

Voice Quality Following Unilateral Vocal Fold Paralysis: A Randomized Comparison of Therapeutic Modalities

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Summary: In this work, a study on the efficacy of different therapeutic modalities in patients with unilateral vocal fold paralysis (UVFP) was carried out. The study included 20 patients with UVFP, divided into two groups. The objective of this work is to evaluate the voice quality in these patients and to compare the voice following surgery and voice therapy. Group I received voice therapy and group II underwent thyroplasty type I and type IV. The voice was assessed pretreatment and 1 and 3 months posttreatment. Different parameters, such as habitual fundamental frequency (F0), signal-to-noise ratio, jitter, shimmer, maximum phonation duration, s/z ratio, and objective and subjective ratings of dysphonia, were analyzed. It was observed that in group I, all the parameters in seven out of ten patients improved significantly, except for shimmer. In group II, voice quality improved in 70% of the patients with all the parameters. As per previous studies, jitter and shimmer improved after a rehabilitation procedure. However, in this work, it is observed that shimmer did not improve in patients receiving voice therapy. The present study is the first of its type documenting and comparing the efficacy of voice therapy and thyroplasty type I and type IV in patients with UVFP.

Key Words: UVFP–Voice quality–Voice therapy–Thyroplasty–Dysphonia.

INTRODUCTION

The term vocal fold paralysis (VFP) summons the image of a motionless larynx. Unilateral vocal fold paralysis (UVFP) may result from injury to the nerves or mechanical fixation of the vocal fold.¹ VFP has been conceptualized as a precise lack of motion due to the complete absence of neural input. It encompasses partial or complete denervation and variable degrees of reinnervation.²⁻⁵ Patients with UVFP are characterized by weak or “breathy” voice, effortful speaking, and difficulty generating loud voice. The glottic closure may not be complete and is affected with even mild asymmetries in the neural input. Asymmetries in vocal fold tension may affect pitch, vocal stamina, and high or low intensity phonation. The degree to which each of these manifestations of UVFP is present varies depending on the individual’s ability to compensate; the size, shape, position, and passive biomechanics of the paralyzed vocal cord; and the underlying pulmonary function.

Mechanisms of nerve damage

Injury to recurrent laryngeal nerve (RLN) or vagus nerve anywhere along its course results in impaired vocal function. Intact RLN carries out functions like swallowing, breathing, coughing, and phonation, and all these functions require vocal fold motion. The axons of RLN are myelinated and grouped within the vagus nerve. The left vagus follows the carotid artery into the mediastinum and crosses anterior to the aortic arch, the length being 12 cm.⁶ The RLN loops medially under the aorta and ascends within the tracheoesophageal groove. The right vagus descends with the common carotid artery. The approximate length

of right RLN is 5–6 cm.⁷ Right RLN is at risk during thyroid surgery.

Netterville et al found thyroid surgery to be the most common cause of iatrogenic RLN paralysis. Carotid endarterectomy may lead to postoperative vocal fold immobility.⁸ The incidence of RLN paralysis increases with the age of the patient.⁹ Compressive injury to RLN is seen in Ortner syndrome.¹⁰ Of the reported cases of RLN paralysis, 17–32% have viral etiologies like herpes simplex virus, varicella zoster, and influenza virus. Other etiologic factors may be nonlaryngeal tumors like thyroid, lung, or esophageal tumors.^{11,12} Sribodhi et al were the first to propose that the aberrant regeneration of nerve fibers was responsible for VFP after RLN injury.¹³ Reinnervation may be inappropriate, leading to chronic paralysis because of simultaneous contraction of antagonistic muscles.¹⁴

Clinical evaluation of VFP

Unilateral superior laryngeal nerve (SLN) injuries are concomitant with very slight voice change, diplophonia, frequent throat clearing, paroxysmal coughing, voice fatigue, and foreign body sensation in the throat. Pitch range is decreased in these patients. On indirect laryngoscopy (IDL), the vocal folds appear normal during quiet respiration. Deviation of the posterior commissure to the paralyzed side is seen.

Unilateral SLN and RLN injuries occur usually in high vagal or brainstem lesions. Unilateral RLN injury is the most common situation encountered. Voice is breathy, but the normal vocal cord starts to compensate soon with therapy or surgery. The airway is adequate and there is no stridor.

