

Correlations between Videostroboscopy and Constant Light Examination with Intraoperative Findings and Histopathology—Our Experience

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Abstract

Objective: To assess the role of stroboscopy in the diagnosis of vocal cord lesions. **Study Design:** Prospective interventional study. **Setting:** Academic tertiary care medical centre. **Materials and Methods:** 50 patients with complaints of hoarseness of voice were clinically evaluated and diagnosis was made using Rigid Videolaryngoscopy, Flexible Videolaryngoscopy and Videostroboscopy. Patients underwent microlaryngeal surgery and a final diagnosis made with histopathological examination. The intra-operative findings and the final histopathological diagnosis were compared with the diagnosis made with rigid, flexible videolaryngoscopy and stroboscopy. **Results:** Intra-operative findings correlated with stroboscopic findings in 84% of patients, with fiberopticlaryngo-pharyngoscopic diagnosis in 54% of patients and with rigid video-laryngoscopy in 46% of patients. Videostroboscopy showed the highest diagnostic co-relation on histopathology (80%) as compared to rigid videostroboscopy (56%) and flexible videolaryngoscopy (58%). Videostroboscopy also elucidated vocal fold abnormalities that were missed on rigid or flexible laryngoscopic examinations. **Conclusion:** Videostroboscopy is a valuable complement to a thorough vocal history and physical examination. Videostroboscopy is superior to constant light laryngeal examination in diagnosis of vocal cord lesions.

Keywords

Stroboscopy, Video Laryngoscopy, Fiberopticlaryngo-Pharyngoscopy, Histology

1. Introduction

Voice is the output obtained from an extremely complex, multidimensional and varia-

ble physiological phenomenon [1]. Even a slight variation in the anatomy of the vocal chords can change the quality of voice, which commonly presents itself as “hoarseness of voice”. The evaluation of vocal fold anatomy, mucosa and gross movement can be performed while illuminating the vocal folds with a constant light source. But the evaluation of vocal fold vibration requires special imaging technology in order to “slow down” vibration for assessment. Currently, the most widely used technique for assessing the vibratory characteristics of the vocal folds is known as Videostroboscopy, which has turned into an accepted and essential component of the comprehensive evaluation of voice disorders. Stroboscopy plays a key role in the diagnosis of vocal cord pathology. Stroboscopic imaging of the vocal fold vibratory function during phonation continues to play a central role in diagnostic, therapeutic and surgical decisions during the management and treatment of voice disorders [2].

This study is aimed at analysing the role of stroboscopy in diagnosing vocal cord lesions and the advantages it offers over visualization of the larynx with a constant light source.

2. Aim and Objectives

To assess the usefulness of videostroboscopy in diagnosing vocal cord lesions.

To co-relate the clinical diagnosis provided by rigid, flexible videolaryngoscopy and videostroboscopy with intra-operative findings and a final histopathological diagnosis.

3. Material and Method

3.1. Study Design and Setting

This is a prospective Interventional study done at the ENT Department of Yashoda Hospital, Secunderabad, Telangana, India between August 2013 to August 2015. All patients above the age of 10 years who received treatment at our hospital by microlaryngeal surgery during the study period were included in this study. Children below the age of 10 years were excluded since the laminar structure of their vocal cords was not fully developed. Patients with vocal cord palsy or complete aphonia/dysphonia were also excluded since strobe effect cannot be produced in these patients. A total of 50 patients were enrolled.

3.2. Procedure

All Patients who came to our OPD with complaints of voice change, after being filtered through our inclusion and exclusion criterion, were considered.

A detailed history of all patients was taken including the onset of symptoms and their progression, aggravating or relieving factors like cold, cough, history of vocal abuse, diurnal variation, voice fatigue and other associated symptoms such as aspiration, gastro-oesophageal reflux and throat clearing. All patients were clinically examined in the OPD. Vocal cords were evaluated by:

- 1) 70° Videolaryngoscopy.

2) Flexible Videolaryngoscopy.

3) Videostroboscopy.

Videostroboscopic diagnosis was made on the basis of amplitude, mucosal waves, vibratory behaviour, symmetry, regularity and glottal closure.

After complete pre-operative evaluation, patients were taken up for micro-laryngeal surgery (MLS). In each case, the lesion was excised and sent for Routine Histopathology. The intra-operative findings and final histopathological diagnosis were then correlated with the rigid, flexible video laryngoscopic and video stroboscopic diagnosis. No blinding can be done in this study as it is an interventional procedure.

