

## Original Research Article

# Voice outcome after type-1 thyroplasty for unilateral vocal cord paralysis: our experience at tertiary care hospital

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## ABSTRACT

**Background:** Vocal cord paralysis is a clinical sign caused by paralysis of intrinsic muscles of larynx due to dysfunction of recurrent laryngeal nerve or injury to the vagus nerve. One of the common and effective methods of medialization is by using silicone implants. This study was aimed at prospectively assessing and analysing the vocal outcomes and quality of life of patients in type 1 medialization thyroplasty using silicone implants.

**Methods:** Prospective study of 18 months was done on 17 patients with unilateral vocal cord paralysis. Surgical procedure for the patients was standardized by using silicon implant to medialize the cord. The parameters used for the pre and post treatment objective analysis were stroboscopic analysis, psychoacoustic evaluation, maximum phonation time (MPT) and patient's self-assessment.

**Results:** In our study all 17 patients with unilateral vocal cord paralysis who were subjected to vocal cord medialization using silicone implant showed a statistically highly significant improvement in all the parameters of assessment. The mean preoperative MPT was 7.260 and post-operative MPT showed significant improvement and was 17.428 seconds. mean preoperative GRBAS score was 11.695 and post-operative was 3.826. Similarly, pre op vocal handicap index was 31.173 which decreased significantly after the procedure was 7.695.

**Conclusions:** In the present study, we obtained favourable results of medialization thyroplasty as expressed by objective analysis of voice including GRBAS score and acoustic analysis as well as maximum phonation time apart from traditional voice recording.

**Keywords:** Maximum phonation time, Psychoacoustic analysis, Silicone implant, Stroboscope, Unilateral vocal cord palsy

## INTRODUCTION

Phonation is one of the highest functions of the human larynx. It is evolved not only for the verbal communicative faculty of speech and language but also for certain none verbally communicated messages

Voice disorders may be defined as a voice quality which is easily fatigable and is associated with pain and discomfort with phonation. There is age and gender discordance with the speaker. The voice maybe inaudible

or incapable of fulfilling linguistic and paralinguistic features.<sup>1</sup>

Voice disorders may be divided into four major categories (Clark A Rosen And Thomas Murray): 1) organic voice disorder: vocal nodules vocal fold polyp vocal fold cyst, leukoplakia, rinks edema, carcinoma of vocal fold, laryngitis etc., 2) non organic (functional voice disorders); muscle tension dysphonia, psychogenic dysphonia, conversion dysphonia etc., 3) movement disorders of larynx (neuro muscular control

abnormalities): unilateral and bilateral vocal folds paralysis, spasmodic dysphonia (abductor and adductor), essential tremors of larynx and 4) systemic disorders affecting voice production: gastro esophageal reflux disease (GERD), neurological diseases (e.g. Parkinson disease etc.).<sup>2</sup>

There are four main potential uses for voice evaluation that include providing a measure of severity of the disorder and degree of variance from established normal values, an outcome measure to help assess responsiveness to treatment, to help during voice therapy to set therapy goals and characterizing the voice and voice problem, thereby providing supportive evidence for a differential diagnosis.<sup>3</sup>

Since these disorders affect the function of an organ, different techniques have been established for the evaluation and diagnosis of voice disorders. These may be described as:

**Perceptual analysis of voice quality:** It involves assessing the characteristics of the voice and grading the severity of specific abnormal features such as hoarseness, roughness etc. GRBAS (grade, roughness, breathiness, and strain) scale: it is the most widely used due its relative simplicity.<sup>4</sup> Each dimension is rated on a four-point scale where 0=no perceived abnormality, 1=mild, 2=moderate, 3=severe abnormality.

