A Randomized Treatment-Placebo Study of the Effectiveness of Acupuncture for Benign Vocal Pathologies

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Summary: Acupuncture is a widely accepted treatment option for many medical ailments in China. Some reports claim that acupuncture is effective for treating dysphonia associated with benign pathological tissue changes. However, many of these reports are based on anecdotal evidence that lacks a scientific experimental design. The objective of this study was to investigate the effectiveness of intensive acupuncture therapy for dysphonias associated with benign pathological changes with a randomized, control design. Twenty-four subjects aged between 19 and 51 years were randomly assigned to either an experimental group or a placebo group. The experimental group received acupuncture on acupoints *Renyin* (Stomach Channel 9), *Lieque* (Lung Channel 7), and *Zhaohai* (Kidney Channel 6), which are all related to improving throat problems and vocal function, whereas the placebo group received acupuncture on acupoints *Houxi* (Small Intestine Channel 3) and *Kunlun* (Bladder Channel 60), which are not related to voicing. All subjects received 10 intensive acupuncture sessions within a 20-day period. Acoustic analysis of voice range profile, perceptual analysis of voice quality, and self-perceptions of quality-of-life (QOL) measurement by patients were the outcome measures for determining treatment efficacy. Results revealed significant improvement in the treatment group in all three aspects when compared with the placebo group. The acupuncture effect was maintained into the second week after the completion of acupuncture treatment.

Key Words: Voice therapy—Alternative voice treatment—Traditional Chinese medicine.

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INTRODUCTION

Vocal misuses and abuses are frequently considered the contributing factor to dysphonia. Depending on the degree of misuses and abuses, pathological changes in the vocal folds may also be involved.[1,2] These changes include thickening of the vocal fold tissue and formation of vocal fold nodules or polyps.[2] These pathological changes and the associated dysphonia are usually treated with conservative voice therapy, which consists of vocal hygiene education to help eliminate the source of misuse and abuse[3] and vocal facilitative techniques to encourage appropriate and optimal voice use.[1] Surgical management may be considered if voice therapy fails.[2] However, up to 20% of dysphonic patients may show no improvement despite voice therapy and surgical intervention.[4] Therefore, it is not surprising to find that many dysphonic patients look for alternative treatment.

The objective of this study was to investigate the effectiveness of acupuncture in treating dysphonia associated with benign pathological changes in vocal fold tissues. Acupuncture is chosen as the alternative treatment in this study because it is a widely applied treatment approach in China, where no conservative type of voice therapy, as in developed countries, is available, as the speech pathology profession does not yet exist there.

General principle of acupuncture

Acupuncture by the Chinese can be dated back to 2000 years ago. It has attracted much scientific interest since the 1970s.[5] Traditionally, acupuncture is believed to be associated with the concepts of *qi* (the essential energy), *jing-luo* (meridians or channels), *xue* (acupoints), and *yin-yang* theory.[6,7] In traditional Chinese medicine (TCM), *qi* is the building block of living humans and is fundamental to the proper functioning of human body.[8] Two main types of *qi* or energy are involved in acupuncture. They are *ying qi* that circulates in the body and bring nourishments to body parts and *wei qi* that protects the body from external invasions.[6] *Jing-luo* are channels or meridians through which *qi* is circulated. The *jing-luo* connect all parts of the body.[8] *Xue* or acupoints are nerve endings located on the channels for acupuncture. Each acupoint is named with the name of the meridian or channel and a number. The names of the 12 major meridians are taken from the internal organ to which each of these merdians is connected (see Appendix I). When these acupoints are needled, they will induce specific effects on their corresponding organs.[9] The *Yin-yang* theory states that normally the body will have an equal amount of *yin* (negative) and *yang* (positive) to establish a homeostasis.[8] Imbalance of *yin-yang* in a certain internal organ would result in illnesses in that particular organ. Acupuncture is designed to restore the *yin-yang* equilibrium by regulating the *qi* through needling at specific *xue* (acupoints).[9] In the view of traditional Chinese medicine, pathological change in the vocal folds leads to an injury or deficiency in *yin*. Then, an excessive *yang* at the larynx results, which causes the accumulation of phlegm-heat.[10] The pathological tissue change, according to the principle of traditional Chinese medicine, can be resolved if the *yin-yang* equilibrium is restored.