4. Results and Observation

A total of 50 patients with vocal cord lesions were evaluated and a clinical diagnosis was arrived at using rigid videolaryngoscopy (70°), flexible video-laryngoscopy and videostroboscopy. All of the patients underwent microlaryngeal surgery and a final diagnosis was made along with histopathological examination. The intra operative findings together with the final histopathological diagnosis were co-related with the clinical diagnosis made using rigid, flexible videolaryngoscopy and videostroboscopy through a simple percentage analysis.

4.1. Sex Distribution

Out of the 50 patients selected for study, 39 were male and 11 were female (Male: Female Ratio = 3.5:1).

4.2. Age Distribution

Figure 1 depicts age range among sample population. The age range varied between 12 to 82 years, with a mean age of 46.7 years. 14 patients were in the age range of 41 to 50 years.

4.3. Duration of Symptoms: Figure 2

26 cases presented themselves within 1 - 3 months of the onset of symptoms, with the minimum duration being 7 days and the maximum being 1 year post the onset of symptoms.

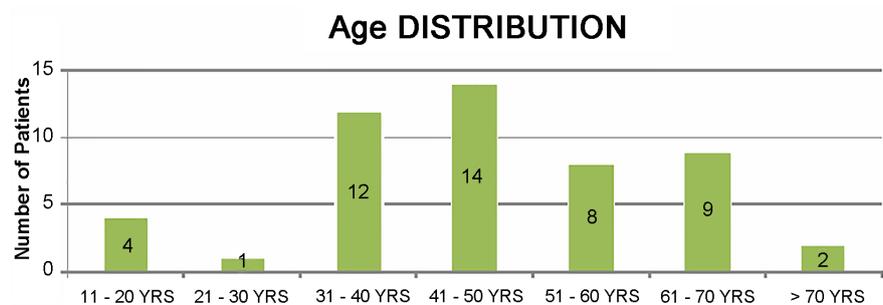


Figure 1. Depicting age range among sample population.

All patients presented the chief complaint of voice change. Most of them had associated symptoms as well such as throat pain, cough, frequent throat clearing, the sensation of foreign body presence in the throat, vocal fatigue, throat irritation etc.

4.4. Habit: Table 1

40 of the patients among those who presented these symptoms reported excessive speaking, mostly attributed to their profession or to an inherent habit. It was observed that laryngeal lesions were most common among excessive voice users such as school teachers/lecturers and businessmen/marketing executives. Occupational requirements forced these patients to make excessive use and abuse of their voices. Few among the patients were smokers, alcoholic, or both. Three of them reported the habit of tobacco or beetle nut chewing.

4.5. Symptoms: Figure 3

All patients presented voice change.

4.6. Occupation

Vocal abuse and implication in laryngeal lesion (Figure 4).

4.7. Rigid Laryngoscopic Diagnosis [70° Videoendoscopic Diagnosis]: Figure 5

On performing Videoendoscopy, it was deduced that 21 patients has right-side lesion, 15 had left-side lesion and 5 patients had bilateral lesion. In 9 patients, the lesion could

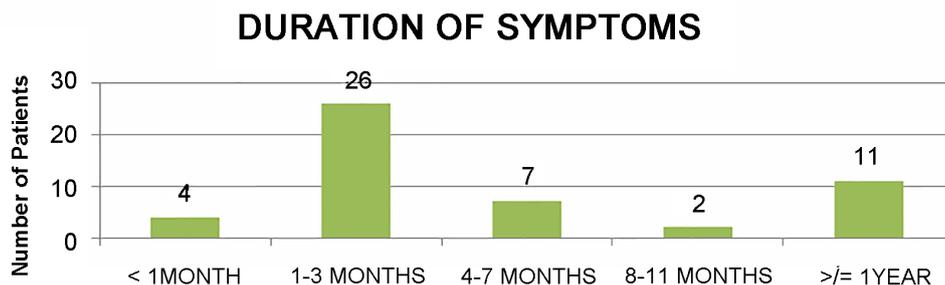


Figure 2. Time since the onset of symptoms.

Table 1. Depicting habits observed in the population with laryngeal lesions.

