative tasks, sounds produced with a semiocluded vocal tract, and other phonation elicitation techniques. Finally, we will work through a mock initial therapy session in fast-forward, practicing each step from return of normal phonation at the sound level through conversational speech.

Carissa Portone-Maira, MS, CCC-SLP, Emory Voice Center, 550 Peachtree St. NE, Atlanta, GA 30308

## Adapted Yoga Techniques for Voice Therapy and Singing Voice Rehabilitation

Voice clients often present with sub-optimal motor behaviors that negatively impact effective integration of respiration, phonation and articulation in their speech and/or singing. Improving voice production requires therapeutic approaches that can appropriately and effectively target a client's specific challenges, e.g., structural weakness/tension/imbalance, or sub-optimal respiratory patterning, physical energy, or sensory awareness.

Adapted yoga techniques can be effective holistic tools for addressing such challenges. They are designed to link awareness and attention to sensory attributes of training tasks in movement, breathing, and voicing.

Adapted postures and movement (*asana*) can strengthen weak muscle groups or facilitate relaxation and stretch of chronically contracted ("held") muscle groups. It can be especially helpful in improving postural relationships of the head, neck, shoulders and torso.

Adapted breath work (*pranayama*) can be used to increase awareness and control of respiratory movement patterning, which can increase control of tidal volume and inhalatory and exhalatory flow rates. It is also a potent tool for managing negative stress response.

Participants will learn examples of adapted yoga movement and breath work for use in voice therapy and singing voice rehabilitation.

Kenneth Tom, Ph.D., CCC-SLP, RYT, Associate Professor, California State University Fullerton  
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**Discovering a Language of Communication: Training the Male Voice from the Female Perspective**

This session will demonstrate how to guide male students in registration negotiation from the female voice teacher perspective. Learning how to correctly communicate the process of male registration negotiation via specific instructional language and knowledge of physiology is paramount for a female voice teacher since a female cannot either experience or accurately demonstrate for a male how properly to negotiate their *passaggio* due to physiological and structural difference between the sexes. Literature written on the subject is very clear in the usage of breath management and vowel modification as the primary tools for negotiating the male *passaggio*. However, my research and experience in the field has shown that, in practice, female teachers could benefit from more clarification and hands-on experience in this important area of instruction. The workshop will demonstrate to female voice teachers, in a master class format, how to identify, diagnose and correct issues in negotiating the male *passaggio* as appropriate to each singer using specific language and methodology.

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## Conversation Training Therapy

### Objective:

People with voice problems report difficulty with voice use in conversation, yet, most voice therapy programs train voice techniques for conversation as the last step in therapy, if at all. These methods may fail to take into account the needs of patients, and violate tenets of motor learning theory, which may prohibit transfer of therapeutic techniques to conversational speech, let alone, be the causative factor in high drop-out rates in voice therapy.

### Methods/Design:

In order to address this significant conceptual problem in voice therapy, the current workshop introduces a new voice therapy program, known as Conversation Training Therapy (CTT), development by the Investigators, and a team of expert voice-specialized speech-language pathologists and patients with voice problems.

### Results:

CTT differs from traditional voice therapy in that it targets voice techniques in conversation in the first session, and throughout, using patient narratives as stimuli. The program is highly individualized and immediately practical for real world application. In addition, CTT meets the therapeutic voice goals of patients in as little as 3 to 4 sessions.

### Conclusion:

Conversation Training Therapy has the potential to change service delivery of voice therapy and decrease time in treatment while increasing treatment results, thus reducing the substantial healthcare burden imposed by voice problems. Conversation Training Therapy represents the first time a voice therapy program has been created with patients and master clinicians as part of the research and development.

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## **Incorporating Fatigue-Resistance Exercises into Vocal Warm-ups for Singers as a Means to Injury Prevention**

Although warm-ups are a standard opening to the singing lesson routine, most of the standard vocalizes—Vaccari, Panofka, Marchesi, Concone, and others—are geared toward specific skill acquisition as opposed to fatigue resistance specifically. This workshop advocates the incorporation of fatigue-resistance exercises and principles—Titze (2001), Milbrath & Solomon (2003), Sell (2005), and others—into the vocal warm-up process. Suggestions for assessment and modification of warm-ups for individual singers will be discussed, as well as prescribing performance literature based on skills assessed through specific vocal warm-ups.

The exercises and concepts explored in this session are based upon recent research in exercise science principles, which suggests that [skill acquisition] + [fatigue resistance] = [injury prevention] (Powers & Howley, 2012), as well as the presenter's current research activity with Dr. Mary Sandage at Auburn University.

