Etiology, Pathophysiology, Treatment Choices, and Voice Results for Unilateral Adductor Vocal Fold Paralysis: A 3-Year Retrospective


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Summary: Unilateral vocal fold paralysis is now considered a common disorder seen in the practice of otolaryngology and voice pathology. Concern first is for the accurate diagnosis of the associated etiology in an efficient and thorough fashion. When etiology has been determined the focus of treatment becomes the management of the presenting symptoms, which typically include dysphonia and dysphagia. A retrospective study was conducted reviewing the records of 117 patients with unilateral adductor vocal fold paralysis who presented to a large otolaryngology practice and clinical voice lab from 1995 to 1998. Demographic data reveal most patients to range in age from 16 to 91 with a dominant clustering for ages 50 to 70. Gender distribution reveals males slightly exceed females in this sample. Data regarding etiology type are collected in great detail, revealing that disease and surgery involving the chest contribute the greatest to the overall number in this study and that anterior approach to cervical spine surgery contributes as much as thyroid surgery. General outcomes of the patients are reviewed. A small group (n = 25) of patients who had pretreatment and posttreatment data available revealed statistically significant differences between voice outcomes for patients who were treated with medialization and for those treated with therapy. Patients receiving therapy had less severe symptoms pretreatment, while greater gains pretreatment to posttreatment were shown for those who had surgical medialization. Key Words: Vocal fold paralysis—Treatment—Management—Therapy.

Unilateral adductor vocal fold paralysis is a physical diagnosis resulting from brainstem involvement or compromise of the vagus nerve or its recurrent laryngeal nerve (RLN) and superior laryngeal nerve (SLN) branches. The etiology of the paralysis is varied, including concomitant disease processes; vagus, RLN, and SLN lesions; trauma; neuritis; and idio-
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pathic. Functional voice and swallowing changes are dependent on the paralytic positioning of the vocal fold in relation to the glottal midline, the presence or absence of muscle atrophy, and the patient's acquired compensatory voicing and swallowing behaviors. While patients whose vocal cord paralysis results in a more midline resting position may complain of vocal fatigue and mild dysphonia, it is generally acknowledged that greater degrees of glottic incompetence lead to more severe symptoms of dysphonia and dysphagia.

Evaluation and treatment for unilateral adductor vocal fold paralysis are best served through the voice care team's involving the otolaryngologist and the voice pathologist. The clinical assessment of these patients is designed to discover the etiology of the paralysis, especially in the absence of suspected causes such as surgical trauma or a known disease process. The work-up may include computed tomography (CT) scans of the head, neck, and chest as well as a chest x-ray (CXR). Electromyographic (EMG) evaluation of laryngeal muscle activity is valuable to determine the exact nature of the paralysis. When necessary, an objective assessment of swallowing function may be conducted to determine the integrity of airway protection.

The voice pathologist may help determine the functional voicing condition of the patients. These functional evaluations include ratings of perceptual quality of voice productions, acoustic and aerodynamic analysis of vocal function, and videostroboscopy for documentation of vocal fold position and observation of vocal fold vibratory characteristics when possible. Stroboscopic signs of vocal fold paralysis include (1) abnormal vibration with predominant vertical movements, (2) large irregular amplitudes, (3) poor vocal fold closure, (4) asymmetrical vibration, (5) apparent flutter of the affected fold, and (6) absence of edge deflections (upward, on deflected fold). The severity of these signs, as well as voice quality and vocal function measures, is dependent on the relative positioning of the folds in relation to glottal midline.

Once the etiology of the paralysis has been determined and the appropriate medical treatment has been initiated (if required), direct management of the compromised voice production may begin. Voice therapy and temporary Gelfoam injections may be useful for improving voice quality and swallowing during the appropriate period of time of waiting for possible nerve regeneration. The experienced voice pathologist is capable of offering appropriate compensatory techniques while discouraging those that may prove detrimental to functional voice recovery. Indeed, low-impact vocal exercises along with the natural positioning of the vocal folds due to atrophy may preclude the need for further treatment. Heuer et al reported data supporting the use of objective analysis of voice as a potential prognostic indicator for differentiating those patients who may require only therapy from those that will go on to require surgery for adequate voice recovery. When further treatment is required, surgeons have several options for medializing the vocal folds, including Teflon, collagen, and fat injections; type I thyroplasty; arytenoid adduction; and nerve muscle pedicle reinnervation procedure.

