Self-Training Voice Therapy for Patients with Hoarseness

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Background: *Vocal abuse or muscle tension dysphonia is one of the most common diseases in Otorhinolaryngology Clinic. Professional voice users and patients with cleft palate are at increased risk for voice disorder. Voice therapy is the first line of management; however, limitation of speech service causes treatment inaccessibility in Thailand and developing countries.*
Objective*: To find the effectiveness of a self-training voice program in increasing maximum phonation time, decreasing relative average perturbation between pre-treatment and post–treatment, and improvement treatment by a self-administered post-treatment questionnaire.*
Material and Method: *Sixteen patients with hoarseness received vocal hygiene and self-training program of diaphragmatic breathing as well as coordination of breathing with phonation for 10 weeks. Voice assessment, Maximum phonation time and relative average perturbation with Computer Speech Lab; ear nose, throat examination and videostroboscopy were performed at 1st visit and the final or 4th visit. Maximum phonation time with a stopwatch; maximum duration of counting time and perceptual assessment for 6 parameters (grade, instability, roughness, breathiness, asthenia, and strain) were done pre-treatment; at the 3th; 6th; 10th weeks; and post-treatment.*
Results: *The Wilcoxon Sign Rank Test revealed that the self-training voice therapy program significantly increased maximum phonation times from Computer Speech Lab, as well as from stopwatch, the maximum duration of counting.*
Conclusion: *The self-training program is an effective treatment for functional voice disorders.*

Keywords: *Self-Training Therapy, Voice therapy, Voice disorders, Hoarseness, Cleft*

J Med Assoc Thai 2017; 100 (Suppl. 6): S136-S144
Full text. e-Journal: *http://www.jmatonline.com*

Professional voice users and patients with cleft palate are at increased risk for voice disorders. The incidence of dysphonia with significant burden for the individual and society is 6.60 to 7.90%[1-3] and it was between 0.26% and 3.20% of all otolaryngology outpatient attendances[4-6]. The lifetime prevalence of dysphonia is 29.10%[7]. Of the teachers questioned, 54% reported missing work because of a voice problem. A number of papers summarize the pooled results from previous studies on occupations at risk of voice disorders[3,8-10]. Patients with dysphonia or voice disorders are less productive at work and have increase health care cost[9,11]. In addition, people with dysphonia had poor physical and psychosocial functioning[12]. If the vocal hyperfunction continues, the hardened tissue is increase in size until nodules or polyps develop on the vocal folds. Voice problems also results in loss of productivity at work, especially if the individual needs oral communication for working (teachers, operator, salesperson etc.); sick leave in case of severe voice problems for voice rest and having a poor quality of life. Children with cleft palate are also at risk at a voice disorder from velopharyngeal insufficiency. Hoarseness, breathiness and easy fatigue are common symptom in children with cleft palate from strain vocalization (put the vocal cords while trying to build the pressure necessary for normal speech).

Successful management of functional voice disorders includes identifying and modifying aberrant vocal and breathing patterns. Unless these changes are made, vocal disorders either persist or recur frequently[13]. Voice therapy is usually recommended as the first line of treatment for these patients[14]. Reduction or elimination of vocal abuse helps to restore normal voice[15,16] and effective breathing support helps to maintain a normal speaking duration. Voice therapy needed qualified speech and language pathologists

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who have experiences related to voice disorders. Unfortunately, there are limitation of speech and language pathologists in some developing countries, where patients need to spend extra time and expense in order to get speech services in tertiary health care units, where are the only places providing such services in some developing countries (Thailand, Vietnam, India, Malaysia etc.). Furthermore, speech and language pathologists are not available in some countries in Southeast Asia (Lao People's Democratic Republic, Republic of the Union of Myanmar). Patients with voice disorders have limitation or no access voice therapy in these countries. Developing new strategies, self-training voice therapy for patients with dysphonia or hoarseness would decrease the cost of treatment and the number of visits for voice therapy.

