Original Article

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Role of Videolaryngostroboscopy in the diagnosis of dysphonic patients with normal fiberoptic laryngoscopy

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ABSTRACT

***Background*:** Dysphonia is altered voice quality, pitch, loudness, or vocal effort that impairs people's quality of life. It is a very common complaint affecting nearly one-third of a population at some point in their life and could be caused by infection, tumor, trauma, vocal cord paralysis, etc.
Indirect mirror or endoscopic laryngoscopy is used to assess the laryngeal condition in dysphonic patients seeking mainly for the cause, but frequently the findings were normal or unremarkable.
Videolaryngoscopy (VLS) is very useful in dysphonic patients who have an otherwise normal indirect or flexible laryngoscopic examination. In addition to providing information regarding vocal fold vibrations, the image obtained through VLS can be magnified to make a more detailed assessment of the vocal cord anatomy than is possible with rigid of flexible laryngoscopy.

Objective of study: To assess the videolaryngostroboscopic findings in dysphonic patients with normal fiber-optic laryngoscopy.

Patient & Method: A cross-sectional study, Fifty patients were included in the study; They had complained of dysphonia, and the fiber-optic laryngoscopic examination was normal. Videostroboscopy were obtained for all patients to assess vocal fold vibration and seek any abnormal findings.

Results: A total of 50 patients were enrolled in this study. Regarding the stroboscopic findings, 42% of the patients were normal, 15 (30%) had early soft singer's nodules, 6 patients (12%) had intracordal lesions, 4 patients (8%)had vocal cord polypoidal changes, 2 patients (4%) had presbylaryngis, and the other 2 patients (4%) had sulcus vocalis.

Conclusion: VLS is beneficial in detecting vocal cord lesions in patients with normal fiber-optic laryngoscopy. A high proportion (more than half) of dysphonic patients with normal fiber-optic laryngoscopy had abnormal findings**.**

Keywords: Stroboscopy, Videolaryngoscopy, Fiberoptic laryngoscopy, Dysphonia.

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Introduction:

Dysphonia (impaired voice production) is a very common complaint affecting nearly one-third of the population at some point in their life. The term dysphonia is often used interchangeably with hoarseness. However, this terminology is imprecise, as ***hoarseness*** is a symptom of altered voice quality reported by patients, while ***dysphonia*** characterizes impaired voice production as recognized by a clinician. Dysphonia is often caused by benign or self-limited conditions, but it may also be a presenting symptom of a more serious or progressive condition requiring prompt diagnosis and management.[1,2]

Nearly all dysphonic patients are examined by visualizing the inner laryngeal surface, including the vocal cords with an indirect mirror or endoscopic laryngoscopy, to uncover the cause of dysphonia.

Frequently, no visible causes can be found during laryngoscopic examination. **Videolaryngostroboscopy (VLS)** is a useful tool for detailed visual analysis of the vocal cords' vibratory characteristics or parameters and can elucidate early changes not visible to the naked eye or functional laryngeal conditions owing to the magnified image obtained.

The target of this research study aiming to categorize the cause of voice problems in dysphonic patients with normal laryngeal examinations.

Phonation:

Sound is produced by the larynx when expiratory airflow induces the vibration of free edges of the vocal cords as a result of the interaction of aerodynamic and myoelastic forces.

Five conditions must be met to support normal phonation:[3,4]

1. appropriate vocal cord approximation,
2. adequate expiratory force,
3. sufficient vibratory capacity of the vocal cords (elasticity),
4. favorable vocal cord contour, and
5. volitional control of the vocal cord length and tension.

There are three main types of normal vibratory patterns: model, falsetto, and glottal fry (Fig. 1-1).[3,4]

