Changes of vocal function in teachers during their career life

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Abstract

This project aimed 1) to investigate the change of vocal function in teachers over time with voice intervention provided and 2) to compare the self-perceived quality of life (QoL) between the practicing teachers and student teachers. The project consisted of two prospective studies, in which practicing teachers (study 1) and student teachers (study 2) were recruited as subjects respectively. In study 1, the subjects were randomly assigned to two groups: voice training group and no-training group. In study 2, the subjects were randomly assigned to three groups: vocal hygiene (VH) group, vocal hygiene and voicing technique training (VHT) group, and no-training group. Participants in the intervention groups were invited to attend the corresponding training workshops respectively. In both studies, results demonstrated no significant positive change of vocal function in subjects after intervention provided. Also, no significant difference was found between the practicing teachers and student teachers on the self-perceived QoL. These findings did not support the hypotheses that 1) interventions with vocal hygiene education would lead to significant positive change in vocal function, and 2) the student teachers would have a better self-perceived QoL than the practicing teachers.

Teachers are among one of the most vocally demanding occupational groups (Yiu & Chan, 2005). They are at increased risk of having voice disorders and high prevalence of voice disorders among teachers has been reported. Munier and Kinsella (2008) reported the prevalence rate of voice problems among teachers was 80% in North County Dublin; Angelillo, Di Maio, Costa, Angelillo and Barillari (2009) reported 60% of the teachers in Italy had voice problems. In Hong Kong, voice disorders are also common among teachers: An earlier local study revealed that about 18% of the patients with voice disorder who seek the public speech therapy clinic in Hong Kong are teaching professionals (Yiu & Ho, 1991). More recently, Lee, Lao and Yu (2010) reported the prevalence of voice disorders among primary school teachers in Hong Kong to be 70%. Similarly, Chong and Chan (2010) reported that around 74% of the primary and secondary school teachers in Hong Kong had voice problems. Yiu and Chan (2005) estimated that around one-third of the local teachers are having voice problems, with about 13% percent of them took at least one day off work per year because of the voice problems. This represented at least a HK$6.7 million loss in salary per annual (Yiu & Chan, 2005).

It has been suggested that teachers' voice problems usually appear after several years of work (Simberg, Laine, Sala & Ronnemaa, 2000). In Hong Kong, the percentage of prospective teachers who have voice problems increased from 15.4% to 36.5% within a three-year period of time starting from the first year of teaching (Yiu & Chan, 2005). This means a more than double increase in the prevalence rate.

Voice problems in teachers during their career life

The high prevalence rate of voice disorders in teachers reflects the significant magnitude of the problem in the overall teaching population. Yet, it did not reflect the population distribution of the problem at different stage of their career life. Therefore, comparison of voice between student teachers and practicing teachers would be useful to determine the most

affected group in the teaching population. This can also help reveal the development of voice problems in the career life of teachers.

Intervention programs of voice

In Hong Kong, no compulsory course on voice protection is offered to teachers (Yiu & Chan, 2005). To improve the situation of the high prevalence rate of voice problems in teachers, it is important to develop the intervention programs for the local teachers.

Vocal education programs was found to be effective in preventing the emergence of the vocal problems as it can increase the clients' awareness of the voice problems so that they can seek early intervention (Bovo, Galceram, Pertruccelli & Hatzopoulos, 2007). One important element in the vocal education programs is the vocal hygiene education. Several studies have been aimed to investigate the efficacy of the vocal hygiene programs: Chan (1994) reported that kindergarten teachers who received the vocal hygiene education program showed significant voice improvement afterwards. In this study, however, only female subjects were included. Bovo et al. (2007) investigated the effectiveness of a preventive voice program with vocal hygiene education in kindergarten and primary school teachers, and positive effect was shown. Pasa, Oates and Dacakis (2007) also found that preventive voice intervention with vocal hygiene training was likely to be effective for primary school teachers. Yet, objective measurements of the vocal function (such as phonetogram) were limited in these studies. Overall, vocal hygiene education was effective for the teaching population. Yet, due to the limitation in subject selection and the choices of outcome measures, the findings were difficult to be generalized to different situation (e.g., effect of the vocal hygiene education program on the change of vocal function in primary and secondary teachers in Hong Kong).

Voice and quality-of-life

Voice has been described as multidimensional in nature and voice disorders can lead to *physical* and *functional* impairment, such as organic changes of the vocal folds, vocal fatigue and throat discomfort. Voice problems also affect communication (daily and/or social), reduce ones' job performance, and may even lead to unemployment. All these can have adverse *psychological impacts* on the person (Van Houtte, Claeys, Wuyts & Van Lierde, 2011).

Clinical evaluation of voice involves assessing the voice quality (using acoustic measures and auditory-perceptual measures); the vocal function (using voice range profile, videostroboscopy, and/or aerodynamic measures); and quality of life (QoL) measurements (Chan, 2008). Among the measures, the voice quality and vocal function evaluations involve the objective instrumental measurements and the professional judgment of the clinicians, which have been frequently applied in the clinical practice. Yet, the self-evaluation of voice using QoL protocols was also suggested to be a significant measure as its result can reflect the clients' own perception about the problem, which would be one of the major considerations for choosing the intervention approaches (Ilomäki et al., 2009).

Attempts have been made to correlate the self-perceived voice-related QoL with the voice quality and/or the vocal function measures (Bassi et al., 2011; Hummel, Scharf, Schuetzenberger, Graessel & Rosanowski, 2010; Ilomäki et al., 2009; Wuyts et al., 2000). Yet, foci were usually put on the voice quality measures, while studies related to the vocal function measures, including objective measurements such as the voice range profile measures, were limited. Moreover, some of these studies focused on only one objective measure instrument (Hummel et al., 2010; Wuyts et al., 2000) and others adopted strict inclusion criteria for sampling (e.g., female teachers only) (Bassi et al., 2011; Ilomäki et al.,

2009). These made it difficult to generalize the findings to different condition (e.g., the situation in male teachers).