This will be an interactive session where the participants will actively engage in both group and individual warm-ups. In one-on-one segments, individuals will be guided through vocalises that help them experience some fatigue and the aspects of subglottal pressure management that need to be overcome with fatigue resistance training. An important distinction will be made between voice fatigue resistance and respiratory fatigue resistance.

Equipment: Piano (will provide handouts)

Matthew Hoch, D.M.A., Assistant Professor of Voice, Music Department, 101 Goodwin Hall, Auburn University, AL 36849

**Vocal Ease: Power without Pain, Strength without Strain: Learning to Feel the Vibratory Sensations of a Sustainable, Richer, and Fuller Speaking Voice using the Lessac System**

In this experiential workshop, participants will use familiar events to access and recognize the kinesthetic vibratory sensations inherent in a healthy resonant speaking voice. Using the Lessac System, we will explore how the pleasurable feeling of resonance can serve as the basic building block to access an effortless speaking voice. These tools will then be directly applied to everyday usage and text work. This workshop may be particularly useful for performers, educators who work with kinesthetic learners, and singers and singing teachers who are looking for methods to translate the sensations of the healthy singing voice to the speaking voice.

Diane Gaary, M.F.A., Associate Professor Temple University, Philadelphia, PA, Arcadia University, Glenside, PA, and Westminster Choir College, Princeton, NJ

Robin Carr, M.F.A.: Associate Professor of Voice and Acting at the University of Southern Mississippi, Hattiesburg, MS

### **Techniques and Exercises for Singing Voice Specialists to Use for Habilitating Singing Voice Disorders--What to Use When?**

This will be a practical “how-to” workshop detailing the process of evaluating and developing a treatment plan for singers after a diagnosis of voice disorders such as paresis, vocal cord bowing, nodules, polyps, etc. Sharing from an expertise as a Singing Voice Specialist for over 25 years, there will be a focus on “what to listen for,” how to treat the various symptoms, and how to effectively manage the recovery process in the singing voice.

Recommendations for emphasis of treatment for the various voice disorders will be delineated. Progressively more demanding exercises for various treatment goals will be demonstrated with explanations of their technical foundations.

Discussion will include: how to create a practice regimen for singer between sessions with the Singing Voice Specialist, the importance of psycho-emotional support for the recovering singer, how to encourage compliance with the treatment, communicating with other vocal and medical professionals about the singer’s treatment, and other related issues. A take-away handout listing exercises and treatment suggestions will be provided.

Deanna McBroom, M.M., Professor of Music/Director of the Voice Program, Department of Music, College of Charleston, Charleston, SC, Singing Voice Specialist, Evelyn Trammell Institute for Voice and Swallowing, Medical University of South Carolina, Charleston, SC

## **Hennessy Whole BodyVoice™ BodyWorkShop: Improving Breath Management and Resonance Using Release Maneuvers for Head and Neck**

**Objective:** Participants improve breathing mechanics and reduce muscle tension dysphonia through a comprehensive muscle release sequence focusing on the head and neck, including laryngeal release and intra-oral massage.

Overworking muscles in the head and neck adversely affect many aspects of the speaking and singing voice, including pitch range, dynamics, consistency, ease, articulation, and flexibility. Releasing misplaced head and neck tension ameliorates these issues, improving both resonance and breath flow. Without that understanding, speakers and singers often use increased air pressure to remedy these resonance faults. Unfortunately, the resulting higher subglottic pressure often destabilizes the larynx. To restore stability, compensatory behaviors often involve even more tension in the head and neck. With increasing tension, the resonance deteriorates further, and the cycle continues. Learning to release the overworking muscles instead of merely intensifying air pressure results in better breath management and enhanced resonance.

**Methods:** This hands-on workshop employs massage (including intra-oral massage), release, and breathing techniques. Simple exercises demonstrate the practical application of muscle release to breathing and vocalization. Methods that inform this work include the Alexander Technique, Laban/Bertenieff, shiatsu massage, strain-counterstrain (passive positional release), Stough Breathwork, Pilates Breathwork, and the Thompson Method. There is no floor work in this workshop. All exercises can be done while sitting or standing, as well as during phonation. A comprehensive muscle release sequence, including laryngeal and intra-oral massage, targets muscles in the:

- neck (upper trapezius, erector spinae, suboccipital, sternocleidomastoid, scalene, levator scapulae, suprahyoid, infrahyoid);
- jaw (masseter, temporalis, digastric, medial pterygoid, lateral pterygoid);
- tongue (genioglossus, geniohyoid, hyoglossus, styloglossus, stylohyoid, lingualis); and
- oropharynx (velum, palatoglossus, tensor veli palatini, levator veli palatini)

**Results and Conclusions:** Participants leave the workshop with improved breathing habits and enhanced resonance. The comprehensive massage and exercise sequence taught in this workshop provides participants with a valuable takeaway for home and studio use, allowing them to experience the dynamic relationship between breath management, resonance, and muscle release in the head and neck, including the cervical spine, occiput, jaw, tongue, larynx, and oropharynx.

