

## **Stroboscopy, Voice Handicap Index and Maximum Phonation Time as Objective and Subjective Methods to Assess the Voice Quality Following Micro Laryngeal Surgery in Benign Lesions of the Vocal Cords**

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### **Abstract**

**Background:** Altered voice quality is commonly reported by patients with benign lesions of the vocal cords; 84% of them could be corrected surgically. Patient's response as subjective improvement in voice quality and objective improvement on Stroboscopy has revolutionized the role of voice clinics.

**Aim:** To evaluate the final outcome of micro-laryngeal surgery for benign lesions of vocal cords with Stroboscopy and subjective improvement of quality of voice with voice handicap index and Maximum phonation time.

**Materials:** 71 patients with benign lesions of vocal cords like cysts, polyps, nodules, plaques, angiomas, fibromas and Reinke's edema were included in a prospective study for a period of 25 months. Preoperative and postoperative Stroboscopy variables of amplitude, mucosal wave, and glottic closure were used. Subjective assessment of voice quality was done by voice Handicap index questionnaire. Maximum phonation time was calculated before and after surgery. The study data was analyzed statistically to assess the significance using paired 't' test and Chi square test.

**Results:** Patients were aged between 16 and 65 years. Out of 71 patients, 49 (69.12%) were males and 22 (30.98%) females, with a male to female ratio of 2.22:1. 49/71 (69.01%) patients belonged to the age group of 26 to 45 years. The mean age was  $44.56 \pm 3.15$  years. Hawkers were 21 (29.57%), Agriculturists were 18 (25.35%), Office goers were 14 (19.71%). Significant improvement on Stroboscopy variables and Voice handicap indices postoperatively at the end of 10 weeks was noted with p value 0.001.

**Conclusions:** Voice quality assessment on Stroboscopy and VHI (Voice handicap index) was ensuring satisfaction to both the patients and the surgeon alike. The assessment methods were not time consuming and except to the initial cost of establishing Stroboscopy the overall results of the study were effective.

**Keywords:** Vocal cords, Stroboscopy, Micro-laryngeal surgery, Voice handicap index and subjective assessment

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### **Background**

In Humans primary mode of communication is voice and change in its quality results in functional difficulties and social problems in the person [1]. Benign

lesions affecting the vocal cords may occur in any age groups and included cysts, polyps, nodules, plaques, angiomas, fibromas and Reinke's edema [2]. Even though there are technically advanced methods of surgical removal of these lesions cold steel method remains the commonest method used till to date [3]. The change in quality of voice in terms of medical literature is described as hoarseness of voice, dysphonia, change in voice and falsetto [4]. The benign lesions impair the normal undulating movement of the mucosal layer of vocal cords, prevent complete approximation of the vocal cords and also reduce the maximal amplitude of movement of the vocal cords [5]. These abnormalities in turn affect the pronunciation quality of voice and duration of quality voice production [6]. The patients over a time period with disturbed voice quality suffer from lack of self-confidence, varying degrees of psychological and social problems ultimately affecting their quality of life [7]. Most of these benign lesions are as a result of prolonged voice abuse, overuse and misuse [8]. Recurrent collision and shearing stress forces resulting from abuse of voice act upon the mucus membrane of edges of the vocal cords causing mucosal changes and micro vascular injuries to lamina propria and surface basement membrane of the vocal cords [9]. Usually altered quality of voice was treated by voice therapy by trained speech and language pathologists [10]. Surgical intervention was possible by advanced methods of using radiofrequency probes, laser treatment co ablation techniques but cold steel method was used in majority of surgeons even today [11]. Micro laryngeal surgery remains the choice of treatment as it allows the surgeon to work with both the hands [12]. Use of endoscopes during micro laryngeal surgery, give an added advantage to observe a magnified image of vocal cords, so as to avoid excessive use of force while excising the benign lesions, excessive mucosal trauma so as to retain the vibratory characteristics of the layered