- ✓ ***Model Register***

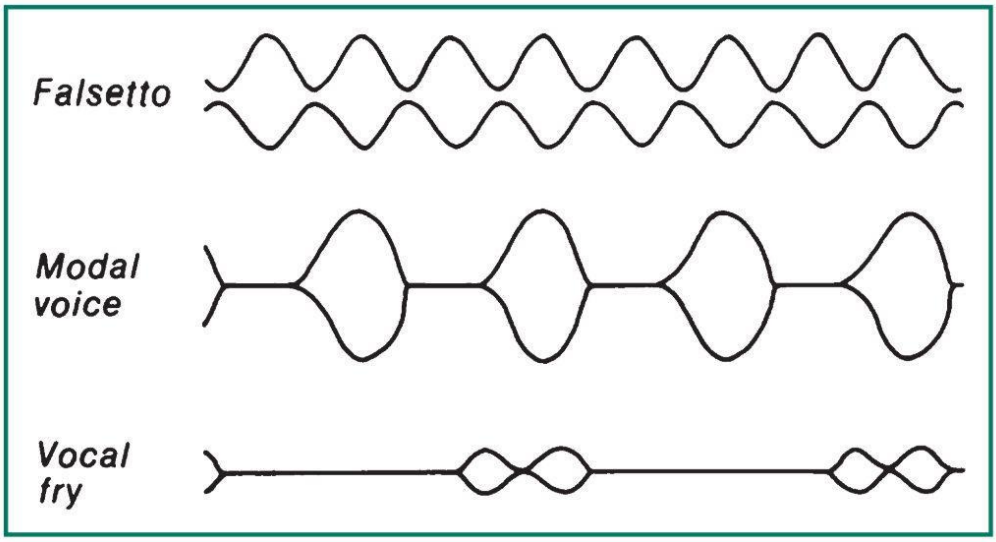
  The vocal cords exhibit a normal vibratory topography as the mucosa vibrates independently of the muscle.

- ✓ ***Falsetto***

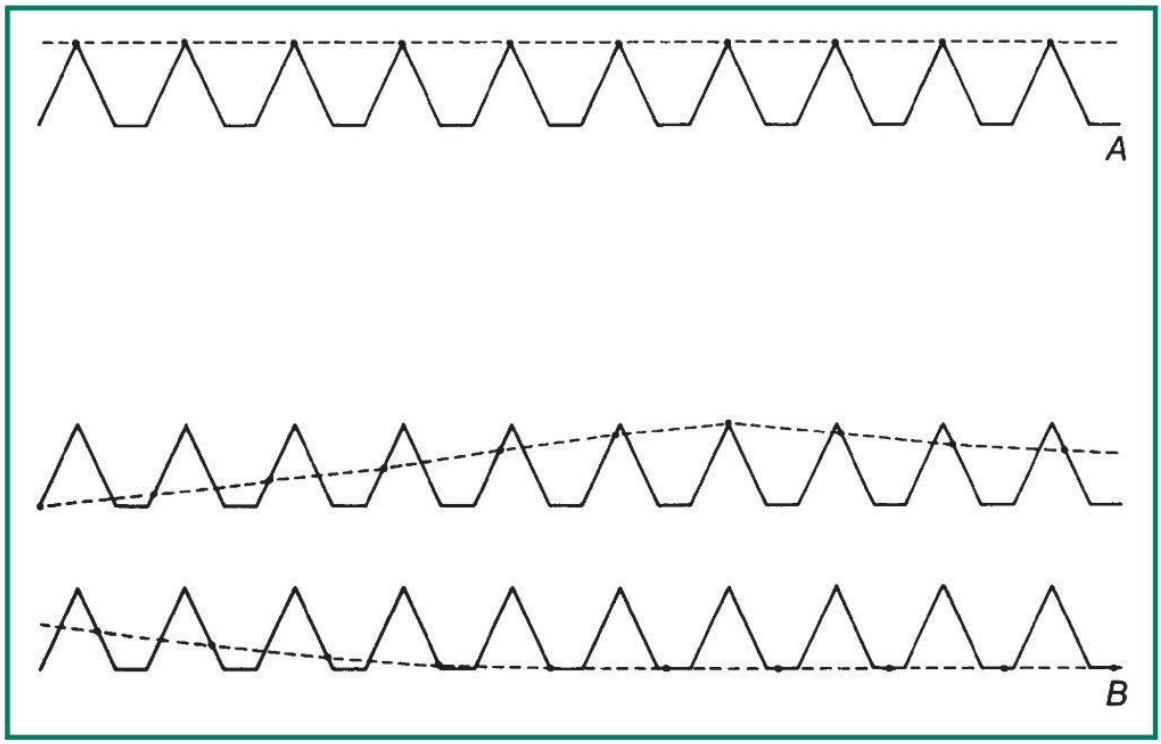
  The glottal closure is incomplete, and only the uppermost free edges of the cords are involved in vibration, creating a high-pitched voice.

