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Phonatory deviation diagram in two vocal rehabilitation programs

Diagrama de Desvio Fonatório em dois programas de reabilitação vocal

Diagrama de Desvío Fonatório en dos programas de rehabilitación vocal

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Abstract

Objective: To compare both vocal perceptual analysis and Phonatory Deviation Diagram (PDD) of a group of patients undergoing voice therapy with Vocal Function Exercises (VFE) and a group undergoing Comprehensive Vocal Rehabilitation Program (CVRP). **Methods:** 72 professional voices with vocal complaint, sent to voice rehabilitation of behavioral dysphonia, were followed during six speech therapy sessions. The participants were randomly divided into two groups. One of them was submitted to CVRP and the other, the VFE. The analyzed speech material was the / ε / vowel, recorded in Vocal Quality module of VoxMetria program (CTS Informatica) for extraction of the phonatory deviation diagram, pre and post therapy times. The groups were compared according to the general level of the voice deviation, acoustic aspects and to the distribution of the PDD vocal samples, in terms of normal area, density, shape and location in the quadrants. **Results:** The only difference was on the density of the PDD record on post vocal therapy, and the VFE group had a more concentrated record after the therapy compared to CVRP group ($p = 0.031$). Only individuals from the CVRP group showed differences on the vocal perceptual analysis,

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IB was responsible for the study design, data collection and analysis and the manuscript writing;
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VP was responsible for the study design and data collection;
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and most of them had their voices assessed as with no deviation in the post-intervention. **Conclusions:** Comprehensive Vocal Rehabilitation Program promotes an improvement of voice quality, but there was no correspondence of the vocal perceptual analysis with acoustic analysis, as the phonatory deviation diagram was sensitive to identify changes only in the evaluation of patients undergoing Vocal Function Exercises.

Keywords: Voice; Dysphonia; Acoustics; Speech, Language and Hearing Sciences.

Resumo

Objetivo: Comparar a análise perceptivo-auditiva vocal, análise acústica e diagrama de desvio fonatório (DDF) de pacientes submetidos à terapia de voz com os exercícios de função vocal (EFV) e de pacientes submetidos ao Programa Integral de Reabilitação Vocal (PIRV). **Métodos:** 72 profissionais da voz com queixa vocal, encaminhados para reabilitação vocal por disfonia comportamental, foram acompanhados por seis sessões de terapia de voz. Os participantes foram divididos aleatoriamente em dois grupos. Um deles foi submetido ao PIRV e o outro, ao EFV. O material de fala analisado foi a vogal /ɛ/, gravada no módulo qualidade vocal do programa Voxmetria (CTS Informatica), para extração do DDF, nos momentos pré e pós-terapia. Os grupos foram comparados de acordo com o grau geral do desvio vocal, aspectos acústicos e com a distribuição das amostras vocais no DDF, em relação à área de normalidade, densidade, forma e localização nos quadrantes. **Resultados:** Houve diferença apenas quanto à densidade do registro do DDF no pós-terapia vocal, sendo que o grupo EFV apresentou registro concentrado no pós-terapia quando comparado ao grupo PIRV. Apenas indivíduos do grupo PIRV apresentaram diferenças na avaliação perceptivo-auditiva pré e pós, sendo que mais indivíduos tiveram suas vozes avaliadas como sem desvio no pós-intervenção. **Conclusões:** O Programa Integral de Reabilitação Vocal promoveu melhora da qualidade vocal, porém não houve correspondência da análise perceptivo-auditiva com a análise acústica, já que o diagrama de desvio fonatório foi sensível para identificar mudanças somente na avaliação dos pacientes submetidos aos exercícios de função vocal.

Palavras-chave: Voz; Disfonia; Acústica; Fonoaudiologia.

