Biomedical Research 2017; 28 (9): 3874-3879 *ISSN 0970-938X*
www.biomedres.info

Clinical observation of the effect of voice training on patients with vocal cord polyps after phonomicrosurgery.

Huihua You, Pan Zhuge*, Hanqing Wang, Yulan Zhang, Huanle Du

Department of Otolaryngology, Jinhua Centrel Hospital, Jinhua, Zhejiang Province, PR China

Abstract

The aim of the current study was to evaluate the clinical effectiveness of voice training on patients with vocal cord polyps after phonomicrosurgery. The experimental group included 55 patients with vocal cord polyps after phonomicrosurgery that underwent voice training. Laryngostroboscopy, Voice Handicap Index (VHI), and Dysphonia Severity Index (DSI) were applied to evaluate patient voice quality. In the control group, no voice training was imparted to 41 patients after phonomicrosurgery. The inter- and intra-group differences in laryngostroboscopy, VHI, and DSI were compared statistically. No statistical inter-group difference was noted in the mucosal wave and incomplete glottal closure between the two groups, before and after surgery. Further, there was no statistical inter-group difference in the VHI, MPT, Jitter, F_0-High, I-Low, and DSI values between the two groups before surgery. Although the VHI value improved in both groups after surgery, its value was lower in the experimental group than in the control group after surgery. Further, the value of Jitter was lower in the experimental group than that in the control group after surgery. After surgery, Jitter, I-Low, and DSI values improved in the experimental group but the control group showed improvements only in the Jitter and DSI values. Laryngostroboscopy, VHI, and DSI can be used to comprehensively assess the voice quality of patients with vocal polyps before and after phonomicrosurgery. Voice training improves the self-evaluated voice quality and vocal stability in patients after phonomicrosurgery.

Keywords: Vocal cord polyps, Phonomicrosurgery, Voice training, Laryngostroboscopy, Voice handicap index, Dysphonia severity index.

Accepted on January 27, 2017

Introduction

Clinically, a vocal cord polyp is a common benign vocal proliferative disease, which occurs in the superficial layer of vocal fold lamina propria. Previous research has demonstrated that phonomicrosurgery, including the use of CO_2 laser and cold excision, can improve the voice handicap in patients with vocal cord polyps with a low recurrence rate. This confirmed the important role of phonomicrosurgery in the treatment of vocal cord polyps [1-3].

In-depth research on the microstructure and vocal mechanism of vocal cords verified that voice therapy has certain therapeutic effects on vocal cord polyps [4,5]. The core contents of voice therapy include voice training and vocal hygiene education. Voice training mainly consists of relaxation training, breathing exercises, vocal function exercises, resonant improvement exercises, and carryover exercises. Vocal hygiene education mainly involves the prevention of misuse and abuse of voice. Ju et al. [6] systematically studied changes of indicators such as acoustics, aerodynamics, and self-perceived voice handicap of patients with vocal cord polyps using voice therapy after phonomicrosurgery. They found that voice therapy could preferably improve the self-perceived voice quality of patients after phonomicrosurgery. However, clinicians who observe the clinical effects of patients using voice therapy after phonomicrosurgery need an assessment tool that is relatively easy to operate, allows assessment of results quickly, and is reliable and reproducible.

The assessment methods for voice quality that are commonly used in clinic include laryngostroboscopy, the Voice Handicap Index (VHI), and Dysphonia Severity Index (DSI) [7-11]. The current study aimed to evaluate the clinical effect of voice training on patients with vocal cord polyps after phonomicrosurgery using these assessment tools.

