# **Original Research Article**

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# Correlation of electroglottograph with vocal cord pathology

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## **ABSTRACT**

**Background:** Vocal cord disorders are very commonly encountered in ENT Outpatient. Electroglottogram is a non-invasive method for the examination of the vocal fold vibrations. It exerts no influence at all on articulation and production of sound and is cost effective. The aim of the present study was to validate the clinical correlation of electroglottogram in patients presenting with hoarseness of voice.

**Methods:** 30 patients with history of hoarseness of voice and 30 normals were selected from ENT outpatient and inpatient department over a period of 2 years. All subjects underwent detailed ENT history taking, clinical examination, rigid laryngoscopy and electroglottography and results were documented.

**Results:** Electroglottography waveforms of various voice disorders like vocal cord nodule, polyp, papilloma and haemangioma showed specific changes like double peak or notch in closing phase of waveform in case of mass lesion over the vocal cords and fuzzy waveform with prolonged closing time in case of vocal cord palsy. Significant difference was noted in certain electroglottographic parameters for phonated vowels /a/, /i/ and /u/ for certain vocal cord disorders.

**Conclusions:** Electroglottograph helps in diagnosing the pathology related to vocal cords, whether it is mass lesion over the vocal cords or vocal cord palsy but to differentiate in between mass lesions, clinical examination has to be done to confirm the diagnosis.

**Keywords:** Electroglottograph, Rigid laryngoscopy, Jitter, Shimmer, Contact index, Opening rate, Closing rate, Contact quotient perturbation, Contact index perturbation

## INTRODUCTION

Analysis of the vibrations of the vocal folds in terms of different parameters constitute an important aspect to be considered in the diagnosis of the voice disorders.<sup>1</sup> Several methods of analysing the vocal cord vibrations have been advised of which electroglottography (EGG) is one. It is a non-invasive method for examination of vocal fold vibrations, first reported by Fabre, which has been in use for clinical and research purposes for decades.<sup>2,3</sup>

The aim of the study was to establish correlation of electroglottograph in cases of vocal cord pathology presenting as hoarseness of voice by comparing the glottal waveforms in normal and abnormal voice conditions.

## **METHODS**

Patients with history of change of voice presenting to the ENT outpatient and inpatient department of tertiary referral centre between 1<sup>st</sup> November 2012 to 31<sup>st</sup> October 2014 and patients between age groups 15-60 years were included in the study. Subjects were excluded if malignancy larynx or acute laryngeal disorders were diagnosed.

In this prospective study, 30 patients with history of change of voice ae well as 30 normal subjects were taken.

All subjects underwent direct laryngoscopic examination to diagnose and document vocal cord pathology. Then their voice samples were recorded by using Dr Speech Software with an electrograph, Tiger DRS incorporation, Model No-EG-PC3 as shown in Figure 1.



Figure 1: Electroglottograph, Tiger DRS incorporation, Model No: EG-PC 3.

The subjects were seated comfortably infront of the instrumentation, electrodes placed over thyroid cartilage. Patients were told to take a deep breath and phonate /a/ at a comfortable pitch and loudness as long as possible. The microphone was adjusted so that the distance between microphone and subject's mouth was around 5-6 inches. The same instructions were given to the patients for /i/ and /u/ and EGG parameters and waveforms documented as in Figure 2. The EGG parameters used were jitter (J), shimmer (S), contact index (CI), opening rate (OR), closing rate (CR), contact quotient perturbation (CQP) and contact index perturbation (CIP).



Figure 2: Demonstration of electrode placement over thyroid cartilage.

#### Statistical methods

All the statistical calculations were done through SPSS 16.0 (2007) for windows. Independent samples T test and ANOVA-2 way were applied.

## **RESULTS**

The subjects comprised of two groups each with 30. Group 1 (subjects with normal voice) Group 2 (subjects with hoarseness of voice). In the Group 2, out of 30, 14 were diagnosed with vocal cord nodule, 7 were vocal cord polyp, 6 were vocal cord palsy, 2 were vocal cord papilloma and one case was vocal cord hemangioma.

Table 1: Showing F value (ratio of variance in means) and significant p value (<0.05) for EGG parameters in normal v/s clinical group.

