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# **Original Research Article**

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# Role of stroboscopy in evaluation of patients with vocal abnormalities

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## **ABSTRACT**

**Background:** Stroboscopy is an examination in which strobe light is combined with laryngoscopy, to visualize the vocal fold vibration. It makes use of the Talbot's law for visualizing the vibrating vocal fold having frequency of around 250 times per sec. This technique was used for studying voice abnormalities and evaluate related pathologies. The aim and objective was to evaluate patients with vocal abnormalities with the help of stroboscope and to study the mucosal wave pattern pre and post treatment of vocal cord pathologies.

**Methods:** A prospective observational study was conducted at a tertiary care facility in central India. 50 patients with vocal abnormalities for more than 2 weeks were subjected to stroboscopy. Written informed consent from eligible patients was obtained and they were evaluated by stroboscopy using Karl Storz stroboscope with 70 degree 8 mm telescope, model no.: 20140020032. A second follow up stroboscopy was done two months post treatment and the parameters were recorded.

**Results:** VC nodule was observed as the most common pathology followed by vocal polyp, carcinoma and chronic laryngitis. It was also observed that there was statistically significant difference (p<0.001) in pre and post treatment findings of different parameters of voice evaluated using stroboscopy.

**Conclusions:** Video stroboscopic evaluation proved to be a useful and reliable tool for evaluation and treatment of the patients with voice abnormalities as the changes in pre and post treatment voice parameters were found to be statistically significant.

Keywords: Voice abnormality, Stroboscopy, Vocal cord pathology, Mucosal wave pattern

### INTRODUCTION

Voice abnormality is one of the commonest problems faced by ENT surgeons. Laryngopharyngeal disorders are the main culprit for such voice changes. As larynx is a difficult organ to examine, regular developments were made to visualize this organ more appropriately, starting from Manuel Garcia in 1854 who started with a mirror guided autolaryngoscopy till stereoscopic magnified laryngoscopy, stroboscopy as well as flexible laryngoscopies.

Voice abnormality is defined as the variations in the voice features like pitch, loudness or quality, from the normal features for a particular age group, gender, geography and culture. A change in voice is considered a

disorder if an individual faces difficulty in day-to-day activities due to abnormality in voice. The major signs and symptoms of voice disorders are roughness, hoarseness, breathiness, aperiodicity, strained/strangled quality, asthenia, aphonia, phonation breaks.

Proper coordination among the voice production subsystems (respiratory, vibratory and resonating) controls the production of normal voice. Any disturbance in these subsystems or disturbance in the coordination of these subsystems can cause vocal abnormality and disorders. Based on these disturbance voice disorders can be classified as organic, functional and psychogenic.<sup>1</sup>

While examining patients with voice abnormalities using endoscopes, even though we get a real time assessment of the larynx, early lesions are difficult to appreciate.

Stroboscopy solved this problem as this enabled us to assess and document the vocal cord movement and vibration along with its real time assessment. The study of various parameters of this mucosal vibration enabled identification of early lesions and thus led to effective diagnosis of various vocal cord pathologies.

The scope of study was using the technique of videostroboscopy for evaluation of vocal cord pathologies and assessment of patients treated in the facility. Stroboscopy is an examination in which strobe light is combined with laryngoscopy, to visualize the vocal fold vibration. It makes use of the Talbot's law for visualizing the vibrating vocal fold having frequency of around 250 times per sec.

Video-stroboscopy measures the vocal fold vibrations while speaking and the parameters are recorded pre and post treatment. Strobe box has two types of light, a flashing xenon and a constant halogen for constant viewing. A microphone is used to detect the fundamental frequency of the vocal folds. The flashing strobe light creates an illusion that the cords are moving in slow motion, but it is actually a composite image, sampled from a variety of glottal cycles. This illusion helps to record the various stroboscopic parameters.<sup>2</sup>

The different stroboscopic parameters included in this study are defined as below.

Periodicity is the consistency of sequential glottic cycles.

Amplitude is the horizontal movement of the vocal fold from the median plane.

Mucosal wave is the independent horizontal movement of mucosa over vocal fold.

Symmetry is the evenness of vocal folds, that is, opening, closing, maximum lateral-medial excursion during the glottic cycle.