Ruth Williams Hennessy, B.M., M.M., Director, Hennessy Whole Body Voice

### **Functional Voice Training for Pop/Rock Singers**

Pop/rock singers must have a flexible vocal mechanism to create the wide range of vocal sounds required for the genre. Many of these singers are also instrumentalists who have extensive knowledge of how their instruments work. These performers often find it useful to understand the mechanics of the voice and appreciate a training regimen that offers systematic solutions to common vocal faults. A functional approach to vocal training will help the student gain a better understanding of their instrument while also mastering the wide variety of vocal colors necessary for the style.

The workshop will begin with an introduction of three of the most important functional foundations of pop/rock singing: a free larynx, a flexible tongue, and control of the soft palate. The instructor will then work with two students in a master class setting to demonstrate practical application of these tools. Participants will leave with a basic understanding of how to apply these techniques in the private studio and how to do their own research on vocal function for pop/rock singers.

Matthew Edwards, MM, BM, Associate Director of the CCM Voice Pedagogy Institute, Shenandoah Conservatory at Shenandoah University, 1460 University Drive, Winchester, VA 22601

## Research-Based Conducting Techniques for Efficient Vocal Production

Have you ever wondered why singing with a particular conductor often leaves you vocally fatigued?

Choral conductors spend countless hours working with singers to achieve a desired tone: one that is free from undue tension and vocal strain. Some vocal and choral pedagogues suggest, however, that particular conductor gestures may trigger more tension in the neck (i.e., extrinsic laryngeal muscles), back, abdominals, and other important areas for vocal production. Eichenberger, for example, has long asserted that “what they (choristers) see” is “what you (conductors) get.” Jordan (1996) has similarly posited that “rigid, angular, and tense” (p. 13) gestures are transmitted to singers and reflected in the choral sound. Such tension could unwittingly compromise the very vocal efficiency that the director may be seeking, thus frustrating conductors and leaving choristers vocally strained.

This session will provide a brief overview of a relatively new line of research in choral music. This research, inspired in part by studies in the social- and neuro-sciences, could provide insight into the nonconscious physical responses that a conductor may evoke from his or her choristers. Based on the results of these studies, the presenters will lead participants through a series of movement and gestural exercises designed to evoke efficient vocal production from singers in a time-efficient and non-verbal manner. This session is perfect for any director who might want to be more “vocally friendly” in the rehearsal room and on the podium.

Jeremy N. Manternach, Ph.D., Assistant Professor of Vocal/Choral Music Education, The University of Iowa

Melissa Brunkan, Ph.D., Assistant Professor of Vocal/Choral Music Education, Association or Affiliation: Louisiana State University

**Soul Ingredients®: Developing the Rhythm, Phrasing, and Vocal Runs in Soul Singing**

This interactive workshop will guide participants in understanding how the execution of sound relates to the execution of rhythm in the styles of R&B, pop, and gospel. Through a series of vocal exercises we will: discuss rhythmic “feel” and its execution; explore the natural rhythms and phrasing that occur with everyday expressions and applying them to vocal exercises; practice placing speech rhythms against established drum patterns using iPhone or iPod apps and/or electric keyboard settings; and learn a step-by-step method for developing and executing vocal runs.

Trineice Robinson-Martin, EdD, EdM, MM, BA, Princeton University, Princeton, NJ, Rider University, Lawrenceville, NJ, Soul Ingredients Voice Studio, 195 Drift Avenue, Lawrenceville, NJ

## **Application of Mindfulness-Based Techniques for Voice Development**

Mindfulness-Based Stress Reduction (MBSR) is a well-researched protocol developed by Jon Kabat Zinn in the 1970's. The purpose of this program has historically been to relieve program participants of their symptoms of anxiety and depression. Since that time, the application of mindfulness strategies to a variety of life settings has been growing.

