

Research Article

Observational Study of Clinical, Endoscopic and Voice Characteristics in Patients with Vocal Cord Lesions Presenting with Persistent Hoarseness

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ABSTRACT

Background: Persistent hoarseness is a common otorhinolaryngological complaint and may result from a variety of structural vocal cord lesions. Clinical examination alone may not adequately reflect the functional impact of these lesions; therefore, endoscopic findings, perceptual voice assessment, acoustic parameters, and patient-reported voice handicap provide a more comprehensive evaluation.

Aim: To evaluate the clinical, endoscopic, and voice characteristics of patients with vocal cord lesions presenting with persistent hoarseness.

Material and Methods: This hospital-based prospective observational study included 85 patients with persistent hoarseness and an identifiable vocal cord lesion. Detailed clinical history and endoscopic evaluation were performed. Lesions were assessed for type, laterality, mucosal wave, glottic closure, surface characteristics, and supraglottic hyperfunction. Voice evaluation included the GRBAS scale, Voice Handicap Index-10 (VHI-10), fundamental frequency, jitter, shimmer, harmonics-to-noise ratio (HNR), maximum phonation time (MPT), and S/Z ratio. Data were analyzed using IBM SPSS version 24.0, with $p < 0.05$ considered statistically significant.

Results: The mean age was 44.36 ± 12.48 years, and 61.18% were males. Vocal nodules were the most common lesion (25.88%), followed by polyps (21.18%) and cysts (11.76%). Bilateral involvement was frequent in nodules (81.82%) and Reinke's edema (88.89%) ($p < 0.001$). Reduced or absent mucosal wave varied significantly among lesion types ($p = 0.004$). Moderate dysphonia was present in 43.53% of patients. With increasing dysphonia severity, jitter, shimmer, S/Z ratio, and VHI-10 scores increased significantly, whereas HNR and MPT decreased (all $p < 0.001$). VHI-10 correlated positively with GRBAS grade ($r = 0.69$, $p < 0.001$).

Conclusion: Vocal cord lesions produced distinct endoscopic and voice abnormalities. Combined clinical, endoscopic, perceptual, acoustic, aerodynamic, and VHI-10 assessment provided a comprehensive evaluation of persistent hoarseness.

Keywords: Persistent Hoarseness, Vocal Cord Lesions, Videolaryngoscopy, Grbas, Voice Handicap Index-10.

INTRODUCTION

Hoarseness is a perceptible alteration in voice quality characterized by changes in pitch, loudness, clarity, stability, or vocal effort. It is one of the most frequent symptoms encountered in otorhinolaryngology practice and may result from functional, inflammatory, structural, neurological, or neoplastic abnormalities of the larynx. Persistent hoarseness deserves particular attention because prolonged alteration in voice may indicate an underlying vocal fold lesion that

requires detailed visualization and functional assessment. Structural lesions of the vocal folds are important causes of persistent dysphonia and may substantially interfere with communication, professional performance, and social interaction. Benign vocal fold lesions are particularly important because they commonly affect individuals with occupational or habitual voice use and may produce persistent symptoms despite the absence of serious systemic illness.¹ Vocal cord lesions encompass a heterogeneous group of

