ORIGINAL ARTICLE

Correlation Between Measures of Perceptual Assessment of GRB and Contact Quotient (CQ)☆

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Abstract

Objective: The aim of the present work is to correlate the perceptual parameters grade, roughness, and breathiness of the GRB scale with the contact quotient (CQ) obtained by electroglotography.

Material and method: 70 samples of normal and pathological voices were analysed by means of auditory-perceptual analysis and electroglotography. The perceptual analysis was carried out by two expert judges depending on the parameters grade, roughness, and breathiness. The CQ values were obtained through the VoceVista System Version 3.3.7.

Results: The results show a strong correlation between CQ and breathiness ($r = -0.869$), whereas between grade of dysphonia and CQ ($r = -0.567$), and roughness and CQ ($r = 0.643$) the correlation is average.

Conclusions: It is possible to establish relationships between the vibrational behaviour of the vocal folds and the resulting phenomenon that we perceive auditively. The most relevant parameter in this respect was breathiness. The correlation between grade, roughness and CQ was weaker.

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PALABRAS CLAVE
Electroglotografía; Evaluación perceptual; Cociente de contacto; GRB; Soplo; Aspereza; Disfonia

Correlación entre medidas de evaluación perceptual GRB y cociente de contacto

Resumen

Objetivo: El objetivo del presente trabajo es correlacionar los parámetros perceptuales de grade, roughness y breathiness de la escala GRBAS con el cociente de contacto (CQ) obtenido por medio de electroglotografía.

Material y método: Se analizaron 70 muestras de voces normales y patológicas por medio de análisis auditivo-perceptual y electroglotografía. El análisis perceptual fue llevado a cabo por dos jueces expertos en función de los parámetros grade, roughness y breathiness. Los valores de CQ fueron obtenidos por medio del sistema VoceVista Versión 3.3.7.

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Introduction

Perceptual assessment is one of the most accessible resources in voice assessment because it enables a first approach to the functional status of the voice without a specific instrument. Various scales have been created for this purpose. The most used worldwide is the GRBAS\textsuperscript{1,2} or GRB, its abbreviated version.

This scale enables formal perceptual assessment according to certain audible parameters. Each of the letters of the anagram forming its name describes a specific parameter: grade (G), rough (R), breathiness (B), asthenia (A) and strain (S) and are scored from 0 to 3 according to the vocal severity or status of the subjects, 0=normal and 3=severe. In this context, several studies have demonstrated the efficacy and precision of perceptual assessment,\textsuperscript{1-6} and have accredited its use in various populations with normal voices and with voice disorders.\textsuperscript{7-9}

Nevertheless, in some contexts, perceptual assessment is still considered a subjective test. Therefore, in seeking objective endorsement and comprehensive assessment of the vocal phenomenon, relationships have been established between the various assessment instruments and their corresponding parameters to observe possible areas where they coincide that provide further support.

Electroglottography, in this regard, is an objective assessment instrument that provides a precise measure of the vibratory movement of the folds and the proportion of contact resulting from each of the vibratory cycles.\textsuperscript{10} The contact quotient (CQ), is one of the values that specifically reflects this condition and its importance has been described in reporting normal values according to the characteristics of the subject and vocal use.\textsuperscript{11-14}

The aim of this paper was to correlate the perceptual G, R, and B parameters of the GRBAS scale with the CQ obtained by electroglottography in order to relate the vibratory behaviour of the vocal folds to the irradiated and perceived vocal result.

Material and Methods

Participants

A total of 70 patients were studied retrospectively (39 males and 31 females), diagnosed by videostroboscopy with nodules, polyp, Reinke’s oedema, vocal fold palsy and normal voice (Table 1).

Procedures

The samples of vocal emissions and the electroglottography were undertaken simultaneously. Both procedures were carried out in an acoustically silent environment treated with noise control. Each participant was seated comfortably upright on a chair.

A SAMSON C03U (Syosset, NY) microphone was placed in front of the patient at a distance of 10 cm to take the acoustic signal. For the electroglottography, the skin around the participant’s neck area was cleaned with spirit to remove any traces of grease or dirt and to maximise contact of the electrodes with the skin. The two electrodes, attached to a Velcro tape, were placed externally on each participant’s neck at the level of the thyroid lamina. The Velcro band was tight enough to ensure appropriate contact between the electrodes and the skin.

Each participant performed prolonged emission of the vowel /a:/ in Spanish for at least 3 s twice consecutively at a comfortable frequency and intensity. The best sound signal, at least 3 s in duration, was accepted.

