The Effect of a Voice Therapy Program Based on the Taxonomy of Vocal Therapy in Women with Behavioral Dysphonia

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Summary: Objective. This study aims to propose and analyze the effect of a voice therapy program (VTP) in women with behavioral dysphonia.

Materials and Methods. This is a controlled, blinded, and nonrandomized cohort study. Participants of this study were 22 women with behavioral dysphonia divided into two groups: G1, 11 women with behavioral dysphonia who received the VTP, and G2, 11 women with behavioral dysphonia who did not receive any intervention. Before and after 6 weeks, the outcome variables evaluated in both groups were auditory-perceptual evaluation of the global degree of vocal quality (vowel /a/ and counting), instrumental acoustic parameters, Voice-Related Quality of Life, vocal and larynx symptoms, and musculoskeletal pain. The statistical analysis used the Wilcoxon, chi-square, and Mann-Whitney tests ($P < 0.05$).

Results. After 6 weeks, we observed a significantly higher improvement in the general degree of vocal deviation in vowels, a reduced F0 and symptom of "fatigue while talking" in G1, and an increased "shoulder" pain intensity in G2. Both groups showed improvement in the socioemotional domain of Voice-Related Quality of Life. In addition, the comparison between the groups showed a significantly greater reduction in fundamental frequency and the "voice loss" symptom in G1 compared with G2.

Conclusions. The VTP using semioccluded vocal tract exercises obtained a positive effect on voice quality, symptoms, and musculoskeletal pain in women with behavioral dysphonia. The proposal, based on the taxonomy of voice therapy, seems to have promoted a phonatory balance, muscle relaxation, and improvement in the vocal resistance of this population.

Key Words: Behavioral dysphonia–Voice therapy–Voice training–Voice–Voice disorders.

INTRODUCTION

Voice disorders are usually characterized by changes related to pitch, loudness, or voice quality, which might limit communication efficiency and generate physical, emotional, or social impairment to the speaker.[1] There is no standard classification of dysphonia[1]; however, the current international proposal divides it into behavioral and organic.[2]

Behavioral dysphonia is a voice change with an etiology directly related to the use of the voice.[2,3] It can affect the individual at different levels, such as respiratory, glottal, resonance, and articulatory, and can affect coordination between levels.[2] Besides, behavioral dysphonia can generate voice and larynx symptoms,[2] discomfort, and pain in the laryngeal and cervical muscles.[4,5] Among the vocal characteristics of these patients, we can find upper breathing patterns; hard vocal attacks; voice quality changes, characterized especially by roughness and strain; as well as an incorrect use of the resonant cavity and poor articulation.[6–13] In addition, the literature shows that there might be excessive muscle tension in the cervical and laryngeal muscle, with the presence of a global, median, or anteroposterior constriction of the vestibule and an elevated position of the larynx and shoulders, among others.[4,6,11,14]

The therapeutic procedures prescribed for behavioral dysphonia were traditionally classified into two types: direct or indirect.[1,15] The indirect approach consisted of interventions that sought to assist the individual in understanding voice usage and decreasing vocal misuse. The direct approach was aimed at modifying the voice production to make it more efficient, and included the practice of vocal exercises.[15] Therefore, the most common treatment was the combination of direct and indirect therapy,[1,15,16] as indirect and direct therapy occupied about 25% and 75% of treatment time, respectively.[16]

Recently, a new approach called taxonomy of voice therapy[17] emerged as a proposal for the description and classification of vocal interventions, which also suggests a standardization of the terminology. This approach is more robust and opposes the simplistic classification that subdivides therapeutic programs only into the categories of direct and indirect, as programs that belong to the same category may not be equivalent or comparable. The proposal has two main justifications. The first is to increase the understanding of the therapeutic components of the process that provide specific gains for each of the vocal aspects of the participants. The second is to allow better communication between professionals and increase the scientific evidence in the area, showing which programs can and cannot be compared through meta-analysis. In this way, it becomes possible to carry out more studies that establish specific procedural protocols for each vocal

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pathology. In addition, the taxonomy should be dynamic and subject to modifications, according to the needs and advances of science.

The literature shows several therapeutic programs[3,18–35] and exercises[36,37] that can be used in the treatment of behavioral dysphonia. Even though previous studies have demonstrated the effectiveness of the aforementioned programs and exercises, the design of existing proposals was not based on taxonomy of voice therapy,[17] and so they cannot be classified at all levels, in all categories, subsystems, types of tasks, and degrees of freedom of each phase or session.[17] Thus, there is the need for scientific evidence showing whether the taxonomy of voice therapy can be used effectively to create a proposal for a voice therapy program (VTP) that seeks the comprehensive vocal rehabilitation of all the subsystems involved in behavioral dysphonia. Therefore, the aim of this study was to propose and analyze the effect of the VTP based on the taxonomy of vocal therapy in women with behavioral dysphonia.

MATERIALS AND METHODS

Type of study

This is a controlled, blind, and nonrandomized quasiexperimental study.

Ethical considerations

The survey was carried out according to the Resolution No. 466/12 of the National Health Council, approved by the Institutional Research Ethics Committee under report number 1.235.463. The volunteers participating in the study were informed about the research and agreed to participate by signing an informed consent form.

Study location

The study was carried out in a Clinic-School of Speech Therapy.

Professionals

This study was carried out by a group of five professionals to provide blinding about the stages of the research. The roles of the professionals were as follows:

- Professional 1: Speech therapist—responsible for the sample selection and allocation of participants in the groups; blinded regarding evaluation stages of outcome variables.
- Professional 2 and Professional 3: Speech therapists—responsible for the evaluation of outcome variables; blinded regarding the allocation of participants in the groups.
- Professional 4: Speech therapist—responsible for performing speech therapy; blinded regarding the steps of the evaluation.
- Professional 5: Speech therapist—responsible for editing the materials regarding the outcome variables that were sent for evaluation by professional evaluators, who did not participate in the survey; and also for handling and collecting the data into tables. The evaluators were also blinded regarding sample selection, allocation of participants in intervention groups, and the steps of data collection of the outcomes of the intervention.

Participants

The sample size was calculated based on a pilot study. Four subjects from each group were collected. We used the largest standard deviation found for the difference between the evaluations before and after the intervention, considering all outcomes, which was 25.50 Hz in the fundamental frequency variable of the outcome of the instrumental acoustic parameters. Adopting a significance level of 5% and the power test of 80% to detect a minimum difference between the groups equal to a standard deviation, the sample size required was 10 participants in each group to be studied.

The participants in this study were women with dysphonia, who had already performed a vocal screening and laryngology examination (nasolaryngoscopy, telelaryngoscopy, and laryngostroboscopy). In the assessment for eligibility, by applying the selection criteria of the sample, the participants responded to a questionnaire prepared by researchers that addressed the topics of identification, occupation, voice complaint, and health data.

Participants were those who signed the informed consent form and aged between 18 and 45 years, female, with behavioral dysphonia evidenced by a current voice complaint, voice screening, and laryngology evaluation. Individuals whose complaint and vocal health data pointed to an etiology predominantly related to voice use, as well as voice changes detected in the voice screening, and larynx with the presence of benign lesions—cysts with contralateral reaction, edemas, and bilateral vocal nodules—were considered to have been diagnosed with behavioral dysphonia.[2]

Participants who reported a clinical history of neurological or syndromic disorders, psychogenic dysphonia, laryngeal or lung surgery, previous treatment due to voice problems, or hearing dysfunctions were excluded.

Therefore, we selected 22 participants who were allocated into two groups: group 1 (G1), including 11 women (average age of 29.50 years) with behavioral dysphonia who received the VTP, and group 2 (G2), including 11 women (average age of 29.63 years) with behavioral dysphonia who did not receive any intervention. The allocation of participants was nonrandom because the group without intervention (G2) had to complete the research and start rehabilitation as soon as possible. Because of ethical reasons, this group of participants was also rehabilitated by the researchers of this study, with their rehabilitation in another research group started immediately after reevaluation. As such, the first 11 participants included were allocated to G2 and the remaining 11 participants were allocated to G1. The participants were blinded about the existence of two separate research groups.

Evaluation of outcome variables

Two evaluations were performed for outcome variables that included the same procedures, with a 6-week interval between them (first week and sixth week).

The primary outcome variables selected were auditory-perceptual evaluation of the global degree of vocal quality,

acoustic evaluation, and self-evaluation of voice (Voice-Related Quality of Life [V-RQOL], self-assessment of vocal and larynx symptoms, and musculoskeletal pain).

