

# Multi Parametric Voice Assessment: Sri Ramachandra University Protocol

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**Abstract** Emergence of “Voice specialty clinics” in ENT and Speech Language Pathologist (SLP) practice in India necessitates development of standard protocols for assessment and management of voice disorders. Based on recommendations from European Laryngological Society in Dejonckere (Eur Arch Otorhinolaryngol 258:77–82, 2001), a comprehensive voice assessment protocol was adapted for Indian population. This study aimed at verifying the face validity and feasibility of using the developed voice assessment protocol in a multi specialty tertiary care hospital. It included: history, clinical examination, visual analysis, perceptual analysis, aerodynamic measures, acoustic analysis and patients’ self assessment of voice. The developed protocol was administered on 200 patients with voice concerns and problems. Correlation of self assessment with the assessment by the professionals was done using Kendall tau\_b correlation test. The scores of self assessment did not correlate significantly with acoustic measures. Differences in lab findings and self percept of voice indicated that these two were complementary measures in the protocol. Further, diagnosis and management decisions were arrived through a consensus discussion involving the ENT surgeon, SLP and the patient. Vocal hygiene and voice conservation were

advised to all patients. Recommendations for voice therapy and/or surgery were provided based on findings from the protocol. The study demonstrated feasibility of using a comprehensive protocol for effective documentation, comparisons, review, training and treatment planning.

**Keywords** Voice protocol · Multi-parametric analysis · Self assessment · Clinical decisions

## Introduction

Voice disorders are deviations in terms of ‘quality, pitch, loudness, or flexibility in voice’ from the voices of others of similar age, sex and cultural groups [1, 2]. They are classified as organic, functional or a combination of both [3]. According to a study in 2007 [4], around six percent of the general population in the world experiences voice problem. A survey in 2008, on professional voice users in India estimates an alarming 40–50% incidence of voice disorders among singers, teachers, politicians and vendors (hawkers) [5]. Although, voice disorders are not life threatening (other than malignancies), they impose a significant impact on day- to- day activities [6]. According to Smith et al., the estimate of the impact of voice disorders is found to be similar to impact of life threatening diseases such as cancer [7]. These have necessitated the concerned to reach voice clinics for help in recent years.

Voice function is multidimensional and complete analysis of all aspects of the voice problem such as structural and behavioral changes, functional impact of voice etc. is essential. So, a basic comprehensive protocol is needed and will be useful to assess organic and functional voice disorders (dysphonia). Such a protocol will also be useful in making comparisons with literature when presenting/

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publishing the results of voice analysis/treatments, and meta-analysis. In most voice clinics, the ENT surgeon makes diagnosis based on clinical and endoscopic examination of the larynx. The speech pathologist evaluates the voice for its function perceptually and acoustically (if available) after a referral from the ENT surgeon. Decision on management is made after these initial assessments by the professionals (independently/jointly).

In the recent years, voice facilities in India have been improving and professionals involved are increasingly dependent on each other to arrive at diagnostic and treatment decisions. This proposed comprehensive protocol will also facilitate communication of results among professionals (ENT surgeons, SLP, referring specialists, etc.) and including the patient while making decisions on management, hence leading to better patient care, and documentation.

The protocol is based on the framework proposed by the European Laryngological Society. The European Laryngological Society (ELS) guidelines primarily advocate a basic non-sophisticated multi parametric approach to voice assessment. The guidelines of the ELS include five components: perceptual evaluation, stroboscopy, acoustic analysis, aerodynamic measures, and self-evaluation. In the same line the following protocol was proposed considering economy of time, professionals involved and instrumentation to suit Indian needs, yet meet international standards.

### Aim of the Study

The present study aimed (1) To develop a comprehensive protocol to assess organic and functional voice disorders (2) To check face validity and feasibility of using the comprehensive protocol in an interdisciplinary voice clinic of a tertiary care centre.

### Method

Based on the recommendations made by ELS a comprehensive voice assessment protocol was developed. The protocol was given to four ENT surgeons and Speech Pathologists for content verification. The ENT surgeons and the Speech pathologists were asked to include and modify the protocol to meet the needs of the Indian scenario. The suggestions and modifications were incorporated for the final version of the voice assessment protocol. The developed protocol was administered on 200 patients who reported to the hospital with voice related concerns and problems. A data recording sheet was constructed to accommodate all components of voice assessment and the data was subjected to statistical analysis.

### Analysis

1. Correlating the subjective self assessment and a multiparametric acoustic analysis using Kendall tau\_b correlation test.
2. Classification of voice disorders and management decision based on the findings from the protocol.