Resumen

Objetivo: Para comparar la voz de análisis perceptiva, análisis acústicos y auditivo diagrama de desvío fonatorio (DDF) de pacientes sometidos a terapia de voz con los ejercicios de la función vocal (EFV) y de los pacientes se han sometidos a rehabilitación Vocal completo programa (PIRV). **Métodos:** 72 profesionales en voz con vocal queja, enviado para rehabilitación vocal por disfonía comportamiento, fueron acompañados por seis sesiones de terapia del habla. Los participantes se dividieron al azar en dos grupos. Uno de ellos fue presentado a PIRV y el otro el EFV. El material del discurso analizado fue registrado en el módulo de programa de calidad vocal Voxmetria (Informatica de CTS), a la extracción del DDF, pre veces y post terapia. Los grupos fueron comparados según el grado General de aspectos acústicos de la voz y con la distribución de muestras vocales en DDF. **Resultados:** No hubo diferencias así como la densidad del registro DDF después de terapia vocal, el grupo se concentró en post registro presentado terapia EFV en comparación con grupo PIRV. Sólo individuos PIRV grupo mostró diferencias en la evaluación perceptual-pre y post audición, ya que más personas tenían sus voces como no se desvían después de la intervención. **Conclusiones:** El programa completo de rehabilitación Vocal promovió la mejora de la calidad vocal, pero no había ninguna coincidencia de análisis perceptivo-audiencia con análisis acústico, puesto que el diagrama de desvío fonatorio era sensible para identificar cambios en la evaluación de pacientes sometidos a los ejercicios de la función vocal.

Palabras clave: Voz; Disfonía; Acústica; Fonoaudiología.

Introduction

The voice evaluation of patients with dysphonia should be multidimensional, that is, it must include data of auditory, acoustic and visual analysis, in addition to self-assessment protocols of the impact of the voice problem[1]. Acoustic and perceptual-auditory analysis are important clinical tools that must be analyzed together, in order to effectively follow-up each patient development throughout the therapeutic process[2].

Despite of the known subjectivity and the lack of a standardized protocol[3,4], the perceptual-auditory analysis is the most traditional evaluation of the voice clinic routine. It provides important information about the laryngeal anatomy, the presence, type and degree of any vocal deviation, therefore, it is considered to be the gold standard for the vocal evaluation[1,5]. On the other hand, the acoustic analysis is an objective evaluation of the vocal production that contributes to: a better acoustic understanding of the voice, to strengthen the association between the perceptual-auditory and the acoustic analysis, to monitor the vocal therapy outcomes and to compare the effectiveness of different types of vocal treatment[6].

The vocal rehabilitation process can offer voice and communication improvement as well as develop an adapted voice for different vocal demands, that may be personal, social or professional[1]. The literature describes some different approaches each one with its advantages and disadvantages; the clinician must choose the best therapeutic approach for each patient[1]. For professional voice users, the vocal therapy rehabilitation must involve all the altered physiological systems and the patient's identification, awareness, and modification of any harmful vocal habits[7]. It is known that the professional voice users, such as teachers, singers, telemarketers, reporters, gymnastics instructors, salesmen, receptionists, actors, among many others, are those who are at greater risk of developing vocal problems[8,9,10,11].

One of the vocal rehabilitation approaches is the Physiological therapy approach with a holistic orientation[12,13]; its purpose is to modify the inadequate physiological activity. The Vocal Function Exercises (VFE), proposed by Stemple et al[14,15], reinforces and rebalance the vocal subsystems[14,15,16] by means of a systematic exercise program. They are indicated for any type of voice disorder characterized by vocal hypo or hyperfunction and/or muscular imbalance[1]. The VFE has shown positive vocal outcomes, such as increasing the phonation volume, the airflow measurements and the maximum phonation time[15].

There is also the Comprehensive Vocal Rehabilitation Program (CVRP), it is also a program with a holistic orientation; but, differently from the VFE, it understands the vocal disorder as being multifactorial, therefore, it requires different intervention perspectives[17]. Hence, the program focuses on five characteristics: body-voice integration, glottal source, resonance, coordination of subsystems and communicative attitude[17].

Thus, in order to verify the differences and the effectiveness of the VFE and the CVRP, the objective of this study was to analyze and to compare the vocal perceptual-auditory evaluation and the acoustic analysis outcomes of two groups of patients undergoing voice therapy; being one group submitted to the Vocal Function Exercises (VFE) and another group submitted to the Comprehensive Vocal Rehabilitation Program (CVRP).

