VOICE EVALUATION: CLINICAL ASPECTS

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ABSTRACT:

Voice is a multidimensional series of measurable events and it is necessary that various dimensions of voice are measured to obtain an accurate knowledge about the vocal function. This article discusses the international status of voice evaluation and highlights the clinical voice evaluation as conducted at the Department of Speech Sciences, All India Institute of Speech and Hearing, Mysore. Also, suggestions regarding the minimum requirements for various clinics are made.

1. Voice Evaluation

"In the field of Otology and Audiology, several techniques for the clinical examination of auditory function have been established and standardized. As a result of the standardization of these techniques, it is possible to compare the auditory function of different subjects examined at different places and/or different occasions and to monitor the results of treatments in a reliable manner. With regard to phonation, various methods have been proposed and used by many clinicians and researchers all over the world. Unfortunately, none of these methods appears to be standardized on an international basis. For some of these techniques, such as stroboscopy of the vibrating vocal folds, airflow measurement, measurement of maximum phonation time and determination of the speech and vocal range, a majority of investigators seem to be in agreement in terms of the significance of these tests and the interpretation of the data thereby obtained. It might be a good time to discuss standardization of the clinical examination of voice" (Hirano, 1981).

Voice is defined as the laryngeal modulation of the pulmonary airstream, which is then further modified by the configuration of the vocal tract (Brackett, 1971). The production of voice is dependent on three primary factors; viz., 1) pulmonic air pressure, 2) laryngeal vibration and 3) transfer function of the vocal tract, with each of these factors having measurable parameters. Thus, voice is considered a multidimensional series of measurable events, implying that a single phonation can be assessed in many different ways. Further, development of technology has permitted the analysis and measurement of various types of parameters of voice.

The ability to predict and control vocal behavior needs exact knowledge obtained from measurement and analysis of various aspects of voice. The major purposes of voice evaluation are:

1) to determine the cause, precipitating & maintaining factors,
2) to determine the degree and extent of the cause,
3) to determine the severity of the problem,
4) to determine the prognosis and
5) to develop a therapeutic program.

Objective evaluation of voice becomes essential to facilitate better diagnosis & thus implication of better rehabilitative methods. This would also improve the efficiency of speech pathologists as has been done in the field of Audiology with the use of various diagnostic instruments. It is essential that a common standard of voice evaluation is followed to facilitate communication between all concerned.
2. Voice Evaluation:

INTERNATIONAL STATUS

Hirano (1989) has discussed the current international status of clinical voice evaluation on the basis of the answer to a questionnaire administered to laryngologists, phoniatritions and speech pathologists working in various parts of the world, which is summarized in Table 1.

Measurements and procedures used:

1. Air flow
   - Subglottic pressure
   - Glottal resistance
   - Glottal efficiency
   - AC/DC ratio
   - Airflow/intensity ratio
   - Phonation quotient (PQ)
   - Vocal Velocity Index (VVI)
   - Maximum Phonation Time (MPT)

2. Fo range
   - SPL range
   - Habitual Fo
   - Habitual SPL
   - Voice range profile
   - Vocal register examination.

3. Stroboscopy
   - video-stroboscopy
   - Ultra - High -speed photographs
   - Electrogloggiography
   - Photoelectric glottography
   - Ultra-sound glottography

4. Tape recording
   - Sound spectrogram
   - Pitch perturbation
   - Amplitude perturbation
   - S / N ratio
   - Noise energy measurement
   - Spectrum envelope
   - LTAS
   - Inverse filter acoustic
   - Inverse filter aerodynamic
   - VOT
Perceptual evaluation

Other acoustic analysis.

5. Laryngeal mirror

Telescopy of larynx
Fibroscopy of Larynx
Microscopy of larynx

6. X-ray Laryngography

Computed tomography
Magnetic resonance imaging

7. EMG needle surface

8. Vital capacity

pulmonary function test
Rib cage & abdominal movements

9. Audiometry

Table 1 depicting various measurements and procedures used in various setups all over the world. (Those underlined have been reported to be used by Speech Pathologists (more than 20%, Hirano, 1989). Those used at AIISH Mysore have been indicated by BOLD letters. Apart from these several other measure/ procedure/ examinations used at AIISH are discussed.

As voice production is a complex event in which auditory, acoustic and aerodynamic events are produced by the interaction of physiological mechanisms, it is necessary that as many vocal facets as possible are measured to get a complete and accurate picture of voice production. A complete evaluation should encompass case history, oral mechanism examination, tests for respiratory, laryngeal and resonatory systems. In the following discussion both qualitative and quantitative tests are included and the merits and implications of each test is discussed. Further normative data, where available are provided.

