The Laryngoscope

Preliminary Data on Two Voice Therapy Interventions in the Treatment of Presbyphonia

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Objectives/Hypothesis: Presbyphonia is common among elderly individuals, yet few studies have evaluated behavioral treatment approaches for presbyphonia. The primary aim of this study was to assess the short-term efficacy of two types of voice therapy—vocal function exercises (VFE) and phonation resistance training exercise (PhoRTE) therapy—in the treatment of presbyphonia. The secondary aim was to determine if differences in adherence and treatment satisfaction existed between the two therapy approaches.

Study Design: Prospective, randomized, controlled.

Methods: Preliminary data from 16 elderly participants with presbyphonia randomly assigned to VFE, PhoRTE, or a no-treatment control group (CTL) were analyzed. Before and after a 4-week intervention period, participants completed the *Voice-Related Quality of Life* (V-RQOL) questionnaire and a perceived phonatory effort (PPE) task. Additionally, participants receiving treatment completed weekly practice logs and a posttreatment satisfaction questionnaire.

Results: Preliminary data revealed VFE and PhoRTE groups demonstrated a significant improvement in V-RQOL scores. However, only PhoRTE demonstrated a significant reduction in PPE, as suggested by the study's causal model. The CTL group did not demonstrate significant changes. Numerically, VFE registered slightly greater adherence to home practice recommendations than did PhoRTE, but PhoRTE perceived greater treatment satisfaction than VFE.

Conclusions: Findings provide new evidence regarding the efficacy of voice therapy exercises in the treatment of age-related dysphonia and suggest PhoRTE therapy as another treatment method for improved voice-related quality of life and reduced perceived vocal effort in this population.

Key Words: Aging, presbyphonia, voice disorder, treatment.

Level of Evidence: 2b.

***Laryngoscope*, 124:1869–1876, 2014**

INTRODUCTION

Presbyphonia is a common clinical finding among the elderly and poses a significant barrier to life satisfaction.[1,2] This voice disorder results from age-related laryngeal and respiratory degenerative changes, which lead to glottal incompetence[3] and a decline in inspiratory and expiratory pressures.[4] A deterioration in vocal function in the elderly has been putatively linked to a reduced amount and *intensity* of speech.[5] Interestingly, and analogous to findings of senior athletes,[6] the voice of elderly singers sounds younger, clearer, and louder than the elderly nonsinger's voice.[7] Additionally, both elderly male[8] and female[8,9] singers maintain a stable fundamental frequency throughout the lifespan. Those differences suggest the benefit of increased vocal activity for vocal longevity.

Current Evidence for Behavioral Treatment of Presbyphonia

Over the past decade, eight studies have been conducted on voice therapy for presbyphonia.[10–17] In brief, an overwhelming majority of patients with presbyphonia believe voice therapy is beneficial[15] and exhibit a significant improvement in voice-related quality of life,[13,14] a finding not observed in patients who forego voice therapy.[14] Furthermore, patients with presbyphonia report a significant decrease in phonatory effort after completing voice therapy.[13] Most important, patients with presbyphonia who receive voice therapy exhibit a significant improvement in their functional vocal status.[16]

To date, published prospective studies have only investigated the efficacy of voice therapy approaches for treating individuals with presbyphonia,[10–13,17] but none

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Editor's Note: This Manuscript was accepted for publication November 27, 2013.

Presented at the Voice Foundation's 40th Annual Symposium, Philadelphia, PA, U.S.A., 1–5 June 2011.

Financial Disclosures: Aaron Ziegler, Katherine Verdolini Abbott, Michael Johns III, and Adam Klein-None; Edie Hapner—Plural Publishing. Conflict of Interest: Aaron Ziegler and Edie Hapner—Authors for Plural Publishing. The authors have no other funding, financial relationships, or conflicts of interest to disclose.