abnormalities including vocal nodules, polyps, cysts, Reinke's edema, granulomas, papillomatous lesions, leukoplakia, and other localized mucosal abnormalities. These lesions differ in their pathogenesis, morphology, site, laterality, vibratory behavior, and effect on phonation. Repeated mechanical trauma from excessive or inappropriate voice use is considered an important contributor to several phonotraumatic lesions, while smoking, laryngopharyngeal reflux, chronic cough, throat clearing, environmental irritants, and occupational voice requirements may additionally influence their development and persistence. Structural abnormalities alter the normal biomechanical properties of the vocal folds and can interfere with regular glottic closure and mucosal vibration, thereby producing characteristic changes in voice quality.² The clinical manifestations of vocal fold lesions vary according to the nature and extent of the lesion. Persistent hoarseness is usually the predominant complaint, although patients may also report vocal fatigue, reduced vocal range, throat discomfort, excessive effort during phonation, intermittent voice breaks, chronic cough, foreign-body sensation, or difficulty maintaining voice for prolonged periods. The functional effect of a lesion cannot always be predicted solely from its gross size or external appearance. Therefore, comprehensive evaluation requires assessment of both the morphological features of the lesion and its effect on voice production. Evaluation of vocal fold polyps, for example, has demonstrated the importance of integrating morphological assessment with perceptual, aerodynamic, and acoustic voice measurements rather than relying on lesion dimensions alone.³ Endoscopic examination represents a fundamental component of evaluation in patients with persistent hoarseness. Rigid or flexible laryngoscopy permits visualization of the vocal folds and allows assessment of lesion type, anatomical location, laterality, surface characteristics, vascularity, glottic closure, and associated laryngeal abnormalities. Videostroboscopy provides additional information regarding vocal fold vibration, particularly mucosal wave, amplitude, periodicity, phase symmetry, and glottic closure patterns. Certain apparently uncomplicated benign lesions may coexist with less obvious abnormalities such as sulcus vocalis, emphasizing the importance of careful examination of the vibratory characteristics and structural integrity of the vocal fold cover.⁴ Persistent mucosal abnormalities also require careful characterization because some lesions may possess greater clinical significance

than routine phonotraumatic lesions. Vocal fold leukoplakia is clinically recognized as a white plaque-like mucosal abnormality and may represent different underlying pathological processes. Smoking and other mucosal irritants remain important considerations during the assessment of such patients. Consequently, evaluation of persistent hoarseness should include a detailed history of tobacco exposure, alcohol consumption, vocal behavior, reflux-related symptoms, occupational voice demand, and other potential risk factors. Clinical and endoscopic findings should be interpreted together when determining the need for further investigation or histopathological assessment.⁵ Voice disturbance is multidimensional and cannot be completely characterized by laryngeal visualization alone. Patient perception of voice difficulty represents an important component of disease burden because seemingly similar vocal fold lesions may produce different degrees of functional limitation. Instruments such as the Voice Handicap Index and its shorter VHI-10 version provide a standardized method for assessing the perceived effect of voice problems on daily activities and communication. Patient-reported measures complement clinical examination and are useful for documenting baseline impairment as well as changes following management of benign vocal fold lesions.⁶ Perceptual and objective voice assessments further strengthen the clinical evaluation of patients with vocal cord lesions. The GRBAS scale provides a structured auditory-perceptual assessment of the overall grade of dysphonia, roughness, breathiness, asthenia, and strain. Acoustic analysis provides quantitative information through parameters such as fundamental frequency, jitter, shimmer, and harmonic-to-noise ratio, while aerodynamic measures such as maximum phonation time provide information regarding phonatory efficiency. Relationships between perceptual ratings, acoustic abnormalities, aerodynamic function, and patient-reported voice handicap support the use of a multidimensional approach rather than dependence on any single voice parameter.⁷

MATERIALS AND METHODS

The present study was conducted as a hospital-based prospective observational study in the Department of Otorhinolaryngology at a tertiary care hospital. A total of 85 consecutive patients presenting with persistent hoarseness and diagnosed with vocal cord lesions were enrolled. The study was designed to evaluate the demographic and clinical profile, characteristics of

vocal cord lesions on endoscopic examination, and associated perceptual and objective voice abnormalities. A total of 85 patients of either sex presenting to the outpatient or inpatient services with persistent hoarseness were included after detailed clinical evaluation. Persistent hoarseness was defined as alteration in voice quality persisting for more than three weeks. Patients satisfying the eligibility criteria and providing written informed consent were enrolled consecutively to minimize selection bias.