3.1 Case History:-

Brief case history facilitates the diagnosis & its mainly obtained by eliciting information from the patient regarding his voice problem. The case history used at the deptt. of Speech sciences, AIISH is given in Appendix A. The information obtained from the case history helps the diagnostician to hypothesize about the possible cause, its degree and extent which may be further confirmed by other tests.

3.2 Oral Mechanism Examination:-

An examination of the oral mechanism reveals the structural and functional status, which may be sometimes related to the current voice problem.
3.3 Evaluating the functions of the respiratory system:-

Abnormalities of the respiratory system may lead to voice problems as they affect the expiratory air necessary for speech. Hence it becomes necessary to evaluate the functions of the respiratory system in the case of a voice disorder.

3.3.1 Qualitative tests:- Evaluation of breathing habits:-

It would be necessary to analyze breathing habits for special types of voice problems associated with cerebral palsy or for cases of insufficient respiratory habits. In these cases the patients should be referred for a medical consultation.

3.3.2. Quantitative tests:-

3.3.2.1 Vital Capacity: It is the maximum volume of air which can be exhaled following deep inhalation by an individual. It provides an estimate of the amount of air potentially available for the production of voice. The normal vital capacity for an Indian adult male is 2500 ccs for female is 1500 ccs.

3.3.2.2. Mean airflow rate:- It is the amount of volume of air/unit time used during phonation. It provides information on the functioning and coordination of both the respiratory and laryngeal systems. The normal MAFR is 80 cc/sec to 200 cc/sec.

Both vital capacity and mean airflow can be measured using an expirograph. However, attempts have been made to estimate vital capacity, mean air flow rate and phonation quotient based on the measurement of height, weight and maximum phonation duration (Jain & Ramaiah), 1967; Verma et al., 1982; Nataraja & Rashmi, 1984; Rau & Beckett, 1984; Krishna Murthy, 1986; Sudhir Bhanu, 1987). Studies have repeatedly shown that it is possible to estimate the vital capacity of an individual, normal or dysphonic with an accuracy of +/-300 c.c., provided there is no gross or known respiratory pathology, by measuring height and weight of the individual. Further Rau & Beckett (1984) Sudhir Banu (1987), Krishna Murthy 1986 have suggested that mean air flow rate = (77 + 0.236PO), where PO = Vital Capacity/Maximum Phonation Duration. Thus using a weighing machine, measuring tape and a stop watch it is possible to estimate Vital Capacity, Phonation Quotient and Mean air flow rate of an individual.

Reduced vital capacity indicates abnormality in the respiratory system and normal vital capacity with very high or low mean airflow rate indicates abnormal laryngeal functioning. For example high AFR is obtained in patients with vocal fold paralysis (adductor type) and low MAFR is observed in spastic dysphonia.

Mean air flow rate as observed in different groups of dysphonics (both males & females) are shown low. (Based on Studies Conducted at AIISH.)

1. Functional voice disorders : 202 cc/sec
2. Vocal nodules : 310 cc/sec
3. Vocal cord paralysis : 332 cc/sec
4. Chronic laryngitis : 255 cc/sec
5. Other organic conditions : 192 cc/sec
3.3.2.3 Maximum duration of sustained blowing: This is the maximum length of time an individual can maintain an oral flow of air and can be measured with the help of a stop watch.

3.4 Evaluating the functions of the laryngeal system: These evaluations should preferably be done in a quite place.

3.4.1 Qualitative/Perceptual tests: Pitch, loudness & quality are the parameters which could be evaluated. Pitch is the psychological correlate of frequency and indicates the vibratory capability of the vocal folds. The level of the pitch could be assessed as high/low/normal. A part from this the stability of the pitch in phonation and breaks and tremors also need to be assessed. An audio training cassette could be used to aid the assessment of pitch & frequency. Loudness & quality of voice are relative in nature & controversy exists among researchers about these.

3.4.2 Quantitative measurements:

3.4.2.1 Modal frequency: The frequency most often used by an individual while he is in the act of producing spontaneous speech is termed modal frequency. The measurement of the modal frequency permits to know whether the individual is using appropriate pitch or not.

FO can be measured by using anyone of these instruments: Frequency meter, Visipitch, vocal-2. PM 100. Spectrogram, Digipitch, Computer with speech interface unit and software.

