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A Clinical study of Electroglottography in the Diagnosis of Laryngeal Disorders

Sunil B. Bhoj
Lecturer,
Department of Otolaryngology
All India Institute of Speech and Hearing, Mysore - 570 006

N.P. Nataraja
Reader & Head of the Department of Speech Science
All India Institute of Speech and Hearing, Mysore - 570 006

A. Jagadish
Research Assistant
Department of Speech Science
All India Institute of Speech and Hearing, Mysore - 570 006

INTRODUCTION

Clinicians have relied on two basic techniques in the assessment of Laryngeal Pathology, listening to the voice and viewing the larynx with a mirror or other device. While much can be learned by the perceptual evaluation of voice quality, these judgements often are unreliable in a clinical setting. Although careful visual examination is of fundamental importance, particularly in cases of anatomical abnormalities indirect laryngoscopy is limited by lack of objective documentation.

Objective measurement of vocal fold vibration is important in evaluating, planning treatment and documentation of laryngeal disorders.

There are several methods of studying vocal cord vibration. They are:

1. Stroboscopy
2. Ultra Sound Glottography
3. Ultra high speed Photography
4. Inverse filtering method
5. Photo-electric Glottography (P.G.G.)
6. Electro Glottography (E.G.G.)

We have used the method of Electroglottography in this study,

Electroglottography (E.G.G.)

This techinque makes use of motion induced variation in the electrical impedance between two electrodes placed on the skin covering the thyroid laminae. A weak, high frequency signal, (0.5-10MHz) is applied to one electrode. The other electrode picks up the electrical current passing through the Larynx. The transverse electrical impedance varies with the opening and closing of the glottis, and results in a variation of the electrical current in phase with the vibratory phase of the vocal folds.

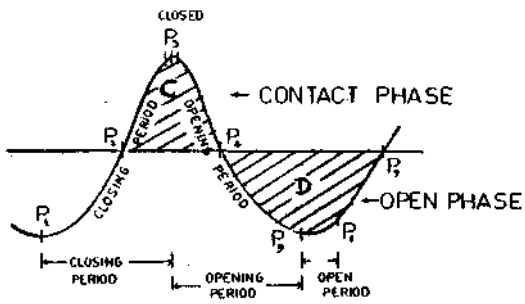
Glottographic techniques appear to offer some insight into more subtle vibratory and tension abnormalities that are associated with laryngeal disorders. Similarly valuable diagnostic information, such as indications of abnormal increased vocal fold tension or cycle to cycle variability in the vibration of

vocal cords may be identified and measured from the wave forms obtained by EGG.

Wechsler (1977) also studied the glottal wave forms with individuals having different laryngeal pathologies like vocal nodules, unilateral paralysis, bowing of vocal cords, laryngitis, before, during the after the administration of voice therapy and/or surgical treatment.

Each vibrating cycle has two major phases (Hirano, 1981) the open phase and the closed phase. The open phase is further divided into opening and closing phases. Various quotients and indices can be calculated using the measurement of duration of different phases of the vibrating cycle in order to study the glottal wave forms. They are Open Quotient, Speed Quotient and Speed ratio.

Figure: Electroglottogram in normals



ELECTROGLOTTOGRAM - NORMAL

Open Quotient (O.Q):

It is given by the formula:

$$O.Q = \frac{\text{duration of the open phase}}{\text{duration of entire cycle}}$$

The larger the open phase, the larger the O.Q. The value of O.Q is 1.0 when there is no complete glottal closure.

Speed Quotient (S.Q):

Dejonckere and Labacq (1985) in an attempt to quantify the shape of the glottal signal introduced this. It is calculated by the formula:

$$S.Q. = \frac{\text{Area of contact phase}}{\text{Area of open phase}} = \frac{C}{D}$$

Speed Index (S.I):

According to Hirano (1980) ". . . . Speed index is another useful measure of glottogram derived from speech quotient".

$$\text{Speed Index} = \frac{\text{Speed Quotient} - 1}{\text{Speed Quotient} + 1}$$

Advantages:

1. The procedure is associated with no discomfort to the subject.
2. The EGG reflects the glottal condition both during the closed phase and open phase.
3. The presence or absence of glottal vibrations can be readily determined.
4. The fundamental period of vibration is easily determined as the beginning of each closed phase marked by a sharp rise in the graphic display.
5. Quantitative interpretation of the glottal condition appears to be valid.
6. When EGGs are obtained simultaneously with other records on vocal fold vibration, a qualitative interpretation of the EGGs become possible.