Examination of voice and larynx must be incorporated in the assessment. Voice is studied by vocal capability battery, and larynx is evaluated by endoscopic examination. The measurement of voice parameters becomes a task of supreme importance as any voice pathology can cause increased noise components in the voice signal, such as amplitude irregularities and variations with different patterns, subharmonic frequency components, turbulent noise, voice breaks, and tremors.¹⁵

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Treatment options

The treatment options for UVFP include medical (voice) therapy and surgical therapy. The decision for surgical or behavioral intervention for patients with VFP is determined by the patient view of vocal handicap, the expectation on the part of the surgeon and the voice therapist, and the treatment that will address the patient's primary concerns. Outcome assesses the broad value of treatment for individual patients by measuring change across intervention. Efficacy studies explain why and under what circumstances treatments succeed. There has been a study regarding the efficacy of voice therapy.¹⁶

Voice therapy

The focus of voice therapy is the modification of deviant vocal symptoms identified by the voice pathologist during the diagnostic valuation. Voice therapy is the principal treatment in patients who have a favorable (ie, median) position of the paralyzed fold and fairly equal tonicity between vocal folds. Boone was among the pioneers to compile and formulate a philosophy of voice treatment called symptomatic voice therapy.¹⁷ The most commonly used voice therapy techniques for UVFP include vocal hygiene and modification of voice use and the voice use environment. In addition, direct voice therapy techniques (eg, flow phonation, hyperadduction exercises, yawn sigh technique, and proper use of the respiratory support for phonation, phrase, and word timing) are often used. Studies find voice treatment to be a substantial factor in improving voice function.^{18,19} Voice treatment can resolve a voice disorder if commenced before any medical intervention.²⁰

Surgical therapy

The laryngeal framework surgery was first introduced in 1915 with the development of a thyroid cartilage flap.²¹ Surgical medialization is currently the procedure of choice for most cases of UVFP. The commonly performed laryngeal framework surgery is the type I thyroplasty proposed by Isshiki et al.²² However, thyroplasty still forms the most extensively performed management option for UVFP. Detailed literature of research studies related to UVFP, its management, and findings are summarized in [Table 1](#).

METHODOLOGY

The study sample comprised patients with UVFP who reported breathiness of voice as the main complaint to the Department of Otorhinolaryngology at the Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh. The research design includes a randomized/prospective clinical study that included 20 patients who were attending the Outpatient Department of the Department of Otorhinolaryngology, and were referred for voice therapy to the Speech and Hearing Unit. The patients were selected according to the following inclusion and exclusion criteria:

The following were the inclusion criteria:

- Patients with UVFP
- Age range: 20–50 years

- No abnormality on chest radiography
- Normal computed tomography/magnetic resonance imaging

The following were the exclusion criteria:

- Patients having vocal fold nodules, granulomas, polyps, etc
- Patients unfit for surgery
- Patients not willing for surgery
- Patients on extremes of age

The patients were divided into two groups using a computerized randomization table. Written informed consent was taken from all the patients. The sample population comprised two groups. Each group was composed of 10 participants. Power analysis was carried out to verify whether or not the sample sizes considered in the study were sufficient. The sample size was determined using Equation (1) considering $\alpha = .01$ and power = 0.95.

$$n = \frac{[(3_{\alpha} + 7_{1-\beta})]\sigma}{d} \quad (1)$$

where $3_{\alpha=0.01} = 2.33$ and $7_{1-\beta} = 1.64$, d = significant difference or detectable difference, and σ = pooled standard deviation.²³

- Group I: patients who received voice therapy after UVFP
- Group II: patients who were managed surgically for UVFP using a combination of thyroplasty type I and type IV

Evaluation

The following assessments formed a part of the study:

1. Voice analysis
2. IDL
3. Fiberoptic laryngoscopy
4. Objective voice rating
5. Subjective voice rating
6. X-ray chest: anterior lateral view
7. Computed tomography/magnetic resonance imaging: skull base to T4

Clinical assessment

The detailed otolaryngological/physical/general systemic examination was done by the medical personnel before the vocal assessment.

Laryngeal examination

A laryngeal mirror was used to perform the IDL.

Fiberoptic laryngoscopy

Fiberoptic laryngoscopy was performed to measure the degree of glottal incompetence (and to see the exact glottal closure after the treatment). This was done using a fiberoptic endoscope (Karl Storz, Tuttlingen, Germany). Radiological examination, which was composed of chest radiography (Posterioranterior [PA] view), was taken to rule out any malignancy in the lungs/chest

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