Verifying the effectiveness of using resonance tubes in voice therapy with elderly people

Verificação da eficácia do uso de tubos de ressônancia na terapia vocal com indivíduos idosos

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ABSTRACT

Purpose: Verifying the effectiveness of the Finnish resonance tube method in a group of elderly subjects with complaints of vocal and respiratory changes. **Methods:** The sample was made up of dwellers from a long-term care institution (LTCI) who were equally distributed into Research Group (G1) and Control Group (G2). 42 elderly, 30 of whom female, between 62 and 93 years old took part in the research. A sociodemographic survey was applied followed by spirometry and voice recording both prior to and after the intervention. G1 attended six resonance tube sessions, while G2 attended six vocal health workshops. The voices recorded were analyzed following the GRBASI scale. **Results:** G1 significantly improved while G2 did not have any significant voice change. Spirometry improved in G1 and worsened in G2. **Conclusion:** The Finnish resonance tube technique was effective in treating the elderly with presbyphonia symptoms and aided in improving their vocal quality and vital capacity.

Keywords: Aged; Voice; Voice Training; Vital Capacity; Quality of Life

RESUMO

Objetivo: Verificar a eficácia do uso da técnica "Tubos de Ressonância – Método Finlandês" em um grupo de indivíduos idosos com queixas de alterações vocais e respiratórias. **Métodos:** A amostra foi composta por residentes de uma instituição de longa permanência para idosos (ILPI), divididos igualmente entre Grupo de Pesquisa (G1) e Grupo de Controle (G2). Foram incluídos na pesquisa 42 idosos, dos quais 30 do gênero feminino, na faixa etária de 62 anos a 93 anos de idade. Foi aplicado um inventário sociodemográfico seguido da espirometria e da gravação das vozes, antes e depois da intervenção. O G1 participou de seis sessões com a técnica "tubos de ressonância" e o G2 participou de seis oficinas de saúde vocal. As vozes gravadas foram analisadas segundo critérios da escala GRBASI. **Resultados:** O grupo G1 obteve melhora significativa, enquanto o grupo G2 não obteve mudança vocal significativa. A espirometria obteve melhora no G1 e piora no G2. **Conclusão:** A técnica finlandesa de tubos de ressonância apresentou eficácia na terapia com indivíduos idosos com sintomas de presbifonia, auxiliando na melhora da qualidade vocal e da capacidade vital.

Descritores: Idoso; Voz; Treinamento da Voz; Capacidade Vital; Qualidade de Vida

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INTRODUCTION

Aging brings about morphological and functional changes that impact the whole organism and may limit some everyday activities in elders. Scholars claim that the laryngeal structures and functions wear out with age, which may affect voice quality[1,2].

Laryngeal changes due to aging, known as presbylarynges, are identified by specific markers such as bowing and atrophy of the vocal folds, presence of sulcus vocalis, loss of conjunctive tissue, reduction in mucosa thickness, loss of elasticity of the vocal fold surface layer, and incomplete glottal closure. The latter issue is highly important since it causes noticeable vocal changes such as breathiness and voice intensity loss[1].

These changes in the physical laryngeal structure lead to several functional alterations, such as lower vital capacity and maximum phonation time, causing short breath, higher fundamental voice frequency in men and lower fundamental voice frequency in women, increased jitter and fundamental frequency variability, higher nasality and duration of articulatory pauses, worsening of voice quality, voice instability followed by laryngeal tension, lower speech speed and intensity as well as reduced vocal tessitura, diadochokinesis for repeated syllables, and maximum intraoral pressure[3]. These age-related voice changes are called presbyphonia.

The onset and development of presbyphonia and the degree of voice deterioration depend on depend on physical and psychological health, background, and constitutional, racial, hereditary, social, and environmental factors, including lifestyle and physical exercise[4].

Vocal therapy programs targeting voice quality and phono--articulatory dynamics lead to changes in voice patterns, in communication, and in the vital capacity of healthy elders. Vocal exercises have been proposed to favor glottal closure, increase subglottal pressure and voice intensity, stabilize voice quality and fundamental frequency, as well as globally improve the speech functional system[3]. The treatment indicated for both presbyphonia and presbylarynges is vocal rehabilitation focusing on reducing the supraglottic hyperfunctional compensation while simultaneously stimulating vocal attack, besides developing better breathing support for speech[5].