Numerous studies have examined the clinical management of patients with vocal cord paralysis. Vocal fold paralysis is considered a common (or frequent) condition seen by otolaryngologists, and diagnostic assessment and care of the patient have changed over the last several years owing to advances in radiologic imaging, surgical techniques, electrophysiological testing, and videostroboscopic examination. The changing health-care climate necessitates analysis of how such services are delivered in a thorough and fiscally responsible fashion. Kendall presented the results of a survey in which 23 otolaryngologists were questioned regarding their management of patients with vocal fold paralysis. Respondents to that survey reflected the shift toward increased use of CT scanning for evaluation of the entire course of the RLN in patients with undiagnosed etiology, whereas earlier studies reported CXR as the predominant diagnostic tool. Selective clinical application of laryngeal EMG and strong support for use of voice therapy for patients whose degree of dysphonia allowed for more conservative management were also reported in Kendall's survey.

The purpose of the current study was the careful inspection of clinical management trends and of physician and voice pathology practices associated with patients with unilateral adductor vocal fold paralysis who presented to a large practice (9 physicians, 5 speech pathologists) over a 3-year period.
Specifically, this study was designed to (1) evaluate the etiology and pathophysiology of patients with unilateral adductor vocal fold paralysis, (2) study demographic data associated with this population, and (3) analyze selected medical and therapeutic treatment choices and resulting voice outcomes.

**METHOD**

**Patient analysis**

The records of 188 patients whose diagnosis code 478.30 indicated the condition of vocal fold paralysis during the years from 1995 to 1998 were selected from the medical records at Dayton Head and Neck Surgeons Inc, in Dayton, Ohio. Of these, 117 met the criteria for inclusion in the current study. The primary interest of this study was the management of individuals presenting with symptoms of unilateral adductor paralysis; therefore, descriptions of unilateral vocal fold paresis, unilateral abductor vocal fold paralysis, and bilateral paresis or paralysis were excluded from the data analysis. All records were reviewed for patient identification, demographic data including occupation, first visit, presenting complaint, pertinent medical history, date of onset, stated position of paralyzed vocal fold, tests performed, treatment, medical outcomes, voice outcomes, number of stroboscopy examinations performed, and stroboscopy ratings. Of these 117, 98 patients were initially referred to the Blaine Block Institute for Voice Analysis and Rehabilitation for videostroboscopic assessment, and 35 of those were later referred back for voice and/or swallowing management. Additional data were collected on perceptual ratings, number of therapy sessions, and subsequent stroboscopy exams. Outcomes, defined and documented by the final or most recent physician note in the patient's medical record, were coded for later analysis. Summary statistics, frequencies, and cross-tabulations were utilized to obtain descriptive analysis of the data. Logistic regression was used in examining the predictive value of certain categorical variables on the outcomes “voice improved” or “voice did not improve.”

**Pretreatment and posttreatment data**

Twenty-five patients followed closely by both the Blaine Block Institute and Dayton Head and Neck Surgeons had pretreatment and posttreatment stroboscopy examinations that were available for data collection and comparison. This analysis combined the available surgical treatments Gelfoam and thyroplasty (Teflon was not used with any patient in this subset) into one treatment-type category. Speech (voice) pathology was the second treatment type, and combined speech pathology and medialization was the third. For this subset of data we asked two questions: (1) Does treatment type have an effect on posttreatment vocal quality? and (2) Is the difference between posttreatment and pretreatment vocal quality correlated with treatment type? Statistical analysis was conducted using analysis of variance (ANOVA) and post hoc testing.

**RESULTS**

**Patient identification and demographics**

Extensive descriptive statistics, including summaries, frequencies, and cross-tabulations, were run on the data. For the 117 patients reviewed, age ranged from 16 to 92 years, with a mean of 64 years and a mode of 70 years. Sixty-five (55.6%) of the cases were male and 52 (44.4%) were female. Occupations reported included 62 (53%) retired, 12 skilled employed (10.3%), 12 professional (10.3%), 2 unskilled employed (1.7%), 21 unemployed (17.9%), and 1 student (.9%), and 7 (6%) did not provide that information.