Methods

Subjects

From September 2011 to December 2012, 55 patients with vocal cord polyps were enrolled in the experimental group at the Department of Otolaryngology in Jinhua Central Hospital. The inclusion criteria were as follows: (1) a chief complaint of hoarseness with a course of disease more than three months, (2) confirmation by laryngoscopy that the first and second 1/3 junction surface at the edge of the vocal cords were smooth

and that translucent pedunculated neoplasm or fusiform translucent smooth neoplasm with a wider base were formed by the free edge of the vocal cords, and (3) agreement to voice training treatment after surgery. The exclusion criteria included vocal cord tumors, vocal nodules or Reinke's oedema, and a medical history of laryngopharyngeal reflux disease. In the control group, 41 patients with vocal cord polyps were enrolled to participate in the study. The inclusion and exclusion criteria were the same as the experimental group, except postoperative voice training was not included. All patients were provided with vocal hygiene education for one month prior to surgery. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Jinhua Central Hospital. Written informed consent was obtained from all participants.

In both the experimental group and control group, no statistical difference was found for clinical factors including sex, age, course of disease, and professional voice. In the study, a "professional voice" referred to the voice of teachers, salesmen, consultants, tour guides, etc., who have worked in their respective fields for more than six months (Table 1).

Table 1. *Statistical analysis of basic information in two groups.*

Parameters	Experimental group (n=55)	Control group (n=41)	P
Gender (n (%))			0.818
Male	9 (16.4%)	4 (9.8%)	
Female	46 (83.6%)	37 (90.2%)	
Age (mean ± SD; y)	36.95 ± 8.74	35.56 ± 9.09	0.835
Course (mean ± SD; m)	9.27 ± 4.3	9.32 ± 4.82	0.777
Professional voice? (n (%))			0.863
Yes	16 (29.1%)	11 (26.8%)	
No	39 (70.9%)	30 (73.2%)	

Laryngostroboscopy

The laryngostroboscopy system (XION Co., Ltd., Germany) was used to examine patients, who were in a seated position, in a quiet environment. The pharyngeal mucosa was anesthetized with 1% tetracaine that was sprayed thrice. Patients were asked to relax and breathe calmly. The rigid laryngoscope was placed at an angle of 70 degrees into the mouth of the examinees. The lens was closed to the posterior pharyngeal wall and in parallel to the level of the vocal cord. Examinees were instructed to produce/I/. A designated examiner observed the examinees' vocal cord polyp volume and location, vocal fold vibration symmetry, period, amplitude and closure, and mucosal waves on a monitor, videoed them, and assessed characteristics of the disease condition.

Subjective evaluation of self-perceived voice handicap

A resident was assigned to explain the significance of investigation to the patients. Using the Chinese version of VHI [12], patients graded the Physical (P), Functional (F), and Emotional (E) parts on their own. Each part consisted of 10 questions with the corresponding options individually representing the frequency of episodes: 0 as "never", 1 as "seldom", 2 as "sometimes", 3 as "often", and 4 as "always". In each part, the total score was the sum of the scores for each of the 10 questions, which ranged from zero to 40. The total score (T) was the sum of these three parts, which ranged from zero to 120. A higher score in an individual part indicated a significant effect of voice handicap on this part, while a higher total score suggested a more severe subjective evaluation of self-perceived voice handicap.

Objective acoustic and aerodynamic assessment and the calculation of dysphonia severity index

The assessment was carried out in a voice test chamber using DiVAS voice analysis software (XION Co., Ltd., Germany), in line with the acoustic standards in a living room. A headset microphone was worn and the microphone probe was positioned 30 cm away from the mouth. The patients were asked to relax and breathe calmly. The MPT, Jitter, F_0-High, and I-Low tests were performed according to the methodology outlined below, and the DSI score was calculated.

MPT test: After taking a deep breath, patients were asked to continuously pronounce the vowel "a" with a self-perceived comfortable tone and loudness of sound, for as long as possible. Tone and loudness were tested thrice. The sound sample with the longest duration was used in the test.

Jitter test: Patients were asked to continuously pronounce the vowel "a" with a self-perceived comfortable tone and loudness of a sound, for as long as possible. The duration was about three seconds. Tone and loudness were tested thrice. The Jitter value of each sample, ranging from 0.5 to 1.5 s, was evaluated and the final measurement was calculated as the average reading noted across the three trials.