<table>
<thead>
<tr>
<th>Age Group in years</th>
<th>Normal fundamental frequency in Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
</tr>
<tr>
<td>4 - 7</td>
<td>233</td>
</tr>
<tr>
<td>7 - 11</td>
<td>255</td>
</tr>
<tr>
<td>11 - 13</td>
<td>247</td>
</tr>
<tr>
<td>14 - 15</td>
<td>177</td>
</tr>
<tr>
<td>16 - 25</td>
<td>139</td>
</tr>
<tr>
<td>26 - 35</td>
<td>142</td>
</tr>
<tr>
<td>36 - 45</td>
<td>147</td>
</tr>
<tr>
<td>46 - 55</td>
<td>148</td>
</tr>
<tr>
<td>56 - 65</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 2 showing Fundamental frequency in Speech for normal Indian population (Based on studies conducted at AIISH.)

3.4.2.2 Frequency range: It is the difference between the highest and the lowest frequencies an individual can phonate. As the measurement of this range has severe limitations, the frequency range used in speech and phonation are being used to assess the conditions of vocal system. During speech, using a normal phonatory mechanism, a certain degree of variability in frequency is expected and indeed is necessary. Too limited or too wide variation in frequency is an indication of abnormal functioning of the vocal system. However, even if an individual has frequency range within normal limits he may still use little inflection during speech. An octave and a half in males and two octaves in females is considered normal frequency range. This can be measured by using any of the instruments used to measure FO.
Table 3 showing the Frequency Range in Phonation and Speech in Normals and Dysphonics. (based on Studies conducted at AIISH).

*(The frequency range is measured as the difference between the highest and the lowest frequency and the mean is the mean of frequency ranges of the population specified.)*

### 3.4.2.3. Maximum Phonation Duration (MPD).

It is the maximum amount of time an individual can sustain phonation after taking a deep inhalation. It is the simplest test that demonstrates the status of the respiratory system and the relative efficiency of the interaction of the respiratory and laryngeal systems. Short phonation durations are associated with laryngeal pathology. The normal MPD for adult females and males ranges from 15 secs to 30 secs and can be measured using a stop watch.

Table 4 showing Maximum Phonation Duration for different Dysphonic groups.

1. Functional Voice disorders  
2. Vocal nodules  
3. Vocal cord paralysis  
4. Chronic Laryngitis  
5. Other organic Conditions  

### 3.4.2.4 Optimum Frequency: O.F. is the fundamental frequency of voice that is most suitable for a particular individual. This along with Fo will give an estimate of how much the subject is deviating from the optimum. The therapy can be focused towards modelling the pitch of the subject. At Speech Sciences Lab, AIISH, the resonance of the vocal tract is measured by feeding in frequency from ‘500’ to 8000 Hz into the Vocal tract. The obtained resonating frequency divided by ‘8’ for males and ‘9’ for females gives the optimum frequency.

### 3.4.2.5 s/z ratio: It is the ratio between the durations of sustained /z/ and /s/. The subject is instructed to sustain /s/ and /z/ as long as possible and the time is determined using a stop watch. This measure provides information about the laryngeal system, as in the production of /s/ vocal fold vibration does not occur whereas for /z/ it does. Normals s/z ratio ranges from 0.9 to 1.1. s/z ratio other than the normal range indicates laryngeal dysfunction.

Table 5 showing S/Z ratio in different groups of Dysphonias

1. Functional Voice disorder  
2. Vocal Nodule  
3. Vocal Cord paralysis  
4. Chronic Laryngitis  
5. Other Organic conditions
3.1.2.6 Jitter/ frequency fluctuations: Jitter is the cycle to cycle variation in period that occurs when an individual sustains phonation at a constant frequency. Some degree of Jitter exists in the laryngeal signal as it is Quasi-periodic. However, when adjacent periods become so dissimilar that perceptible noise is introduced into the overall spectrum the laryngeal dysfunction is suggested. Jitter greater than 3% is considered abnormal.

Jitter can be calculated by obtaining the wave form (Laryngeal) and calculating the ‘T’ taken for consecutive cycles. It is measured using the following formula:

\[ J = \frac{(T_1 - T_2) + (T_2 - T_3) + (T_3 - T_4) + T_4 - T_5}{MSEC}. \]

Where \( T_1, T_2, T_3, T_4, T_5 \) are periods for five consecutive cycles in the slottal wave forms. At Speech Sciences Lab AIISH, it is calculated from the laryngeal signal obtained using Electroglostograph.