More importantly, the conclusion about the relationship between the self-perception measures and the objective and/or subjective measures of voice remains controversial. Thus, clients' perception of voice problems could be unrelated from the commonly assessed voice parameters (Bassi et al., 2011; Hummel et al., 2010; Ilomäki et al., 2009; Wuyts et al., 2000). For this reason, obtaining information from all types of clinical evaluations of voice would be important during the investigation of voice problems. Any similarities or discrepancies between the clients' perception of his/her voice problem and the objective measures of voice impairment severity will provide a more client-centered perspective for the development of an appropriate intervention program, which can therefore address the client's concerns of voice disorders more comprehensively. This may include intervention covering areas at the activity and participation levels rather than just tackling the problem at the impairment level (Ma & Yiu, 2001).

The primary objective of this study was to investigate the change of vocal function in practicing teachers and student teachers over time with voice intervention provided. The second objective was to compare between the practicing teachers and student teachers on the self-perceived voice-related QoL measurements.

In measuring QoL, a number of outcome measures have been used.

QoL measures

Voice Handicap Index (VHI) is one of the most psychometrically robust and well studied instruments (Franic, Bramlett & Bothe, 2005) for measuring how voice problem affects ones' in physical, emotional and functional domains. The Cantonese version of VHI-30 showed high reliability and validity in the Cantonese population (Lam et al., 2006). The VHI-30 is a 30-item questionnaire which can be divided into three parts. Each part of the

questionnaire made up of 10 questions. The three parts of questions help investigate the effects of voice disorders on a person's functional, physical and emotional aspects during social and daily communication respectively. A five-point ordinal rating scale was used, with the answer "Never" equals a score of 0 and "Always" equals a score of 4. In general, the higher the VHI scores, the greater effects of voice disorders on a person (Lam et al., 2006).

Voice Activity and Participation Profile (VAPP) is a well validated measure (Ma & Yiu, 2001) to evaluate the self-perceived severity of the voice problem and their self-perceived impact of voice disorders on several areas (e.g., job) (Yiu, Wei, van Hasselt & Wong, 2007). VAPP assesses the impact of voice disorders on ones' life at the activity and participation levels, following the International Classification of Functioning (World Health Organization, 2001) literature. The VAPP comprised five sections with a total of 28 items. The subjects' self-rated severity of the voice problems and their self-perception about the impact of voice problems on four aspects, including job, daily communication, social communication and emotion were evaluated in the five sections respectively. An equal-appearing interval (EAI) rating scale with ten-point was used in the Cantonese version of VAPP (Ma & Yiu, 2001).

Risk assessment

Voice risk calculator (VRC) is an instrument that evaluates ones' vocal status, amount of vocal use and physiological condition for identifying any possible risk factors that are associated with the development of voice problem (Ho, 2011). The VRC consisted of 40 questions and a section for obtaining the demographic information. The questions can be divided into three parts: The first part consisted of questions which sought the subjects' self-perceived vocal status. Any present of vocal symptoms were also identified in this part. A five-point ordinal rating scale was used for judging the vocal condition, with the description "very severe" given a score of 4 and "very good" given a score of 0. A total of four questions made up this part. The second part is made up of twenty-six questions. In this

part, the subjects' amount of voice use for occupational needs and daily usage was investigated. The possible risks factors associate with voice problems were also identified. Text responses and a five-point ordinal rating scale (point "0" = "never" and point "4" = "always") were used to evaluate the amount of voice use. The last part, which contained 10 items, required the respondents to report their general and voice-related physiological condition in the past 6 months to 1 year. In general, the higher the VRC scores, the greater risk of a person to have the voice disorders (Ho, 2011).

Survey for obtaining background information from teachers

General Teaching Survey (GTS) is a newly developed instrument for teachers in this project. It was designed to obtain their background information (mainly voice-related), which can be used to evaluate the relationship between their work and the voice problems. The questions were chosen to reflect the teaching duties and the teaching environment, which have been reported in the literature that might affect the voice quality (Lindstrom, Waye, Södersten, McAllister & Ternström, 2011).

The GTS is a 14-item questionnaire with four sections, which investigated information about the recent voice condition, the effect of voice problems on work, factors that influence the voice and the teaching history of the respondents respectively. No total GTS score was supposed to be generated. However, nominal rating scales were applied in some items of the survey. For example, for the description of the recent voice condition, five choices were given, which are "very poor", "poor", "fair", "good", "very good". (Appendix A)

In addition, a number of instrumental measurements were also used to measure the outcome.

Vocal function measures

Voice range profile (VRP) has been found to be a useful tool to detect improvement of vocal function due to the voice training (Speyer, Wieneke, van Wijck-Warnaar & Dejonckere,

2003). It provides quantitative evaluations of the voice training using several voice measurements, which includes the maximum frequency, the minimum frequency, the maximum intensity, the minimum intensity and the profile area. Among these parameters, it has been suggested the maximum frequency and maximum intensity are two of the key predictors of voice training (Siupsinskiene & Lycke, 2011).

Videostroboscopic images provide qualitative evaluation of vocal fold condition and movement (Rosen, 2005). The vocal fold condition is a direct reflection of the health of larynx.

Methods

To investigate the change of vocal function in the practicing teachers and student teachers overtime (the primary objective) and to compare between the practicing teachers and student teachers on the self-perceived voice-related QoL measurements (the second objective), the project consisted of two prospective studies, in which practicing teachers and student teachers were recruited as the subjects respectively. In both studies, interventions that involved vocal hygiene education were adopted. Yet, the content of the intervention programs varied among groups and different outcome measures were performed in the two studies. The details are as follows:

Study 1 (change of voice condition in practicing teachers)

Participants

A total of 115 full-time practicing teachers were recruited from two kindergartens, one primary school, two secondary schools and two special schools in Hong Kong. The subjects were randomly assigned to two groups: 1) an experimental group, in which subjects were provided with voice training (Group VT); and 2) a no-training group (Group NT).