F0-high and I-low tests: Patients were asked to pronounce the vowel "a" with a self-perceived comfortable tone and loudness of a sound, allowing the particularly comfortable tone and loudness to be noted. Based on these values, the highest and lowest possible tone and loudness were recorded. F_0-High and I-Low of test results were adopted. The final measurement was noted as the average reading observed across the three trials.

Calculation of the DSI score: Based on the adopted MPT, Jitter, F_0-High, and I-Low values, the DiVAS voice analysis software was applied to calculate the DSI score.

Surgical methods

All patients were administered general anesthesia and microsurgery was performed by an experienced otolaryngology practitioner. The pedunculated polyps were cut and excised from the polyp pedicle. The interior micro-valve technique was

applied for polyps with a wide base. The microstructure of the vocal cords was retained as much as was possible.

Voice training program

Patients received the voice training for about three months, once every two weeks, for duration of approximately 60-90 min. Four physicians educated with knowledge and skills of voice therapy from the Department of Otolaryngology presented brief explanations about vocal polyps and voice therapy. The contents of training primarily included: (1) relaxation training, (2) breathing exercises, (3) vocal function exercises, (4) resonant improvement exercises, (5) carryover exercises, (6) prevention of misuse and abuse of voice, and (7) popularization of health knowledge of voice use [13,14]. At each session, the patients practiced the techniques of correct voice emission. All patients received voice treatment training materials created by us with repeated emphasis on individualized practice at home. The effects of the home practice were evaluated at the beginning of each subsequent session. We also monitored the progress of exercise and answered patient questions by telephone follow-up.

Evaluation of effectiveness

Laryngostroboscopy was conducted again four months after surgery. The disappearance of vocal cord polyps was considered as the criterion of cure. We re-evaluated the VHI, MPT, Jitter, F_0-High, and I-Low were tested to calculate the DSI score.

Statistical analysis

If the data met normality and homogeneity of variance criteria, the mean ± standard deviation were considered as descriptive statistics and a t-test was applied to analyse differences between the two groups. If the data did not meet the criteria of normality and homogeneity of variance, however, the median and quartiles were considered as descriptive statistics and a rank sum test was applied to analyse group differences. A p-value less than 0.05 was considered to be statistically significant.

Results

General therapeutic effects

The amplitude, symmetry, and periodicity of two groups of vocal cord vibrations in the two groups of patients before surgery were normal. In the experimental group, a weakened mucosal wave was noted and an incomplete glottal closure was observed in 18 and 21 patients, respectively. In the control group, 3 patients showed a weakened mucosal wave while an incomplete glottal closure was found in 16 patients. After surgery, laryngoscopy showed that there was no polyp recurrence in either group. The mucosal wave, glottal closure, and VHI scores (E, F, P, T) in both groups, the Jitter, I-Low, and DSI scores in the experimental group, and the Jitter and DSI scores in the control group were improved after surgery (Table 2).

Table 2. *Intra-group evaluation of laryngostroboscopy, VHI, DSI in two groups of patients before and after surgery.*

Parameters	Before surgery	Postoperative follow-up	z/t	p
Experimental group				
Mucosal wave (n (%))			-4.12	0
Normal mucosal wave	37 (67.3%)	54 (98.2%)		
Weakened mucosal wave	18 (32.7%)	1 (1.8%)		
Glottal closure (n (%))			-4.58	0
Normal glottal closure	34 (61.8%)	55 (100%)		
Incomplete glottal closure	21 (38.2%)	0		
Function score (mean ± SD)	6.33 ± 6.31	3.09 ± 2.21	5.49	0
Physiology score (mean ± SD)	12.64 ± 7.76	5.91 ± 3.03	8.99	0
Emotion score (mean ± SD)	5.82 ± 7.8	2.38 ± 2.26	4.27	0
Total score (mean ± SD)	24.65 ± 19.47	11.13 ± 6.48	7.07	0
MPT (mean ± SD; s)	19.11 ± 3.56	18.38 ± 3.77	1.5	0.138
Jitter (mean ± SD (%))	2.03 ± 0.67	1.07 ± 0.34	9.03	0
F_0-High (mean ± SD; Hz)	398.75 ± 55	410.33 ± 49.76	-1.38	0.172
I-Low (mean ± SD; dB)	56.85 ± 4.54	54.93 ± 3.43	3.08	0.003
DSI (mean ± SD)	-0.08 ± 1.21	1.43 ± 0.87	-8.74	0
Control group				
Mucosal wave (n (%))			-3.32	0.001
Normal mucosal wave	28 (68.3%)	39 (95.1%)		
Weakened mucosal wave	13 (31.7%)	2 (4.9%)		
Glottal closure (n (%))			-4	0
Normal glottal closure	25 (61%)	41 (100%)		
Incomplete glottal closure	16 (39%)	0		
Function score (mean ± SD)	5.71 ± 5.31	4.44 ± 3.78	3.37	0.002
Physiology score (mean ± SD)	11.78 ± 7.68	7.9 ± 5.64	7.66	0
Emotion score (mean ± SD)	4.49 ± 5.02	3.98 ± 4.76	2.87	0.007
Total score (mean ± SD)	21.8 ± 15.94	16.76 ± 12.65	7.18	0
MPT (mean ± SD; s)	19.34 ± 3.37	19.17 ± 3.67	0.21	0.838