The objective of this study was to investigate the effectiveness of a self-training voice therapy in increasing maximum phonation time (MPT), decreasing relative average perturbation (RAP) from Computer Speech Lab (CSL), as well as to quantify the improvement invoice symptoms resulting using measurements of a self-assessment questionnaire (Self Administered Post-Treatment Questionnaire: SPTQ) in patients with hoarseness.

Material and Method

Study design

This was a prospective study and carried out in a tertiary referral center followed a design outline. According to the Helsinki Declaration (HE500609), the Ethics Committee of Khon Kaen University reviewed and approved the research protocols.

Participants

Patients with hoarseness of more than 2 weeks duration, aged 20-55 years (working age and no senile voice changes), who had a computer or a device capable of reading VCDs, were enrolled in the study. They had no diseases that might directly cause or be risk factors for voice disorders :thyroid diseases, chronic upper respiratory tract, pulmonary diseases, heart diseases, rhinologic diseases, psychological diseases, laryngeal mass or laryngeal pathology, with the exception vocal nodules and small polyps (diameter $\leq$2 millimeters).

A sample size of twenty-one patients was required for detection of a mean difference of MPT change of 4 seconds, with a dropout rate 20 %, between pretreatment and post treatment of voice therapy to give a 95 % significant level, with the power of 90 %. Five patients withdrew from the study because they could not follow the program for personal reasons. Sixteen patients remained to complete the protocol.

Establishing the Self-Training Voice Therapy

The Self-Training Voice Therapy program was established based on both new strategies and existing data that were extensively reviewed, including voice education (VE), diaphragmatic breathing (DB) and coordination of breathing and phonation (CBP)[14,17-21]. The VE and self-training program manual and worksheet were modified from the literature and was validated by 2 experts, for content or face validity (full domain of the concepts and representation of the domain) and construct validity (theoretical principles related to concepts). After revision, the VE and the self-training voice therapy program were incorporated into a video presentation (VCD). A program manual and worksheet were also prepared for the revised version. Data from five patients with hoarseness were used to assess content validity, reliability, and comprehension of the language in the revised version. The final program comprised: 1) a VCD presentation for vocal education, 2) a VCD presentation for 4 postures of breathing exercises, included lying, sitting, standing, and walking, 3) a VCD presentation for CBP in serial speech (counting, 7 days a week, 12 months a year, and serial Thai alphabets), 4) a program manual, and 5) a worksheet for self-compliance monitoring.

Outcomes

The primary outcome measure was MPT, which has been a common clinical parameter for assessment of vocal function[22-24]. This was carried out using Computer Speech Lab (CSL), a multi-dimensional voice program (MDVP). A trained speech and language pathologist assessed the MPT from subjects sustaining the three vowels (/a:, u:, i:/), while the subject spoke carrier phases in the Thai language before measurement: "Painaima…" for prolonging /a:/, "Paijabpoo…" for /u:/, and "Sawatdee…" for /i:/, in order to practice sustaining comfortable and optimal pitch and loudness by her/his auditory feedback. Each vowel with optimal pitch and loudness, acoustic assessment, including MPT and RAP were carried out. Three recordings of each vowel were done pre-treatment at the 1st visit and post-treatment at the 4th visit or 10 weeks after treatment.

The Self Administered Post-Treatment Questionnaire (SPTQ) is a self-assessment tool that reflects the patient's perceived degree of voice improvement and compliance after the treatment. At

the 4th visit, subjects were asked to fill in the SPTQ in order to assess (1) voice symptom improvement, (2) vocal clarity, (3) ease of speaking and singing, and (4) ability to use the voice in everyday situations. It is scored on a 5-point scale, whereby 1 = not at all, 2 = a little, 3 = moderate, 4 = much and 5 = very much[25].

Perceptual assessment using 6 parameters and the maximum duration time (MDT) of counting while the subject counted after taking a deep breath were used as supplementary outcome measures at every visit to assess progress. The six parameters included G: Grade e.g., overall impression, I: Instability e.g., fluctuation of voice, R: Roughness e.g., hoarseness, B: Breathiness e.g., breathy voice, A: Asthenia e.g., a weak voice or speaking with minimal air volume, S: Strain e.g., forced or stressed voice. They are known as GIRBAS and this is a popular and reliable perceptual scale[26,27] . Each parameter was scored on a scale of 0-3 (0 was considered normal; 1 = slightly disturbance; 2 = moderate disturbance; 3 = severe disturbance)[28]. For the MDT of counting, the patient was asked to take a deep breath and count. The duration of counting with a single breath was measured using a stopwatch. In addition, each subject also filled in a questionnaire composed of personal information and characteristics at the 1st visit.