The five elements are grade (G), a description of degree of hoarseness, roughness (R) perceptual irregularity of vocal fold vibrations, breathiness (B) or the assessment of the air leakage through the glottis, asthenia (A) denotes weakness and lack of power, strain (S) reflects a perception of vocal hyper function. The overall grade of hoarseness is the most reliable voice quality parameter with strain and asthenia being relatively poor.<sup>5,6</sup>

CAPE-V- (consensus auditory perceptual evaluation of voice) and vocal profile analysis: -are other modalities of measurement of quality of voice.<sup>5-8</sup>

**Acoustic measures of voice quality:** It provides quantitative measures based on the voice signal (waveform and spectrum) recorded using a microphone. The microphone acts as a transducer, converting the acoustic signal into an electrical signal. Commonly used commonly acoustic parameters are: Fundamental frequency- measure of rate of vibration of vocal folds; jitter- variation/ perturbation in frequency; shimmer-variation/perturbation in intensity; harmonic to noise ratio (HNR).<sup>9-11</sup>

**Aerodynamic measures of voice quality:** Clinically there are three main factors that can be measured which are of interest in voice production: a) air volume- body plethysmography is the gold standard for obtaining measurements of changes in air volume during speech or singing. It is used mainly for research purposes, b) air

flow- it is usually specified in terms of volume velocity. It gives an indication of functional efficiency of the laryngeal system.<sup>12</sup> c) Maximum phonation time (MPT)- it is measured by asking the subject to inhale as deeply as possible and then sustain a steady state vowel sounds EE/AA as long as possible.<sup>14</sup> The longest of three repeated measurements is selected. Values under 10 seconds are regarded as pathological.

**Quality of life measures (Patients self-reporting tools:** It includes a) vocal handicap index (VHI-10 and VHI-30)- It is a disease specific patient questionnaire which allows self-reported grading of the effect of the voice problem on quality of life.<sup>14,15</sup> VHI-10 consists of 10 and VHI-30 of 30 items respectively which assess the impact of the voice disorder on physical, functional and emotional aspects of the patient's quality of life.<sup>15</sup> It has also been used as an outcome measure and indicator of response to treatment. Mean normative values of total score for VHI-30 are 6.86 (SD=9.88) and for VHI-10 are 2.83 (SD=3.93) and voice symptom scale- (VoISS).<sup>16</sup>

**Tele-laryngoscopy:** Using 70- degree rigid endoscope or fibroptic laryngoscope (FOL)- It has better optical resolution and higher sensitivity. They are used to diagnose organic lesions of larynx and rule out functional disorders.

**Vediostroboscopy:** There has been much advancement in the laryngeal treatment protocols in last 50 years.<sup>17</sup> Office base procedures are gaining much importance nowadays. Treatment modalities can be used with the following aims: a) To develop the best possible voice quality based on physical status of larynx; b) To eliminate abusive vocal behaviours; c) To develop appropriate respiratory support.

Laryngeal treatment procedures can be divided as: non-surgical which includes 1) Medical treatment includes treatment for acid reflux, URTI, allergies and anxiety etc. 2) Voice therapy and surgical treatment that includes microlaryngoscopic surgery and laryngeal injection techniques. Brunings was first to describe injection of the vocal folds when he injected paraffin via a direct laryngoscope approach under local anesthesia. Arnold introduced the use of Teflon.<sup>18,19</sup> Other materials used nowadays for injection laryngoplasty include fat, Silicone, etc.<sup>20-25</sup> (c) Laryngeal Framework surgery- Payer in 1915 is credited with first description of laryngeal framework surgery. Isshiki was first to describe using an alloplastic material (sialistic) and also to stress the benefits of carrying out the procedure under a local anaesthesia using patient's voice for feedback.<sup>23</sup> Laryngeal framework surgery allows the size of glottic aperture, plane of closure of vocal folds and vocal fold length to be modified. It also maintains the dynamics without invasion of vocal folds and alteration of their mass or stiffness. Isshiki et al described four types of thyroplasty: type-I: medialization, also called lateral compression; type-II: lateralization, also called medial

compression; and type-III: shortening; type-IV: lengthening.<sup>23</sup>

This study was aimed at prospectively assessing and analysing the vocal outcomes and quality of life of patients in type 1 medialization thyroplasty using silicone implants.