**Clinical analysis**

Onset in weeks of presenting complaints ranged from 1 to 60, with the average onset at the time of first visit reported to be 9.6 weeks and with 28 (23.9%) of the cases presenting as previously diagnosed. Hoarseness was the primary presenting complaint in 62 (53%) cases, followed by hoarseness and dysphagia in 40 (34.2%) cases. The remaining 15 (12.8%) patients reported complaints such as difficulty breathing. A significant smoking history was reported by 43 (36.8%) individuals. There were a reported 51 (43.6%) nonsmokers, and 23 (19.7%) records did not provide clear information regarding smoking history. Left vocal fold paralysis was confirmed in 81 (69.2%) of the patients, leaving 36 (30.8%) confirmed cases of right true vocal fold paralysis. Confirmation of presence and side of paral-
ysis was done during the initial physical (mirror) exam or subsequently in the voice lab via laryngeal videostroscopy. Descriptions of vocal fold position were all either paramedian or lateral.

Etiological data were collected in great detail for the initial review. See Table 1 for the listing of specific etiologies. Iatrogenic causes during surgery included carotid endarterectomy for 12 (10.2%) of the patients, thyroid surgery for 8 (6.8%), anterior approach to cervical fusion for 7 (6%), thoracic surgery for 6 (5.1%), skull base surgery for 4 (3.4%), and intubation trauma for 2 (1.7%). Disease processes and primary malignancies included left lung in 16 (13.7%) of the patients; mediastinal in 11 (9.4%); cardiovascular in 10 (8.5%); neoplasms involving the larynx, trachea, or neck in 7 (6%); thyroid in 4 (3.4%); and right lung in 2 (1.7%). This last category represents primary malignancies identified on CT; however, these lesions gave rise to paratracheal adenopathy and right vocal fold paralysis. Etiology associated with central neurological dysfunction made up 6 (5.1%) of the cases, and idiopathic accounted for 19 (16.2%) of the total number. Five (4.3%) of the cases presented with a long-standing history of vocal fold paralysis. See Figure 1 for the distribution of side of paralysis among these etiologies.

**Patient management**

In 60 of the 117 cases of vocal fold paralysis, the cause was unknown at the time of initial visit. In addition to the initial physical exam, the pattern of assessment included CT scans of the neck and chest in 34 (29.1%) of the cases; CT of the neck in 6 (5.1%); CT of the head, neck, and chest in 2 (1.7%); CXR in 9 (7.7%); and magnetic resonance imaging (MRI) of the neck and chest in CT of the 2 (1.7%). For all cas-

<table>
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<th>Frequency</th>
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<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<td>Cardiovas</td>
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<td>Total</td>
<td>116</td>
<td>99.1</td>
<td>100.0</td>
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**TABLE 1. Distribution of Etiologies for 117 Patients with Unilateral Adductor Vocal Fold Paralysis**
es additional diagnostic work-up included videostrobo-
scopy in 98 (83.8%) and objective assessment of
swallowing (modified barium swallow, fiberoptic
endoscopic evaluation of the following, or barium
pharyngoesophagram) in 18 (15.4%).

**Treatment analysis**
For 67 (57.3%) of the 117 cases, primary treat-
ment included referral to another medical specialist.
Twenty-eight (24%) were referred to other physi-
cians including oncologists, pulmonologists, and cardio-
avascular surgeons. Speech pathology received 35
(29.9%) referrals for therapy. Sixteen (13.7%) of the
total number (117) of patients had no recorded fol-
low-up appointments after their first visit.

Direct otolaryngologic intervention with 48 of the
patients resulted in surgical management including
13 (27.1%) Gelfoam injections, 11 (22.92%) thyro-
plasty medializations, 5 Teflon (10.42%) injections,
12 (25%) observe only, and 7 (14.6%) designated as
other. Services provided by speech pathology in ad-
dition to the stroboscopy exams included voice
therapy, with number of therapy sessions ranging
from 1 to 13, with a mean of 5.6. Twelve of these
patients ultimately received both speech and med-
ical treatment (ie, voice therapy and some form of
surgical medialization).