- ✓ ***Glottal Fry***

This is characterized by an excessively low-pitch voice with the vocal cords tightly approximated for a longer than normal duration during the vibratory cycle**.**



(Fig. 1-1) The normal vibratory pattern of vocal folds. [5]



(Figure 1-2) **An illustration of the principle of stroboscopy**

Principle of Stroboscopy:

Stroboscope's light illuminates portions of successive vibratory cycles. The eye fuses the illuminated points into an illusion of slow motion. If the stroboscope is synchronized with vocal fold vibration (A), a similar point is illuminated on each successive cycle and the vocal fold appears to stand still. If slightly desynchronized (B), each cycle is illuminated at a slightly different point, and a slow-motion effect is created (Fig. 1-2).

When the images are presented to the viewer at the proper rate (using VLS), the vocal cords appear to be moving slowly and create smooth cycles, separating and then returning to the midline (Fig. 1-3).[5,6,7]

(Figure 1-3) Montage of normal stroboscopic examination showing normal wave, normal duration of closure, and normal amplitude.[10]

Vibratory Parameters of Videostroboscopy[3,8]

1. The Symmetry of Vibration:

It refers to the movement of the right and left vocal cords relative to each other. The right and left cords normally vibrate as mirror images of one another. Differences in the mechanical properties of the two vocal cords will, however, result in asymmetric movements. The symmetry of vibration is influenced by

differences in position, shape, mass, stiffness, elasticity, and tension of the vocal cord tissues.

2. **The Periodicity of Vibration:**

It refers to the relative length of the glottal cycle, which should be stable from cycle to cycle. Use of the synchronized strobe setting can confirm that vibration is periodic. If the length of the vibratory cycle is stable from cycle to cycle, then a static image will persist with the strobe set to the synchronized mode. If the length of the vibratory cycle changes, a movement of the vibratory edge will appear in the synchronized mode. Periodicity depends on the mechanical properties of the vocal cords and the expiratory force applied to them.

3. **Phase Closure:**

It refers to the percentage of time for which the vocal cord edges are open and/or closed during a single cycle of vibration. The phase characteristics are normally influenced by the mode of phonation (falsetto, modal phonation, and glottal fry) and the pitch and loudness of phonation.

4. **The Amplitude of Vibration:**

It refers to the amount of lateral movement of the vocal cords during vibration.

5. **Glottic Configuration:**

It refers to the shape or contour of the glottis opening, if there is one, at the point of maximal closure during the vibratory cycle. Other terms for this characteristic include the contour of the glottal margin and the vocal cord closure pattern.

6. **Mucosal wave*:***

It refers to the movement of the superficial tissues over the vocal cord as the air moves through the glottis. The mucosal wave can be seen as a traveling wave in the superficial tissues over the top of the vocal cord surface from medial to lateral. Slow-motion (or frame-by-frame) analysis of the videostroboscopic recording is usually required for an adequate evaluation of the mucosal wave. The mucosal wave is interrupted by abnormalities of the vocal cord mucosal cover such as scarring, inflammation, and edema.

Table 1-1 shows stroboscopic parameters and their changes by benign laryngeal pathology.[9]

(Table 1-1) Stroboscopic findings in common benign vocal cord lesions.

Stroboscopic Parameters	Pathology		
	V.C. Nodule	**Intracordal Cyst**	**V.C. Polyp**
Symmetry	Normal	Asymmetric	Asymmetric
Periodicity	Normal	Aperiodic	Aperiodic
Glottis Closure	Reduced (hourglass shape)	Reduced	Irregular
Amplitude	Reduced	Reduced	Reduced
Mucosal Wave	At nodule site, either reduced in early stage (edema) or absent in the firm nodule	Reduced throughout the affected side and absent over the cyst	Little or no wave

Aim of the Study:

To assess the role of VLS in the diagnosis of dysphonic patients with normal or no findings by fiberoptic examination.

II/I Study Design:

This was a cross-sectional study conducted at the Department of Otorhinolaryngology, Head and Neck Surgery, in Al-Sadar Medical City, Al-Najaf Governorate, from January 2018 to January 2019.

II/II Patients Selection:

Fifty patients were included in the study; they had complained of dysphonia even though their fiber-optic laryngoscopic examination was *normal*. Video stroboscopic examination, using a 70-degree rigid endoscope connected to an Atoms Servant S61 strobe unit, was done for them. Consent was obtained from all the patients.

Inclusion Criteria:

Dysphonic patients with normal fiber-optic laryngoscopy were enrolled regardless of age and gender.