Method

This research was approved by the UNIFESP Ethics Committee under the protocol number 0715/10. In accordance with the requirement of the Resolution 196/96 (Brazil Resolution MS / CNS / CNEP No. 466, December 12th, 2012), all participants signed the informed consent form.

A blinded clinical trial was performed. The individuals were invited to participate in this study on a voluntary basis through announcements at their workplaces, such as schools, shops, telemarketing centers, universities, Internet and radio stations. A total of 306 individuals were contacted but only 80 met the inclusion criteria and were available to participate in the therapeutic process and to attend for the first evaluation session.

The CVRP group and the VFE group began both with 40 patients each. Three patients of the CVRP group and five patients of the VFE group abandoned the treatment. The inclusion criteria were: professional voice users between 18 and 50 years old, with voice complaints for more than six months, related to the vocal use, and otorhinolaryngological and speech language pathologist diagnosis of behavioral dysphonia[1], with referral for vocal rehabilitation. Subjects with speech, lan-

guage hormonal and/or neurological disorders and recent acute dysphonia were excluded. Therefore, there was a total of 72 subjects participating in the therapeutic process.

All volunteers underwent speech-language pathology assessment before and after the vocal therapy. The assessment consisted of vocal perceptual-auditory evaluation and acoustic analysis. In the first therapy session, the subjects were randomized and divided into two groups: the VFE group, with 35 subjects, who underwent voice therapy based on the vocal function exercises; and the CVRP group, with 37 subjects, who underwent the Comprehensive Vocal Rehabilitation Program. Online database register software randomly divided the patients in each group.

Two voice- specialist speech-language pathologists conducted the vocal therapy. They received previous training on the database usage, instructions of the clinical trial format, instructions of the randomization and guidance on the two vocal programs application. In addition, there was also a weekly monitoring of the methods application. Both voice specialists conducted the therapy for both groups in separate moments. The therapy took place at several different places and in different schedules, according to the voice specialists and the patient's agenda.

The perceptual-auditory evaluation was performed by three voice specialists, with extensive clinical experience and more than eight years of experience in the field. For the evaluation, the voices were presented in a random order. The evaluation was blinded, that is, the evaluators did not have any information regarding the patient's therapy group (CVRP or VFE). The voices were presented in pairs, but without any identification of the recording moment (pre or post-therapy). The three voice- specialists evaluated the overall dysphonia degree with a numerical scale of 4 points (0 = no deviation, 1 = mild deviation, 2 = moderate deviation, 3 = severe deviation). In order to test the intra-rater reliability, 43 voices were repeated and only the answers of the most reliable evaluator were considered for the final analysis.

For the acoustic evaluation, the Phonatory Deviation Diagram (PDD) of the Voxmetria Program was used (CTS *Informática*). The PDD is a feature that allows an automatic extraction of vocal measurements and that offers the voice distribution in a simple diagram[6]. The configuration of the vocal samples distribution analysis was based on the Madazio et al[2] study; the normality area, the density, the shape and the place in the quadrants of the graph were considered. Regarding the normality area, the distribution was classified as in or out of the normality area defined by the software. Regarding the Density, it was classified as: concentrated (when all of the points were located inside one square of the software graph) or spread (when the points were distributed into more than one square). Regarding the Shape, it was classified as: horizontal (distance between the points at the coordinate X was longer than the distance between the points at the coordinate Y, $X>Y$); vertical (distance between the points in the coordinate X was shorter than at the coordinate Y, $X<Y$); or circular (distance between the points in both coordinates were approximately the same, $X\approx Y$), regardless of the density (Figure 1).

The Phonatory Deviation Diagram was also divided into four quadrants: the left lower – quadrant 1, the normality area; the right lower – quadrant 2; the right upper – quadrant 3; and left upper – quadrant 4 (Figure 2).