Glottal closure refers to the amount of closure between the vocal folds during the adducted phase of phonation.

Through this study, it was tried to evaluate the advantages of using stroboscopy as a diagnostic tool for evaluation of various vocal pathologies. This study also intended to check the statistical significance of various stroboscopic parameters in both the pre and post treatment stages to establish the validity of stroboscopy as a reliable tool in diagnosis of various vocal cord pathologies.

## Aims and objectives

The aims and objectives were evaluation of patients with vocal abnormalities with the help of stroboscope and to study the changes in the mucosal wave pattern pre and post treatment of vocal cord pathologies.

### **METHODS**

This was a prospective observational study carried out at department of otorhinolaryngology and head and neck surgery, Gandhi medical college and associated Hamidia hospital, Bhopal during January 2018 to June 2019. Patients who have vocal abnormalities, coming to our OPD were assessed.

### Inclusion criteria

Patients with voice changes for more than 2 weeks were included in the study.

### Exclusion criteria

Patients with acute conditions of larynx and pharynx; patients with cardio-pulmonary disease; pregnant and lactating mother and children below 15 years and adults above 70 years were excluded from the study.

# Sample size

50 patients were included according to the inclusion criteria and were subjected to stroboscopic evaluation.

Patients (50) with vocal abnormalities for more than two weeks were subjected to stroboscopy. The patients who fulfilled the inclusion criteria were enrolled in the study. Written informed consent from eligible patients was obtained and they were evaluated by stroboscopy using Karl Storz stroboscope with 70 degree 8 mm telescope, model no.: 20140020032. A second follow up stroboscopy was done two months post treatment and the parameters were recorded.

# Different parameters and variables

Demographic parameters were age and sex. The parameters assessed using strobe were periodicity, amplitude, symmetry, mucosal wave and glottic closure. The other parameters were occupation and exposure to risk factors.

## Investigation

X-ray soft tissue neck, hormonal test/thyroid function test, CT larynx and chest along with other routine blood investigations were also performed wherever required.

# Statistical analysis

All the data analysis was performed using IBM SPSS ver. 20 software. Quantitative data was expressed as mean and standard deviation and categorical data was expressed as percentage. Frequency distribution and cross tabulation was used to prepare table. Independent sample t test, paired test was used to compare the mean whereas Chi square test was used to compare the percentage. Level of significance was assessed at 5%.

#### RESULTS

Voice abnormalities were found to be more prevalent among patients with age of 15-30 years (52%), followed by 31-45 years (30%). Comparing vocal cord pathology with the age of patients we found that VC nodule, VC polyp, pseudosulcus vocalis, Reinke's oedema were more prevalent in young working age group (15-45 years). Carcinoma was more common in patients with older age (46-60 years of age; 66.7%), chronic laryngitis were more common in patients with age between 15-30 years (83.3%), leukoplakia in 31-45 years (100%) and papilloma was equally distributed in age group between 15-30 and 31-45 years.

In the study it was observed that the most common risk factors for vocal abnormalities was voice abuse (62%) followed by smoking (44%), LPRD (30%) and alcohol (22%). Figure 2 shows the detailed graphical comparison between vocal cord pathology and risk factors.

Out of the 50 total patients considered in this study, only 36 patients were treated in our facility and followed up after 2 months post treatment. It was observed that out of the 36 patients, 13 (36%) patients underwent surgical treatment and 23 (64%) underwent medical treatment.

In vocal cord pathologies like VC polyp, cyst and papilloma, surgical treatment was given, which included micro laryngeal surgery, followed by speech therapy after 2 weeks and necessary lifestyle modifications and voice rest as per the patient's risk factors. Whereas, in pathologies like VC nodule, Reinke's oedema, pseudosulcus vocalis, chronic laryngitis and dysphonia plica ventricularis, medical treatment was given, which included anti reflux medications, steroids, antibiotics wherever necessary along with speech therapy, lifestyle modifications and voice rest individualized as per the patient history. Figure 1 shows the pre and post treatment stroboscopic images in a vocal cord polyp patient.

Table 1: Pre and post treatment comparison (n=36).