Ear nose throat (ENT) examination and videostrobolaryngoscopy: ENT examination is part of the routine assessment for patients with voice disorders. Two researchers, both otolaryngologists, performed both the ENT examination and videostrobolaryngoscopy. The Setting was the Speech and Voice clinics, Srinagarind Hospital, Faculty of Medicine, Khon Kaen University.

Data analysis

Descriptive analyses: means and standard deviations, and means and interquartile ranges (IQR) were analyzed for the MPT, RAP; frequency and percent for display data of subject characteristic and scores of self-reported improvement from the SPTQ. The paired *t* test was used to compare outcomes: MPT and RAP of the average 3 prolongations of each vowel (/a/, /u/, and /i/) between pre-treatment (1st visit) and post-treatment (4th visit) (Wilcoxon Signed Rank Test). SPSS software (Statistical Package for the Social Sciences, version 11.5, SSPS Inc, Chicago, Illinois, USA) was used in statistical analysis, and the level of significance was set at $p<0.05$.

A repeated measures ANOVA was used to compare perceptual assessments of GIRBAS, MPT of the vowels /a/, /u/, and /i/, and the MDT of counting pre-treatment and post-treatment at 3, 6 and 10 weeks after the self-training voice therapy. For each ANOVA that resulted in significant F ratio, post hoc analysis was performed using the Bonferroni correction. Friedman's test was used for data that had violated the assumptions necessary to run the one-way ANOVA with repeated measures. For each Friedman's test that resulted in significant χ^2 value, the Wilcoxon Signed Rank Test was used to repeat the analysis.

Results

Subject characteristics, risk factors for hoarseness, time off work and the cost for each treatment displayed in Table 1. Most patients had severe hoarseness in morning (37.5 %) and all day (25%), common cause of hoarseness was talking too much (81.3%), common signs and symptoms were dry throat, hoarseness, loss of voice, tried or soft voice after talking, could not sing high pitch song, and hard glottal attack, respectively.

ENT examination revealed that most patients had normal otologic and neck examinations; only one case had congestion of nasal mucosa. A summary of the videostrobolaryngoscopy findings at the pre-treatment and post treatment visits are shown in Table 2.

The Wilcoxon Signed Rank test showed increases in MPT and decreases in RAP of vowels /a/, /u/ and /i/ between pre-treatment and post- treatment after the self-training voice therapy (Table 3).

Perceptual assessments, such as GIRBAS, MPT and MDT of counting in a breath, were analyzed by ANOVA with a Bonferroni correction for comparisons as shown in Table 4.

The average scores of SPTQ indicated that patients had improvement of voice, clarity of voice and ease of voice that was moderate to good. The ability to use the voice in everyday situations produced the highest score as showed in Table 5.

Discussion

Voice therapy in some developing countries has limitation or no services because of the lack of professionals, particularly, speech and language pathologists. Very few voice centers have a multidisciplinary team and a complete protocol for the management of voice disorders in northeastern Thailand and Southeast Asia. This self-training voice therapy program reduces the cost of treatment, both