Voice production is an inherently kinesthetic, mind-body based activity. In this workshop I will introduce the attendees to the basics of mindfulness and it's research history. Then I will guide participants through a number of activities oriented toward familiarizing them with a mindfulness-based approach. An exercise for general development of mindfulness and two exercises for the application of mindfulness to voice production will be provided.

Barbara Wilson Arboleda, M.S., CCC-SLP, Clinical Coordinator, Voice & Speech Laboratory,  
Massachusetts Eye and Ear Infirmary, 243 Charles St., Dedham, MA 02114



**“22<sup>nd</sup> Century Belt Techniques” – Exercises for Developing a Healthy Pop/Rock & Contemporary Musical Theater Belt**

Demonstration and dissemination of vocal exercises designed to facilitate a CCM Pop/Rock Belt. These exercises include a Voice Consonant Series, as well as a “Call vs. Cry” series illustrating the practical application of Source Filter Theory/Vocal Tract Reactance. All attendees will be invited to participate in the exercises. A handout will be distributed so that attendees can walk away with these exercises and an understanding of the techniques involved.

For over 20 years David Sabella-Mills has been involved in research and studio application of Contemporary Belt Techniques. In addition his own personal training and career as a classical Counter-Tenor, this research and application has allowed him to develop a unique understanding of how to teach these different and demanding vocal sounds efficiently and safely to young singers who are now employing these techniques in their own careers on both Broadway and CCM Concert stages. These simple and effective vocal exercises make it possible for singers to cross styles from Legit to Contemporary Rock sounds effortlessly (and safely) with little to no vocal fatigue. These twelve voiced consonant exercises and four call vs. cry exercises will complement and enhance any teacher’s studio techniques and understanding of this complex and required professional vocal sound.

David Sabella-Mills, 57 Ernst Avenue, Bloomfield, NJ 07003

### **Applying Functional Vocal Exercises to Solve Technical, Musical and Health Problems in Singers**

In the voice community there is increasing interest in and recognition of the need for scientifically grounded vocal exercises as stimulus for behavioral changes in the vocal and breathing mechanisms. Many who teach singing use exercises passed down to them from their teachers without understanding what they are supposed to do and why they work when they are successful. This workshop will explain and demonstrate the effect of various vocal exercises on the volunteer singers and will clarify why it is never necessary to directly manipulate the larynx, the muscles in the throat or to use imitation of someone else as a teaching tool.

Jeannette LoVetri, Director, The Voice Workshop, 317 West 93rd Street, #3B, New York, NY, Artistic Director, CCM Vocal Pedagogy Institute, Shenandoah Conservatory, Winchester, Virginia, 10025

### **Understanding Voice-Overs and the Voice-Over Professional: An Overview**

A "voice-over" is defined in the industry as the voice we hear "over" the scenes we watch in a TV commercial, movie, documentary, a cartoon or other visual broadcast, or what is heard in a radio commercial or an audio book. In voice-overs the copy and the text are matched with the perfect vocal delivery. A "read" melds the personality of the actor's voice with well-written copy to bring a story to life. Doing voice-overs demands a particular combinations of skills. In this workshop we will work with text to examine the following: Finding and using the best vocal tone and dramatic range, smooth phrasing, breath control, and superb diction, (free of regional accents, unless an accent is required). First-rate reading training including the use of language, timing, inflection, articulation and emotion. Identifying the individual styles that are right for you. Performers must also understand who the audience is (to whom am I speaking?) and how to analyze and personalize copy. The goal of the workshop is for those doing a voice-over to know what skills are required and for the audience to gain greater understanding of voice-overs and the demands they place on performers' voices.

Lynn Singer, Actor, Acting and Speech Teacher, Creator of *Voiceworks*, 201 West 16th Street, New York, NY 10011

### **Fascinatin' Phrasing: A Workshop Focused on Utilizing Consonants for Phrasing**

Phrasing makes the song. It can influence the style, genre, rhythmic feel. It can highlight humor, emotion and effectively communicate. And when phrasing is accomplished by clearly stating the lyrics as though communicating it leaves the audience helpless with desire to hear every word. Great phrasing of 'the hook' makes a song memorable – sometimes so memorable that you'd pay good money to get the hook OUT of your head.

In this workshop we will explore the use of crisp, clear consonants to define phrasing and take your songs to a more professional level.