Inclusion Criteria

Patients aged 18 years or above with persistent hoarseness and an identifiable vocal cord lesion on laryngeal examination were included. Patients with benign, premalignant, or suspicious vocal cord lesions such as vocal nodules, polyps, cysts, Reinke's edema, leukoplakia, papillomatous lesions, granulomas, and other localized lesions affecting vocal fold vibration were considered eligible. Patients capable of undergoing endoscopic examination and voice assessment were included.

Exclusion Criteria

Patients with acute laryngitis, isolated vocal cord paralysis without a structural lesion, previous laryngeal surgery, previous radiotherapy to the head and neck region, known neurological disorders significantly affecting voice, severe respiratory disease interfering with phonation, congenital laryngeal abnormalities, and patients unable to cooperate with endoscopic or voice assessment were excluded. Patients with inadequate endoscopic visualization or incomplete clinical data were also excluded.

METHODOLOGY

A detailed history was obtained regarding age, sex, occupation, duration and progression of hoarseness, vocal abuse or excessive voice use, smoking, tobacco chewing, alcohol consumption, symptoms suggestive of gastroesophageal or laryngopharyngeal reflux, recurrent respiratory infections, allergy, chronic cough, throat clearing, dysphagia, odynophagia, breathing difficulty, neck swelling, and previous episodes of similar complaints. Occupational voice demand was categorized as low, moderate, or high. General physical examination and complete ear, nose, throat, oral cavity, neck, and systemic examinations were performed. Duration of hoarseness was categorized as 3 weeks–3 months, >3–6 months, >6–12 months, and >12 months for analysis.

Endoscopic Evaluation

All patients underwent laryngeal examination using rigid or flexible video-endoscopy under standard clinical conditions. The vocal folds were systematically assessed for the type of lesion, side involved, anatomical location, size, number, surface appearance, color, vascularity, and involvement of the free edge of the vocal fold. Lesions were categorized as unilateral or bilateral and according to their location in the anterior, middle, or posterior third of the vocal fold. Glottic closure pattern, symmetry of vocal fold movement, mucosal wave, vibratory amplitude, supraglottic hyperfunction, edema, erythema, and presence of associated laryngeal abnormalities were documented. Where clinically indicated, videostroboscopic findings were recorded to assess periodicity, phase symmetry, mucosal wave, and completeness of glottic closure.

Voice Assessment

Voice was assessed in a quiet environment before definitive treatment. Perceptual voice evaluation was performed using the GRBAS scale, which assessed overall grade of dysphonia, roughness, breathiness, asthenia, and strain. Each component was graded from 0 to 3, where 0 represented normal voice and 3 represented severe abnormality. Patients were asked to sustain the vowel /a/ at a comfortable pitch and loudness and to perform standardized connected speech for assessment.

Acoustic and Aerodynamic Voice Parameters

Objective voice analysis included fundamental frequency (F0), jitter percentage, shimmer percentage, and harmonics-to-noise ratio (HNR), wherever technically feasible. Maximum phonation time (MPT) was determined by asking the patient to sustain the vowel /a/ after maximum inspiration, and the longest value from repeated acceptable attempts was recorded in seconds. The S/Z ratio was evaluated as an additional aerodynamic indicator of phonatory efficiency. These parameters were correlated with the nature and endoscopic characteristics of the vocal cord lesions.

Voice-Related Quality of Life

The functional impact of hoarseness was evaluated using the Voice Handicap Index-10 (VHI-10). Patients rated 10 voice-related statements on a five-point scale, producing a total score ranging from 0 to 40, with higher scores indicating greater perceived voice-related handicap. The VHI-10 score was compared across different lesion types and grades of perceptual dysphonia.

