Longitudinal Voice Outcomes After Voice Therapy in Unilateral Vocal Fold Paralysis

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Summary: Objectives. To investigate the long-term effectiveness of voice therapy in vocal outcomes of patients with unilateral vocal fold paralysis (UVFP) and vocal productions of patients with long-standing treatment-naïve UVFP treated with voice therapy.

Study design. Prospective observational study.

Methods. A voice therapy protocol was applied individually in three stages. Fifteen sessions were scheduled twice a week in 70 patients with UVFP. Forty-seven patients were treated within a year of the diagnosis (group 1). The remaining patients had delayed therapy (at least 1 year after diagnosis) (group 2). Multidisciplinary assessment included nasofibroscopy, videostroboscopy, acoustic and aerodynamic parameters, and perception of voice impairment measures. A subgroup of the 70 patients (n = 32) was reassessed after 1 year of follow-up.

Results. Our voice therapy protocol significantly improved voice productions and perception of voice impairment in group 1 ($P < 0.0001$). Patients in group 2 experienced less hoarseness and had improved perception of voice impairment ($P = 0.007$). The improvement was long lasting and persisted at 1 year of follow-up in both groups.

Conclusions. Voice therapy is effective in patients with UVFP and its benefits are sustained over time. Early referral for voice therapy seems to be associated with greater benefit, but quality of life also improves for patients despite delayed treatment.

Key Words: Unilateral vocal fold paralysis–Voice therapy–Speech therapy–Dysphonia–Voice pathology.

INTRODUCTION

Unilateral vocal fold paralysis (UVFP) may appear as a consequence of vagus nerve dysfunction or as a compromise of its laryngeal nerve branches. The etiology of UVFP may be iatrogenic, but noniatrogenic trauma, malignancy, infections, and toxins have been implicated. It may also be idiopathic.[1–4]

Paralysis of the vocal fold may present with a wide range of symptoms, ranging from very mild dysphonia to severe dysphagia. Swallowing and functional voice changes depend on the position of the paralyzed vocal fold relative to the midline, the severity of muscle atrophy, and the patient's ability to compensate for these. Patients with uncompensated UVFP may experience changes in acoustic and aerodynamic voice characteristics that directly affect their quality of life, whether dysphagia is present or absent. The primary treatment goal in patients without swallowing difficulties is to improve voice function.[5,6]

Multidisciplinary teams including speech therapists and otorhinolaryngologists currently evaluate and treat patients with UVFP.[7] A variety of behavioral and surgical techniques are available, including hard glottal attack, half-swallow boom, abdominal breathing, head and neck relaxation, lip and tongue trills, and resonant voice as mainstays of speech therapy.[7–9] Surgical options for this disorder include medialization of the vocal folds, type I thyroplasty, arytenoid adduction, and nerve reinnervation procedures.[5,10]

Outcomes related to surgical procedures have been reported,[10–12] but to our knowledge, only five studies regarding the efficacy of voice therapy support the utility of behavioral techniques in patients with UVFP.[8,13–16] Unfortunately, different methodologies and voice techniques have been applied leading to significant study heterogeneity. The need for protocolized care is obvious. Furthermore, no one has specifically evaluated the long-term efficacy of therapy in voice productions and perception of vocal disability in a representative sample of patients with demographic characteristics which may be generalizable.[14]

The purpose of this study was to investigate the long-term efficacy of a three-tiered voice therapy protocol in vocal outcomes of patients with UVFP initiated within a year of the diagnosis, as well as its effects on patients with long-standing untreated UVFP.

MATERIALS AND METHODS

We performed a prospective study of all patients with UVFP evaluated in our clinic between September 2009 and June 2012. The local ethics committee approved the research protocol, and informed consent was obtained from all subjects included in the study.

A total of 105 patients were referred for evaluation and treatment at our Voice Pathology Unit. Five patients presented with bilateral vocal fold paralysis, eight were classified as paretic, nine died because of tumor progression, and 13 did not complete voice

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therapy. Only patients with unilateral paralysis of the vocal fold completing the treatment protocol were included in data analysis.

A total of 70 subjects with UVFP received protocolized voice behavior therapy. Time from UVFP diagnosis to the beginning of treatment was recorded in each subject. The sample was divided into two subgroups according to time to initiation of treatment. We established the 1-year cutoff based on evidence that axonal regeneration after nerve injury is limited to 12 months.[6,17]

Forty-seven patients received therapy within a year of the diagnosis (group 1) with a median time to treatment of 5 months (interquartile range [IR]: 5). The remaining 23 patients were treated more than 1 year after diagnosis (group 2), with a median time of 78 months from diagnosis to the beginning of the treatment (IR: 251).