Habits	Number of patients
Smoking and tobacco chewing	1 (2%)
Smoking	2 (4%)
Alcoholism	6 (12%)
Smoking and alcoholism	3 (6%)
Tobacco chewing	3 (6%)

SYMPTOMS

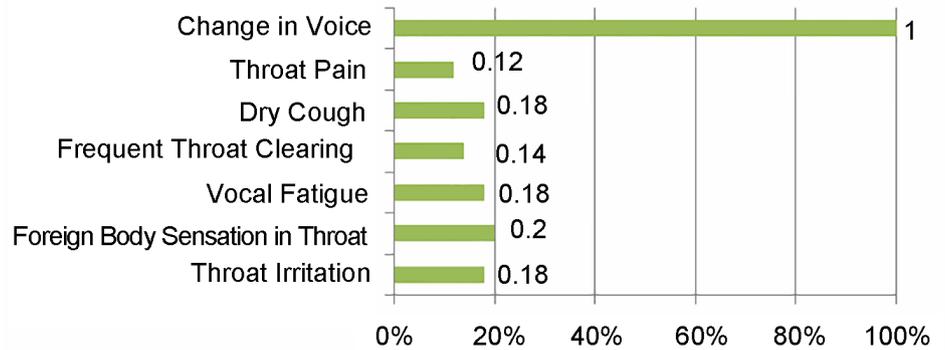


Figure 3. Symptoms.

VOCAL ABUSE AND OCCUPATION

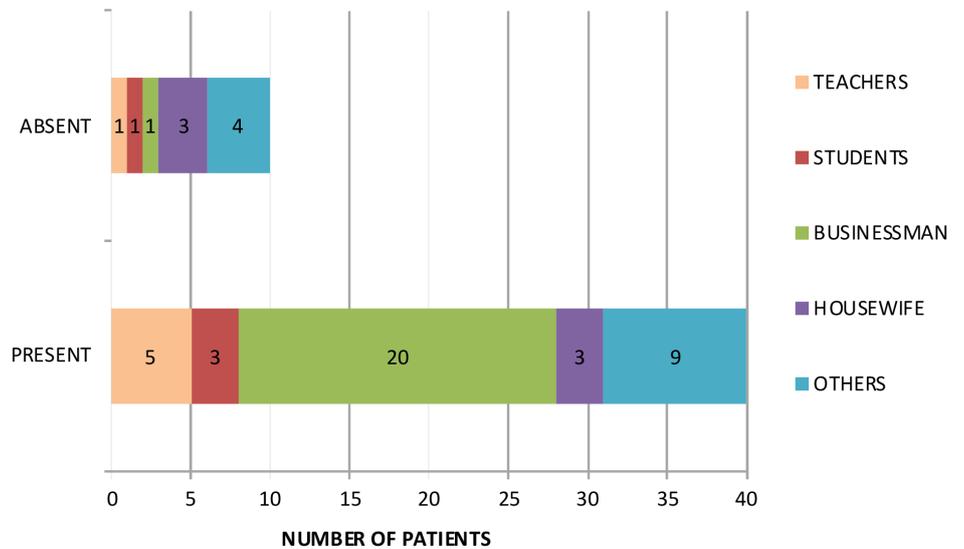


Figure 4. Relating vocal abuse and occupation.

RIGID VIDEO-LARYNGOSCOPY DIAGNOSIS

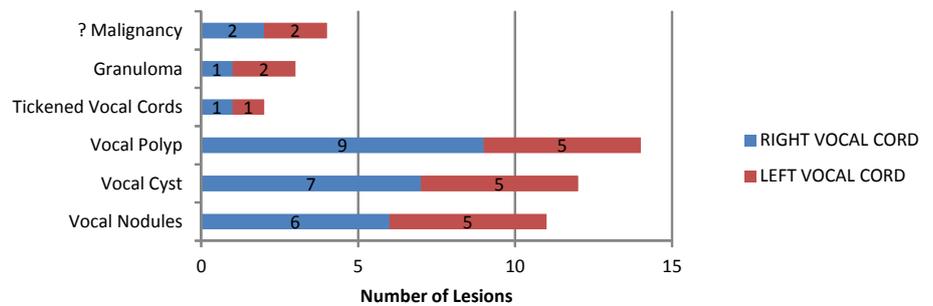


Figure 5. Table depicting diagnosis on rigid laryngoscope.

not be identified even with rigid videolaryngoscopy. Considering bilateral lesions to be two lesions, bilateral being 5 cases *i.e.* 10 lesions, 21 right and 15 left lesions, we are left with a total of 46 lesions which were identified using 70° rigid video-laryngoscopy.

