

SPEECH DISORDERS

Vocal improvement after voice therapy in the treatment of benign vocal fold lesions

Miglioramento vocale dopo trattamento logopedico di lesioni cordali benigne

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SUMMARY

Benign vocal fold lesions are common in the general population, and have important public health implications and impact on patient quality of life. Nowadays, phonosurgery is the most common treatment of these lesions. Voice therapy is generally associated in order to minimize detrimental vocal behaviours that increase the stress at the mid-membranous vocal folds. Nonetheless, the most appropriate standard of care for treating benign vocal fold lesion has not been established. The aim of this study was to analyze voice changes in a group of dysphonic patients affected by benign vocal fold lesions, evaluated with a multidimensional protocol before and after voice therapy. Sixteen consecutive patients, 12 females and 4 males, with a mean age of 49.7 years were enrolled. Each subject had 10 voice therapy sessions with an experienced speech/language pathologist for a period of 1-2 months, and was evaluated before and at the end of voice therapy with a multidimensional protocol that included self-assessment measures and videostroboscopic, perceptual, aerodynamic and acoustic ratings. Videostroboscopic examination did not reveal resolution of the initial pathology in any case. No improvement was observed in aerodynamic and perceptual ratings. A clear and significant improvement was visible on Wilcoxon signed-rank test for the mean values of Jitt%, Noise to Harmonic Ratio (NHR) and Voice Handicap Index (VHI) scores. Even if it is possible that, for benign vocal fold lesions, only a minor improvement of voice quality can be achieved after voice therapy, rehabilitation treatment still seems useful as demonstrated by improvement in self-assessment measures. If voice therapy is provided as an initial treatment to the patients with benign vocal fold lesions, this may lead to an improvement in the perceived voice quality, making surgical intervention unnecessary. This is one of the first reports on the efficacy of voice therapy in the management of benign vocal fold lesions; further studies are needed to confirm these preliminary data.

KEY WORDS: Voice therapy • Cyst • Polyp • Benign vocal fold lesion

RIASSUNTO

Le lesioni cordali benigne sono patologie frequenti e con un impatto importante sulla qualità della vita del paziente. Sebbene al giorno d'oggi la fonochirurgia rappresenti il punto di partenza per il trattamento di tali lesioni, non sono ancora stati definiti degli standard terapeutici ed è abitudine comune associare al trattamento chirurgico anche quello logopedico, allo scopo di eliminare gli atteggiamenti vocali disfunzionali. Scopo del lavoro è confrontare le modificazioni del segnale vocale di un gruppo di pazienti affetti da lesioni cordali benigne, valutate con un protocollo multidimensionale, e trattato con terapia logopedica. Sono stati arruolati 16 pazienti consecutivi, 12 femmine e 4 maschi, con un'età media di 49.7 anni. Ognuno di essi è stato sottoposto a 10 sessioni di terapia logopedica in un periodo di 1-2 mesi. Il segnale vocale di ogni paziente è stato valutato prima e al termine del trattamento logopedico, con un protocollo multidimensionale che includeva, oltre all'esame videostroboscopico, anche la valutazione di parametri aerodinamici, acustici, percettivi e autovalutativi. In nessun caso l'esame videostroboscopico ha evidenziato la risoluzione della patologia. Né i parametri acustici né quelli percettivi sono migliorati significativamente al termine della terapia logopedica. I valori di Jitt%, di Noise to Harmonic Ratio (NHR) e i punteggi del Voice Handicap Index (VHI), invece, sono migliorati significativamente al termine della terapia logopedica. Nonostante sia possibile che, per quanto riguarda le lesioni cordali benigne, il beneficio sulla qualità vocale ottenuto con la terapia logopedica sia solo modesto, il trattamento risulta comunque efficace per il paziente, come dimostrato dal significativo miglioramento dell'autopercezione vocale. Se effettuata come primo trattamento, quindi, in una percentuale di pazienti la terapia logopedica potrebbe determinare un miglioramento dell'auto percezione della qualità vocale e tale risultato potrebbe rendere inutile il trattamento chirurgico. Quello riportato è uno dei primi studi che ha cercato di analizzare l'efficacia della terapia logopedica nel trattamento delle lesioni cordali benigne. Occorrono pertanto ulteriori studi che possano confermare questi dati preliminari.