### Results and Discussion

The results are presented in three sections:

- I. The protocol that was developed (Annexure 1)
- II. Correlation of patients' self assessment of voice and acoustic analysis by the professional
- III. Categorization of voice disorders and management decisions

#### Development of the Protocol

A culture specific voice assessment protocol had been developed based on ELS protocol and it included:

1. Significant history
2. Clinical examination based on physical inspection and indirect laryngeal examination.
3. *Visual analysis*: It involved stroboscopic assessment of parameters such as glottal closure pattern [8], regularity, symmetry of the vocal fold vibration, mucosal wave, amplitude of vocal cord vibration, Non vibratory portion and hyperadduction of ventricular band.
4. *Perceptual assessment*: It included auditory perceptual assessment on a GRBAS scale [9] (G- Grade; R- Roughness; B- Breathiness; A- Asthenia and S- Strained) in 'speaking voice' (spontaneous speech/reading/counting numbers) and voice profile (pitch, loudness, quality, pitch breaks and voice breaks) in 'phonated voice' (sustained vowels) by the Speech pathologist.

**Table 1** Kendall's tau\_b correlation between scores of V-DOP and parameters of the acoustic measures

	Jitter (%)	I <sub>0</sub> -low dB (A)	F <sub>0</sub> -high (Hz)	MPT (sec)	DSI
Severity	-0.03	-0.01	-0.46*	0.02	-0.01
Physical	0.04	-0.03	-0.01	-0.3*	0.03
Emotional	0.00	0.04	0.06	-0.01	0.17
Functional	0.02	0.06	0.05	-0.14	0.04
Total	0.03	0.09	0.04	-0.09	0.03

\* Correlation is significant at 0.05 level

**Table 2** Clinical diagnosis and treatment decisions of organic voice disorders

Voice disorder	No. of subjects	Diagnosis	Criteria for choice of management (information on visual analysis)	Treatment decisions
Vocal fold nodule (early)	23 (7 M and 16 F)	Hyperfunctional voice disorder	Soft pliable nodules with mucosal waves present	Voice therapy—breathing and vocal function exercises
Vocal fold nodule (organized)	2 (1 M and 1 F)	Hyperfunctional voice disorder	Organized nodule, stiff and waves absent at the site, tensed larynx (MTD grade I, II or III)	Trial Voice therapy for 1 month focusing on reduction of vocal hyperfunction, Re- assessment and microlaryngeal surgery (MLS) followed by voice therapy
Chronic laryngitis/vocal fold scarring	16 (7 M and 9 F)	Hyperfunctional voice disorder	Inflammation and hypertrophied larynx, stiffness of cord increases; mucosal wave reduced or absent at site	Anti inflammatory medications, Voice therapy to unlearn hyperfunctional behaviors
Vocal fold polyp/polypoidal degeneration	16 (11 M and 5 F)	Hyperfunctional voice disorder	Soft pliable polyp; increased mass; aperiodic and asymmetric movements; compensatory hyperfunction. (MTD grade I, II or III)	Microlaryngeal surgery (MLS) followed by voice therapy
Vocal fold papilloma	2 (2 M)	Hyperfunctional voice disorder	Multiple growth at glottis or subglottis; stiff and waves absent at the site	Microlaryngeal surgery (MLS) followed by voice therapy
Glottal web	5 (5 M)	Hyperfunctional voice disorder	Reduced vibratory area	Excision of the web
LPR	12 (8 M and 4 F)	Hyperfunctional voice disorder	Vocal fold edema, interarytenoid band and arytenoid congestion	Proton pump inhibitors (PPI) and Prokinetics, lifestyle modification and follow up
Vocal fold edema	14 (4 M and 10 F)	Hyperfunctional voice disorder	Increased mass and aperiodic and asymmetrical; compensatory hyperfunction (MTD grade I, II or III)	Anti inflammatory medications and voice therapy
Unilateral vocal fold paralysis/paresis	20 (12 M and 8 F)	Hypofunctional voice disorder	Bowing of vocal folds, level difference, compensatory hyperfunction (MTD grade I, II or III)	Voice therapy—effort closure exercises and vocal function exercises for 3 months, Re-assessment and medialization thyroplasty
Keratosis	10 (5 M and 5 F)	Hyperfunctional voice disorder	Leukoplakia growth or plaque, stiff and waves absent at the site, tensed larynx (MTD grade I, II or III)	Microlaryngeal surgery (MLS) followed by voice therapy
Sulcus vocalis	13 (10 M and 3 F)	Hypofunctional voice disorder	Decreased mass and increased stiffness, reduced/absent mucosal wave and amplitude; compensatory hyperfunction (MTD grade I, II or III)	Fat injection laryngoplasty followed by voice therapy
Contact ulcer	1 (1 M)	Hyperfunctional voice disorder	Ulceration, inflammation, tensed larynx (MTD grade I, II or III)	Anti inflammatory medications and voice therapy
Hematoma	2 (2 M)	Hyperfunctional voice disorder	Localized collection of blood, reduced mucosal wave, tensed larynx (MTD grade I, II or III)	Microlaryngeal surgery (MLS) followed by voice therapy
Intracordal cyst	9 (3 M and 6 F)	Hyperfunctional voice disorder	Stiff, aperiodic, compensatory hyperfunction	Microlaryngeal surgery (MLS) followed by voice therapy
Ectasia	1 (1 F)	Hyperfunctional voice disorder	Dilated blood vessel, aperiodic, reduced amplitude and mucosal wave	Voice rest