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DOI: 10.1002/lary.24548

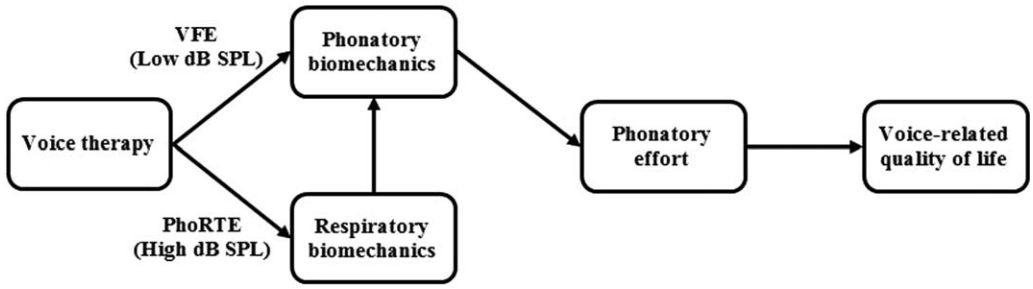

Fig. 1. Proposed flowchart delineating a causal model linking voice therapy to changes in phonatory and respiratory biomechanics, phonatory effort, and voice-related quality of life.

have compared voice therapy techniques to assess the superiority of one approach over another. Furthermore, the literature lacks suggestions for a causal model describing mechanisms of voice change from behavioral treatment of presbyphonia that may assess the potential differential impact of two types of voice therapy. Therefore, a causal model was developed, which stated that targeted voice therapy may affect phonatory biomechanics directly or indirectly through altered respiratory behavior resulting in reduced phonatory effort and lead to an improved voice-related quality of life (Fig. 1).

The causal model suggests that an effective therapeutic approach for presbyphonia will be one that targets the biological bases of the condition, or degenerative respiratory and laryngeal changes as a result of aging. These changes in muscle mass and strength—sarcopenia—are targeted in other parts of the body by engaging in structured exercise that emphasizes an increased level of physical activity to overload the muscle and reverse the sarcopenia process.[18] This type of exercise training—resistance training—has demonstrated positive effects on sarcopenia in older adults by reducing secondary aging effects that occur from muscle atrophy and weakness.[19]

Based on the causal model, it was hypothesized that the intervention groups in this study would result in more positive changes in voice across the experimental period than seen in a no-intervention control group. Furthermore, the causal model suggests that one therapy, a treatment requiring high-vocal intensity phonation and that loads both respiratory and laryngeal musculature, will result in more positive changes than the other therapy, a treatment requiring low vocal intensity phonation.

Study Aims

The purpose of this study was to compare two interventions and no treatment for adults with presbyphonia by using a prospective, randomized, controlled experimental design to assess the short-term efficacy of two voice therapy approaches, as demonstrated by a change in quality of life and perceived phonatory effort. Secondary aims of this study were to examine differences in patient adherence and treatment satisfaction.

MATERIALS AND METHODS

All procedures were approved by the institutional review boards at Emory University and the University of Pittsburgh (IRB #00037045 and #10060268, respectively). The experiment used a prospective, randomized, controlled design.

Participants

Twenty elderly adults aged 60 years and over enrolled in the study (Fig. 2). For this preliminary study, the sample size was selected arbitrarily to generate the necessary results for a power analysis for future studies.

All participants a) reported a current voice problem, including a complaint of reduced vocal loudness or increased vocal effort; b) received a diagnosis of presbyphonia by a fellowship-trained laryngologist[14]; c) received an auditory–perceptual diagnosis of vocal asthenia by a voice-specialized speech-language pathologist (SLP); d) were judged perceptually by a SLP to be free of dysarthria, dysfluency, or language problems; e) passed hearing, cognition, and mood screenings; f) were currently nonsmokers (five years or more); g) reported no progressive neuromuscular diseases affecting voice; h) denied concomitant health problems affecting voice; i) completed menopause, if female; j) reported using current medications for at least one month before participation; k) denied current use of inhaled corticosteroids or prednisone; and l) stated willingness to persist with the 6-week protocol. In addition, participants were included, if stimulable for improved voice quality as assessed by a SLP during the physician's examination visit. Stimulability testing is a routine part of the voice evaluation to determine candidacy for treatment.[20] No participants were excluded based on race, ethnicity, or gender. In accordance with standards on reporting randomized, controlled studies,[21] participant characteristics are provided in Table I.

