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THE ROLE % IRREGULARITY IN ELECTROGLOTTOGRAPHIC ASSESSMENT OF LARYNGEAL PHONATORY FUNCTION IN PATIENTS WITH VOCAL FOLD PARESIS – PRELIMINARY REPORT

SHORT NOTE

% Irregularity is a coefficient computed by Speech Studio software at laryngographical (electroglottographic) examination of the larynx. The authors analysed values of % Irregularity obtained in 3 patients with vocal fold paresis. The patients were followed up for 6 months. Laryngography was performed 3 times in each of them at 3 months' intervals. The value of % Irregularity was elevated in all patients immediately after the onset of complaints. It decreased after 3 and 6 months in the patient who regained the mobility of the paralysed vocal fold and in the patient with effective functional compensation by the healthy vocal fold. The value of % Irregularity did not normalize in the remaining patient whose vocal fold did not regain its mobility. The value of % Irregularity seems to correlate with perceptual degree of dysphonia.

1. INTRODUCTION

Electroglottographic examination of the larynx (EGG, laryngography) was first described by Fabre in 1957. EGG waveform represents the phases of vocal fold vibration. Its amplitude is related to vocal fold contact area. At the beginning of the examination two plate electrodes are strapped into position onto the subject's neck and held in contact at the level of the thyroid cartilage. The device measures the impedance between them. Interpretation of the waveform consists in analysing its morphology and calculating EGG measures. Speech Studio software, operating the laryngograph, among other coefficients computes Cx also called % Irregularity (6).

The Cx display consists of a horizontal and vertical axes both displaying frequency on a logarithmic scale (30-1000Hz) and divided into 64 equally spaced divisions. This gives a two dimensional matrix of 4096 elements (referred to as bins). Fx values in data sample are values of consecutive periods of vocal fold vibratory cycles during phonation. The Cx cross-plot is built up by calculating the frequency of the first Tx value in the data sample and using this as the horizontal coordinate for the relevant bin. The frequency of the second Fx value is then calculated and used as a vertical coordinate, thus pinpointing the specific bin in the matrix which is then incremented. The

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second coordinate is then used as the first or horizontal coordinate and another Fx value is taken from the data sample as the second or vertical coordinate. In this way the matrix is filled up until the whole data sample has been processed and characteristic scatter pattern formed.

% Irregularity is based on taking a three bin width diagonal of the Cx plot as representing regular voice, counting all fundamental frequency pairs outside central band and presenting as a percentage of the total number of fundamental frequency pairs (6). % Irregularity is a measure representing percentage of irregular vocal fold vibrations in the voice sample.

Vocal fold movements in a healthy speaker are regular. In patients with VFP its irregularity is frequent.

Examples of recordings of % Irregularity from healthy speakers and patients with vocal fold paralysis (Figure 1, 2).