PAROLE CHIAVE: *Terapia logopedica • Cisti cordali • Polipi cordali • Lesioni cordali benigne*

Acta Otorhinolaryngol Ital 2012;32:304-308

Introduction

Up to 29.9% of the general public has at least one lifetime voice disorder, and 7.2% miss one or more working days¹. In particular, benign vocal fold lesions, such as cysts and polyps, are common in the general population and are associated with important public health implications and impairment in patient quality of life^{2,3}. Nowadays, phonosurgery constitutes the therapeutic base for congenital or acquired benign vocal fold lesions (cysts, pseudocysts, gelatinous/angiomatic polyps, fusiform oedema)^{4,5}. Generally, surgical treatment is associated with voice therapy that can be performed before and/or after phonosurgery^{6,7}. The indication for phonosurgical treatment in patients with benign vocal fold lesions is related to many different factors: surgeon's experience, grade of dysphonia, type of lesion and vocal request of the patient. In clinical practice, voice therapy is often recommended in patients with intracordal lesions of small dimensions before surgery. Voice therapy consists of five basic behaviourally-based approaches: vocal hygiene, direct facilitation of vocal production, respiratory support, muscle relaxation and carryover⁸. The rationale for a non-surgical approach lies in the fact that voice therapy minimizes detrimental vocal behaviours that increase the stress at the mid-membranous vocal folds, and may lead to better voice quality and voice performance that is sufficient to cope with everyday vocal load^{9,10}. Nonetheless, the most appropriate standard of care for treating benign vocal fold lesions has not been established, and no consensus exists with respect to recommending voice therapy, because only limited objective data exist regarding its efficacy^{11,12}; on the other hand, the large majority of recent publications on benign vocal fold lesions therapy are mostly focused on advances in surgical management¹³⁻¹⁵. The aim of this study was to analyze the voice changes in a group of dysphonic patients affected by benign vocal fold lesions, evaluated with a multidimensional protocol before and after voice therapy.

Materials and methods

Participants

Sixteen consecutive patients, 12 females and 4 males, admitted to the ENT department of the "L. Sacco" Hospital in Milan complaining of dysphonia, were enrolled in the study. All patients were affected by a benign vocal fold lesion, diagnosed with fibre optic laryngoscopy, and were scheduled for voice therapy before phonosurgery. The mean age was 49.7 ± 10.2 years (range 38-66). Twelve patients had cysts ($n = 8$) or pseudocysts ($n = 4$), 3 had gelatinous polyp and 1 had unilateral vocal fold oedema. Each patient involved had 10 voice therapy sessions with an experienced speech/language pathologist for a period of 1-2 months, before being scheduled for

Table I. Distribution for sex, age and laryngeal pathology. Mean \pm standard deviation and range (in parentheses) are reported.

	Males	Females	Total
Sex	4	12	16
Age	46.8 ± 8.4 (38-63)	50.6 ± 10.8 (39-66)	49.7 ± 10.2 (38-66)
Laryngeal pathology			
Cyst	2	6	8
Pseudocyst	1	3	4
Gelatinous polyp	1	2	3
Vocal fold oedema	-	1	1

microphonosurgery. Frequency of therapy sessions was twice a week. The distribution for sex, age and laryngeal pathology are reported in Table I.

Voice assessment

Each patient was evaluated, before and after voice therapy, using a multidimensional set of minimal basic measurements suitable for voice assessment and therapy outcome measurements recently proposed by the European Laryngological Society and adopted by the Italian Society of Phoniatics 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. Each patient underwent videolaryngoscopy with either a rigid or flexible endoscope. Endoscopic examinations were conducted using either 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). The GIRBAS scale was used for the perceptual voice analysis^{18,19}; an experienced phoniatician and a speech pathologist jointly rated each patient on conversational speech and sustained vowels, and discussed the results of perceptual analysis in order to assign a score for each of the items included in the GIRBAS scale.

Patients were asked to utter an /a/ in modal voice for as long as possible; the voice signal was recorded with the microphone approximately 15 cm from the voice source to avoid an airflow effect and was directly stored in the host computer. The Computerized Speech Lab (CLS) (Version 5.05) with a 4300 external module of Kay Elemetrics Corporation (Lincoln Park, NJ) 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. Spectrography of the sustained vowel [a] at FFT-1024 points ranging between 0 and 8 kHz was obtained; the sample frequency was 20,000 Hz. The Yanagihara classification was used²⁰. Based on spectrographic analysis, each patient's voice was

Table II. GIBBAS data for pre- and post-treatment assessment. The number of patients with a given score for each parameter of the GIBBAS scale before and after voice therapy is reported. p values on Wilcoxon test are shown.