Several neurological explanations have been put forward to explain the mechanism of acupuncture. The *qi* is interpreted by some scientists as the electrical depolarization or energy in the *jing-luo*, which are actually nerve fibers.[11,12] Needling at specific *xue* (which are the nerve endings) triggers neurotransmissions to the cortical area of the brain. It is believed that the endocrine and autonomic nervous system are activated by these cortical activities[13] and subsequently stimulate and speed up the healing process of the body.[11,12]

Acupuncture for voice disorders

Yao[14] reported on three case studies of acupuncture to treat dysphonia after radiotherapy for nasopharyngeal carcinoma, unilateral vocal fold paralysis, and acute aphonia from laryngitis. In his study, acupuncture was applied primarily to *Yan Si Xue* and secondarily to acupoints specific to the disease possessed by individual subjects. The acupuncture was reported to be effective as all three subjects regained their voices and/or experienced improvement of voice quality after 10 to 15 intensive treatments. However, this report was only anecdotal in nature, and there was no attempt to control for the spontaneous recovery of the subjects. A detailed

statement about the outcome measures was not reported by the author. Another descriptive study that investigated the effect of acupuncture on thickened vocal folds was also reported.[15] A total of 50 occupational voice users with thickened vocal folds were treated with acupuncture of *Renyin* (Stomach Channel 9) and *Shuitu* (Stomach Channel 10) acupoints. Each course of acupuncture consisted of seven daily sessions. After eight courses of treatment, 14 subjects (28%) recovered with "slight im provement," 12 subjects (24%) recovered "effectively," and 24 subjects (48%) recovered "significantly." No details were given on how these outcomes were determined.

Yang[10] reported the results of a large-scale study (N = 227, of which 108 were men and 119 were women), which compared the effects of Western medicine, Chinese herbal drug alone, and the combination of acupuncture and Chinese herbal drug on treating vocal nodules. The subjects were assigned to either an acupuncture-supplemented-with-Chinese-herbal-drug treatment group (N = 109), a Western-medicine control group (N = 56), or a Chinese-herbal-drug-control group (N = 62). The three groups were reported to be comparable in age, sex, and course of illness. There were no details as to what specific Western medicine or herbal drug were given to the two control groups. The treatment group received 10 intensive sessions of acupuncture on *Kaiyin Yihao Xue* [which is approximately 1 cm lateral to *Renying* (Stomach Channel 9), and *Hegu* (Liver Channel 4) acupoints] and took the Chinese herbal drug. Yang[10] reported a significantly higher effective rate for the treatment group (93.6%) than for the Western-medicine control group (66.1%) and the Chinese-drug control group (83.9%) ($P < 0.01$). Yang[10] contended that the combination of acupuncture and Chinese herbal drug was more effective than was the Chinese herbal drug or Western medicine alone. Nevertheless, there were no details on what and how outcome measures were applied in the study.

Crevier-Buchman et al[16] reported acupuncture and botulinum toxin (BOTOX®, Allergan, Inc., Irvine, CA) in treating two subjects with spasmodic dysphonia. Their results showed that although both types of treatment resulted in significant improvement in phonatory frequency, maximum phonation time, speech rate, phrase grouping, and duration of reading, the effect brought about by the Botox was found to be of shorter term when compared with that of the acupuncture, which lasted for up to 12 months after treatment.

These reports provided some evidence and information on acupuncture for treating voice disorders. However, they are of little help in establishing the effectiveness of acupuncture in treating voice problems as the outcome measures are primarily subjective judgments made by the clinicians or reports by the subjects, whereas a description of treatment was not detailed.

More recently, Lee et al[17] examined the effects of acupuncture treatment on ten subjects with adductor spasmodic dysphonia. Their description of the methodological design is clearer, and they provided a detailed account of the outcome measures. Significant improvements in some acoustic measures and the self-perceptions of the subjects were reported. Nevertheless, different acupoints at different times during the course of treatment for each subject makes the interpretation and generalization of results problematic.

The studies reviewed above have the limitation that no control group was employed. This study, therefore, set out to conduct a randomized control blind study with objective outcome measures. The outcome measures included acoustic analysis of vocal function (phonetogram), perceptual voice evaluation, and the self-perceptions of the subjects of the voice problem and its impact on daily functions. The aim of this study was to investigate whether a ten-session-long intensive acupuncture therapy (over 20 days) would restore normal vocal functioning in subjects with hyperfunctional dysphonia associated with vocal fold pathological changes.

METHOD

Participants

A total of 54 Chinese female subjects were recruited from the ear, nose, and throat outpatient clinic of the Nanjing First Affiliated Hospital. All subjects selected were women aged between 19 and 55 years to ensure that voice quality changes related to puberty (before 18 years) or aging (above 56

years) were not included in the sampling. All subjects reported no history of asthma, neurological disorders, or hearing problem. They were also not receiving any medication or another therapy that might have an effect on voice or having an upper respiratory tract infection at the time of the study. They were randomly assigned to either an experimental group or a placebo group. Because of attrition, only 24 of them (mean age = 33.17; SD = 9.64; range = 19–51) who attended all sessions and had a complete set of data were included in the analysis. Seven (29.2%) were teachers, five (20.8%) were students, five (20.8%) were labor workers, three (12.5%) were executives, two (8.3%) were shop owners, and the remaining two (8.3%) were a librarian and a retired person. No subject had any experience with acupuncture treatment before. Thirteen subjects had vocal nodules, three had vocal polyps, and eight had vocal fold thickening.