The lesions were identified based on their size, shape and appearance. The most common one among them was found to be a vocal polyp. 4 of the cases were suspected of containing malignancy during rigid video-laryngoscopic examination. For 6 cases, the diagnosis was inconclusive *i.e.* the lesion could not be definitively categorized.

4.8. On Flexible Video Laryngoscopy: Figure 6

22 patients bore right, 17, left and 8 bore bilateral vocal cord lesions. Among 3 patients, the lesion could not be identified through flexible video-laryngoscopy. Considering bilateral lesions to be 2 lesions, with bilateral being 8 cases *i.e.* 16 lesions, 22 right and 17 left, we were left with a total of 55 lesions which were identified using flexible video-laryngoscopy. The lesions were identified based on their site, size, shape and appearance.

The most common lesion was found to be a vocal polyp. 6 cases were suspected of containing malignancy through flexible video-laryngoscopy. Two lesions that could not be identified on rigid video-laryngoscopy were identified through flexible video-laryngoscopy as keratosis of the right vocal cord and papilloma of the left vocal cord. Three patients who appeared to have unilateral lesions on rigid video-laryngoscopy were found to have bilateral lesions on flexible video-laryngoscopy. Another patient who was diagnosed with bilateral vocal nodules on video-endoscopy was found to have ulceration over the left vocal cord instead of a nodule on flexible video-laryngoscopy. In 2 cases, diagnosis remained inconclusive even after flexible video-laryngoscopy.

4.9. Video-Stroboscopic Examination Side of the Lesion: Figure 7

Stroboscopy revealed 22 lesions on the right side, 18 on the left and 11 bilateral lesions (a total of 62 lesions).

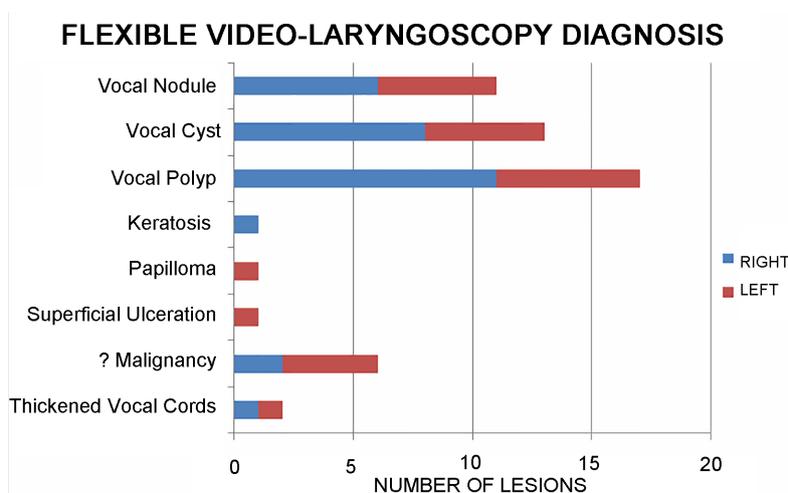


Figure 6. Table depicting diagnosis made on Flexible laryngoscopy.

A majority of the lesions (about 40 percent) were located at the junction formed by the anterior, middle and the middle 1/3 rd of the vocal cords. Other lesion sites included the anterior or the posterior half of the vocal cords, the anterior or middle 1/3 rd of the vocal cords and the posterior half of the vocal cords. Three lesions were located at the vocal process.

Glottal closure (**Table 2**): Irregular closure was seen in 10 cases (20 percent). Complete closure was witnessed only in granuloma of vocal processes. Hourglass closure was observed in 8 cases (16 percent) out of which, 2 had bilateral vocal nodules and 4 had bilateral benign lesions located at identical sites on both vocal cords. The different types of glottal configurations seen were as follows.