micro vascular structure of vocal fold and to operate in precision [13]. Postoperative voice therapy after 4 weeks helps the patients to gain confidence and avoiding abuse of voice to prevent recurrences [14]. Preoperative and post operative assessment with Stroboscopy helped the surgeon to observe the high frequency oscillations of the mucosal folds of the vocal folds which are not appreciated by the naked eyes. Subjective evaluation of the patients' satisfaction was agreed upon by the many authors as the best practice in assessing the success of any medical or surgical procedure [15]. This could be done by using a structured questionnaire answered by the patients to assess the voice handicap and quality of life before and 10 weeks after the surgical procedure [16]. The commonly used dysphonia-specific quality of life questionnaire was the Voice Handicap Index (VHI) developed by Jacobson *et al* [17]. The present study was an attempt to assess the quality of life of patients reporting with dysphonia and their subjective reporting of improvement after 10 weeks to develop a voice quality assessment protocol in the Hospital where the study was conducted.

**Aims and Objectives of the Study:** To evaluate the final outcome of micro-laryngeal surgery for benign lesions of vocal cords with Stroboscopy and subjective improvement in voice quality with voice handicap index and maximum Phonation time. Objectives were to study the preoperative and post operative differences in amplitude, mucosal wave deformation (movement) and incomplete glottic closure; and difference in mean scores of VHI and MPT.

## Materials

71 patients attending the department of ENT with complaints of dysphonia in the age group of 16 to 65 years were included over a period of 25 months starting from June 2018 at Government Medical College and General Hospital, Nellore, Andhra Pradesh. Institutional ethics committee was approached for ethical clearance and

accordingly a structured questionnaire and consent letter was approved in addition to the approval.

**Inclusion Criteria:** Patients aged between 16 and 65 years of both genders were included. Patients with symptoms of Dysphonia lasting for more than 6 months were included. Patients with benign lesions of the vocal cords were included. Patients willing to undergo pre and post operative dysphonia assessment protocol and able to answer the structured questionnaire were included. Patients satisfying American Society of Anesthesiology grading (ASA grade I and II) were included.

**Exclusion Criteria:** Patients not willing to participate in dysphonia assessment and answer the questionnaire were excluded. Patients aged below 16 years and above 65 years were excluded. Patients with risk factors like Diabetes Mellitus, Cardiopulmonary diseases, immunosuppressive diseases and renal diseases were excluded. Patients with pre-existing articulation disorders, post laryngeal surgery and malignant diseases were excluded. All the patients willing to consent and matching the inclusion and exclusion criteria were elicited of history of dysphasia followed by demographic details. All the subjects were subjected to surgical profile, and Quality of voice assessment using Stroboscopy and Voice handicap index method. Under general anesthesia all the subjects were performed, micro laryngeal surgery and /or endoscopic visualization and cold steel method was used to excise the benign lesions of vocal cords. At the end of 10<sup>th</sup> week, the patients were subjected to Stroboscopy and VHI assessment. Maximum phonation times before and after surgery were compared. VHI was validated by going through the answers of the patients to the structured questionnaire

which contained the questions related to patient's self-perception related to functional, physical, and emotional impact of dysphonia on quality of life (QOL) [18]. Patients answered 30 questions on a 5-point Likert scale anchored by 0 and 4, representing "never" and "always," respectively. High scores indicated a graver degree of self-assessed handicap which gave negative impact of dysphonia on QOL. The total score of the questionnaire was 120 points. A shift of 18 points was considered to be statistically and clinically significant change in VHI.

**Statistical Analysis:** All the data was analyzed using standard statistical methods like mean, standard deviation, percentage and the difference in means was assessed by using paired 't' test. Count data was minimized in terms of proportions and their difference in proportion was analyzed by using Chi square test. The level of significance was always at 95% for all statistical analysis.

