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Effects of kazoo finger technique as the time of execution

Efeitos da técnica *finger kazoo* conforme o tempo de execução

Efectos de la técnica finger kazoo conforme el tiempo de ejecución

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Abstract

Objective: Compare the effect of the technique of Finger Kazoo (FK), according to the execution time, in women with normal voice and larynx. **Methods:** 45 volunteers emitted the vowel /a:/ before and after three series of the 15 repetitions of FK technique. The times of all repetitions of the technique were timed and summed up, and the subjects were divided into groups according to the total execution time: group I (up to five minutes); group II (five minutes and one second to seven minutes); group III (seven minutes and one second to ten minutes); and group IV (ten minutes and one second to fifteen minutes). The groups I, II, III were 12 subjects in group IV, with eight. Were performed glottal and spectrographic acoustic analysis, auditory perceptual (RASATI scale) and vocal self-assessment. Kruskal-Wallis and post hoc tests were applied. **Results:** The spectrographic of narrowband had significant decrease noise in high, medium and low frequencies in group IV, compared to group II. In the spectrographic of broadband there was no difference between groups. In all groups, occurred self-reported best voice, without significance. In RASATI, there was significant decrease of hoarseness and asthenia in group I, compared to groups II and III. MDVPA without significance. **Conclusion:** It was not possible to find an ideal time to perform the FK, but there was a difference in the effects generated by the technique in the subjects who performed the same number of repetitions, with auditory improvement of the voice with up to 5 minutes of FK and improvement in the spectrograph only after 10 minutes. In all groups, qualitative improvement of vocal self-perception was observed.

Keywords: Voice; Larynx; Voice training.

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CFH: study conception and design, data analysis and interpretation, drafting, revision and final approval of the version to be published.
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Resumo

Objetivo: Comparar o efeito da técnica de *finger kazoo* (FK), conforme o tempo de execução, em mulheres com voz e laringe normal. **Métodos:** 45 voluntárias emitiram a vogal /a:/ antes e após três séries de 15 repetições da técnica FK. Foram cronometrados e somados os tempos de todas as repetições da técnica, e os sujeitos foram divididos em grupos conforme o tempo de execução total: grupo I (até 5min de execução); grupo II (de 5,1min até 7min); grupo III (de 7,1min até 10min); e grupo IV (de 10,1min até 15min). Os grupos I, II e III ficaram com 12 sujeitos e o grupo IV, com oito. Foram realizadas medidas acústicas glóticas e espectrográficas, avaliação vocal perceptivoauditiva (escala RASATI) e autoavaliação vocal pré e pós-FK. Kruskal-Wallis e post hoc foram aplicados. **Resultados:** Na espectrografia de banda estreita, houve diminuição do ruído nas altas frequências no grupo IV comparado ao grupo II. Na espectrografia de banda larga, não houve diferença entre os grupos. Em todos os grupos, ocorreu melhor voz autorreferida, sem diferenças. Na RASATI, houve diminuição significativa da rouquidão e da astenia no grupo I, quando comparado aos grupos II e III. **Conclusão:** Não foi possível estabelecer um tempo ideal de execução do FK, mas houve diferença em relação aos efeitos gerados pela técnica nos sujeitos que realizaram o mesmo número de repetições, com melhora perceptivoauditiva da voz com até 5min de FK e melhora espectrográfica apenas a partir de 10min. Em todos os grupos, foi observada melhora qualitativa da autopercepção vocal.

Palavras-chave: Voz; Laringe; Treinamento da voz.