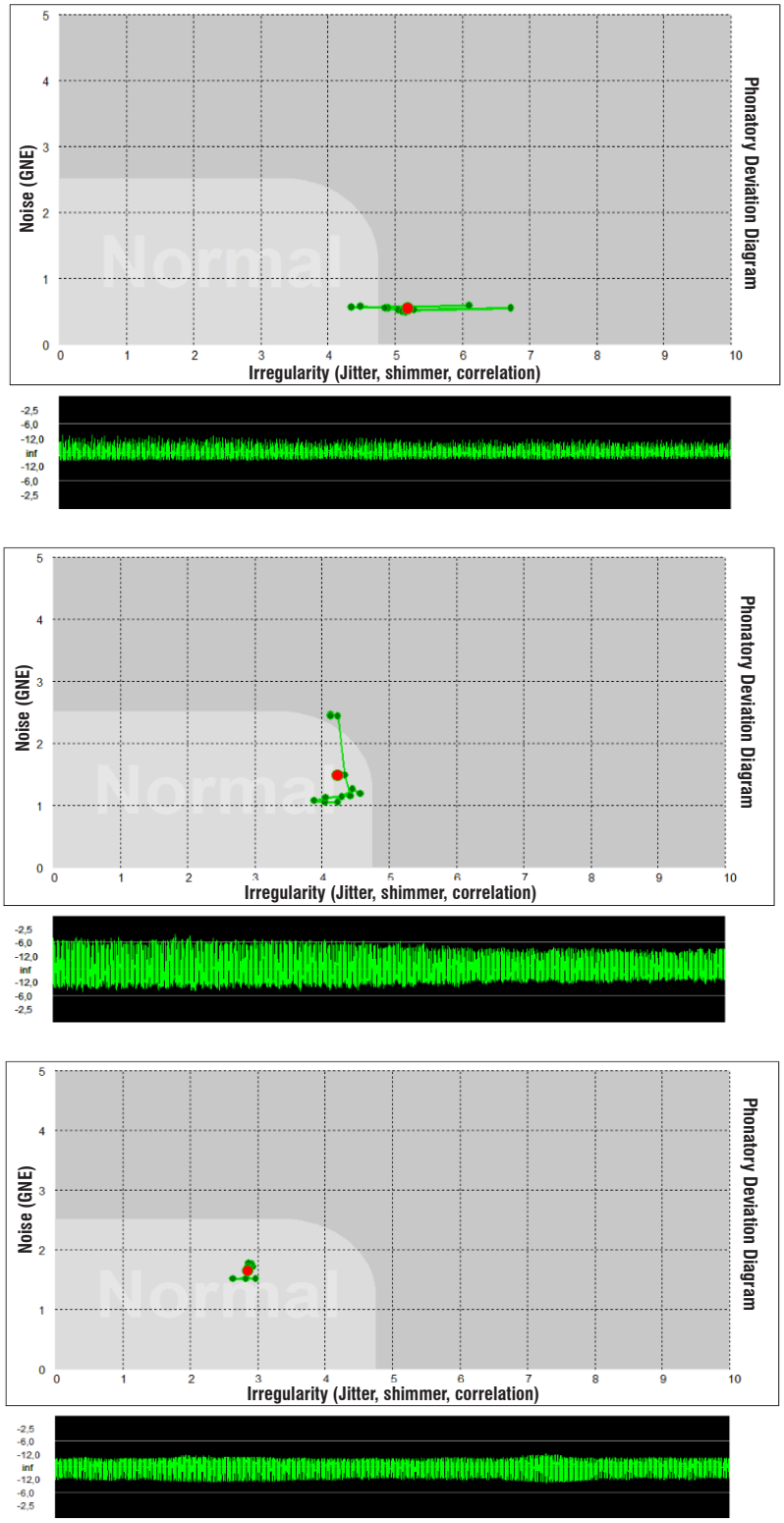

Figure 1. Vocal samples distribution examples of the PDD: A – spread density and horizontal shape; B – spread density and vertical shape; C – concentrated sample and circular shape