The aim of the present study is to explore any significant relationship between Electroglottographic Measurements to Indirect Laryngoscopy findings in various laryngeal disorders, and to differentiate various laryngeal disorders.

METHODOLOGY:

The present study consists of 100 cases who reported to All India Institute of Speech and Hearing, Mysore, with the complaints of voice problems. The subjects were examined by ENT specialists, Speech Pathologists and Audiologists between April 1987 to March 1988.

Table 1: Showing sex distribution.

Total No. of Cases	....	100
Female	....	25
Male	....	75

The age range of the cases studied was 10 to 58 years.

They were subjected to a thorough ENT examination including indirect laryngoscopy and endoscopy using Hopkins Rigid Endoscope.

The voice evaluation included the measurement of glottal wave from using the following:

1. Electrolaryngograph (Kay Elemetrics Ltd)
2. High Resolution Signal Analyzer (B & K type C 2033)

The subjects were seated comfortably in front of the instrument. The two electrodes were placed on the skin adjacent to the thyroid cartilage. The position of the electrodes were adjusted until clear glottal wave form appeared on HRSA Screen when the subject phonated.

The subjects were instructed to say vowel */\/* in normal speaking voice while maintaining the frequency and intensity.

The data for all the parameters were collected and were subjected to statistical analysis using computer programs.

Observations and Discussion:

The subjects having laryngeal disorders encountered during our study were grouped as follows:

Table 1: Dettails of the subjects

	Males	Females	Total
VC paralysis	20	2	22
Vocal Nodules	22	10	32
Inflammatory Disorders	14	5	19
Cordal lesions	g	2	10
Glottic Chink	11	6	17
	75	25	100

RESULTS AND DISCUSSION

In general, the clinical groups showed significant difference on all the parameters measured when compared to those of normals (Sridhar 1986), (See Table 2)

When each clinical sub-group was compared with other sub-groups, significant differences were found on closing time, closed time, opening time, open time and open quotient. Further the examination of mean values of these parameters shows that the sub-groups can be differentiated based on these parameters, i.e., Vocal Cord Paralysis group showed highest closing period when compared to all other groups.

The glottal chink group showed maximum value for closed time (2.103ms) among the clinical groups. TheClinical group with cord lesions showed an opening time of 3.38ms, which was similar to normal. Vocal Cord Paralysis group showed lowest value for opening time (1.99ms) which is almost half of the normal value. Vocal nodule and cord lesions group showed very low open quotient values when compared to normals. The cord lesions group showed the highest value for speed quotient (2.46ms) when compared to other groups. The mean values for Speed index did not show much deviation from normal values.

Table2: showing the significance of difference between the clinical groups (by T-test)

	Vocal cord paralysis Vs Inflamma-tory disorders	Vocal cord paralysis Vs Vocal cord lesions	Vocal cord paralysis Vs Vocal nodules	Vocal cord paralysi Vs Glottic chink	Inflamma-tory disorders Vs Vocal cord lesions	Inflamma-tory disorders Vs Vocal nodules	Inflamma-tory disorders Vs Glottic chink	Vocal cord lesions Vs Vocal nodules	Vocal cord lesions Vs Glottic chink	Vocal nodules Vs Glottic chink
Closing Time	+	+	+	+	+	+	+	-	+	+
Closed Time	-	+	+	+	+	+	+	+	+	-
Opening Time	+	+	+	+	-	+	-	-	+	+
Open Time	+	+	+	+	-	-	+	-	+	+
Period	-	+	+	-	+	+	-	-	+	+
Open Quotient	+	+	+	+	+	+	+	+	+	+
Speed Quotie	+	-	+	-	-	-	+	-	-	+
Speed Index	-	+	-	-	-	-	-	-	+	

CONCLUSIONS:

Thus the findings of the present study indicate that the Glottogram can be used to corroborate the findings observed using laryngoscopy.

In summary, Glottographic measurements appear to have potential as a valuable component in a multilevel analysis of voice disorders.

Such measurements must be interpreted in the light of accurate examination of larynx during phonation.

Further data are likely to clarify the potential role of these techniques in general care of the voice patients.

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