Procedures

Informed consents were obtained from all subjects. The subjects in both groups were told that the acupuncture aimed to improve their voice conditions. Three assessments were carried out during the course of the study. The assessments included a pretreatment (PRE) assessment conducted before the first acupuncture treatment, a posttreatment assessment (POST-1) immediately after the tenth acupuncture treatment session, and a follow-up assessment (POST-2) 2 weeks after the tenth acupuncture session to determine the maintenance effect. The outcome measures taken included phonetogram recording, the Voice Activity and Participation Profile (VAPP),[18] and a sentence recording task for perceptual voice quality evaluation. These measures will be described in the following sections.

Phonetogram recording

Recording and analysis of phonetograms (voice range profiles) were carried out in a quiet room with the Swell *Real-time DSP Phonetograph* Version 2.0 (*Phog* 2.0, AB Nyvalla DSP, Stockholm, Sweden) with a Pentium III 500-MHz PC computer. Voice samples were captured with a professional grade, head-mounted condenser microphone (AKG Acoustics C420, Vienna, Austria) at a microphone-to-mouth distance of 5 cm. This short distance aimed to increase the signal-to-noise ratio. To calibrate the phonetogram to register intensity level measured at a 30-cm source-recording distance as recommended by Schutte,[21] a 1-kHz sinusoidal tone generated by the *Phog* 2.0 program was directed through a loud speaker 5 cm away from the microphone (this is equivalent to the microphone-to-mouth distance applied in this study). A sound level meter (Quest Electronics, Model 215, Oconomowoc, WI) placed at a perpendicular distance of 30 cm from the loud speaker measured the intensity level of the tone. The intensity registered by the sound level meter was input into the *Phog* 2.0 system (within 1 dBA).[19] The lower intensity contour of the voice range profile was obtained first. Each participant was first asked to sustain the vowel /a/ at the scale C4 (261.6 Hz) after a tone generated by the *Phog* system. While sustaining the vowel, the participant was asked to decrease the intensity gradually until the lowest intensity at that particular pitch was reached. This step was repeated for every semitone down and then up the piano scale until the pitch was too low or too high for the participant to produce.[19–21] Similar steps were employed for the upper intensity contour, with the subject gradually increasing the intensity from the comfortable intensity to the highest intensity at that particular pitch.

VAPP

VAPP[18] was a quality-of-life (QOL) measurement. It assesses impact of voice disorders on daily communication, job, social communication, and emotional aspects by providing activity limitation scores and participation restriction scores.

Sentence recording for perceptual voice evaluation

Each subject was required to produce the sentence /ba ba da bɔ/ (father hits the ball) six times. This sentence was chosen as there were no fricatives or aspirated sounds in the words that might perceptually mask abnormal breathiness.[22,23] The first three productions were taken as practice items, and only the last three productions were recorded. Among the three productions, the second one was selected for the perceptual analysis.

Acupuncture

The subjects were randomly assigned to an experimental or placebo group. A double-blind design was

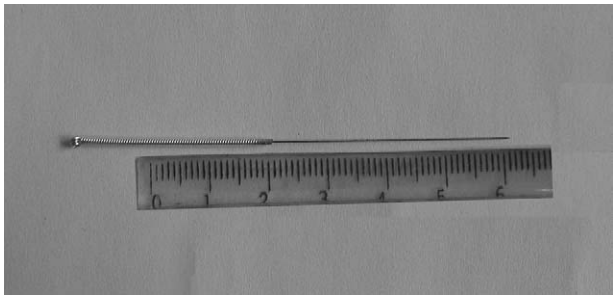

FIGURE 1. Needle used in acupuncture.

FIGURE 2. Acupoint *Renyin*.

applied with the subjects and examiners not knowing the group allocation. All subjects underwent three assessment sessions and ten acupuncture sessions within a 6-week period. Twelve subjects from the experimental group and 12 subjects from the placebo group were included in the final analysis.

The acupuncture was conducted by an acupuncturist (M.Y., fifth author), who had 20 years of experience in acupuncture and traditional Chinese medicine at the Nanjing First Affiliated Hospital. All sessions were conducted in the morning, approximately 2 hours after the subjects had breakfast to ensure that the food provided sufficient energy to facilitate the effect of acupuncture.[11,12] The subjects were also advised to have sufficient rest at home throughout the course of treatment to maximize the effect of acupuncture for recovery. The subjects were given acupuncture once every 2 days. Therefore, the entire course of treatment lasted for 19 days. The needles used in acupuncture were made of stainless steel, 40 mm in length, and 0.32 mm in diameter (made by Hwatuo, Suzhou, China, PRC; Figure 1).