Jitter (mean ± SD (%))	1.98 ± 0.65	1.28 ± 0.5	6.29	0
F_0-High (mean ± SD; Hz)	397.54 ± 59.18	412.59 ± 45.97	-1.24	0.222
I-Low (mean ± SD; dB)	56.68 ± 4.74	55.34 ± 3.64	1.31	0.197
DSI (mean ± SD)	0.03 ± 1.11	1.16 ± 1.29	-4.12	0

Evaluation of the effectiveness of voice training

No statistically significant differences were noted in the mucosal wave, glottal closure, VHI, and DSI between the experimental and control groups before the surgery. There was also no statistically significant difference in the mucosal wave, glottal closure, MPT, F_0-High, I-Low, and DSI values between the groups after the surgery. The VHI score and Jitter values recorded after the surgery were superior in the experimental group to those noted for the control group (Table 3).

Table 3. *Inter-group evaluation of laryngostroboscopy, VHI, DSI in two groups of patients before and after surgery.*

Parameters	Experimental group	Control group	z /t	p
Before surgery				
Mucosal wave (n (%))			-0.11	0.916
Normal mucosal wave	37 (67.3%)	28 (68.3%)		
Weakened mucosal wave	18 (32.7%)	13 (31.7%)		
Glottal closure (n (%))			-0.08	0.933
Normal glottal closure	34 (61.8%)	25 (61%)		
Incomplete glottal closure	21 (38.2%)	16 (39%)		
Function score (mean ± SD)	6.33 ± 6.31	5.71 ± 5.31	0.51	0.612
Physiology score (mean ± SD)	12.64 ± 7.76	11.78 ± 7.68	0.54	0.592
Emotion score (mean ± SD)	5.82 ± 7.8	4.49 ± 5.02	0.95	0.342
Total score (mean ± SD)	24.65 ± 19.47	21.8 ± 15.94	0.77	0.446
MPT (mean ± SD; s)	19.11 ± 3.56	19.34 ± 3.37	-0.32	0.751
Jitter (mean ± SD (%))	2.03 ± 0.67	1.98 ± 0.65	0.39	0.701
F_0-High (mean ± SD; Hz)	398.75 ± 55	397.54 ± 59.18	0.1	0.918
I-Low (mean ± SD; dB)	56.85 ± 4.54	56.68 ± 4.74	0.18	0.858
DSI (mean ± SD)	-0.08 ± 1.21	0.03 ± 1.11	-0.46	0.649
Postoperative follow-up				
Mucosal wave (n (%))			-0.85	0.397
Normal mucosal wave	54 (98.2%)	39 (95.1%)		
Weakened mucosal wave	1 (1.8%)	2 (4.9%)		
Glottal closure (n (%))			0	1
Normal glottal closure	55 (100%)	41 (100%)		
Incomplete glottal closure	0	0		
Function score (mean ± SD)	3.09 ± 2.21	4.44 ± 3.78	-2.19	0.031
Physiology score (mean ± SD)	5.91 ± 3.03	7.9 ± 5.64	-2.23	0.028
Emotion score (mean ± SD)	2.38 ± 2.26	3.98 ± 4.76	-2.18	0.032
Total score (mean ± SD)	11.13 ± 6.48	16.76 ± 12.65	-2.84	0.006
MPT (mean ± SD; s)	18.38 ± 3.77	19.17 ± 3.67	-1.02	0.309
Jitter (mean ± SD (%))	1.07 ± 0.34	1.28 ± 0.5	-2.48	0.015
F_0-High (mean ± SD; Hz)	410.33 ± 49.76	412.59 ± 45.97	-0.23	0.821
I-Low (mean ± SD; dB)	54.93 ± 3.43	55.34 ± 3.64	-0.57	0.57
DSI (mean ± SD)	1.43 ± 0.87	1.16 ± 1.29	1.24	0.22