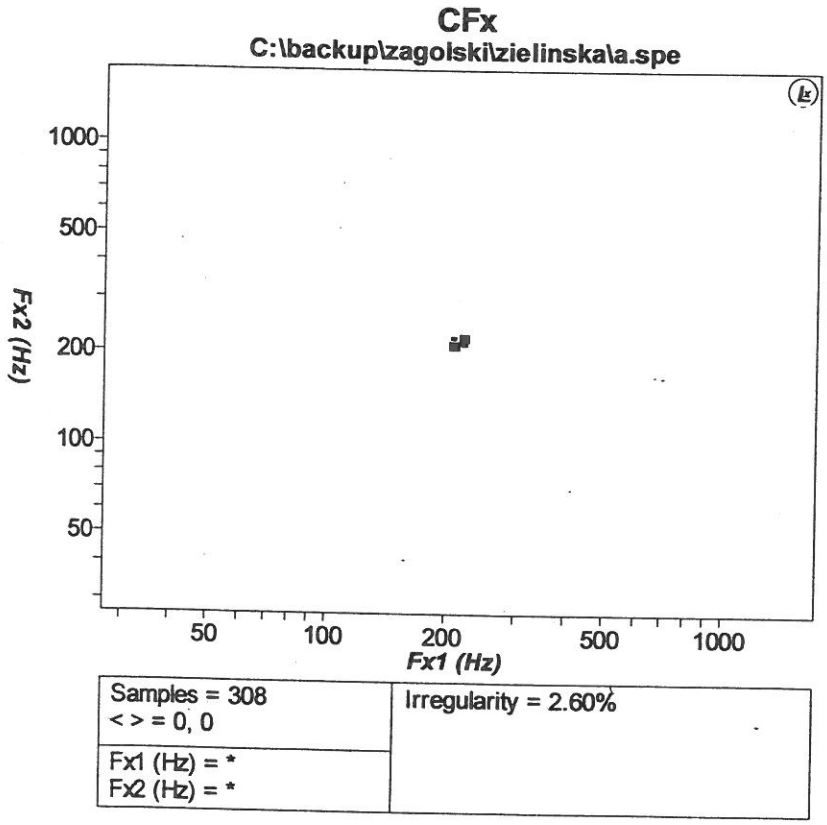

Fig.1. Histogram Cx and computed value of % Irregularity. The recording was obtained in a healthy subject articulating prolonged 'a'.

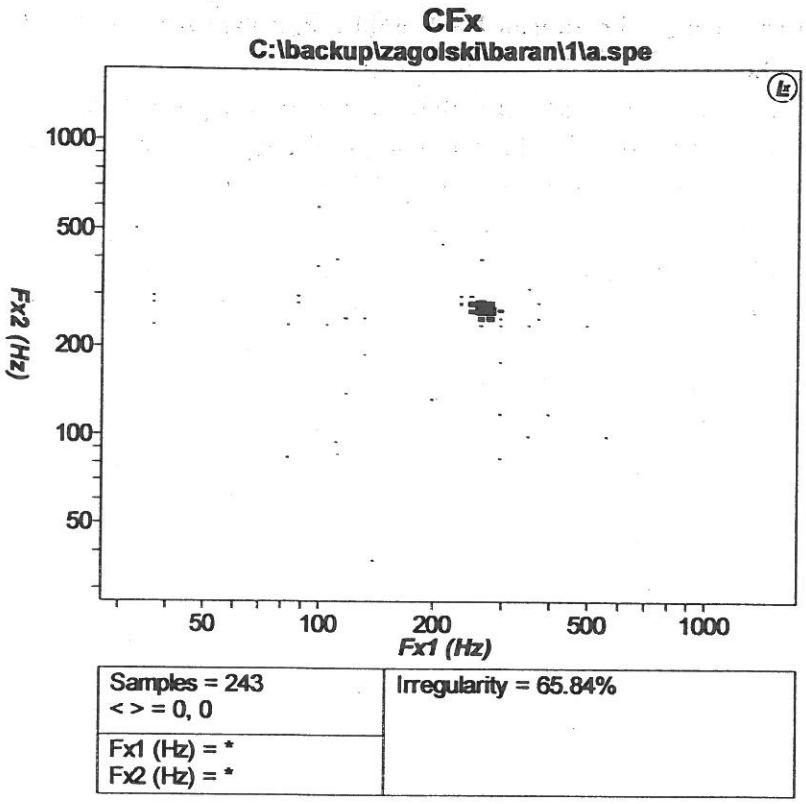

Fig.2. Recording obtained in a female speaker with left vocal fold paresis (high value of % Irregularity).

2. MATERIAL AND METHODS

An Electroglottograph (Fourcin Laryngograph Processor produced by Laryngograph Ltd.) was used to assess vocal function in 35 patients with unilateral or bilateral vocal fold paralysis (VFP). The values of % Irregularity obtained in 3 individuals were analysed. The patients were followed-up for 6 months. Three recordings: immediately after the onset of complaints, at 3 and 6 months were obtained from each of them. Examinations were performed at the Institute of Technology of the Pedagogical Academy in Kraków. The task consisted of vowel 'a' articulated in prolonged way, at comfortable pitch and volume. It was repeated three times (5).