**Outcome analysis**
In the large group (117), possible general out-
comes after medical treatment included voice im-
provement (vcimprov) or voice did not improve (vc-
noimprov); spontaneous return (spontreturn); patient
did not follow up (ptdnfu); other medical manage-
ment (othermed); patient satisfied (ptsat); and ob-
serve, or ongoing (treatment ongoing). Voice im-
provement or no improvement was coded and
documented as the outcome for 49 of the 117 cases.
Tabulations indicated 40 patients had subjectively re-
ported voice improvement after medical treatment or
voice therapy, whereas 9 did not. Four patients re-
ported spontaneous improvement and 3 patients
were satisfied knowing their diagnosis and did not
wish further treatment. Eighteen patients were ulti-
mately managed by other medical specialists. Four
patients had treatments that were considered ongoing
at the end of the data-collection period. Previously
mentioned were 16 patients who failed to return af-
fter their initial visit. There were an additional 23 pa-
tients who did not have outcomes documented.

Using the broad categories age, gender, and side of
paralysis as independent variables and the outcome
“voice improved” or “voice did not improve” \( (n =
49) \) as the dependent variable, a logistic regression
was run. None of the independent variables predict-
ed outcome with any statistical significance ($P < .05$). Similarly, logistic regression using etiology and medical treatment and therapy as independent variables did not predict outcome with any statistical significance ($P < .05$).

**Pretreatment and Posttreatment Data**

Distribution of demographic and etiological data did not vary significantly from the larger data set among the group of 25 subjects whose records provided pretreatment and posttreatment stroboscopy ratings (see Table 2). Treatments provided to these 25 patients included medialization via thyroplasty for 7 (28%) and Gelfoam for 6 (24%), voice therapy for 6 (24%), combined voice and medical intervention for 5 (20%), and combined Gelfoam and thyroplasty for 1 (4%). Side of paralysis was dominated by 18 (72%) left. There were 13 males and 12 females, whose ages were evenly distributed across subjects, with ages 49, 59, and 70 receiving slightly higher counts.

To examine treatment effect on voice outcome, the medical treatments were combined into a single medialization group (medialization). The two other treatment groups were speech pathology (sppath) and combination medical and speech pathology (combomedsp). Data were collected from the 7-point (Likert) perceptual rating scale (1 = normal to 7 = aphonie) of the videostroboscopy examination sheet routinely used by Blaine Block Institute voice pathologists.

To answer the first question regarding treatment type and posttreatment vocal quality, an ANOVA was run to look at the relationship between posttreatment vocal quality (postvq) and treatment type (txtype). There were no significant differences in posttreatment vocal quality between treatment types ($P = .605$).

An ANOVA was run to answer the second question, “Is the difference between posttreatment and pretreatment vocal quality correlated with treatment type?” Significant differences were found for vocal quality improvements (diff.vq) between the treatment types (txtypes) ($P = .011$). Since it was of interest to know which group(s) caused the differences in voice improvement, a post hoc test was run to look at all pairwise comparisons between the treatment types. Because of homogeneity of variances between groups ($P = .672$), the Tukey-Kramer (honestly significant difference) test was used. The Tukey-Kramer test indicated that the only significant difference in improvement is between the speech pathology and medialization groups ($P = .009$). The 95% confidence interval for the difference between those groups indicates that the medialization group shows an im-

### TABLE 2. Distribution of Etiologies for 25 Patients in the Pretreatment and Posttreatment Data Analysis Group

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
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*Valid: N = 25. Missing: N = 0
improvement in vocal quality that is between 0.55 and 4.02 points higher than that of the speech pathology group. See Figure 2.

To determine if there was a relationship between the choice of treatment and the pretreatment vocal quality, an ANOVA was run on txtype and pretreatment vocal quality, (prevq). Significant differences were found between the treatment groups (P = .039). Again homogeneity of the variances between the groups (P = .867) necessitated a post hoc analysis with the Tukey-Kramer test. That test indicated the only significant difference was between speech pathology and medialization groups (P = .030). The 95% confidence interval for the difference between those groups shows that the medialization group has a pretreatment vocal quality between 0.16 and 3.46 points more severe than that of the speech pathology group (see Figure 3).

