

## **Clinicoetiopathological Study of Benign Lesions of Vocal Cord and Its Management**

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**Conflicts of Interest:** Nil

### **Abstract**

**Background:** Chronic suppurative otitis media has been known to cause ossicular erosion that leads to moderate to severe hearing loss. Surgical treatment of CSOM involves exenteration of disease from the middle ear cleft, followed by reconstruction of hearing mechanism. Ossiculoplasty has been done earlier as a second stage operation after a gap of six months to one year for removal of disease from middle ear and mastoid which involves increased morbidity, hospitalization and increased cost. Hence, this study is undertaken to evaluate hearing results after single stage exenteration of disease and reconstruction of ossicular chain.

### **Objectives**

1. To study the clinical findings in tubotympanic and atticofacial types of CSOM.
2. To evaluate the hearing results of single stage ossiculoplasty in tympanoplasty by PTA and by graft take up.
3. To study the complications after surgery such as, hearing loss, facial palsy, recurrence, etc.

### **Methodology**

All patients diagnosed with CSOM (safe and unsafe type) with PTA of ABG >40 dB. Based on their intraoperative findings, all patients underwent tympanoplasty with intact canal wall/canal wall down mastoidectomy with ossiculoplasty and were followed up until 1 year

### **Results**

Out of 50 patients, 64% had safe type while 36% had unsafe disease. All patients had incus necrosis, followed by stapes suprastructure in 34% of patients and malleus necrosis in 12% of patients, with unsafe ears showing higher percentage of ossicular necrosis. Patients with intact stapes suprastructure, had 79% ABG <20dB as compared to absent stapes suprastructure where only 29% achieved ABG <20 dB which was statistically significant (p=0.00006). There was a significant difference in the hearing outcome (p=0.014) with regard to presence of malleus.

### **Conclusion**

Single stage ossiculoplasty does have a beneficial effect in terms of patient compliance and cost effectiveness, on patients undergoing tympanoplasty for CSOM, with

hearing results comparable to staged operations done worldwide.

### **Introduction**

Normal voice requires laryngeal function to be coordinated, efficient, and physiologically stable<sup>1</sup>. Benign lesions of vocal folds can be a cause of disturbance in balance of the laryngeal system and can cause an effect on leading to varying degrees of dysphonia. Recently benign larynx are becoming quite common because of increased environmental pollution due to rapid industrialization and development<sup>2</sup>.

Voice disorders can have a significant influence on vocational, social and the emotional adjustments of the patients<sup>2</sup>. These lesions are potential medical disorder.

The larynx is a major component of the upper respiratory tract and lies just anterior to the upper end of the digestive tract<sup>3</sup>. Various benign lesions of larynx are a cause of inflammation of the larynx. A lesion is said to be benign when its microscopic and gross characteristics are considered relatively silent implying that it will remain localized, will not spread to other sites, and will be amenable to local surgical removal<sup>3</sup>. The most commonly occurring benign lesions of the vocal folds are vocal cord nodules, vocal cord polyps, vocal cord cysts, reinkes edema.

The present study aims to understand the aetiology of benign vocal fold lesions and their management with a combination of speech therapy, conservative management and microlaryngeal surgery and analyzing the change in voice using the voice handicap index (VHI)<sup>4</sup>.

### **Materials and Methods**

The study was conducted on admitted patients in the Department of ENT, Vydehi Institute of Medical Sciences and Research Centre, Whitefield, Bangalore

**Sample size** - 120

### **Statistical Analysis**

The Statistical analysis was performed by STATA 11.2 (College Station TX USA). Patients Age distribution, gender distribution. Symptoms such of hoarseness of voice Foreign body sensation, Recurrent throat clearing, dry cough, LRPD, Allergic symptoms. Also habits such as smoking, alcohol consumption, other substance abuse, severity of the disease, type of lesion, position and side of the lesion were reported as frequency and percentages.

### **Descriptive Statistics**

Descriptive analysis of all the explanatory and outcome parameters was done using mean and standard deviation for quantitative variables, frequency and proportions for categorical variables.

### **Inferential Statistics**

Students paired t-test were used to find the pre and post comparison of functional, physical and emotional score and total score of the individual patients and these expressed as mean and standard deviation. The level of significance was set at  $P < 0.05$ .

### **Method of Collection of Data**

Detailed history was taken followed by complete ENT examination.

Patients with symptoms of hoarseness of voice; vocal fatigue and pain or discomfort on speaking; throat symptoms such as globus sensation ; dry cough were assessed using indirect laryngoscopic examination, diagnostic hematological, histopathological , radiological and 90<sup>0</sup> direct video laryngoscopic examination.