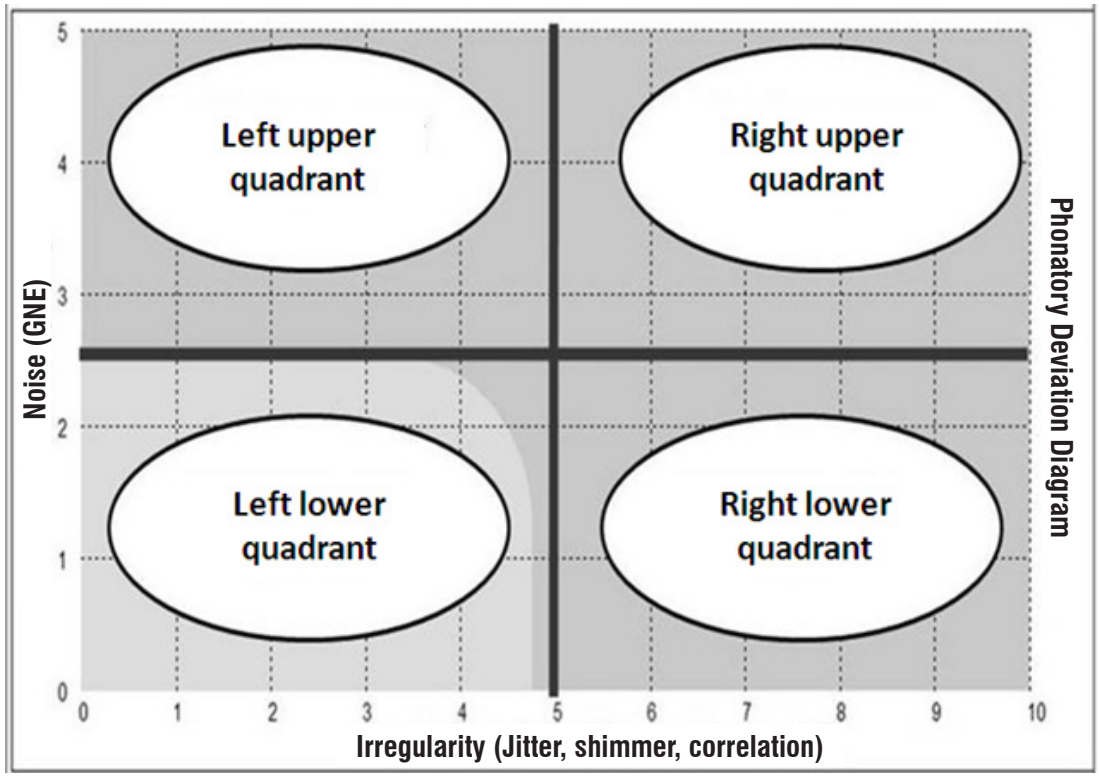

Figure 2. PDD didactical division in four quadrants

The vocal therapy occurred once a week for six weeks. At the first session, the patient received an information sheet about vocal health. In all the sessions, each patient was imparted about vocal hygiene aspects, encouraged to discuss his doubts with the therapist and to perform the vocal exercises twice a day. Both groups participants received support materials per week, which were: a written guideline with the exercises for the week; a paper sheet to record the frequency of the exercises that were to be performed at home and a CD with the recording of the exercises.

The therapy sessions were defined as the pre-established description for each method[15,16,17,19]. The activities for the CVRP group were: Session I. Work with the glottal source; Session 2. Work with the glottal source and the resonance; Session III to VI. Work with the glottal source, the resonance and the coordination of subsystems[17,19]. For the VFE group, four exercises were performed: I. Warm-up exercises; II. Vocal fold shortening exercises; III. Vocal fold gentle lengthening exercises and IV. Vocal folds adduction[15,16].

The acoustic voice analysis used the HP Pavillion zv6000, Athlon 64 AMD, Windows XP computer with the VoxMetria Program, Version 4.0 and the Genius HS-04SU headset microphone. The samples were recorded and edited in order to eliminate the first second of the emission, marked by natural instability; therefore, the analyzed sample was the subsequent three seconds. The speech material analyzes was the sustained vowel /ɛ/, in usual pitch and loudness, recorded in two different moments: the first session, the pre-therapy moment, and the sixth session, the post-therapy moment.

On the VFE group initial evaluation, 10 voices were classified as G0, 12 as G1 and 13 as G2; for the CVRP group, 4 voices were classified as G0, 18 as G1 and 15 as G2.