Outcome Measures

The primary outcome measures included the distribution and clinical characteristics of vocal cord lesions, their endoscopic morphology, and severity of voice impairment. Secondary measures included associations of lesion characteristics with age, sex, occupational voice use, smoking status, duration of hoarseness, GRBAS score, VHI-10 score, maximum phonation time, and acoustic parameters.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 24.0. Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range according to data distribution, whereas categorical variables were presented as frequencies and percentages. Normality was assessed using the Shapiro–Wilk test. The independent-samples t-test or Mann–Whitney U test was used for two-group comparisons, while one-way ANOVA or Kruskal–Wallis test was applied for comparisons involving more than two

groups. Categorical variables were analyzed using the chi-square test or Fisher’s exact test. Correlations between endoscopic, perceptual, and acoustic voice parameters were assessed using Pearson’s or Spearman’s correlation coefficient as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 85 patients with persistent hoarseness and endoscopically identified vocal cord lesions were evaluated. The mean age of the study population was 44.36 ± 12.48 years. The largest proportion of patients belonged to the 41–50-year age group (27.06%). Males constituted 61.18% of the study population. Hoarseness of 3 weeks to 3 months was observed in 36.47% of patients, while 14.12% had symptoms persisting for more than one year. Vocal abuse/excessive voice use was the most frequently identified associated factor (49.41%), followed by smoking (36.47%) and symptoms suggestive of laryngopharyngeal reflux (34.12%).

Table 1. Demographic and Clinical Profile of the Study population (n=85)

Variable	Number (n)	Percentage (%)
Age group (years)		
18–30	16	18.82
31–40	20	23.53
41–50	23	27.06
51–60	17	20.00
>60	9	10.59
Sex		
Male	52	61.18
Female	33	38.82
Duration of hoarseness		
3 weeks–3 months	31	36.47
>3–6 months	24	28.24
>6–12 months	18	21.18
>12 months	12	14.12
Occupational voice demand		
High	30	35.29
Moderate	32	37.65
Low	23	27.06
Associated factors*		
Vocal abuse/excessive voice use	42	49.41
Smoking	31	36.47
Tobacco chewing	19	22.35
Alcohol consumption	24	28.24
Symptoms of laryngopharyngeal reflux	29	34.12
Chronic cough/throat clearing	21	24.71

Associated factors were not mutually exclusive.

Vocal nodules were the most common lesion and were observed in 22 patients (25.88%),

followed by vocal polyps in 18 (21.18%) and vocal cord cysts in 10 (11.76%). Reinke’s

edema was identified in 9 patients (10.59%), while leukoplakia was detected in 8 patients (9.41%). Vocal nodules were more frequently observed among females, whereas polyps, leukoplakia, granulomas, and other localized

lesions were more common among males. However, the overall association between sex and type of vocal cord lesion was not statistically significant ($p=0.151$).

Table 2. Distribution of Vocal Cord Lesions according to Sex (n=85)

Type of lesion	Total n (%)	Male n (%)	Female n (%)	p-value
Vocal nodules	22 (25.88)	8 (36.36)	14 (63.64)	
Vocal polyp	18 (21.18)	13 (72.22)	5 (27.78)	
Vocal cord cyst	10 (11.76)	5 (50.00)	5 (50.00)	
Reinke's edema	9 (10.59)	6 (66.67)	3 (33.33)	
Leukoplakia	8 (9.41)	7 (87.50)	1 (12.50)	
Papillomatous lesion	6 (7.06)	4 (66.67)	2 (33.33)	
Granuloma	7 (8.24)	5 (71.43)	2 (28.57)	
Other localized benign lesions	5 (5.88)	4 (80.00)	1 (20.00)	0.151
Total	85 (100.00)	52 (61.18)	33 (38.82)	

*Percentages in male and female columns represent proportions within each lesion category. p-value was calculated using the chi-square/Fisher's exact test as appropriate.

Endoscopic evaluation demonstrated marked differences in lesion morphology. Bilateral involvement was particularly frequent in vocal nodules (81.82%) and Reinke's edema (88.89%), whereas most polyps, cysts, and leukoplakic lesions were unilateral. The difference in bilateral involvement among lesion groups was statistically significant ($p<0.001$).

Reduced or absent mucosal wave was most frequently observed in leukoplakia (87.50%) and cystic lesions (70.00%) and also differed significantly across lesion types ($p=0.004$). Irregular surface morphology was present in all patients with leukoplakia and showed a significant association with lesion type ($p<0.001$).