## Results

Among the 71 patients, included in the study there were 49 (69.12%) males and 22 (30.98%) females with a male to female ratio of 2.22:1. Patients aged between 16 and 25 years were 11 (15.49%), between 26 and 35 years were 23 (32.39%), between 36 and 45 years were 26 (36.61%), between 46 and 55 years were 08 (11.26%), between 56 and 65 years were 03 (04.22%), (Table 1). The mean age was  $44.56 \pm 3.15$  years. Among the subjects hawkers were 21 (29.57%), Agriculturists were 18 (25.35%), Office goers were 14 (19.71%), house wives were 08 (11.26%) students were 06 (08.45%), Professional voice users were 04 (05.63%), (Table 1). There was no statistical significance in the incidence of demographic features in the subjects (*p* value more than 0.05)

**Table 1: Shows the demographic features of the subjects in the study (n-71).**

Variable	Number	Percentage	Male	Percentage	Female	Percentage	P value
<b>Age</b>							
16 to 25 years	11	15.49	06	08.45	05	07.04	
26 to 35 years	23	32.39	16	22.53	07	09.85	0.143
36 to 45 years	26	36.61	20	28.16	06	08.45	
46 to 55 years	08	11.26	05	07.04	03	04.22	
56 to 65 years	03	04.22	02	02.81	01	01.40	
<b>Profession</b>							
Hawkers	21	29.57	17	23.94	04	05.63	
Agriculturists	18	25.35	10	14.08	08	11.26	
Office goers	14	19.71	09	12.67	05	07.04	0.132
Housewives	08	11.26	04	05.63	04	05.63	
Students	06	08.45	04	05.63	02	02.81	
Professional voice users	04	05.63	03	04.22	01	01.40	

The nature of the benign lesions observed clinically in the subjects were benign vocal cord polyps in 17 (23.94%), vocal nodules in 13 (18.30%), benign cysts in 12 (16.90%), fibromas in 09 (12.67%), hemangiomas in 09 (12.67%), benign plaques in 07 (09.85%) and Reinke's edema in 04 (05.63%) patients. (Table 2) All the lesions were subjected to histopathological study and a final diagnosis of the lesion was made and in 69/71 (97.18%) the clinical diagnosis was confirmed.

**Table 3: Shows types of benign lesions of vocal cords observed in the study (n-71).**

Type of lesion	Number	Percentage
Polyps	17	23.94
Cysts	13	18.30
Nodules	12	16.90
Fibroma	09	12.67
Hemangiomas	09	12.67
Plaques	07	09.85
Reinke's edema	04	05.63

Benign lesions of vocal cords were observed on the left vocal cords in 29 (40.84%) patients and 25 (35.21%) on the right vocal cords and the remaining 17 (23.94%) on both the vocal cords in this study. Stroboscopic findings for changes in amplitude, mucosal wave and glottic closure were observed preoperatively and postoperatively after MLS. The preoperative mean values of VHI in their respective domains of Functional, physical, emotional and total values were 25.37, 28.55, 31.85 and 29.19 respectively. The same mean values at the end of 10<sup>th</sup> week of post operative period, showed a decrease to 09.10, 10.05, 12.35 and 08.45

respectively. (Table 3) There was a shift of 18 points which was considered to be statistically and clinically significant change in VHI following Micro laryngeal surgery in this study. Maximum phonation time (MPT) was a coordinated function of vital capacity of the lung and vocal cords in conserving the expired air to produce a controlled phonation. The duration before and after surgery were observed in all patients and found that the mean MPT value was as low as  $07.97 \pm 1.75$  minutes before surgery and it was  $13.85 \pm 1.80$  minutes at 10<sup>th</sup> week after surgery. (Table 3), (p value was 0.001; less than 0.05 taken as significant).

**Table: 3 showing Pre-operative, post operative (10 weeks later) Stroboscopy and VHI**

Variables	Pre-operative		Post-operative		P value
	Number	Percentage	Number	Percentage	
<b>Stroboscopy findings</b>					
1. Glottic closure					
Complete	03	04.22	59	83.09	
Incomplete	68	95.77	12	16.90	0.001
2. Mucosal fold changes					
Asymmetry	06	08.45	09	12.67	
Absence	05	07.04	01	01.40	0.001
3. Mucosal amplitude					
Reduced	60	84.50	05	07.04	0.001
Normal	00	00.00	56	78.87	
<b>VHI (mean values)</b>		<b>SD</b>		<b>SD</b>	
Functional domain	25.37	06.08	09.10	05.15	
Physical domain	28.55	05.86	10.05	06.14	
Emotional domain	31.85	05.90	12.35	04.95	
Total VHI score	29.19	04.88	08.45	05.16	
Maximum Phonation time	07.97	01.75	13.85	01.80	0.001

