VOCAL, LARYNGEAL AND SELF-PERCEPTION MEASUREMENTS OF DYSPHONIC TEACHERS: ANALYSIS AFTER VOICE THERAPY

Parâmetros vocais, laríngeos e de autopercepção de professoras disfônicas: análise após tratamento fonoaudiológico

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ABSTRACT

Purpose: to analyze the results of evaluations vocals, laryngeal and self-perception after speech therapy in a group of dysphonic teachers. **Method:** this is a retrospective study carried out using a handbook review of 42 patients with hyperfunctional dysphonia, yielding data of hearing-perceptual and acoustic analysis, laryngeal exams and Voice Activity and Participation Profile (VAPP) before and after speech therapy. Patients were treated by students of speech language therapy, under supervision of a single professional using direct therapy, which consists in vocal techniques, and indirect, with exposure about vocal health care. **Results:** in respect to hearing-perceptual assessment, 73,8% of voice samples were described as better in post treatment situation. The parameters grade of dysphonia (G) and roughness (R) most contributed for voice improvement. In acoustic analysis, there was significantly change after therapy for jitter, perturbation of frequency, shimmer and perturbation of amplitude parameters. Laryngeal analysis demonstrated that 43% have improved in visual-perceptual assessment after vocal therapy; 38% of the exams had no change with therapy and 19% were worst at discharge moment. Considering VAPP, was possible to verify significant improvement in post treatment situation for all parameters, and the biggest difference between the averages before and after vocal therapy refers to "effects of this alteration at work". **Conclusions:** there was an improvement of hearing-perceptual parameters grade of dysphonia (G) and roughness (R), acoustic parameters of perturbation of frequency and amplitude, in larynx image and a positive impact of voice in evaluated patient's quality of life after voice therapy.

KEYWORDS: Dysphonia; Voice Disorders; Speech Therapy; Rehabilitation

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■ INTRODUCTION

Hyperfunctional voice disorders may be triggered by ignorance about correct voice use, making useful an inappropriate vocal model and by maintenance of harmful vocal habits[1], characterized as the most common vocal disorder in teachers. Teachers depend of their voices to pass on the contents in a satisfactory way, to discuss and communicate with students and the other professionals who work at school. However, many factors contribute for appearance of vocal problems in this category. For example, the inadequate conditions of job environment such as noise, dust, extended workday and the lack of training for a correct voice use[2].

The goal of voice therapy for these patients is to minimize or correct the unsuitable voice use with the purpose of restore phonatory function. To reach this goal, two different approaches can be used: the direct one, which consists in changing the harmful aspects for vocal production by doing specific exercises; and the indirect, which focus in the managing of bad habits that contribute or get the dysphonia worse[3], for example, smoke, scream, poor hydration and others.

According to the assessment protocol prepared by Phoniatrics Comittee of European Laryngological Society[4], the following components most be considered in vocal assessment: hearing-perceptual and acoustic analysis, estroboscopy, airflow measurements and patient's self-perception of vocal problem. Standardize outcomes allows they can be passive of comparison with the ones which are already described in literature no matter if they use the same type of approach.

About voice therapy with teachers, literature describes positive outcomes with many different types of approach. Researches analyzing the effectiveness of Vocal Function exercises[5,6], Resonance Method[7,8] and global vocal approach[9] with dysphonic teachers, concluded that those techniques are efficient in voice rehabilitation of this group, with improvement of vocal characteristics and positive impact in quality of life after treatment.

Sound amplification is also described in literature as efficient for voice improvement of dysphonic theachers[8,10] besides conducting programs about vocal behavior with guidance of vocal hygiene[6,10].

As shown, researches emphasizes the importance of a global vocal approach with direct therapy (specific exercises) and indirect (guidance about vocal health care)[5,6,10], avoiding use of a single program focusing in vocal hygiene[11].

Literature demonstrates that teachers submitted to vocal therapy for dysphonia which have improved their voice quality also showed positive vocal self-perception after 18 months of follow up, keeping professional voice use[12].

Whereas dysphonia has become a concern cause of absenteeism, with a negative impact on professional, social and economical levels for teachers, it becomes essential to know the outcomes of vocal rehabilitation in order to ensure the quality of care for these professionals. The purpose of this study is to analyze vocal, laryngeal and self-perception parameters of voice assessment after treatment in a group of dysphonic women teachers, who have been discharged from vocal therapy.