3. RESULTS

Elevated values of % Irregularity were obtained in all patients in the first recording. All 3 patients suffered from considerable dysphonia (table I).

After 3 months the immobility of the paralysed vocal fold in patient no 1 did not resolve. However, the value of % Irregularity in this patient decreased and perceptual voice quality improved due to functional compensation in the larynx. The functional compensation consists in accommodation of the healthy vocal fold to new anatomical and physiological conditions in the

larynx caused by the paralysis of one of the vocal folds. The phenomenon results in satisfactory contact of the healthy vocal fold with the paralysed one.

The remaining patients did not regain mobility of paralysed vocal folds. Yet in patient no 2 the value of % Irregularity obtained in the second recording was considerably lower due to compensation by the healthy vocal fold. Perceptual degree of dysphonia in patient no 2 was much lower than in the first examination. In patient no 3 voice quality in the second recording was like at the first examination and the value of % Irregularity was likewise elevated.

After 6 months of follow-up patient no 1 regained the mobility of the paralysed vocal fold and the value of % Irregularity was comparable to the values obtained in healthy speakers (3). The voice quality was normal. In patient no 2, who developed compensation by the healthy vocal fold, the value of % Irregularity was similar as in patient no 1 and the voice quality was normal. In patient no 3 we obtained elevated value of % Irregularity and observed considerable dysphonia in the third recording.

The results we obtained in the speakers with VFP must be treated as preliminary.

Table I

Patient	1st recording	2nd recording	3rd recording
1	90,99	12,74	8,3
2	39,51	30,08	0,47
3	65,84	86,77	71,64

Tab. 1 Values of % Irregularity in consecutive recordings.

4. DISCUSSION

The value of % Irregularity does not reflect mobility or immobility of vocal folds. However, the results we obtained suggest that values of the coefficient are correlated with perceptual degree of dysphonia. In VFP contact between free margins of the paralysed and healthy vocal folds is usually incomplete (1, 2, 4). Abnormal contact between vocal folds causes dysphonia (1, 2, 4). The values of % Irregularity are normalized as a result of returning mobility of the paralysed vocal fold or functional compensation by the healthy vocal fold. Good contact between vocal folds is a necessary condition of normal voice.

5. CONCLUSIONS

The results we obtained suggest that % Irregularity best represents voice disorders in patients with VFP. The coefficient makes it possible to objectify dysphonia and its changes caused by resolving immobility of the paralysed vocal fold or by effective functional compensation in VPF patients. Our observations, however, must be confirmed by further studies.

REFERENCES

[1] Cheyne H.A., Nuss R.C., Hillman R.E.: Electroglottography in the pediatric population. Arch Otolaryngol Head Neck Surg 1999, 125, 1105.

[2] Hanson D.G., Gerratt B.R., Karin R.R., Berke G.S.: Glottographic measures of vocal fold vibration: an examination of laryngeal paralysis. Laryngoscope, 1988, 98, 541.

[3] Kulinowski W., Zielińska J., Zagólski O.: Zastosowanie laryngografii w ocenie zaburzeń ruchowych krtani. Journal of Medical Informatics and Technologies 2000, 5, BI, 111.

[4] Murty G.E., Carding P.N.: Combined glottographic measurement of vocal cord paralysis in the outpatient clinic. Clin Otolaryngol, 1992, 17, 3.

[5] Zielińska J.: Zastosowanie metod wizualizacji mowy w nauczaniu i diagnostyce dzieci z wadą słuchu. Rozprawa doktorska, WSP, Kraków, 1994.

[6] Lx Speech Studio Manual, „Laryngograph Ltd."