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Videostroboscopic Evaluation of Patients with Benign Vocal Cord Lesions Following Micro Laryngeal Surgery in a Tertiary Care Centre

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Abstract: ***Background: Benign vocal cord lesions are one of the common causes of dysphonia. With the advent of microlaryngeal surgery, it is possible to remove lesions on the vocal cord precisely. Videostroboscopy is an advanced technique used to analyze the vibratory pattern of vocal fold mucosa. This study was conducted to compare the video stroboscopic findings in benign vocal cord lesions before and after surgery and to assess the outcome of surgical excision of benign vocal cord lesions on vocal fold vibration using video stroboscopy and voice analysis. Methodology: This prospective observational study was conducted among 46 patients with benign vocal cord lesions who underwent microlaryngeal surgical excision. in the Department of ENT, Government Medical College Thiruvananthapuram. Videostroboscopy, voice analysis, and voice handicap index were performed pre - and post - operatively. Postoperative results showed significant improvement in stroboscopic parameters, voice analysis, and voice handicap index, indicating effective surgical outcomes. Results: Postoperatively there was improvement in stroboscopic parameters of vocal cords. After surgery, objective and subjective voice improvement was observed in the voice analysis and voice handicap index respectively.***

Keywords: Benign vocal fold lesions, videostroboscopy, voice analysis, voice handicap index, micro laryngeal surgery

1. Introduction

Benign vocal cord lesions are commonly encountered causes of dysphonia that affect the quality of life[1]. The primary cause of the lesions is vibratory injuries from excessive or aggressive use of the voice. Occupational and lifestyle vocal demands appear to be additional risk factors.

The various treatment options for benign vocal cord lesions are voice therapy, medical management and phono surgery. Surgery is the treatment option when conservative measures fail. With the advent of microlaryngeal surgery, it is possible to precisely remove lesions on the vocal cord without disrupting the delicate microarchitecture of the vocal cord. The accepted standard treatment for benign lesions is microlaryngeal surgery, coupled with adequate voice therapy.

The fundamental frequency of vocal fold vibration is typically more than 100 cycles per second, which is high compared with the ability of the retina to process individual images[2]. To assess the vibration pattern during phonation, it must be observed in slow motion and is the basis of stroboscopy[3]. A stroboscopic light source brightly illuminates the vocal folds across multiple vibratory cycles and a series of images are captured that highlight the vocal folds at successive phases of the cycle. Its working is based on Talbot's law[4] which states that flashing light shining on an oscillating moving object can freeze the motion. The stroboscopic examination was first performed by Oertel[3].

It has an important role in diagnostic, therapeutic, and surgical decisions[5, 6]. The examination technique provides good visibility and fine details about vocal cord vibratory cycles. Many authors have reported the importance of videostroboscopic examination in diagnosing vocal cord disorders[7]. This study was conducted to compare the video stroboscopic findings in benign vocal cord lesions before and after surgery and to assess the outcome of surgical excision by voice analysis and voice handicap index score.

2. Methodology

This prospective observational study was done for 18 months (From February 2021 to July 2022) in the Department of ENT, Government Medical College, Thiruvananthapuram

All patients with benign vocal cord lesions who underwent micro laryngeal surgery at Government Medical College, Thiruvananthapuram during the study period who were willing to participate were included in the study. Tracheostomised patients, with a history of neck or thyroid surgery and below 12 years of age were excluded from the study.

The procedure was explained to each patient and they were assessed by video stroboscopic examination using a standardized stroboscopic system, with a rigid 70 degree endoscope and the findings were noted.10% lignocaine spray was used to anesthetize the oropharynx and eliminate the gag reflex. Stroboscopic parameters like the amplitude of vibration, mucosal wave, symmetry, periodicity, and glottic closure pattern were studied.