Auditory-perceptual and acoustic evaluation

Vocal evaluation was carried out by auditory-perceptual evaluation of the global degree of vocal quality and instrumental acoustic parameters, from a voice recording that took place in a room with acoustic insulation and environmental noise lower than 50 dB sound pressure level. For voice recording, the participants were placed in a standing position and were told to perform the emission of sustained vowel /a/, and to count from 1 to 10, both in usual pitch and in loudness. The emissions were captured by an AKG microphone, model C-444PP (AKG Acoustics GmbH, Vienna, Austria) positioned at an angle of 45° from the mouth of the participant and 4 cm away from the corners of the mouth, recorded directly into a computer system consisting of an Intel Pentium 4 computer with the Creative Sound Blaster sound card, model Audigy II (Creative Technology Ltd, Creative Resource, Singapore). The recordings were carried out by the professional audio editing software Sound Forge 10.0 (Sony Creative Software Inc, Middleton, WI) at a 44,100-Hz sampling rate on a mono, 16-bit channel.

For the auditory-perceptual evaluation of the global degree of vocal quality, the samples were arranged in pairs (initial and final assessment), randomized, and recorded in a DVD 52×, 4.7 GB, with audio format PCM 96 kHz, 16 bit, mono, converted to waveform extension, without identification of the participant, with replication of 20% of the sample pairs. Later, they were sent for perceptive-auditory analysis of voice quality by three voice specialists with at least 5 years of experience in voice evaluation, who were not the researchers of this study. The evaluators were instructed to analyze the parameter of the global degree of vocal quality (generalized feeling of vocal deviation), where, for each pair of voices, they should indicate whether sample A was better, worse, or remained the same in relation to sample B. Reliability values were calculated by intra- and inter-evaluators, and it was decided to use the most common response among the three evaluators. We chose to analyze only this parameter by passing the overall impression of vocal deviation, which includes all of its characteristics.

For the acoustic evaluation of the instrumental acoustic parameters, the emission samples of the vowel /a/ were edited with the software Sound Forge 10.0 (Sony Creative Software Inc), deleting the beginning and the end of the emission to avoid the influence of the natural periods of instability, keeping 3.5 seconds of emission. The instrumental acoustic parameters were made with the software *Multi Dimension Voice Program* (*MDVP*) (Kay Elemetrics Corporation, Lincoln Park, NJ) with a sample rate of 44 kHz, 16 bit. The measures analyzed were the fundamental frequency (F0), jitter percent (jitt), shimmer percent (shim), noise-to-harmonics ratio, amplitude variation (vAm), and fundamental frequency variation (vF0).

Voice-related Quality of Life

The Brazilian version[38] of the V-RQOL protocol[39] consists of 10 questions. To answer these questions, the participants must consider the intensity and frequency of occurrence of the problem. The participants were instructed to evaluate each item on a scale of one (not a problem) to five (very big problem). The V-RQOL analyzes the physical domain (questions 1, 2, 3, 6, 7, and 9), the socioemotional domain (questions 4, 5, 8, and 10), and the total domain (all 10 questions). A standard algorithm was used to calculate the scores of the protocol's domains.

Vocal and larynx symptoms

The 13 symptoms of the protocol of the Vocal Disorder Screening Index[40] were used to analyze the frequency of vocal symptoms. The symptoms investigated were hoarseness, voice loss, breaking voice, low-pitched voice, strained speech, phlegm, dry cough, cough with secretions, pain when speaking, pain when swallowing, secretions in throat, and dry throat. The form of analysis was adapted from the Likert scale, which is the most popular scale for the analysis of categorical variables as it allows the attribution of statements to values.[41] The participants were asked to report the frequency of each symptom in the last 30 days, on a Likert scale of "never" (zero) to "always" (three).

Musculoskeletal pain

The Musculoskeletal Pain Research Questionnaire[4] was used to investigate the frequency and intensity of musculoskeletal pain. Only the regions near the larynx were investigated, namely, the anterior and posterior parts of the neck, shoulders, upper back, temporal region, submandibular, masseter, and larynx. To investigate the frequency of musculoskeletal pain, the participants were directed to indicate, for each region, one of the response options, which varied between "never" and "always." Later, the answers were placed on a four-point Likert scale, where "never" was equal to zero and "always" referred to three. Then, they were instructed to indicate the intensity of that pain in each of the mentioned regions, in a visual-analog individual scale of 100 mm, the left limit being equivalent to no pain and the limit on the right equivalent to the worst possible pain. Subsequently, this mark was measured with a ruler to check the corresponding score in millimeters.

Vocal speech therapy intervention

The intervention period lasted 4 weeks (second week to fifth week). During that interval, G1 went through eight sessions of intervention over 4 weeks. In contrast, those in G2 had no intervention and only remained with their activities, being reassessed after 6 weeks. The VTP was composed of eight sessions lasting approximately 30 minutes, with a biweekly frequency.

The goals of the VTP were elaborated based on the main changes and common needs of participants with behavioral dysphonia. The general objectives of the program were balancing phonation, enhancing knowledge, and providing strategies for the participants to improve their health, production, and vocal behavior. Therefore, specific objectives have been established for each session.

In contrast, the methodology of intervention was organized based on the taxonomy of voice therapy,[17] so it would be possible to describe and properly classify the process involved in the changes obtained by the participants. The program consists

of three general categories of instruments: indirect intervention, direct intervention, and methodology for the application of the intervention.[17] The strategies of the VTP are described below in the three aforementioned categories:

- Instruments of direct intervention: Consist of activities or participative tasks using techniques as tools and are grouped into five categories of subsystems primarily involved in the implementation of the therapeutic program. Considering that the subsystems are interrelated and are not likely to be addressed individually, we chose to include at least one strategy from each subsystem in the program to make it more robust. The subsystems are the auditory, vocal function, respiratory, musculoskeletal, and somatosensorial. The target is directed according to the degrees of freedom from one to five in each proposed exercise. Each exercise can engage several subsystems; however, the degrees of freedom indicate the subsystems that are the therapist's primary focus for the task. In addition, the tasks are subdivided into activities and participations, where activities are tasks with isolated techniques and participations are those that include real-life situations. The categories of direct intervention at the secondary level were discrimination, orofacial modification, sensorineural, pitch modification, respiratory support, and coordination.
- Indirect intervention instruments: In this program, indirect intervention instruments are primarily pedagogy intervention tools, subdivided into strategies to improve knowledge, in which the therapist provides knowledge about the specific framework of the participant and his or her specific peculiarities, and addresses issues and information on vocal production and vocal hygiene. This approach starts with instructions regarding vocal hygiene, in which the therapist provides strategies to improve vocal health, specifically adapted to result in changes in the vocal behavior of each participant.
- Method of application of the intervention: The methodology of the extrinsic structure of application that refers to the therapist has a hierarchical structure with an increase in the level of difficulty and gradual inclusion of the work on the function itself. The structure of modeling by imitation, along with guidelines on how to implement the vocal techniques, duration, pitch, loudness, speech speed, and muscle adjustments suitable for performing each task, was applied by the therapist only in a prior session, in which therapeutic evidence of the techniques was carried out. Therapeutic evidence was classified as positive, negative, or neutral. For that purpose, the sustained emission of the vowel /a/ and counting from 1 to 10 were recorded and analyzed before and after each task.[42] In cases where there was negative therapeutic evidence, the technique of the task was replaced with one of the proposals (with positive evidence) that answered the same goal.

The intervention followed the type of task and preset execution time for the session, as shown in Table 1. Six tasks were performed by session, split between activities and participations. The activities ranged from tongue or lip trills, humming, and fricatives in usual pitch and loudness, and their variations. In contrast, the participation tasks were related to speech function, by association with vowels, syllables, and concatenated speech, to make the tasks closer to the speech of the participants as a means to promote generalization, that is, tasks that were closer to the real-life vocal use of that participant.[17] At the end of each task, the participants took 30 seconds of passive rest (absolute silence), in which they could ingest 250 mL of water, without this being an intervening variable, since hydration occurs systemically.[43]

TABLE 1.
Analysis of Auditory-perceptual Evaluation of the Global Degree of Vocal Quality of the Women of Group 1 and Group 2

		G1		G2		
Sample	Analysis	n	%	n	%	*P*-Value
Vowel	Worse	3	27.27%	4	36.36%	0.012
	Equal	0	0.00%	5	45.45%	
	Better	8	72.73%	4	18.18%	
Count	Worse	3	27.27%	3	27.27%	0.318
	Equal	3	27.27%	6	54.55%	
	Better	5	45.45%	2	18.18%	

Note: Pearson chi-square ($P < 0.05$).
Abbreviations: n, number of subjects; %, percentage of subjects; G1, group 1; G2, group 2.