In summary, although patients in the medialization treatment group had a more severe pretreatment voice quality than those in the speech pathology group, both groups had an undetectable difference in posttreatment ratings. On average, the medialization treatment effects a larger vocal quality improvement than does speech pathology treatment in patients with the most severe dysphonia. Differences in pre-

treatment vocal quality, posttreatment vocal quality, or vocal quality improvement between the combmedsp group and the other two were not detectable in this sample. Given the small number of subjects for this analysis, there may be insufficient power to find such a difference.

**DISCUSSION**

Unilateral vocal fold paralysis is a common condition encountered within this large otolaryngology practice. Careful physical examination and diagnostic work-up must proceed in a methodical and sequential fashion. Patients with unilateral adductor vocal fold paralysis often present with more severe symptoms of dysphonia and dysphagia requiring immediate management. Patterns of care and voice outcomes relative to etiology, age, gender, occupation, and similar demographics are important clinical indicators for intranstitutional and interinstitutional comparison.

Examining the etiology and pathophysiology of unilateral adductor vocal cord paralysis produced data that are consistent with etiologies reported in the literature. Our study listed the specific etiological groupings, which proved informative. Thyroid surgery is commonly reported as the most frequent

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**FIG. 2.** Posttreatment vocal quality and treatment types for 25 patients in pretreatment and posttreatment data analysis group.
surgical trauma cause of vocal cord paralysis.\textsuperscript{3,7,8} Interestingly this study found carotid endarterectomies exceeded and anterior approach to cervical fusion was close to thyroid surgery as iatrogenic causes of unilateral adductor vocal fold paralysis associated with surgeries in the neck. Malignancies involving the left lung and mediastinum made up the largest etiological group in the chest, followed closely by cardiovascular conditions (ie, aortic aneurysms). Overall, 16.3\% of the cases were idiopathic. This closely reflects percentages reported by Terris et al in their 1991 retrospective study of evaluation of unilateral vocal fold paralysis.\textsuperscript{3} That study included an overview of causes of vocal cord paralysis, which stated that 14.3\% of all cases were idiopathic. Similarly our demographic data paralleled those of their study, which reported on 84 patients seen from 1983 to 1991. Age ranges reported in that study were from 20 to 91 years, with a mean of 58. Gender distribution was reported as 53.6\% male and 46.4\% female. Side of paralysis was 67.9\% left and 32.1\% right.\textsuperscript{3}

Additional patient-related data were collected for this study. Retired was the largest category of occupations, and this is certainly in keeping with the reported age distribution. Vocal fold paralysis is associated with older adults, as their overall risk of neurologic and neoplastic disorders that may affect the larynx increases.\textsuperscript{7} Of these patients, 43\% did not report a significant smoking history, while 36\% did. There was unclear documentation for 19.7\% of the group, and it is suspected that there were more smokers in this group. Numerous symptoms may accompany the condition of unilateral vocal fold paralysis, but our patients’ symptoms clustered between hoarseness and hoarseness and dysphagia combined.

CT scanning of the neck and chest was the imaging study of choice for our physicians for patients who presented an unknown cause. This reflects the increasing trend reported in the literature of preference for CT scans of the chest over CXRs in the evaluation of the course of the RLN.\textsuperscript{3,5,18} The use of fiberoptic endoscopy is advocated by some who suggest its relative comfort as an adjunct exam makes it a valuable tool.\textsuperscript{5} Videostroboscopy or videoendoscopy should be included as part of the initial diagnostic work-up.\textsuperscript{5,7} We reflected this trend, as 89\% of our patients received at least 1 videostroboscopic exam. There is clear debate in the literature as to the usefulness of videostroboscopy in the management of patients with unilateral adductor vocal fold paralysis.\textsuperscript{18} We agree that stroboscopic ratings of vibratory characteristics are of limited utility due to poor signal detection in patients whose paralyzed cord rests in a more lateral position. Utilization of video-
laryngoscopy equipment, with its features of bright illumination, magnification, and video and still recording for documentation of vocal fold mobility and position, configuration of glottic closure, and supraglottic compression and for discrete description of vocal fold edge, is extremely valuable. The images also serve as an excellent teaching tool for the patient, with whom the voice pathologist spends considerable time explaining exam results. Our use of objective assessments for complaints of dysphagia is limited. All patients are questioned regarding dysphagia. Descriptions of intermittent coughing on thin liquids are the most prevalent response and those patients are immediately counseled regarding dysphagia precautions. The speech pathologist or physician makes recommendations for a modified barium swallow or fiberoptic endoscopic evaluation of swallowing study if more serious symptoms persist.