Due to various factors, which included attrition and un-analyzable data, only 69 subjects (40 males and 29 females) had complete set of data for analysis. Twelve of them did not report their age, the remaining 57 of them reported the age to be 23 to 57 years with a mean of 38.80 years and standard deviation of 9.45 years. Unfortunately, a large proportion (about two-third) of the subjects who completed the program declined to take further post-intervention assessment.

Procedure

Voice Training Workshop The subjects were invited to participate in a voice training workshop. The workshop was delivered by a qualified speech therapist experienced in voice therapy. The workshop took three hours and it covered voice protection education (such as introducing guidelines of living and speaking habits that are beneficial for healthy voice production and checklist of vocal abusive behaviors) and short exercises on voice projection for classroom teaching. The content of workshop was based on the programs developed by Yiu and Chan (2003) and Yiu and Ma (2001). The workshop was held at the beginning of the academic year (during August and September) in each participating school for the voice training group and at the end of the project for the no-training group and any other teachers in the participating schools respectively.

Questionnaires The *self-rating questionnaires* were used to measure the outcome. The participants completed the Cantonese version VHI-30, VRC, GTS and the Cantonese version VAPP at the beginning of the project. Then, they completed the VHI-30, VRC and GTS again one year after the project.

Study 2 (change of voice condition in student teachers)

Participants

One hundred and five final year university student teachers were recruited from the local tertiary institutions with teachers training programs. Those with dysphonic symptoms were

excluded during sampling. The participants were randomly assigned to two experimental groups (Group VH – the group with vocal hygiene information given, N=55; and Group VHT – the group with vocal hygiene information and voicing technique training given, *N* = 50). Moreover, a group who received no training (Group NT) was recruited (*N* = 46). Since the subjects were student teachers, they could only be recruited during the school terms of each academic year (September to May annually). Because of attrition, complete set of data were obtained from 5 males and 38 females aged between 22 and 36 with a mean of 24.05 years and standard deviation of 2.62 years only. Overall, the attrition rate was 47%.

Due to the limitation of data collection, different numbers of data set were obtained for different measures during the initial assessment, the first re-assessment (performed at about two to six month after the intervention) and the second re-assessment (performed at about one year after the intervention).

Procedure

Preventive voice training Programs For Group VH, the subjects attended an one-hour workshop that focused on the vocal care information, including checklists of vocal abusive behaviors and voice protective behaviors. For Group VHT, the subjects attended a two-hour workshop, in which vocal care information (similar to that given to Group VH) and voice projection training exercise were provided. Some content of the workshops was adapted from the program developed by Yiu and Chan (2003). Following the completion of the workshop, the participants could access to an online program with content similar as the workshop they attended.

Questionnaire The Cantonese version VHI-30 was used as one of the outcome measures.

Voice recording for VRP analysis Phonetogram (VRP) recordings were carried out in a quiet room using the Swell's Real-time DSP phonetograph Version 2.0 (*Phog* 2.0, AB

Nyvalla) with a Pentium III 500-MHz PC computer and a 17-inch monitor (Philip 170B4). A head-mounted condenser microphone (AKG Acoustics, C420) was used to capture the voice samples at a 5cm distance from the mouth. Calibration of loudness level of the Phog 2.0 system was carried out each time before recordings.

At the beginning of the examination, subjects were asked to sustain /a/ at a musical note (for female: middle C; for male: G below middle C) at their comfortable loudness. Then, the recordings were continued with the standard VRP procedure (Ma et al., 2007): Subjects were required to gradually decrease/ increase the loudness with sustained phonation until it reaches their lowest/ highest loudness level without whispering and vocal fry. This procedure was repeated with different tones until the maximum and minimum frequencies produced by the subject were obtained. In general, the VRP provided measurements of the maximum and minimum fundamental frequency (Hz), the maximum and minimum intensity (dB), and the total profile area (dB semitone).

Videostroboscopic image recording for perceptual evaluation The examination of the larynx was conducted using Kay's Rhino-Laryngeal Stroboscope (RLS Model 9100B). During examination, the larynx was first visualized under continuous halogen illumination at rest. Second, it was visualized under both halogen and stroboscopic illumination during sustained /i/ at comfortable pitch and loudness. Some subjects, who demonstrated substantial sensitive gag response, failed to complete the videostroboscopic examination.

Perceptual evaluation and reliability measures Perceptual rating measure was performed on the videostroboscopic images. The videos were first screened in a selection procedure of the rating of clarity. The clarity of videos was rated by an undergraduate year four student studying Speech and Hearing Sciences in the University of Hong Kong. A three-point scale was used for rating, with "clear" means the images can be certainly judged with good lighting, good focus and the vocal folds can be completely seen; "semi-clear"

means the images can be partially judged with fair lighting, fair focus and/or partially seen vocal folds; and "Unclear" means the images cannot be judged due to poor lighting, poor focus and/or the vocal folds cannot be seen". Only images rated as "clear" and "semi-clear" were selected for the final rating process. Table 1 lists the number of videos that were rated as "clear" and "semi-clear". Three experienced judges participated in the rating process.

Table 1

The number of videos that were rated as "clear" and "semi-clear"

	Clarity	
	Clear	**Semi-clear**
Number of videos	21	26

The Stroboscopic Assessment Form (SAF), with parameters adapted from the Stroboscopy Examination Rating Form (SERF) (Poburka, 1999), was used for the perceptual evaluation in this study. The parameters included 1) mass and redness – with the area represented by the number of boxes being the rating unit, which reflect the extent and size of pathology, 2) amplitude – with an ordinal rating scale of five ranks, from 20 to 100 (20%, 40%, 60%, 80%, 100%) and the higher percentage represents the better vocal function, 3) supraglottic activity – with an ordinal rating scale of six ranks, from 0 to 5 and the smaller rating represents the better vocal condition, and 4) glottal closure – with seven descriptive rating labels: complete, anterior gap, posterior gap, hourglass, spindle gap, irregular and incomplete. (Appendix B).