GIBBAS scores	G		I		R		B		A		S	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
0	1	1	5	3	4	10	7	5	7	4	10	11
1	5	8	8	7	7	4	7	8	7	5	5	4
2	7	5	3	1	2	1	1	3	1	4	1	1
3	3	2	0	5	3	1	1	0	1	3	0	0
p value	0.07		0.08		0.09		0.09		0.06		0.41	

classified as either type 1, 2 or 3, according to Titze's recommendations; only those classified as type 1 or 2 underwent perturbation analysis. A sustained /a/ was used with a sample frequency of 50,000 Hz. 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 obtain a self-assessment on the perceived QoL.

Voice therapy

Vocal hygiene was provided as an initial step of voice therapy. Vocal hygiene education included education on how the normal voice is produced, identification of individual vocal abuse patterns, education on how to reduce/eliminate the vocal abuse, emphasis on the importance of hydration, education on the adverse effects of irritants and the influence of laryngopharyngeal reflux and certain medications. The voice therapy techniques applied varied according to phonatory behaviour of the patient and aimed to reduce associated hyperkinetic behaviours (anterior-posterior contraction, latero-lateral shortening of vocal tract) and to obtain the best possible vocal fold vibration. Therapy was directed towards progressive development of optimal breathing, abdominal support and gentle improvement of intrinsic muscle strength and agility, without supraglottal hyper-functional compensation. Abdominal breathing was practised to maintain appropriate subglottal air pressure, avoiding shallow, upper chest breathing and phonation on residual air. Humming, resonant voice, yawing-sigh technique and laryngeal manipulation were the techniques more frequently applied.

Statistical analysis

The results were given as arithmetic mean \pm standard deviation, with the exception of ordinal variables. MPT, perturbation analysis, perceptual analysis, Yanagihara score and VHI data of patients before and after voice therapy were compared using a Wilcoxon signed-rank test. A significance level of 0.05 for all testing was used. Statistical analyses were performed using the SPSS 18.0 package (SPSS Science, Chicago, IL). The study was carried out

according to the Declaration of Helsinki and approved by the Institutional Review Board of the "L. Sacco" Hospital of Milan.

Results

Videostroboscopic examination did not reveal resolution of the initial pathology in any case. Patients had an MPT of 14.4 ± 7.5 seconds before voice therapy and 14.9 ± 7.9 seconds after. The difference with a Wilcoxon signed-rank test was not significant ($p = 0.33$).

The perceptual voice analysis of patients before and after voice therapy is reported in Table II. The parameters G, R and I were moderately improved, but these differences were not statistically significant on Wilcoxon signed-rank test.

Before voice therapy, by spectrographic analysis with Yanagihara's classification, 5 patients were classified as grade 1, 8 patients as grade 2 and 3 patients as grade 3. At the end of the voice therapy, voice signals were classified as grade 1 in 4 patients, grade 2 in 10 patients and grade 3 in 2 patients. These differences were not statistically significant with a Wilcoxon signed-rank test.

Since a type 1 or 2 signal was obtained for all the patients before and after voice therapy, all voices underwent perturbation analysis. Results of perturbation analysis and statistical comparison with a Wilcoxon signed-rank test are shown in Table III. A general reduction of Fo was found, but the difference was not significant. A clear and significant improvement was visible for the mean values of Jitt% ($p = 0.04$) and NHR ($p = 0.04$).

Table III. Perturbation analysis data: only voices with clear harmonic structure on sound spectrography underwent perturbation analysis. Mean, standard deviation and p values before and after voice therapy are reported. p values on Wilcoxon test are also reported.

	Before voice therapy	After voice therapy	p value
Jitt%	2.3 ± 1.27	1.9 ± 0.97	0.04
Shim%	4.8 ± 1.95	4.2 ± 1.29	0.06
NHR	0.13 ± 0.14	0.10 ± 0.02	0.04
Fo	186 ± 54.03	173 ± 42.7	0.64

Table IV. VHI data (mean, standard deviation and p values before and after voice therapy).

