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Multidimensional assessment of vocal changes in benign vocal fold lesions after voice therapy

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ABSTRACT

Objective: To evaluate through a multidimensional protocol voice changes after voice therapy in patients with benign vocal fold lesions.
Methods: 65 consecutive patients affected by benign vocal fold lesions were enrolled. Depending on videolaryngostroboscopy the patients were divided into 3 groups: 23 patients with Reinke's oedema, 22 patients with vocal fold cysts and 20 patients with gelatinous polyp. Each subject received 10 voice therapy sessions and was evaluated, before and after voice therapy, through a multidimensional protocol including videolaryngostroboscopy, perception, acoustics, aerodynamics and self-rating by the patient. Data were compared using Wilcoxon signed-rank test. Kruskal–Wallis test was used to analyse the mean variation difference between the three groups of patients. Mann–Whitney test was used for post hoc analysis.
Results: Only in 11 cases videolaryngostroboscopy revealed an improvement of the initial pathology. However a significant improvement was observed in perceptual, acoustic and self-assessment ratings in the 3 groups of patients. In particular the parameters of G, R and A of the GIRBAS scale, and the noise to harmonic ratio, Jitter and shimmer scores improved after rehabilitation. A significant improvement of all the parameters of Voice Handicap Index after rehabilitation treatment was found. No significant difference among the three groups of patients was visible, except for self-assessment ratings.
Conclusion: Voice therapy may provide a significant improvement in perceptual, acoustic and self-assessed voice quality in patients with benign glottal lesions. Utilization of voice therapy may allow some patients to avoid surgical intervention.

1. Introduction

Although non-neoplastic voice disorders are not life-threatening diseases, they may limit communication activities and have important public health implications. Consequently, voice-disordered patients may lose time from work, seek disability claims and utilize health care resources, exacerbating societal economic hardship and decreasing productivity [1]. Roy et al. [2], who studied the prevalence, risk factors and occupational impact of voice disorders in a random sample of 1326 adults, reported that the lifetime prevalence of a voice disorder was 29.9%. Vocal fold polyps, cysts and Reinke's oedema represent a significant portion of non-neoplastic voice disorders [3] and impair patients' quality of life (QOL) [4]. Although the identification of the most appropriate standard of care for benign vocal fold lesion is necessary, a standard has not been established yet and no consensus exists with respect to recommending voice therapy [5]. Even if voice therapy has been considered first line treatment for vocal folds polyps, cysts and nodules [6], and the American Academy of Otolaryngology Head and Neck Surgery Foundation guidelines advocate for voice therapy in patients with benign vocal fold lesions prior to surgical intervention [7], a survey on otolaryngologists' practice [8] reported that 91% of the U.S. otolaryngologists preferred voice therapy as initial treatment for nodules, but only 30% preferred voice therapy as initial treatment for polyps. Microphonosurgery represents the therapeutic approach most widely adopted for congenital or acquired benign vocal fold lesions and the majority of recent publications on benign vocal fold lesions therapy are focused on the advances in surgical management [9–11]. The paucity of published data on the effect of voice therapy in the treatment of benign vocal fold lesion is probably one of the major reasons for this attitude.

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Voice therapy consists of five basic behaviourally based approaches: vocal hygiene, direct facilitation of vocal production, respiratory support, muscle relaxation, and carryover [12]. The rationale of this approach lies in the fact that minimizing detrimental vocal behaviours that increase the stress at the mid-membranous vocal folds may lead to better voice quality and to voice performance that is sufficient to cope with everyday vocal load [13]. Moreover, voice therapy prevents relapse and potentially prevents need for more invasive therapy. Only few authors tried to assess the effect of non-surgical intervention in the management of benign vocal fold lesions. Yun et al. [14] reported that 20–38% of patients with vocal folds polyps may avoid surgery if vocal hygiene is provided; Cohen et al. [4] found that voice therapy is an effective treatment for vocal fold polyps and cysts. Nakagawa et al. [15] found that 10% of vocal fold polyps could be resolved with conservative treatment. Even if these studies reported an improvement in the clinical findings or in patient's perception of voice quality, none of the authors used a set of reliable and valid instruments, neither for the evaluation of the voice signal, nor for the self-assessment of the voice related QOL. Therefore the majority of these results are difficult to compare.

The aim of this study is to analyse the voice changes in a group of dysphonic patients affected by benign vocal fold lesions evaluated through a multidimensional protocol before and after voice therapy. This latter has been proposed by the European Laryngological Society and includes valid and reliable instruments that are largely used in the clinical practice.