<table>
<thead>
<tr>
<th>Phoneme</th>
<th>Normals Males</th>
<th>Normals Females</th>
<th>Dysphonics Males</th>
<th>Dysphonics Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>0.65</td>
<td>0.058</td>
<td>0.70</td>
<td>0.20</td>
</tr>
<tr>
<td>i</td>
<td>0.110</td>
<td>0.030</td>
<td>0.41</td>
<td>0.19</td>
</tr>
<tr>
<td>u</td>
<td>0.070</td>
<td>0.050</td>
<td>0.25</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Table 6 depicting mean jitter values in normals and dysphonics.

Variations in fundamental frequency in phonation greater than +/−3 Hz is considered as fluctuation in fundamental frequency and number of such variations within one second is termed speed of fluctuation. These two parameters have been found to differentiate dysphonics from normals and also different types of dysphonias (Kim et. al., 1982; Imaizumi et. al., 1980, Yoon et. al., 1984).

<table>
<thead>
<tr>
<th>Normal</th>
<th>Dysphonics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>Extent of fluctuations (In Hz)</td>
<td>3.00</td>
</tr>
<tr>
<td>Speed of fluctuations (No. of variations per sec.)</td>
<td>6.03</td>
</tr>
</tbody>
</table>

Table 7 showing the Extent and speed of Fluctuations in Fundamental Frequency in Normals and Dysphonics. Fig 1 shows the frequency and intensity curves used for the measurement of extent and speed of fluctuation in phonation.
3.4.2.7 Intensity Range: It is the maximum and minimum sound pressure levels an individual can produce at a comfortable phonation. As the measurement of this range has several limitations, intensity range in phonation and speech are being used for clinical evaluation of voice disorders. It is an estimate of the capability of the mechanism. Normal intensity range is from 40 to 80 dB and reduced intensity range is often caused by paralysis of vocal cords and some of the weakness of muscles of respiration. This can be measured by using SPL meter, PM - 100, Vocal - 2, Visipitch, etc.

<table>
<thead>
<tr>
<th><em>Intensity Range</em></th>
<th>Normals</th>
<th>Dysphonics</th>
</tr>
</thead>
<tbody>
<tr>
<td>(In relative dB)</td>
<td>Mean</td>
<td>Range</td>
</tr>
<tr>
<td>Phonation</td>
<td>4.00</td>
<td>1 - 11</td>
</tr>
<tr>
<td>Speech</td>
<td>25.00</td>
<td>16 - 38</td>
</tr>
</tbody>
</table>

Table 8 showing the Intensity Range in Phonation and Speech in Normals and Dysphonics.

*(Intensity range is measured as the difference between the highest and the lowest frequency and the mean is the mean of the intensity ranges of the population specified.)*

3.4.2.8 Shimmer: Shimmer refers to the cycle to cycle variations in amplitude that occur when an individual attempts to sustain phonation at a constant frequency & intensity. It estimates the glottal function.
Shimmer of 3% can be considered normal and above 3% is abnormal. At Speech Science Lab, AIISH shimmer is measured from glottal waveform Lx from using the formula

\[ S = (A_1 - A_2) + (A_2 - A_3) + (A_3 - A_4) + A_4 - A_3 \text{ dB} \]

4

Where \( A_1, A_2, A_3, A_4 \) and \( A_5 \) are the amplitudes of five consecutive cycles in the glottal wave form.

<table>
<thead>
<tr>
<th>Phoneme</th>
<th>Normals Males</th>
<th>Normals Females</th>
<th>Dysphonics Males</th>
<th>Dysphonics Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>.030</td>
<td>.70</td>
<td>1.78</td>
<td>.87</td>
</tr>
<tr>
<td>i</td>
<td>.070</td>
<td>.37</td>
<td>1.17</td>
<td>.91</td>
</tr>
<tr>
<td>u</td>
<td>.15</td>
<td>.44</td>
<td>1.74</td>
<td>.92</td>
</tr>
</tbody>
</table>

Table 9 showing mean shimmer values in normals and dysphonics.

Variations in Intensity in phonation greater than \(+/- 3\) dB is considered as fluctuation in intensity and number of such variations within one second is termed speed of fluctuation. These two parameters have been found to differentiate dysphonics from normals and also different types of dysphonias (Kim et al., 1982; Imaizumi et al., 1980, Yoon et al., 1984).