Vocal rehabilitation is made up of exercise groups classified according to the usual approach of phonoaudiologic dysphonia treatment. Studies have verified the effects of sounded blowing exercise with semioccluded vocal tract on the voice of elders with vocal complaints. Vocal quality and loudness increased by favoring glottal closure and a balance between the aerodynamic and myoelastic laryngeal forces. Vocal fold tonus also improved, which provides a clearer laryngeal sound, positive changes in resonance focus, and higher pitch[6].

Vocal tract semiocclusion during resonance tube phonation is used in vocal exercises as an effective technique to change patterns related to voice resonance and quality. These glass tubes (8 and 9 mm internal diameter, 25 to 28 cm length), called resonance tubes, are used by Finnish specialists in vocal training and therapy. Resonance tubes have been used in functional dysphonias (hypofunction and hyperfunction), in unilateral recurring laryngeal nerve paralysis, and nodules[7]. Among these disorders, the indications for hypofunctional voice treatment match the disorders in presbyphonic elders.

Researching this method and its use is relevant for the clinical practice in treating voice disorders so that its benefits and results are documented[8]. However, the lack of research evidence has made the method little known outside of Finland. Studies by several authors who follow the technique created by Sovijärvi[7-10] indicate it is highly beneficial in vocal therapy for treating numerous types of vocal fold disorders.

Given that voice suffers the effects of aging and that vocal exercises benefit vocal production, this research sought to investigate how effective the Finnish resonance tube method is in a vocal intervention program with a group of elderly subjects with voice aging characteristics.

METHODS

The present cross-sectional descriptive study was based on a Prospective Randomized Clinical Trial.

Initially, the project was presented to the *Sociedade Porto Alegrense de Auxílio aos Necessitados* (Porto Alegre Society for Aiding People in Need – SPAAN). After it was accepted and the Institutional Term of Consent was signed, the elders living in an institution in the city of Porto Alegre, RS, Brazil, were invited to take part in the research. The project and the research procedures were then detailed. All elders who took part in the research signed the Term of Informed Consent.

The inclusion criteria were: age above 60 years, voice with signs and symptoms of aging, cognitive and functional ability to answer questionnaires and undergo speech therapy, absence of pathologies limiting locomotion, social life, or functionality.

Out of the 131 institution dwellers at the time of the research, 54 subjects were randomly included in the groups by a draw of numbered cards. 12 subjects were removed from this sample for not effectively taking part in the proposed therapy program due to health issues, dementia onset and/or death. The final sample, thus, comprised 42 independent elders aged 62 to 93 years old living in a long-term care institution (LTCI), out of whom 30 (71.4%) were female and 12 (28.6%) were male, equally divided into the research groups.

A questionnaire was applied so as to characterize the study's population. The questions were based on other vocal health questionnaires used in previous studies[11-13]. Next, the elders were instructed on the voice recording procedures and exercises proposed. At a later moment, the subjects were randomly assigned to one of the two vocal therapy groups. The same number of male and female subjects was assigned to each group since voice changes are greatly influenced by gender.

Eight meetings were held, being two assessment events (both prior to and after the vocal intervention) and six phonotherapy sessions. In the first meeting, in March, 2012, the participants' voice samples were recorded in a digital device with the microphone placed at 5 cm and 45° from their mouths. The subjects were seated and the room was silent. This recording registered the sustained vowel /a/ and a count from 1 to 10. An aerodynamic assessment was also performed by spirometry, which uses the maximum inhaling and exhaling to measure the volume of air exhaled. The elders were assessed while comfortably seated by a table, where the spirometer was placed at an appropriate height. The subjects then were instructed to inhale as much air as possible and to force exhaling all the air into the spirometer. The value obtained represented the Vital Capacity (VC) and was used as an assessment criterion in the study.

The elders were split between a Research Group (G1) and a Control Group (G2). Group G1 used exclusively the Finnish resonance tube method and no other method or voice warm-up was employed. Group G2 attended workshops with a dynamic approach to vocal health. The speech therapy intervention program had one one-hour weekly session for six weeks for both groups. After this period, the participants' voices were recorded using the same conditions of the initial assessment. This second assessment took place in June and July, 2012.

