# Vocal Parameters and Self-Perception in Individuals With Adductor Spasmodic Dysphonia

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**Summary: Objective.** The study aimed to compare and correlate perceptual-auditory analysis of vocal parameters and self-perception in individuals with adductor spasmodic dysphonia before and after the application of botulinum toxin.

**Study Design.** This is a prospective cohort study.

**Methods.** Sixteen individuals with a diagnosis of adductor spasmodic dysphonia were submitted to the application of botulinum toxin in the thyroarytenoid muscle, to the recording of a voice signal, and to the Voice Handicap Index (VHI) questionnaire before the application and at two time points after application. Two judges performed a perceptual-auditory analysis of eight vocal parameters with the aid of the *Praat* software for the visualization of narrow band spectrography, pitch, and intensity contour.

**Results.** Comparison of the vocal parameters before toxin application and on the first return revealed a reduction of oscillation intensity ($P = 0.002$), voice breaks ($P = 0.002$), and vocal tremor ($P = 0.002$). The same parameters increased on the second return. The degree of severity, strained-strangled voice, roughness, breathiness, and asthenia was unchanged. The total score and the emotional domain score of the VHI were reduced on the first return. There was a moderate correlation between the degree of voice severity and the total VHI score before application and on the second return, and a weak correlation on the first return.

**Conclusions.** Perceptual-auditory analysis and self-perception proved to be efficient in the recognition of vocal changes and of the vocal impact on individuals with adductor spasmodic dysphonia under treatment with botulinum toxin, permitting the quantitation of changes along time.

**Key Words:** Adductor spasmodic dysphonia–Vocal quality–Perceptual voice judgments–Botulinum toxin–Voice handicap.

## INTRODUCTION

Laryngeal dystonia is a vocal disorder of neurologic origin and is characterized as task-dependent focal action-induction dystonia that affects laryngeal motor control.[1,2] It is recognized and referred to in the literature as spasmodic dysphonia because of its main vocal signal, ie, the presence of spasms,[3] the most frequent being adductor spasmodic dysphonia (AdSD), which is of higher prevalence among women.[4]

AdSD is characterized by involuntary spasms of the laryngeal muscles observed at the beginning of phonation,[5] associated with vocal symptoms such as strained-strangled voice quality, intermittent voice breaks,[6] and effort in speech production,[7] with a reduction of intelligibility, which compromise communication and affect the quality of life of an individual[8] both in functional, emotional, and social terms.[9]

The application of botulinum toxin (BTX) to the laryngeal muscles is currently considered to be the treatment of choice,[10] inducing paresis or paralysis of the laryngeal muscles and reducing the vocal symptoms for a period of time.[11]

Although the application of BTX for the treatment of AdSD is beneficial, it may also have side effects associated with the iatrogenic characteristics of the treatment, such as the presence of voice breathiness,[12] reduction of vocal intensity, hoarseness, alteration of airflow, effort to speak, fatigue, and reduction of the range of fundamental frequency in semitones.[13] The duration of the effect of treatment varied from 3 to 4 months.[14–16]

The effect of treatment with BTX has been demonstrated by different methods, such as vocal acoustic measurements, aerodynamic measurements, laryngoscopy, perceptual-auditory analysis performed by judges,[9,17–19] and self-perception of voice quality by the patient.[17] However, there is no information that might permit to draw conclusions about a standardized tool or that might permit the quantitation of the time of benefit and of the reduction of voice changes detected in AdSD.

In view of the above considerations, it is important to review evidence in the literature,[17,18,20] and according to the experience with patients to construct a tool to be used in the clinical setting without the need for high-cost technology to permit the assessment of vocal signs, together with visual analysis of narrow band spectrography and of recordings of pitch intensity for the follow-up of BTX treatment.

BTX treatment leads to improvement of vocal symptoms, although persons with AdSD do not consider their voice to be normal.[20,21] On this basis, there is concern about determining the impact of treatment on the voice quality of patients with dystonia, with a search for different perspectives for the analysis of the effect of medication on voice quality, interpersonal communication and communicative performance during daily activities, and also with the identification of patient satisfaction regarding the duration and effect of treatment.

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At present, one of the questionnaires more frequently used as an indicator of the effectiveness of treatment with BTX regarding the improvement of symptoms and of the quality of life of patients with AdSD is the Voice Handicap Index (VHI),[22] which is available in the version validated for the Portuguese language.[23]

Thus, the objective of the present study was to compare and to correlate the perceptual-auditory analysis of vocal parameters and self-perception in individuals with AdSD before and after the application of type A BTX.

## METHODS

This was a prospective cohort study which was approved by the Research Ethics Committee (Protocol N$^0$ 8339/2013). All subjects gave written informed consent to participate.