PRAAT software, which is usually used to analyze speech was adopted in the study for voice analysis. The voice of each patient was recorded in a soundproof room with the microphone held 30 cm from the patient. Each subject was asked to phonate vowels at their modal tone at their comfortable intensity after a deep inspiration. It provides quantitative measures based on the voice signals[8]. The microphone acts as a transducer, converts the acoustic signal into an electric signal, and the amplified electric signal is recorded. The values for parameters such as fundamental frequency, jitter, shimmer, and harmonics - to - noise ratio were obtained. Maximum Phonation Duration (MPD) was also noted.

A Voice Handicap Index (VHI - 30) questionnaire was given to each patient to assess the patient's perception of voice

problems. A validated Voice Handicap Index (VHI) questionnaire developed by Jacobson et al was used[9].

After doing all necessary preoperative workups and getting fitness for anaesthesia, all patients were undergone microlaryngeal surgery under general anesthesia. Lesions were completely removed and sent for histopathological examination. Voice rest was advised for two weeks for all patients. Videostroboscopy and acoustic analysis were repeated at the post - operative review in the sixth week. The Voice Handicap Index (VHI) questionnaire was also re - administered on review and the scores were noted.

Statistical analysis

Data were entered in Microsoft Excel Sheet and SPSS version 25.0 further analysed the data. Categorical variables were expressed as proportions and quantitative variables as mean and standard deviations. Outcomes based on video stroboscopic findings were tested using the Wilcoxon Signed Rank Test. The outcomes based on acoustic analysis and the Voice Handicap Index were tested using a paired 't' test.

3. Results and Observations

A total of 46 patients with benign vocal cord lesions who had undergone microlaryngeal surgery at Government Medical College Thiruvananthapuram were included in the study. The majority of patients were males (69.6%) with a male - to - female ratio of 2.3: 1.

Age ranged between 12 to 76 years. The mean age of presentation was 48.2 years. The majority presented in their 6th decade of life (37%) (Table 1). There were no elite vocal performers in our study.26.1% of the patients were professional voice users, 34.8% were non - vocal professionals, and 39.1% were non - vocal non - professionals (Fig1).

Hoarseness was the most common presenting complaint in all the study subjects (100%) (Table 2). The next common complaint was vocal fatigue in 35 patients (76.1%). Other presenting complaints were foreign body sensation throat (13%), chronic dry cough of non - pulmonary origin (8.7%), breathing difficulty (2.2%), throat pain (2.2%), and odynophagia (2.2%).

The majority of the patients presented between 6 - 12 months of symptom onset (37%).21.7% of the patients presented between 3 - 6 months, 15.3% within 3 months, 13% of patients between 12 - 24 months, and another 13% of patients after 24 months.

The most common comorbidity in our patients was Diabetes mellitus in 18 patients (39.1%), followed by Hypertension in 10 patients (21.8%). Hypothyroidism was present in 9 patients (19.6%), Laryngopharyngeal reflux disease in 7 patients (15.2%), Allergy in 2 patients (4.3%), and a history of Pulmonary tuberculosis in 1 patient (2.2%).

In our study 47.8% (22 patients) were smokers and 43.5% (20 patients) were alcoholics. No other addictions were noted in the study subjects.

We found the following predisposing factors in our study (Table 3).

Out of 46 patients in our study, the majority had vocal cord polyps (63%), followed by vocal cord cysts (19.6%).8.7% of the patients presented with vocal cord keratosis, and 4.3% each had vocal cord granuloma and papilloma (Table 4).

22 patients had lesions on the right side (47.8%), 22 patients had lesions on the left side (47.8%) and 2 patients had bilateral lesions (4.3%).

The majority of lesions were at the junction of the anterior1/3rd and middle 1/3rd of the vocal cord (47.8%). The next common site was the middle 1/3rd (32.6%) of the vocal cords. Both anterior and middle 1/3rd was involved in 8.7% of patients, posterior 1/3rd in 6.5% and the entire length of the vocal cord was involved in 4.3%.

Vocal cord polyps were more commonly found at the junction of the anterior and middle 1/3rd while granulomas were found at posterior 1/3rd. Keratosis involves in anterior and middle 1/3rd of the vocal cord or its entire length equally.