Variables		Pre	Post	P value	
variables		N (%)	N (%)	1 value	
S	Symmetric	4 (10.3)	35 (89.7)	<0.001	
Symmetry	Asymmetric	32 (97)	1 (3)	<0.001	
Amplitude	Decreased	23 (82.1)	5 (17.9)	<0.001	
	Normal	13 (29.5)	31 (70.5)	<0.001	
D	Periodic	9 (21.4)	33 (78.6)	<0.001	
Periodicity	Aperiodic	27 (90)	3 (10)	<0.001	
Mucosal wave	Present	2 (5.7)	33 (94.3)		
	Absent	10 (100)	0 (0)	< 0.001	
	Reduced	24 (88.9)	3 (11.1)		
Glottic closure	Present	8 (19)	34 (81)	<0.001	
Giottic ciosure	Absent	28 (93.3)	2 (6.7)	<0.001	

Table 2: Most common vocal cord pathology.

Ctudu	VC lesions					
Study	VC nodule (%)	VC polyp (%)	Papilloma (%)			
George et al (2007) <sup>5</sup>	17	64				
Fritzel et al (2012) <sup>4</sup>	51	-	-			
Shin et al (2013) <sup>6</sup>	20	59	-			
<b>Rajput et al</b> (2015) <sup>3</sup>	21		4			
Nimkar et al (2019) <sup>7</sup>	26	10	-			
Present study	18	14	4			

Table 3: Common risk factors.

C4 J	Risk factors						
Study	Smoking (%)	Alcohol (%)	Voice abuse (%)	LPRD (%)			
George et al (2007) <sup>5</sup>	27	-	66	-			
Fritzel et al (2012) <sup>4</sup>	25.33	-	-	-			
Danasekaran VS (2013) <sup>8</sup>	56	37	31	-			
Sindhu Pal et al (2013) <sup>9</sup>	33	22	17	-			
<b>Rajput et al (2015)</b> <sup>3</sup>	34	32	-	-			
Present study	44	22	62	30			

Table 4: Comparing stroboscopic parameters pre and post treatment.

	Stro	Stroboscopic parameters								
Study	Sym	Symmetric Normal amplitude		le	Periodic		Presence of mucosal wave		Complete glottic closure	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
George et al <sup>5</sup>	2	26	-	-	-	-	17	27	0	29
Rajput et al <sup>3</sup>	2	49	4	50	29	50	20	47	-	-
Present study	4	35	13	31	9	33	2	33	8	34





Figure 1: Vocal cord polyp before and after excision (a) pre op; (b) post op.

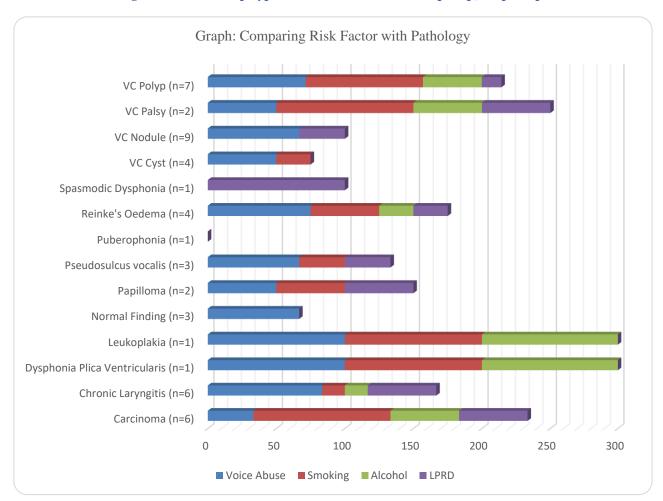


Figure 2: Comparing risk factor with pathology.

While evaluating stroboscopic parameters post treatment, as detailed in Table 1, we found that majority of the patients had symmetric vocal cord (89.7%), normal amplitude (70.5%), periodic vocal cord movements (78.6%), presence of mucosal wave (94.3%) and complete glottic closure (81%), showing a considerable improvement from their pretreatment findings, with significant p values.