Patients with diagnosis of benign vocal fold lesions such as V.C polyp, V.C cyst, V.C nodule, V.C granuloma, V.C keratosis, V.C leukoplakia, laryngopharyngeal reflux disease and reinkes edema etc after the confirmation of diagnosis with 90 degree direct video laryngoscopy underwent microlaryngeal surgery.

On admission informed written consent was taken for all patients before surgery.

Surgery was done under general anesthesia in all cases after obtaining fitness for the same after complete work-up.

Intraoperative findings were noted and samples were sent for histopathological examination.

After surgery and speech therapy all cases were followed up for a minimum period of 3 months at an interval of one month and then three months, and at each visit patients were asked to fill the VHI questionnaire so as to assess the improvement in physical, functional, emotional and total scores before and after the treatment.

**Duration of study:** Prospective study from January 2017 to June 2018

**Results**

The results of the study conducted on 120 patients coming to E.N.T OPD coming to VIMS and RC were as follows.

Age Distribution Among Study Patients	
Number of cases	120
Mean	42.52
SD	11.36
Min - Max	21-70

Table 1: Age distribution amongst patients

**Observation:** Amongst 120 patients included in the study, the youngest patient was found to be 21 years and eldest 70 years; mean age being 42 years

	Number of Cases	Percentage
21-30	21	17.50%
31-40	37	30.83%
41-50	25	20.83%

51-60	33	27.50%
61-70	4	3.33%
Total	120	

Table 2: Age group distribution amongst study patients

**Observation:** 30.83% of patients were in the age group of 31-40 years; followed by 27.50% patients lying in the range of 51-60 years; and only 3 percent patients in the age group of 61-70 years.

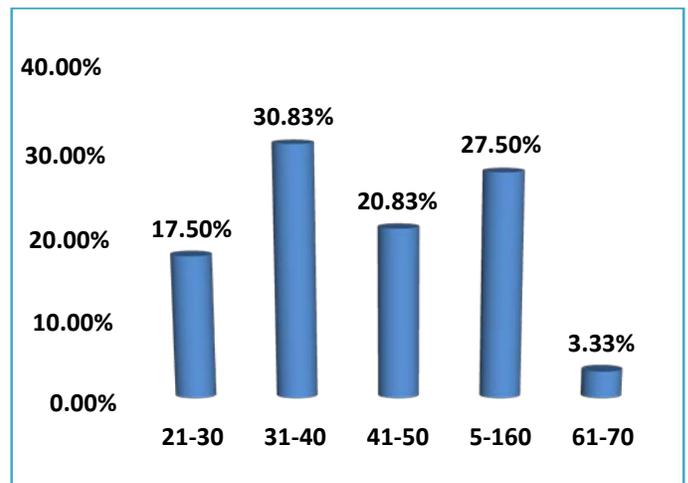


Figure 1: Bar Chart Representing Age Distribution Amongst Study Patient

Gender Distribution Among Study Patients		
	Number of Cases	Percentage
Male	95	79.17%
Female	25	20.83%
Total	120	

Table 3: Gender Distribution amongst Study Patients

**Observation:** Amongst 120 Study patients majority i.e 95 patients were male and 25 were female.



Figure 2: Pie chart depicting the Gender Distribution in the Study Patients

**Symptoms of Patients**

Symptoms Of Hoarseness Of Voice Amongst Study Patients		
	Number of Cases	Percentage
Yes	120	100%
No	0	
Total	120	

Table 4: Occurrence of hoarseness of voice amongst the study patients.

**Observation:** All the 120 Patients included in our study presented with hoarseness of voice

Foreign Body Sensation		
	Number of Cases	Percentage
Yes	76	63.33%
No	44	36.67%
Total	120	

Table 5: Occurrence of foreign body sensation amongst the study patients.

**Observation:** Amongst the 120 study patients 76 patients had symptoms of foreign body sensation in the throat.

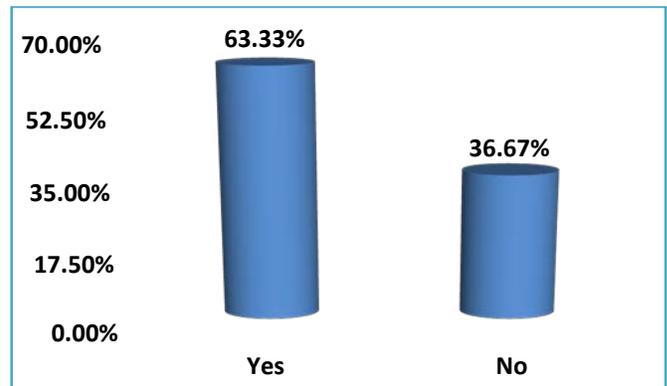


Figure 3: Graph representing occurrence of symptoms of foreign body sensation in the study patients

Recurrent Throat Clearing		
	Number of Cases	Percentage
Yes	59	49.17%
No	61	50.83%
Total	120	

Table 6: Occurrence of recurrent throat clearing amongst the study patients.