<table>
<thead>
<tr>
<th>Normal</th>
<th>Dysphonics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of fluctuations (in dB SPL)</td>
<td>Mean</td>
</tr>
<tr>
<td>3.00</td>
<td>0 - 4</td>
</tr>
<tr>
<td>Speed of fluctuations (No. of variation per sec)</td>
<td>Mean</td>
</tr>
<tr>
<td>1.00</td>
<td>0 - 4</td>
</tr>
</tbody>
</table>

Table 10 showing the Fluctuations in Intensity in Normals and Dysphonics.

3.4.2.9 Measurement of vocal fold vibration: There are various techniques to study the vibration/contact of the vocal folds, of which Electroglottography (EGG) and inverse filtering are the two non-invasive techniques. Lx waveform represents the contact area of the vocal folds and is usually obtained during sustained vowel phonation.

Lx waveform in normals is usually a triangular waveform with a skew to the left. The labels in the Lx wave such as the ones shown below (in fig. 2) represents the different positions of the vocal folds.
Fig. 3: Showing different phases of vibratory cycle in msec.

- $P_{3a}-P_{1}$ = Closing period.
- $P_{3b}-P_{2}$ = OPEN period (in $\approx 0.1\%$, $P_{3b} \approx P_{2}$)
- $P_{5}-P_{3b}$ = Opening period.
- $P_{5}-P_{5}$ = $\approx 0.1\%$ period.
- $P_{1}-P_{2}$ = Period of the vibratory cycle.
- $P_{4}-P_{2} = B_{1}$ = Base of contact phase.
- $P_{7}-P_{4} = B_{2}$ = Base of open phase.
- $H_{1}$ = Height of contact phase.
- $H_{2}$ = Height of open phase.

In normals, the wave shape is smooth and the closing phase is shorter than the opening phase. Various patterns distinguish the pathological states.

Apart from the wave shape, the speed quotient, the open quotient and the time taken for opening, closing, open, and closed phases of the vocal folds can be calculated from the Lx. Open quotient is the proportion of the period during which the glottis is open to the total period.

**Open quotient (OQ)**

\[
\text{OQ} = \frac{\text{Time for which the glottis is open (open phase)}}{\text{Total period}}
\]

This is always lesser than 1 and increases with increase in FO. At high FO glottal closure may not occur and OQ will be equal to one in this condition. Speed Quotient (SQ) measures the ratio of the opening and closing phases.

**Speed quotient (SQ)**

\[
\text{SQ} = \frac{\text{Opening Time (OT) (3-4)}}{\text{Closing Time (CT) (1-2)}}
\]

This is always greater than 'one' in normal conditions and varies directly with vocal intensity and is unaffected by FO.
Table 11 depicting OQ and SQ values for normals and dysphonics.

3.4.2.10. Inverse filtering:- The vocal tract acts as a filter allowing the resonance frequencies to pass through it. The resonances of vocal tract can be derived and a filter with its inverse can be constructed. Speech signal, when subjected to such a filter, will lose the effect of vocal tract and the original glottal waveform is restored. Inverse filtering can be done mechanically by a tube of mathematical calculations of digitized speech signal to obtain Lx waveforms. The same measurements for EGG will hold good for the inverse filtered glottal wave.

3.4.2.11. H/N Ratio:- It is the ratio between the sound pressure level of the harmonics and noise in a glottal signal. This can be obtained by measuring the intensity of the harmonics and the noise. Also a measurement of the number of harmonics visible in the glottal spectra can be determined. The rationale is that, as the breathiness increases, the level of the noise component raises and the value of the H/N ratio will decrease. Also, as the noise level increases, the number of harmonics visible gets reduced as the higher harmonics are masked. Therefore, these two measures indicate the amount of air passing through the open glottis from which the degree of breathiness/Hoarseness can be quantified. H/N ratio can be measured from the glottal spectra. The level of first harmonic to noise ratio is usually above 1.5 and the number of harmonics visible in the glottal spectra in normal conditions in 30 to 35. Reduced number indicates the degree of hoarseness.

Other measurements like LTAS (long-term-average-spectra), rise-time & fall-time could also be of use in voice evaluation.

3.5 Evaluation of the resonatory system:-

3.5.1. Qualitative tests:-

3.5.1.1. Resonance Profile:- This provides information about the resonatory system. A profile as suggested by Wilson (1979) is given below.