The resonance tube therapy sessions with G1 followed the methodology described by Simberg and Laine[8], using 1 L plastic containers with a line on their sides indicating 6 cm of water level, tube depth adjusted to 5 cm, and glass tubes (8 mm to 9 mm internal diameter and 24 cm to 25 cm length). The subjects were comfortably seated with their backs straight for better phonation. Tube height was adjusted according to each subject so as to favor an effortlessly appropriate posture. The elders were told to keep the container with water on the table without holding it with their hands. With the tube between the index finger and the thumb at about 1 mm from the teeth and keeping the lips rounded to properly seal the tube and prevent air from escaping, they were instructed to emit continuous sounds, nonsensical words, and to hum the tune of "Happy Birthday to You." Examples were used from the study by Simberg and Laine[8], which suggests using a prolonged /b/ in the tube emissions, besides the sounds "u," "jjjuu," "jjjiibbuu," and "jjiibbiiuu." The sounds were emitted only in vocal intonation, with no articulation, producing bubbles in the water during emission. The therapist demonstrated the exercise so the subjects would copy it. Variations in intonation and sounds were individually inserted as the patients felt at ease with phonation. The emission of the selected sound into the tube was controlled in order to avoid sudden vocal attacks or changes in the emission pattern. The individual fatigue limits were respected with rest periods of up to two minutes between emissions.

The vocal health counseling interventions with G2 were carried out through playful activities such as games and music. The weekly workshops lasted for one hour and approached the process of vocal aging and voice care procedures, such as laryngeal hydration, consumption of coffee, alcohol, tobacco, and voice medication, physical exercise, effects of food on the voice, sleep and the influence of rest on the voice, and voice development from infancy to old age. At the end, each participant reported on the acquisition of this knowledge. Volunteer students from the Speech Language, Pathology and Audiology course of the institution carrying out the study aided in the research.

The voices collected underwent an auditory-perceptual assessment by a speech language therapist specialized in voice whose reliability had been previously attested. The recordings of sustained vowel production and number counting were analyzed using the GRBASI[14,15] scale, which stands for Grade (overall degree of dysphonia), Roughness, Breathiness, Asthenia, Strain, and Instability, ranging from 0 to 3, namely: 0 absent; 1 slight, 2 moderate, and 3 severe.

The software SPSS (Statistical Package for the Social Sciences v.17.0 for Windows) was used to statistically analyze the data for normality through the Shapiro-Wilk test, which showed normal distribution of the continuous variables. The descriptive analysis was performed by calculating the means (standard deviation) for the demographic and quantitative variables and for the spirometry. The GRBASI values were expressed by the median followed by the minimum and maximum values to facilitate the clinical interpretation of the results. The nominal variables were described by their absolute and relative values. The inferential analysis of the results was performed by means of Mann-Whitney's U-test to compare the GRBASI medians between the study and control groups. Wilcoxon's U-test was used to compare the intragroup medians, both before and after the intervention, for both groups. Likewise, Student's t-test and the paired t-test were used to compare the intergroup and intragroup spirometry means, both before and after intervention. By categorizing age in the study group, the Yates' chi-squared test was applied to verify the association between age group and improvement in GRBASI and spirometry. All tests adopted significance level at α=0.05%. The significant values were identified with an asterisk (*).

The present study was approved by the Research Ethics Committee of the Universidade Federal de Ciências da Saúde de Porto Alegre, under protocol 1091/10.

RESULTS

The average participant age in both groups was 79 years old, with standard deviation of 7.13 in G1 and 10.37 in G2. Differences were observed in the pre-and post-intervention GRBASI scale assessments with the resonance tube exercises for most parameters, with the exception of breathiness. The same was not true for the control group, in which the analysis of the GRBASI scale parameters did not show significant

Table 1. Numeric and percentage distribution of the subjects in both study groups according to gender, marital status, and schooling

Variable	Group 1 n (%)	Group 2 n (%)	Total n (%)
Total population			
Women	15 (71.4)	15 (71.4)	30 (71.4)
Men	6 (28.6)	6 (28.6)	12 (28.6)
Marital status			
Married	1 (4.8)	0 (0)	1 (2.38)
Single	5 (23.8)	9 (42.9)	14 (33.33)
Widowed	14 (66.7)	10 (47.6)	24 (57.14)
Divorced	1 (4.8)	2 (9.5)	3 (7.14)
Schooling			
Never studied	7 (33.3)	2 (9.5)	9 (21.42)
Incomplete elementary	10 (47.6)	15 (71.4)	25 (59.52)
Complete elementary to complete higher education	4 (19.2)	4 (19.1)	8 (19.04)