Discussion

A study showed that although 91% of otolaryngology practitioners in the United States chose voice therapy as the preferred treatment for vocal nodules, only 30% recommended it as the preferred treatment for vocal cord polyps [15]. This could be attributed to the insufficient recommendation of clinical voice therapy, treatment habits, and fewer reported studies on voice therapy in patients with vocal cord polyps. From the perspective of patients, surgery can quickly treat voice disorders, conforming to the demands of their own interests. In fact, previous studies on the treatment of vocal cord polyps mainly focused on surgery, particularly on the superiority of phonomicrosurgery [16,17]. Our results showed that both the postoperative laryngostroboscopy findings and the self-perceived VHI of patients with vocal cord polyps after surgery were improved in both the control and experimental groups. Although there was no significant change in indicators such as MPT and F_0-High before and after surgery, the DSI scores in both groups improved after surgery, which was consistent with results shown in previous reports. Vocal cord polyp is a benign vocal proliferative disease, which occurs in the superficial layer of vocal fold lamina propria. Early lesions are mainly attributed to haemorrhage, oedema, and fibrin deposition while lesions that appear later are caused by their further development into tissue fibrosis and amyloidosis, or due to a hyaline change, leading to the stiffness of the cladding layer of the vocal cords, increased quality, decreased softness, and reduced resilience. This in turn results in a weakened mucosal wave, reduced amplitude, serious lesions, and even changes of symmetry and periodicity of the vocal cords [18,19]. Excising diseased tissues by phonomicrosurgery

quickly and effectively resolves problems such as a weakened mucosal wave, which is caused by the increased quality and stiffness of cladding layer of the vocal cord lesions or the glottic insufficiency due to the existence of polyps, thereby improving the postoperative voice quality of patients.

Recent in-depth research on pathophysiology and pathogenesis of vocal cord polyps has brought increased attention to the effectiveness of voice therapy for vocal cord polyps [10,20]. Some scholars believe that the popularization of vocal training and vocal hygiene education help patients learn health knowledge of using voice to avoid voice misuse and abuse, which reduces sustained vocal fold mucosa vibration trauma caused by bad sound behaviors. This creates conditions viable for the healing of the absorption of polyps. Constant practice cultivates the correct method for soft vocal attack and coordination of subglottic pressure and glottal closure. This allows the exhaled airflow in vocalization to be completely converted into vibrating waves in the vocal cord. This results in the improvement of the objective pronunciation quality of patients [21,22]. Some clinical experiences on voice therapy can be summarized as follows: (1) arrangement of an appropriate training program, (2) inclusion of a relatively fixed teaching staff with rich experience, (3) concise training materials, (4) adherence to follow-up; and (5) reasonable expectations.

Some scholars systematically studied changes of indicators such as acoustics, aerodynamics, and self-perceived voice handicap of patients with vocal cord polyps using voice therapy after phonomicrosurgery [23]. We were interested in assessing the effectiveness of voice therapy/voice training on the voice of patients with vocal cord polyps after phonomicrosurgery, from the perspective of clinical work, using a method with mature clinical technique, easy manipulation, rapid obtaining results, and reliable repeatability, such as laryngostroboscopy, VHI, DSI, etc.

