

# Relationship Between Acoustic Measurements and Self-evaluation in Patients With Voice Disorders

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**Summary: Objective.** The study aimed to determine whether there is a relationship between acoustic measures and self-evaluation in patients with voice disorders.

**Study Design.** This is a descriptive, transversal, and observational study.

**Methods.** Patients (257) who answered the Voice Handicap Index protocols (VHI) and the Voice Symptoms Scale (VoiSS) and recorded the vowel /e/ were included. Standard deviation (SD) measures of the fundamental frequency (F<sub>0</sub>), jitter, shimmer, and the glottal to noise excitation ratio (GNE) vowel /e/ were taken.

**Results.** There was a weak positive correlation between all scores of VoiSS and the SD of the F<sub>0</sub> and jitter. The overall scores, physical limitation, and VoiSS showed weak positive correlations with shimmer. The overall scores, limitation, and emotional VoiSS showed weak negative correlations with the GNE. The VHI did not correlate with any of the acoustic measurements. There was no difference in the mean of the acoustic measures of the SD of F<sub>0</sub>, jitter, and GNE because of a voice problem detected from the cutoff points of VoiSS. There was no difference in any of the acoustic measurements when patients with and without voice problems were compared from VHI cutoffs.

**Conclusions.** There is a correlation between the scores of VoiSS and acoustic measurements. Patients with self-reported voice problems in VoiSS present greater deviations in acoustic measures, mainly in jitter. There is no correlation between the VHI scores and the acoustic measures and no difference in the averages of these measures between patients with and without voice problems detected from the VHI cutoffs.

**Key Words:** voice-voice disorder-vocal assessment-acoustic analysis-self-evaluation.

## INTRODUCTION

The vocal assessment process should consider the multidimensionality involved in the demonstration of a voice disorder.<sup>1</sup> The assessment should include a visual examination of the larynx, perceptual assessment of vocal quality, aerodynamic measures, acoustic analysis, and vocal self-assessment procedures.<sup>2,3</sup> Each of these items has a specific relevance and provides particular information on voice disorder, whether in view of the clinician or the patient. Clinical decisions for treatment to be offered should use the integrated interpretation of these data, enabling the characterization of vocal behavior, identification of the possible etiology and triggering and maintaining factors, and description of the vocal adjustments used and the association between the vocal aspects and the impact caused on patient's communication.

Acoustic analysis has become more accessible and its use in clinical practice has increased. This is mainly because it is non-invasive and provides quantitative measures of vocal function.<sup>4</sup> This form of evaluation details the mechanism of sound generation, providing an indirect estimate of the vibratory patterns of the vocal folds, the shapes of the vocal tract, and their possible modifications.<sup>5</sup> However, acoustic analysis cannot estimate the impact of voice disorders on the daily life of a patient.<sup>6,7</sup>

Self-assessment is fairly valued in vocal evaluation and has been widely disseminated in recent decades.<sup>8</sup> It aims to capture the patient's perception about the voice problem. This includes how the problem impacts the patient's daily life. It allows for obtaining crucial and complementary information regarding other evaluation methods.<sup>9</sup>

The Voice Symptoms Scale (VoiSS) is considered the most accurate and psychometrically robust protocol for vocal self-assessment of all the available self-assessment tools.<sup>8,10,11</sup> It provides information about the use of voice for communication, physical symptoms, and the emotional impact of a voice problem on the life of the individual.<sup>12</sup> Another self-assessment tool is the Voice Handicap Index (VHI), which aims to quantify the psychosocial consequences of voice disorders<sup>13</sup> in the life of a patient. VHI is the most senior protocol, with greater dissemination in the international clinical context and with more publications.<sup>8</sup>

In clinical practice, the challenge is to integrate information from different vocal assessment procedures, noting the complementarities of data, what favors the definition of the diagnosis, as well as the establishment of conduct and monitoring of the case.<sup>1</sup>

A systematic review<sup>14</sup> pointed out that acoustic measures, because they are less subjective and provide important information about vocal function, are an additional diagnostic tool that improves the quality of diagnosis and treatment to be offered to patients with dysphonia.

Some studies<sup>15,16</sup> have shown, for example, that acoustic analysis can improve the diagnostic classification of a voice disorder when associated with clinical information of the case and an auditory-perceptual evaluation of voice quality,<sup>15</sup> and the combination of acoustic and auditory-perceptual measures increases

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the accuracy in determining the presence or absence of a voice disorder and the severity of this deviation.<sup>16</sup>

Of the vocal assessment procedures, there is greater integration among the acoustic analysis, the perceptual analysis, and the laryngeal visual examination, but a smaller association between the acoustic information and the patient's self-assessment of his or her voice problem.<sup>17</sup> Overall, the different measures appear to be independent and complementary in vocal evaluation.