Exclusion Criteria:

- Congenital dysphonia
- Acquired dysphonia, with a history of the following:

- ✓ Laryngeal trauma,
- ✓ Laryngeal or thyroid surgery,
- ✓ Radiotherapy and/or chemotherapy,
- ✓ Smoking, and
- ✓ Gastro esophageal Reflux Disease

II/IV Statistical Analysis:

The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS), version 24. The data was presented as frequency, percentages, mean, and standard deviation (SD). A Chi-square test was used to compare frequencies, and the analysis of variances (ANOVA) test was used to compare the mean age among the findings. The level of significance (P-value ≤ 0.05) was considered to be significant. The findings were presented in tables and figures using Microsoft Office software, version 2010.

Results:

A total of 50 patients were enrolled in this study with a mean age of 32.5 ± 13.2 years (range: 10–71). There were 31 males and 19 females, with no significant differences in age between the genders (P > 0.05) (Table 2-1).

(Table 2-1) Age and gender distribution of the studied group.

Age (Year)	Male		Female		Total	
	No.	%	No.	%	No.	%
≤ 20	7	22.6	4	21.1	11	22.0
21–30	14	45.2	5	26.3	19	38.0
31–40	4	12.9	1	5.3	5	10.0
41–50	1	3.2	4	21.1	5	10.0
51–60	4	12.9	2	10.5	6	12.0
> 60	1	3.2	3	15.8	4	8.0
Total	31	62.0	19	38.0	50	100.0
p-value = 0.16 (not significant)						

They had complained of dysphonia of varying durations, as in Table 2-2, where 21 patients (42%) had complained about suffering from dysphonia for several years (≥ 5 years), 25 patients for 1–4 years, and only four patients for several weeks (Less than 1 year).

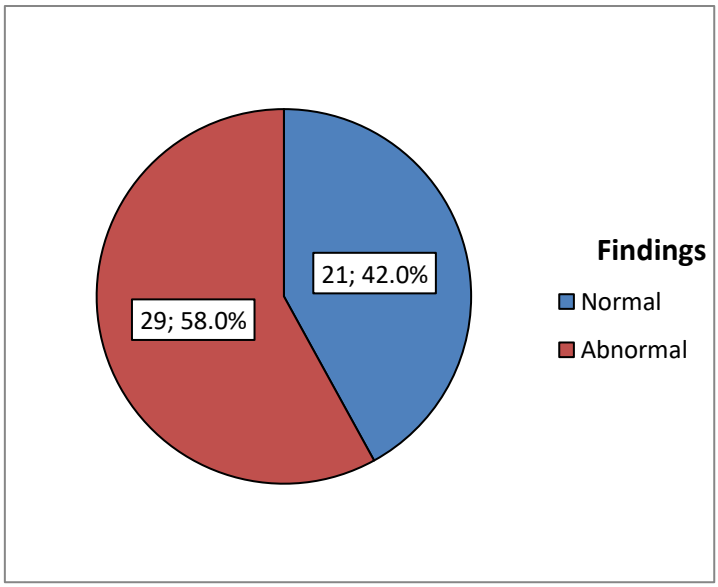
(Table 2-2) Distribution of the study group according to the duration of dysphonia.

Duration of Dysphonia	No.	%
≥ 5 years	21	42.0
1–4 years	25	50.0
< 1 year	4	8.0
Total	50	100.0

In these 50 patients, the indirect mirror and fiberoptic laryngoscopies were normal, while the stroboscopy results for 21 (42%) patients were normal too. However, the other 29 patients (58%) exhibited vocal cord pathology (Fig. 2-1). These were distributed as follows: 15 patients (30%) had early soft singer's nodules, 6 patients (12%) had intracordal lesions, 4 patients (8%) experienced vocal cord polypoidal changes such as, vocal cord cyst, fibroma, and malignancy. 2 patients (4%) had presbylaryngis, and the other 2 patients (4%) had sulcus vocalis (Table 2-3).

(Table 2-3) Distribution of the study group according to the stroboscopic findings.

Finding	No.	%
Normal	21	42.0
Early soft singer's nodules	15	30.0
Intracordal lesions	6	12.0
Vocal cord polypoidal changes	4	8.0
Presbylaryngis	2	4.0
Sulcus vocalis	2	4.0
Total	50	100.0



(Figure 2-1) Distribution of the study group according to the stroboscopic findings (N = 50).

Figure 2-2 shows that traditional laryngeal examination was unable to detect early laryngeal pathology such as polyps, nodules, and cysts, while stroboscopes revealed the pathology clearly.