On Stroboscopy symmetry was absent in all cases before and after surgery, it was present in (87%) and remained absent only in (13%). This was a statistically significant improvement. (*Wilcoxon* signed rank test: P<0.001)

Before surgery, amplitude was decreased in 89.1% and after surgery, amplitude became normal in 97.8% of cases which was also statistically significant.

Pre - operatively on the right side, mucosal wave was absent in 20.8% and decreased in 79.2%. Postoperatively, it came to normal at 91.7%. On the left vocal cord, mucosal wave was absent in 33.3% and decreased in 66.7%. Postoperatively, it turned to normal in 87.5% and these were also statistically significant (p - value was significant (<0.001).

Pre - operatively, 45 patients had incomplete glottic closure (97.8%) and only one had complete glottic closure. Postoperatively, in only 15 (32.6%) patients incomplete glottic closure persisted and 31 patients gained complete glottic closure (67.4%) and the P value was significant.

Maximum Phonation Duration (MPD) also showed statistically significant improvement. Before surgery, the mean MPD was 6.54 sec, which was improved to 15.09 sec post - operatively. The p - value was (<0.001).

On Acoustic analysis there is a statistically significant improvement in the intensity of speech, Maximum Phonation Duration (MPD), and harmonic - to - noise ratio (mean HNR) postoperatively. Pathological voice samples usually show a higher jitter and shimmer[8], in this study there is a statistically significant reduction in jitter and shimmer postoperatively which shows the good outcome of treatment.

The Voice Index Handicap (VHI score) showed improvement in the Functional, Emotional, and Physical domains. The mean score before surgery was 64.48 after surgery, the score

improved to 8.96 and was statistically significant (p - value <0.001). (Fig2)

4. Discussion

Videostroboscopy and acoustic analysis are new methods for diagnosing and deciding the management of vocal cord lesions. They detect the changes in vocal cords both visually and acoustically which can be compared pre - and post - operatively, and hence the effectiveness of the treatment can be assessed. Many authors have reported the importance of video stroboscopic examination in diagnosing vocal cord disorders[10].
The study aims to evaluate the stroboscopic findings before and after micro laryngeal surgery in benign lesions of the vocal cords and to find the subjective improvement in voice postoperatively using acoustic analysis and voice handicap index.

A total of 46 patients with benign lesions of vocal cords who underwent microlaryngeal surgery at Government Medical College Thiruvananthapuram during the study period were included in this study. There were 32 males (69.6%) and 14 females (30.4%) with a male - to - female ratio of 2.3: 1. Majority of the patients belonged to the age group of 51 - 60 years (37%) and the mean age was 48.2 years. The youngest patient studied was 12 years and the eldest was 76 years. Similar results were seen in a study by Banjara et al[10]. In their study, 61.6% of cases were males and 38.4% were females, with a male: female ratio of 1.5: 1. The age group most commonly affected was 21 to 30 years. But in a study by Woo et al[11], a female preponderance was seen.70% of the patients were females and only 15% were males. The mean age of the patients in his study was 45 years.26.1% of our study subjects were professional voice users including teachers, politicians, and vendors.34.8% were nonvocal professionals including shopkeepers and receptionists and 39.1% were nonvocal non - professionals including manual laborers and housewives. In a study by Upadhyay et al[1], also non - vocal professionals were the most affected and the incidence was maximum in housewives (32%) followed by laborers (15%). In the case of vocal professionals, teachers were the group commonly affected (13%) followed by vendors (11%).

All patients in our study presented with complaints of hoarseness. The next common symptom was vocal fatigue which was seen in 76.1%. Other presenting complaints were foreign body sensation throat (13%), chronic dry cough (8.7%), breathing difficulty (2.2%), throat pain (2.2%), and odynophagia (2.2%). In a study by Sasindran et al[12], change in voice or hoarseness was the common presenting complaint in 40 patients (100%).17.5% of patients presented with vocal fatigue, and 15% with cough and heartburn. These results are similar to the present study.