Procedures

Recruitment, screening, and randomization. Recruitment was performed by a SLP who was part of the multidisciplinary team at the Emory Voice Center. An individual was initially seen for a comprehensive evaluation by a fellowship-trained laryngologist and SLP. Following informed consent, each individual underwent a hearing screening to ensure age-appropriate hearing or adequately managed sensory-neural hearing loss with the use of hearing aids, as evidenced by a response during audiometric testing in a sound-isolated booth at 40 dB HL at 0.5 kHz, 1 kHz, and 2 kHz presented in sound field.[22] Next, each individual underwent a screening to ensure age-appropriate cognitive ability based on results from the *Mini Mental State Examination* (MMSE).[23] A score of ≥ 20 was required for further participation in the study. Then, each individual underwent self-administration of the *Elderly Depression Scale-Short Form* (EDS-SF),[24] and a score of ≤ 5 was required for further participation. Finally, individuals satisfying inclusion criteria were randomized to one of three groups using a

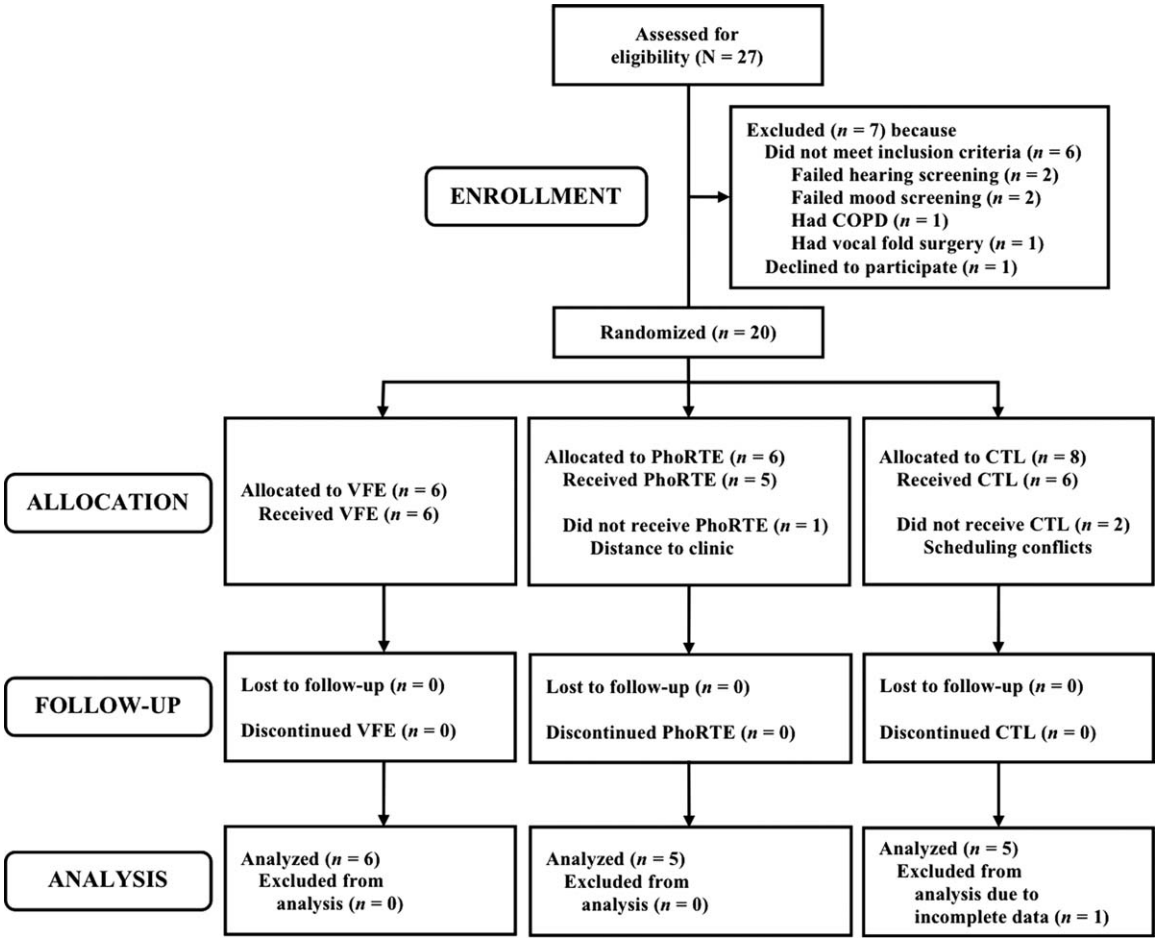

Fig. 2. Flowchart of study procedures.

computer algorithm: vocal function exercises (VFE), phonation resistance training exercise (PhoRTE) therapy, or a no-intervention control group (CTL). All participants were briefly counseled on voice hygiene and given a written copy of a handout that describes vocal hygiene recommendations.