1. Hypernasality
   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
   | No | Yes |
   Hyponasal sounds

2. Hyponasality
   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
   | No | Yes |
   Hyponasal sounds
Indian Speech, Language and Hearing Tests - The ISHA Battery - 1990

3. Nasal emission of sounds
   
<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   Sounds emitted

4. Facial grimaces
   
<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
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</table>

   Describe

5. Articulation defective
   
   List defective sounds.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>

3.5.1.2. Test for Hyponasality:

The subject can be asked to blow the cheeks, blow a balloon, suck through a straw, phonate /i/ and sustain /s/ and nasal emission during this act can be checked for. Apart from this, suitable reading passages to test hypernasality could be constructed.

Conditions preventing velopharyngeal (VP) closure between the oro-pharynx and the naso-pharynx will produce excessive nasality and an obstruction in the posterior portion of the nasal passages or nasopharynx causes Denasality. Hyponasality can be detected by asking the subject to phonate /i/ and /s/ and placing the finger below his nostrils to check for air escape. As these sounds need a tight VP closure in normal conditions no air escape can be detected. Air escape suggests abnormal VP Closure. Also the patient could be instructed to suck through a straw and blow his cheeks to check for normal VP closure. Denasality could be detected by asking the subject to sustain a nasal continuant. If there is obstruction in the nasal passage then it will result in a failure of sustaining a nasal continuant.

3.5.2. Quantitative Tests:

3.5.2.1. TONAR: This gives the oral and nasal airflow ratio measured through an Acroometer during the production of different speech sounds. Decreased ratios indicate hypernasality and its degree and increased ratios indicate Hyponasality and its degree.

3.5.2.2. Nasalance: This also is a ratio of oral to nasal airflow and can be measured by instructing the patient to sustain vowels or utter words into a mouth piece with oral/ nasal divisions. The normal ratio computed is around 30. (Based on AIISH Studies)

3.6 Speech sample recording:

The importance of speech sample recording in serving as a reference for the patient in therapy and thus depicting the improvement is well known. It is essential for any further analysis as well. The speech sample should include a standardized reading passage, conversation, phonations of vowels and sustained /S/, /Z/ repetitions of /p/ /t/ /k/ for diadochokinetic rate measurements and sentences having words representing the vowels and consonants of the language being tested. Also, the record should have the identification of the patient for his name, age, sex and problem.
3.7. Diagnosis:-

It is essential that the diagnostician integrates the information from case history, oral mechanism examination and tests to diagnose the problem and its cause. Before considering the patient for voice therapy any pathology should be ruled out by a medical examination. If necessary the diagnostician can recommend other evaluations.

4. Minimum suggested requirements:-

So far, the clinical voice evaluation procedure has been discussed. However, it might not be possible for all the clinicians to evaluate all the parameters for lack of facilities. Hence different types of clinics can have different facilities depending upon their ability. However, the following have been suggested as the minimum requirements for different types of clinics.

4.1 Single person Clinic:

- Tape recorder
- Stop watch
- Pen torch
- Pitch pipe/audio-tape for ear training.

4.2. Medium Clinics: In addition to those mentioned in 4.1 the following may be included:

A Personal Computer (PC/XT) with A/D & D/A converter and necessary software. The software can be added in phases depending on the availability of funds.

4.3. Full-fledged clinic: In addition to the above other instruments like real fibrooptic time analyzers, glottographs and pneumotacho units, fibrooptic laryngoscope with video-recording facilities will be useful.

From the current technology these suggestions have been made. However, as technology advances more use of computers will be found. It is hoped that these will help to have a standard evaluation and reporting procedures throughout the country, which possibly would improve the therapy techniques also. It is hoped that these evaluation procedures would be used by speech clinicians to make contributions as a member of the team in the evaluation of voice disorders.

Reference

Indian Speech, Language and Hearing Tests - The ISHA Battery - 1990


Enclosure - 'A' CASE HISTORY FOR VOICE DISORDERS.

<table>
<thead>
<tr>
<th>Case Name:</th>
<th>No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age:</td>
<td>Date:</td>
</tr>
<tr>
<td>Sex:</td>
<td></td>
</tr>
</tbody>
</table>

Occupation:

Clinician:
1. Description of the problem and the case

2. Onset and duration of the problem:

3. (a) Does the subject get irritation/pain in the throat - While speaking While not speaking

(b) Does the subject have difficulty in swallowing solids/liquids

(c) Does the subject become aphonic, if he or she speaks for some time?