	Before voice therapy	After voice therapy	p value
VHI t	25.3 ± 12.2	23.3 ± 10.2	0.048
VHI f	5.8 ± 4.3	5.1 ± 3.4	0.371
VHI e	4.6 ± 4.3	3.1 ± 3.8	0.039
VHI p	14.8 ± 5.8	15.3 ± 5.1	0.043

p values on Wilcoxon signed-rank test, mean ± standard deviation of pre- and post-therapy measures are reported. Abbreviations: VHI t, total; VHI f, functional; VHI e, emotional; VHI p, physical.

VHI values before and after voice therapy are shown in Table IV. For the VHI total score as well as for the physical and emotional subscale scores, improvement was found and the differences were significant.

Discussion

Voice modifications after voice therapy in a group of 16 subjects with benign vocal fold lesions was assessed using a multidimensional protocol. No clear and significant improvement was observed in aerodynamic and perceptual ratings, while better scores were found on acoustic and self-assessment ratings. Only NHR, Jitt%, VHI e, VHI p and VHI total score showed improvement after rehabilitation treatment. This is the first report in the international literature on vocal modification after voice therapy for benign lesions using a multidimensional protocol. Only a few studies^{3,12}, in fact, have tried to compare the voice characteristics of a group of patients affected by benign monolateral vocal lesions and treated with voice therapy. In a study by Young-Sun et al.¹², voice evaluation and vocal hygiene were provided to 340 patients with vocal polyps. In order to assess the effect of vocal hygiene eight parameters, (gender, occupational vocal demand, smoking, reflux symptoms, age, hoarseness duration, polyp size and haemorrhagic change) were compared before and after voice therapy. In an article by Cohen et al.³, the main outcome measure was voice improvement, defined by the patient, at last follow-up, stating that his/her voice improved sufficiently to meet his/her daily voice needs most of the time. Both studies reported an improvement in the patient's perception of her/his voice quality. However, the voice modifications induced by rehabilitation techniques were not specifically investigated and precise multidimensional data were lacking in both studies. Moreover, neither study used a set of validated questionnaires for the assessment of vocal improvement. Even if the patient's perception of dysphonia, rather than clinical and instrumental measures, is nowadays considered to be the strongest primary outcome measure²³, voice has to be

considered as a multidimensional phenomenon²⁴ and definition of voice improvement based only on patient report is limited.

Regarding the usefulness of voice therapy, the results reported here are less clear if compared with previous studies; however, if self-assessment data are considered, in our study patients also reported an improvement of voice quality as demonstrated by the statistically significant differences between the VHI p, VHI e and VHI total score before and after the voice therapy. This finding is not surprising since the use of voice in a more efficient manner and the reduction of trauma at the mid-membranous vocal fold, obtained with voice therapy, may improve the patient's self impression of voice, despite the persistence of the polyp or cyst.

In the present study, only the self-assessment measures showed a significant improvement, while objective voice quality was not modified. Various factors may have contributed to this result such as poor adherence to therapy or inadequate choice of rehabilitative technique²⁵. However, it is also possible that for benign vocal fold lesions, only a small improvement of voice quality can be achieved with voice therapy. Nonetheless, rehabilitation treatment seems useful for patients as demonstrated by the improvement in self-assessment measures. Thus, we might speculate that voice therapy leads to an improvement sufficient to cope with everyday vocal load. Moreover, even if surgical management of patients in the present study was not analyzed, it is possible to speculate that voice therapy may increase adherence to behavioural and rehabilitative recommendations in the post-operative period.

The present study should be considered as a preliminary report on the effect of voice therapy in the management of benign vocal fold lesions evaluated with a multidimensional protocol. This is, in fact, a consecutive case-series study, and a control group, receiving for example only vocal hygiene programmes, was not included. For this reason, the evidence level for this study is quite low (Level C according to the UK National Health Service) and it is not possible to demonstrate that the improvement in self-assessment measures is a consequence of rehabilitation treatment. Nonetheless, this is one of the first analyses of the effects of vocal therapy in the management of benign vocal fold lesions. Further studies are needed to better clarify the role of voice therapy in the management of these diseases. Moreover, it is possible that if voice therapy is provided as initial treatment, it may lead to an improvement in the perceived voice quality in some patients with benign vocal fold lesions, and this could make surgical intervention unnecessary. Voice surgeons should consider this possibility during pre-operative counselling.

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Received: June 27, 2011 - Accepted: December 13, 2011

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