Baseline and follow-up evaluations. At the baseline visit, each participant completed the V-RQOL.[25] Then, the participant was asked to provide an estimation of perceived phonatory effort (PPE). To determine PPE, the participant used a direct magnitude estimation scale[26] on which "100" represented "comfortable effort during phonation," "50" represented "half as much effort as comfortable," "200" represented "two times as much effort as comfortable," and so forth.[27,28]

Participants returned for follow-up measures within one week of completion of the intervention, or 6-weeks postbaseline in the case of the CTL group. At the follow-up visit, each participant completed the V-RQOL[25] and provided a rating of PPE, which were anchored to the participant's baseline ratings to limit drift due to increased awareness of voice. Finally, participants in the VFE and PhoRTE groups completed a post treatment satisfaction questionnaire.[29]

Interventions. Participants receiving an intervention attended four 45-minute treatment sessions—either VFE or PhoRTE—over the course of four weeks, which were provided by one of two participating voice-specialized SLPs. Execution of VFE[30,31] involved four exercises: 1) maximum sustained phonation on /i/ on the pitch F above middle C (males dropped down an octave); 2) an ascending glide over the entire pitch range on /o/; 3) a descending glide over the entire pitch range on /o/; and 4) maximum sustained phonation on the pitches middle C and D, E, F, and G above middle C (males dropped down an octave) on /o/. Participants learned to use low abdominal breathing, a frontal focus with an inverted megaphone mouth shape, and were instructed to complete the exercises as quietly as possible but while maintaining a clear and consistent voice.

PhoRTE[32] (a homophone to the Italian word *forte* meaning loud and strong), adapted from Lee Silverman Voice Treatment (LSVT),[33–35] consisted of four exercises: 1) loud maximum sustained phonation on /a/; 2) loud ascending and descending pitch glides over the entire pitch range on /a/; 3) participant-specific functional phrases using a loud and high voice; and 4) phrases from exercise #3 in a loud and low voice. Low abdominal breathing gestures were encouraged. All feedback thereafter was limited to reminding participants to maintain a "strong" voice. During therapy sessions, participants were expected to maintain a SPL between 80 and 90 dB, as measured by a sound level meter positioned at a microphone-to-mouth distance of 30 cm.

PhoRTE, while derived from the therapeutic studies on LSVT, differed in several ways. First, PhoRTE sessions occurred once weekly as opposed to a more intensive intervention schedule for LSVT (i.e., four days per week for four weeks). Second, PhoRTE incorporated two different manners of producing participant-specific functional phrases (i.e., a loud and high voice and a loud and low voice),[36] Finally, PhoRTE home practice required fewer repetitions than is typically required for

TABLE I.
Summary of Participant Characteristics by Group.

Group/Participant	Sex	Age	Race
VFE			
1	female	83	Caucasian
3	male	66	Caucasian
9	female	74	Caucasian
10	male	78	Caucasian
13	male	78	Caucasian
17	male	60	Caucasian
Mean (SD), $n = 6$	2 females; 4 males	73.2 (8.6)	
PhoRTE			
6	male	79	Caucasian
7	female	78	Caucasian
8	female	72	Caucasian
11	female	80	Caucasian
20	male	71	Asian
Mean (SD), $n = 5$	3 females; 2 males	75.8 (4.0)	
CTL			
2	male	79	Caucasian
4	female	69	Caucasian
5	male	76	African American
14	female	91	Caucasian
15	male	73	Caucasian
Mean (SD), $n = 5$	2 females; 3 males	77.6 (8.4)	
Overall Mean (SD), $N = 16$		75.4 (7.2)1	

CTL = no-treatment control group; PhoRTE = phonation resistance training exercise; SD = standard deviation; VFE = vocal function exercises.

patients receiving LSVT (two versus 10 repetitions of each exercise per practice session, respectively).