Table 2. Comparison between the groups regarding the GRBASI scale auditory-perceptual assessment and the pre- and post-intervention spirometry

Variable assessed	Group 1 (n=21) (p-value)	Group 2 (n=21) (p-value)
G – Grade of dysphonia	0.025*	1.000
R – Roughness	0.002*	0.414
B – Breathiness	0.083	0.317
A – Asthenia	0.025*	1.000
S – Strain	0.008*	0.317
I – Instability	0.008*	0.083

* Significant values (p≤0.05) – Wilcoxon U-test

differences between the assessments prior to and after the vocal health workshops (Tables 1 and 2).

When asked to self-rate the improvement of voice symptoms after the study, 19 subjects in G1 (90%) stated a decrease in voice symptoms/complaints. In G2, only two subjects (9%) reported noticing a reduction in voice symptoms or complaints (Figure 1).

A significant positive difference was found between the pre- and post-intervention spirometry values for both groups, with an improvement in G1 and worsening in G2 (Table 3).

In the auditory-perceptual voice analysis, age was taken into account. Group G1 was split as "62 to 75 years old" and "76 to 93 years old" so that the relation between the benefits

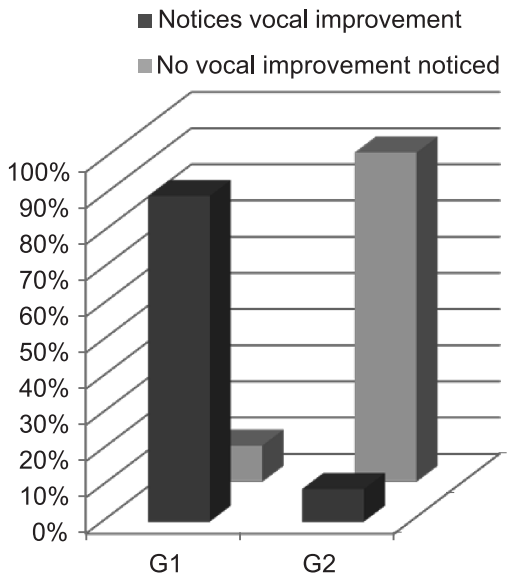

Figure 1. Self-rated vocal symptoms after the interventions

of the resonance tube technique and age was verified. In Yate's chi-squared test, no difference in improvement was observed between both age groups (Table 4).

DISCUSSION

The percentage of those above 60 years old has been growing faster than any other age group in nearly every country[16].

Table 3. Comparison of pre- and post-intervention spirometry

Variable	Group 1 (n=20) Average (SD)			Group 2 (n=22) Average (SD)		
	Pre	Post	p value	Pre	Post	p-value
Spirometry	1123 (541.464)	1861 (509.388)	0.000*	1335.71 (759.135)	1070.95 (608.916)	0.003*

*Significant values (p≤0.05) – Paired t-test

Table 4. Assessment of the improvement in G1 by age group pre- and post-intervention

Auditory-perceptual assessment	62-75 years n (%)	76-93 years n (%)	p-value
G – Grade of dysphonia	2 (33.3)	2 (20)	0.935
R - Roughness	2 (33.3)	8 (53.3)	0.730
B – Breathiness	1 (16.7)	2 (13.3)	1
A – Asthenia	2 (33.3)	2 (20)	0.935
S – Strain	2 (33.3)	5 (33.3)	1
I – Instability	2 (33.3)	5 (33.3)	1
Spirometry	6 (100)	15 (100)	-

* Significant values (p≤0.05) – Yates' chi-squared test

IBGE (Brazilian Institute of Geography and Statistics) reports that 48.9% of the elders living in Brazil have some type of disease[17]. Studies point to age-related diseases, among which the wearing of the laryngeal structure and functions may affect voice quality[1,2].