To carry out the tasks at home, the participants were guided to perform two activities using the techniques presented in the session. In the odd-numbered sessions, humming and tongue or lip trills in usual pitch and loudness were used, and in the even-numbered sessions, fricative sounds and tongue or lip trills in usual pitch and loudness were used (Table 1). The participants were instructed to perform the tasks for 1 minute, twice a day, and to record audio during one of the two at-home tasks and send the file by mobile phone for control by the therapist.

Data analysis

The normality of the variables was analyzed using the Shapiro-Wilk test ($P < 0.05$). Considering that the data were not normal, we used the nonparametric test for dependent groups, and the Wilcoxon test was used to compare the results of pre- and postintervention evaluations for both groups. To compare the groups, we decided to calculate the difference between the pre- and the postintervention evaluations, individually, in both groups. The values of the differences were compared using the nonparametric test for independent groups, the Mann-Whitney test. The analysis of the general degree of vocal quality was made using the chi-square test. The intra- and inter-evaluator reliability for the perceptive-auditory evaluation of vocal quality was made with the Kappa test. The classifications used for the Kappa test results were insignificant (0.00–0.20), median (0.21–0.40), moderate (0.41–0.60), substantial (0.61–0.80), and almost perfect (0.81–1.00).[44] A significance level of 5% was considered for all tests. The software used for statistical analysis was the *Statistica 17.0* (Stat Soft Inc., Tulsa, OK).

RESULTS

Table 1 shows that there was a significantly higher relative frequency of improvement in the overall degree of vocal quality in G1 compared with G2 ($P = 0.012$). Regarding the test in which the participants counted from 1 to 10, there was no difference between the groups. The reliability results have shown that the Kappa intra-rater coefficient was 1.00 for vowels and 0.33–1.00 for counting, and the Kappa inter-rater coefficient was between 0.31 and 0.37 for vowels and 0.22 and 0.36 for counting.

Table 2 shows that there was a significant reduction in the voice's F0 in G1 after the VTP ($P = 0.036$). In addition, the difference between pre- and postintervention pointed out a significantly greater reduction of F0 in G1 compared with G2 ($P = 0.025$).

In relation to the V-RQOL, we can see in Table 3 that there was a significant improvement after the intervention in both groups (G2 $P = 0.049$; G1 $P = 0.043$) in the socioemotional domain.

It can be observed that there was a significant reduction of the symptom "low-pitched voice" after the intervention in G1 ($P = 0.043$) (Table 4). When comparing the groups, we could see that there was a significantly greater reduction in the symptoms of "loss of voice" ($P = 0.042$) in G1 compared with G2 (Table 4).

Concerning musculoskeletal pain, no difference was observed in the frequency of musculoskeletal pain between the evaluations before and after the intervention, or between the groups (Table 5); however, there was a significant increase in the intensity of musculoskeletal pain in the "shoulders" region during the "after" period in G2 ($P = 0.027$) (Table 6).

DISCUSSION

The current literature presents a description of some VTPs for behavioral dysphonia.[3,18–21,23–29,31,32,34,45] However, these therapeutic programs do not follow the taxonomy of vocal therapy,[17] and the heterogeneity of the methodological proposals of these studies makes it difficult to understand and meta-teach the subsystems, stages, and procedures applied in the therapeutic process. Additionally, it is unclear what, in fact, contributes to vocal improvement in each of these programs. Thus, it becomes difficult, both through meta-reading and practice, to make a clinical reasoning that goes beyond the numerical relationship between approach and result, and to make clinical decisions based on scientific evidence. The purpose of taxonomy is precisely to establish a standard terminology to describe clinical approaches for greater systematization and classification of the procedures used in vocal rehabilitation, which can support evidence-based clinical decision-making, which is the primary goal of clinical research.[17] The proposal of the taxonomy seems robust and consistent, but only by analyzing the therapeutic proposals prepared with its methodology is it possible to verify the correspondent applicability

TABLE 2.
Analysis of Instrumental Acoustic Parameters of the Voices of Women in Group 1 and Group 2

							Difference			
Parameter	Group	Evaluation	1Q	Median	3Q	*P*-Value	1Q	Median	3Q	*P*-Value
F0	G1	Before	184.49	191.39	218.21	0.035*	–8.96	–4.07	–0.26	0.025*
		After	171.13	190.24	209.24					
	G2	Before	187.29	199.91	215.34	0.061	–4.09	9.08	19.42	
		After	196.58	214.30	234.77					
Jitt	G1	Before	1.01	1.50	2.43	0.483	–0.19	0.03	0.67	0.160
		After	1.29	1.83	2.45					
	G2	Before	0.90	1.58	2.48	0.075	–1.16	–0.24	0.15	
		After	0.88	1.05	1.78					
vF0	G1	Before	1.13	1.46	2.01	0.262	–0.07	0.21	0.51	0.082
		After	1.27	1.89	2.18					
	G2	Before	1.19	1.87	2.70	0.130	–1.32	–0.32	0.23	
		After	1.09	1.28	1.94					
Shim	G1	Before	2.58	3.57	4.58	0.326	–0.82	–0.41	0.25	0.620
		After	2.65	3.08	3.64					
	G2	Before	2.58	3.28	5.36	0.533	–3.21	–0.14	0.65	
		After	2.38	3.16	4.66					
vAm	G1	Before	7.70	8.71	13.28	0.888	–3.67	1.34	3.75	1.000
		After	8.59	11.21	12.36					
	G2	Before	8.71	9.84	12.84	0.929	–2.29	–0.46	4.00	
		After	6.24	8.37	14.35					
NHR	G1	Before	0.12	0.13	0.15	0.888	–0.01	0.00	0.01	1.000
		After	0.12	0.13	0.15					
	G2	Before	0.11	0.12	0.14	0.959	–0.02	0.00	0.02	
		After	0.11	0.13	0.14					

* Wilcoxon test ($P < 0.05$) and Mann-Whitney test ($P < 0.05$).
Abbreviations: 1Q, first quartile; 3Q, third quartile; G1, group 1; G2, group 2; F0, fundamental frequency; jitt, jitter percent; shim, shimmer percent; NHR, noise-harmonic ratio; vAm, amplitude variation; vF0, fundamental frequency variation.

TABLE 3.
Characterization and Comparison of Voice-related Quality of Life of Group 1 and Group 2

							Difference			
Domain	Group	Evaluation	1Q	Median	3Q	*P*-Value	1Q	Median	3Q	*P*-Value
Socioemotional	G1	Before	68.75	81.25	93.75	0.043*	0.00	6.25	12.50	0.903
		After	84.38	90.63	96.88					
	G2	Before	50.00	68.75	87.50	0.049*	0.00	6.25	18.75	
		After	50.00	87.50	93.75					
Physical	G1	Before	56.25	72.92	87.50	0.123	2.08	8.37	14.59	0.777
		After	72.92	85.42	91.67					
	G2	Before	25.00	50.00	62.50	0.241	–8.33	4.17	20.83	
		After	33.34	66.67	75.00					
Total	G1	Before	67.50	73.75	83.75	0.068	1.25	8.75	16.25	0.967
		After	78.75	88.75	91.25					
	G2	Before	37.50	57.50	70.00	0.092	–5.00	5.00	20.00	
		After	45.00	70.00	82.50					

* Wilcoxon test ($P < 0.05$) and Mann-Whitney test ($P < 0.05$).
Abbreviations: 1Q, first quartile; 3Q, third quartile; G1, group 1; G2, group 2.

and clinical efficiency (Chart 1). Thus, the present study has proposed a therapy program for behavioral dysphonia, which is composed of techniques that meet the general objectives of a therapy for behavioral dysphonia proposed and organized as per the categories and subsystems of the taxonomy of vocal therapy.[17]

In this study, the results relative to vocal quality show an improvement in the global degree of vocal quality in the women from G1 compared with G2, only for the emission of sustained vowels (Table 1).

Studies indicate that the detection of differences in only one type of sample is common, as counting number is similar to daily conversation, but its classification shows a greater variability due to the influence of the verbal phonetic and phonological context, and prosodic fluctuations. In contrast, the sustained vowels, although less representative of the daily standard, are less susceptible to phonetic variability.[46,47]

Behavioral dysphonia does not have a single vocal pattern, but a general degree of vocal deviation made up, to a greater or lesser degree, by strain, roughness, and breathiness.[2,4,5,11,12,48–51] Considering the intervention methodology of the VTP, it is believed that the axis of indirect intervention might have contributed with pedagogical strategies to reduce abuses and bad usage of the voice. In contrast, the axis of direct intervention works with the secondary levels of discrimination, orofacial modification, sensorineural, pitch modification, respiratory support, and coordination. The taxonomy of vocal therapy seeks to use the universal terms to describe the intervention. However, to understand the anatomical and physiology involved in the methods provided by rehabilitation, it is important to mention that the exercises that make up the secondary level are known in the literature as semioccluded vocal tract exercises (SOVTEs).[36,37] The SOVTEs include lip or tongue trills, fricatives, and humming exercises that favor the interaction between the glottis (source) and the supraglottic tract (filter).[36] These exercises cause a partial occlusion to the exit of air, which increases the intraoral pressure in the vocal tract, reduces the frequency of the first formant, and increases the inherent reactance of the vocal tract, and therefore the interaction between source and filter. With these partial occlusions, the exit of air and the retroflex supraglottic pressure might have a greater influence on the intraglottic pressure, which reduces the pressure of the airflow, decreases the coalition force between the vocal folds, and keeps them slightly abducted.[36,52,53] As such, these exercises promote an efficient, balanced, and normotensive voice production. In addition, SOVTE allows several associations between exercises, adapting its utilization to the objective of each therapy session.