A multidimensional diagnostic therapeutic assessment (pretreatment and posttreatment evaluation) was completed in the 70 patients with UVFP that received voice therapy.[18]

A comprehensive clinical assessment of the patients was designed to ascertain the etiology of the paralysis, including a thorough medical history, evidence of surgical trauma, or infection. Computed tomography of the skull base, neck, and upper thorax was performed in all patients with UVFP of unknown etiology. Rhino-laryngo-fibroscopy with continuous light and a telelaryngoscopy with stroboscopic light were performed in all patients by two experienced otorhinolaryngologists, with special emphasis placed on vocal fold position and glottal closure. Rigid (Storz 70° Tele-Laryngoscope) and flexible (Olympus Fiberscope) endoscopes (Hopkins Optical ® KARL STORZ 8706C A, 70º optical view) were used. Laryngoscopy was performed at the time of initial diagnosis and 1 month after the end of voice therapy. Interobserver agreement for pretreatment glottal closure was classified as very good based on the weighted kappa score of 0.87 (standard error 0.095); for posttreatment, the weighted kappa score was 0.86 (standard error 0.1062). Demographic characteristics, glottal closure, and etiology of the paralysis by group are shown in Table 1.

TABLE 1.
Characteristics of Patients With Unilateral Vocal Fold Paralysis by Group

	Total (n = 70)	Group 1 (n = 47)	Group 2 (n = 23)
Age (mean; SD)	54 (14)	51 (14)	59 (13)
Gender, n (%)			
Male	25 (34)	19 (40)	6 (26)
Female	45 (66)	28 (60)	17 (74)
Glottal closure			
Pretreatment, n (%)			
Complete closure	28 (40)	16 (34)	12 (52)
Incomplete			
Membranous portion	17 (24)	12 (26)	5 (22)
Irregular	25 (36)	19 (40)	6 (26)
Vocal fold position			
Paramedian	37 (59)	26 (60)	11 (55)
Intermediate	18 (29)	12 (28)	6 (30)
Lateral	8 (12)	5 (12)	3 (15)
Etiology, n (%)			
Thyroidectomy	40 (57)	31 (66)	9 (40)
Idiopathic	14 (20)	7 (15)	7 (30)
Other surgery	8 (11.5)	4 (9)	4 (17)
Other causes	8 (11.5)	5 (10)	3 (13)

Notes: Groups 1 and 2: patients that started voice therapy before or after 1 year from diagnosis of paralysis, respectively.

A self-assessment perception of voice impairment was available for each patient who completed a Voice Handicap Index (VHI-10), including a global index from three subscales: functional, emotional, and physical.[19,20] A phoniatrician and a speech pathologist evaluated each patient for conversational speech and sustained vowels, using maximum phonation time (MPT /a/).

WPCVox program (Universidad Politecnica de Madrid (UPM). ISBN: 84-688-8911) was used to achieve objective voice evaluation. A correlation of results obtained with this program and *Multidimensional Voice Program* (*MDVP*) (Universidad Politecnica de Madrid (UPM). ISBN: 84-688-8911) is well established.[21] *WPCVox* is an application dedicated to recording and analyzing speech signals. The matching of most parameters extracted with *WPCVox* and MCVP allows for data transfer among them, so those patients evaluated with *MDVP* could be evaluated by *MDVP* and *WPCVox* and subsequently compared with *WPCVox*, obtaining very similar results.[21,22]

Voices were recorded using a Sennheiser e845 microphone (© Sennheiser Electronic Corporation 2015 | USA) located approximately 15 cm from the mouth and below the chin, to reduce airflow effects. A 16-bit Windows compatible sound card with 44.1 kHz of sampling frequency was used. The room where recordings were performed had a background noise level less than 45 dB as measured by the SL-100 Termomed digital sound level meter.

A spectrography was done selecting 3–5 seconds from the most stable region of three times sustained vowel /a/ sound at FFT-1024 points, ranging between 0 and 5.5 kHz. The sample frequency was 22,050 Hz. Yanagihara's classification was used to rate the voice spectrograms. Based on spectrographic analysis, each patient's voice was classified as either type 1, 2, or 3, according to Titze's recommendations; only those classified as type 1 underwent perturbation analysis.[23–25] Two speech therapists evaluated the signal. Interobserver agreement for pretreatment Yanagihara's was classified as very good based upon the weighted kappa score of 0.87 (standard error 0.098). Weighted posttreatment kappa score was 0.81 (standard error 0.094).

Voice perturbation parameters were calculated with a sustained vowel /a/ with a sample frequency of 44,100 Hz, and include shimmer (ShdB) and jitter absolute (Jita) values, and noise-to-harmonics ratio (NHR). We also incorporated relative average perturbation and amplitude perturbation quotient that showed a high correlation quotient with Jita (0.906) and ShdB (0.976), respectively. Fundamental frequency (F0) was also estimated.[18]

Voice therapy

Most of the patients had little knowledge of vocal techniques before enrollment in voice therapy. We therefore focused on