Subjects in the experimental group received acupuncture on three pairs of acupoints that were related to voicing.[24] They were *Renyin* (Stomach channel 9) on the neck (Figure 2), *Lieque* (Lung channel 7) on the wrist (Figure 3), and *Zhaohai* (Kidney channel 6) on the ankle (Figure 4). Needles were inserted into the acupoints to a depth until the subjects reported needling sensation or energy (*qi*) sensation.[6,25] The needling depth was about 3 cm for *Renyin* and 2 cm for *Lieque* and *Zhaohai*. After the needles were inserted in place, electrical stimulation through the acupuncture stimulator was applied to *Renyin* (St 9) for the entire session (Figure 5). A current of 3 mA was first applied to the acupoints, and the magnitude was then increased 1 mA at a time until the subject reported beginning to feel the sensation caused by the electrical stimulation. The purpose of electrical stimulation of the acupoints (electroacupuncture) is considered to serve the same purpose as twirling the needle manually to facilitate the *qi* sensation in the traditional method.[24,26] Subjects in the placebo group received placebo acupuncture on two pairs of acupoints, *Houxi* (Small intestine channel 3) on the hands and *Kunlun* (Bladder channel 60) on the ankles. These points do not have any direct or indirect relationship with voicing.[24] Table 1 lists the location and associated functions of the acupoints in this study. The acupoints are illustrated in Appendix II. The acupuncture took place in a quiet clinic room with the subjects lying supine on a couch comfortably. Each acupuncture session lasted for 30 minutes.

Data analysis

Phonetogram analysis

Five measurements were obtained with the *Phog* 2.0 program for each subject: highest fundamental frequency, frequency range, highest intensity level, intensity range, and total area (in semitone dBA). Two-way repeated analyses of variance (ANOVAs) were carried out on each of these five phonetogram measures from the three assessments

FIGURE 3. Acupoint *Leique*.

FIGURE 4. Acupoint *Zhaohai*.

(session effect—as the within-subject variables) with the two groups (experimental versus placebo) as the between-subject variable (group effect). The multivariate Pillai trace test of significance, which is considered a robust test against violation of assumptions in multivariate tests,[27] assessed the potential main effects and interactions. To avoid possible inflated type 1 error because five separate ANOVAs were carried out, an adjusted alpha level of 0.01 (0.05/5) was applied.

VAPP

The Total VAPP score, Self-Perceived Severity Scores, Activity Limitation Score, Participation Restriction Score, and Emotion Score were obtained from the three assessment sessions. Two-way repeated ANOVAs were carried out on each of these five measures from the three assessments (within-subject variables) with the two groups (experimental versus placebo) as the between-subject variable. The alpha level was set at 0.01 (0.05/5) as five ANOVAs were carried out.

Perceptual voice evaluation

The recorded sentences produced by the subjects were analyzed for two perceptual qualities: breathiness and roughness.[22,28,29] These two perceptual qualities are generally considered to be the results of the physiological impairment of the vocal folds caused by organic lesions.[2] Breathiness is related to incomplete glottis closure, and roughness is related to aperiodic vibration.[22]

Two final-year speech pathology students (aged 22 years) from The University of Hong Kong took part in judging the voice perceptually. They both had completed a course in voice science and disorders, were fluent in Putonghua, and were not informed of the purpose of the study. They first underwent a perceptual voice evaluation training program with two sets of synthesized sentences (breathy and rough) created with the *HLSyn Speech Synthesis System*, Version 2.2 (Sensimetrics, Cambridge, MA). Synthesis details are described in a separate study by Yiu et al.[23] Within each training set, two stimuli were paired up randomly from a set of seven stimuli with increasing severity of breathy or rough quality to form a total of 30 stimulus pairs. Each judge was asked to determine whether the second stimulus of each stimulus pair was more severe (+) or less severe (−) than the first stimulus with a seven-point scale on either side of a reference or zero point, which means "no change." After each rating, correct answers were provided. Then each judge was presented the stimulus pair again. This stimulus-response-feedback paradigm has been shown to be effective in training perceptual voice evaluation skills.[22] Both judges completed the breathy and rough training stimulus set in about 90 minutes.