Poburka (1999) suggested the SERF showed a better agreement and reliability of ratings when compare to other rating forms. Moreover, it was reported that using the SERF allows "faster rating times, less hesitation in making the ratings, and less confusion over left and

right orientations on the form" (Poburka, 1999, p. 412). Therefore, the SERF was taken as reference.

Fifteen percent of the total samples were selected for the reliability measures. The selected samples were repeated. Hence, these samples were rated by each rater for twice for calculating the intra-rater agreement. Also, the ratings of the same stimuli by the three judges were compared for calculating the inter-rater reliability. Due to the missing data, dummy samples (about 40% of the total samples being rated) were added so that three video clips were presented for each subject. Yet, the rating of the dummy samples was not included in the final data analysis. Moreover, all samples to be rated were randomized between-subjects and within-subjects before rating.

It was suggested that the validity of measure can be improved with the provision of external referenced standards (anchors) of the parameters to be rated (Rosen, 2005). Therefore, an anchor showing the normal vocal condition was provided. Then, the randomized samples and the anchor were presented in a Microsoft PowerPoint file by subject for rating. A 27-inch Apple LED monitor was used for rating for each rater. Three practice trials were provided before the actual rating process. During the rating process, the raters were required to mute the computer before rating to avoid the effect of auditory input on visual perceptual rating. The raters could view the stimuli and anchors as many times as they needed. Also, the raters were allowed to take a break after rating every six subjects. Finally, the three judges came up with a consensus rating for the final analysis.

Data analysis

Change of vocal function in teachers over time with voice intervention provided

Change of vocal function in practicing teachers (study 1)

Due to the high attrition rate of the no-training group at the post-intervention stage, the subjects in the no-training group was too few (N = 3) for making comparisons between the

intervention group and the no-training group. Therefore, analysis was only performed on the intervention group (Group VT).

Data in the study were collected at two time points, during pre- and post-intervention. The Wilcoxon signed ranks test was performed on the VHI and VRC scores to determine the change of vocal function overtime. The VAPP scores were not involved in the within-subjects comparisons as the measure had only been completed by the subjects during pre-intervention. Moreover, means and standard deviations of the VHI, VRC and VAPP scores were generated. For GTS, background information that reflected the subjects' self-perceived voice-related QoL during work was extracted and described.

Change of vocal function in student teachers (study 2)

Due to the high attrition rate of the no-training group, the subjects in the no-training group were too few ($N = 2$) for the between-subjects comparisons of the intervention groups (Group VH and Group VHT) and the no-training group. Hence, only the intervention groups were involved in the analysis.

Data in the study were collected at three time points, during pre-intervention, post-intervention 1 and post-intervention 2. The repeated-measure Friedman test was performed on the results of VHI and VRP measurements to determine the change of vocal function overtime. For the videostroboscopic measure, since the number of data set collected at post-intervention 1 was too few ($N = 4$) to be included in the final analysis, Wilcoxon signed rank test was performed on the videostroboscopic rating instead. Means and standard deviations were also generated for results of all outcome measures in study 2.

Comparisons of self-perception of voice-related QoL between practicing and student teachers

The Mann-Whitney test was performed to compare the VHI scores of the practicing teachers (in study 1) and student teachers (in study 2).

Result

Change of vocal function in teachers over time with voice intervention provided

Change of vocal function in practicing teachers (study 1)

Table 2 lists means and standard deviations of the VHI scores, VRC scores and VAPP scores of Group VT. The Wilcoxon signed ranks test confirmed that no significant within-subjects difference was present for the pre- and post-intervention results of the VHI scores ($p = .270 > .05$) and the VRC scores ($p = .155 > .05$). Voice and work-related background information of the subjects was also obtained using the GTS. During pre-intervention, 39% of the respondents described their voice condition as "poor" or "very poor". 42% of the respondents reported a present of voice problems within the twelve months by the time of completing the survey, with 31% of them requested day-leave(s) due to the dysphonia. Besides, about 47% of them reported a reduced participation in certain activities due to the voice problems. While during post-intervention, only 8% of the respondents described their voice condition as "poor" or "very poor". 32% of the respondents reported a present of voice problems within the twelve months by the time of completing the survey, with 25% of them requested day-leave(s) due to the dysphonia. Moreover, only 28% of them reported a reduced participation in certain activities due to the voice problems.

Table 2

Means (standard deviations) of the VHI, VRC and VAPP scores of Group VT

	Pre-intervention	**Post-intervention**
VHI scores	19.11 (17.47)	22.48 (17.49)
VRC scores	56.25 (9.36)	51.18 (10.66)
VAPP scores		
Total	55.16 (50.96)	-
Activity Limitation Score	23.66 (19.73)	-
Participation restriction score	16.76 (19.14)	-

Change of vocal function in student teachers (study 2)

Table 3 lists the results of the intra-rater and inter-rater agreements of the three raters in the perceptual analysis of videostroboscopic images. *Agreement within one unit* for the ratings of mass and redness, amplitude, and supraglottic activity; and *the exact agreement* for the ratings of glottal closure patterns were set as the criterion level for the reliability analysis.