Table 3. Endoscopic Characteristics According to Type of Vocal Cord Lesion

Endoscopic characteristic	Nodules n=22	Polyp n=18	Cyst n=10	Reinke's edema n=9	Leukoplakia n=8	Others n=18	p-value
Bilateral involvement	18 (81.82)	2 (11.11)	2 (20.00)	8 (88.89)	1 (12.50)	5 (27.78)	<0.001
Incomplete glottic closure	15 (68.18)	12 (66.67)	7 (70.00)	6 (66.67)	5 (62.50)	10 (55.56)	0.966
Reduced/absent mucosal wave	4 (18.18)	6 (33.33)	7 (70.00)	6 (66.67)	7 (87.50)	9 (50.00)	0.004
Irregular surface	2 (9.09)	3 (16.67)	2 (20.00)	3 (33.33)	8 (100.00)	8 (44.44)	<0.001
Supraglottic hyperfunction	8 (36.36)	7 (38.89)	4 (40.00)	3 (33.33)	3 (37.50)	6 (33.33)	0.999

Values are expressed as n (%). "Others" included papillomatous lesions, granulomas, and other localized benign lesions. Perceptual voice assessment demonstrated significant differences in most components of the GRBAS scale. Overall grade of dysphonia and roughness were greatest among patients

with leukoplakia, followed by Reinke's edema. Mean VHI-10 score also varied significantly according to lesion type ($p<0.001$), with the highest mean score observed among patients with leukoplakia (27.10 ± 5.80). Asthenia showed no statistically significant variation between lesion groups ($p=0.215$).

Table 4. Comparison of GRBAS and VHI-10 scores according to vocal cord lesion

Voice parameter	Nodules n=22	Polyp n=18	Cyst n=10	Reinke's edema n=9	Leukoplakia n=8	Others n=18	p-value
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Grade (G)	1.45 ± 0.51	1.83 ± 0.62	1.70 ± 0.48	2.11 ± 0.60	2.38 ± 0.52	1.89 ± 0.68	0.004
Roughness (R)	1.55 ± 0.60	1.89 ± 0.58	1.70 ± 0.48	2.22 ± 0.67	2.50 ± 0.53	1.94 ± 0.64	0.003
Breathiness (B)	1.18 ± 0.50	1.56 ± 0.62	1.50 ± 0.53	1.67 ± 0.50	1.88 ± 0.64	1.61 ± 0.61	0.041
Asthenia (A)	0.73 ± 0.46	0.83 ± 0.51	0.90 ± 0.57	1.11 ± 0.60	1.25 ± 0.71	0.94 ± 0.54	0.215
Strain (S)	1.27 ± 0.55	1.61 ± 0.61	1.40 ± 0.52	1.78 ± 0.67	2.00 ± 0.53	1.56 ± 0.62	0.046
VHI-10 score	15.80 ± 5.10	20.20 ± 6.00	18.90 ± 5.40	23.40 ± 6.20	27.10 ± 5.80	21.80 ± 6.70	<0.001

Values are expressed as mean ± standard deviation. Comparison was performed using one-way ANOVA/Kruskal-Wallis test as appropriate.

According to the overall GRBAS grade, 26 patients (30.59%) had mild dysphonia, 37 (43.53%) had moderate dysphonia, and 22 (25.88%) had severe dysphonia. Increasing

severity of dysphonia was associated with progressively higher jitter, shimmer, S/Z ratio, and VHI-10 scores and progressively lower HNR and maximum phonation time. These differences were statistically significant. Mean maximum phonation time decreased from 15.30 ± 3.10 seconds in mild dysphonia to 8.60 ± 2.40 seconds in severe dysphonia (p<0.001).