■ METHOD

This work was reviewed by the Research Ethics Committee of the Federal University of Minas Gerais and approved on the report number ETIC 482/08.

This is a longitudinal retrospective study using a chart review, in which were yielded data from patients identified as having hyperfunctional dysphonia who were discharged from voice therapy. Therapy was administered by speech therapist students of the Federal University of Minas Gerais supervised by a unique professional, from March 2007 to July 2011. Teachers reported the following criteria were included in this study: being female teacher, have a diagnosis of hyperfunctional dysphonia, have done vocal therapy and have been discharged from the treatment. 167 charts were collected, of which 42 fit on inclusion's criteria, remaining in the study.

The following data were analyzed in pre and post treatment moment: patient's voice recording for perceptual analysis, the values of acoustic analysis and Voice Activity and Participation Profile (VAPP) and the medical's report from laryngeal examination and also age, kind of dysphonia and number of treatment sessions.

All teachers were submitted to therapy approach which included direct therapy with vocal exercises and indirect with guidance about vocal health care and professional voice use. Vocal therapy was performed once a week, in pair, with duration of 30 minutes. Patients were guided about doing exercises at home three times a day for a period of three to five minutes, besides doing vocal warming techniques before initiating professional voice use. In direct approach were included vocal techniques of corporal, orofacial organs, voice and phonation methods[14]. Vocal techniques were selected according to vocal characteristics of each patient, so therapeutic planning was individualized and personalized.

Voice samples referred to the connected speech, which included emission of weekdays and sustained vowel /a/ in usual way with no variation of pitch and loudness, excluding the beginning and the end of the emission because of its irregular features. The recordings were made directly in a Dell® computer, model Optiplex GX260, with Direct Sound® professional sound board and professional condenser unidirectional microphone Shure® was used too. Individuals remained standing during the recording, with the microphone laterally positioned at a distance of 5 cm from the mouth, with a 90 º angle. Records were made in a silent room. The same procedure done in the first assessment was repeated in the discharge's moment, so there were two voice samples for each patient.

Hearing-perceptual analysis

Voice samples pre and post therapy were given to two speech therapists with more than five years of experience in voice's assessment, in a way that they didn't knew if the record corresponded to pre therapy or post therapy situation. The speech therapists should analyze voices in a consensual way, listening the first and the second sample of each patient and classifying the second sample as better, worst or equal the first one. Then, they should choose two of the six parameters Grade, Roughness, Breathiness, Asteny, Strain, Instability (GRBASI)[15] to judge which of them most contributed for voices improvement or worsening. In cases which the second voice sample corresponded to pre treatment situation, outcome was considered in inverse way.

Grades of vocal deviation for each parameter of GRBASI scale were not analyzed.

Acoustic Analysis

The values of acoustic analysis before and after therapy were analysed from patient's chart. Voice samples of sustained vowel /a/ were recorded and analyzed by *Computerized Speech Lab (CSL)* MDVP, from Kay Pentax®. Following values were considered: fundamental frequncy (**F0**), jitter (%), shimmer (%), pertubation of frequency (PPQ %), perturbation of amplitude (APQ %) and harmonic-to-noise ratio (NHR dB). Values were obtained from vowel /a/ sustained emission. The choice of such parameters in this research is justified by their prevalence in studies of speech therapy area[16-18].

Laryngeal exams

The reports from laryngeal examination before and after therapy of each patient were taken from medical records, digitalized and sent to two otorhinolaryngologists with at least five years of experience in area, so that they could judge in a consensual way, if the laryngeal examination is better, worst or have no change after vocal therapy. Reports from pre and post treatment situation were randomized, and otorhinolaringologist have no knowledge about which moment of therapy reports corresponded. They should analyze if the first shown laryngeal exam improved or worsened according to the second. In cases which the second report corresponded to pre treatment situation, outcome was considered in inverse way.

For reports analysis, the following data were considered: presence/absence of vocal fold lesion; kind of glottal closure and presence/absence of involvement supraglottis structures. Evaluators judged report's written transcript without analyze directly larynx image of patients due to absence of image record in most of handbooks.

As the otorhinolaringological reports evaluations were done in consensus, judge's analysis occurred simultaneously and together.

Both of evaluator's group, speech therapist and otorhinolaringologist have knowledge about the fact that patients were submitted to treatment for dysphonia. To minimize bias in outcomes interpretation of hearing-perceptual and larynx analysis, treatment moment was randomized, so judges have no knowledge if voice samples or otorhinolaringological reports corresponded to pre or post treatment situation. Is also important ensure that evaluation dates or information about patients were not offered to judges.