Mucosal waves: Out of the 62 lesions identified using stroboscopy, 11 percent showed complete absence of mucosal waves on the side of the lesion. This suggested malignancy. 4.8 percent showed reduced mucosal waves on the side of the lesion consisting of adynamic segments (non-vibrating areas of the vocal fold with no mucosal wave and poor amplitude of vibration), one among which was diagnosed as keratosis and two others suspected to be malignant owing to their appearance. Mucosal wave was intact in 54 percent of the lesions that mainly constituted vocal nodules and polyps. In about 17 percent, mucosal wave was reduced and was absent over the lesion which is characteristic of a vocal cyst. Mucosal wave was reduced on the side of the lesion in a total of 16 lesions (25 percent).

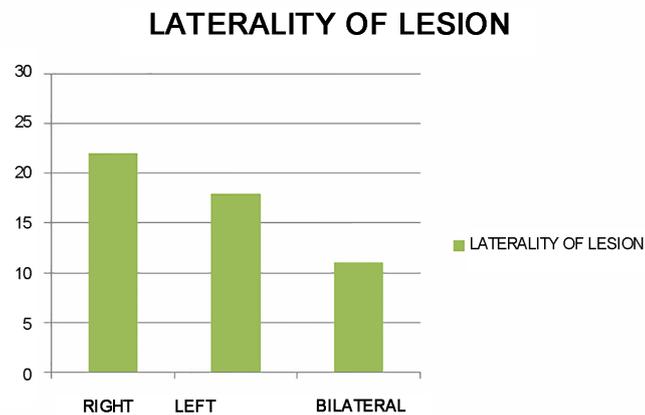


Figure 7. Table depicting diagnosis made on videos trobosc examination.

Table 2. Observations regarding glottal closure made with stroboscopic examination.

S. No.	Glottal Configuration	Percentage
1.	Complete	4%
2.	Irregular	20%
3.	Hour Glass	16%
4.	Posterior Gap	8%
5.	Variable	52%

Amplitude: Amplitude of vibration was reduced in almost all of the cases on the side of the lesion. In 7 lesions, there was no amplitude of vibration as mucosal wave was completely abolished. Amplitude of vibration was normal only in 2 cases, *i.e.* granuloma left vocal process and intubation granuloma.

Symmetry: Asymmetry was seen in all cases except for 3 which were cases of bilateral vocal nodule and in 2 cases of granuloma.

Periodicity: Mucosal waves were aperiodic in all except those with bilateral vocal nodules and granuloma.

4.10. Stroboscopic Diagnosis

The lesions were identified with stroboscopy on the basis of the site of the lesion, glottal closure, symmetry, amplitude and the periodicity of mucosal waves. Video-stroboscopic diagnosis did not match that of rigid and flexible video-endoscopic diagnosis in 46 percent (23 patients) and 36 percent (18 patients) of cases respectively. Stroboscopic examination led to a change in provisional diagnosis in 36 percent of the cases.

Two patients appeared to have benign vocal cord lesions on stroboscopy, which were suspected to be malignant due to irregular glottal closure and absent mucosal waves over the vocal cords. Another patient in whom no obvious vocal cord lesion could be identified through rigid and flexible video-laryngoscopy, video-stroboscopy revealed the presence of bilateral vocal cord nodules.

One contact lesion and sulcus vocalis was identified with stroboscopy, which were missed during rigid and flexible video-laryngoscopy. In 18 cases, there was diagnosis change.

One patient with thickened vocal cords was diagnosed with Reinke's edema on stroboscopy since mucosal waves and amplitude showed a marked reduction. Stroboscopy also helped in establishing diagnosis in two cases from which a conclusive diagnosis could not be arrived at through rigid and flexible video-laryngoscopy. There was a change in diagnosis among 36% of the patients (**Figure 8**).

4.11. Intra-Operative Findings and Videostroboscopy: Table 3

The intra-operative findings matched with video-stroboscopic findings in 84% of the cases. In 16% of the cases, there was intra-operative change in the videostroboscopic diagnosis from one benign lesion to another.

4.12. Stroboscopy and Histo-Pathological Co-Relation: Figure 9

Histopathology (HPE) was used to confirm diagnosis in all cases. In 76 percent (38 patients) of the cases, it was observed that the histopathological diagnosis co-related with stroboscopic diagnosis compared to 44 percent (22 patients) and 52 percent (26 patients) of rigid and flexible video-laryngoscopic diagnosis respectively. In 12 out of 50 cases, the diagnosis did not co-relate with histopathological diagnosis.