Table 1. Demographic characteristics of subjects

Characteristics	Number	Percentage/ Mean±SD)/ Min: Max
Gender		
Female	15	93.80
Male	1	6.20
Age		
Mean ± SD (years)	16	37.94±7.22
Min: Max		23:52
Occupation		
Teachers	8	50.00
Government or Company officers	4	15.80
Business girls	3	18.60
Graduate student	1	1.60
Duration of speaking (hour)/day (hours)		
Mean ± SD		5.50±2.16
Min: Max		2:10
Average voice use/day (hours)		
Mean±SD		5.62±1.00
Min: Max		24 : 7
Duration of hoarseness		
- <2 months	0	0
- 2 months - 4 months	2	12.50
- 4 months - 6 months	3	18.80
- 6 months -12 months	2	12.50
- >12 months	9	56.20
Number of leaving day for each treatment (days)		
Mean ± SD		0.97± 0.39
Min: Max	-	0.50:2.00
Living expense for each treatment (baths)		
Mean ± SD		526.25±381.52
Min: Max	-	100:1,500
Smoking		
No	16	100.00
Alcohol drinking		
No	12	75.00
Sometime (not often)	4	25.00
Hearing		
Left ear		
Normal	15	93.80
Dullness	1	6.20
Right ear		
Normal	16	100.00

SD = Standard deviation

through the reduction the numbers of clinic visits from 10 visits to 4 visits and there is less time lost from work. It also decreases expenses for transportation and appointments from 5,262.50 Baht or US$ 164.45 in a traditional program to be 2,105 Baht or US$ 65.78 (1 US$ = 32 Baht) for the current self-training program (Table 1), as well as decreasing the nation's health care expenses. Moreover, it helps to decrease the burden on the speech pathologist, the only one in this area.

Sixteen patients with dysphonia attended for self-training voice therapy. Most of them had had signs and symptoms for more than 12 months. There was improvement of mucosal lesions; two bilateral pre-nodules disappeared and one case changed from bilateral pre-nodules to a single pre-nodule within 10 weeks (Table 2). This suggests that tissue damage from

Table 2. Summary of videostrobolaryngoscopy findings

Characteristic	Pre-treatment		Post-treatment(10 weeks)	
	Number	%	Number	%
Videostrobolaryngoscopy				
Mucosal lesion				
Left				
Normal	10	62.50	12	75.00
Prenodules	6	37.50	4	25.00
Right				
Normal	10	62.50	13	81.20
Prenodules	6	37.50	3	18.80
Laryngeal tension				
Normal	12	75.00	11	68.80
MR 4*	4	25.00	5	31.20
Mucosal wave				
Left				
Normal	15	97.75	14	87.50
Decrease	1	6.20	2	12.50
Right				
Normal	14	87.50	15	93.75
Decrease	2	12.50	1	6.25

*MR4: Morrison-Rammage classification type 4

Table 3. Comparisons of MPT and RAP of vowels /a/, /u/, and /i/

Variable	Time of treatment	Mean±SD	*Median (IQR)*	Z	*p*-value
MPT /a/	Pre-treatment	8.43±3.43	8.11(6.98 – 10.13)	- 3.17	0.002*
	Post-treatment 10 weeks	13.36±4.55	11.87(10.08 – 15.70)		
MPT /u/	Pre treatment	10.67±6.29	9.07(7.65 – 12.49)	-2.42	0.016*
	Post treatment 10 weeks	14.86±4.87	14.32(11.25 – 16.90)		
MPT /i/	Pre treatment	9.70±3.28	9.71(7.78 – 11.48)	-3.30	0.001*
	Post treatment 10 weeks	15.95±5.06	15.27(12.41 – 18.63)		
RAP /a/	Pre treatment	1.23±0.59	1.11(0.76 – 1.66)	-2.10	0.036*
	Post treatment 10 weeks	0.92±4.55	0.90(0.46 – 1.21)		
RAP /u/	Pre treatment	0.82±0.31	0.77(0.65 – 0.95)	-0.698	0.485
	Post treatment 10 weeks	0.90±0.44	0.88(0.58 – 1.16)		
RAP /i/	Pre treatment	1.15±0.69	0.89(0.67 – 1.76)	-1.53	0.125
	Post treatment 10 weeks	0.84±0.77	0.69(0.32 – 1.13)		

SD = Standard deviation; IQR = Interquartile range
*significant at *p*-value <0.05

pre-nodules might may be halted before the development of nodules, e.g. a fibroblastic response involving increased fibronectin deposition [29] that make voice therapy more difficult. It suggests that short-term voice therapy has a trauma-reducing effect and that these mucosal lesions will disappear if patients continue with a long-term voice therapy program. Laryngeal tension and mucosal wave improvement may need continuing voice therapy to get rid of hyperfunctional vocal behavior and muscle tension that increase subglottal pressure leading to escalating trauma that could be stopped by voice therapy[19]. The outcomes clearly show that the self –training program significantly increased the MPT from both objective acoustic analysis (Table 3) and perceptual assessments (Table 4), MPT of each average vowel (/a/, /u/ and /i/)