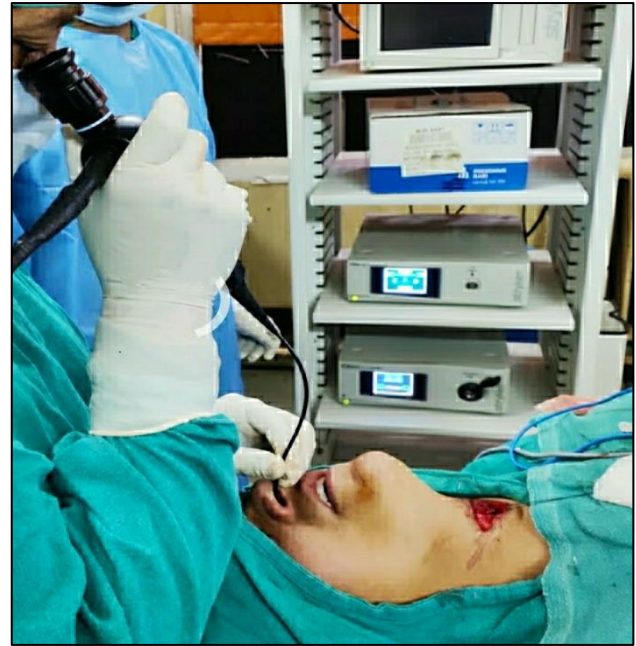
## METHODS

This prospective study was conducted in GMC Srinagar from August 2017 to February 2019 over duration of 18 months after clearance from the local ethical committee. Patients who presented to ENT outpatient with hoarseness of voice were evaluated. Those patients who had unilateral vocal cord palsy were included in the study. An informed consent was taken and patients were evaluated to identify cause of vocal fold paralysis. Detailed clinical examination was done after taking proper history.

Thorough investigations including fiber optic laryngoscopy, rigid endoscopy (through mouth), and computed tomography (CT) scan, stroboscopy were done to find out the causes of vocal cord paralysis.<sup>17</sup> Those with structural, neoplastic or inflammatory causes were excluded from the study. All patients were given voice therapy by speech pathologist for 5 months once weekly, each of 30 min sessions and patients who improved with speech therapy were continued with the same treatment. Patients who did not show improvement even after 6 months were taken up for surgical intervention. Patients presenting to OPD 5 months after the onset of idiopathic vocal cord palsy were directly taken up for surgical management i.e. surgical medialization- Isshiki's type I thyroplasty using silicone implant under local anaesthesia using 2% lidocaine with intraoperative monitoring using fibroptic imaging as shown in Figure 1.

Preoperative and postoperative comparison of voice was done by voice recording, GRBAS score, VHI and MPT.<sup>4, 6, 13-15</sup> In our study out of 25 patients who were diagnosed with unilateral vocal cord palsy, 8 patients showed significant improvement with speech therapy and hence were continued with the same. Remaining 17 patients were taken up for surgical intervention i.e. type 1 thyroplasty using silicone implant.

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as mean±SD and categorical variables were summarized as frequencies and percentages. Graphically the data was presented by bar and pie diagrams. The pre and post-operative assessment of various parameters was established by paired t-test. A p-value of less than 0.05 was considered statistically significant.



**Figure 1: Depicting intraoperative examination of vocal cords using fibreoptic laryngoscopy.**

### *Inclusion criteria*

Patients in the age group of 15-75 years who were clinically diagnosed with unilateral vocal fold paralysis were taken in the study.

### *Exclusion criteria*

Patients with laryngotracheal malignancy, previous vocal cord surgery, and with multiple cranial nerve palsies were excluded from the study.

### *Pre and post treatment assessment*

All the patients who were included in the study were analyzed on the following parameters.

### *Stroboscopic analysis*

We analyzed the stroboscopic analysis for symmetry of vocal fold vibration, glottic closure and wave pattern.<sup>17</sup>

### *Perceptual evaluation*

GRABS scale was used and following parameters assessed (grades, roughness, asthenia, breathiness, and strain) scale.<sup>4,6</sup> This scale included 4 points (0 to 3; 0 for normal, 3 for severe) for determining the overall grade of dysphonia and character of voice including strained, leaky, breathy, and rough.