Most of the patients in our study presented between 6 - 12 months of symptom onset (37%). In a study by Woo et al[11], the majority of the patients (68.6%) presented within 1 year. In a study by Upadhyay et al[1], the most common predisposing factor was voice abuse (84.8%) similar to this study.

The major pathological conditions we observed were vocal cord polyps (63%) followed by vocal cord cysts (19.6%). It was similar to a study by Jensen et al[13], in which out of 97 patients 63 had vocal cord polyps (64.9%) and 17 had vocal cord cysts (17.5%). In their study 12 vocal cord nodule cases and 5 Reinke's oedema cases that underwent phono surgery were included. In this study, no vocal cord nodule or oedema cases were included as all of these cases were successfully treated by conservative measures during the study period.

Out of 46 patients in our study, right and left vocal cords were equally affected with 47.8% each and 2 vocal cord polyp cases had bilateral cord involvement (4.3%). In a study by Thomas G et al[14], 22 patients had a unilateral lesion (15 on the right cord and 7 on the left) and 8 patients had bilateral lesions.

The most common site of the vocal cord affected in our study was the junction between the anterior and middle 1/3rd (47.8%) which corresponds to the area of maximum vibration during phonation followed by the middle 1/3rd of the vocal cord (32.6%). Both anterior and middle 1/3rd were affected in 8.7% of cases. Polyps and cysts were seen most commonly at the junction of anterior and middle 1/3rd of the vocal cords while granulomas were seen in the posterior 1/3rd.

In this study on video stroboscopic examination symmetry between two vocal cords was absent in all cases before surgery. After surgery, 87% of cases gained statistically significant symmetry. In a study by Thomas G et al[14], symmetry of the vocal cord was present in 6.6% of cases preoperatively which improved to 86.66% after surgery which was also statistically significant.

In our study, amplitude was decreased in 89.1% of cases pre - operatively. After surgery, amplitude became normal at 97.8%. In a study by Sasindran et al[12], a pre - operatively decrease in amplitude was noticed in 70% of cases, and post - operatively normal amplitude was achieved in 87.5% of cases which was statistically significant.

Movement of the mucosal wave was rated separately for each vocal fold in our study, Patients with vocal cord cysts showed absent mucosal waves in all cases and decreased mucosal waves in polyps. Keratosis, granuloma, and papilloma had decreased or absent mucosal waves on the involved segment. Postoperatively, there was a significant improvement in the mucosal wave in all these lesions. Statistically significant improvement in the mucosal wave was also noted in studies by Thomas G. et al[14] and Sasindran et al[12]. Shohet et al[15] showed that mucosal wave was the important parameter in differentiating vocal cord cysts from polyps. They found that mucosal wave was always decreased or absent in vocal cord cysts and is present in polyps. This can be explained by ''Hirano's body cover'' theory[16]. According to this theory, an increase in the elastic constant of the body (vocalis muscle contraction) or the cover (fibrotic or carcinomatous lesion) causes a decrease in mucosal wave. Polyps and nodules have an oedematous submucosa than cysts and are likely to have an intact or increased mucosal wave. In cysts, there will be a degree of fibrosis in the surrounding tissue and therefore decreased or absent mucosal wave.

Periodicity reflects the regularity of the vibration of the vocal folds. It was absent preoperatively in the majority of cases

(89.1%) in our study. After surgery, periodicity was present in 93.5% of cases with a significant p - value. A similar improvement in periodicity was also noted in a study by Woo et al[11].

In our study, 45 patients had incomplete glottic closure (97.8%) and only one patient had complete glottic closure pre - operatively. Postoperatively this was improved and 67.4% of patients achieved complete glottic closure. Similar findings were found in a study by Thomas G. et al[14] the glottic closure which was incomplete in all the study subjects was improved to complete closure in 96.66% of cases post - operatively.

