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Dysphonia Severity Index as an Easily Applicable Objective Measure of Dysphonia

Thesis
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Abstract

The aim of this work was to investigate the usefulness of the Dsysphonia Severity Index (DSI) as an easily applicable objective multiparametric measure in assessing the severity of dysphonia and to compare its objective results with the perceptual assessment of voice by GRBAS scale. Furthermore it was investigated whether the DSI can differentiate between different diagnosis groups of dysphonia. This study included 30 patients with dysphonia and 30 normal subjects. The DSI was measured in the dysphonia group as well as the control group. The DSI in patients was significantly lower than the control group. Also the DSI could differentiate significantly between the three perceptual grades of dysphonia which were divided according to grade score of GRBAS scale, while there was no significant difference in the DSI between the functional dysphonia group and MAPLs group. In addition there was a highly significant negative correlation between the DSI as an objective measure and the perceptual Grade of GRBAS scale as a subjective measure. The DSI is a useful objective measure in the assessment of dysphonia and in quantifying the different degrees of dysphonia as identified by the perceptual Grades of GRBAS scale.

Key words: Dysphonia Severity Index, Objective measure, Perceptual assessment, GRBAS scale.

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List of abbreviations

BVP	Buffalo Voice Profile.
CSL	Computerized Speech Labaoratory.
DSI	Dysphonia Severity Index
EVA	Evaluation Vocal Assistee.
F0	Fundamental Frequency.
F-High	Highest Frequency.
F-Range	Frequency Range.
G	Grade of overall voice quality.
HNR	Harmonic to Noise Ratio.
I-Low	Lowest Intensity.
I-Range	Intensity Range.
J%	Jitter %.
MAPLs	Minimal Associated Pathological Lesions
MDVP	Multi-Dimensional Voice Program.
MPT	Maximum Phonation Time.
NNR	Normalized Noise Ratio.
ORD	Ordinal scale.
PQ	Phonatory Quotient.
SNR	Signal to Noise Ratio.
SOM	Self Organizing Map.
SRP	Speech Range Profile.
SSVR	System for Singer Voice Analysis.
ST-Range	Semitone Range.
VA	Visual analog scale.
VC	Vital Capacity.
VHI	Voice Handicap Index.
VPA	Vocal Profile Analysis system.
VRP	Voice Range Profile.
V-RQOL	The Voice Related Quality Of Life measure.

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Introduction

At the centre of an intended communication is the message which a speaker wishes to transmit to a receiver. In human oral communication the message is normally formulated in words. But the expressed message consists not only of the words but also of paralinguistic phenomena, eg, body language, tone, rhythm, speech velocity, pauses etc. The human voice is highly relevant here, as it influences the attitude of a listener towards his partner in communication. While this attitude is only 7% dependent on the content of the speech, it is 55% dependent on facial expression and 38% dependent on the sound of the voice **(Mehrabian, 1971).** In evaluating a speaker's personality, listeners are influenced by the speaker's tone of voice more than by the content of the words **(Yogo et al., 2000)**.

Voice is an audible sound produce by phonation**.** Phonation is the physical act of sound production by means of vocal fold interaction with the exhaled air stream. Puffs of air are released with an audible frequency range which resonates in the supraglottic cavities. So there are three systems constitute the vocal apparatus: the respiratory system, the larynx, and the supraglottic vocal tract. Normally, these complex systems are integrated to produce high vocal quality **(Aronson, 1990).**

Aronson, (1990) postulated that a voice disorder exists when "quality, pitch, loudness or flexibility differs from the voices of others of similar age, sex and cultural group". Voice disorders, often known by the generic name **dysphonia** when caused by laryngeal pathology, convey the presence of a poor functioning of the voice in its most general aspects. Dysphonia can be classified as organic, functional, minimal lesions, and psychiatric.