In 5 cases, stroboscopy could not help differentiate between vocal nodules and vocal polyps. Another case that was diagnosed as vocal cyst with video-stroboscopy revealed

pseudo-epitheliomatous hyperplasia with histopathology.

Another case that was diagnosed to be malignant due to generalised loss of mucosal waves and irregular glottal closure turned out to be leukoplakia without dysplasia on histopathological examination.

The highest diagnostic co-relation between histopathology and video-stroboscopy was seen in cases of malignancy and was the lowest for vocal polyps (**Figure 10**).

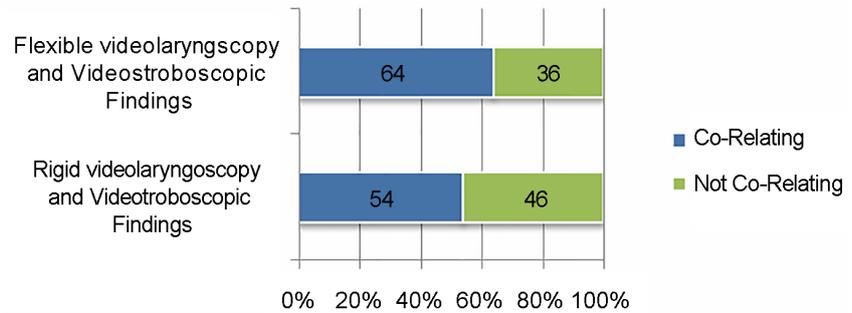


Figure 8. Correlation between flexible and rigid videolaryngoscopic examination with stroboscopic examination.

Table 3. Cases with intraoperative change in diagnosis.

S. NO.	Stroboscopic Diagnosis	Intra-Operative Diagnosis
1.	Right Vocal Polyp, Left Vocal Nodule (1 case)	Bilateral Vocal Nodules
2.	Left Vocal Cyst (2 cases)	Left Vocal Polyp
3.	Bilateral Vocal Nodules (1 case)	Right Vocal Nodule, Left Vocal Cyst
4.	Left Vocal Polyp (1 case)	Left Vocal Nodule
5.	Right Vocal Polyp (2 cases)	Right Vocal Nodule
6.	Right Vocal Nodule with Left Contact Lesion (1 case)	Bilateral Polyps

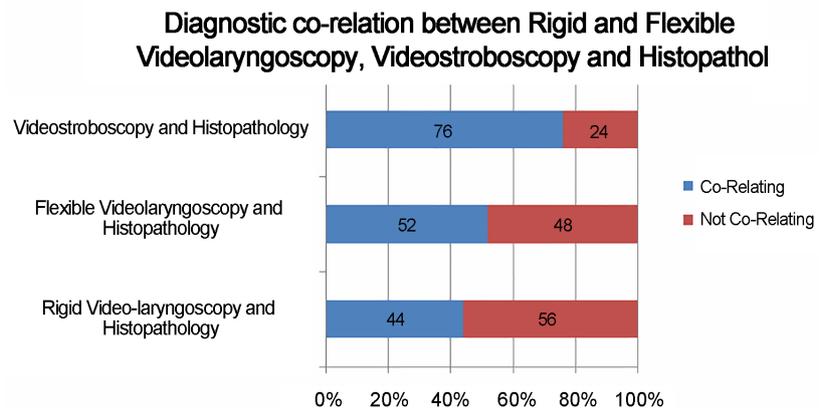


Figure 9. Correlation observed between videostroboscopy, flexible and rigid videolaryngoscopy with that of histopathology.

Video-stroboscopy identified clinically malignant lesions in 9 cases out of which 8 co-related during histopathological examination. One case which was diagnosed as a malignancy on video-stroboscopy due to the appearance of a lesion and due to the generalised loss of mucosal wave, turned out to be leukoplakia without dysplasia during histopathological examination. Rigid and flexible video-laryngoscopy were unable to help in differentiating between benign and malignant lesions in 4 and 2 cases respectively. Thus sensitivity of rigid videolaryngoscopy, flexible videolaryngoscopy and stroboscopy is 50%, 75% and 100% respectively for detection of malignant lesions and specificity is 100%, 100% and 97.9% respectively. Thus stroboscopy is highly sensitive compared to other two investigations and slightly less specific.

4.13. Diagnostic Correlation between Rigid and Flexible Video Laryngoscopy and Videostroboscopy with Intra-Operative Findings: Figure 11

Video-stroboscopy correlated in 84% of patients with intra-operative findings while FLP and Rigid Video-laryngoscopy correlated in 54% and 46% of patients.