Table 5. Acoustic, Aerodynamic and VHI-10 Parameters According to Severity of Dysphonia

Parameter	Mild n=26 (30.59%)	Moderate n=37 (43.53%)	Severe n=22 (25.88%)	p-value
Fundamental frequency, F0 (Hz)	185.40 ± 31.20	173.80 ± 29.40	161.90 ± 28.70	0.028
Jitter (%)	0.82 ± 0.26	1.24 ± 0.39	1.71 ± 0.48	<0.001
Shimmer (%)	3.24 ± 0.88	4.69 ± 1.15	6.21 ± 1.42	<0.001
HNR (dB)	20.80 ± 3.50	17.20 ± 3.10	13.90 ± 2.80	<0.001
Maximum phonation time (seconds)	15.30 ± 3.10	11.80 ± 2.70	8.60 ± 2.40	<0.001
S/Z ratio	1.08 ± 0.13	1.23 ± 0.18	1.42 ± 0.22	<0.001
VHI-10 score	12.80 ± 4.30	20.40 ± 4.80	29.10 ± 5.20	<0.001

Values are expressed as mean ± standard deviation.

Correlation analysis demonstrated a strong positive relationship between the VHI-10 score and overall perceptual grade of dysphonia (r=0.69, p<0.001). Higher VHI-10 scores were

also positively correlated with jitter and shimmer, whereas significant inverse correlations were observed with HNR and maximum phonation time. The overall GRBAS grade demonstrated a significant negative correlation with maximum phonation time.

Table: 6. Correlation between Perceptual, Acoustic, Aerodynamic and Quality-of-Life Parameters

Variables correlated	Correlation coefficient (r)	p-value
VHI-10 vs overall GRBAS grade	0.69	<0.001
VHI-10 vs jitter (%)	0.58	<0.001
VHI-10 vs shimmer (%)	0.61	<0.001
VHI-10 vs HNR	-0.55	<0.001
VHI-10 vs maximum phonation time	-0.63	<0.001
GRBAS grade vs maximum phonation time	-0.59	<0.001

Overall, vocal nodules and polyps constituted the predominant lesions among patients presenting with persistent hoarseness. Significant variation was observed among lesion types in bilateral involvement, mucosal-wave abnormality, surface

morphology, perceptual voice impairment, and VHI-10 scores.

DISCUSSION

The present study evaluated 85 patients with persistent hoarseness and demonstrated that vocal cord lesions occurred predominantly in middle-aged adults, with a mean age of 44.36 ± 12.48 years and the highest proportion in the 41–50-year age group (27.06%). Males constituted 61.18% of patients. Vocal abuse or excessive voice use was identified in 49.41%, smoking in 36.47%, and symptoms suggestive of laryngopharyngeal reflux in 34.12%. Furthermore, 36.47% of patients presented within 3 weeks–3 months of onset of hoarseness. These observations were comparable with **Vivek et al. (2020)**, who evaluated 70 patients with hoarseness and reported male predominance of 78.6%, with 22.9% each belonging to the 31–40- and 51–60-year age groups. Voice abuse was reported in 41.4% of their patients, while 47.1% presented within 1–3 months. Smoking was an important predisposing habit, being reported in 54.29% of patients. The relatively high frequency of vocal abuse in both studies emphasized the contribution of repetitive phonotrauma to persistent voice symptoms.⁸ Vocal nodules constituted the most frequent lesion in the present study, affecting 22 patients (25.88%), followed by vocal polyps in 18 (21.18%), vocal cord cysts in 10 (11.76%), Reinke's edema in 9 (10.59%), and leukoplakia in 8 (9.41%). Although the overall study population showed male predominance, nodules were more frequent among females, with 14 of 22 cases (63.64%), whereas polyps showed male predominance, with 13 of 18 cases (72.22%). The association between sex and lesion type was not statistically significant ($p=0.151$). **Malik et al. (2019)** studied 50 patients with benign vocal cord lesions and reported polyps as the most common lesion (56%), followed by nodules (32%), cysts (10%), and papilloma (2%). Their study also showed an overall male predominance of 70%, compared with 61.18% in the present study. Interestingly, 75% of vocal nodules in their series were bilateral, which was close to the bilateral involvement of 81.82% observed among nodules in the present study. Differences in the relative frequency of nodules and polyps may reflect variations in occupational voice demand, referral patterns, and patient selection.⁹ Endoscopic examination in the present study revealed significant lesion-specific differences in vocal fold morphology. Bilateral involvement was observed in 81.82% of nodules and 88.89% of patients with Reinke's edema, whereas polyps (11.11%), cysts (20.00%), and leukoplakia (12.50%) were predominantly unilateral ($p<0.001$). Reduced or absent mucosal wave was present in 70.00% of cysts, 66.67% of