(d) Was the onset of voice problem sudden, gradual, others (intermittent)

(e) Does the severity of the problem vary? If yes, describe;

4. Use of voice in daily work:

(a) Does the subject indulge in excessive and loud speaking

(b) Does the subject work in a noise environment where speaking involved

(c) Is the subject exposed to heavy smoke chemical fumes sudden changes in temperature

5. Habits Smoking - If yes, how many a day Clearing of throat - If yes, how frequently Singing - if Yes, duration in a day formal singing informal singing immitating

Is the singer is a professional singer? Yes/ No

6. Medical history
7. History of previous treatment
   Medical
   Surgical
   Non-medical - voice therapy/ psycho-therapy/ behaviour therapy/ others (Specify)

8. Physical development - Normal/ abnormal
   Secondary sexual development - Normal/ abnormal

9. Associated problems-
   Sensory/ motor
   Behaviour deviations (if any)

10. Speech mechanism (structure and functions)

11. Secondaries (if any)

12. Voice:
    Habitual frequency

    a) Vowel /a/ Range /i/ Range /u/ Range
    ---- ----------------- ----------------- ----------------- 
    b) Reading
    c) Speaking
    d) Frequency Range Lowest
    e) Intensity Range Lowest

    Extent of fluctuations in frequency
    Extent of fluctuations in intensity

    Speed of fluctuations in frequency
    Speed of fluctuations in intensity

    Present/ absent

    Pitch breaks
    f) Optimum frequency (in Hz)
    g) Vital capacity in CCS
    h) Mean air flow rate (cc/sec)
    i) Phonation duration (sec)

    /a/ /i/ /u/ /z/ /s/ 

    1 1

    *= Natural frequency
    *= Optimum frequency

    Phonation quotient:
13. Glottogram:

<table>
<thead>
<tr>
<th>Ref: Wave Shape</th>
<th>Voltage:</th>
<th>Fo</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Wave</td>
<td>P1</td>
<td>P3</td>
</tr>
<tr>
<td>II Wave</td>
<td>PP2</td>
<td>P4</td>
</tr>
<tr>
<td>III Wave</td>
<td>P5</td>
<td>P6</td>
</tr>
<tr>
<td>IV Wave</td>
<td>P7</td>
<td>P8</td>
</tr>
<tr>
<td>V Wave</td>
<td>Period</td>
<td></td>
</tr>
</tbody>
</table>

Amplitude (Shimmer)

+ve peak -ve peak Cq.T.C.T. Qq.TOT

1 Wave
2 Wave
3 Wave
4 Wave
5 Wave

S.Q = OQ = S.T =

14. Harmonic analysis
   1. No. harmonics clearly visible
   2. H/N Ratio

Remarks:

11. Articulation: Normal/ abnormal
describe if abnormal

12. Rate of speech: Normal / abnormal
describe if abnormal

13. Rythm: Normal / abnormal
describe if abnormal

14. Prosody: (a) Intonation Normal / abnormal
            (b) Stress Normal / abnormal
            (c) Duration Normal / abnormal

Describe if abnormal:

Remarks:

15. Provisional diagnosis and recommendation:

16. P. Diagnosis code:

ENT:
ENT diagnosis code:

Signature of the Staff

Signature of the Clinician
Discussion:

Mr. R. Oza, Chairman of the session, congratulated Dr. N.P. Nataraja and Dr. Savitri for their excellent paper. He marked as follows - "...... I am really proud to say that this is one particular topic on which we will be in a far better position to give very specific recommendations in terms of the test". He suggested that some of 'us' should undertake the adventure of getting regional institutions setup where the speech pathologists can send the voice samples or the clients themselves, if possible for analysis. He later, called for discussion.

Dr. M.N. Hegde & Dr. D. Vasantha had given the following written comments.

Dr. M.N. Hegde - "I like the paper by Nataraja & Savitri. They have summarized various aspects of voice evaluation with an emphasis on objective measurement of specified behaviors.

Voice is a paradoxical field

1) On the one hand, we have sophisticated instruments routinely used in its study.

2. On the other, our clinical work in voice has been extremely subjectively based - especially assessment and measurements. Student clinician training is the most difficult in voice because of this: Many instruments are expensive and are not available to most clinicians - a point well recognized by the authors of this paper. However I thought that a greater emphasis should have been given to clinical evaluation without the help of the instruments. Of course my own preference consistent with that of the authors is to make instrumental assessment. But it is just not practical in many situations.

- Even when you do use instruments to assess voice or any other behavior, you still have an assessment problem that needs to be addressed. So I suggest the following:

1) First, the instruments help measure a behavior, but they do not necessarily make a clinical diagnosis. Although it is not a criterion of diagnosis, we do need to emphasize that clinicians should be trained to match their clinical judgement with instrumental measures. They do not always go together.