In the present study, the mean MPD before surgery was 6.54 sec, and postoperatively, it improved to 15.09 sec and this improvement was statistically significant. A study by Zeitels et al[17], showed an improvement in the mean MPD after surgery (20.1 seconds from 16.7 seconds) but was not statistically significant.

Fundamental frequency is a measure of the rate of vibration of the vocal folds. In the study, a statistically significant improvement in the frequency with p - value < 0.001 is observed postoperatively. A study by Janani et al[18], also showed a statistically significant improvement in fundamental frequency but there was no remarkable change noted in the fundamental frequency after surgery by Thomas G. et al[45].

In the study, there is a statistically significant improvement in the intensity of speech after the surgery with a p - value <0.001.

Jitter is due to the instability of the cord during vibration and correlates with the periodicity of vocal fold vibration. A Jitter of 1.040% is the threshold for pathology in PRAAT software. In our study, preoperatively the mean jitter values were above this level and there was a significant reduction in jitter postoperatively. Studies by Thomas G. et al[14], and Jensen et al[13], also showed signification reductions in the post - operative values.

Shimmer or amplitude perturbation refers to the small cycle - to - cycle changes in the amplitude of the voice signal. In this study, there was a statistically significant improvement in the shimmer post - operatively. In the study by Jensen et al[13], shimmer improved postoperatively and was again statistically significant.

The harmonics - to - noise ratio is the mean intensity of an average noise - free waveform divided by the mean intensity of the isolated noise component for the series of waveforms in the voice. The greater the noise, the lower the HNR. It is expressed in decibels (dB). Normal voice has a low level of noise. In our study, there is an improvement in the harmonic - to - noise ratio post - operatively which is statistically significant. A study by Thomas G. et al[14], also showed an improvement in the harmonic - to - noise ratio after surgery but was not statistically significant.

The Voice handicap index (VHI) data represent the patient's perception of the voice problem in daily life about the emotional, functional, and physical activities. In the study, VHI showed a significant reduction in the total scores as well as in subscales, between the pre and post - treatment groups. The mean pre - operative total VHI score was 64.48 which was decreased to 8.96 postoperatively. Patients were affected more in the physical domain. The severity rating of the voice handicap index is 0 - 30 as a minimal handicap, 31 - 60 as a moderate handicap, and more than 60 as a significant handicap. According to this classification, there were 30 patients with severe handicaps and 16 patients with moderate handicaps in our study pre - operatively. After surgery, all of them improved to minimal handicap. In a study by Sasindran et al[12], the mean pre and post - operative total VHI scores were 48.5 and 24.6 respectively. There was significant improvement in total scores as well as in subscales.6 cases in their study showed no improvement following surgery and they explained probable causes as age, posterior laryngitis, smoking, and muscle tension dysphonia.

5. Conclusion

The study demonstrates that micro laryngeal surgery significantly improves the stroboscopic parameters, voice analysis, and voice handicap index in patients with benign vocal cord lesions. These findings underscore the effectiveness of surgical intervention in restoring vocal function and improving the quality of life for affected patients.

Tables and Charts

Age Distribution

Table 1: Distribution of sample according to age

Age in years	Frequency	Percentage
12 - 20	2	4.3
21 - 30	3	6.5
31 - 40	9	19.6
41 - 50	6	13
51 - 60	17	37
61 - 70	8	17.4
71 - 80	1	2.2
Total	46	100

Table 2: Distribution of sample according to symptoms

Symptom	Frequency	Percentage
Hoarseness	46	100
Vocal fatigue	35	76.1
Foreign body sensation throat	6	13
Dry cough	4	8.7
Breathing difficulty	1	2.2
Throat pain	1	2.2
Odynophagia	1	2.2

Table 3: Distribution of sample according to predisposing factors

Predisposing factors	Frequency	Percentage
Voice abuse	39	84.8
Smoking	22	42.8
Alcoholism	20	43.5
Hypothyroidism	9	19.6
LPRD	7	15.2
Allergy	2	4.3