Table 4 and Table 5 list the means and standard deviations of the results of the VHI, the VRP measurements and the videostroboscopic perceptual rating of Group VH and Group VHT respectively. Repeated-measure Friedman tests were carried out to investigate the change in results of the VHI and VRP measurements, while Wilcoxon signed rank tests were perform to determine the change in results of the videostroboscopic perceptual rating for subjects in the two intervention groups. The findings are listed in Table 6 and Table 7. For Group VH, no significant within-subjects difference was found for all pre- and post-intervention measures results. For Group VHT, statistical significant difference (that is, a decrease) of the pre- and post-intervention results was found in the maximum frequency measurement only (Friedman's Chi-Square = 8.240, $d.f. = 2$, $p < .05$). The Wilcoxon signed rank test further confirmed the significant difference was present between the pre-intervention and the post-intervention 2 results ($p < .05$).

Analysis was also performed on the glottal closure pattern rating. The glottal closure patterns were classified into three categories: The first category was the normal glottal closure patterns. In general, only the “complete” glottal closure pattern is described as normal. Yet, for female, posterior gap is also considered to be normal (Biever & Bless, 1989). The second category was the abnormal glottal closure patterns without observable vocal pathology. These patterns would include “posterior gap” (for male) and “anterior gap” (for both male and female). The third category was the abnormal glottal closure patterns with observable vocal pathology. These patterns would include “hourglass”, “spindle gap”,

"irregular" and "incomplete". Table 8 lists the percentage of the corresponding glottal closure patterns of the three categories in Group VH and Group VHT respectively.

Table 3

Intra-rater and inter-rater agreements in the perceptual analysis of videostroboscopic images

		Intra-rater (%)			**Inter-rater (%)**		
Parameters for perceptual rating		**Rater 1**	**Rater 2**	**Rater 3**	**Raters 1 and 2**	**Raters 2 and 3**	**Raters 1 and 3**
Mass							
Left	Agreement within 1 unit	100	100	100	100	100	100
Right	Agreement within 1 unit	100	100	100	100	100	100
Redness							
Left	Agreement within 1 unit	75	75	100	90.7	92.6	94.4
Right	Agreement within 1 unit	75	75	100	92.6	90.7	92.6
Amplitude							
Left	Agreement within 1 unit	100	100	100	100	100	100
Right	Agreement within 1 unit	100	100	100	100	100	100
Supraglottic activity							
AP	Agreement within 1 unit	100	100	100	94.4	94.4	88.9
ML	Agreement within 1 unit	100	100	87.5	100	94.4	96.3
Glottal closure							
	Exact agreement	83.3	100	85.7	87.0	88.9	88.9

Key: AP: Anterior-posterior; ML: Medial-lateral

Table 4

Means (standard deviations) of the VHI scores, the VRP measurements results and the videostroboscopic perceptual rating results of Group VH

Outcome measures	Pre -intervention	Post -intervention 1	Post -intervention 2
VHI scores	13.58 (9.88)	16.24 (13.21)	18.55 (14.66)
VRP measurements			
Maximum frequency (Hz)	995.19 (268.30)	1077.3 (198.72)	924.25 (248.09)
Minimum frequency (Hz)	132.48 (23.92)	128.98(17.73)	125.11 (23.67)
Maximum intensity (dB)	107.75 (7.76)	104.29 (7.36)	107.45 (4.55)
Minimum intensity (dB)	56.54 (6.20)	52.94 (5.25)	59.90 (7.28)
Profile areas (dB x semitones)	1190.8 (318.19)	1224.1 (250.03)	1114.9 (286.96)
Videostroboscopic rating			
Mass (Left)	.0000 (.000)	-	.3125 (.793)
(Right)	.2000 (.447)	-	.3750 (.806)
(Left plus right)	.2000 (.447)	-	.6875 (1.58)
Redness (Left)	.6000 (.894)	-	.6875 (1.01)
(Right)	.2000 (.447)	-	.7500 (1.06)
(Left plus right)	.8000 (1.10)	-	1.438 (1.90)
Amplitude (%) (Left)	40.00 (.000)	-	30.00 (10.33)
(Right)	32.00 (10.95)	-	28.75 (10.25)
Supraglottic activity (AP)	2.800 (1.64)	-	2.250 (1.06)
(ML)	1.400 (.548)	-	1.500 (.516)

Key: AP: Anterior-posterior; ML: Medial-lateral

Table 5

Means (standard deviations) of the VHI scores, the VRP measurements results and the videostroboscopic perceptual rating results of Group VHT

Outcome measures	Pre -intervention	Post -intervention 1	Post -intervention 2
VHI scores	13.27 (7.69)	22.36 (15.31)	23.00 (13.05)
VRP measurements			
Maximum frequency (Hz)	1104.5 (194.54)	1065.0 (195.91)	1017.2 (126.34)
Minimum frequency (Hz)	138.35 (14.86)	137.75 (13.48)	138.21 (10.16)
Maximum intensity (dB)	107.12 (7.14)	106.54 (6.06)	111.00 (5.88)
Minimum intensity (dB)	56.88 (8.62)	55.36 (7.22)	58.09 (4.74)
Profile areas (dB x semitones)	1175.2 (307.63)	1094.1 (303.66)	1208.7 (281.80)
Videostroboscopic rating			
Mass (Left)	.5000 (.837)	-	.1667 (.408)
(Right)	.5000 (.548)	-	.1667 (.408)
(Left plus right)	1.000 (1.26)	-	.3333 (.817)
Redness (Left)	.6667 (1.63)	-	.3333 (.817)
(Right)	.1000 (2.45)	-	.3333 (.817)
(Left plus right)	1.667 (4.08)	-	.6667 (1.63)
Amplitude (%) (Left)	33.33 (10.33)	-	26.67 (10.33)
(Right)	26.67 (10.33)	-	23.33 (8.16)
Supraglottic activity (AP)	1.500 (1.05)	-	1.667 (.817)
(ML)	1.333 (.516)	-	1.333 (.516)

Key: AP: Anterior-posterior; ML: Medial-lateral

Table 6

Within-subjects comparison of the VHI scores and the VRP measurements results of Group VH and Group VHT