The prevalence of females in the study population (Table 1), despite being higher than the overall Brazilian population[18], was already expected since it is known that women are the majority of the individuals in elderly care institutions[19,20]. The impact of hormone issues in hoarseness-breathiness voice quality must be pointed out. During menopause, women are no longer able to maintain vocal fold tonus and resistance, which leads to progressive atrophy of the two vocal folds and causes noticeable breathiness. The mucous membrane covering the vocal folds becomes thin and dehydrated. The voice masculinization in elder women is caused by the lower ovarian activity and the dramatic decrease in progesterone and estrogen levels that ensues[21].

The vocal tract is also impacted according to the individual's communicative profile. In elderly care institutions, being single or widowed, as well as having little schooling, are issues that have been widely discussed and are related to elder loneliness and abandon[22-24]. Low educational level, evident in the profile of the dwellers of the institution studied, is also related with institutionalization and with the social communication deficit[25]. These factors, when inserted into a vocal loss context, further worsen relationship difficulties and significantly hinder social relations[26].

The GRBASI scale results show that the voice parameters improved in the group undergoing resonance-tube therapy (G1) when compared to the control group (G2), which attended vocal health workshops. The global dysphonia grade (G) significantly improved in G1, indicating global benefits in the elders' voice, who attempt to reduce the evidence of aging in their voice (Table 2). G1 members also improved in roughness (R), asthenia (A), strain (S), and instability (I), which are important parameters since they indicate the effective benefit of the resonance tube technique under the GRBASI scale, considered the gold standard in voice assessment. Hence, this technique contributes to a better source-filter interaction and for elderly vocal quality.

With aging, histological changes in the vocal folds contribute to issues such as a reduction in elastic and collagen fibers, which lead to lower laryngeal muscular tonus. Consequently, glottal closure is incomplete during phonation, which is related to the prevalence of breathiness in the voice-quality assessment in G1, who had good results, albeit not statistically significant.

The resonance tube technique also yielded positive results in the elders' vital capacity (CV), which assesses the maximum amount of air that can be exhaled after a maximal inhaling. In the respiratory system, exhaling suffers the most with aging. A lower CV may cause difficulty in sustaining emission, leading to glottal tension in order to maintain voice production, besides frequent inhaling and several pauses in speech. That leads to excessive neck muscle contraction and causes laryngeal tension when one tries to maintain phonation equilibrium[27,28].

It was found that G1 improved in spirometry, while G2 worsened in this criterion over the same period. One of the reasons for that finding is the temperature changes in southern Brazil to which the subjects were exposed during the study. The first spirometry assessment of both groups took place in March, during summer, while the reassessment was done in June and July, during winter, leading to the interference of several respiratory factors and the possible worsening of chronic respiratory conditions. Nevertheless, despite the negative influence of temperature, the resonance tube technique had positive results as G1 subjects improved their respiratory quality.

It could be seen that, between the age groups (younger and longeval elders), the longeval subjects, despite collecting more losses over the years, benefited from the resonance tube technique just as much as the remaining subjects (Table 4). The Finnish resonance tube technique is not limited by the patient's age and may be successfully used regardless of the age group in improving vocal fold closure, in reducing vocal losses typical of aging, and in benefiting respiration. The loss of age-related muscle flexibility essentially takes place due to the lower muscle elasticity[29]. The exercise provided by the resonance tubes contributes to vocal fold elasticity, which decreases over the years, and therefore recovers elders' voice quality and facilitates communication regardless of the age group.

It could be seen that G1 reported an improvement in voice quality perception after the speech therapy intervention (Figure 1). Such improvement in self-rating helps raising self-esteem and incentives social participation. Autonomy is highly important to elders and involves several aspects, being communication a major one. Despite carrying several conditions such as hypertension and diabetes, the elders who can decide for themselves what to do and who satisfactorily communicate with those around them are happier and more socially integrated. However, the elders who lack control over their diseases may suffer from depression, social reclusion, sedentarism, cognitive deficit, low self-esteem, and refusal to care for themselves[30]. This made the elders' satisfaction with their voice improvement an important goal after the speech therapy program.

CONCLUSION

The Finnish resonance tube technique was beneficial to the vocal and respiratory parameters assessed. The responses observed during the study lead to the conclusion that this technique can be considered effective in treating age-related voice changes as a whole, besides also aiding in elders' respiratory capacity.

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