Table 4: Distribution of sample according to type of lesion

Type of lesion	Frequency	Percentage
Polyp	29	63
Cyst	9	19.6
Keratosis	4	8.7
Granuloma	2	4.3
Papilloma	2	4.3
Total	46	100

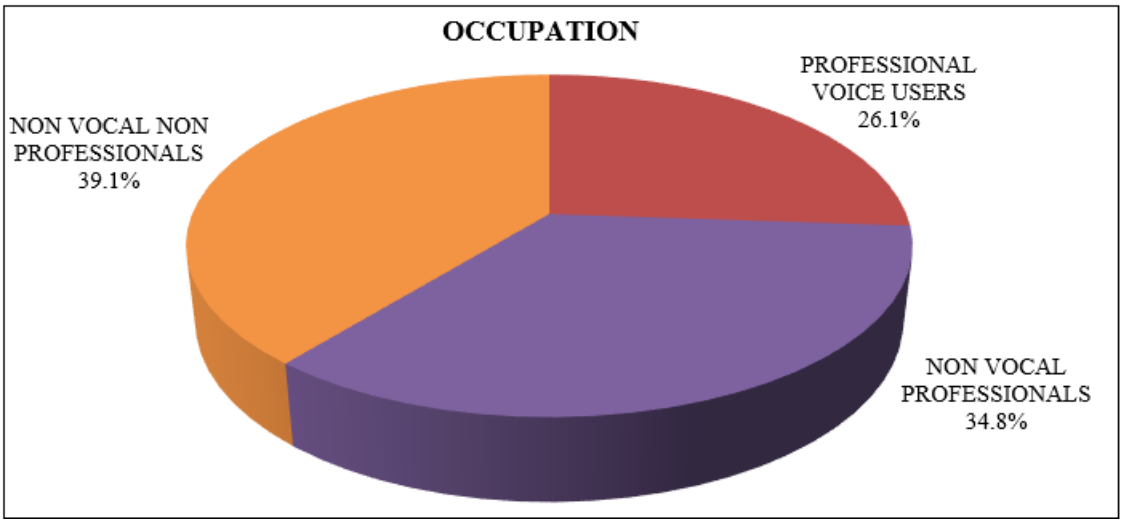

Figure 1: Distribution of sample according to occupation

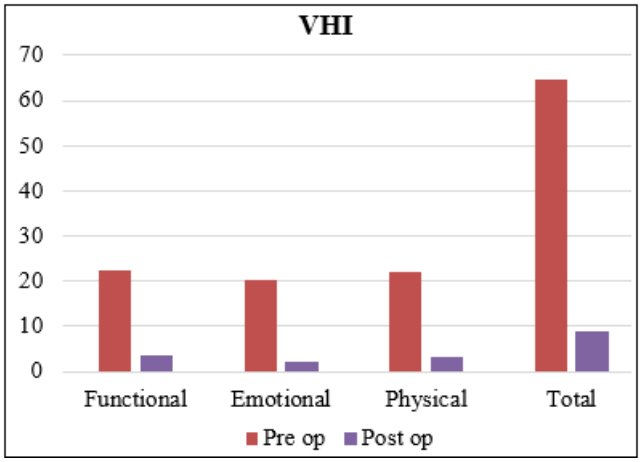

Figure 2: Comparison of pre - operative and post - operative VHI scores

References

[1] Upadhyay A, Zaidi AK, Mundra RK. A Comprehensive Analysis of Benign Vocal Fold Lesions Causing Hoarseness of Voice and Our Experience with Cold Knife Endolaryngeal Surgery in a Tertiary Healthcare Centre. Indian J Otolaryngol Head Neck Surg.2019 Oct; 71 (Suppl 1): 515–21.