**Observation:** Amongst the 120 study patients 59 patients had symptoms of recurrent throat clearing amongst study patients.

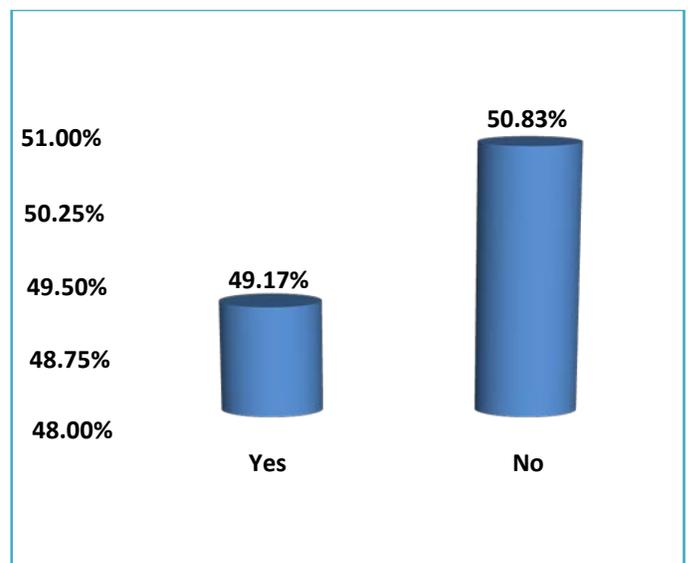


Figure 4: Graph representing occurrence of symptoms of recurrent throat clearing in the study patients.

Dry Cough		
	Number of Cases	Percentage
Yes	50	41.67%
No	70	58.33%
Total	120	

Table 7: Occurrence of symptom of dry cough amongst the study patients.

**Observation:** Amongst the 120 study patients 50 patients had symptoms of recurrent throat clearing ,while 70 patients i.e almost 58.3% patients didn't have this complaints.

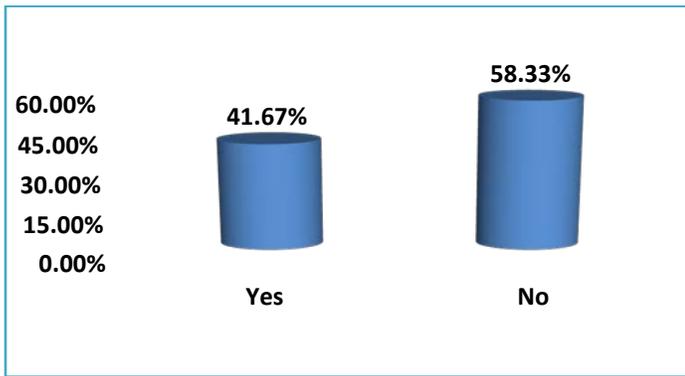


Figure 5: Graph representing occurrence of symptoms of dry cough amongst the study patients.

Laryngopharyngeal Reflux Symptoms		
	Number of Cases	Percentage
Yes	64	53.33%
No	55	46.67%
Total	120	

Table 8: Occurrence of symptoms of laryngopharyngeal reflux amongst the study patients.

**Observation:** Amongst the 120 study patients 64 patients i.e 53.33% had symptoms of laryngopharyngeal reflux .

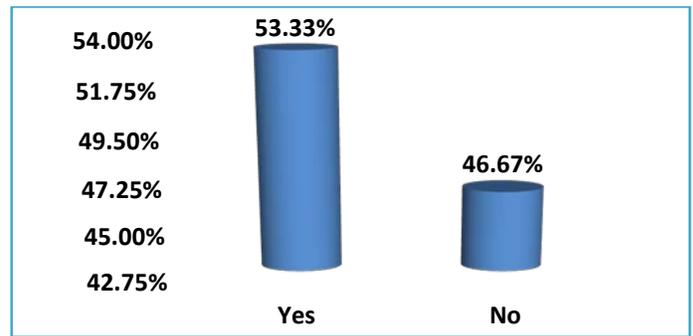


Figure 6: Graph representing occurrence of symptoms of laryngopharyngeal reflux amongst the study patients.