The PhoRTE exercises were selected because of their high intensity nature that might induce changes to muscle structure and function to reverse the degenerative sarcopenia process.[12] In addition, phonatory–resonatory interaction through a widened mouth and narrow pharynx, as occurs with the use of the vowel /a/, creates an acoustic situation that allows a speaker to shout safely. This megaphone mouth shape at low to medium high pitches raises the first formant frequency to reinforce the fundamental and second harmonic of the source. The resulting phonatory–resonatory interaction helps to recalibrate phonatory effort by assisting vocal fold vibration and maximizing phonatory efficiency. Furthermore, coupling a narrowed epilarynx tube with increased adduction provides maximum power transfer from the glottis to the lips to further increase vocal loudness.[37] Finally, the PhoRTE program subscribes to a task-dependent model of motor control by including functional phrases to help with generalization of voice techniques to conversation.[38]

Home practice program. Participants in both intervention groups were instructed to practice their respective treatments, VFE or PhoRTE, twice daily every day, to perform each exercise twice during each practice session, and to log their practice. Participants were instructed to complete practice logs only for completed exercises. From the practice log, the percent of prescribed exercises completed was computed to measure treatment adherence. The protocols of the two treatments controlled for what was assumed to be equivalent practice durations if the participant was adherent to the twice daily practice sessions. Participants received written instructions on how to complete daily home practice and a compact disc with audio demonstrations of the respective exercises.

RESULTS

Statistical Analysis

Inferential statistical analyses of the preliminary data were used to examine pretreatment to posttreatment changes within groups, and between group differences were examined descriptively for the primary outcome measures (i.e., V-RQOL and PPE). Inferential statistical analyses were also used to investigate between group differences in the secondary outcome measures (i.e., treatment adherence and treatment satisfaction). Due to the preliminary nature of this study and the small sample size, an alpha level of 0.10 was used to minimize the type II error rate in analyzing treatment effects on primary and secondary outcome measures. Of the 20 enrolled participants, only 16 participants were included in the data set for analysis. Of the four who were excluded, three dropped out of the study prior to data collection and one participant in the no-treatment control group had an incomplete data set. Therefore, data from six VFE participants, five PhoRTE participants, and five CTL participants were analyzed.

Participant Characteristics

Participants were seven women (44%) and nine men (56%) aged 60 to 91 years ($M = 75.4$ years, SD = 7.2). Post-hoc analyses using Fisher's exact test and between-subject ANOVAs confirmed the equivalence of groups on gender ($P = .825$, Fisher's Exact Test), age ($F[2, 13] = 0.501$, $P = .617$, $\eta_p^2 = .072$), baseline V-RQOL scores ($F[2, 13] = 0.880$, $P = .438$, $\eta_p^2 = .119$), and baseline PPE ratings ($F[2, 13] = 1.948$, $P = .182$, $\eta_p^2 = .231$) (Tables (I–III)).

V-RQOL

Individual scores, group means and standard deviations, difference scores, and percent change values for the V-RQOL data before and following the 4-week intervention period are displayed in Table II. Results revealed that the VFE and PhoRTE groups experienced a significant improvement in mean pretreatment to posttreatment V-RQOL scores (80.8 to 87.5, $t[5] = 1.964$, $P = .054$, one-tailed, $d = 0.80$ and 88.5 to 95.0, $t[4] = 2.152$, $P = .049$, one-tailed, $d = 0.96$, respectively). The CTL group did not demonstrate a significant change in mean V-RQOL scores (87.5 to 91.5, $t[4] = 1.554$, $P = .195$, $d = 0.70$).

The data were reanalyzed after excluding a PhoRTE participant who commenced therapy without registering quality of life impairment (as evidenced by a score of 100 on the V-RQOL). Removal increased the PhoRTE percent change value (8.03 to 10.66), and it was slightly greater than that of the VFE group (9.30).

TABLE II.
Individual Scores, Mean Pretreatment and Posttreatment Scores, Standard Deviations, Percent Change, and P Values for the VFE, PhoRTE, and CTL Groups on the *Voice-Related Quality of Life*.