Self-reporting protocol

To assess dysphonia's impact in quality of life, the Voice Activity and Participation Profile (VAPP) validated for Brazilian Portuguese[9] was used. The VAPP is composed of 28 questions divided into five parameters: self-perception of the vocal problem severity, effects of this alteration at work, social communication, daily communication and emotional effects. For each question, the participant's answer according to their perception is represented on an analog scale of 10 cm: not affected (left) and affected (right). The score's average, in centimeters, was extracted from each parameter. The protocols applied pre and post therapy were attached in patient's records.

The statistical analysis used was the SPSS (Statistical Package for the Social Sciences), version 17.0. Firstly, a descriptive analysis of data was performed with measures of central tendency and dispersion. Later, the Wilcoxon Signed Rank Test was used. The standard level of significance used was 95%.

■ RESULTS

The research was done with chart reviews of 42 teachers, and the age range was 27 to 57 years old, with a mean of 40,8 years. Among these, 57.1% were diagnosed with functional dysphonia and 42.9% of organofunctional dysphonia. The number of speech therapy sessions ranged from six to 30, with an average of 16 sessions and mode of nine sessions.

Hearing-perceptual analysis

The results of hearing-perceptual analysis are shown in Figure 1, according to speech therapist's perception of voice samples in post therapy moment. In Figure 2, parameters of GRBASI scale

are distributed according each ones influence in voice improvement or worsened in post treatment situation. It's possible to notice that situations in which patients showed improvement in voice quality after treatment, is related to Grade (G-100%), Roughness (R-80,64%), Breathiness (B-54,84%) and Strain (S- 12,91%). In cases of worsening in voice quality after treatment, this was related to worsening in Grade (G-100%) and Roughness (R-100%) of vocal quality.
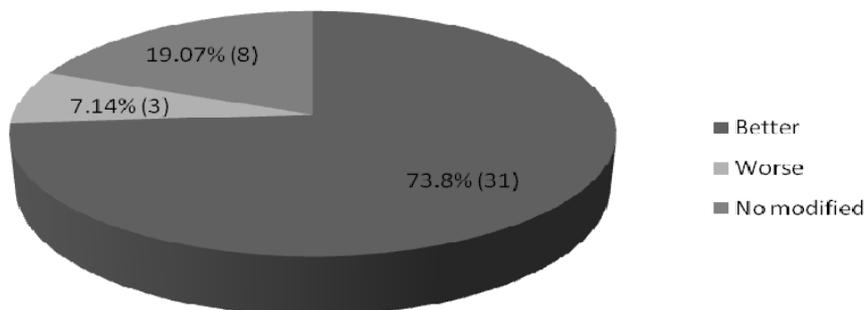

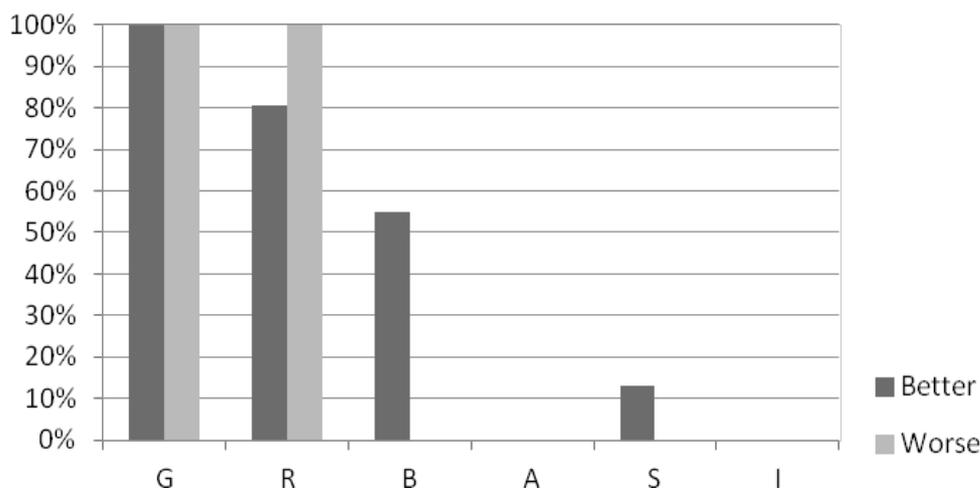**Figure 1 – Results of the hearing-perceptual analysis**

Figure 2 – Distribution of GRBASI parameters according their influence in voice change.