The use of SOVTE might have promoted a phonatory balance and overall improved vocal quality. The overall improvement in vocal quality might be due to the reduction of strain at the glottic level, a common trait of behavioral dysphonia.[54] The excessive strain at the glottic level is a compensatory strategy carried out by individuals with benign lesions associated with the presence of a glottic chink, in an attempt to promote greater glottal closure and increase the intensity of the voice. The SOVTEs exert a partial occlusion on the air exiting, which generates a superglottic retroflex pressure opposed to infraglottic pressure, expanding the pharynx and increasing the transglottic air flow, which decreases the coalition strength and keeps the vocal folds slightly abducted.[36,52,53] In these cases, the SOVTEs aim at decreasing the excessive glottic strain, to promote the glottal respiratory support and mobilize the mucous membrane, to enable the reabsorption of acquired injuries and decrease the mucosa's stiffness in cases of congenital lesions, in addition to promoting the improvement of the mucosal wave and the complete glottal closure in a normotensive way. As such, it is possible to reduce the noise by lowering the strain and roughness components, and by increasing the harmonic component in the voice. There might be a slight increase of breathiness in the voice, which could be controlled by improving the glottal closure.

Concerning the instrumental acoustic parameters, there was a reduction of the voice's F0 in the revaluation of G1, this reduction being significantly higher than that found in the group that was not subjected to the vocal intervention, G2 (Table 2).

TABLE 4.
Analysis of the Frequency of Vocal Symptoms in Women of Group 1 and Group 2

							Difference			
Symptom	Group	Evaluation	1Q	Median	3Q	*P*-Value	1Q	Median	3Q	*P*-Value
Hoarseness	G1	Before	2.00	2.00	3.00	0.360	–1.00	0.00	0.00	0.313
		After	1.00	2.00	3.00					
	G2	Before	3.00	3.00	4.00	1.000	0.00	0.00	0.00	
		After	3.00	3.00	4.00					
Voice loss	G1	Before	1.00	1.00	2.00	0.270	–1.00	0.00	0.00	0.042*
		After	0.50	1.00	2.00					
	G2	Before	1.00	2.00	2.00	0.090	0.00	1.00	1.00	
		After	1.00	2.00	3.00					
Breaking voice	G1	Before	2.00	2.00	2.00	1.000	–0.50	0.00	0.00	0.715
		After	1.00	2.00	2.00					
	G2	Before	2.00	3.00	4.00	0.236	–1.00	0.00	0.00	
		After	2.00	3.00	3.00					
Low-pitched voice	G1	Before	1.00	2.00	2.50	1.000	–0.50	0.00	0.00	0.570
		After	1.00	2.00	2.50					
	G2	Before	0.00	1.00	2.00	0.779	–1.00	0.00	1.00	
		After	1.00	1.00	2.00					
Strained speech	G1	Before	2.00	2.00	3.00	0.043*	–1.00	–1.00	0.00	0.082
		After	1.00	1.50	2.00					
	G2	Before	2.00	2.00	4.00	0.422	0.00	0.00	0.00	
		After	2.00	2.00	3.00					
Phlegm	G1	Before	1.00	1.50	2.50	0.690	–1.00	0.00	0.50	0.630
		After	1.00	1.00	2.00					
	G2	Before	1.00	2.00	2.00	1.000	0.00	0.00	0.00	
		After	1.00	2.00	2.00					
Dry cough	G1	Before	1.00	1.00	1.00	0.690	–1.00	0.00	0.50	0.464
		After	0.00	0.50	2.00					
	G2	Before	1.00	2.00	2.00	0.674	–1.00	0.00	1.00	
		After	1.00	2.00	2.00					
Cough with secretion	G1	Before	0.00	0.00	1.00	1.000	0.00	0.00	0.00	0.480
		After	0.00	0.00	1.00					
	G2	Before	1.00	1.00	1.00	0.361	0.00	0.00	1.00	
		After	1.00	1.00	2.00					
Pain when speaking	G1	Before	1.00	1.50	2.50	1.000	–0.50	0.00	0.00	0.456
		After	0.50	1.50	2.00					
	G2	Before	1.00	2.00	2.00	0.248	–1.00	0.00	0.00	
		After	1.00	2.00	2.00					
Pain when swallowing	G1	Before	0.00	1.00	2.00	0.140	–1.50	–0.50	0.00	0.196
		After	0.00	0.00	1.00					
	G2	Before	0.00	1.00	2.00	1.000	–1.00	0.00	1.00	
		After	1.00	1.00	2.00					
Secretion in throat	G1	Before	0.00	0.50	1.00	0.463	–0.50	0.50	1.00	0.255
		After	0.50	1.00	1.00					
	G2	Before	1.00	2.00	2.00	0.463	–1.00	0.00	0.00	
		After	1.00	2.00	2.00					
Dry throat	G1	Before	1.00	1.50	2.50	0.345	–1.00	0.00	0.50	0.064
		After	0.50	1.50	2.00					
	G2	Before	2.00	2.00	3.00	0.067	0.00	0.00	1.00	
		After	2.00	3.00	4.00					

* Wilcoxon test ($P < 0.05$) and Mann-Whitney test ($P < 0.05$).
Abbreviations: 1Q, first quartile; 3Q, third quartile; G1, group 1; G2, group 2.

This result can be explained by the way in which the intervention was carried out. The therapeutic program was supported by three main axes: indirect intervention, direct intervention, and a method for applying the intervention.[17] The overall purpose of indirect intervention was to improve participants' knowledge and provide strategies with which they could improve their health, production, and vocal behavior. These goals have been implemented through vocal pedagogical strategies with the

TABLE 5.
Analysis of the Frequency of Musculoskeletal Pain in Women of Group 1 and Group 2

							Difference			
Region	Group	Evaluation	1Q	Median	3Q	*P*-Value	1Q	Median	3Q	*P*-Value
Back of the neck	G1	Before	0.50	1.50	2.00	0.108	0.00	0.00	1.00	0.495
		After	1.00	2.00	2.00					
	G2	Before	2.00	2.00	4.00	0.753	0.00	0.00	1.00	
		After	2.00	3.00	4.00					
Shoulders	G1	Before	0.00	1.00	2.00	1.000	0.00	0.00	0.50	0.629
		After	0.50	1.00	2.00					
	G2	Before	1.00	2.00	3.00	1.000	0.00	0.00	1.00	
		After	2.00	2.00	2.00					
Upper back	G1	Before	0.50	1.50	2.00	0.177	−1.00	−0.50	0.00	0.573
		After	0.00	0.50	1.50					
	G2	Before	1.00	2.00	3.00	0.753	−1.00	0.00	0.00	
		After	1.00	2.00	2.00					
Temporal region	G1	Before	0.00	1.00	1.50	0.422	0.00	0.00	0.50	0.302
		After	1.00	1.00	2.00					
	G2	Before	1.00	2.00	3.00	0.463	−1.00	0.00	0.00	
		After	1.00	2.00	3.00					
Masseter	G1	Before	0.00	0.00	0.00	0.361	0.00	0.00	1.00	0.405
		After	0.00	0.00	1.00					
	G2	Before	0.00	1.00	2.00	0.767	−1.00	0.00	1.00	
		After	0.00	1.00	2.00					
Submandibular region	G1	Before	0.00	0.00	0.00	0.422	0.00	0.00	0.50	0.890
		After	0.00	0.00	1.00					
	G2	Before	0.00	0.00	1.00	0.685	0.00	0.00	1.00	
		After	0.00	1.00	1.00					
Larynx	G1	Before	0.00	0.00	0.50	0.108	0.00	0.00	1.00	0.061
		After	0.00	1.00	2.00					
	G2	Before	1.00	3.00	4.00	0.308	−1.00	−1.00	1.00	
		After	1.00	2.00	3.00					
Front of the neck	G1	Before	0.00	0.00	0.50	0.361	0.00	0.00	1.00	0.127
		After	0.00	0.50	1.50					
	G2	Before	1.00	3.00	3.00	0.176	−1.00	0.00	0.00	
		After	1.00	2.00	2.00					