Group/Participant	Baseline (Pretreatment)	Follow-Up (Posttreatment)	Absolute Difference	Percent Change	Test Statistic	*P* Value
VFE						
1	80.0	85.0	5.0	6.25		
3	90.0	90.0	0.0	0.00		
9	62.5	85.0	22.5	36.00		
10	90.0	97.5	7.5	8.33		
13	92.5	97.5	5.0	5.41		
17	70.0	70.0	0.0	0.00		
Mean (SD), $n = 6$	80.8 (12.3)	87.5 (10.2)	6.7 (8.3)	9.30 (13.5)	$t = 1.964$**	.054*
PhoRTE						
6	97.5	100.0	2.5	2.56		
7	82.5	97.5	15.0	18.18		
8	75.0	85.0	10.0	13.33		
11	87.5	95.0	7.5	8.57		
20	100.0	97.5	−2.5	−2.50		
Mean (SD), $n = 5$	88.5 (10.4)	95.0 (5.9)	6.5 (6.8)	8.03 (8.25)	$t = 2.152$**	.049*
CTL						
2	90.0	92.5	2.5	2.78		
4	95.0	90.0	−5.0	−5.26		
5	75.0	82.5	7.5	10.00		
14	85.0	95.0	10.0	11.76		
15	92.5	97.5	5.0	5.41		
Mean (SD), $n = 5$	87.5 (7.9)	91.5 (5.8)	4.0 (5.8)	4.94 (6.73)	$t = 1.554$**	.195
Overall Mean (SD), $N = 16$	85.3 (10.4)					

Note. *Significant difference at $P \leq 0.10$ level, one-tailed.
**From repeated-measures *t* test.
CTL = no-treatment control group; PhoRTE = phonation resistance training exercise; SD = standard deviation; VFE = vocal function exercises.

PPE

Individual ratings, group means and standard deviations, difference scores and percent change values for PPE ratings before and following the 4-week intervention period are shown in Table III. Results showed that PPE ratings decreased significantly in the PhoRTE group only (144 to 102, $t[4] = -2.370$, $P = .077$, two-tailed, $d = -1.06$). Neither the VFE group nor the CTL group demonstrated a significant difference in PPE ratings (142.5 to 109.2, $t[5] = -1.865$, $P = .121$, two-tailed, $d = -0.76$; 101 to 103, $t[4] = 1.000$, $P = .374$, two-tailed, $d = 0.45$, respectively).

Adherence and Treatment Satisfaction

Participants in the VFE and PhoRTE groups demonstrated adherence to treatment recommendations, and no differences were detected between groups ($P = .411$). One participant in the PhoRTE group practiced significantly less than any other participant and skewed the averaged data for adherence. A post-hoc analysis of the data removing this participant from the PhoRTE data resulted in a more balanced assessment of the practice patterns of the PhoRTE group, 88.2%, nearly equivalent to the average practice of the VFE group (89.3%). Results for treatment satisfaction data revealed no differences in ratings between VFE and PhoRTE on the three questions: extent to which participants a) liked the particular therapy ($P = .285$); b) felt voice changed because of therapy ($P = .227$); and c) felt voice changes were caused by the particular therapy ($P = .550$) (Table IV).

DISCUSSION

The data from this study provide optimism that there may be short-term benefits from two therapy approaches, VFE and PhoRTE, for improvement of voice-related quality of life in elderly individuals with presbyphonia. The causal model tested in this study proposed that therapy-induced changes in laryngeal biomechanics, possibly partly related to changes in respiratory biomechanics, would lead to a reduction in perceived phonatory effort and, ultimately, result in an improvement in voice-related quality of life. Significant pretreatment to posttreatment increases were documented in V-RQOL scores for both intervention groups, in comparison to scores for a no-treatment control group, which did not improve. The magnitude of pretreatment to posttreatment differences on the V-RQOL in each treatment group (VFE and PhoRTE) exceeded changes in an untreated group of elderly individuals with presbyphonia. The improvement of patient-reported outcome measures in a group of elderly individuals with presbyphonia

TABLE III.
Individual and Mean Pretreatment and Posttreatment Ratings, Standard Deviations, Difference Scores, Percent Change, and *P* values for the VFE, PhoRTE, and CTL Groups on Perceived Phonatory Effort.