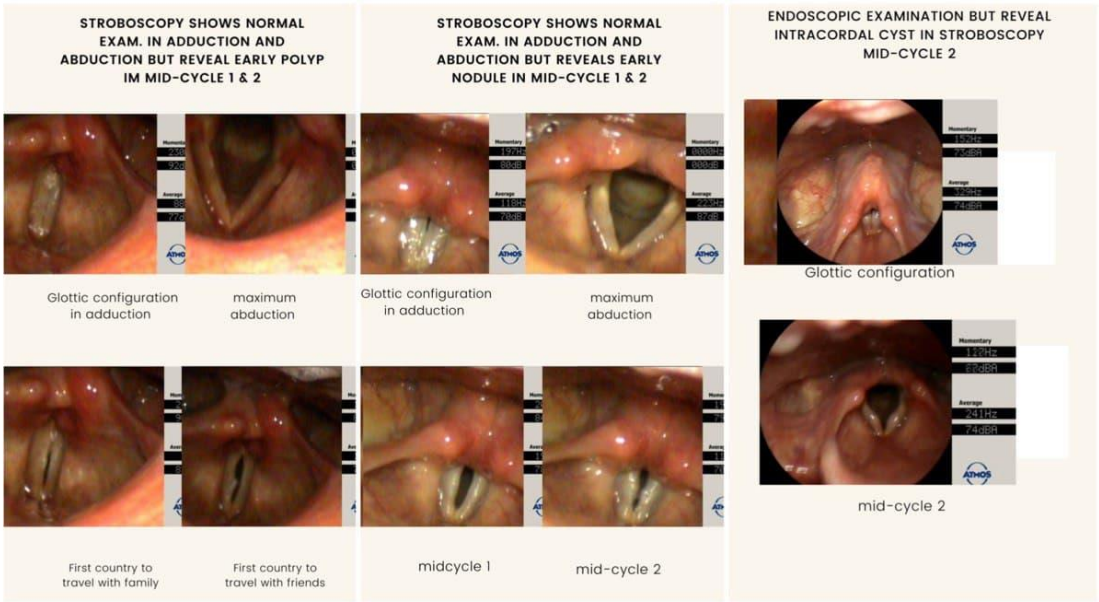
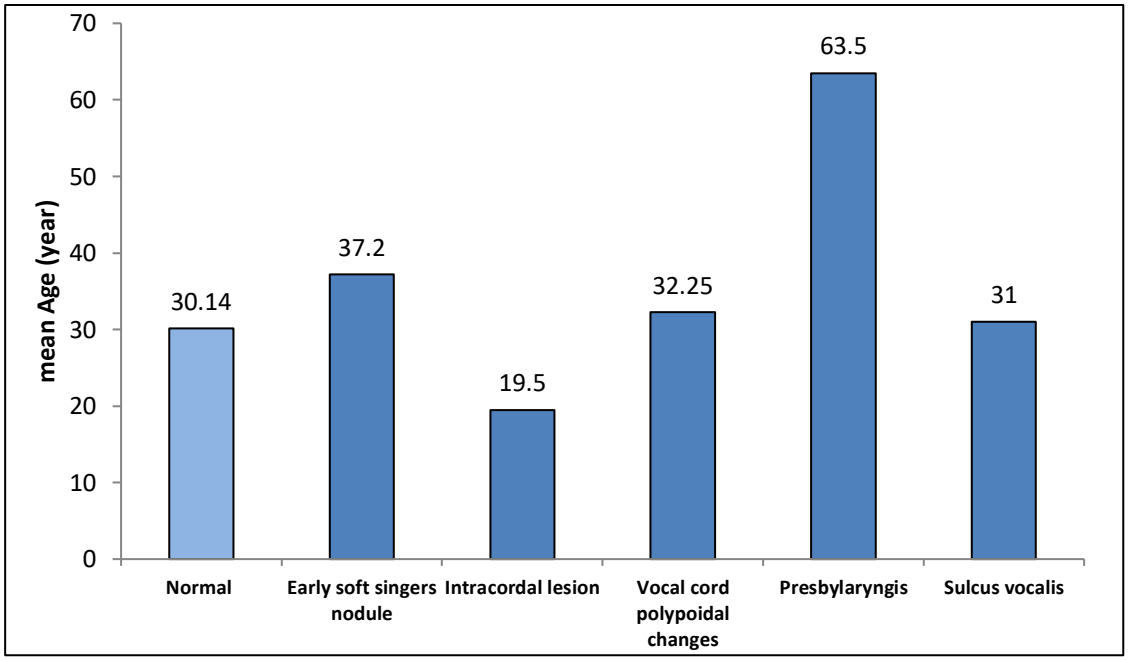


Figure 2-2

(Table 2-4) Relationship between stroboscopic findings and age.