Occupation of The Study Patients

Occupation	Total Number of Patients	Percentage
Homemakers	14	12%
Businessman	13	11%
Policeman/Retired Policeman/Traffic Policeman/Security Guards	12	10%
Street Vendors/Hawkers/Salesman/Shop Owners	26	22%
Carpenters/Mason/Contractors/Cooks/Painters/Drivers/Electrician/Farmer/Bus Conductor	25	21%
Engineers	3	3%
Singers	11	9%
Teachers/Tuition Teachers/School Teachers	16	13%
Total	120	

Table 9 : Table representing the different occupations of the study patients.

Majority of the patients i.e 22% of the patients were street vendors/hawkers/ shopkeepers and salesman who gave history of screaming and shouting;followed by 16 patients i.e 13% patients who were teachers and almost 9% patients were singers who gave history of voice abuse.12% patients were homemakers who gave history of screaming and talking loudly at home with children. 11% patients were businessman who were self employed and had variety of business such as cloth sellers,merchants etc.with history of talking loudly. 10% patients were security guards/policeman/traffic policeman etc. who had to talk loudly or shout while at work.21% of patients were masons/painters/farmers/carpenters/drivers/bus conductors etc.

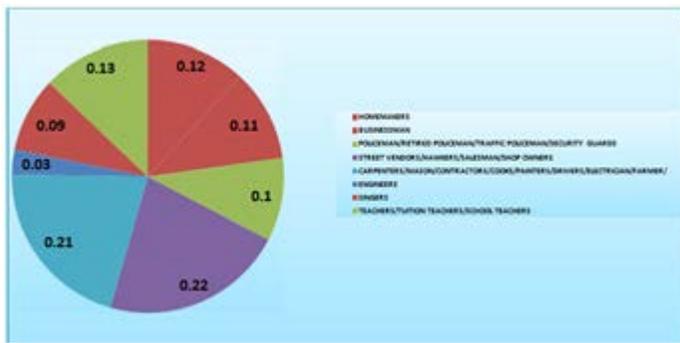


Figure 7: Bar Chart representing different occupations of the study patients.

**Personal Habits of Patients**

Smoking		
	Number of Cases	Percentage
Yes	50	50%
No	50	50%
Total	120	

Table 10: Table showing the number of smokers and non smokers amongst the study patients.

**Observation:** Almost 50% of the patients were smokers amongst the study patients.

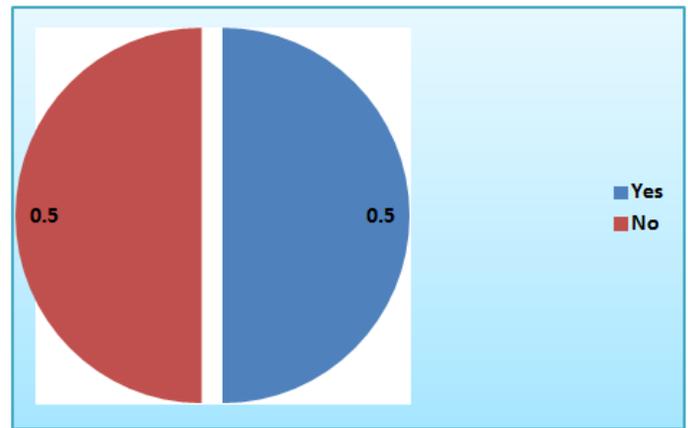


Figure 8: Pie chart representing the number of patients who were smokers amongst the study patients.

Alcohol Consumption		
	Number of Cases	Percentage
Yes	42	35%
No	78	65%
Total	120	

Table 11: Table depicting the number of patients with personal habits of alcohol consumption.

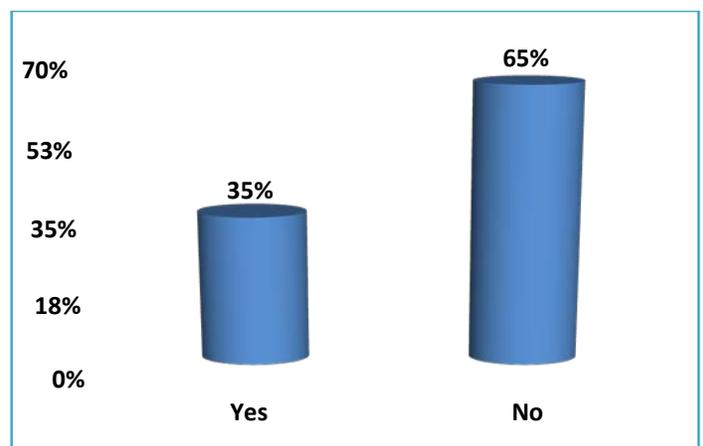


Figure 9: Graph representing the number of patients with habits of alcohol consumption amongst the study patients.