### Participants

The study was conducted on 16 individuals with a clinical diagnosis of AdSD, 11 (68.75%) were women and 5 (31.25%) were men, ranging in age from 25 to 90 years (mean: 57 years and 2 months). Of these, 81.25% had associated vocal tremor (VT) and other movement disorders associated with AdSD that did not promote changes in vocal production, ie, blepharospasm and cervical dystonia (12.5%), cervical dystonia (6.25%), generalized dystonia (6.25%), hemidystonia (6.25%), oromandibular tremor (6.25%), tremor in the cephalic region, cervical dystonia, and blepharospasm (6.25%).

Only patients with a diagnosis of adductor laryngeal dystonia participated in the study, whereas patients with other types of laryngeal dystonia were excluded. The subjects included were individuals who were receiving treatment for the first time or who needed to be submitted to a new BTX injection as the last application had occurred more than 120 days (mean: 223.31 days; range: 161–412 days) before, and there were no clinical signs of the effect of the medication since the last application. The 16 selected individuals had received, on average, 3.9 BTX injections before the current application.

The Pearson coefficient was applied for the inclusion of these subjects in order to determine the relationship between the degree of severity of vocal quality at the preapplication time and the time since the last application of the botulin toxin (number of days). A correlation coefficient of 0.41 ($P$ value = 0.11) was observed, permitting us to conclude that time has no influence on vocal severity since last application. This permitted us to consider all patients to be equal even with different time since the last application.

The following were the exclusion criteria: individuals with previous laryngeal surgeries, previous dysphonia, and language, speech, or hearing disorders, or dementia reported by individuals themselves or their relatives, or obtained from their medical records. Also excluded were patients with other neurologic changes, such as dysarthria, Parkinson's disease, ataxia, cerebellar atrophy, sequelae of cerebrovascular accidents, and others.

### Procedures

All patients were submitted to the standardized application of type A BTX (Dysport®) (Wrexham, United Kingdom) by the introduction of a needle/electrode through the cricothyroid membrane at 0.5 cm from the median sagittal line at a lateral and superior angle of 30°–45° until reaching the thyroarytenoid muscle guided by electromyography. Twenty units of type A BTX were applied unilaterally on the left side of the larynx to all patients.

All participants were submitted to the recording of the vocal signal and responded to the VHI, a questionnaire validated for the Portuguese language,[23] before BTX injection, on the first return (R1) held on average 36 days later (range: 28–49 days), and on the second return (R2) held on average 137 days after application (range: 112–189 days).

### Sound signal capture

The voice sound signal was captured and recorded using a professional microphone G-Track (Samson, Technologies, New York) and the *Sound Forge* 6.0 software (Sony Creative Software Inc, Middleton, Wisconsin, United States) at a sampling rate of 44,100 Hz and 16 bits, and stored in wav format. The procedure was carried out in an acoustically treated room with noise kept at less than 50 dB and monitored with a digital sound level meter. All participants performed prolonged emission of the vowel /a/, in Portuguese, three consecutive times at habitual vocal intensity and frequency at each time of assessment (preapplication, R1, and R2). The more stable sound signal was extracted visually from the vocal sample of the 16 subjects, the beginning and end of emission were discarded because of their irregular characteristics, and the best sound signal with at least 3 seconds of sound production was accepted.

### Instrument for assessment

Eight vocal parameters, described in Table 1, were proposed for the perceptual-auditory assessment of subjects with AdSD. This analysis was performed based on auditory stimuli (sustained emission of the vowel /a/) and on visual stimuli obtained with the free access *Praat* software, version 53.42,[24] permitting the visualization of the pitch and intensity contour of the vocal signal (Figure 1), and with narrow band spectrography considering the following configurations: bandwidth of 43 Hz and 0.03 (30 ms), frequency range from 0 to 5000 Hz, time step of 0.002 seconds, and frequency step of 20 Hz (Figure 2).

The vocal parameters were quantified using a visual analogue scale consisting of a 10-cm line with anchors at each end, with 0 on the left end (no change or absence) and 10 on the right end (severe change or permanent presence). A response form was elaborated for data recording using Microsoft Office Excel (Redmond, Washington, United States), permitting the analysis of each of the eight vocal parameters using the cursor to mark the values on a line. The values were then recorded automatically and transferred to a spreadsheet.

### Perceptual-auditory analysis of vocal parameters

The analysis was carried out by two specialized speech-language pathologist with a mean of 10 years of clinical experience in voice analysis and without hearing complaints, with judge 1 (J1) being the most experienced. The previously edited 47 voice recordings corresponding to the 16 subjects tested before the application of BTX and at R1, and to 15 individuals tested