**Table 2** continued

Voice disorder	No. of subjects	Diagnosis	Criteria for choice of management (information on visual analysis)	Treatment decisions
Adductor spasmodic dysphonia	1 (1 F)	Hyperfunctional voice disorder	Quick adductory movements and tensed larynx	Neurological evaluation and voice therapy
Laryngeal tremor	1 (1 M)	Hyperfunctional voice disorder	Rhythmic movement, tensed larynx (MTD grade I, II or III)	Neurological evaluation and voice therapy
Presbylarynges	2 (2 M)	Hypofunctional voice disorder	Atrophy and bowing of vocal fold, compensatory hyperfunction (MTD grade I, II or III)	Voice therapy

5. *Aerodynamic measures*: It included simple aerodynamic measurements such as Maximum Phonation Time (MPT) and s/z ratio.
6. *Acoustic analysis*: It included frequency and intensity parameters, perturbation related measures, and Dysphonia Severity Index (DSI), a single weighted multiparametric measure [10].
7. *Self evaluation by the patient*: Voice Disorder Outcome Profile (V-DOP) developed by Mahalingam et al. [11] was administered for assessing individual’s percept of voice problems in domains such as physical, emotional and functional aspects for Indian population. [Annexure 2 (English version) and Annexure 3 (Tamil version)]
8. *Reporting*: The ENT surgeon made the preliminary medical diagnosis. The SLP evaluated vocal functions and behaviors. Final diagnosis and recommendation for treatment was decided by the ENT surgeon and the SLP.

**Correlation of Patients’ Self Assessment of Voice and Acoustic Analysis by the Professional**

Correlation between the physical, emotional, functional domains, total score and self perceived severity of V-DOP with the parameters of acoustic measures was evaluated using Kendaul tau\_b correlation test. The results are tabulated in Table 1. The overall perceived severity of the voice disorder showed a negative correlation ( $r = -0.46$ ;  $P < 0.05$ ) with F<sub>0</sub>-high (Hz). This probably is due to association of the patient’s inability to sustain high pitches (restricted frequency range). There was a negative correlation ( $r = -0.3$ ;  $P < 0.05$ ) between physical domain and the MPT. Reduced MPT implied poor coordination between breathing and phonation or incapacity of the voice production mechanism. This reflected in elevated physical (discomfort) score and was statistically significant. However, the total V-DOP score did not correlate significantly with any of the parameters of acoustic analysis i.e. jitter %, I<sub>0</sub>-low dB (A), F<sub>0</sub>-high (Hz), maximum phonation time (sec) and DSI.

**Categorization of Voice Disorders and Management Decisions**

Based on the information from history, behavioral observation and visual analysis, clinical diagnosis was made as organic or functional voice disorder. The clinical diagnosis and treatment decisions of Organic and Functional voice disorders are given in Tables 2 and 3, respectively. All patients presented with changes in voice with varying degrees of severity. Acoustic and aerodynamic analysis allowed documentation of vocal function (allowing scope

**Table 3** Clinical diagnosis and treatment decisions of Functional voice disorders

Voice disorder	No. of subjects	Diagnosis	Criteria for choice of management (information on visual analysis)	Treatment decisions
Dysphonia	21 (9 M and 12 F)	Hyperfunctional voice disorder	Tensed larynx	Voice therapy—breathing and vocal function exercises
Plica ventricularis	2 (2 M)	Hyperfunctional voice disorder	Ventricular band hyperadduction and strain	Voice therapy—vocal function exercises
Muscle tension dysphonia (grades I, II, and III)	7 (4 M and 3 F)	Hyperfunctional voice disorder	Excessive muscle tension, normal structures, tensed larynx	Voice therapy—laryngeal massage, breathing and vocal function exercises
Functional aphonia	1 (1 F)	Hypofunctional voice disorder	Unable to adduct during phonation, but adducts during cough and laugh	Voice therapy
Puberphonia	19 (19 M)	Hyperfunctional voice disorder	Normal structures, stiff vocal folds, posterior glottic chink (in many), tensed larynx	Pitch alteration and vocal function exercises

Discussing specifics of every patient is beyond the scope of this article, and so most observable signs are documented in the above table

for comparisons during/after treatment). Self assessment provided scope to understand the impact of the voice change in the patient's life. The table below summarizes the choice of management. All subjects were counseled on vocal hygiene and conservative voice use. Adequate hydration, dietary modification to reduce reflux disease and refraining from abusive vocal behaviors were recommended.

## Conclusions

The study highlighted the feasibility of using a culturally adapted comprehensive protocol for inter-disciplinary approach to voice diagnostics and management. Differences in lab findings and self percept of voice indicated that these two are complementary measures for comprehensive voice analysis and treatment. Such information would be helpful in clinical decisions such as prioritizing patient selection for treatment. Addressing this difference through client education becomes crucial in management. Visualization of laryngeal function helped patients and family members to understand the mechanism of vocal function and hence aided in counseling to improve compliance in the treatment. The protocol also serves as an excellent tool for teaching juniors and residents in training.

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