Other Substance Abuse		
	Number of Cases	Percentage
Yes	22	18.33%
No	98	81.67%
Total	120	

Table 12: Table depicting the number of patients with personal habits of other substance abuse.

**Observation:** 22 patients amongst the 120 study patients had habits of other substance abuse.

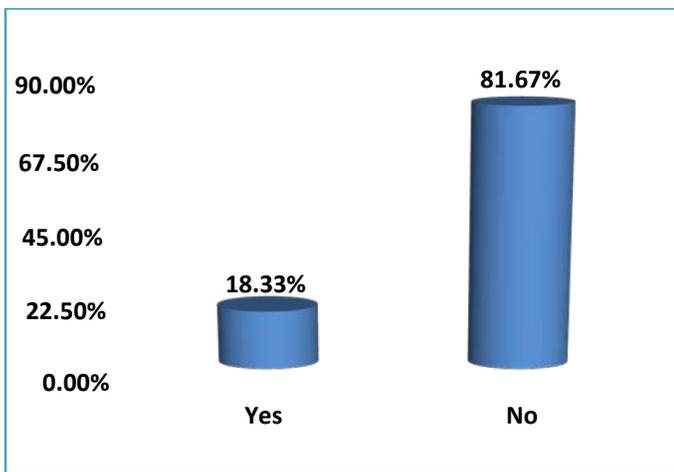


Figure 10: Graph depicting the number of patients with personal habits of other substance abuse.

Distribution of Different Type of Lesion, Position of Lesion and Side Occupied By the Lesion

Distribution of Type of Lesion		
	Number of Cases	Percentage
Vocal Cord Polyp	59	66%
Vocal Cord Cyst	7	8%
Vocal Cord Nodule	14	16%
Others	10	11%
Total	90	

Table 13: Table depicting the distribution of different types of benign vocal cord lesions amongst the 90 out of 120 patients.

**Observation:** Amongst the 120 patients included in the study,90 patients presented with benign vocal cord lesions such as vocal cord polyps, nodules, cysts and others such as vocal cord granuloma, vocal cord keratotic patch and leukoplakic patch. Majority of the patients i.e 66%,59 cases had vocal cord polyp and only 7 cases presented with vocal cord cysts,14 patients had vocal cord nodules and 10 patients presented with other lesions.

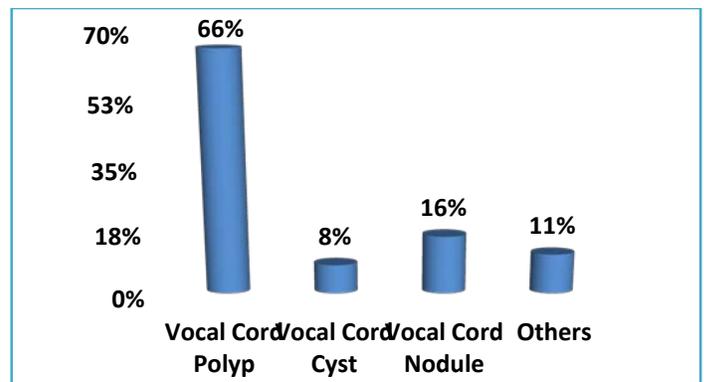


Figure 11: Graph depicting the distribution of different types of benign vocal cord lesions amongst the 90 out of 120 patients.

Position of Lesion		
	Number of Cases	Percentage
Anterior Third	43	47.78%
Middle Third	31	34.44%
Posterior Third	8	8.89%
Anterior Commisure	8	8.89%
Total	90	

Table no.14 - Table depicting the position of the different benign vocal cord lesions on the vocal cords amongst the 90 out of 120 patients.

**Observation :** Majority of the cases,43 out of the 90 cases the lesion was seen occupying the anterior one third of the vocal cord followed by 31 cases in which the lesions were seen occupying the middle third of the vocal cords. 8 cases each were seen occupying the posterior one third and the anterior commissure of vocal cords.

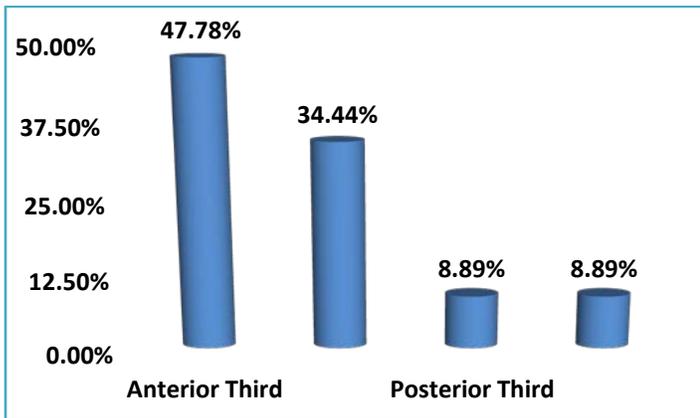


Figure 12: Graph depicting the position of the different benign vocal cord lesions on the vocal cords amongst the 90 out of 120 patients.