2. Materials and methods

2.1. Participants

Sixty-five consecutive patients, 12 males and 53 females, affected by benign vocal fold lesions attending the Phoniatric department at Sacco Hospital were enrolled in the study. The mean age was 43.8 ± 17.7 years (range 11–75). Twenty out of the 65 patients were professional voice users. Based on the videolaryngostroboscopic examination the cohort of patients was divided into three groups: 23 patients had Reinke's oedema (Group 1), 22 patients had cysts (Group 2) and 20 patients had gelatinous polyps (Group 3). Patients characteristics are reported in Table 1.

Each patient was scheduled to have microphonosurgery and received 10 voice therapy sessions with an experienced speech/language pathologist for a period of 1–2 months before surgery. Frequency of therapy sessions was twice a week. No additional pharmacological treatment was provided.

2.2. Voice assessment

Each patient was evaluated, before and after voice therapy, following the multidimensional set of minimal basic measurements suitable for voice assessment and therapy outcome measurements proposed by the European Laryngological Society and adopted by the Italian Society of Phoniatrics and Logopedics (SIFEL, Società Italiana di Foniatria e Logopedia) [16,17]. The second evaluation was carried out at the end of the voice therapy, approximately 1 or 2 months after the first evaluation. This protocol included five different approaches: videolaryngostroboscopy, perception, acoustics, aerodynamics and self-rating by the patient. Each patient underwent a videolaryngostroboscopy, with either a rigid or flexible endoscope using a Storz FNL-10RP2 fiberscope (STORZ Endoskop Productions GmbH, Tuttlingen, Germany) or Atmos 4450.47 70° rigid telescope (ATMOS Medizin Technik GmbH & Co KG, Leuzkirch, Germany). All the videolaryngostroboscopies have been recorded and the recordings assessed by two phoniatricians blind to whether they were conducting pre- or post-treatment assessment. According to the change in the lesion size the patients were divided in to two groups: "improvement" and "not improvement"; similarly to the original study of Yun et al. [14] the lesion was considered improved when its size was decreased to more than half of its original size or when it completely resolved. The GIRBAS scale was used for perceptual voice assessment [18,19]. The conversational speech and the sustained vowels of each patient were recorded in the host computer and the recordings rated jointly by an experienced phoniatrician and a speech pathologist who finally discussed the results of the analysis in order to assign an univocal score for each of the items included in the GIRBAS scale. For the recording of voice signal a microphone approximately 15 cm from the voice source was used, in order to avoid airflow effect. The two raters were blind to whether they were conducting pre or post treatment evaluations. Moreover no information regarding the patient was provided to the raters during the evaluation session and none of them had familiarity with the patients since they were not involved in the treatment program.

For aerodynamic evaluation, each patient was asked to utter an /a/ in modal voice for as long as they could. The voice signal was stored in the host computer. The Computerized Speech Lab (CSL) with a 4300 external module of Kay Elemetrics Corporation was used. The maximum phonation time (MPT) was determined by measuring the sustained /a/ in three productions on the basis of the oscillogram signal. The longest sustained phonation was used for further processing.

A spectrography of the sustained vowel /a/ at FFT-1024 points ranging between 0 and 8 KHz was performed; the sample frequency was 20,000 Hz. Based on spectrographic analysis, each patient's voice was classified as either type 1, 2 or 3, according to Titze's recommendations [20]; only those classified as type 1 underwent perturbation analysis. A sustained /a/ was used with a sample frequency of 50,000 Hz; only the central portion of the uttered /a/ was used for perturbation analysis, avoiding onset and offset of phonation. Jitter (Jitt%), shimmer (shim%), noise to harmonic ratio (NHR), as well as average fundamental frequency (Fo) were calculated. Finally, each patient completed autonomously the Italian VHI [21,22] to have self-assessment data on the perceived QOL.

2.3. Voice therapy

Vocal hygiene was provided as an initial step; this latter included notions on normal voice production, vocal abuse patterns and their resolution, hydratation's prominent role, effects of irritants and laryngopharyngeal reflux. As far as it concerns the applied voice therapy techniques, they varied according to phonatory behaviour of the patient himself. The aim was to reduce associated hyperkinetic behaviours (anterior–posterior contraction, latero-lateral shortening of vocal tract) and to obtain the best possible vocal fold vibration thanks to the development of optimal breathing and to the improvement of intrinsic muscle

Table 1
Patients characteristics.

	Gender		Age (years)
	Male	Female	
Group 1 (Reinke's oedema)	4	19	43.3 ± 18.3 (12–75)
Group 2 (vocal fold cyst)	4	18	40.7 ± 14.5 (22–67)
Group 3 (gelatinous polyp)	4	16	47.8 ± 19.7 (11–70)
Total	12	53	43.8 ± 17.7 (11–75)