Reinke's edema, and 87.50% of leukoplakic lesions, compared with 18.18% of nodules and 33.33% of polyps ($p=0.004$). These findings were supported by **Shohet et al. (1996)**, who studied 32 patients with vocal fold cysts, polyps, and nodules using videostroboscopy and found that the mucosal wave was absent or diminished in 100% of true vocal fold cysts, whereas it was present or increased in 80% of vocal polyps ($p<0.05$). In comparison, the present study demonstrated a reduced/absent wave in 70.00% of cysts and 33.33% of polyps, confirming that impairment of the mucosal wave was considerably greater with cystic lesions than with polyps.¹⁰

Perceptual voice assessment in the present study demonstrated significant differences among lesion types for overall grade of dysphonia ($p=0.004$), roughness ($p=0.003$), breathiness ($p=0.041$), and strain ($p=0.046$). Leukoplakia produced the highest mean grade (2.38 ± 0.52), roughness (2.50 ± 0.53), and VHI-10 score (27.10 ± 5.80), while Reinke's edema was associated with a grade score of 2.11 ± 0.60 and VHI-10 of 23.40 ± 6.20 .

Nacci et al. (2017) evaluated 40 patients with organic dysphonia and demonstrated substantial voice impairment among patients with polyps, nodules, cysts, and Reinke's edema. Their preoperative VHI scores were 37.2 ± 16.6 for polyps, 32.1 ± 12.5 for nodules, 41.5 ± 15.9 for cysts, and 33.3 ± 6.7 for Reinke's edema. Reinke's edema also showed particularly marked acoustic abnormalities, with jitter of $4.55 \pm 1.25\%$ and shimmer of $11.46 \pm 3.23\%$. Although their study used the full VHI rather than VHI-10, both studies demonstrated that structural vocal fold abnormalities were accompanied by substantial patient-perceived and objectively measurable voice impairment.¹¹ The present study further demonstrated progressive deterioration of acoustic voice quality with increasing perceptual severity of dysphonia. Jitter increased from $0.82 \pm 0.26\%$ in mild dysphonia to $1.24 \pm 0.39\%$ in moderate and $1.71 \pm 0.48\%$ in severe dysphonia ($p<0.001$). Similarly, shimmer increased from $3.24 \pm 0.88\%$ to $4.69 \pm 1.15\%$ and $6.21 \pm 1.42\%$, respectively ($p<0.001$), whereas HNR progressively decreased from 20.80 ± 3.50 dB to 17.20 ± 3.10 dB and 13.90 ± 2.80 dB ($p<0.001$).

Jiang et al. (2009) objectively evaluated pathological voices and reported MDVP jitter values of $0.40 \pm 0.19\%$ in normal subjects, $0.59 \pm 0.23\%$ in patients with nodules, and $1.02 \pm 1.17\%$ in those with polyps. Corresponding shimmer values were $0.91 \pm 0.72\%$, $1.28 \pm 0.69\%$, and $1.59 \pm 1.15\%$, respectively. Signal-to-noise ratio also decreased from 31.2 ± 3.08 dB in normal subjects to 29.3 ± 3.67 dB in nodules