Dysphonia may be broadly defined as a perceptually audible change of the patient's habitual voice, as self-judged or judged by listeners. Dysphonic voice may be also descriebed as a voice that fails to meet a patient's vocal demands **(Kotby, 1995).**

Although there is no universally accepted classification system for voice problems, there are two major classes of voice disorder related to etiology: organic and functional **(Titze, 1994)**. However, this dichotomy is somewhat problematic, because minor tissue changes such as vocal fold thickening, vocal nodules and vocal polyps can be understood as either organic or functional disorders (**Boone, 1987)**. But according to **kotby's** classification **(1986)** voice disorders were classified into three main groups: Organic voice disorders, Non- organic (Functional) voice disorders and Minimal Associated Pathological Lesions (MAPLs). Non-organic voice disorders are defined as an impaired voice sound, and/or reduced vocal capacity, and/or impaired laryngeal sensations in the absence of causal organic laryngeal pathology **(Aronson, 1990)**. Minimal Associated

Pathological Lesions include: Vocal fold nodules, vocal fold polyps, Reinke's edema, contact granuloma and vocal fold cysts **(Kotby, 1986).**

As the voice is a multidimensional phenomenon, like physical strength, it cannot be measured with a single scale or test **(Hartl, et al., 2005).** An assessment of voice disorders should consist of history taking including subjective self evaluation of voice, , perceptual voice assessment, (video)laryngostroboscopy and objective measures (such as aerodynamic measures & acoustic measures) **(Dejonckere et al., 2001)**.

The medical diagnosis of voice pathology is mainly based on an endoscopic examination of the larynx and upper airway tract. Voice dysfunction is assessed by perceptual judgment and objective measurements. The clinician generally performs the subjective assessment while the objective analysis is performed by the voice laboratory instruments **(Sataloff, 1997).**

The perceptual assessment in its most simple form is a description of the sound of the voice. This can be useful in clinical practice, but it lacks precision and is hardly useful to compare results of therapy in individuals or between groups of patients, in addition to its wide degree of variability depending on the professional background and experience of the judges (**Hirano, 1981)**.

Next to the perceptual assessment, objective measures which include aerodynamic measures and the acoustical analysis of voice samples have been used for the characterization of voice quality **(Rabinov et al., 1995)**. During the last two decades, clinicians and researchers have developed a variety of techniques for objective measurement of voice quality **(Sataloff, 1997).** However, there are no strict standards in investigation of voice quality parameters, although there is some consensus nowadays that voice is a multidimensional phenomenon and should be investigated by means of voice quality and vocal function analyses **(Dejonkere et al., 2001).**

A major obstacle to the use of a single acoustic or aerodynamic parameter for objective assessment of dysphonia is that different disease processes affect various aspects of voice performance to different degrees. Moreover acoustic measurements cover only part of information contained in perceptual analysis. For this reasons several teams have proposed a multiparametric approach to enhance the scope of data. The combination of several objective parameters seems to correlate better with perceptual analysis than single measures. However a disadvantage of some of these multiparametric methods is the need of specific equipment for some of the parameters used **(Yu et al., 2001)**.

The Dysphonia Severity Index (DIS) is an objective multiparametric measurement. The DSI was derived from a multivariate analysis with the goal to describe the perceived voice quality, based on an integration of voice range profile, aerodynamic, and acoustic measurements. To incorporate the perceptual nature of voice assessment, the index is based on perceptual severity ratings of vocal quality. The parameters used for the DSI are the highest frequency (F0-high in Hz), lowest intensity (I-low in dBSPL), maximum phonation time (MPT in seconds), and jitter (%) **(Wuyts et al., 2000)**.

To prove the usefulness of DSI in assessing dysphonia, it should be known how well such a measure differentiates among people with and without dysphonia, and if it could distinguish between different perceptual grades of dysphonia, also if there is a relationship between the DSI and different clinical diagnosis groups of dysphonia. Furthermore it would be interesting to assess the correlation of DSI with the perceptual assessment of patient with voice disorders.

Aim of the work

The aim of this work was to investigate the usefulness of the Dysphonia Severity Index (DSI) as an easily applicable objective multiparametric measurement in assessing the severity of dysphonia, and to compare these objective results with perceptual scoring of the GRBAS scale.