Sally Morgan, BA, Director/Voice Teacher, Sing Like You Speak, 15 W 139 St, #14M, New York, NY 10037

### **Recognizing the Elusive Obvious**

Joan is talented, but she just does not work hard enough. How often do we think that? In fact Joan might be working very hard, but her internal map is incomplete or there is a block. She is really "trying", and thinks she is doing what is being asked. She don't understand what is wrong.

We all move according to our internal somatic map. However our body map may be at odds with what we are actually doing. Intellectually we all "know", but somatically that knowledge might be off base. For example, telling a young singer not to bring her head forward does not help since she is genuinely not aware that she is doing it. In fact the head movements might be diversionary movements related to poor breath support.

As voice teachers, and coaches our attention is on the obvious movements or tensions present in our students. We don't always see what is really going on. We don't recognize the subtle physical instabilities or blocks that really prevent good voice use. When confronted with a singer struggling with technique or expression, many teachers find it difficult to identify the source of the problem. Postural changes must come from the *inside*, through experiential explorations, to be effective and lasting.

The focus of this interactive workshop is to provide participants with tools to identify somatic elements frequently observed in students who struggle with their technique. Participants will be guided through methods of identifying the areas of potential problems including poor balance, locked knees, subtle tension and holding patterns or jaw and tongue tension. Participants will experience for themselves how subtle changes in stance, or relationship of the trunk and ribs to the lower body can alter voice quality and ease.

Marina Gilman, M.M., M.A., CCC-SLP, Speech Language Pathologist, Emory Voice Center, Dept Otolaryngology Head & Neck Surgery, Emory University

**Embodying the Voice: Optimizing Anatomy from the Foot to the Head**

This workshop will explore the geography of the vocal mechanism within the context of the surrounding structures. The anatomy will be explored from the foot to the head in order to understand the effect of good alignment for optimal vocalising. Links will be drawn between kinaesthetically linked structures within the body framework to demonstrate how efficiency can be reached and injury risk reduced and the use of imagery will be discussed for passing anatomical concepts on to students and patients.

Jennie Morton, BSc (Hons) Osteopathy, Founder, Healthy Performers, Lecturer in Performing Arts Medicine, Osteopathy, University College London, British Association for Performing Arts Medicine, 324 W. 84<sup>th</sup> St., #23, New York, NY 10024

**Teaching the Menopausal Singing Voice**

There is a growing body of research into the effect of menopause on the voice. A recent study by Dr. Caprilli entitled “The Effect of Menopause on the Elite Singing Voice; Singing through the Storm” focused on world-class singers’ experiences with menopause, investigating strategies that peri- and post-menopausal elite singers utilize to maintain vocal quality and range. This workshop will share exercises and strategies discovered through the study that can be used in the modern voice studio with students experiencing hormonally induced change such as loss of range, reduced breath capacity and difficulty matching pitch. Both CCM and Classical vocal styles will be addressed.

Barbara Fox DeMaio Caprilli, D.M.A., Asst. Prof. of Voice, University of Central Oklahoma School of Music, Box 179, 100 North University Drive, Edmond, OK 73034

### **Voice Feminization and Masculinization: Techniques and Tips**

Working with transgender clients requires a unique set of skills, even for voice-specialized SLPs. This workshop will engage participants in hands-on tasks to address pitch, resonance, and nonlinguistic aspects of voice and communication. Approaches for trans men and trans women will be presented.

While the workshop is intended for those who already have some background in working with trans clients, it will be an information-dense session that is sure to provide helpful tools to both new and experienced clinicians. Basic-level approaches will serve as the foundation for more advanced techniques that are especially helpful in challenging cases. The general format will be the introduction of a need (e.g., modifying resonance), description of the general approach (e.g., facilitating an open oral resonance for trans men), and then addressing how to advance one's skills beyond an elementary service.

Participants will be provided with a detailed handout of presented techniques to use as a reference.

Last but not least, because cultural competence is prerequisite to clinical competence, participants will be provided a handout regarding the critical and often unfamiliar aspects of transgender care and experience.

Both presenters are passionate about caring and advocating for the trans community, and clinically specialize in voice and communication training for trans men and women.