Vocal Cord Involved		
	Number of Cases	Percentage
Right	43	48.31%
Left	38	42.27%
Both	8	8.99%
Total	89	

Table 15: Table depicting the vocal cord involvement amongst the 90 out of 120 patients.

**Observation:** In majority of the cases i.e almost 43 cases right vocal cord involvement was seen followed by left

vocal cord involvement in 38 cases and 8 patients showing bilateral vocal cord involvement.

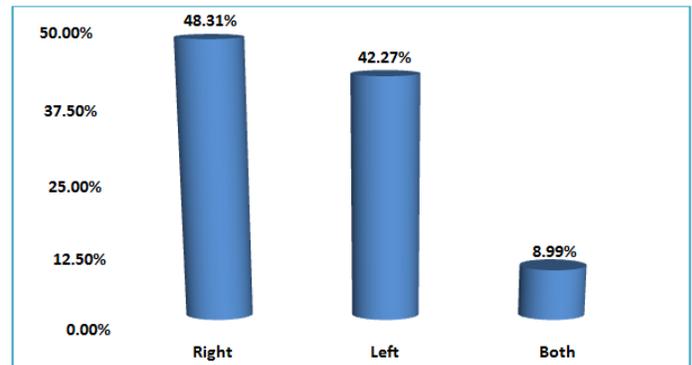


Figure 13: Graph depicting the vocal cord involvement amongst the 90 out of 120 patients.

**Improvement In Vhi Score**

Functional Component				
	Surgical		Conventional	
	Mean ± Sd	P-Value	Mean ± Sd	P-Value
Pre	17.21 ± 2.78		13.0 ± 2.90	
1 Month	14.64 ± 2.70	<0.001	11.77 ± 2.01	<0.001
3 Months	13.47 ± 2.18	<0.001	11.40 ± 1.45	<0.001

Table 16: Improvement in the functional component of the VHI score amongst the patients pre treatment and then at follow up visits at 1 month and 3 months.

**Observation:** There was a significant improvement in the functional component of the VHI scores of the study patients in both the groups; 90 patients were treated by microlaryngeal surgery followed by speech therapy included in the surgical group while 30 patients with laryngopharyngeal reflux disease and reinkes edema were treated conservatively and were included in the

conventional group. Significant improvement was seen in both the groups post microlaryngeal surgery and conservative management (speech therapy and vocal hygiene) when compared on the follow up visits at 1<sup>st</sup> month and 3<sup>rd</sup> month.



Figure 14: Graph depicting improvement in the functional component of the VHI score amongst the patients pre treatment and then at follow up visits at 1 month and 3 months.

Physical Component				
	Surgical		Conventional	
	Mean ± Sd	P-Value	Mean ± Sd	P-Value
Pre Surgery/Pre Treatment	16.98 ± 1.61		13.13 ± 2.33	
1 Month	13.44 ± 1.68	<0.001	11.67 ± 1.81	<0.001
3 Months	12.27 ± 1.51	<0.001	11.17 ± 1.29	<0.001

Table 17: Improvement in the physical component of the VHI score amongst the patients pre treatment and then at follow up visits at 1 month and 3 months.

**Observation:** There was a significant improvement in the physical component of the VHI scores of the study

patients in both the groups; 90 patients were treated by microlaryngeal surgery followed by speech therapy included in the surgical group while 30 patients with laryngopharyngeal reflux disease and reinkes edema were treated conservatively and were included in the conventional group. Significant improvement was seen in both the groups post microlaryngeal surgery and conservative management (speech therapy and vocal hygiene) when compared on the follow up visits at 1<sup>st</sup> month and 3<sup>rd</sup> month.



Figure 15: Graph depicting improvement in the physical component of the VHI score amongst the patients pre treatment and then at follow up visits at 1 month and 3 months.

Emotional Component				
	Surgical		Conventional	
	Mean ± Sd	P-Value	Mean ± Sd	P-Value
Pre Surgery/Pre Treatment	13.37 ± 2.48		10.33 ± 3.09	
1 Month	8.73 ± 2.11	<0.001	7.53 ± 1.46	<0.001
3 Months	7.34 ± 1.70	<0.001	6.27 ± 0.69	<0.001

Table 18: Improvement in the emotional component of the VHI score amongst the patients pre treatment and then at follow up visits at 1 month and 3 months.