### DISCUSSION

## Vocal cord pathology distribution

VC nodule (18%), VC polyp (14%) followed by carcinoma (12%) and chronic laryngitis (12%) emerged as the most common vocal cord pathologies. Similar findings were revealed by the study done by Rajput et al where diagnostic analysis was carried out and it was found that the majority of the patients (21%) were suffering from nodule and only 4% of the patients were found to be suffering from papilloma, which was comparable with the present study findings.<sup>3</sup> Fritzel et al noticed predominance of vocal fold nodules (38%) which was followed by cysts and sulci.<sup>4</sup> The results implied that vocal fold nodules were the most frequent pathology with voice disorders, followed by vocal fold polyp which was further substantiated by findings in previous studies as tabulated in Table 2.

The present study indicated the trend of vocal cord pathologies with the age of patients. VC nodule, VC polyp, pseudosulcus vocalis, Reinke's oedema were found more prevalent in young age group (15-45 years). Carcinoma was found more common in patients with older age (46-60 years of age; 66.7%), chronic laryngitis were more common in patients with age between 15-30 years (83.3%), leukoplakia in 31-45 years (100%) and papilloma was equally distributed in age group between 15-30 and 31-45 years. This was in partial agreement with another study by Nimkar et al 2019 which showed that nodules were common in age group of 31-40 (46.15%) and polyps were common in the age group of 51-60.7

In present study the common risk factors for vocal abnormalities were voice abuse (62%) followed by smoking (44%), LPRD (30%) and alcohol (22%). Among them we found that smoking (p=0.003) was a highly significant risk factor. Voice abuse (p=0.036), alcohol (p=0.043) and LPRD (p=0.032) were also significant risk factors for predicting vocal abnormalities in present study cohort.

The same was substantiated by the similar study results showing percentage of smokers among patients as shown in Table 3.

# Pre-treatment stroboscopic analysis

The study showed that 48% of the patients with voice complaint were having asymmetricity, decreased

amplitude, aperiodicity and absent mucosal wave in the pre-treatment phase. This was comparable with the study of Rajput et al where preoperatively 50% of the patients were having asymmetricity, decreased amplitude, aperiodicity and absent mucosal wave during stroboscopic examination.<sup>3</sup> All five stroboscopic parameters were abnormal in different vocal cord pathologies while evaluated during pre-treatment. The significant p values of these parameters showed the reliability of stroboscopy as a diagnostic tool for vocal cord pathologies. This was in agreement with observations of Printza et al who evaluated the diagnostic relevance of stroboscopy in voice disorders related with benign pathology and applied results in evidence-based health care.<sup>10</sup>

## Post treatment stroboscopic analysis

On post treatment follow up and stroboscopic analysis after 2 months we found that majority of the patients had shown improvement in the parameters with statistically significant p value less than 0.001. The statistical significance observed in pre and post treatment stroboscopic parameters and it's agreement to the previous studies in this area draws a probable conclusion that stroboscopy is a reliable diagnostic tool for establishing voice disorders. Also, it was found efficient in managing the voice abnormalities and even in choice of treatments due to the agreement with pathologies in pre and post treatment phase.

The post treatment parameters showed symmetric vocal cord (89.7%), normal amplitude (70.5%), periodic vocal cord movements (78.6%), presence of mucosal wave (94.3%) and complete glottic closure (81%). These were comparable with findings of George et al 2007 where in the parameters where near to normal and statistically significant on post-operative follow up after 6 weeks (Table 4).<sup>5</sup>

The current results are also in agreement with a similar study by Rajput et al where there was statistically significant difference in the observations of periodicity and mucosal wave done preoperatively and postoperatively at 15 days and 2 months interval (Table 4).<sup>3</sup>

## Limitations

Cross-sectional nature and small sample size were the main limitations of the present study. A large randomized clinical trial was needed to strengthen the present study findings.

# **CONCLUSION**

Based on the present study, it was observed that voice abnormalities were more common in males between 15-30 years of age. VC nodule, VC polyp followed by carcinoma and chronic laryngitis were observed to be the most common pathologies. Stroboscopy enables precise

assessment of vocal cord lesions, thereby helping the surgeons to the plan the treatment accordingly. Statistically significant difference was observed in pre and post treatment findings of different voice parameters, evaluated using stroboscopy. It can also be used to assess the effectiveness of treatment chosen by comparing difference in the pre and post treatment recordings. Hence, the technique of videostroboscopy proves to be a practical and easy method of documentation of data and is a useful and reliable tool for evaluation of the patients with vocal cord pathologies.

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Institutional Ethics Committee

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