Several studies<sup>18,19</sup> that analyzed the correlation between the acoustic measurements of jitter, shimmer, and the harmonic-noise ratio and voice handicap in patients with voice disorders showed inconsistent results.

The acoustic and VHI measures proved to be independent when patients with voice disorders of different etiologies (functional dysphonia, unilateral vocal fold paralysis, nodules, cysts, polyps, and Reinke's edema) were analyzed together. However, when analyzed separately, there was a positive correlation between VHI and acoustic measurements.<sup>18</sup>

Research<sup>19</sup> analyzed the correlation between acoustic measurements and the VHI in pre- and postintervention situations. There was no correlation between these measurements in both situations. However, there was greater change in VHI than in acoustic measures in the postintervention situation.

Another study<sup>20</sup> investigated the correlation among the stroboscopic findings of laryngeal visual inspection, acoustic measures, auditory perception, and self-evaluation—through the VoiSS and the VHI—in situations of pre- and postoperative benign vocal fold lesions. It was found that there was no correlation between the VHI and the acoustic analysis in both situations. However, there was a correlation between the VoiSS and the measures of jitter, shimmer, and harmonic-noise ratio postoperatively. The study<sup>20</sup> concluded that both self-assessment tools were useful in monitoring the effects of treatment offered. In turn, the VoiSS provides more integrated information in comparison to the acoustic data.

Inconsistent findings in these studies<sup>18–20</sup> may indicate that there is no clear relationship between these measures in vocal evaluation, and these justify the need for further studies and reinforce the fact that a single type of assessment procedure is not enough to characterize a voice disorder.

Most of these studies<sup>15,18–20</sup> investigated the correlation between VHI measurements and acoustic measurements, without using the VHI results, to determine the outcome (presence or absence of a voice problem), and therefore without realizing comparison of acoustic measures in patients with and without self-reported voice problem. Only one study<sup>17</sup> used the cutoff of the total score of VHI and analyzed the differences of cepstral and spectral measurements between patients with and without self-reported voice problem.

Moreover, among the studies reviewed for the development of this research, only one<sup>20</sup> of them analyzed the correlation between VoiSS, which is considered a robust protocol for vocal self-assessment,<sup>10</sup> and acoustic measurements. Moreover, the study of the correlation between acoustic measurements and VoiSS can clarify important questions about the physiological aspects underlying vocal symptoms, as acoustic parameters provide data strongly correlated to the physiology of vocal production.<sup>5</sup>

In this context, because of the need for studies that investigate the integration of multidimensional information obtained in the vocal clinic, and the inconsistent findings on the association between acoustic analysis and self-assessment, the aim of this study was to determine whether there is a relationship between acoustic measurements and self-reported measurements obtained from VHI and VoiSS in patients with voice disorders. The study also aimed to compare acoustic measurements in patients with and without voice problems detected by self-assessment instruments.

For the present study, we started with the following hypotheses: there is a correlation between acoustic measurements and scores on VHI; there is a correlation between acoustic measurements and scores on VoiSS; patients with self-reported voice problems on VHI have a higher deviation in acoustic parameters; and individuals with self-reported voice problems, detected by VoiSS, show greater deviation in acoustic parameters. Thus, we seek to advance the knowledge and research between acoustic and self-assessment measures, either by inserting VoiSS and by considering the results of the scores of these instruments (VHI and VoiSS) for categorization of patients with and without voice problem.

## METHODS

### Study design

This study is descriptive, transversal, and observational. It was approved by the ethics committee of the institution of origin, with opinion number 52492/12. All participants were informed about the study and provided free and informed consent.

### Subjects

This study involved patients evaluated in a voice laboratory of a higher education institution in the period between May 2012 and July 2015. The following were the eligibility criteria for participation in the study:

- patients aged 18 years and below 65 years, considering that individuals younger than 18 years may be under the influence of vocal changes and those over 65 years tend to take a more negative vocal self-assessment in relation to the population of young adults<sup>21</sup>
- patients who presented with vocal complaint, with a positive answer to the question "Do you consider that you have a voice problem now?"
- patients who have undergone laryngological evaluation in the two previous weeks when data collection was conducted to confirm diagnosis of voice disorder
- patients who finished filling in the two protocols of self-assessment (VHI and VoiSS)
- patients without professional voice use because voice professionals tend to have worse scores in vocal self-assessment instruments and a greater awareness of their vocal difficulties<sup>21</sup>
- patients who did not undergo vocal treatment (therapy or surgery) prior to the time of data collection

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