	Vowels	Parameters	F value	P value
		J	12.013	0.001
		S	25.883	0.000
		OR	8.072	0.006
		CR	6.063	0.017
	A	CIP	10.021	0.003
		J	12.738	0.001
		S	20.967	0.000
		CQ	4.350	0.042
Normal group v/s		CI	5.643	0.021
clinicals	I	CR	5.984	0.018
		CQP	8.603	0.005
		J	12.169	0.001
		S	9.017	0.004
	U	CQ	4.359	0.041

The mean and SD in clinical males and females were found to be higher when compared to normal for all the vowels which was statistically significant (p <0.05). The mean and SD of shimmer of phonation /a/, /i/ and /u/ for males and females of the clinical group were also found to be higher compared to normal (p <0.05).

The mean and SD for contact quotient in clinical males were found to be higher compare to normal males only

for vowel /a/ whereas clinical females were found to be higher compare to normal females for all the vowels. A significant difference was noted in normal and clinical groups for contact index only for vowel /i/.

The mean of opening rate in clinical males were found to be higher compare to normal for vowels /a/ and /i/ whereas clinical females were found to be higher compare to normal females for vowels /a/ and /u/. The

difference noted in normal and clinical groups of OR was significant only for vowel /a/. Similarly, the difference in mean of CR between clinical subjects and normal was significant only for vowels /a/ and /i/.

Comparison of normal electroglottograph waveform with pathological waveform was made. The subjects were seated comfortably in front of the instrument. The electrodes were placed on the thyroid cartilage. Then each subject was asked to phonate /a/ as long as possible at a comfortable pitch and loudness and the waveforms were recorded.

In vocal cord nodule, a characteristic double peak or notch or dip was present in closing phase or rising slope of electroglottograph waveform in 85.71% of cases. In pedunclated vocal cord polyp, a notch was noticed in opening phase of electroglottograph waveform in 50% of cases and in sessile polyp, similar notch was noticed in closing phase in 33.33% of cases. In vocal cord papilloma and haemangioma, a notch was noticed in closing phase of waveform in all the cases. In vocal cord palsy (unilateral) fuzzy waveform with prolonged closing time was present in all the cases (100%). All the waveforms showed weaker amplitude compare to the normal waveforms.

#### **DISCUSSION**

Electroglottogram is a non-invasive method for the examination of the vocal cord vibration. It is based on measuring impedance across the neck of the speaker. When vocal folds are closed electric current can pass through them. But when vocal folds are apart, an insulating air gap separates them and the impedance across the larynx is higher. Thus the impedance changes across the larynx indicate the variation of contact area between the vocal folds. The present study was undertaken for a period of two years. The aim of our study was to correlate the clinical diagnosis with the EGG parameters and EGG waveforms to say whether EGG is a reliable tool to diagnose vocal cord pathology or not.

In our study, all the pathological waveforms showed weaker amplitude compared to normal waveforms. These results were similar to the results obtained by Colton and Conture that showed that the amplitude of the EGG is almost always weaker for pathological voices than for the normal voices.<sup>4</sup>

Our study showed a notch or dip or double peak in the closing phase of the waveform in case of mass lesion on the vocal cord like vocal cord nodule, polyp, papilloma and haemangioma. The results were similar to the study done by Abberton et al, which showed a double peak in 60% of cases those had mass lesion over vocal cord.<sup>5</sup> This double peak is due to double contact of the vocal

cords because of the nodule which comes in the way of vocal cord closure.

The present study showed a notch in opening phase of the waveform in 50% of pedunculated vocal cord polyp cases. The results were similar to the study conducted by Wei et al which showed a notch in opening phase in pendunclated vocal cord polyp.<sup>6</sup> This is because the pendunclated polyp will be pushed up during the opening phase because of increased subglottic pressure and because of this there will be double contact in opening phase.

Our study showed significant difference for some parameters like J, S, CQ, OR and CIP for vowels /a/ in vocal cord palsy group whereas study done by Zag'olski and Carlson showed significant difference in contact quotient, open quotient and percent irregularity but no significant difference was noted for CQ.<sup>7</sup>

#### **CONCLUSION**

Electroglottograph can be used in clinical set up to diagnose vocal cord pathologies and can be used as a screening procedure in patients with voice disorders. Despite its limitations, EGG yields useful information about the behaviour of the vocal folds during phonation. The results show convincingly that the EGG signal is related to the contact area between the vocal folds, thus confirming its utility in studying voice disorders.

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