and 25.5 ± 8.2 dB in polyps. Significant differences were observed for several perturbation measures ($p < 0.05$), supporting the present observation that increasing vocal pathology and perceptual impairment were accompanied by increased frequency and amplitude perturbation and reduced harmonic quality.¹² Aerodynamic impairment was another important finding in the present study. Maximum phonation time progressively decreased from 15.30 ± 3.10 seconds among patients with mild dysphonia to 11.80 ± 2.70 seconds in moderate dysphonia and 8.60 ± 2.40 seconds in severe dysphonia ($p < 0.001$). Simultaneously, the S/Z ratio increased from 1.08 ± 0.13 to 1.23 ± 0.18 and 1.42 ± 0.22 ($p < 0.001$), indicating progressive reduction in phonatory efficiency. **Dar et al. (2019)** compared 41 patients with benign vocal fold lesions with 41 healthy controls and reported a mean MPT of 14.42 ± 5.62 seconds in affected males compared with 18.15 ± 5.88 seconds in healthy males. Among females, MPT was 10.81 ± 3.44 seconds in patients with lesions compared with 15.72 ± 6.21 seconds in controls, with the difference in females reaching statistical significance ($p = 0.003$). Their findings supported the progressively shortened MPT observed in the present study, particularly among patients with severe dysphonia.¹³ Voice-related quality of life deteriorated markedly with increasing severity of dysphonia in the present study. Mean VHI-10 scores increased from 12.80 ± 4.30 among patients with mild dysphonia to 20.40 ± 4.80 in moderate dysphonia and 29.10 ± 5.20 in severe dysphonia ($p < 0.001$). The moderate dysphonia group in the present study therefore had a VHI-10 score particularly close to that reported by **Singh et al. (2022)**. In their prospective study of 53 patients with benign vocal cord lesions, the mean preoperative VHI-10 was 20.7 ± 3.5 . Vocal polyps accounted for 43.3% and nodules for 30.1% of their cases. Following treatment, the VHI-10 decreased to 12.6 ± 2.5 at 4 weeks ($p = 0.001$) and to 8.5 ± 2.3 at 8 weeks ($p < 0.001$). The close agreement between their baseline VHI-10 and the value of 20.40 ± 4.80 among patients with moderate dysphonia in the present study supported the usefulness of VHI-10 for quantifying the functional burden associated with vocal cord lesions.¹⁴ Correlation analysis in the present study further established that subjective voice handicap reflected measurable abnormalities in perceptual, acoustic, and aerodynamic voice function. VHI-10 showed a strong positive correlation with the overall GRBAS grade ($r = 0.69$, $p < 0.001$), jitter ($r = 0.58$, $p < 0.001$), and shimmer ($r = 0.61$, $p < 0.001$), while

inverse correlations were observed with HNR ($r = -0.55$, $p < 0.001$) and maximum phonation time ($r = -0.63$, $p < 0.001$). GRBAS grade was also inversely correlated with MPT ($r = -0.59$, $p < 0.001$). **Sasindran et al. (2019)** evaluated 40 patients with benign vocal fold lesions using videostroboscopy and VHI and demonstrated a significant relationship between patient-perceived voice impairment and objective vocal fold function, particularly mucosal-wave abnormalities. They observed diminished or absent mucosal waves in 100% of vocal fold cysts, while the mucosal wave remained present in approximately 60% of polyps; significant improvement in both VHI and stroboscopic parameters occurred following treatment ($p < 0.0001$). Taken together with the correlations found in the present study, these observations indicated that perceptual assessment, patient-reported handicap, acoustic analysis, aerodynamic testing, and endoscopic examination provide complementary information and are best interpreted as components of a multidimensional evaluation of persistent hoarseness.¹⁵

CONCLUSION

Persistent hoarseness was commonly associated with structural vocal cord lesions, with vocal nodules and polyps being the predominant abnormalities. Endoscopic evaluation demonstrated significant differences in lesion laterality, mucosal wave, and surface characteristics. Increasing severity of dysphonia was associated with worsening acoustic and aerodynamic parameters and higher VHI-10 scores. A multidimensional assessment combining clinical examination, endoscopy, perceptual evaluation, and objective voice analysis was useful for comprehensive evaluation of patients with vocal cord lesions.

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