Our results indicated that postoperative voice training improved the subjective self-perceived voice handicaps (F, P, E, and T values of VHI) of patients with vocal polyps. However, in addition to Jitter findings, the results of objective voice handicap (MPT, F_0-High, I-Low, DSI) and laryngostroboscopy did not show improvement. The VHI is a questionnaire composed of functional, emotional, and physical categories. The functional category describes the patient's voice handicaps in daily life. The emotional category describes the emotional reactions to the voice disorder. The physical category describes subjective features of patient feelings as throat discomfort, vocal changes, and etc. The results of the assessment could be affected by the patient's character, course of disease, social status, education, requirements of career, or social interaction with voice [24]. Voice training enabled patients to recognize their voice problems more clearly, improved vocal comfort led by the treatment, and established reasonable treatment expectations, thus, improving patient's self-perceived voice handicap. Jitter is the small and rapid change that occurs on the fundamental frequency of vibration in the vocal voice process. It is affected by the quality and tension of the vocal cords, differences in biomechanical properties, and innervations. Jitter reflects the stability of vocal cord vibration to some extent. Our findings suggested that postoperative voice training improves the stability of vocal cord vibration.

Compared to the rapid improvement of voice quality by surgery, the duration of voice training, and patient compliance, can also affect the therapeutic outcome. A limitation of our study is the short follow-up time after surgery. A longer follow-up period will allow us to observe the long-term effectiveness of voice training on the outcome of phonomicrosurgery.

Conclusion

The combined application of laryngostroboscopy, VHI, and DSI can be used to quickly, easily, and effectively assess the voice handicap characteristics of patients with vocal cord polyps before and after phonomicrosurgery, meeting the requirements of clinical work. Voice training after phonomicrosurgery could preferably improve vocal stability and the subjective evaluation of self-perceived voice handicap in functional, emotional, and physical categories. Since the time involved in execution and the compliance of patients to voice training could affect the therapeutic outcome, the long-term effectiveness of voice training on phonomicrosurgery remains to be understood.

Acknowledgement

This article was supported by the grant of Zhejiang Provincial Science Fund (No.2011C23129), and Jinhua Municipal Key Project (No.2011-3-009).

Conflict of Interest

All authors have no conflict of interest regarding this paper.

References

1. Sridharan S, Achlatis S, Ruiz R, Jeswani S, Fang Y. Patient-based outcomes of in-office KTP ablation of vocal fold polyps. Laryngoscope 2014; 124: 1176-1179.
2. Jensen JB, Rasmussen N. Phonosurgery of vocal fold polyps, cysts and nodules is beneficial. Dan Med J 2013; 60: 4577.
3. Mizuta M, Hiwatashi N, Kobayashi T, Kaneko M, Tateya I, Hirano S. Comparison of vocal outcomes after angiolytic laser surgery and microflap surgery for vocal polyps. Auris Nasus Larynx 2015; 42: 453-457.
4. Nakagawa H, Miyamoto M, Kusuyama T, Mori Y, Fukuda H. Resolution of vocal fold polyps with conservative treatment. J Voice 2012; 26: e107-110.
5. Yun YS, Kim MB, Son YI. The effect of vocal hygiene education for patients with vocal polyp. Otolaryngol Head Neck Surg 2007; 137: 569-575.
6. Ju YH, Jung KY, Kwon SY, Woo JS, Cho JG, Park MW, Park EH, Baek SK. Effect of voice therapy after

phonomicrosurgery for vocal polyps: a prospective, historically controlled, clinical study. J Laryngol Otol 2013; 127: 1134-1138.