Tentative outline is as follows:

- |             |   |
|-------------|---|
| 0:00 – 0:05 | Introduction<br>Brief intro of presenters<br>Orient participants to notion of building a loosely-organized corpus of exercises and techniques that they can integrate into their practice as they wish                                    |
| 0:06 – 0:15 | Pitch work<br>Basic approaches to pitch elevation and lowering<br>Strategies for practice<br>Partnered practice   |
| 0:16 – 0:30 | Resonance<br>Matching pitch and resonance for authenticity<br>Fronted/forward resonance for trans women<br>Open oral resonance ("count big" exercise) for trans men<br>Small group "break out" session for practicing specific techniques |
| 0:31 – 0:45 | Nonlinguistics<br>Intonation: traveling on vowels; gliding vs. stepping; legato vs. staccato<br>Gait and stance for trans men and trans women<br>Small group "break out" session for practicing specific techniques                       |
| 0:46 - 0:55 | Tips for carryover and generalization   |

Leah B. Helou, PhD, CCC-SLP, UPMC Voice Center, University Ear, Nose & Throat Specialists (Mercy), Building D, Suite 2100, 1400 Locust Street, Pittsburgh, PA 15219

Christie Block, MA, MS, CCC-SLP, Private Practice, 65 Broadway, Suite 822, New York, NY 10006

### **Inverse Filtering Workshop**

The pulsating glottal airflow, or the voice source, is the raw material of the voice. It is dependent on how the vocal folds vibrate, so it has a clear clinical relevance. Today, are excellent tools are available for voice source analysis. This workshop will demonstrate one of these methods, the Decap freeware.

A participant will be asked to repeat the syllable /pae/ with continuously decreasing vocal loudness. A set of vowels of different loudnesses will be analyzed and the voice source parameters extracted. The result will show that it is easy to analyze the voice source by these means and also it will demonstrate how the voice source varies with vocal loudness.

Johan Sundberg, Ph.D., Professor in Musical Acoustics, KTH, Royal Institute of Technology, Dept. of Speech, Music and Hearing, Lindstedtsv. 24, SE-10044, Stockholm, Sweden

Filipa M. B. Lã, Ph.D. DMA, Assistant Professor of Music, Dept. of Communication and Arts, University of Aveiro, Campus Universitário de Santiago, 3810 - 193 Aveiro, Portugal

## **Touching the Voice: Practical Ways to Apply Listening Hands**

### Touching the Voice: Listening Hands

Many voice and speech teachers are exploring how best to integrate the principles of the Alexander technique to free the voice. This workshop proposes to explore aspects of how one may best integrate principles of the Alexander Technique principles with voice training.

1) Use of hands on in voice in a positive, non-invasive manner. How teachers use hands on in training has a profound impact on the actor and is not generally dealt with in usual voice/speech training programs. While Alexander Technique Teacher training takes a minimum of three years, nonetheless, voice/speech teachers can learn simple ways to support through positive hands on work, even if they are not trained as Alexander Technique Teachers. Some of the ideas covered are inspired from the book, *The Ethics of Touch*.

2) Alexander's principles were initially designed to address vocal misuse though oftentimes people identify the technique with movement. The workshop will explore ways to integrate Alexander Technique principles in creative ways to acting text, eschewing the more old fashioned rigid approach to the Alexander work, covered in Janet Madelle Feindel's "The Thought Propels the Sound".

### Workshop Overview:

- Examine individual hands on work
- Partner hand on work and ways to make this safe and comfortable
- Explore ways to apply hands on work to vocal release
- Investigate ways to use hands on work to open back diagonals
- Apply ways to integrate Alexander Technique Explorations with voice, clear speaking and text
- Ways to use AT principles with creativity and expressiveness to enhance performance

Janet Madelle Feindel, M.F.A., DLT, ATI, Fitzmaurice Voice, Full Professor, Voice/Dialect and Alexander Technique Specialist, Voice/Alexander Technique, School of Drama, Purnell Center, Carnegie Mellon University, Pittsburgh, PA 15213

### Speech Therapy for Vocal Tremor

**Objective:** The purpose of this workshop is to present and demonstrate methods used to assess and reduce the perception of vocal tremor during speaking in those diagnosed with vocal tremor.

**Methods/Design:** Participants will be provided with handouts summarizing the methods of assessment and speech therapy methods used to facilitate reduced perception of vocal tremor during speaking. Preliminary information about best candidates for this treatment approach will also be presented. Finally, a patient demonstration of the methods used to evaluate the respiratory, phonatory, and vocal tract contributions to vocal tremor will be presented. In addition, methods for reducing the perception of vocal tremor during speaking will also be demonstrated.

**Conclusions:** Upon completion of this workshop, participants will be able to identify, discuss, and perform assessment and speech treatment of individuals with vocal tremor.