Wilcoxon test ($P < 0.05$) and Mann-Whitney test ($P < 0.05$).
Abbreviations: 1Q, first quartile; 3Q, third quartile; G1, group 1; G2, group 2.

presentation and discussion of a video about production and vocal behavior, and an illustrated presentation and discussion on vocal health and hygiene habits. In addition, the direct intervention aimed to reduce phonatory effort and to establish the respiratory support for phonation, directing airflow, balancing resonance, mobilizing the mucosa of the vocal folds, promoting complete glottal closure, and balancing pneumo-phono-articulatory coordination. To this end, the tasks with activities and participations worked with the five subsystems: auditory, vocal function, somatosensorial, musculoskeletal, and respiratory. The literature shows that participants with dysphonia, who have an excessive strain component on extrinsic muscles of the larynx, tend to have an elevated vertical position of the larynx, which causes the vocal folds to stretch, increases the strain placed on them, and, consequently, the frequency of the voice.[55] A study that analyzed the position of the larynx and pharynx during the SOVTE, similar to that of the present study, showed that this type of exercise promotes different postures of the vocal tract while they are being performed. In general, the SOVTE can promote a lower vertical position of the larynx, a narrower aryepiglottic opening, and a pharynx wider than in its position at rest, generating less laryngeal compression.[55] Such findings show that the set of tasks performed during the 4 weeks of rehabilitation in G1 may have rebalanced the laryngeal musculature, enlarged the vocal tract, and promoted the lowering of the larynx. As a result, it is believed that there was a greater relaxation of the vocal folds, which became less tense. Such changes might have produced a significantly lower fundamental frequency compared with the preintervention period.

As for the V-RQOL, there was significant improvement in the socioemotional domain in both groups, with no significant difference between them (Table 3). Considering that the group that was not subjected to the intervention obtained equivalent improvement in the V-RQOL, it is assumed that these results have been a consequence of the Hawthorne[56] effect. In this phenomenon, participants' behavior was altered only because they were

TABLE 6.
Characterization and Comparison of the Intensity of Musculoskeletal Pain of Group 1 and Group 2

							Difference			
Region	Group	Evaluation	1Q	Median	3Q	*P*-Value	1Q	Median	3Q	*P*-Value
Back of the neck	G1	Before	0.00	0.00	5.50	0.345	–2.00	4.50	12.50	0.678
		After	0.00	5.50	15.00					
	G2	Before	0.00	0.00	21.00	0.236	–1.00	8.00	24.00	
		After	1.00	1.,00	25.00					
Shoulders	G1	Before	0.00	0.50	48.50	0.915	–3.50	0.50	1.00	0.165
		After	0.50	7.00	17.50					
	G2	Before	0.00	0.00	8.00	0.027*	0.00	6.00	28.00	
		After	0.00	14.00	37.00					
Upper back	G1	Before	0.00	0.00	1.50	0.053	0.00	1.00	8.50	0.705
		After	0.00	1.50	9.50					
	G2	Before	0.00	0.00	29.00	0.400	–15.00	0.00	28.00	
		After	0.00	23.00	42.00					
Temporal region	G1	Before	0.00	0.00	2.00	0.345	–1.00	0.50	18.00	0.512
		After	0.00	1.50	18.00					
	G2	Before	0.00	0.00	0.00	0.715	0.00	0.00	1.00	
		After	0.00	0.00	2.00					
Masseter	G1	Before	0.00	0.00	0.00	0.422	0.00	0.00	0.50	0.632
		After	0.00	0.00	2.00					
	G2	Before	0.00	0.00	0.00	1.000	0.00	0.00	0.00	
		After	0.00	0.00	0.00					
Submandibular region	G1	Before	0.00	0.00	0.00	0.592	0.00	0.00	1.00	0.738
		After	0.00	0.00	2.00					
	G2	Before	0.00	0.00	0.00	0.465	0.00	0.00	0.00	
		After	0.00	0.00	0.00					
Larynx	G1	Before	0.00	0.00	0.00	1.000	0.00	0.00	0.00	0.553
		After	0.00	0.00	1.00					
	G2	Before	0.00	12.00	54.00	0.332	–51.00	–10.00	9.00	
		After	0.00	8.00	15.00					
Front of the neck	G1	Before	0.00	0.00	4.50	0.715	0.00	0.00	5.00	0.396
		After	0.00	1.50	8.00					
	G2	Before	0.00	2.00	53.00	0.161	–53.00	0.00	1.00	
		After	0.00	0.00	11.00					

* Wilcoxon test ($P < 0.05$) and Mann-Whitney test ($P < 0.05$).
Abbreviations: 1Q, first quartile; 3Q, third quartile; G1, group 1; G2, group 2.

aware that they were being studied, receiving attention, and professional refuge, even if in the case of G2, it only happened at evaluation sessions.[56] The data from this study corroborate this phenomenon, mainly because there was an improvement only in the socioemotional domain. This domain consists of issues that have a direct relation to psychosocial factors, such as feeling depressed, frustrated, or anxious, avoiding participating in social events, and becoming less communicative due to the voice. Studies that have examined the effect of other vocal rehabilitation interventions in individuals with dysphonia also found positive results in placebo groups or groups without any intervention, which were attributed to the Hawthorne[57,58] effect. Because we could not find a significant difference between the groups for any of the fields, it can be ascertained that the VTP did not interfere with the V-RQOL of the participants.

As for the vocal symptoms, the VTP provided a reduction in the frequency of the symptom "fatigue while talking" on the reassessment of G1, in relation to the preintervention evaluation; however, there was no difference between the groups for this symptom (Table 4). In contrast, although no significant difference could be detected between the evaluations, in the comparison between groups, it was observed that the reduction of the "loss of voice" symptoms was significantly greater in G1, the group that was subjected to VTP, in relation to G2 (Table 4). In addition to the above issues on the direct actions of the SOVTE, the reduction of the "vocal fatigue" symptom in G1 after the intervention and the significantly greater reduction of the symptom of "loss of voice" in the respective group might be due to improved vocal resistance throughout the therapeutic process proposed in this study. The improvement of vocal resistance might have an anatomic physiologic cause or is related to changes in vocal behavior. The direct intervention included six tasks, carried out for 3 minutes each, with a passive rest of 30 seconds between them. Interval training, as used in the present study, is proposed by the physiology of exercise to alternate between periods of training and rest.[59] This happens because during periods of

Session 0	**Objectives** o Improving knowledge on production and vocal behavior o Improving knowledge on vocal health and hygiene o Providing strategies to improve your production and vocal behavior o Providing strategies to improve your vocal health
	Taxonomy system o Indirect intervention **Taxonomy's subsystems** o Pedagogy intervention **Degrees of freedom** o One
	Proposed tasks for the session o Presentation and discussion of a video about production and vocal behavior o Presentation and discussion of an illustrative presentation on vocal health: habits and vocal hygiene vocals
Session 1	**Objectives** o Mobilizing the mucosa of the vocal folds o Balancing resonance o Reducing the phonatory effort
	Taxonomy system o Direct intervention **Taxonomy's subsystems** o Somatosensorial (discrimination) o Musculoskeletal (orofacial modification) **Degrees of freedom** o Two (one to two per exercise) **Task** o Activity Therapy Task
	Proposed tasks for the session o Discrimination: semi-occluded vocal tract - humming in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - humming in usual pitch for three minutes o Discrimination and orofacial modification: semi-occluded vocal tract - humming associated with a snap of the tongue in usual pitch for three minutes o Discrimination and orofacial modification: semi-occluded vocal tract - humming associated to the rotation of the tongue in the vestibule in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for three minutes **Home Program Structure (daily, twice a day)** o Discrimination: semi-occluded vocal tract - humming in usual pitch for one minute o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for one minute
Session 2	**Objectives** o Mobilizing the mucosa of vocal folds o Promoting the complete glottal closure o Reducing the phonatory effort o Working the respiratory support during phonation o Directing the air flow o Balancing pneumo-phono-articulatory coordination
	Taxonomy system o Direct intervention **Taxonomy's subsystems** o Somatosensorial (discrimination) o Auditory (sensorineural) o Vocal function (pitch modification) o Respiratory (respiratory support and coordination) **Degrees of freedom** o Four (one to three per exercise) **Task** o Activity Therapy Task

CHART 1. Proposal of the program of vocal therapy based on the taxonomy of vocal therapy.