Group/Participant	Baseline (Pretreatment)	Follow-Up (Posttreatment)	Absolute Difference	Percent Change	Test Statistic	*P* Value
VFE						
1	125	100	−25.0	−20.0		
3	100	100	0.0	00.0		
9	150	100	−50.0	−33.3		
10	200	100	−100.0	−50.0		
13	100	125	−25.0	25.0		
17	180	130	−50.0	−27.8		
Mean (SD), $n = 6$	142.5 (41.7)	109.2 (14.3)	−33.3 (43.8)	−17.7 (26.6)	$t = -1.865$**	.121
PhoRTE						
6	100	100	0.0	00.0		
7	100	50	−50.0	−50.0		
8	200	150	−50.0	−25.0		
11	200	100	−100.0	−50.0		
20	120	110	−10.0	−8.3		
Mean (SD), $n = 5$	144 (51.8)	102 (35.6)	−42.0 (39.6)	−26.7 (23.1)	$t = -2.370$**	.077*
CTL						
2	100	100	0.0	00.0		
4	100	100	0.0	00.0		
5	125	125	0.0	00.0		
14	100	100	0.0	00.0		
15	80	90	10.0	12.5		
Mean (SD), $n = 5$	101 (16.0)	103 (13.0)	2.0 (4.5)	2.5 (5.6)	$t = 1.000$**	.374
Overall Mean (SD), $N = 16$	130 (42.1)					

Note. *Significant difference at $P \leq 0.10$ level, two-tailed.
**From repeated-measures *t* test.
CTL = no-treatment control group; PhoRTE = phonation resistance training exercise; SD = standard deviation; VFE = vocal function exercises.

following voice therapy is consistent with results from prior research (Berg et al., 2008; Sauder et al., 2010).

Significant improvement in perceived phonatory effort accompanied voice-related quality of life changes for the PhoRTE group, but not the VFE group, a finding that partially supports the causal model explored in this study, and moreover, that can also be inferred from previous research in a similar cohort.[13] Differences in PPE pretreatment to posttreatment changes between VFE and PhoRTE may be explained by unique vocal tract configurations and their influence on vocal fold vibration. Whereas VFE are characterized by an inverted megaphone-shaped vocal tract, PhoRTE therapy employs a megaphone-shaped vocal tract. Consistent with nonlinear dynamics, rounded vowels such as /o, u/ using a wide open pharynx as in the case of VFE, have been shown to decrease vocal fold adduction. Open vowels such as /a, æ/ using a narrow pharynx and high larynx, as in PhoRTE, have been shown to cause greater vocal fold adduction. In the population of interest, increased adduction is a desired laryngeal target. Perhaps a reduction in the glottal half-width due to increased adduction lowered the required subglottal pressure and resulted in a decrease in perceived phonatory effort.[37,39]

Whereas improvement in V-RQOL scores was accompanied by numerical decreases in PPE in both treatment groups, the no-treatment control group exhibited the opposite finding. For that group, pre- to posttreatment PPE actually increased slightly, even with anchoring the posttreatment estimation of phonatory effort to pretreatment ratings. In light of that finding, elderly individuals who forego therapy seem to employ increased muscle tension at the level of the glottis to achieve phonatory closure during voicing.

Given these preliminary findings, PhoRTE may have a slight advantage over VFE for producing benefit from a physiologic perspective because it demands a higher intensity of effort, which better addresses the overload principle required to induce neuromuscular changes in strength.[40] Increased neuromuscular activity of both the respiratory and laryngeal systems from PhoRTE should lead to even greater improvement in respiratory and laryngeal biomechanics than VFE, ultimately causing a significant reduction in PPE. Furthermore, phonatory efficiency from a megaphone-shaped vocal tract configuration may have also contributed to decreased phonatory effort.[37] Additionally, inclusion of task-specific exercises, as used in PhoRTE, to address the exercise training principle of specificity and promote carryover may result in a greater change in respiratory and laryngeal biomechanics during conversational speech. Consequently, phonatory effort for the PhoRTE group should demonstrate a larger change than VFE.