**Observation:** There was a significant improvement in the emotional component of the VHI scores of the study patients in both the groups; 90 patients were treated by microlaryngeal surgery followed by speech therapy included in the surgical group while 30 patients with laryngopharyngeal reflux disease and reinkes edema were treated conservatively and were included in the conventional group. Significant improvement was seen in both the groups post microlaryngeal surgery and conservative management (speech therapy and vocal hygiene) when compared on the follow up visits at 1<sup>st</sup> month and 3<sup>rd</sup> month.



Figure 16 : Graph depicting improvement in the emotional component of the VHI score amongst the patients pre treatment and then at follow up visits at 1 month and 3 months.

Improvement In The Total Score				
	Surgical		Conventional	
	Mean ± SD	P-Value	Mean ± SD	P-Value
Pre	47.57 ± 6.24		36.47 ± 8.05	
1 Month	36.82 ±	<0.001	30.97 ± 4.58	<0.001

	5.41			
3 Months	33.08 ± 4.49	<0.001	28.83 ± 307	<0.001

Table 19: Improvement in the total scores of the VHI amongst the patients pre treatment and then at follow up visits at 1 month and 3 months.

**Observation:** There was a significant improvement in the total scores of the VHI scores of the study patients in both the groups; 90 patients were treated by microlaryngeal surgery followed by speech therapy included in the surgical group while 30 patients with laryngopharyngeal reflux disease and reinkes edema were treated conservatively and were included in the conventional group. Significant improvement was seen in both the groups post microlaryngeal surgery and conservative management (speech therapy and vocal hygiene) when compared on the follow up visits at 1<sup>st</sup> month and 3<sup>rd</sup> month.



Figure 17: Graph depicting improvement in the total scores of the VHI amongst the patients pre treatment and then at follow up visits at 1 month and 3 months.

### Discussion

Vocal cord lesions like vocal nodules, polyps and cysts though benign are significant because they disrupt the vocal fold vibratory function causing dysphonia. Precise MLS with efforts to preserve as much normal tissue as possible remains the surgery of choice for symptomatic

benign laryngeal mass lesion. In this study, an acceptable voice allowing the patient to perform a routine normal life is considered to be the cure.

Removal of lesion, restoring the vibratory function and optimizing the voice are the goals of treatment of benign vocal fold lesions. Ideally lesions not responsive to voice therapy / medical therapy have to be excised by microlaryngeal surgery. Objective and subjective assessment of the laryngeal functions before and after surgery help to evaluate the effectiveness of the treatment. Quantification of such results also helps to compare voice outcome using different phonosurgical technique In this study direct video laryngoscopy, detailed history, microlaryngeal surgery and VHI<sup>4</sup> scores were evaluated. The 120 patients with benign lesions of vocal folds, symptoms of LPRD were divided into two groups, out of which 90 patients having Vocal cord lesions like vocal nodules, polyps ,cysts, granuloma and 30 patients who had only LPRD and cases of REINKES EDEMA underwent microlaryngeal surgery followed by speech therapy and conservative management involving Proton Pump Inhibitor's, speech therapy, vocal hygiene respectively. VHI<sup>4</sup> scores were calculated prior to micro laryngeal surgery and conservative management and at 1 month and 3 months.

In our study, age of patients with benign laryngeal lesions ranged from 21 to 70 years with majority of patients ranging from 31 to 40 years. There was male predominance 95 male (79.17%) patients which were comparable to the results of Wani et al<sup>79</sup>. All the patients included in the study had history of hoarseness of voice. Parikh NP noted that 100 % cases in their study were presented with hoarseness<sup>80</sup>. Singhal et al<sup>81</sup>, Baitha et al<sup>82</sup> and Hegade et al<sup>83</sup> in their study found that hoarseness was the most common complaint. Other symptoms that the patients presented with were foreign body sensation

seen in 63.33%, recurrent throat clearance which was seen in 49.17%, Dry cough which was seen in 41.67%, symptoms of LPR in 53.33% cases and allergic symptoms in 43.33%. Smoking which contributes to the erythema, edema and generalized inflammation of the vocal tract was noted in the 50 male patients while all the female patients were non-smokers. Habits of alcohol consumption was seen in 35% patients and 18.33% patients had habits of other substance abuse such as tobacco chewing, betel nut chewing etc.