Acoustic Analysis

Table 1 reveals the values of acoustic analysis pre and post treatment. There were significant differences for jitter, PPQ, shimmer and APQ parameters.

Laryngeal examinations

Figure 3 gives a descriptive analysis of laryngeal examinations data. It shows that 43% of patients have improved in visual-perceptual larynx assessment after vocal therapy; 38% of the exams didn't change with therapy and 19% were worst at discharge moment.

Self-reporting protocol

In table 2 are the results of five VAPP parameters comparing the scores before and after treatment. All parameters have significant improvement in post therapy, and the biggest difference between the averages before and after vocal therapy refers to "effects of this alteration at work".

Table 1 – Comparision of acoustic measurements before and after treatment

Parameter	Situation	Mean	Standard deviations	p
F0	Pre	209,98	34,54	0,554
	Post	210,99	34,33	
Jitter	Pre	1,47	1,06	0,000
	Post	0,78	0,46	
PPQ	Pre	0,80	0,52	0,019
	Post	0,53	0,46	
Shimmer	Pre	6,00	3,52	0,001
	Post	4,42	2,27	
APQ	Pre	4,31	2,27	0,031
	Post	3,39	1,47	
NHR	Pre	0,18	0,18	0,089
	Post	0,14	0,03	

Wilcoxon Test; $p<0,05$*
Subtitle:
F0 – Fundamental Frequence (Hz)
Jitt – *jitter* (%)
PPQ – Frequence disturbance quotient (%)
Shim – shimmer (%)
APQ – Amplitude disturbance quotient
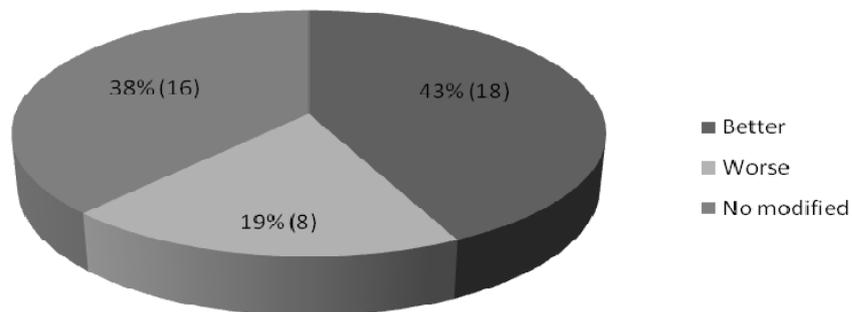NHR – Harmonic-noise proportion (dB)

Figure 3 – Results of laryngeal examinations

Table 2 – Means and standard deviations of VAPP scores before and after treatment

Score	Situation	Means	Standard deviation	P
Self-perception	Pré	3,18	2,76	0,001
	Post	1,38	1,81	
Work effects	Pré	2,45	2,32	0,000
	Post	0,86	1,22	
Daily communication	Pre	1,88	1,98	0,001
	Post	0,86	1,15	
Social communication	Pré	1,01	1,69	0,018
	Post	0,37	0,53	
Emotional effects	Pré	1,83	1,84	0,002
	Post	0,82	1,48	

Wilcoxon test; $p<0,05$*.

DISCUSSION

Despite the methodological differences between the studies investigating the outcome of voice therapy, this study is consistent with the findings of other studies in which the positive effects of voice therapy in dysphonia are reported[3,7,20,21].

The task of comparing voices in the pre and post treatment was chosen for the perceptual analysis because it is characterized as a procedure that allows a direct comparison between the results, and has been described in literature as the most appropriate way to study the quality vocal[22,23].

Time of professional experience was above five years in both groups of judges, once literature shows that evaluator's experience influences in outcomes analysis and their reliability [24,25].

The mean age was 40 years, such as described in literature about the age of teacher's professional group[26]. In respect to number of voice therapy sessions, prevalent value was 9 sessions, matching with international clinical practice which suggests a mean value between six to 10 sessions[27].

In hearing-perceptual assessment, voices have an improvement in 73,8% of cases, supporting the hypothesis that a subjective improve must be considered an important parameter for monitoring treatment efficacy. It was found that parameters which most changed with voice improvement was Grade of dysphonia and Roughness. Breathiness and Strain parameters also appear as influences, but in a small scale. In the same way in cases of improvement, when voices got worst after treatment, G and R parameters most contributed for vocal quality change. Grade (G) of dysphonia and

Roughness (R) most reflected voice improvement in post treatment situation, which is consistent with other researches findings that describe such hearing-perceptual parameters as the most sensitive to vocal rehabilitation and the most common in cases of behavior dysphonia[28,29].