After the training, the two judges were asked to listen to pairs of stimuli recorded from the subjects

FIGURE 5. Electrical current generator used.

as described earlier. The pairing involved the pretreatment/posttreatment recordings (immediate acupuncture effect) and pretreatment/follow-up recordings (medium-term acupuncture maintenance effect). This process resulted in 48 pairs of voice samples (24 subjects x 2 pairs (pretreatment/posttreatment and pretreatment/follow-up). Twenty-five percent (ie, 12 pairs, 6 from the experimental group and 6 from the placebo group) of the samples were randomly selected and repeated to make up a total of 60 pairs of voice samples. This repetition allowed a measurement of intrarater reliability. The entire perceptual assessment session was carried out in a soundproof room at a comfortable listening level through a Sennheiser (HD 25, Old Lyme, CT) headphone. Half of the stimulus pairs were in the order of pretreatment/posttreatment or pretreatment/follow-up order, and the other half were in the reverse order (posttreatment/pretreatment or follow-up/pretreatment). As in the training session, the two judges were asked to rate the second stimulus with reference to the first stimulus in each pair for roughness and breathiness, with the same rating scale as in the training. All stimulus pairs were presented in a random order. The whole process took about 90 minutes. The ratings from the two judges were averaged for each stimulus.

TABLE 1. *Acupoints Used in the Study*

Points (Channel Number)	Location	Functions
Houxi (Small intestine 3)	At the ulnar end of the proximal crease of the fifth metacarpophalangeal joints On the dividing line between red and white flesh	Inflammation of eye Epilepsy, psychic, and psychosomatic dysfunctions Pains on lower arm, wrist, and fingers Disorders of the cervical-spinal column Lumbar pain
Kunlun (Bladder 60)	Midpoint between the prominence of lateral malleolus and the Achilles tendon	Neck ache, headache Lumbalgia Pains in the heel Protracted labor
Lieque (Lung 7)	~2 cm above the wrist crease in the depression below the radial styloid In the cleft between the tendons of *M. brachioradialis* and *M. abductor pollicis longus*	Coughing Diseases of trachea Paralyses and pain in the lower arm Acute infections of urinary tract Micturation dysfunctions
Renying (Stomach 9)	Front edge of sternocleidomastoid muscle ~2 cm lateral to the upper edge of laryngeal prominence Next to carotid artery	Hypertension Bronchial asthma Spastic bronchitis Inflammation in the region of the pharynx and throat, tonsillitis
Zhaohai (Kidney 6)	In the depression inferior to the inferior border of the medial malleolus	Numbness, narcolepsy, fatigue Gynecological disorders Chronic pharyngitis

Data from Lian et al.[24]

TABLE 2. *Mean and Standard Deviation of Voice Range Measures Over Time*

	Pretreatment		Posttreatment		Follow-up	
Measurements/Groups	**Mean**	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
Highest Fo (Hz)						
Experimental	409.28	(94.29)	493.94	(119.08)	502.72	(124.59)
Placebo	430.78	(56.18)	422.96	(58.73)	428.94	(60.22)
Frequency range (Hz)						
Experimental	247.13	(90.63)	347.03	(114.12)	357.66	(119.65)
Placebo	267.34	(59.60)	261.20	(74.30)	271.10	(72.37)
Highest intensity (dB)						
Experimental	96.25	(8.86)	99.17	(7.90)	98.33	(7.20)
Placebo	100.92	(4.68)	102.08	(4.44)	102.25	(4.14)
Intensity range (dB)						
Experimental	27.67	(6.39)	31.67	(6.29)	31.67	(7.18)
Placebo	28.42	(4.89)	28.92	(5.37)	29.67	(5.00)
Area (in semitone x dB)						
Experimental	256.00	(114.16)	311.08	(98.66)	336.50	(128.95)
Placebo	236.00	(103.23)	307.25	(97.42)	323.83	(93.52)

Abbreviation: Fo, fundamental frequency.

RESULTS

Phonetogram measures

The mean voice range measurements for each subject group are listed in Table 2. Significant main session effects ($P < 0.01$) were found in the frequency range measure and voice range area (semitone decibels) (Table 3). No significant main group effect was found for any measure. Significant interaction effects were found in the highest frequency and frequency range measures ($P < 0.01$).

VAPP

Table 4 lists the mean VAPP scores for the two subject groups over the three sessions. Main session effects were found in the Total VAPP score, Self-Perceived Severity Score, and Emotion Score ($P < 0.01$; Table 5). No significant main group effect was found in any of the five VAPP scores (Table 5). Significant session by group interaction effects were noticed in the Total VAPP score and Emotion score ($P < 0.01$; Table 5).

Perceptual voice evaluation

The mean intrajudge agreement within one unit of the 15-point rating scale was 67% for the breathiness and 72% for the roughness. Interjudge agreement measures (also within one unit on the rating scale) were 57% and 62% for the breathiness and roughness, respectively.