Outcome measures	**Friedman's Chi-Square**		***d.f.***		***p***	
	Group VH	Group VHT	Group VH	Group VHT	Group VH	Group VHT
VHI	0.353	1.000	2	2	.838	.607
VRP measurements						
Maximum frequency (Hz)	2.596	8.240	2	2	.273	.016
Minimum frequency (Hz)	4.233	0.839	2	2	.120	.657
Maximum intensity (dB)	2.920	4.514	2	2	.232	.105
Minimum intensity (dB)	3.231	0.857	2	2	.199	.651
Profile areas (dB x semitones)	1.167	1.750	2	2	.558	.417

Statistically significant correlation, $p < .05$ (2-tailed)

Table 7

Within-subjects comparison of the videostroboscopic perceptual rating results of Group VH and Group VHT

Videostroboscopic rating		***Z***		***p***	
		Group VH	Group VHT	Group VH	Group VHT
Mass	(Left)	-1.000	-1.000	.317	.317
	(Right)	.000	.000	1.000	1.000
	(Left plus right)	-.447	-1.000	.655	.317
Redness	(Left)	-1.000	.000	.317	1.000
	(Right)	-.1.069	.000	.285	1.000
	(Left plus right)	-.1.069	.000	.285	1.000
Amplitude (%)	(Left)	-1.732	-1.000	.083	.317
	(Right)	-1.414	.000	.157	1.000
Supraglottic activity	(AP)	.000	-1.342	1.000	.180
	(ML)	-.577	-1.000	.564	.317

Statistically significant correlation, $p < .05$ (2-tailed)

Key: AP: Anterior-posterior; ML: Medial-lateral

Table 8

Percentage of the corresponding glottal closure patterns of the three categories in Group VH and Group VHT respectively

	Pre-intervention		**Post-intervention 1**		**Post-intervention 2**	
Glottal closure patterns	Group VH	Group VHT	Group VH	Group VHT	Group VH	Group VHT
Category 1	60	83.3	-	-	62.5	100
Category 2	40	0	-	-	18.8	0
Category 3	0	16.7	-	-	18.8	0

Comparisons of self-perception of voice-related QoL between practicing and student teachers

Table 9 lists the means and standard deviations of the VHI scores of the practicing teachers and student teachers respectively at pre-intervention stage. Only pre-intervention results were chosen for analysis to ensure a fair comparison between the two groups of subjects without the effects of interventions. The results showed that the VHI scores of the practicing teachers were higher than that of the student teachers. However, the Mann-Whitney test confirmed the student teachers (subjects in Study 2) and the practicing teachers (subjects in Study 1) were not significantly different in the mean VHI scores (Mann-Whitney U = 1207.00, $p = .141 > .05$).

Table 9

Means (standard deviations) of the VHI scores (during pre-intervention) of the student teachers and practicing teachers respectively

	Practicing teachers	**Student teachers**
VHI scores	21.17 (18.70)	13.43 (8.85)

Discussion

The primary objective of the study was to investigate the change of vocal function in practicing teachers and student teachers over time with voice intervention provided. With the findings in similar studies, it was hypothesized that interventions with vocal hygiene education and/or vocal exercise would lead to significant positive change in measures that reflect the vocal function. This includes the subjective self-rating measures of voice or the instrumental measures of the vocal function (VRP and perceptual rating of videostroboscopic images) (Chan, 1994; Bovo et al., 2007; Pasa et al., 2007). However, the current findings did not support the hypothesis: In study 1 (practicing teachers as subjects), no statistical significant improvement was shown in all self-rating measures with results being analysed (VHI, VRC). However, improvement of vocal function was present as reflected from the descriptive information obtained in GTS: After the intervention, the participants reported a better self-perceived voice condition; a reduced prevalence of voice problems and a decreased number of day-leave(s) request due to the dysphonia. They also reported a decreased frequency in the reduced participation in certain activities due to the voice problems. In study 2 (student teachers as subjects), no statistical significant difference of the pre- and post-intervention results was found in most of the outcome measures, excepted for the maximum frequency measurement of the VRP in Group VHT – one of the intervention groups. However, a negative effect (that is, a decrease in the maximum frequency) was noted.

Several possible explanations were discussed to account for the findings in the current studies, which are as follows:

First, subjects' poor adherence of the intervention programs might have contributed to the non-significant change of vocal function after the intervention. It was suggested that subjects' adherence of the intervention is critical for the intervention outcome (Behrman, Rutledge, Hembree & Sheridan, 2008).

One assumption of the current studies was that the subjects would continually follow the advices given in the vocal hygiene education after the one-time workshop. In general, the vocal hygiene guidelines usually required the subject to modify their speaking and living habit to certain extent. These guidelines included those aimed to reduce the vocal abuses behavior (e.g., reduce excessive voice use, avoid speaking with over high pitch and/or loudness, avoid throat clearing and forceful coughing, reduce the intake of some irritating materials such as spicy and greasy food, chocolate, alcohol and cigarette) and those focused on increasing the vocal protective behaviors (e.g., drink more water, reduce speaking rate, allocate appropriate amount of time for vocal rest).

In the current two studies, the subjects were not closely monitored (that is, no live visits) on their daily performance of following the vocal hygiene guidelines after the training workshop session. Therefore, the subjects' compliances to the advices were highly relied on their self-discipline. Yet, when the will of complying with the vocal hygiene guidelines and the living habits or personal interests (e.g., favorite food is spicy food) became conflicts, the subjects might not strictly follow the guidelines.

Moreover, modification of the speaking habits could be even more difficult than that of the living habit. It is because speaking habits – such as habitual loudness and pitch – are much more internalized and would require high level of consciousness in self-monitoring the

abusive behaviors. In other words, even the subjects had the desire to follow the vocal hygiene advices; they might fail to do so due to the inadequate awareness to the problem.