Finding	Number of patients	Age	
		Mean	SD*
Normal	21	30.14	15.26
Early soft singer's nodule	15	37.20	15.46
Intracordal lesion	6	19.50	10.41
Vocal cord polypoidal changes	4	32.25	18.71
Presbylaryngis	2	63.50	2.12
Sulcus vocalis	2	31.00	0.00
ANOVA (F) test = 0.017 (significant)			



(Figure 2-3 Mean age according to the stroboscopy finding

Moreover, it was significantly found that intracordal lesions, vocal cord polypoidal lesions, and presbylaryngis were more frequent in patients with a longer duration of dysphonia ($P < 0.05$) (Table 2-5).

(Table 2-5) Relationship between Stroboscopic findings and duration of dysphonia.

Finding	Duration of dysphonia			
	≥ 5 years		< 5 years	
	No.	%	No.	%
Normal	7	33.3	14	48.3
Early soft singer's nodule	3	14.3	12	41.4
Intracordal lesion	6	28.6	0	0.0
Vocal cord polypoidal changes	3	14.3	1	3.4
Presbylaryngis	2	9.5	0	0.0
Sulcus vocalis	0	0.0	2	6.9
Chi-square test = 17.91, p-value = 0.003 (significant)				

Discussion:

Dysphonia is a condition that is characterized by altered vocal quality, pitch, loudness, or vocal efforts that impairs one's quality of life. The pathophysiology of hoarseness is characterized by muscle tone-related irregularity in the oscillation of the vocal cords owing to hypertonic dysphonia, incomplete closure of the glottis on vocalizations, or an increase in vocal cord bulk. About one-third of the population will be affected by dysphonia during their lifetime.[2,10]

VLS is indicated when a detailed visual analysis of vocal cord vibrations is desired. It is particularly indicated for any patient who complains of dysphonia but has normal indirect or flexible laryngoscopic examinations. In addition to providing information regarding vocal cord vibrations, the image obtained

through the VLS is magnified to allow a more detailed assessment of the vocal cord anatomy than is possible with rigid or flexible laryngoscopy.[10]

In our study, 62% of the patients were males, and 38% were females, with a male to female ratio of 1.63:1. This figure is consistent with D. S. Deenadayal et al.,[10] where males also predominate (78%) compared to females (22%) in a ratio of 3.5:1.

In the current study, the mean age was 32.5 years, and the majority of the patients were in the third decade. In a study by Printza et al.,[11] the mean age was 51.4 years. This may be due to the difference in the duration of dysphonia. 92% of our patients had dysphonia for several years, while in the study by D.S. Deenadayal et al.,[10] 78% of the patients had dysphonia for less than one year.

We also found that the diagnosis was modified in 58% of the patients studied (Fig. 2-1), as 30% had early soft singer's nodules, 12% had intracordal lesions, 8% had vocal cord polypoidal changes, 4% had presblaryngis, and 4% had sulcus vocalis. However, Satalooff et al.[12] reported that VLS changed the diagnosis in 47% of the patients studied. While D. S. Deenadayal et al.[10] reported that VLS modified the diagnosis in 36% of studied patients and this difference may be comparable with our study.

Casiano et al.[13] compared constant light laryngoscopy with VLS and discovered that VLS altered diagnosis in 44% of dysphonic patients with normal endoscopy. This concurs with our study findings.

In the current study, 30% of the patients had early soft singer's nodules, 8% had vocal cord polypoidal changes, and 4% had sulcus vocalis, which is comparable to a study done by Hansa Banjara et al.,[14] where 22.3% had early soft singer's nodules, 5.4% had vocal cord polyp, and 3.6% had sulcus vocalis.

In this study, the diagnostic value of VLS was found to be important for the diagnosis of many pathological causes of dysphonia, and similar findings have been reported in many papers of research.[15–16]

Conclusion:

VLS is a simple, quick, and noninvasive diagnostic tool that aids in the detection of the cause of dysphonia.

Recommendation:

VLS is beneficial in detecting vocal cord lesions in patients with normal fiber-optic laryngoscopy. Therefore, otolaryngologists will benefit from using VLS in dysphonic patients with normal fiber-optic laryngoscopy.

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