2) A clinician who does not have access to sophisticated instruments will have to place a greater emphasis on case history, dialogue with the client, various phonatory and speech tasks, life style of the client, information about play, physical health including allergies, smoking and so on. Surely, most of these are implied in the paper but I thought they needed to be emphasised and even expanded.

3) A factor that must be measured is the frequency of vocally abusive behaviors in cases of voice disorders that are due to such behaviors. The precision with which this is measured varies, but a serious attempt must be made to establish the frequency of such behavioral episodes as screaming, shouting, singing, excessive talking etc. Once again a detailed interview is the main method.

4) In many cases, besides the frequency of vocally abusive behaviors, we should also assess the duration of certain vocally abusive behaviors.
5) The results of the laryngologists’ examination, though this is the laryngologists’ responsibility, the speech-language pathologist must use and integrate the laryngologists’, observations in his or her diagnosis. It is not sufficient to simply have the laryngologist rule out organic pathology, a vocal nodule is an organic pathology which cannot be ruled out before starting voice therapy.

6) That the assessment is a continuous process is very strikingly evident in voice disorders. This continuous assessment throughout treatment must be done by both the speech language pathologist and the laryngologist.

Regarding the same paper, Dr. Hegde suggested that a range should always be given for any mean reported. He also wondered whether AIISH can make the training tape available to other centers in the country.

Dr. D. Vasantha -

“I think the paper just presented provides an excellent description of the parameters of voice which need to be examined and the procedures used in evaluating the various dimensions of voice. If we can utilize routinely the instrumental techniques of the kind described, there should not be any problem in evolving standard procedures which are internationally approved. Because what is being evaluated is not bound to language unlike other aspects of speech such as articulation. But, I feel the problem facing us is not lack of standard tests for evaluation voice of objectively as much as lack of agreement or the kinds of perceptual tests that may be used in the differential diagnosis of voice problems. In addition, there is no consensus on the definitions of the terms such as harshness, breathiness, hoarseness, voca. fry etc.

The qualitative methods suggested include case history, examination of oral mechanism, evaluation of breathing habits, maximum duration of sustained blowing, maximum phonation duration, maximum frequency range, S/Z ration (a perceptual test for hypernasality). Probably these tests could be recommended for use by all practicing voice clinicians.

A working committee can be constituted with a view to evolve a common proforma for voice evaluation, giving emphasis to the perceptual/ qualitative tests suggested in this paper.”

Mr. Raghunath wanted to know about the procedure for evaluating voice quality in running speech. If not, is it necessary to restrict the voice sample at the sound level? Dr. Savitri replied saying that whenever possible, the spontaneous speech and reading should be included. Most of the objective measurements will include the vowels, but the range of frequency and the range of intensity can be obtained from speech. Speech can be used for analysis other than glottography and measurements of functions of respiratory system.

Mr. R. Oza wanted to know about the minimum duration of spontaneous speech sample that one would want for analysis. Dr. Savitri replied saying that it should be five seconds.

In view of the fact that ISHA has to cater to even the members who are working in very small setups, Dr. Vaidyanathan wanted to know, whether it is possible to have some kind of subjective analysis that could be correlated to a well analyzed acoustic sample. His suggestion was that a tape prepared to guide clinicians in such an analysis will be of great help. Dr. Savitri informed that they have already prepared tapes for ‘ear-training’ of students and that they would now prepare for speech pathologists.
Mr. R. Oza elaborated on the point of preparing 'master tapes' for the guidance of the clinicians. He wanted Dr. N.P. Nataraja and Dr. Savitri to look into the task of correlating subjective judgement to objective analysis. He suggested that a few sets of cassettes may be prepared giving the various samples of resonance problems, problems with hoarseness etc. along with their objective assessment results and the correlated categories of the problem. He advised that the speech pathologists should have academic ambitions and should aspire and work to get the instruments for objective analysis.

Dr. S.K. Kacker remarked that the paper presented is one of the papers which has dealt with the problem excellently, the way it was desired by the organizers. He remarked that it may be easier to acquire computers, however it will be difficult to acquire the software for analysis as that may end up being expensive.

Concluding the session Mr. R. Oza suggested that small groups may be formed to finalize the ISHA test battery as conclusive recommendations could not be arrived at in some of the sessions. This suggestion was welcomed by Dr. S.K. Kacker. This point has to be discussed in the coming (XXIII) ISHA Conference.