Histopathological correlation in malignant lesions: Figure 12.

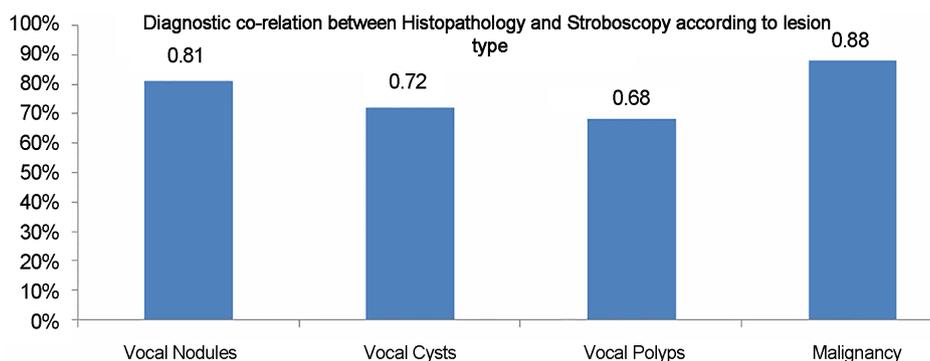


Figure 10. Diagnostic correlation between histopathology and stroboscopy observed according to the lesion.

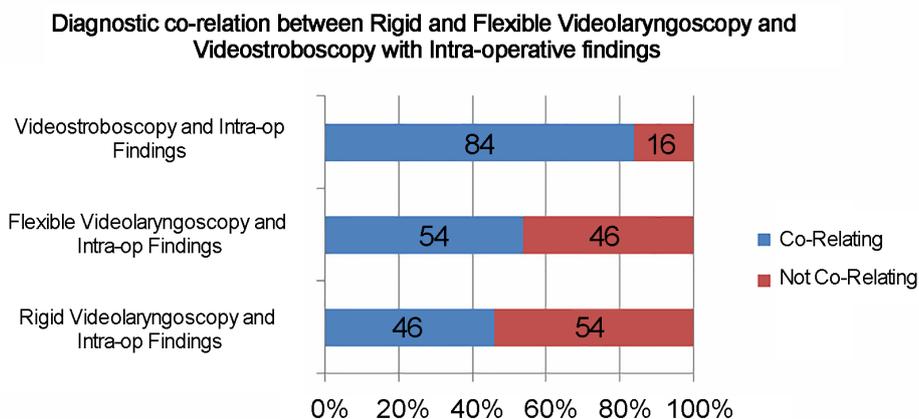


Figure 11. Diagnostic correlation between rigid and flexible videolaryngoscopy and videostroboscopy with intraoperative findings.

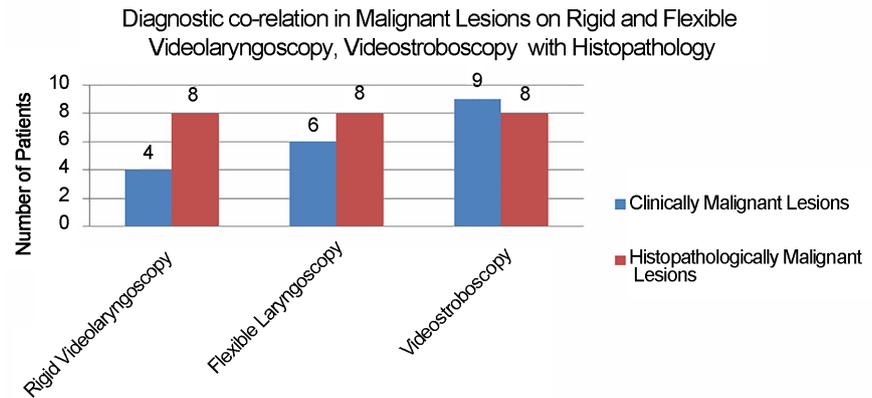


Figure 12. Correlation in malignant lesions.

5. Discussion

This study was conducted in order to identify the relevance of videoendoscopy, flexible laryngoscopy and video-stroboscopy in pre-operative diagnosis of vocal cord pathology. Pre-operative diagnosis was correlated with intra-operative diagnosis and with the final histopathological diagnosis.