Currently our facility does not offer laryngeal EMG as a part of a diagnostic assessment. Its utility as documented in the literature is impressive and we hope to offer it in the future.

Medical surgical treatments offered to our patients are medialization via thyroplasty, Gelfoam, or Teflon. Thyroplasty and Gelfoam were selected most often. Utilization of these methods over Teflon has steadily increased in the last 10 years, as we better understand the effects of these procedures on vibratory characteristics and voice outcome. The subgroup analysis of pretreatment and posttreatment data confirmed that the decision to use surgical options vs voice therapy was influenced by severity of voice symptoms. Surgical intervention was selected or recommended for patients whose voices were generally rated as presenting with a severe dysphonia. Significant differences were found between posttreatment and pretreatment vocal quality of patients who had undergone medialization when compared to the speech pathology treatment group. That only 25 subjects were available for pretreatment and posttreatment data analysis was by default rather than by design and was one of the limitations to a retrospective study. Admittedly, this small number offers poor power to find what other differences in treatment might exist.

Voice therapy was recommended or used for those whose voices were rated less severely. Voice therapy preceded Gelfoam or thyroplasty medialization for 5 of the cases. The value of preoperative voice therapy was documented in a 1996 retrospective study conducted by Heuer et al. While the measures we analyzed differed, theirs based on objective and subjective measures and gender effects and ours on subjective measures only, our findings were similar. Both indicated voice therapy alone tended to be used for patients with less severe ratings while surgical intervention followed more deviant measures. Numerous studies document the use of voice therapy for patients with unilateral adductor vocal fold paralysis who had less severe dysphonia.

In the large data group, overall voice improvement subjectively assessed by patient, physician, or speech pathology was reported for 40 cases. It is not surprising that categorical variables (ie, age, gender, etiology, side of paralysis, or treatment type) did not predict outcome with statistical significance when studies using more discrete measurements are often inconclusive. Our choice in using these variables as predictors merely reflected an effort to investigate any diagnostic or management trends.

A number of patients (16) did not seek follow-up after their first appointment or did not return at some point during their course of medical or therapeutic treatment (23). Such information is rarely offered in the literature. While we consider these numbers high, several explanations are offered: (1) the patient was interested in consultation only, (2) other opinions were sought, (3) other health issues prevailed, (4) there were insurance or financial considerations, (5) final disposition was offered via phone and not documented, (6) treatment was secured elsewhere, or (7) a degree of vocal function was established and satisfied the patient. Patients who did not return to our care after referral to another medical specialist may have (1) had symptoms relieved by treatment (radiation or chemotherapy), or (2) not considered their voice or swallowing symptoms a priority as they dealt with life-threatening disease processes. This is an area that warrants further investigation.

CONCLUSIONS

Retrospective studies have known limits to the generalizability of their results to larger populations. The value of this study was in its thorough inspection of the management trends of patients with unilateral
adductor vocal fold paralysis in a large otolaryngology practice and clinical voice lab. The numbers of these and other patients with paralysis within our practice appear to be steadily increasing. While broad categorical variables selected for analysis did not predict outcomes with statistical significance, extensive summary and descriptive statistics did reveal that the demographics and frequencies of etiologies, treatment choices, and outcomes closely follow trends reported by other facilities. A small subset of data collected on pretreatment and posttreatment voice quality confirmed that decisions made within our practice regarding medical or conservative speech pathology intervention are driven by the degree of severity of presenting symptoms. The small number of records available for pretreatment and posttreatment data collection limited the statistical power to find other significant differences that might exist between treatments. It is our intention to design a prospective study investigating discrete variables related to phonatory function and their relationship to the ultimate outcome of patients with unilateral adductor vocal fold paralysis.

REFERENCES