Table 6 lists the mean and standard deviation of changes in breathiness and roughness ratings of the two groups. A negative sign means a reduction in severity, that is, an improvement in voice quality ratings. The experimental group demonstrated general improvement in the two voice qualities after

TABLE 3. *Results of Repeated ANOVAs for the Phonetogram Data*

	Main Session Effect (the Pillai Trace)	Main Group Effect (the Pillai Trace)	Session x Group Effect (the Pillai Trace)
Highest frequency	$F(2) = 3.97$, $P = 0.03$	$F(1) = 1.48$, $P = 0.24$	$F(2) = 5.29$, $P = 0.01$*
Frequency range	$F(2) = 6.04$, $P = 0.008$*	$F(1) = 2.22$, $P = 0.15$	$F(2) = 7.46$, $P = 0.004$*
Highest intensity	$F(2) = 1.85$, $P = 0.18$	$F(1) = 2.51$, $P = 0.13$	$F(2) = 0.61$, $P = 0.55$
Intensity range	$F(2) = 3.12$, $P = 0.06$	$F(1) = 0.40$, $P = 0.53$	$F(2) = 1.39$, $P = 0.27$
Semitone x dB area	$F(2) = 7.19$, $P = 0.004$*	$F(1) = 0.10$, $P = 0.75$	$F(2) = 0.11$, $P = 0.90$

*Significant at 0.007 level.

TABLE 4. *Mean and Standard Deviation of Voice Activity and Participation Profile (VAPP) Scores Over Time*

	Pretreatment		Posttreatment		Follow-up	
Scores/Groups	**Mean**	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
Total VAPP Score						
Experimental	138.92	(54.64)	105.58	(46.25)	94.75	(45.01)
Placebo	95.92	(50.94)	93.67	(47.61)	87.83	(42.39)
Self-Perceived Severity Score						
Experimental	7.25	(3.33)	4.42	(3.15)	2.83	(2.48)
Placebo	5.00	(1.71)	4.92	(2.07)	3.83	(2.04)
Emotion Score						
Experimental	38.42	(15.56)	19.67	(12.59)	14.67	(12.67)
Placebo	17.08	(11.04)	15.50	(8.98)	11.83	(7.08)
Activity Limitation Score						
Experimental	43.75	(25.16)	29.67	(17.92)	24.67	(19.58)
Placebo	42.17	(17.86)	41.25	(18.28)	40.08	(18.06)
Participation Restriction Score						
Experimental	48.67	(20.35)	51.83	(22.05)	52.58	(22.22)
Placebo	31.67	(23.92)	32.00	(22.73)	32.08	(21.99)

treatment (pretreatment/posttreatment). The mean breathiness rating reduced by 0.92, and the mean roughness rating reduced by 0.25. On the contrary, the placebo group demonstrated deterioration in the two qualities. The improvement demonstrated by the treatment group in breathiness and roughness ratings were both significantly better than those shown by the placebo group ($P < 0.05$, Table 6) immediately after the treatment (ie, pretreatment versus posttreatment phase). No significant difference was found between the two groups in the changes in both qualities in the pretreatment versus follow-up phase ($P < 0.05$, Table 6).

DISCUSSION

The objective of this study was to investigate the effectiveness of a ten-session intensive acupuncture therapy for hyperfunctional dysphonias associated with pathological changes. The objective was set on the hypothesis that acupuncture could restore normal physiological vocal functioning of patients with hyperfunctional dysphonia. The vocal functions were measured acoustically with the voice range profile and perceptually with voice quality ratings. The International Classification of Functioning, Disability and Health (ICF)[30] was employed as the conceptual framework for measuring the self-perceptions of activity limitation and participation restrictions caused by the voice disorders with the VAPP.[18]

Phonetogram

Significant improvement over time (main session effect) was found with the frequency range and voice range area (Table 3). No significant changes were, however, noticed in the intensity measures over time. The highest intensity that the two subject groups could achieve was in the range of 96–102

TABLE 5. *Results of Repeated ANOVA for the Voice Activity and Participation Profile Scores*

	Main Session Effect (the Pillai Trace)	Main Group Effect (the Pillai Trace)	Session x Group Effect (the Pillai Trace)
Total VAPP Score	$F(2) = 5.94$, $P = 0.009$*	$F(1) = 1.28$, $P = 0.27$	$F(2) = 5.14$, $P = 0.01$*
Self-Perceived Severity Score	$F(2) = 18.99$, $P < 0.0001$*	$F(1) = 0.08$, $P = 0.78$	$F(2) = 4.99$, $P = 0.02$
Emotional Score	$F(2) = 8.91$, $P = 0.002$*	$F(1) = 2.22$, $P = 0.15$	$F(2) = 6.21$, $P = 0.002$*
Activity Limitation Score	$F(2) = 3.20$, $P = 0.06$	$F(1) = 1.51$, $P = 0.23$	$F(2) = 2.46$, $P = 0.11$
Participation Restriction Score	$F(2) = 1.28$, $P = 0.30$	$F(1) = 2.51$, $P = 0.13$	$F(2) = 0.84$, $P = 0.45$

*Significant at 0.05 level.