The data of this research are quantitative and continuous variables; therefore, they were submitted to statistical treatment using parametric tests. The Equality of Two Proportions Test was used to compare the moment's pre and post-therapy considering the perceptual-auditory analysis, the density, the shape and the place in the quadrants. Taking into

account that each subject is the control of his-self, the Student's t-test for paired samples was used to compare the following quantitative variables: G, jitter, shimmer, GNE and noise.

Results

Differences in the perceptual-auditory analysis pre and post-therapy were only observed for the patients in the CVRP group; more patients had their voices rated as with no deviation in the post-therapy moment (Table 1).

Table 1. VFE and CVRP perceptual-auditory analysis for the pre and the post-therapy moments

PAA	Pre-therapy		Post-therapy		p-value
	N	%	N	%	
VFE					
G0	10	28.6	17	48.6	0.086
G1	12	34.3	12	34.3	1.000
G2	13	37.1	6	17.1	0.060
CVRP					
G0	4	10.8	24	64.9	<0.001*
G1	18	48.6	9	24.3	0.030*
G2	15	40.5	4	10.8	0.003*

* Significant values (p≤0.05) – Equality of Two Proportions Test

PAA = perceptual-auditory analysis; VFE = Vocal Function Exercise group; CVRP = Comprehensive Vocal Rehabilitation Program group; G0 = no vocal deviation; G1 = mild vocal deviation; G2 = moderate vocal deviation; G3 = severe vocal deviation

The patients submitted to the VFE presented voices with a more concentrated density in the post-therapy moment when compared to the patients submitted to the CVRP (Table 2). No significant difference was found between the two groups in the post-therapy moment regarding the shape and the place in the quadrants (Table 2).

Also, no significant difference was found between both groups for the acoustic measures of jitter, shimmer, GNE and noise on the post-therapy moment (Table 3).

Table 2. Data analysis of the PDD: density, shape and place in the quadrants for the VFE and the CVRP groups on the pre and post-therapy moments

PDD		Pre		Post		p-value
		N	%	N	%	
Density						
VFE	C	12	0.343	21	0.6	0.031*
	S	23	0.657	14	0.4	
CVRP	C	19	0.514	15	0.405	0.351
	S	18	0.486	22	0.595	
Shape						
VFE	V	7	0.2	5	0.143	0.526
	H	26	0.743	28	0.8	0.569
	C	2	0.057	2	0.057	1
CVRP	V	12	0.324	10	0.27	0.611
	H	23	0.622	26	0.703	0.461
	C	2	0.054	1	0.027	0.556
Quadrants						
VFE	LL	26	0.743	29	0.829	0.382
	RU	1	0.029	0	0	0.314
	RL	8	0.229	6	0.171	0.55
CVRP	LU	2	0.054	0	0	0.152
	LL	31	0.838	33	0.892	0.496
	RU	3	0.081	2	0.054	0.643
	RL	1	0.027	2	0.054	0.556

* Significant values (p≤0.05) – Equality of Two Proportions Test
VFE = Vocal Function Exercise group; CVRP = Comprehensive Vocal Rehabilitation Program group; PDD = Phonatory Deviation Diagram group; C = concentrated; S = spread; V = vertical; H = horizontal; C = circular; LL = left lower; RU = right upper; RL = right lower; LU = left upper

Discussion

Nowadays, due to the small amount of studies, the needs to study the effects of vocal therapy are incresing[20]. The method that holds more data and clinical evidence for the treatment success of the behavioral dysphonia is the VFE[15]. Therefore, to verify the effectiveness and the applicability of a new method, such as the CVRP, it is necessary to compare it with this already known method, the VFE.

This research found a significant change in the vocal quality (Table 1) pre and post-therapy, therefore, the CVRP effectiveness was proven for professional voice users. On the other hand, the VFE method was not proven to be effective in the present research, although it was in many previous studies[14,15,21,22]. However, the results indicated a trend towards statistical significance. It is noteworthy, that in the pre-therapy moment, 28.6% (N=10) of the subjects from the VFE group had their voices classified as with no deviation; while for the CVRP group only 10.8% had their voices considered as G=0. This might have somehow influenced the study results.