### *Maximum phonation time*

The patients were asked to pronounce a prolonged /a/ as long as possible after taking a deep inspiration and MPT was recorded using a timer.<sup>13</sup>

**Patients self reporting tools**

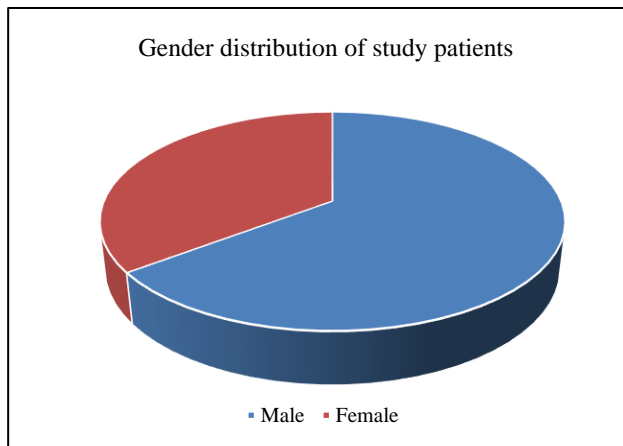
VHI- 10 questions were asked regarding patient’s voice and its impact on his daily social life. Values were assigned between 0-4. Individual scores were then added. Maximum score was 40.<sup>14-16</sup>

**RESULTS**

A total of 17 patients underwent type 1 thyroplasty using silicone block. The mean age of the study population was 53.82 years with a standard deviation of 10.894 years as shown in Table 1. The study population had a slight male preponderance [male 64.71% (n=11), female 35.29% (n=6), as shown in Figure 2. Most of the cases of vocal cord paralysis were of idiopathic origin (70.58%, n=12), 4 cases (23.52%) were following thyroidectomy and 1 case (5.88% n=1) after skull base surgery.

**Table 1: Age in years.**

Number	Maximum	Minimum	Mean±SD
17	72	34	53.826±10.894



**Figure 1: Gender distribution.**

**Perceptual evaluation**

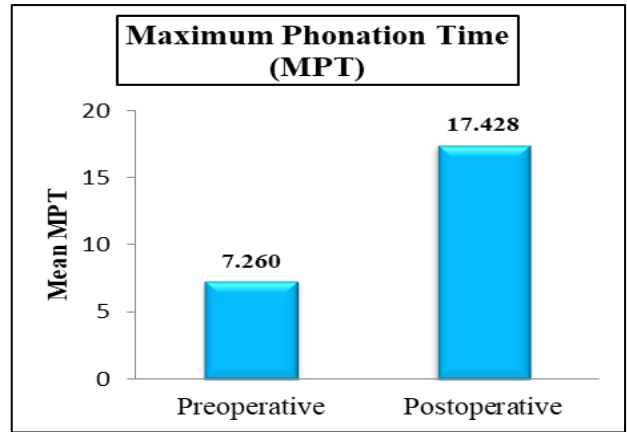
(GRBAS scale) grade, roughness, breathiness, asthenia and strain were the parameters as assessed and on analysis of the results a significant improvement with a p value of <0.001 was seen (Table 2).

**Table 2: Perpetual evaluation using GRBAS scale.**

Mean GRBAS (Pre op)	Mean GRBAS (Post op)	Standard deviation	P value
11.695	3.826	1.472	<0.001

**Maximum phonation time**

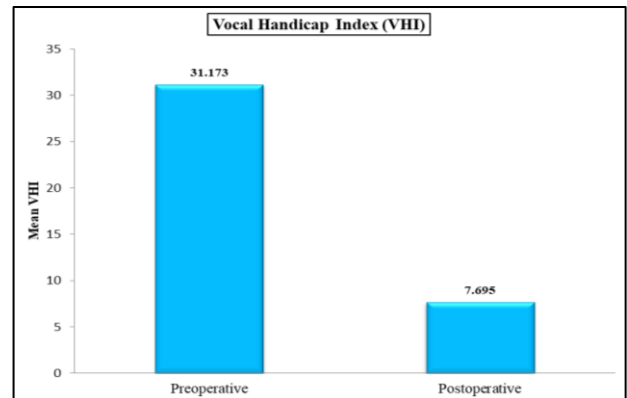
Nearly all patients had an increase in MPT with a significant p value of <0.001 (Figure 3).