TABLE 6. *Mean and Standard Deviation of Paired-Comparison Rating on Breathiness and Roughness Across Group*

		Treatment Group (n = 12)		Placebo Group (n = 12)			
Comparison	**Voice Quality**	**Mean**	**SD**	**Mean**	**SD**	**Mann–Whitney *U***	***P***
Pretreatment/posttreatment comparisons	Breathiness	−0.92	1.62	+0.46	1.10	32	0.02*
	Roughness	−0.25	1.32	+0.75	1.36	37	0.04*
Pretreatment/follow-up comparisons	Breathiness	−0.96	1.63	+0.25	1.41	42	0.09
	Roughness	−0.54	1.64	+0.63	1.19	42	0.09

*Significant at 0.05 level, two-tailed.

dB, which could be the ceiling effect at which subjects would normally achieve 100 dB.[19]

Although no significant main group effect was found in any measure, the significant group by session interaction effect in the two frequency measures (Table 3) indicated that the two subject groups performed differently over time. The experimental group achieved nearly 100 Hz more after acupuncture (mean 409.28 Hz before acupuncture and 493.94 Hz and 502.72 Hz after acupuncture), whereas the placebo group showed no significant changes.

Improvement in the ability of increasing the fundamental frequency after acupuncture in the experimental group could be attributed to the possible improvement in vocal fold condition, which is possibly a reduction of vocal fold mass as a result of the healing of the pathological conditions. Although the setup did not allow any vocal fold image recording, indirect laryngoscopy carried out by an laryngologist (W.H., the seventh author), who was blind to the allocation of subjects, showed all subjects in the experimental group had either reduced size or disappeared vocal mass lesions, whereas the placebo group in general showed no improvement and only two subjects showed reduced size in the lesions. A laryngoscopic examination protocol would have strengthened the merit of the study, but unfortunately, because of the limited resources in many hospitals in Mainland China, such protocol was not available at the time of the study. In summary, improved vocal potentialities, which are reflected by fundamental frequency measures and intensity measures, were observed in subjects receiving acupuncture but not for subjects receiving placebo acupuncture.

VAPP

The Total VAPP Scores, Self-Perceived Severity Scores, and Emotion Scores showed significant improvement after acupuncture (Table 5). The improvement was significantly different between the two groups in the Total VAPP Scores and Emotion Scores ($P \leq 0.01$). It should be noted that the Total VAPP Score, Emotion Score, and Participation Restriction Score demonstrated by the placebo group in the pretreatment session were relatively lower than those by the experimental group (Table 4), although no significant main group effect was demonstrated, probably masked by the large standard deviations of the corresponding scores.

Perceptual voice quality change

The breathiness and roughness ratings in the experimental group showed a mean improvement of 1 and 0.25 units, respectively, which were both statistically significant on the 15-point rating scale. The placebo group, on the other hand, demonstrated deteriorations in the perceptual voice quality. The significant results between the two groups of subjects in the perceptual quality ratings lend additional support to the positive beneficial effect of "appropriate" acupuncture to the reduction of breathy and rough voice qualities.

Several limitations in the study design warrant discussion. The first limitation was the sample size. Only 24 subjects were included in the final analysis. Therefore, these results should be treated as preliminary rather than as conclusive. Second, the study only examined the short-term effect (14 days after treatment completion). A longer period of posttreatment follow-up would establish the long-term effect of acupuncture on treating dysphonia, which

is especially important as hyperfunctional dysphonias are chronic conditions and information on how long the effect of acupuncture can be maintained is essential.

In summary, this study represented a preliminary attempt to investigate the treatment effectiveness of acupuncture on the acupoints *Renyin* (Stomach Channel 9), *Lieque* (Lung Channel 7), and *Zhaohai* (Kidney Channel 6) for treating hyperfunctional voice disorders. The results of this study showed that there were significant improvements in the changes of highest fundamental frequency, frequency range, perceptual breathiness and roughness, Total VAPP Score, Self-Perceived Severity Score, and Emotion Score. Treatment effects over a longer term need to be investigated.

The findings showed that acupuncture is an effective treatment alternative for hyperfunctional dysphonia in the short term (at least 14–20 days after termination of treatment). This finding corroborated previous reports that acupuncture is an effective treatment to voice disorders[10,14,15,31–33] and has important clinical implications as this provides an alternative that is less invasive than surgical and/or medical management.[2] Furthermore, as it took a relatively shorter time (ie, 20 days) for improvements to occur, it is also an alternative that reacts more quickly to traditional voice therapy.