Second, inaccurate implementation of the voicing techniques due to the inadequate training might also be related to the lack of improvement after the intervention. In the current project, apart from the vocal hygiene education, training of the voice projection techniques in classroom teaching was also provided to the intervention group in study 1 and one of the intervention groups in study 2 (Group VHT). In general, the voice projection exercise could promote the appropriate and effective voice use. However, incorrect implementation of these training could produce a reverse effect. In the current studies, only short exercises of the voice projection were provided for the subjects, which might not be enough for all subjects to master the techniques. Hence, inaccuracy could be resulted during the implementation of voice projection in daily situation. This can be harmful to the subjects' voice. For example, if the subjects misunderstood increased loudness as better voice projection, the inappropriate increase in loudness would cause stress on the vocal folds of the subjects. This might be one of a possible reason in explaining the negative change of maximum frequency shown in Group VHT, in which voice projection training was provided.

The second objective of the current project was to compare between the practicing teachers and the student teachers on their self-perceived voice-related QoL measured by VHI. The objective was set up on the hypothesis that the self-perceived QoL of the student teachers would be significantly better than that of the practicing teachers. Concerning the current findings, it was observed that although the student teachers showed a better self-perceived voice-related QoL (that is, a lower VHI score) than the practicing teachers, the results of the two groups were not significantly different. Thus, the present findings did not fully support the hypothesis. The following are the possible explanations for the findings:

First, due to the high attrition rate in both studies, the number of subjects being included in the final analysis was not balance between groups. Therefore, valid comparison between the two groups could not be completely attained and the differences between groups might not be fully demonstrated.

Second, it was expected that the different performance of the two groups might be related to the following risk factors of voice problem. This included 1) vocal demand in a week, 2) stress and anxiety, and 3) age (Thomas, Kooijman, Cremers & de Jong, 2006). In the studies, the mean age of the student teachers was about 14 years younger than the practicing teachers. Also, all the practicing teachers recruited were full-time teaching professional in different education institution in Hong Kong. Hence, it was expected that the practicing teachers would have higher vocal demand as well as more stress than the student teachers due to the heavier teaching workloads. Yet, the above-mentioned risk factors could be interfered with other factors such as the working environment and personality (World Health Organization, 2001). Thus, concrete conclusion could not be drawn before the information of other risk factors were taken into account and compared between the two groups of participants.

Limitation of the present studies and future research directions

Sample size Due to the high attrition rate of subjects, a great number of the recruited subjects did not participate in any of the outcome measures. This greatly reduced the number of subjects included in the final analysis. Only 69 subjects and 43 subjects were included in the final analysis of study 1 and study 2 respectively. Hence, the sample size might only be large enough to give some preliminary rather than conclusive results.

The missing of no-training group subjects data A number of subjects who participated in the studies did not completed all the outcome measures at different stages (pre- or post- intervention), which led to the presence of missing data in outcome measures

for different groups at different stages. Moreover, in both study 1 and study 2, the problem was especially serious in the no-training group. Therefore, the data of the no-training group was not enough to be involved in the final analysis for both studies. This lead to the difficulty in determining the effectiveness of the intervention programs in the two studies as comparison could not be made between the intervention groups and the no-training groups.

To improve, future studies are recommended to include a better system of controlling the attrition rate. For example, rewarding terms (e.g., free reports about the vocal condition) can be added to increase the motivation of subjects in participating in the study. A larger sample size should also be targeted to attain enough samples for the final analysis.

Conclusion and clinical implication

The current studies did not support the hypothesis that positive change of vocal function would be shown after giving intervention with vocal hygiene education. Also, the research finding did not demonstrate significant difference between the practicing teachers and student teachers on their self-perceived voice-related QoL.

In order to develop an effective preventive intervention program for the local teachers, it is recommended to continue investigating the effectiveness of intervention programs with voice education (including the vocal hygiene education and voicing techniques training) for teachers. Yet, modifications of the methodology of the current study are recommended. This may include 1) recruiting a larger sample size, and 2) a better control on the attrition of subjects.

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Appendix A

The General Teaching Survey (GTS)

聲線問題與教學的關係
Developed by Dr. Karen Chan

你現在是否全職從事教學工作?
☐ 是 ☐ 否 (你不需填寫這份問卷)

聲線狀況

1. 在過往十二個月內，你會怎樣形容你的聲線狀況？
☐ 很差 ☐ 差 ☐一般 ☐ 好 ☐ 很好

2. 如你現在有聲線問題，是何時發現？

☐不足一個月 ☐一至兩個月前 ☐三至六個月前
☐七至十二個月前 ☐一年以上 ☐不適用,我的聲線沒問題

聲線對工作的影響

3. 過往十二個月內，你因聲線問題而要請假的次數有多少天？

☐ 聲線有問題, 但沒有請假
☐ _____天 ☐ 不適用,我的聲線沒問題

4. 過往十二個月內，你有沒有因聲線問題而要減少參與以下的項目？

☐ 教學 ☐ 課外活動 ☐ 與同工會議 ☐ 與學生在課後會議
☐ 輔導學生 ☐ 與家長會議
☐ 其他與工作有關的活動, 請列明: _____
☐不適用,我的聲線沒問題

影響聲線的因素

5. 你認為下列那些項目正在影響你的聲線？

☐ 運氣方法不適當 ☐ 用聲不當
☐ 飲食習慣 ☐ 休息不足
☐ 個人情緒問題 ☐ 個人健康問題 ☐ 個人教學方法
☐ 班房設計不適當 ☐ 課堂編排不適當 ☐ 每班學生人數不適當
☐ 經常參與課外活動 ☐ 教學時沒有用擴音器
☐ 學校附近環境噪雜 ☐ 學生秩序差
☐ 其他: _____