Resumen

Objetivo: Comparar el efecto de la técnica finger kazoo (FK) conforme el tiempo de ejecución en mujeres con voz y laringe normales. Métodos: 45 voluntarias emitieron la vocal / a: / antes y después de tres series de 15 repeticiones de la técnica FK. Fueron cronometrados y sumados los tiempos de todas las repeticiones y los sujetos fueron divididos en grupos de acuerdo uma el tiempo de ejecución total: grupo I (hasta 5 minutos); grupo II (de 5,1min a 7min); grupo III (7,1min a 10 min); y grupo IV (de 10,1min a 15 min). Los grupos I, II y III se quedaron con 12 sujetos y el grupo IV con ocho. Se llevaron a cabo mediciones acústicas, glóticas y espectrográficas, evaluación vocal perceptivo audiotiva (escala RASATI) y auto evaluación vocal pre y post-FK. Kruskal-Wallis e post hoc fueron aplicados. Resultados: En la espectrógrafia de banda estrecha, hubo reducción del ruído en las frecuencias altas en el grupo IV en comparación con el grupo II. En la espectroscopia de banda ancha, no hubo diferencias entre los grupos. En todos los grupos ocurrió mejor voz de auto-reporte sin diferencias. En la RASATI, hubo uma disminución significativa de la ronquera y la astenia en el grupo I, cuando comparado a los grupos II y III. Conclusión: No fue posible establecer un tiempo ideal de ejecución del FK, pero no hubo diferencias cuanto a los efectos generados por la técnica en los sujetos que realizaron el mismo número de repeticiones, con mejora perceptivo auditiva de la voz para hasta 5min del FK y mejora espectrográfica apenas desde 10min. En todos los grupos, hubo uma mejora cualitativa de la autopercepción vocal.

Palabras clave: Voz; Laringe; Entrenamiento de la voz.

Introduction

Vocal speech therapy aims to promote normotension to the laryngeal and respiratory muscles, to improve voice quality and the muscle conditioning of all voice production levels (breathing, phonation and articulation/resonant levels). Therefore, speech therapists have several tools, such as the vocal techniques, which can vary their mode of execution and duration according to the purpose of therapy[1,2].

Considering the diversity of vocal techniques that can be applied to several cases of dysphonia, there are still few studies focused on the effects of each of them, and do not compare different execution times, but instead, they analyze the speech before and after a number of repetitions to verify the effects on the voice [3-5].

The Semioccluded vocal tract exercises (SVTE) have been widely investigated, particularly those with resonance tubes, mainly analyzing the effects before and after their implementation[3-5] or comparing the effects of different SVTE[6,7]. A technical Finger Kazoo is a variation of SVTE in which there is a partial occlusion of the lips and resistance to the exit of the sound, favoring the perception of the whole vocal tract, optimizing like internal sensations and improving the glottic firmness[8]. However, there are a few evidences about the specified time training with each technique on comparisons of the effects of the same technique, for different types of voice disorders in different running times as in this paper [2,5,8-11].

Despite the wide dissemination of aspects related to the physiology of physical exercise, there is not enough scientific evidence about the effects of exercising small laryngeal muscles in charge of voice production [5]. Therefore, vocal results and the possibility of muscle fatigue resulting from each vocal technique should be guided through greater knowledge on the ideal time of execution[1,2,8,9]. It should be assumed that the improvement of strength and muscular endurance depends on the frequency, duration and intensity of the performed technique, muscle resistance being understood as the ability of a muscle group to perform repeated contractions over a long period of time [12].

In Brazil, there are some studies focusing on execution time, when using the sonorous tongue vibration technique [2,9,10]. One of them, including 15 women and 15 men with no vocal alterations or laryngeal disorders, has compared the time prior to execution of the technique with 1, 3, 5 and 7 min of execution. It showed that women had better results after 3 min and men after 5 min[9]. Another paper used the same execution times of the previous in women with vocal nodules and in a control group who performed placebo exercise. They concluded that the time of the sonorous vibration of tongue with the best sound and auditory-perceptive results was 5 min and noticed increased laryngeal tension and vocal worsening, after 7 min[10.]

A different study, with the same vocal technique of that previous research, included 43 women with normal larynx, and analyzed their voices at 0, 1, 3 and 5 minutes, with increased fundamental frequency (f0) and reduction of noise from 3 min of execution and increased sound pressure from 1 min[2].

On the international scenario, no studies comparing vocal effects along different times of execution on the same vocal technique have been found up to now.

Based on the above, the aim of this study was to compare the effects of the *finger kazoo* (FK) technique, according to execution time, in women with normal voice and larynx.

Methodology

Study Design

This research is an analytical, cross-sectional, quantitative and contemporary study, approved by the Ethics Committee of the institution of origin (016 945 / 2010-76).

Research subjects

Inclusion criteria were: signing the Informed Consent; women; ages 18 to 40; free from dysphonia or laryngeal disorders[2-4,9,10].