Many patients kept a mild deviated voice even after the six sessions of vocal therapy. For instance, the VFE group had 34.3% of the patients classified with mild vocal deviation, G=1, both at the pre and post-therapy moments. Perhaps, more therapy sessions were necessary in order to adequate the vocal deviation.

Taking into to account that the vocal parameters of strain and asthenia suffer cultural influences[23] and may be evaluated as more or less severe, there might have been a vocal change, but despite of this change, the overall dysphonia degree remained the same. The acoustic analysis strengthens this hypothesis.

To obtain the vocal quality acoustic data, the present research used the PDD. The PDD is a diagram that allows the automatic extraction of the acoustic data by using combine parameters and offering a distribution of the vocal sample in a graphic presentation [6]. It also suggests probable phonatory mechanisms that are used by the patient[2]. The vocal samples analysis of the PDD considers

Table 3. Acoustic parameters for the VFE and the CVRP groups for both therapy moments and divided by sex

	Female				Male			
	VFE		CVRP		VFE		CVRP	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Jitter								
Mean	0.49	0.33	0.33	0.29	0.63	0.47	0.22	0.18
Median	0.18	0.2	0.17	0.16	0.2	0.23	0.23	0.17
SD	0.64	0.4	0.43	0.34	1.56	0.69	0.05	0.05
CV	131	121	133	118	249	146	23	30
Min	0.07	0.06	0.08	0.07	0.1	0.08	0.15	0.11
Max	1.88	1.68	2.27	1.63	6.05	2.4	0.32	0.29
N	21	21	29	29	14	14	8	8
CI	0.27	0.17	0.16	0.12	0.82	0.36	0.04	0.04
p-value	0.324		0.463		0.672		0.095	
Shimmer								
Mean	4.28	4.32	4.36	4.07	6.86	6.65	7.06	6.96
Median	3.37	4.16	3.49	3.29	5.55	5.25	6.2	4.12
SD	1.68	2.2	2.6	2.72	4.74	3.58	4.24	7.67
CV	39	51	60	67	69	54	60	110
Min	1.98	1.84	1.9	1.03	2.72	2.43	3.76	2.53
Max	7.13	12.17	14.31	14.22	21.24	14.84	17.07	25.62
N	21	21	29	29	14	14	8	8
CI	0.72	0.94	0.94	0.99	2.49	1.87	2.94	5.31
p-value	0.933		0.339		0.835		0.939	
GNE								
Mean	0.8	0.8	0.74	0.79	0.85	0.84	0.75	0.74
Median	0.87	0.86	0.85	0.83	0.87	0.9	0.76	0.8
SD	0.15	0.17	0.21	0.17	0.09	0.14	0.17	0.24
CV	19	21	28	22	10	16	23	33
Min	0.51	0.35	0.3	0.44	0.68	0.46	0.47	0.25
Max	0.96	0.96	0.96	0.98	0.96	0.95	0.96	0.95
N	21	21	29	29	14	14	8	8
CI	0.06	0.07	0.08	0.06	0.05	0.07	0.12	0.17
p-value	0.979		0.164		0.867		0.885	
Noise								
Mean	1.07	1.06	1.3	1.13	0.86	0.89	1.27	1.33
Median	0.79	0.81	0.87	0.95	0.8	0.67	1.23	1.08
SD	0.62	0.7	0.87	0.7	0.36	0.56	0.72	1
CV	58	66	67	62	42	63	56	75
Min	0.39	0.39	0.39	0.31	0.42	0.46	0.41	0.45
Max	2.27	2.93	3.13	2.57	1.56	2.45	2.42	3.35
N	21	21	29	29	14	14	8	8
CI	0.27	0.3	0.32	0.26	0.19	0.29	0.5	0.69
p-value	0.945		0.212		0.868		0.867	

Student`s t-test for paired samples
CV = Coefficient of Variation; CI = Confidence Interval

the normality area, the density, the shape and the four quadrants[6].

Considering the density, there was a significant difference between the pre and the post-therapy moments for the VFE group (Table 2); there was an increase in the occurrence of concentrated density, characteristic of a strain voice[6]. Moreover, the CVRP group presented a density decrease in the post-therapy moment. This data supports the hypothesis that there was a change on the vocal quality from roughness or breathiness to strain in the post-therapy moment. Clinical findings suggest

that the vocal function exercises indeed favor a strain and more projected vocal quality, which is in agreement with a more concentrated density in the PDD graph[6].