**Figure 3: Depicting MPT pre and postoperatively.**

**VHI**

Patients showed significant improvement with a p-value of <0.005 (Figure 4).



**Figure 4: Depicting VHI values pre and postoperatively.**

**DISCUSSION**

The first report of a phonosurgical procedure appeared when Brunings introduced the concept of vocal fold medialization by injection of paraffin within the body of the paralyzed fold. This was followed by Payr’s description of an external approach.<sup>1</sup> Isshiki and associates were the first to introduce the concept of alloplastic implant material for medialization.<sup>23</sup>

The present study of 17 patients consists of 11 males and 6 females with age ranging from 34 to 72 years. Pal et al in their study also had incidence more in males with male:female ratio of 1.50:1.<sup>26</sup> Male to female ratio in study of Baitha et al was 2:1.<sup>27</sup> Left vocal cord palsy was seen in nearly 65% of the patients. Out of 17 patients in our study, 11 had vocal cord palsy due to idiopathic cause and rest was post-surgery. Patients who underwent medialization in our study nearly all the patients who had medialization using silicone block had an increase in their MPT from 7.260 to 17.428 with p value of 0.001

Lundy et al in his study on 20 patients concluded that intra operative measurement of MPT appears to be an adequate predictor of the post-operative outcome.<sup>5</sup> In the present study 17 patients with idiopathic vocal cord palsy were evaluated. All patients were given voice therapy initially. Voice therapy was given in the form of vocal exercise e.g. abdominal breathing, hard glottal attacks and pushing etc. Patients were followed for 3-5 months with voice therapy. Only 5 (29%) patients showed improvement with voice therapy and all the three vocal parameters (GRBAS, MPT, VHI-10) changed significantly ( $p < 0.01$ ). 12 patients (61%) who did not show improvement with voice therapy were subjected to surgical procedure Isshiki type-1 thyroplasty.<sup>23</sup> All cases were done under local anesthesia and sialistic block was used. Intraoperative and post-operative steroids were used. There was significant ( $p < 0.01$ ) improvement in all the vocal parameters (GRBAS, MPT AND VHI).<sup>23,29</sup> Elnashar et al had significant improvement in grades of dysphonia ( $p < 0.001$ ) after Gore-Tex medialization for UVFP.<sup>27</sup> Chrobok et al also showed improvement in all vocal parameters after medialization thyroplasty with a silicone implant.<sup>30</sup> Patients were also subjected to post-operative voice therapy. Chowdhury et al also had improvement in vocal parameters (GRBAS, MPT) after medialization thyroplasty.<sup>29</sup>

Psychoacoustic evaluation was using GRBAS scale. Based on a scale of 0-3, with 3 being the maximum score for each patient, the mean score of grade improved from 3 to 1, breathiness from 2.5 to 0.5, roughness from 3 to 0.5, asthenia from 2.5 to 1 and strain from 2.5 to 0.25. A significant p value of  $< 0.001$  was achieved post treatment in our study. Carroll et al had almost all patients improve in GRBAS scale following treatment.<sup>31</sup> Vocal handicap index score showed significant improvement and mean score improved from 31.17 to 7.69 with a significant p value of  $< 0.005$ .<sup>32</sup> Watanabe et al in their study on 43 patients had VHI index significantly improved after the procedure.<sup>33</sup>

## CONCLUSION

Medialization thyroplasty has been well accepted as a procedure and has been standardized in cases of unilateral vocal fold paralysis. In the present study, we conclude that results of medialization thyroplasty can be expressed by objective analysis of voice including GRBAS score and acoustic analysis as well as maximum phonation time apart from traditional voice recording. In our study all 17 patients with unilateral vocal cord paralysis who were subjected to vocal cord medialization using silicone implant a significant improvement in all the parameters of assessment.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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