Majority of the patients i.e 22% of the patients were street vendors/hawkers/ shopkeepers and salesman who gave history of screaming and shouting; followed by 16 patients i.e 13% patients who were teachers and almost 9% patients were singers who gave history of voice abuse. 12% patients were homemakers who gave history of screaming and talking loudly at home with children. 11% patients were businessman who were self employed and had variety of business such as cloth sellers, merchants etc. with history of talking loudly. 10% patients were security guards/policeman/traffic policeman etc. who had to talk loudly or shout while at work. 21% of patients were masons/painters/farmers/carpenters/drivers/bus conductors etc. In study by Chopra H., Kapoor M.<sup>84</sup> et al there were 25.37% patient were housewives; 10.45% patient were teacher, 12% patient were student and 5.9% patient were hawker while in study by Swapan Ghosh et al<sup>85</sup> housewives comprised major group of study with 29% of all patient followed by student (16%); teacher (6%) and singer (5%).

Vocal polyps were the most common benign lesion 66% followed by vocal cord nodule seen in 16% patients. In study conducted by Singhal et al<sup>81</sup> on 50 patients with benign laryngeal lesions vocal cord polyps were observed to be the commonest type of lesions.

Polyyps were most commonly seen at the anterior third of the vocal cords in 47.78% and most commonly seen occupying the right vocal cord 48.31%. In a similar study true vocal cords were found to be the most common site involved(86%) with right cord involvement being more common than left (20%)<sup>86</sup>.

Voice quality is the subjective and patient's assessment if dysphonia is important. The VHI<sup>4</sup> developed by Jacobson et al is a dysphonia specific quality of life questionnaire with good content validity and reliability. The VHI<sup>4</sup> score reflects the patient's perception of the problem in daily life with reference to the patient's emotional, functional and physical activities. It can be used in evaluating the effectiveness of specific voice treatment techniques.

In our study there was a decrease in the VHI total scores from 47.57 in the pre-operative status to 33.08 post-operative which was statistically significant. Each of the sub scales also showed a reduction in scores as functional 17.21 to 13.0, physical and emotional sub scales were statistically significant showing a reduction from 16.98 to 12.27 and 13.37 to 7.34 respectively. Routine voice users had significantly lower VHI scores than those with the high vocal demands.

The patients were categorized on the basis of different presentation of symptoms of hoarseness of voice, recurrent throat clearing, dry cough, LPRD, and VHI scores were calculated prior to and post treatment which signified statistically significant( $p < 0.01$ )

Overall the VHI<sup>4</sup> scores were low in patients with only LPRD complaints when compared to patients with benign vocal fold lesions and those with REINKES EDEMA.

Laryngeal pathologies present widespread causes and factors; correct diagnosis holds the key to treat the disorder. Benign pathology of larynx presents with various symptoms; in this study, the change of voice is seen as the

presenting symptom in all the cases, which means any sign or symptom of laryngeal pathology that point at potential laryngeal pathology. In the study done by Baitha et al.,<sup>87</sup> who observed cough in 30% and fever in 26.36% cases. As in our study, the other associated symptoms such as cough, breathlessness, dysphagia, throat pain, and fever were noticed in the study done by Parikh<sup>88</sup>.

In this study, all the patients were given speech therapy during the trial of conservative management and postoperative cases. The goals of voice therapy are to maximize vocal efficiency, thereby reducing the vibratory trauma that underlies and increases the masses. Precise MLS with efforts to preserve as much normal tissue as possible remains the surgery of choice for symptomatic benign laryngeal mass lesion. In this study, an acceptable voice allowing the patient to perform a routine normal life is considered to be the cure.

#### **Conclusion:**

This study "Clinicoetiopathological Study of Benign Lesions of Vocal Cord And Their Management" was conducted in 120 patients with Symptoms of hoarseness of voice, Foreign body sensation, Recurrent throat clearing, dry cough, LRPD, and Allergic symptoms who presented to the Department of ENT and Head & Neck Surgery at Vydehi Institute of Medical Sciences and Research Centre, Bangalore and the following conclusions were drawn:

1. All the patients included in the study had symptom of hoarseness of voice.
2. The patients with vocal abuse and more voice demand such as professional singers, hawkers, teachers, homemakers, businessman with history of increased voice use had a greater degree of handicap when compared to patients with less voice demand.

3. The VHI scores showed a greater degree of handicap in patients with benign vocal cord lesions when compared to patients with only LPRD symptoms
4. The VHI scores showed a greater degree of handicap in patients with personal habits of smoking and substance abuse when compared to other patients.
5. There was a male preponderance amongst the study patients.
6. Vocal cord polyp was found to be the most common benign vocal fold lesion.
7. The Voice handicap index, reflecting the patient's perception of the voice problems showed a significant decrease in scores, with functional, emotional, physical and total scores all showing statistically significant improvement post operatively and post speech therapy and medical management.

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