Julie Barkmeier-Kraemer, Ph.D., CCC-SLP, ASHA Fellow, Professor, Depts of Otolaryngology, and Communication Sciences and Disorders, University of Utah , 50 N Medical Dr 3C120, Salt Lake City, UT 84132

### 2nd Harmonic Formant Tracking in Modal Voice in Popular Singing

A collaborative presentation demonstrating exercises that provide training of vocal stability and consistency in the middle voice as a basis for belt technique and overall technique for popular vocal music. Assisted by Voce Vista software, demonstrated will be the effectiveness of invoking the 2nd harmonic in modal voice (*vowel /i/*) and tracking that sensation through and beyond the *passaggio*. The exercises, demonstrated by students and audience participants, target the elimination of spacial reasoning relating to higher and lower fundamental frequencies, optimization of resonance and improved pitch accuracy. It is hoped that such emphasis on the training of vocal “function” as opposed to the training of vocal “sounds” will replace the more commonplace imitative strategies which too often fail to consider important physiological differences affecting the belt voice and other extreme rock phonations.

Melissa Cross, M.A., Melissa Cross Vocal Studio, 251 W. 30th Street 11RE, New York, NY 10001

Richard Lissemore, M.M., Doctoral Student, Voice teacher and researcher, The City University of New York, Speech, Language, Hearing Science doctoral program



**Special Session**

**The Aging Voice: You're Only As Old As You Sound!  
Moderator: Nancy Pearl Solomon**

- 7:45a Welcome and Introduction  
*Nancy Pearl Solomon*
- 7:50a The Science of Aging: Mechanisms and Interventions  
*Christian Sell*
- 8:35a Are the Effects of Aging on the Voice Inevitable?  
*Karen Kost*
- 9:00a Special Considerations in the Medical Management of Geriatric Voice Patients  
*Michael Johns*
- 9:25a Coffee Break
- 9:55a Developing Geriatric Vompetence for Clinical Care  
*Sarah Kagan*
- 10:20a Exuberant Voice Therapy for the Aging Voice  
*Eddie Hapner*
- 10:45a Panel Discussion  
*Christian Sell, Karen Kost, Michael Johns, Sarah Kagan, Eddie Hapner*

Eddie R. Hapner, PhD CCC-SLP, Associate Professor, Emory University School of Medicine , Department of Otolaryngology Head and Neck Surgery, Director of Speech Language Pathology, Emory Voice Center, 550 Peachtree Street NE, Suite 9-4400, Atlanta, GA 30308

Michael M. Johns, M.D., Director - Emory Voice Center, Associate Professor – Otolaryngology, Emory University

Sarah H. Kagan PhD, RN, Lucy Walker Honorary Term Professor of Gerontological Nursing, School of Nursing, University of Pennsylvania

Karen Kost, MD, FRCS, McGill University, Department of Otolaryngology – Head and Neck Surgery

Christian Sell, PhD, Drexel University, Department of Pathology and Laboratory Medicine, 245 N. 15th Street, MS 435, Philadelphia, PA 19102

Nancy Pearl Solomon, Ph.D., CCC-SLP, Research Speech-Language Pathologist, National Military Audiology & Speech Pathology Center , Walter Reed National Military Medical Center , America Building, Floor 5, 4954 North Palmer Rd., Bethesda, MD 20889-5630

**Panel – Wednesday, May 27, 2015**

**Caring for the Whole Singer: Medical, Therapeutic, Research, and Pedagogical Perspectives**

Moderator: Mara Behlau, Panelists: David Meyer, Johan Sundberg, Merlin Tan-Geller, Ingo Titze

Multi-disciplinary care of professional voice users is well established at most large medical centers. Singers are special patients and clinical experience, particularly with mistakes is a hard path that can be avoided by sharing information that newcomers in the field should know.

Participants at this panel will share the most difficult cases and what was learned from mistakes made under the pressure of helping artists to be on stage with a reduced amount of time.

First of all, professional voice patients often enter the health environment unsure of what they will experience. Moreover, the artistic mental filter can focus their attention on a different aspect than the one the clinician wants him/her to focus.

Singers are typically treated with medically and possibly with therapeutic approaches. Emergency vocal problems need to be assessed with caution to avoid further complications. Intensive Voice Training may be needed to fulfill the artistic demand. All cautions should be taken in order to do not surpass the healthy limit for voice usage. The regimen of treatment and exercises should be monitored in order to avoid under and overdose.

Occasionally, surgery is necessary, which can cause a major psychological stress on the patient. However, surgery sometimes is seen as a miracle and false expectations can harm the relationship between the patient and the clinician.