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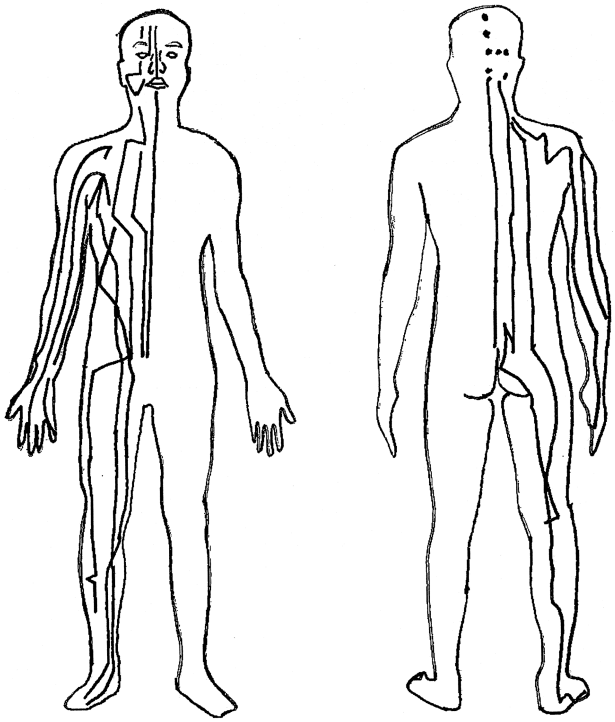
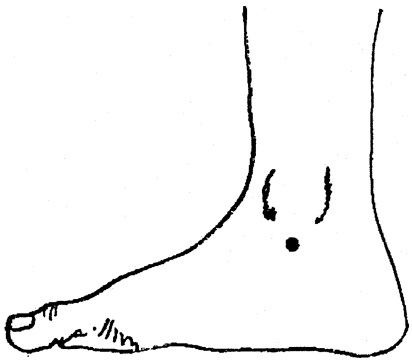
APPENDIX I. TWELVE MAJOR MERIDIANS

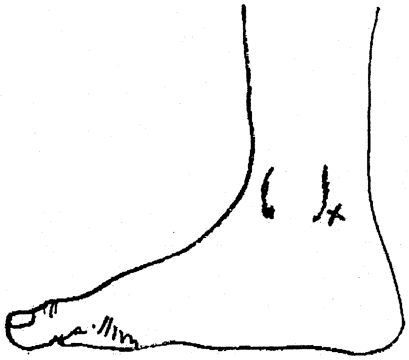


APPENDIX FIGURE 1. Meridians on the right side of the body. 1. Lung Channel (Lu); 2. Large Intestine Channel (LI); 3. Stomach Channel (St); 4. Spleen Channel (Sp); 5. Heart Channel (He); 6. Small Intestine Channel (SI); 7. Bladder Channel (Bl); 8. Kidney Channel (Ki); 9. Pericardium Channel (P); 10. San Jiao Channel (SJ); 11. Gall Bladder Channel (GB); and 12. Liver Channel (Lv).

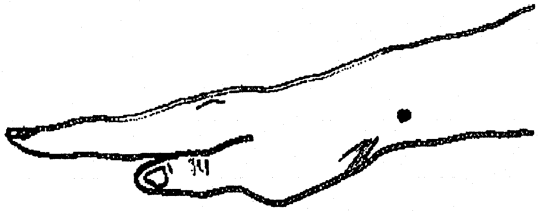
APPENDIX II. ACUPOINTS USED IN THE STUDY



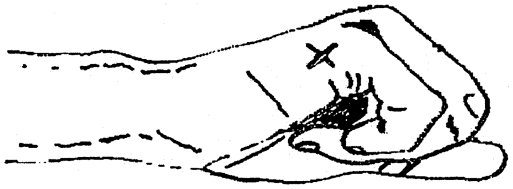
Zhaohoi



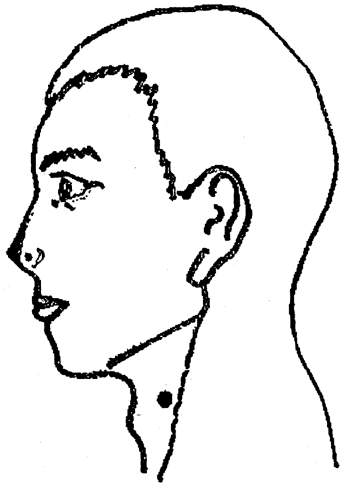
Kunlun



Lieque



Houxi



Renyin

APPENDIX FIGURE 2. Acupoints for treating voice problems (Zhaohoi, Lieque, and Renyin) and control acupoints (Kunlun and Houxi).