Our study comprised of 50 patients. The sex ratio was 3:5:1 while a study by Schindler consisted a sex ratio of 1:3 [3]. The mean age in our study was 46.7 years and a maximum of the patients were in a fourth decade.

5.1. Stroboscopy and Constant Light Laryngeal Examination

The stroboscopic examination was compared with laryngeal examinations by implementing varying methodologies in different studies. Sataloff *et al.* reported that videolaryngo-stroboscopy modified the diagnoses in 47 percent of the patients studied [4]. Casiano *et al.* compared constant light laryngoscopy with stroboscopic light examination and discovered that video-strobo-laryngoscopy altered diagnosis and treatment outcome in 14 percent of patients [5]. In our present study, a total of 62 lesions were identified in 50 patients through video-stroboscopy compared to 46 lesions in 41 patients and 55 lesions in 47 patients through rigid and flexible laryngoscopy respectively. Stroboscopy proved to be highly useful in identifying lesions that could not be identified by constant light examination. Change in diagnosis was observed in 18 cases (36 percent). Videostroboscopy helped in identifying malignant lesions in two cases that appeared to be benign on constant light laryngeal examination. **Figure 12** thus, using video-stroboscopy, a malignant lesion could be identified pre-operatively which proved to be useful not only in management planning but also towards pre-operative patient counselling.

5.2. Diagnostic Co-Relation between Rigid Videolaryngoscopy, Fibreoptic-Laryngo-Pharyngoscopy and Stroboscopy with Intra-Operative Findings

Intra-operative findings correlated with stroboscopic findings in 84% of patients, with

fiberoptic laryngo-pharyngoscopic diagnosis in 54% of patients and with rigid video-laryngoscopy in 46% of patients. The correlation between stroboscopic diagnosis and intra-operative findings was significantly higher compared to video-laryngoscopic and fibre-optic laryngo-pharyngoscopic diagnosis. The results garnered from our study are comparable with a study conducted by Rosa-Hernández Sandemetro *et al.* [6] in which stroboscopic and intra-operative findings were correlated in 181 lesions. In 90 percent of the cases, a diagnostic match was arrived at between stroboscopy and intraoperative diagnosis [6].

5.3. Diagnostic Co-Relation between Rigid Videolaryngoscopy, Fiberoptic-Laryngo-Pharyngoscopy and Stroboscopy with Histopathology

Histopathology is said to be a final, confirmatory test. It was observed that histopathological diagnosis co-related with stroboscopic diagnosis in 76 percent of the cases in comparison with 44 percent and 52 percent for rigid video-laryngoscopy and fibre optic-laryngo-pharyngoscopy diagnoses respectively. The highest diagnostic co-relation of videostroboscopy was for malignancy followed by vocal nodule. Video-stroboscopy was unable to locate dysplastic lesions but was found to be superior to constant light source examination in the diagnosis of malignant lesions.

In the case of benign lesions, the stroboscopic correlation with histopathology was 81% for vocal nodules, 72% for vocal cyst and 68% for vocal polyp. In the case of malignancy, rigid video-laryngoscopy correlation was only 50%, with FLP it was 75% and with stroboscopy it was 88%. Comparing each diagnostic tool with histopathology is important as it helps arrive at a definitive pre-operative diagnosis and in providing appropriate pre-operative counselling and treatment.

Video-stroboscopy shows a higher correlation with histopathological and intraoperative diagnosis in comparison with constant light examination. It is a complement to proper history and routine examination.

Another advantage of video-stroboscopy is that the video can be played back. Hence, the patient will be able to watch the video after the completion of the examination. It also serves as a record for comparing the vocal cord before and after surgery.

The major limitation of stroboscopy is interobserver variability in the findings. An experienced observer will be able to accurately identify diagnosis. Appropriate training and experience will assist in accurate diagnosis.

6. Conclusion

Video-stroboscopy can elucidate vocal fold abnormalities missed during rigid video-laryngoscopy or during fibre-optic laryngo-pharyngoscopic examinations. Any patient with voice problems and unclear diagnosis is a candidate for videostroboscopy. Video-stroboscopic findings show higher correlation with intra-operative findings and with final histopathological diagnosis compared to constant light laryngeal examinations. It is highly sensitive for detecting malignancies and slightly less specific compared to con-

stant laryngeal examinations.

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