In a study which analyzed vocal assessment outcomes in individuals with hyperfunctional voice disorders, there was significant improvement of (R) and acoustic parameter jitter comparing pre treatment results with the long-term ones, referring to 6.1 years after discharge moment[20]. Another research conducted in order to correlate the parameters of GRBASI scale and measures provided by MDVP, concluded that improvement in (G) and (R) parameters correlates with improvement in NHR, suggesting that noise is the most noticeable characteristic in dysphonic voices[29]. However, this correlation remains controversial in the literature and could not be evaluated in this study once that the values of NHR were normal, even before treatment. A study was done with 29 dysphonic patients and they should judge their own voices using the parameters (G), (R) and (B) of the GRBASI scale in analog version, six months after discharge. It was found that the less the individual perceived his voice as (R), the higher the score for improvement in the voice quality, obtained from the parameter (G). This relationship was not observed between the parameters (G) and (B)[30].

Of analyzed voice samples, 7,14% were described as worse in discharge moment, which means that despite vocal quality has no improvement with treatment, other factors influenced to discharge clinical decision. Those factors may be related with

patient himself, such as satisfaction with his own voice, absence of vocal fatigue or vocal quality adapted to social and professional demands or may be based in results of other tools of vocal analysis that are available, assuming that voice analysis is multidimensional. Thereby, self-reporting protocols are important once they can demonstrate patient's self perception about their own voices and its impact in quality of life[19], which could be found by improvement in VAPP parameters in this study.

Data from acoustic analysis reveals that there was significantly change after therapy for all investigated parameters, except for Fo and NHR. This was an expected result, because Fo and NHR values are frequently in normal limits in pre treatment situation even in case of moderate vocal deviations, not suffering changes with therapy. This fact was also observed in a study with women with unilateral vocal fold mobility alteration whose voices were acoustically analyzed. It was found that even before therapy, f0 values were considered normal[31]. The same study verified reduction of PPQ and APQ measurements; nonetheless, this reduction wasn't significantly and values after treatment were higher than normal range proposed by MDVP, Kay Elemetrics®.

In literature, the improvement of acoustic analysis values is controversial. In a study with 50 patients with vocal deviations recruited for voice assessment before and after treatment, it was noticed that 84% improved acoustic parameters, but change was only significantly for jitter[18]. A study analyzed the results of acoustic measurements in dysphonic teachers before and after treatment, and a significantly improvement for jitter, shimmer and NHR was not identified[17]. Significantly change in jitter, shimmer and NHR parameters was described in a study with 78 subjects with chronic dysphonia submitted to vocal therapy[5]. These results suggest that acoustic analysis should not be the only instrument for voice assessment and for measure therapy outcomes, serving as a complementary tool since it only provides analysis from sustained vowels, which did not represent vocal quality present during natural and connected speech[29].

In respect to laryngeal exams, was possible to identify an improvement in most exams in post therapy situation. However, it is necessary to emphasize that the evaluations were made by different experts and different instruments, which may prevent an adequate analysis. Moreover, judges evaluated written transcription of laryngeal examination's report, not evaluating, in a directly way, the larynx images, due to the lack of exams in most of patients chart. This methodological limitation was expected since it is a retrospective

study. Improvement in laryngeal examinations was described in previous research[7,28,29], suggesting that voice therapy improves functionally and anatomically the larynx. In cases of laryngeal exams which had no improvement, the decision of discharge prioritized vocal quality stability and the absence of complaint related to vocal fatigue, which not depends on the improvement in laryngeal assessment. It should be noted that cases of vocal fold cysts and sulcus vocalis do not regress with voice therapy, and so improvement in larynx image can't be found.

Taking in account results of VAPP, is possible verify significantly improvement for all parameters of the questionnaire, showing that the voice therapy has a positive impact on quality of life and in the self –report of vocal problem severity. Considering that the goal of voice therapy with voice professionals is to adapt vocal standard to individual's professional lawsuits, the improvement in "effects of the alteration at work" parameter certify that patient's perception suggest treatment's success while achieving its goal. The following results were found in a study which analyzed PPAV results from 95 dysphonic patients with or without laryngeal alterations, who were recruited for treatment: from patients who had mild vocal deviations, 47% upgraded VAPP scores; between moderate alterations the rate was 59% and in cases of severe alterations, 75%. The protocol was done in a second moment, 12 months after discharge, and it was possible to see that benefits from therapy persists and progress after the end of treatment, what can be noticed by the improvement in VAPP scores in this situation[32].