[2] Scott - Brown's Otorhinolaryngology and Head and Neck Surgery, Eighth Edition Volume 3: Head and Neck Surgery, Plastic Surgery - PDF Drive [Internet]. [cited 2023 Jan 1]. Available from: https: //www.pdfdrive. com/scott - browns - otorhinolaryngology - and - h ead - and - neck - surgery - eighth - edition - volume - 3 - head - and - neck - surgery - plastic - surgery - e176218246. html

[3] Sneha D Rajput, Mittal J Poriya. Stroboscopy: an evolving tool for voice analysis in vocal cord pathologies International Journal of Otorhinolaryngology and Head and neck surgery 2017 October 3 (4) 927 - 93

[4] Mehta DD, Deliyski DD, Hillman RE. Why laryngeal stroboscopy really works: Clarifying misconceptions surrounding Talbot's law and the persistence of vision. J Speech Lang Hear Res JSLHR.2010 Oct; 53 (5): 1263–7.

[5] Mehta DD, Hillman RE. Current role of Stroboscopy in laryngeal imaging. Curr Opin Otolaryngol Head Neck Surg.2012 Dec; 20 (6): 429–36.

[6] Woo P, Colton R, Casper J, Brewer D. Diagnostic value of stroboscopic examination in hoarse patients. J Voice.1991 Jan; 5 (3): 231–8.

[7] E Y, Jr C, M S. Video laryngoscopy using a rigid telescope and video home system color camera. A useful office procedure. Ann Otol Rhinol Laryngol [Internet].1981 Aug [cited 2023 Jan 3]; 90 (4 Pt 1). Available from: https: //pubmed. ncbi. nlm. nih. gov/7271146/

[8] Julian A McGlashan. Evaluation of the voice Scott - Brown's Otorhinolaryngology and Head and Neck Surgery, Eighth Edition Volume 3: Head and Neck Surgery, Plastic Surgery (62) 925 - 938

[9] Rosen CA, Lee AS, Osborne J, Zullo T, Murry T. Development and Validation of the Voice Handicap Index - 10: The Laryngoscope.2004 Sep; 114 (9): 1549–56.

[10] Banjara H, Mungutwar V, Singh D, Gupta A, Singh S. Demographic and Videostroboscopic Assessment of Vocal Pathologies. Indian J Otolaryngol Head Neck Surg.2012 Jun; 64 (2): 150–7.

[11] Woo P, Casper J, Colton R, Brewer D. Aerodynamic and stroboscopic findings before and after microlaryngeal phonosurgery. J Voice.1994 Jun; 8 (2): 186–94.

[12] Sasindran V, Moosankutty S, Mathew N, George NS. Study of Pre and Post Operative Videostroboscopic Evaluation of Benign Vocal Cord Lesions. Indian J Otolaryngol Head Neck Surg.2019 Oct; 71 (Suppl 1): 333–40.
[13] Jensen JB, Rasmussen N. Phonosurgery of vocal fold polyps, cysts and nodules is beneficial.2013; Feb; 60 (2) A4577
[14] Thomas G, Mathews SS, Chrysolyte SB, Rupa V. Outcome analysis of benign vocal cord lesions by video stroboscopy, acoustic analysis and voice handicap index. Indian J Otolaryngol Head Neck Surg.2007 Dec; 59 (4): 336–40.
[15] Shohet JA, Courey MS, Scott MA, Ossoff RH. Value of Videostroboscopic Parameters in Differentiating True Vocal Fold Cysts From Polyps. The Laryngoscope.1996 Jan; 106 (1): 19–26.
[16] Vahabzadeh-Hagh AM, Zhang Z, Chhetri DK. Hirano's cover–body model and its unique laryngeal postures revisited. The Laryngoscope.2018 Jun; 128 (6): 1412–8.
[17] Zeitels SM, Hillman RE, Mauri M, Desloge R, Doyle PB. Phonomicrosurgery in Singers and Performing Artists: Treatment Outcomes, Management Theories, and Future Directions. Ann Otol Rhinol Laryngol.2002 Dec; 111 (12_suppl): 21–40.
[18] 220400218janani. pdf [Internet]. [cited 2023 Jan 2]. Available from: http: //repository - tnmgrmu. ac. in/8820/1/220400218janani. pdf