Mean values in the subjects (n-71). Chi square= 26.483 with 2 degrees of freedom. P value <0.05 being significant (SD: Standard deviation)

## Discussion

Earlier studies had focused on objective voice measurements to prove the success of surgical procedures performed for excision of benign lesions of the vocal cord. But now the focus is on subjective assessment and global vocal function from the patient's perspective [19]. The objective measures of vocal cord function assess only a small component of voice production. [20]. In the present study evaluation of final outcome of micro-laryngeal surgery for benign lesions of vocal cords in the form of variables of Stroboscopy and subjective improvement in voice quality in terms of voice handicap index and maximum phonation time. The patient's expectations are basically based on their profession and social circumstances where the voice was used [21] Jacobson *et al* [10] in 1997 formulated Voice Handicap index to measure of voice handicap with three domains functional, emotional and physical types. Voice is a complex, well-

coordinated system involving aerodynamic and acoustic vibratory apparatuses giving an output of extremely composite, multidimensional and variable physiological phenomena. As a result of such complexity, it is common to encounter some degree of dysphonia even in the normal people's voices. Hence assessment of voice quality does not provide an accurate and reproducible assessment. The present study was conducted on 71 dysphonia patients with a male to female preponderance ratio of 2.2:1. The mean age was  $44.56 \pm 3.15$  years. 49/71 (69.01%) patients belonged to the age group of 26 to 45 years. Similar incidence was reported by Veena Mobarsa *et al* [22], G Thomas [23] and Sharma [24] who also showed a male predominance. Out of 71 patients hawkers were 21 (29.57%), Agriculturists were 18 (25.35%), Office goers were 14 (19.71%), house wives were 08 (11.26%) students were 06 (08.45%), Professional voice

users were 04 (05.63%), (Table 1). There was no statistical significance in the incidence of demographic features in the subjects (p value more than 0.05). All the patients attended the department of ENT after experiencing the symptom of Dysphonia for more than 6 months. The commonest benign lesion encountered were vocal cord polyps in 17 (23.94%), vocal nodules in 13 (18.30%), benign cysts in 12 (16.90%), fibromas in 09 (12.67%), hemangiomas in 09 (12.67%), (Table 2) The VHI mean values in the domains of Functional, physical, emotional and total values were 25.37, 28.55, 31.85 and 29.19 respectively. Postoperatively at the end of 10<sup>th</sup> week the same values changed to 09.10, 10.05, 12.35 and 08.45 respectively. (Table 3) It was observed that a shift of 18 points was present in all the domains which were statistically and clinically significant in this study. MPT was  $07.97 \pm 1.75$  minutes before surgery and it was  $12.85 \pm 1.80$  minutes at 10<sup>th</sup> week after surgery. (Table 3), (p value was 0.001; less than 0.05 taken as significant). Similar reports were found in the literature published by Durand [25] and Thomas *et al.* [23] Sharma [24] also reported similar findings in study of 7 patients at 2nd week postoperative. The study by Thomas *et al* [23] matches with the present study showing significant reduction in the total scores of all domains of PHI postoperatively. Whereas the study by Durand [25] showed an improvement in the last part of first month but later there was a decrease in the score after 3 months. Identical reports as this study were also published by Cheng [26] and Sovani [27] who showed a dramatic decrease in the VHI scores in all the domains of their 21 and 30 patient groups respectively. In a similar study by Virmani N *et al* [28] they concluded that assessment of voice in post operative period with the help of VHI was encouraging to both the patient and the surgeon alike. In this study MPT also showed an improvement at the end of 10th week postoperatively. This study used Vocal Handicap Index and Stroboscopy to

assess the impact of voice quality regained following surgery complaint on patient's quality of life.

## Conclusions

Voice quality assessment on Stroboscopy and VHI (Voice handicap index) was ensuring satisfaction to both the patients and the surgeon alike. The assessment methods were not time consuming and except to the initial cost of establishing Stroboscopy the overall results of the study were effective. Microlaryngeal surgery combined with endoscopes and cold steel cost effective, easy and provided ample opportunity to the surgeon to improve the voice quality in patients with benign lesions of vocal cord.

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