According to what was found in previous studies[2,6], regarding the vocal samples shape, there was no significant difference between the groups, that maintained mostly a horizontal shape, both pre and post-therapy (Table 2). Both groups presented a decrease in the vertical shape, although no statistical difference was found; for the VFE group, seven patients had a vertical shape at the pre-therapy moment and only five in the post-therapy moment; for the CVRP, 12 patients presented a vertical shape in the pre-therapy moment and 10 in the post-therapy moment. This finding also corroborates with other studies[2,6], that found that this vertical shape is less usual for adapted voices. Seven of the 15 voices that were classified as vertical were evaluated as G1, that is, with mild vocal deviation (four from the CVRP group and three from the VFE group); the other eight voices were evaluated as G0, no vocal deviation (two from the CVRP and six from the VFE). Regarding the circular shape, no statistical difference was found between both groups. The CVRP group had a decrease in the occurrence of this type of distribution – two voices were classified as circular at the pre-therapy moment and only one at the post-therapy moment; for the VFE, this type of occurrence was the same in both moments – two voices -. The literature brings no consensus regarding this data. One article found less circular shape occurrence in adapted or normal voices, but with no statistical difference[6]. Another article found greater presence of the circular shape post-vocal therapy when compared to the pre-vocal therapy recording. These authors[2] believes that the circular shape is found when there is a balance between roughness and breathiness.

There was no difference in the place of the vocal samples in the quadrants (Table 2). Even at the pre-therapy moment, most of the patients' voices were within the normality area, the left lower quadrant[6]; and it remained that way in the post-therapy moment. Professional voice users formed both groups; therefore, they could not present any evident and compromising vocal deviation, for this reason, no one was classified with a severe vocal deviation. It is important to highlight that the normality area includes voices with no deviation and also with mild deviations[6]. For the VFE group, 12 individuals (34.3%) had mild deviations in the pre-therapy moment and 9 of them were within the normality area; for the CVRP group, 18 individuals (48.6%) had mild deviations and 15 of them were within the normality area.

The literature has no consensus of any direct correlation between the perceptual-auditory evaluation and the acoustic evaluation[24,25]. This research data showed for the CVRP group that, even with a significant difference in the vocal quality at the pre and the post-therapy moments, still there was no significant change in the jitter, shimmer, GNE and noise parameters (Table 3). Taking into account, that there is not a direct correlation between the perceptual-auditory and the acoustic analysis, these measures should be used as a complementation to each other[6,24].

Most studies[6,21,26,27] establish an average treatment of four to six weeks for research purposes. Although the exact duration of the vocal therapy is not yet clear, since it depends on many intrinsic factors for each patient[15,16,22,24], the present study provided a therapy period of six weeks. These duration was consistent with the Comprehensive Vocal Rehabilitation Program proposal and with several studies that compared different treatment approaches for dysphonia[16,21,26,27]. It is important to highlight that the six weeks of treatment did not lead to the complete vocal recovery for all patients, as previously mentioned. Moreover, it did offer an adapted vocal quality for most of the patients (48.6% for the VFE group and 64.9% for the CVRP group); also it improved the vocal quality, even when not all vocal parameters were better; the VFE group had less individuals classified with moderate vocal deviation and the CVRP group had less individuals classified with moderate and with mild vocal deviation. In addition, six-week therapy duration is enough to provide proprioception improvement, identification of adequate and inadequate vocal habits and knowledge of good vocal practices [19].

In agreement with the present study, previous research compared the effectiveness of the VFE program with the CVRP and found that both were effective; in addition, it found a greater likelihood for improvement when treated with the CVRP[19].

Conclusion

The Comprehensive Vocal Rehabilitation Program promoted a vocal quality improvement. No correlation was found between the perceptual--auditory analysis and the acoustic analysis, once the Phonatory Deviation Diagram was sensitive to identify changes only for the patients submitted to the Vocal Function Exercises. The VFE developed a concentrated density in the PDD, even though, no significant vocal quality changes were observed.

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