Table 4. Comparison of GIRBAS and time of counting

variable	Pre Mean±SD	Post_3 wk Mean±SD	Post_6 wk Mean±SD	Post_10 wk Mean±SD	*p*-value
GIRBAS	8.19±2.95	5.25±2.96	4.25±2.74	2.56±1.97	< 0.001*
MPT /a/	8.79±3.42	11.81±2.80	12.92±4.03	14.08±4.33	< 0.001*
MPT /u/	9.84±3.30	12.87±3.42	14.89±4.84	15.22±4.34	< 0.001*
MPT /i/	9.79±3.38	12.97±3.88	14.99±4.69	16.17±4.86	< 0.001*
MDT	10.29±3.61	12.10±3.06	13.65±3.99	15.30±3.43	< 0.001*

[a] significant different from measurement before (p<0.05)

[b] significant different from measurement at 3 wk (p<0.05)

[c] significant different from measurement at 6 wk (p<0.05)

*significant at p-value <0.05
SD = Standard deviation

Table 5. Summary of The Self-Reported Post–treatment Questionnaire Results

Voice after treatment	Mean±SD	Minimum: Maximum
Improvement of voice	3.44±0.81	1:4
Clarity of vice	3.75±0.58	3:5
Ease of voice	3.63±0.96	2:5
Application for daily life activities	4.25±0.68	3:5

SD = Standard deviation

and gradually decreased the GIRBAS scores and increased the MDT (Table 3 and 4) from pre-treatment to post treatment within 10 weeks. The self-assessment score (SPTQ) also revealed that overall voice improvement, clarity of voice, and ease of voice ranged from moderate to much post-treatment (Table 5). With regard to the application for daily life activities, patients used techniques frequently. Objective acoustic analysis and perceptual measurement, which carry complementary information about possible voice abnormalities[30], and patients' assessment are commonly used for a balanced evaluation of the multidimensional parameters of vocal function. These parameters demonstrate that this program improved voice quality and voice status. The results were similar to voice therapy programs that are administered by speech and language pathologists over a period of 6 months[19]. It shows a positive effect using both objective and perceptual assessments of improved voice quality and vocal status.

This program should also be considered for use in colleges which procedure teachers because voice problems are a relatively common occupational problem among school teachers[18,31-33]. It might be beneficial in prevention programs for voice problems, thereby avoiding the need for voice therapy in occupations that are at risk for voice disorders, e.g., 20% of teacher students reported two or more symptoms of vocal abnormalities during the previous year and 19 % of them had an organic voice disorder[11]. It also supports Government Policy and that of the Thai Health Promotion Foundation, which provides promotion programs rather than intervention programs and this could save costs incurred through universal coverage program.

Conclusion

The self-training program is a positive effect and an effective treatment for patients with hoarseness including professional voice users (teachers, priest, factory workers, and secretary, etc.) or people with cleft palate. It might reduce the burden of the speech therapy workload, service accessibility and treatment cost.

What is already known on this topic?

Vocal abuse or muscle tension dysphonia is the most common in professional voice users and patients with cleft palate. Speech therapy is the 1st line

of treatment. However, these patients cannot access speech services because there are limitation of number of speech and language pathologist and speech services in Thailand.

What this study adds?

The self-training program is one of the effective treatment for vocal abuse or muscle tension dysphonia. It can be applied for providing speech therapy for people with cleft palate and also for professional voice users in other areas in Thailand and some developing countries, where have limitation speech services and similar context to Thailand.

Acknowledgements

This project was supported by a research grant from Faculty of Medicine, Khon Kaen University. We are also grateful to Honorary Professor Robert Peter Mills, Otorhinolaryngolgist, University of Edinburgh, England for his assistance with the English-edition of the manuscript. Thank you The Center of Cleft Lip-Cleft Palate and craniofacial Deformities, Khon Kaen University under Tawanchai Royal Grant Project for support publication.