	Proposed tasks for the session o Respiratory coordination and support: fricative /f/-/β/ in sequence with passage of sonority in usual pitch and abdominal breathing for three minutes o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ in usual pitch and abdominal breathing for three minutes o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ in usual pitch and abdominal breathing for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract fricative /β/ with pitch modifications for three minutes o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills with pitch modifications for three minutes **Home Program Structure (daily, twice a day)** o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ in usual pitch and abdominal breathing for one minute o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for one minute
Session 3	**Objectives** o Mobilizing the mucosa of vocal folds o Balancing the resonance o Reducing the phonatory effort
	Taxonomy system o Direct intervention **Taxonomy's subsystems** o Somatosensorial (discrimination) o Auditory (sensorineural) o Musculoskeletal (orofacial modification) o Vocal function (pitch modification) **Degrees of freedom** o Four (one to three per exercise)
	Task o Activity Therapy Task o Participation Therapy Task
	Proposed tasks for the session o Discrimination and orofacial modification: semi-occluded vocal tract - humming associated to the rotation of the tongue in the vestibule in usual pitch for three minutes o Discrimination and orofacial modification: semi-occluded vocal tract - humming associated with a snap of the tongue in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - humming in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - humming associated to the seven vowels in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills with pitch modifications for three minutes **Home Program Structure (daily, twice a day)** o Discrimination: semi-occluded vocal tract - humming in usual pitch for one minute o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for one minute
Session 4	**Objectives** o Mobilizing the mucosa of vocal folds o Promoting the complete glottal closure o Reducing the phonatory effort o Working the respiratory support during phonation o Directing the air flow o Balancing pneumo-phono-articulatory coordination

CHART 1. (***Continued***)

rest, there is a muscle recovery due to increased oxygen uptake, so the muscles improve their energy capacity during the performance of the tasks.[60] This intermittent work optimizes the muscle results obtained. In spite of the few available data in the literature about the vocal anatomic physiology of the laryngeal muscles, it is known that they are trainable.[61,62] Thus, it is believed that a program with exercises that work with the five subsystems and present a continuous increase of difficulty for the execution of direct tasks by increasing degrees of freedom and the gradual insertion of participation tasks in the sessions might lead to muscular adaptations, which allow greater muscular endurance. Thus, the set of tools used might have improved the vocal behavior, balanced vocal phonation, promoted relaxation, and muscle adaptation, and, consequently, might have

	Taxonomy system o Direct intervention **Taxonomy's subsystems** o Somatosensorial (discrimination) o Auditory (sensorineural) o Vocal function (pitch modification) o Respiratory (respiratory support and coordination) **Degrees of freedom** o Four (one to three per exercise) **Task** o Activity Therapy Task o Participation Therapy Task
	Proposed tasks for the session o Respiratory coordination and support: fricative /f/-/β/ in sequence with passage of sonority in usual pitch and abdominal breathing for three minutes o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ associated with the five vowels in usual pitch and abdominal breathing for three minutes o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ associated with the days of the week in usual pitch and abdominal breathing for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract fricative /β/ with pitch modifications and abdominal breathing for three minutes o Discrimination: semi-occluded vocal tract - lip or tongue trills associated to the five vowels in usual pitch for three minutes
	o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills with pitch modifications for three minutes **Home Program Structure (daily, twice a day)** o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ in usual pitch and abdominal breathing for one minute o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for one minute
Session 5	**Objectives** o Mobilizing the mucosa of vocal folds o Balancing the resonance o Reducing the phonatory effort
	Taxonomy system o Direct intervention **Taxonomy's subsystems** o Somatosensorial (discrimination) o Auditory (sensorineural) o Musculoskeletal (orofacial modification) o Vocal function (pitch modification) **Degrees of freedom** o Four (one to three per exercise) **Task** o Activity Therapy Task o Participation Therapy Task
	Proposed tasks for the session o Discrimination and orofacial modification: semi-occluded vocal tract - humming associated to the rotation of the tongue in the vestibule in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - humming in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - humming associated to the seven vowels in usual pitch for three minutes o Discrimination and orofacial modification: semi-occluded vocal tract - humming associated with a snap of the tongue in usual pitch for three minutes o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills with pitch modifications for three minutes **Home Program Structure (daily, twice a day)** o Discrimination: semi-occluded vocal tract - humming in usual pitch for one minute o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for one minute

CHART 1. (***Continued***)

Session 6	**Objectives** o Mobilizing the mucosa of vocal folds o Promoting the complete glottal closure o Reducing the phonatory effort o Working the respiratory support during phonation o Directing the air flow o Balancing pneumo-phono-articulatory coordination
	Taxonomy system o Direct intervention **Taxonomy's subsystems** o Somatosensorial (discrimination) o Auditory (sensorineural) o Vocal function (pitch modification) o Respiratory (respiratory support and coordination) **Degrees of freedom** o Four (one to three per exercise) **Task** o Activity Therapy Task o Participation Therapy Task
	Proposed tasks for the session o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/-/z/-/j/ sequentially in usual pitch and abdominal breathing for three minutes o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ associated with the five vowels in usual pitch and abdominal breathing for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract fricative /β/ with pitch modifications and abdominal breathing for three minutes o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ associated with the emission of syllables (vazaja-vezeje-vézéjé-viziji-vozojo-vózójó-vuzuju) in usual pitch and abdominal breathing for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills following the rhythm of the song "happy birthday to you" for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills with pitch modifications for three minutes **Home Program Structure (daily, twice a day)** o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ in usual pitch and abdominal breathing for one minute o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for one minute
Session 7	**Objectives** o Mobilizing the mucosa of vocal folds o Balancing the resonance o Reducing the phonatory effort
	Taxonomy system o Direct intervention **Taxonomy's subsystems** o Somatosensorial (discrimination) o Auditory (sensorineural) o Musculoskeletal (orofacial modification) o Vocal function (pitch modification) **Degrees of freedom** o Four (one to three per exercise) **Task** o Activity Therapy Task o Participation Therapy Task

CHART 1. (***Continued***)

caused the laryngeal musculature to be more resistant to fatigue, which could result in an improvement in the perception of stability and less fatigue while talking for G1. This study did not carry out a more direct control, with more specific vocal fatigue tests, which can be considered a limitation. Future studies might be able to accomplish this.

In addition, one of the main causes of vocal change in individuals with behavioral dysphonia is the improper use of the voice,[2] which might cause discomfort in the vocal tract and phonatory imbalance. As such, the indirect intervention to improve knowledge and vocal hygiene that took place in the initial session, and throughout the therapeutic sessions, might have influenced the vocal behavior and change of habits, favoring the phonatory balance and the increase of vocal resistance, which did not happen in G2, as it did not receive any kind of intervention.

Data showed that there was no change in the frequency of musculoskeletal pain (Table 5); however, there was a significant increase in the intensity of musculoskeletal pain in the "shoulders"

	Proposed tasks for the session o Discrimination: semi-occluded vocal tract - humming associated to the days of the week in psalmody voice for three minutes o Discrimination and orofacial modification: semi-occluded vocal tract - humming associated with a snap of the tongue and the five vowels in usual pitch for three minutes o Discrimination and orofacial modification: semi-occluded vocal tract - humming associated to the rotation of the tongue in the vestibule in usual pitch for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - humming with pitch modifications for three minutes o Discrimination: semi-occluded vocal tract - lip or tongue trills associated to the five vowels in usual pitch for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills with pitch modifications for three minutes **Home Program Structure (daily, twice a day)** o Discrimination: semi-occluded vocal tract - humming in usual pitch for one minute o Discrimination: semi-occluded vocal tract - lip or tongue trills in usual pitch for one minute
Session 8	**Objectives** o Mobilizing the mucosa of vocal folds o Promoting the complete glottal closure o Reducing the phonatory effort o Working the respiratory support during phonation o Directing the air flow o Balancing pneumo-phono-articulatory coordination
	Taxonomy system o Direct intervention **Taxonomy's subsystems** o Somatosensorial (discrimination) o Auditory (sensorineural) o Vocal function (pitch modification) o Respiratory (respiratory support and coordination) **Degrees of freedom** o Four (two to three per exercise) **Task** o Activity Therapy Task o Participation Therapy Task
	Proposed tasks for the session o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ associated with the five vowels in usual pitch and abdominal breathing for three minutes o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ associated with the days of the week in usual pitch and abdominal breathing for three o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ associated to the emission of syllables (vazaja-vezeje-vézéjé-viziji-vozojo-vózójó-vuzuju) in usual pitch and abdominal breathing for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract fricative /β/ with pitch modifications and abdominal breathing for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills with pitch modifications for three minutes o Discrimination, pitch modification and sensorineural: semi-occluded vocal tract - lip or tongue trills following the rhythm of the song "happy birthday to you" for three minutes **Home Program Structure (daily, twice a day, after the end of the intervention)** o Discrimination and respiratory support: semi-occluded vocal tract - fricative /β/ in usual pitch and abdominal breathing for one minute o Discrimination and respiratory support: semi-occluded vocal tract - humming in usual pitch and abdominal breathing for one minute o Discrimination and respiratory support:semi-occluded vocal tract - lip or tongue trills in usual pitch and abdominal breathing for one minute