Studies using others instruments to evaluate the impact of dysphonia in quality of life[3,7,], including the Voice Handicap Index[33] also shows that scores are significantly better in pos treatment moment. Instruments that measures self-perception about the vocal problem have high validity, since they allow a quantification of the problem by the patient, instead of obtain a unique measure based exclusive in the day of the consultation [16]. However, in vocal assessment before treatment, essential clinical information for diagnosis and treatment can be not identified if we only consider patient's perspective about vocal problem[34]. Considering that patient can minimize their problem, the other assessment tools are crucial for detecting pathological conditions not evaluated in self-reporting questionnaire.

It is understood that ideal situation for search requires a control group in order to verify if voice therapy is the responsible for voice improvement, larynx image and quality of life aspects analyzed on this study, making possible an effectiveness

analysis of voice therapy itself. However, it was not possible create this group due to methodological restrictions involving study chronology.

Assuming that many patients can show normal values in one or more procedures of voice evaluation in pre treatment situation[3], and so they don't show any improvement in those parameters with treatment, it underscores the need of a multidimensional analysis in order to obtain a real view about treatments effects, avoiding voice changing under or overestimation.

There are many studies that demonstrate voice therapy effectiveness in treatment of dysphonic teachers using different kinds of vocal rehabilitation[5-9]. Evaluation procedures adopted on this research agree with multidimensional voice analysis and are useful to help speech therapists in checking treatment effects and so in clinical decision about discharge moment, attesting voice therapy as beneficial in managing of behavior dysphonia in teachers.

CONCLUSION

In post treatment voice therapy situation, it was found improvement in hearing-perceptual parameters grade of dysphonia, roughness and larynx image in most of teachers. Acoustic parameters jitter and shimmer were better in post treatment moment, with statistical significance. Values of VAPP protocol decreased after treatment, with statistical significance, demonstrating a positive impact of voice in teacher's quality of life after voice therapy. Hearing-perceptual measurements, acoustic analysis, laryngeal examinations and self-reporting protocol proved to be useful tools to measure voice therapy outcomes for teachers with behavior dysphonia.

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RESUMO

Objetivo: analisar os resultados das avaliações vocais, laríngeas e de autopercepção após tratamento fonoaudiológico em um grupo de professoras disfônicas. **Método:** trata-se de estudo retrospectivo com revisão de 42 prontuários de mulheres portadoras de disfonia comportamental, com coleta de dados referente à análise perceptivo-auditiva, acústica, de avaliação laríngea e de protocolo de autopercepção vocal (PPAV) nas situações pré e pós-fonoterapia. As professoras foram atendidas por estudantes do curso de Fonoaudiologia supervisionados por um único profissional. Foram utilizadas terapia direta com a realização de técnicas vocais e indireta com orientação sobre cuidados com a saúde vocal. **Resultados:** com relação à análise perceptivo-auditiva, 73,8% das vozes foram descritas como melhores após a fonoterapia. Os parâmetros que mais se modificaram foram o grau da disfonia (G) e a rugosidade (R). No que concerne à análise acústica, os parâmetros que melhoraram significantemente após o tratamento foram o *jitter*, quociente de perturbação de frequência, *shimmer* e quociente de perturbação de amplitude. A avaliação laríngea demonstrou que 43% das pacientes apresentaram melhora no exame após o tratamento fonoaudiológico; 38% dos exames não sofreram alteração com o tratamento e 19% pioraram no momento da alta. A partir do PPAV, constatou-se melhora estatisticamente significante para todos os domínios no momento pós-fonoterapia, sendo que a maior diferença entre as médias pré e pós-tratamento foi referente ao parâmetro "efeitos no trabalho". **Conclusão:** observou-se melhora dos parâmetros perceptivo-auditivos de grau geral da disfonia e rugosidade, nas medidas acústicas de *jitter* e *shimmer*, bem como melhora da imagem laríngea e impacto positivo da voz na qualidade de vida das professoras avaliadas após o tratamento fonoaudiológico.

DESCRITORES: Disfonia; Distúrbios da Voz; Fonoterapia; Reabilitação

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