TABLE IV.
Individual and Group Means, Standard Deviations, and P Values for the VFE and PhoRTE Groups on Weekly Practice Log (% completed) and Posttreatment Satisfaction Questionnaire.

Group/Participant	Adherence Week 1–4	Treatment Satisfaction		
		Like Therapy	Voice Change	Therapy Cause
VFE				
1	78.0	4	4	2
3	79.6	3	3	1
9	100.0	4	5	3
10	95.8	3	4	3
13	87.5	3	4	2
17	94.8	3	4	3
Mean (SD), $n = 6$	89.3 (9.0)	3.3 (.52)	3.9 (.66)	2.3 (.82)
PhoRTE				
6	100.0	3	4	2
7	17.5	3	5	3
8	56.3	4	4	2
11	96.5	5	4	3
20	100.0	4	5	3
Mean (SD), $n = 5$	74.1 (36.6)	3.8 (.84)	4.4 (.55)	2.6 (.55)
Test statistic	t (4.407) = 0.908*	t (9) = −1.137*	t (9) = −1.297*	t (9) = −0.621*
P value, two-tailed	.411	.285	.227	.550

Note. For "like therapy" scale, 1 = not at all; 2 = somewhat; 3 = moderate; 4 = very much; 5 = extremely. For "voice change" scale, 1 = got a lot worse; 2 = got a little worse; 3 = no change; 4 = got a little better; 5 = got a lot better. For "therapy cause" scale, 1 = voice therapy probably irrelevant to voice change; 2 = voice therapy may have caused voice changes; 3 = voice therapy definitely caused voice changes.

*From independent samples *t* test.

PhoRTE = phonation resistance training exercise; SD = standard deviation; VFE = vocal function exercises.

In addition to the foregoing results, this study investigated adherence to home treatment recommendations in this population. Participants in both VFE and PhoRTE appeared to exhibit fairly regular practice of their home programs, a finding that is consistent with published literature.[17] Although self-report may be inaccurate, in the absence of any clear difference in mean practice between the VFE and PhoRTE groups, the most straightforward interpretation is that improvements in V-RQOL are not likely strongly related to treatment adherence.

Accordingly, although not significant, PhoRTE practiced less than VFE and yet consistently perceived greater satisfaction with the therapy they received. This finding supports a model of voice therapy in which treatment efficacy is optimized by a combination of biomechanical, learning, and adherence factors.[41] Specifically, the high intensity component of PhoRTE may necessitate less practice time than VFE to generate neuromuscular changes in muscle strength. Furthermore, the inclusion of functional speech tasks may promote fast learning because it addresses task-specificity and generalization to extra-therapy situations. In addition, practice of functional speech tasks for transfer of therapy techniques to unique communication situations, as well as the emphasis on increased vocal intensity to addresses a key patient concern— reduced loudness— may both increase self-efficacy and lead to improved treatment adherence.

Limitations and Future Aims

This study was designed to develop preliminary data to support the use of voice therapy for a subset of people with voice complaints secondary to presbylaryngeus. It was also designed to support the use of an alternative therapy that was based on high-intensity vocal exercise in the treatment of presbyphonia. Accordingly, one of the aims of the study was to develop an effect size for future research into the therapeutic treatment of presbyphonia. A limitation of this study is thus the small number of participants. Yet another limitation, although a no-treatment control group was included in the experimental design to determine the influence of time, was the lack of an experimental *treatment* control group, which would have provided evidence on whether the perceived change was due to a placebo effect. Additionally, a longitudinal study that follows participants for more than six weeks is necessary to assess maintenance of treatment effects. Future studies should include a larger sample size, incorporate a placebo treatment, and follow participants longitudinally. In addition, future studies should assess differences in vocal load between VFE and PhoRTE, as well as pre- to posttreatment changes in acoustic and aerodynamic parameters.

CONCLUSION

Indications from this study on voice therapy in individuals with presbyphonia are that behavioral

approaches are effective in the management of age-related voice problems. The study provides further preliminary evidence that individuals with presbyphonia may benefit from various therapeutic approaches for which patients express treatment satisfaction. Finally, this study contributes additional support to a previous finding that individuals with presbyphonia regularly practice voice exercises and exhibit good adherence to treatment recommendations.

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