CHART 1. (***Continued***)

region in the evaluation made after 6 weeks in the group that did not undergo any speech therapy intervention—G2 (Table 6). The investigation of symptoms of musculoskeletal pain in women with behavioral dysphonia is important in the evaluation and treatment through speech therapies because these women show inadequate posture and vocal behavior, often associated with excessive strain on the laryngeal and cervical musculature, which can trigger symptoms of pain in the regions proximal to the larynx in women with behavioral dysphonia.[4] The research in relation to pain symptoms in this population is recent, and there are few studies[5,49] that have verified the effects of techniques in the musculoskeletal pain of women with dysphonia. Studies show that specific manipulation techniques such as those included in the manual laryngeal therapy[5,49] and procedures such as transcutaneous electrical nerve stimulation in the region of the suprahyoid and trapezes might promote the reduction of the frequency and

intensity of pain in the shoulder and neck regions[49] of women with vocal nodules. This can explain the results of this study because the tasks included only the orofacial modifications in the musculoskeletal subsystem,[17] through techniques of humming associated with rotation of the tongue in the vestibule, snap of the tongue, and chewed utterance. Tasks with specific techniques to promote relaxation and improve the muscular pattern of the neck and cervical spine, as well as the body posture, were not addressed. The musculoskeletal aspects of the neck and cervical region, which include the shoulders, were worked out in the VTP only with indirect vocal intervention, by means of pedagogy intervention, in which the therapist provided knowledge and strategies with which the participant can modify his or her vocal behavior and muscle pattern used during vocal production, including posture and strain of regions near the larynx. As such, it could be seen that the approach of the present research was not enough to significantly decrease the intensity of musculoskeletal pain in the shoulders of G1 because the reduction observed descriptively was not significant, and there was no difference in the comparison between the groups. In contrast, in G2, the increase in pain may have occurred because the participants had been diagnosed with behavioral dysphonia, and as these participants did not receive any type of intervention, they went on with their inappropriate vocal behaviors and habits. These factors might have contributed to the increase in pain, as pain is part of the characteristics of this situation.[4] Such data point to the fact that the set of intervention procedures, along with the methodology used to apply the intervention, even without specific tasks for the extrinsic muscles of the larynx, cervical regions, and body posture might, by themselves, bring a rebalancing of the muscles next to the larynx and of the postural pattern used during phonation, and influence the pain perception of the participant with behavioral dysphonia.

The present study presented a selection bias with regard to the nonrandom allocation of the participants in the study groups. As such, we suggest that randomized clinical trials are carried out to confirm the findings of this study, as well as follow-up studies to verify the mid- and long-term effects of the proposed program.

CONCLUSIONS

Under the conditions in which this study was carried out, it could be concluded that the VTP based on the taxonomy of vocal therapy has obtained a positive effect on the global degree and the instrumental acoustic parameters of the vocal quality, the frequency of symptoms, and the intensity of musculoskeletal pain in adult women with behavioral dysphonia. We can also conclude that the proposal of a broad VTP for behavioral dysphonia based on the taxonomy of vocal therapy seems to have promoted phonatory balance and muscle relaxation and improved the vocal resistance of this population.

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REFERENCES

1. Jani R, Jaana S, Laura L, et al. Systematic review of the treatment of functional dysphonia and prevention of voice disorders. *Otolaryngol Head Neck Surg*. 2008;138:557–565. doi:10.1016/j.otohns.2008.01.014.
2. Behlau M, Zambon F, Moreti F, et al. Voice self-assessment protocols: different trends among organic and behavioral dysphonias. *J Voice*. 2017;31:112.e13–112.e27. doi:10.1016/j.jvoice.2016.03.014.
3. Pedrosa V, Pontes A, Pontes P, et al. The effectiveness of the comprehensive voice rehabilitation program compared with the vocal function exercises method in behavioral dysphonia: a randomized clinical trial. *J Voice*. 2016;30:377.e11–377.e19. doi:10.1016/j.jvoice.2015.03.013.
4. Silverio KCA, Siqueira LTD, Lauris JRP, et al. Musculoskeletal pain in dysphonic women. *Codas*. 2014;26:374–381. doi:10.1590/2317-1782/20142013064.
5. Reimann AP, Siqueira LTD, Rondon AV, et al. Efeito imediato da terapia manual laríngea em indivíduos disfônicos. *Codas*. 2016;28:59–65. doi:10.1590/2317-1782/20162015089.
6. Van Houtte E, Van Lierde K, Claeys S. Pathophysiology and treatment of muscle tension dysphonia: a review of the current knowledge. *J Voice*. 2011;25:202–207. doi:10.1016/j.jvoice.2009.10.009.
7. Paoletti OA, Fraire ME, Sanchez-Vallecillo MV, et al. The use of fibrolaryngoscopy in muscle tension dysphonia in telemarketers. *Acta Otorrinolaringol Engl*. 2012;63:200–205. doi:10.1016/j.otoeng.2012.05.005.
8. Zheng Y-Q, Zhang B-R, Su W-Y, et al. Laryngeal aerodynamic analysis in assisting with the diagnosis of muscle tension dysphonia. *J Voice*. 2012;26:177–181. doi:10.1016/j.jvoice.2010.12.001.
9. Cielo CA, Christmann MK, Ribeiro VV, et al. Musculoskeletal stress syndrome, extrinsic laryngeal muscles and body posture: theoretical considerations. *Rev CEFAC*. 2014;3:1639–1649. doi:10.1590/1982-0216201410613.
10. Liang FY, Yang JS, Mei XS, et al. The vocal aerodynamic change in female patients with muscular tension dysphonia after voice training. *J Voice*. 2014;28:393.e7–393.e10. doi:10.1016/j.jvoice.2013.11.010.
11. Mathieson L, Hirani SP, Epstein R, et al. Laryngeal manual therapy: a preliminary study to examine its treatment effects in the management of muscle tension dysphonia. *J Voice*. 2009;23:353–366. doi:10.1016/j.jvoice.2007.10.002.
12. Roy N, Leeper HA. Effects of the manual laryngeal musculoskeletal tension reduction technique as a treatment for functional voice disorders: perceptual and acoustic measures. *J Voice*. 1993;7:242–249. doi:10.1016/S0892-1997(05)80333-9.
13. Dromey C, Nissen SL, Roy N, et al. Articulatory changes following treatment of muscle tension dysphonia: preliminary acoustic evidence. *J Speech Lang Hear Res*. 2008;51:196. doi:10.1044/1092-4388(2008/015).
14. Angsuwarangsee T, Morrison M. Extrinsic laryngeal muscular tension in patients with voice disorders. *J Voice*. 2002;16:333–343. doi:10.1016/S0892-1997(02)00105-4.
15. Anhaia TC, Gurgel LG, Vieira RH, et al. Intervenções vocais diretas e indiretas em professores: revisão sistemática da literatura. *Audiol Commun Res*. 2013;18:361–366. doi:10.1590/S2317-64312013000400019.
16. Gartner-Schmidt JL, Roth DF, Zullo TG, et al. Quantifying component parts of indirect and direct voice therapy related to different voice disorders. *J Voice*. 2013;27:210–216. doi:10.1016/j.jvoice.2012.11.007.
17. Van Stan JH, Roy N, Awan S, et al. A taxonomy of voice therapy. *Am J Speech Lang Pathol*. 2015;24:101. doi:10.1044/2015_AJSLP-14-0030.
18. Colton RH, Casper JK. *Compreendendo Os Problemas de Voz—Uma Perspectiva Fisiológica Ao Diagnóstico E Ao Tratamento*. Porto Alegre: Artes Médicas; 1996.
19. Verdolini-Marston K, Burke MK, Lessac A, et al. Preliminary study of two methods of treatment for laryngeal nodules. *J Voice*. 1995;9:74–85. doi:10.1016/S0892-1997(05)80225-5.
20. Lessac A. *The Use and Training of the Human Voice: A Bio-Dynamic Approach to Vocal Life*. 3rd ed. Mountain View, CA: MayField Pub; 1996.
21. Chen SH, Hsiao T-Y, Hsiao L-C, et al. Outcome of resonant voice therapy for female teachers with voice disorders: perceptual, physiological, acoustic, aerodynamic, and functional measurements. *J Voice*. 2007;21:415–425. doi:10.1016/j.jvoice.2006.02.001.