A contemporary issue is amplified versus unamplified singing. Although some claim the training is the same, acoustic requirements dictate rather different approaches. Another contemporary issue is how computer programs that provide real-time feedback of audio signals can be used.

This panel will offer perspectives and pearls regarding all phases of care. The goal of these senior presenters is to share the general principles of vocal rehabilitation, intensive voice treatment, phonosurgery, vocal pedagogy and recent advances in voice science.

Questions of intersection among these disciplines, scope of practice, treatment strategies and complementary approaches will be discussed. Interdisciplinary interpretation will be practice via case presentations. The worst nightmares will also be discussed. Areas of divergence and convergence will be highlighted according to the latest scientific evidence.

Mara Behlau, PhD – presenter and moderator – Department of Speech language Pathology and Audiology, Universidade Federal de São Paulo – UNIFESP and Centro de Estudos da Voz – CEV, São Paulo, Brazil.

Melin Tan-Geller, MD, Montefiore Medical Center/Albert Einstein College of Medicine, New York, USA

David Meyer, PhD – Shennandoah University Conservatory Voice Pedagogy Research, Winchester, USA

Ingo Titze, PhD - National Center for Voice and Speech, the University of Utah, and the University of Iowa, USA.

Johan Sundberg, PhD - Dept of Speech Music Hearing, School of Computer Science and Communication, KTH, Stockholm Sweden, and University College of Music Education, Stockholm, Sweden.

**Panel – Thursday, May 28, 2015**

**The Real Structure of the Pediatric Vocal Fold: Optical Computed Tomography, Histology, and Other Things We Don't Know Enough About**

Moderator: Christopher Hartnick

Panelists: Shigeru Hirano, Joel Kahane, Luc Mongeau, Susan Thibeault, Peak Woo

Introduction: Christopher Hartnick

Topic: Overview of the Development and Maturation of the Pediatric Vocal Fold Lamina Propria, Controversies, and Optical Imaging (10 minutes)

Dr. Hirano: Update of the Developing Vocal Fold Lamina Propria Anatomy and Histology: How Often Are Three Defined Layers Visualized (10 minutes)

Dr. Thibeault: How Reliably/ Consistently Do We See the Layers of the Vocal Fold Lamina Propria? What Would It Mean If Such Clean Layers Were Not Evident? (10 minutes)

Dr. Mongeau: How Might Mechanical Stimulation Drive the Development of the Vocal Folds? What Would a Viscoelastic Model Look Like Without Such A Well-Defined Three Layer Model? (10 minutes)

Dr. Kahane: Structure to Function: How Developmental Anatomy Leads to Changing Acoustics

Dr. Woo: Future Directions and Other Modalities of “Visualizing” Developing Vocal Folds (Including High Speed Video) (10 minutes)

Panel Discussion and Questions

**Panel – Thursday, May 28, 2015**

**Pediatric Dysphonia**

Moderator: Guillermo Campos

Panelists: Christopher Hartnick, Marc Remacle, Harvey Tucker

**Panel – Saturday, May 30, 2015**

**Controversies in Managing “Urgent” Voice Issues in the Professional Voice User**

Moderators: Thomas Carroll and Michael Pitman

Panelists: Amy Cooper, Adam Klein, H. Steven Sims, Chandler Thompson

**Panel – Saturday, May 30, 2015**

**Difficult Cases: Let the Debating Begin!**

Moderator: Seth Dailey

Panelists: Jennifer Anderson, Shigeru Hirano, Lance Maron

**Saturday, May 30, 2015**

**Phonemicsurgery**

Moderator: Marc Remacle

Panelists: Paul Bryson, Antoine Giovanni, Guillermo Campos, Susan Thibault, Domingos Tsuji

**Panel – Sunday, May 31, 2015**

## **Surgical Care in Singers**

Moderator: Michael S. Benninger

Panelists: Paul Bryson, Glendon M. Gardner, Anastasios Hantzakos, Patricia Murphy, Iris Rodriguez

General Overview, Introduction

Informed-Consent, Confidentiality and Legal issues.

*Michael S. Benninger*

Office-Based Procedures for Singers

*Paul Bryson*

Evaluation and Decision-Making. How Do We Decide When to Operate on a Singer?

*Iris Rodriguez*

Peri-Operative Management, Including Discussion Related to Performance Scheduling. The Role of Voice Therapy.

*Patricia Murphy*

Surgical Technical Caveats and Minimizing Bad Outcomes.

*Tassos Hantzakos*

Non-Laryngeal Surgery in Singers

*Glendon M. Gardner*

Discussion