Assessment Instruments

The GRBAS perceptual assessment scale was used, of which only three vocal parameters were proposed to assess the subjects: G, R, and B. This test was performed based on auditory stimuli (sustained emission of the vowel /a:/). The vocal parameters were quantified using a numerical scale from 0 to 3: 0=normal/with no alteration and 3=severe. The

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal voice</td>
<td>41</td>
<td>58.5</td>
</tr>
<tr>
<td>Nodules</td>
<td>11</td>
<td>15.7</td>
</tr>
<tr>
<td>Polyp</td>
<td>4</td>
<td>5.7</td>
</tr>
<tr>
<td>Cyst</td>
<td>3</td>
<td>4.2</td>
</tr>
<tr>
<td>Reinke’s oedema</td>
<td>3</td>
<td>4.2</td>
</tr>
<tr>
<td>Vocal fold palsy</td>
<td>8</td>
<td>11.7</td>
</tr>
</tbody>
</table>
values were recorded automatically and transferred to a spreadsheet. The EGGs device for singers Model 7050A (D. G. Miller–Eugene, OR) was used for the electroglottograph. VoceVista 3.3.7 (Miller and Horne, 2008) was used for the recording and digital processing. This software has proven capable of processing and analysing the electroglottographic signal in sustained phonation samples. The CQ values were calculated from the EGG waveform cycle by cycle.

Perceptual Analysis of the Vocal Parameters

Each sample was graded jointly by two experts with experience in voice pathology using the abbreviated GRBAS scale (GRB), and scored each of the following items from 0 to 3 (0=normal, 1=mild, 2=moderate, 3: severe) (Table 2).

Statistical Analysis

The intraclass correlation coefficient was used to determine the agreement between expert assessors on the perceptual assessment. The correlation between the total scores obtained in the perceptual-auditory analysis and the CQ was determined using Pearson’s correlation coefficient. All the statistical analyses were performed using SPSS (Statistical Package for the Social Sciences), version 23.0.

Results

The auditory-perceptual assessment performed by the two experts showed a high level of agreement (intraclass correlation coefficient=0.9) for grade of dysphonia, roughness, and breathiness (Table 3).

Likewise, consequent changes were seen between the perceptual assessment and CQ according to each case. There was moderate negative correlation between the G parameter obtained through auditory-perceptual analysis and the contact coefficient ($r=-0.567$). There was a moderate positive correlation ($r=0.643$) between roughness (R) and the CQ, and between breathiness (B) and the CQ there was a considerable negative correlation ($r=-0.869$).

Discussion

Previous studies have attempted to establish correlations between EGG and other vocal function assessments. However, there is no record of studies relating CG and the perceptual parameters of the GRBAS scale.

Isolated auditory-perceptual assessment, like electroglottography, has proved a useful, non-invasive and clinically established tool to characterise and quantify certain vocal parameters in individuals with voice disorders and in normal voices. In this regard, both the perceptual qualities of the voice and the CQ give an account of what is happening at the level of the glottal sound. Therefore, the correlation we highlight in this paper can be clearly explained through the underlying mechanisms and justifies the use of each of the instruments listed. In other words, the degree of correlation can be understood through the vibratory behaviour of the vocal folds established and described using EGG and its audible results.

The mean negative correlation between grade of dysphonia (G) and CQ lies in normalising the phonatory process. A lower grade of dysphonia means a relative increase in the contact coefficient, the normality of which varies between 0.4 and 0.6. Firm closure ensures optimal air passage and the necessary conversion of aerodynamic energy for the acoustic phenomenon to irradiate without difficulty.

For its part, although the positive mean correlation between the perceptual parameter of roughness (R) and CQ is not so conclusive, reciprocity can be explained in terms of proportion of contact time, adductor tension and, consequently, vocal fold tissue stiffness. The more contact time, the greater adduction/tension, increased perception of roughness due to limited movement in the tissues of the free margin.
Finally, the considerable negative correlation between breathiness (B) and closure quotient (CQ) is provided by the opening time of each cycle and its resulting air escape, similar to the glottal behaviour in falsetto register. Contact between the vocal folds is not sufficiently firm, reducing resistance to the passage of the air column causing the perceptual quality of breathiness. The relationship between both parameters is inversely proportional, the lower the contact coefficient, the greater the perception of breathiness.

Conclusion

Although the CQ on its own is of no diagnostic value for a wide range of voice disorders, the relationships provided between each of the acoustic parameters (GRB) and the CQ enable glottal behaviour to be related with the perceptual qualities resulting from same according to the configuration, muscular tension and aerodynamic forces at play during phonation.

Perceptive-auditory analysis and electroglottographic assessment are correlated in different proportions. The pathological variable could be included in further studies that best describes each of the conditions, and thus therapeutic compatibilities could be suggested according to the results of the assessments.

Conflict of Interests

The author has no conflict of interest to declare.

References