22. Verdolini K, Druker DG, Palmer PM, et al. Laryngeal adduction in resonant voice. *J Voice*. 1998;12:315–327. doi:10.1016/S0892-1997(98)80021-0.
23. Yiu EM-L, Lo MCM, Barrett EA. A systematic review of resonant voice therapy. *Int J Speech Lang Pathol*. 2017;19:17–29. doi:10.1080/17549507.2016.1226953.
24. Stemple JC, Lee L, D'Amico B, et al. Efficacy of vocal function exercises as a method of improving voice production. *J Voice*. 1994;8:271–278. doi:10.1016/S0892-1997(05)80299-1.
25. Roy N, Gray SD, Simon M, et al. An evaluation of the effects of two treatment approaches for teachers with voice disorders: a prospective randomized clinical trial. *J Speech Lang Hear Res*. 2001;44:286–296. http://www.ncbi.nlm.nih.gov/pubmed/11324651.
26. Roy N, Weinrich B, Gray SD, et al. Three treatments for teachers with voice disorders. *J Speech Lang Hear Res*. 2003;46:670. doi:10.1044/1092-4388(2003/053).
27. Gorman S, Weinrich B, Lee L, et al. Aerodynamic changes as a result of vocal function exercises in elderly men. *Laryngoscope*. 2008;118:1900–1903. doi:10.1097/MLG.0b013e31817f9822.
28. de Mendonça RA, Sampaio TMM, de Oliveira DSF. Avaliação do programa de exercícios funcionais vocais de Stemple e Gerdeman em professores. *Rev CEFAC*. 2010;12:471–482. doi:10.1590/S1516-18462010005000069.
29. Teixeira LC, Behlau M. Comparison between vocal function exercises and voice amplification. *J Voice*. 2015;29:718–726. doi:10.1016/j.jvoice.2014.12.012.
30. Kotby MN, Shiromoto O, Hirano M. The accent method of voice therapy: effect of accentuations on FO, SPL, and airflow. *J Voice*. 1993;7:319–325. doi:10.1016/S0892-1997(05)80120-1.
31. Kotby MN, Basiouny SE, Hegazi MA. Efficacy of the accent method of voice therapy. *J Voice*. 1991;5:316–320.
32. Fex B, Fex S, Shiromoto O, et al. Acoustic analysis of functional dysphonia: before and after voice therapy (accent method). *J Voice*. 1994;8:163–167. doi:10.1016/S0892-1997(05)80308-X.
33. Bassiouny S. Efficacy of the accent method of voice therapy. *Folia Phoniatr Logop*. 1998;50:146–164.
34. Smith S, Thyme K. Statistic research on changes in speech due to pedagogic treatment (the accent method). *Folia Phoniatr Logop*. 1976;28:98–103.
35. Behlau M, Madazio G, Yamasaki R, et al. Presentation of the Comprehensive Vocal Rehabilitation Program for the treatment of behavioral dysphonia TT—Apresentacao do Programa Integral de Reabilitacao Vocal para o tratamento das disfonias comportamentais. *Codas*. 2013;25:492–496. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S2317-17822013000500492.
36. Titze IR. Voice training and therapy with a semi-occluded vocal tract: rationale and scientific underpinnings. *J Speech Lang Hear Res*. 2006;49:448–459. doi:10.1044/1092-4388(2006/035).
37. de Vasconcelos D, de Oliveira Camargo Gomes A, de Araújo C. Voiced lip and tongue trill technique: literature review. *Distúrb Comun*. 2016;28:581–593.
38. Gasparini G, Behlau M. Quality of life: validation of the Brazilian version of the Voice-Related Quality of Life (V-RQOL) measure. *J Voice*. 2009;23:76–81. doi:10.1016/j.jvoice.2007.04.005.
39. Hogikyan ND, Sethuraman G. Validation of an instrument to measure voice-related quality of life (V-RQOL). *J Voice*. 1999;13:557–569. doi:10.1016/s0892-1997(99)80010-1.
40. de Assis Moura Ghirardi AC, Piccolotto Ferreira L, Pimentel Pinto Giannini S, et al. Screening Index for Voice Disorder (SIVD): development and validation. *J Voice*. 2013;27:195–200. doi:10.1016/j.jvoice.2012.11.004.
41. Likert R. A technique for the measurement of attitudes. *Arch Psychol (Geneve)*. 1932;22:140.
42. Behlau M, Pontes P. *Avaliação E Tratamento Das Disfonias*. São Paulo: Lovise; 1995.
43. McHenry M, Johnson J, Foshea B. The effect of specific versus combined warm-up strategies on the voice. *J Voice*. 2009;23:572–576. doi:10.1016/j.jvoice.2008.01.003.
44. Landis JR, Koch GG. The measurement of observer agreement for categorical 854 data. *Biometrics*. 1977;33:159–174.
45. Paes SM, Zambon F, Yamasaki R, et al. Immediate effects of the Finnish resonance tube method on behavioral dysphonia. *J Voice*. 2013;27:717–722. doi:10.1016/j.jvoice.2013.04.007.
46. Maryn Y, Roy N. Sustained vowels and continuous speech in the auditory-perceptual evaluation of dysphonia severity. *J Soc Bras Fonoaudiol*. 2012;24:107–112.
47. Barsties B, Maryn Y. The influence of voice sample length in the auditory-perceptual judgment of overall voice quality. *J Voice*. 2017;31:202–210. doi:10.1016/j.jvoice.2016.07.006.
48. Behlau M, Madazio G, Oliveira G. Functional dysphonia: strategies to improve patient outcomes. *Patient Relat Outcome Meas*. 2015;243. doi:10.2147/PROM.S68631.
49. Alves Silverio KC, Brasolotto AG, Thaís Donalonso Siqueira L, et al. Effect of application of transcutaneous electrical nerve stimulation and laryngeal manual therapy in dysphonic women: clinical trial. *J Voice*. 2015;29:200–208. doi:10.1016/j.jvoice.2014.06.003.
50. da Cunha Pereira G, de Oliveira Lemos I, Dalbosco Gadenz C, et al. Effects of voice therapy on muscle tension dysphonia: a systematic literature review. *J Voice*. 2017;doi:10.1016/j.jvoice.2017.06.015.
51. Ribeiro VV, Vieira VP, Silverio KCA, et al. Laryngeal manual therapies for behavioral dysphonia: a systematic review and meta-analysis. *J Voice*. 2017;doi:10.1016/j.jvoice.2017.06.019.
52. Story BH, Laukkanen AM, Titze IR. Acoustic impedance of an artificially lengthened and constricted vocal tract. *J Voice*. 2000;14:455–469. doi:10.1016/S0892-1997(00)80003-X.
53. Titze IR. A framework for the study of vocal registers. *J Voice*. 1988;2:183–194. doi:10.1016/S0892-1997(88)80075-4.
54. Ramos AC, Floro RL, Ribeiro VV, et al. Musculoskeletal pain and voice-related quality of life in dysphonic and non-dysphonic subjects. *J Voice*. 2017;doi:10.1016/j.jvoice.2017.05.019.
55. Guzman M, Castro C, Testart A, et al. Laryngeal and pharyngeal activity during semioccluded vocal tract postures in subjects diagnosed with hyperfunctional dysphonia. *J Voice*. 2013;27:709–716. doi:10.1016/j.jvoice.2013.05.007.
56. Fernald DH, Coombs L, DeAlleaume L, et al. An assessment of the Hawthorne effect in practice-based research. *J Am Board Fam Med*. 2012;25:83–86. doi:10.3122/jabfm.2012.01.110019.
57. Yiu EML, Chan KMK, Kwong E, et al. Is acupuncture efficacious for treating phonotraumatic vocal pathologies? A randomized control trial. *J Voice*. 2016;30:611–620. doi:10.1016/j.jvoice.2015.07.004.
58. Faham M, Jalilevand N, Torabinezhad F, et al. Relationship between voice complaints and subjective and objective measures of vocal function in Iranian female teachers. *J Voice*. 2017;31:507.e1–507.e6. doi:10.1016/j.jvoice.2016.10.011.
59. Brooks DS. *Program Design for Personal Trainers*. New York, NY: IDEA Personal Trainer; 2000.
60. Fox EL, Bowers RW, Merle LF. *Bases Fisiológicas Da Educação Física E Dos Desportos*. 4th ed. Rio de Janeiro: Guanabara Koogan; 1992.
61. Sataloff RT. Clinical anatomy and physiology of the voice. In: Sataloff RT, ed. *Professional Voice: The Science and Art of Clinical Care*. San Diego, CA: Singular Publishing Group; 1997:111–130.
62. De Azevedo LL, Passaglio KT, Rosseti MB, et al. Avaliação da performance vocal antes e após a vibração sonorizada de língua. *Rev Soc Bras Fonoaudiol*. 2010;15:343–348. doi:10.1590/S1516-80342010000300006.