Potential conflicts of interest

None.

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การฝึกเสียงด้วยตนเองในผู้ป่วยเสียงแหบ

เบญจมาศ พระธานี, สุภาภรณ์ ศรีร่มโพธิ์ทอง, พัชรีพร แซ่เซียว, รวงรัตน์ แสงนิพันธ์กุล

ภูมิหลัง: การใช้เสียงผิดวิธีหรือการออกเสียงลำบากจากการเกร็งกล้ามเนื้อเป็นโรคที่พบบ่อยโรคหนึ่งในคลินิกหู คอ จมูก อาชีพที่ต้องใช้เสียงมากและผู้ป่วยเพดานโหว่มีความเสี่ยงสูงต่อโรคเสียงผิดปกติ การฝึกพูดเป็นสิ่งแรกที่ต้องคำนึงถึงในการรักษา แต่ความจำกัดด้านการบริการการฝึกพูดทำให้ผู้ป่วยเหล่านี้ไม่สามารถเข้าถึงการรักษาได้ในประเทศไทยและประเทศที่กำลังพัฒนา

วัตถุประสงค์: เพื่อศึกษาประสิทธิภาพของโปรแกรมการฝึกเสียงด้วยตัวเองในการเพิ่มเวลาในการออกเสียงที่ยาวที่สุด การลดค่าความแปรปรวนของระดับเสียง (relative average perturbation) ระหว่างก่อนและหลังรักษารวมทั้งการดีขึ้นจากแบบประเมินเสียงด้วยตนเองของผู้ฝึก

วัสดุและวิธีการ: ผู้ป่วยเสียงแหบ 16 คนได้รับสุขศึกษาเรื่องสุขอนามัยของเสียง และโปรแกรมการฝึกหายใจด้วยตัวเองโดยใช้กระบังลมรวมทั้งการฝึกใช้การหายใจและการพูดอย่างประสานกันเป็นเวลา 10 สัปดาห์ การประเมินเสียง เวลาในการออกเสียงยาวที่สุด และค่าความแปรปรวนของระดับเสียงจากเครื่องวิเคราะห์เสียงด้วยคอมพิวเตอร์ การตรวจด้านหู คอ จมูก และ videostroboscopy ถูกวัดในการตรวจครั้งที่ 1 และครั้งที่ 4 การจับเวลาในการออกเสียงยาวที่สุดด้วยนาฬิกาจับเวลา เวลาในการนับเลขขณะหายใจเข้าลึกที่สุด และการประเมินเสียงด้วยการฟัง 6 ด้าน (ระดับความรุนแรงของเสียงแหบ ความสม่ำเสมอในการออกเสียง เสียงหัว เสียงลมแทรก ความเหนื่อยล้า และความเกร็งกล้ามเนื้อในการออกเสียง) ถูกประเมินก่อนการรักษา สัปดาห์ที่ 3, 6 10 และหลังการรักษา

ผลการศึกษา: การวิเคราะห์ด้วย The Wilcoxon Sign Rank Test พบว่าโปรแกรมการฝึกเสียงด้วยตัวเองสามารถเพิ่มเวลาในการออกเสียงยาวที่สุดจากการวัดด้วยเครื่องวิเคราะห์เสียงด้วยคอมพิวเตอร์และเวลาในการออกเสียงยาวที่สุดและเวลาในการนับเลขขณะหายใจเข้าลึกที่สุดด้วยนาฬิกาจับเวลาอย่างมีนัยสำคัญทางสถิติ

สรุป: โปรแกรมการฝึกเสียงด้วยตัวเองเป็นวิธีหนึ่งที่มีประสิทธิภาพวิธีหนึ่งในการรักษาโรคเสียงผิดปกติที่ไม่มีพยาธิสภาพของกล่องเสียง ซึ่งจะช่วยลดภาระที่หนักของงานด้านการแก้ไขการพูด ปัญหาการเข้าถึงบริการและค่ารักษาพยาบาล