6. 你有否採用任何方法避免聲線持續轉壞？

☐ 多喝水 ☐ 減少用聲 ☐ 多休息
☐ 減少大聲說話 ☐ 減少進食刺激性食物 ☐ 使用擴音器
☐ 參加護聲講座 / 工作坊 ☐ 改善運氣方法
☐ 服食西藥 ☐ 服食中藥 ☐ 其他,請列明_____
☐不適用,我的聲線沒問題

7. 你認為若果參加一些聲線護理班, 會否對你的聲線問題有幫助呢？

☐會 ☐或許 ☐不會 ☐不適用,我的聲線沒問題

任教歷史

8. 你從事全職教學工作有多久？

☐不足一個月 ☐一至兩個月 ☐三至六個月 ☐七至十二個月
☐一年以上至兩年 ☐兩年以上至三年 ☐三年以上至四年 ☐四年以上

9. 你現在任教的級別是(可選擇多過一個答案)

☐ 幼兒班 (N 班) ☐ 幼低至幼高班 (K1 – K3)
☐小一至小三 ☐小四至小六 ☐中一至中三 ☐中四至中五 ☐中六至中七

10. 你現在任教的科目是(可選擇多過一個答案)

☐ 語文 ☐ 數學 / 物理 ☐ 生物 / 化學 ☐ 綜合科學
☐ 社會科學 (如：通識、常識、商科、地理、歷史、宗教)
☐ 音樂 ☐ 美術 ☐ 家政 / 木工 ☐ 體育
☐ 職業培訓 ☐ 特殊教育

11. 你現在有否帶領課外活動 (可選擇多過一個答案)

☐ 紀律 / 制服團隊 (如:童軍、公益少年團) ☐ 體育
☐ 合唱團 ☐ 音樂 (如: 樂器班、樂團) ☐ 朗誦
☐ 美術 / 文化興趣班 (如: 棋藝、攝影) ☐ 科學活動
☐ 語文 ☐ 宗教活動 (如: 團契) ☐ 其他: _____
_____

12. 任教時間：每星期_____小時

13. 除全職教書外，你工餘時有沒有替學生補習?

☐有 每星期教_____小時
☐沒有

14. 你上課時有沒有用擴音器?

☐經常有 ☐間中有 ☐沒有

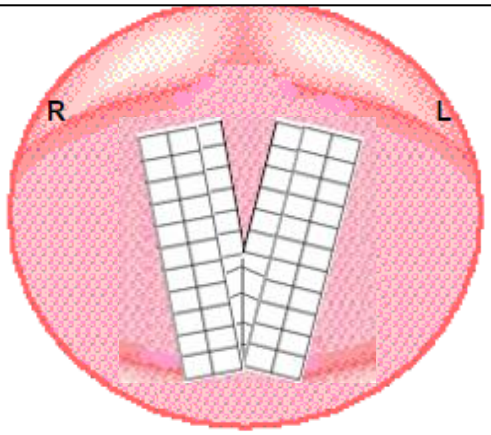
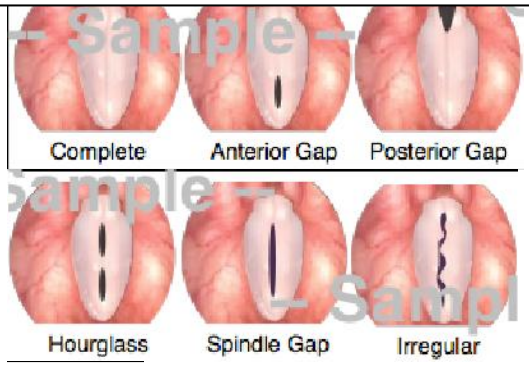
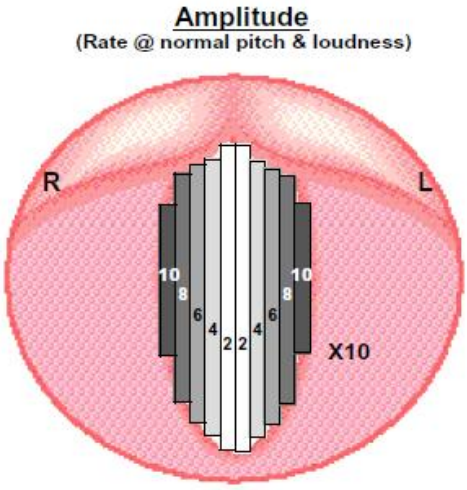
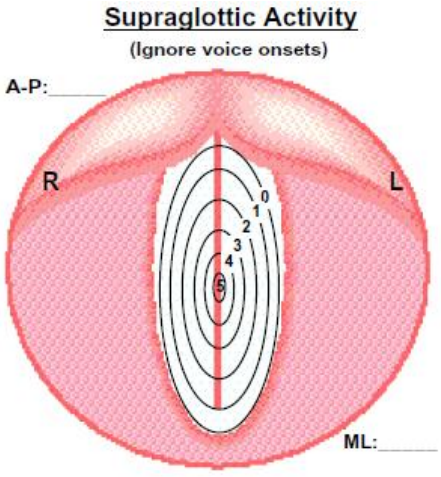
****** 完 ******

Appendix B

The Stroboscopic Assessment From (SAF)

Stroboscopic Assessment From (SAF)

Some parameters were adapted from SERF (Poburka, 1999)

Please mark the extent of lesion on the grid	**Please circle the glottal closure**
 **Right:** **Number of boxes = _____** **Left:** **Number of boxes = _____**	  **Glottal closure:** Appearance of glottis during the most closed portion of the glottal cycle
Please mark the extent of vibratory movement from midline according to the scale (2,4,6,8,10)	**Please mark the degree of compression according to the scale (0-5)**
 **Right:____%** **Left:____%** **Amplitude** Extent of vibratory movement of vocal folds laterally to midline.	 **Supraglottic activity** *Medio-lateral compression(ML)*: true vocal folds being obscured by the ventricular folds. *Antero-posterior compression (A-P)*: compression of shortening of the aryepiglottic folds.