7. Ikuma T, Kunduk M, McWhorter AJ. Objective quantification of pre- and postphonosurgery vocal fold vibratory characteristics using high-speed videoendoscopy and a harmonic waveform model. J Speech Lang Hear Res 2014; 57: 743-757.
8. Taguchi A, Mise K, Nishikubo K, Hyodo M, Shiromoto O. Japanese version of voice handicap index for subjective evaluation of voice disorder. J Voice 2012; 26: 668.
9. Karasu MF, Gundogdu R, Cagli S, Aydin M, Arli T. Comparison of effects on voice of diode laser and cold knife microlaryngology techniques for vocal fold polyps. J Voice 2014; 28: 387-392.
10. Schindler A, Mozzanica F, Maruzzi P, Atac M, De Cristofaro V, Ottaviani F. Multidimensional assessment of vocal changes in benign vocal fold lesions after voice therapy. Auris Nasus Larynx 2013; 40: 291-297.
11. Kunduk M, Dolinger M, McWhorter AJ, Svec JG, Lohscheller J. Vocal fold vibratory behavior changes following surgical treatment of polyps investigated with high-speed videoendoscopy and phonovibrography. Ann Otol Rhinol Laryngol 2012; 121: 355-363.
12. Zhuge P, You H, Wang H, Zhang Y, Du H. An analysis of the effects of voice therapy on patients with early vocal fold polyps. J Voice 2016; 30: 698-704.
13. Van LKM, De BM, Dhaeseleer E, Wuyts F, Claeys S. The treatment of muscle tension dysphonia: a comparison of two treatment techniques by means of an objective multiparameter approach. J Voice 2010; 24: 294-301.
14. Mathieson L, Hirani SP, Epstein R, Baken RJ, Wood G, Rubin JS. Laryngeal manual therapy: a preliminary study to examine its treatment effects in the management of muscle tension dysphonia. J Voice 2009; 23: 353-366.
15. Sulica L, Behrman A. Management of benign vocal fold lesions: a survey of current opinion and practice. Ann Otol Rhinol Laryngol 2003; 112: 827-833.
16. Petrovia LM1, Babac S, Vukovia M, Kosanovia R, Ivankovia Z. Acoustic voice analysis of patients with vocal fold polyp. J Voice 2011; 25: 94-97.
17. Uloza V, Saferis V, Uloziene I. Perceptual and acoustic assessment of voice pathology and the efficacy of endolaryngeal phonomicrosurgery. J Voice 2005; 19: 138-145.
18. Dursun G, Karatayli-Ozgursoy S, Ozgursoy OB, Tezcaner ZC, Coruh I, Kilic MA. Influence of the macroscopic features of vocal fold polyps on the quality of voice: a retrospective review of 101 cases. Ear Nose Throat J 2010; 89: E12-17.
19. Kantas I, Balatsouras DG, Kamargianis N, Katotomichelakis M, Riga M. The influence of laryngopharyngeal reflux in the healing of laryngeal trauma. Eur Arch Otorhinolaryngol 2009; 266: 253-259.
20. Cho KJ, Nam IC, Hwang YS, Shim MR, Park JO, Cho JH, Joo YH, Kim MS, Sun DI. Analysis of factors influencing voice quality and therapeutic approaches in vocal polyp patients. Eur Arch Otorhinolaryngol 2011; 268: 1321-1327.
21. Tomifuji M, Araki K, Niwa K, Miyagawa Y, Mizokami D. Comparison of voice quality after laser cordectomy with that after radiotherapy or chemoradiotherapy for early glottic carcinoma. ORL J Otorhinolaryngol Relat Spec 2013; 75: 18-26.
22. Kim YH, Lee SH, Park CW, Cho JH. Nasalance change after sinonasal surgery: analysis of voice after septoturbinoplasty and endoscopic sinus surgery. Am J Rhinol Allergy 2013; 27: 67-70.
23. Lin L, Sun N, Yang Q, Zhang Y, Shen J. Effect of voice training in the voice rehabilitation of patients with vocal cord polyps after surgery. Exp Ther Med 2014; 7: 877-880.
24. Wheeler KM, Collins SP, Sapienza CM. The relationship between VHI scores and specific acoustic measures of mildly disordered voice production. J Voice 2006; 20: 308-317.

*Correspondence to

Pan Zhuge

Department of Otolaryngology

Jinhua Centrel Hospital

PR China