Exclusion criteria were: report of having any neurological, endocrine, psychiatric, gastric, hormonal or breathing condition; habits of drinking and smoking[2]; reporting any alteration due to periods of menstruation, premenstrual or pregnancy, as well as influenza and/or respiratory allergies on the day of collection; hearing loss; stomatognathic system alterations that could interfere with the technique execution or articulation of the vowel /a:/; having undergone prior speech and/or otorinolaryngologic treatments related to voice; being aware of the studied vocal technique or being disabled to perform it [3,4,11,13].

The participants were subjected to an interview, ENT evaluation, with laryngeal visual inspection, evaluation of their stomatognathic system and its functions, and hearing screening, for the inclusion and exclusion criteria[3,4].

A total of 58 volunteers were included in this research, which were free from dysphonia, but interested in performing vocal improvement. After applying the above criteria, 13 were excluded for the following reasons: one for her menstrual period; one for being a singer; two because they were men; one due to an edema on the vocal folds; one due to *microweb*; one for having vocal groove; another for having vocal nodules; five were excluded because they did not undergo all necessary assessments, and one for presenting hearing loss. Thus, the sample consisted of 45 adult women, aged between 18 and

39 years (mean 23.2 years), blinded to the purpose of this research.

Data collection

In an acoustically treated room (noise less than 50 dBNPS), the participants, all standing erect, issued the vowel /a:/ in maximum phonation time (MPT) and usual pitch and loudness, before and after the execution of the FK technique[2-4,8,9,14]. Their voice was recorded with professional digital recorder Zoom H4n (stereo microphone, omnidirectional, 96 kHz, 16 bits), with input recording level set to 50%, set in a pedestal, at an angle of 90° and with a distance of 4 cm between the microphone and their mouth [3,4].

Next, they performed three sets of FK technique, each with 15 reps in MPT, with 30 s passive rest between them. The passive rest is the lack of laryngeal muscle activity (silence) to restore the muscles involved in voice production vocal[1,3,4].

The execution time of the technique respected the MPT of each subject due to the individual physiological variations. When the technique is performed in TMF, the muscle fibers responsible for the anaerobic metabolism (time less than 3 minutes) are activated first and, as the execution is repeated, the muscle fibers responsible for the aerobic metabolism, responsible for muscular resistance[2].

The FK technique consists of a sound blow, made with rounded and protruded lips and a forefinger touching them vertically, without pressuring them. Thus, when performing this technique, in addition to laryngeal sound, one can hear a secondary noise of the airflow in contact with the index finger. It is important to avoid inflating the cheeks, to keep the tongue relaxed in a low position, and issue constantly in normal pitch and loudness[3,4,8,15,16] without using expiratory reserve.

During technique production, the volunteers remained seated with their feet flat on the floor and straight back, avoiding cervical dislocation or tension[3,4,8,11,13]. They were allowed to intake water to 250ml throughout the data collection period[2-4], since, as occurring in a systemic manner, it does not reach the larynx immediately[12]. After the issuance of the FK series, the participants performed a self-assessment of voice and could choose to "unchanged voice", "better voice" or "worse voice"[3,8,17].

Data analysis

To check for the total FK emission time of each volunteer, all 45 repetitions of the technique (three sets of 15 repetitions) were timed and added together, considering only the periods of sound emission, excluding periods of air inlet and passive rest between the series[3,4].

After determining the total time of FK execution of each participant, they were sorted into four groups, in accordance with the literature:

- Group I (12 participants) – execution of technique in up to 5 min (mean = 4.12, SD = 1.01) [2,9,10,18]
- Group II (12 participants) – execution from 5.1min to 7min (mean = 6.06, SD = 0.55) [9,10];
- Group III (12 participants) – execution from 7.1 min to 10 min (mean = 8.28, SD = 0.87);
- Group IV (eight participants) – execution from 10.1 min to 15 min (mean = 12.54, SD = 1.77) [14].

Voice samples collected before and after the FK were analyzed using the Multi Dimensional Voice Program Advanced (MDVPA) from Kay Pentax® with 44 kHz sample rate and 16 bit, and standardized analysis window in 4s, edited without interference from voice onset and end of emission[3,4,11]. Measures considered important for this study were pooled, since the MDVPA offers many analyzing the same acoustic vocal phenomenon, and a group analysis provides greater consistency to interpretation.

Thus, the **frequency measurements** taken were: f0; f0 maximum (fhi); f0 minimum (flo); Standard deviation of f0 (STD); **frequency disturbance measures**: absolute jitter (Jita); Jitter percentage (Jitt); Average relative perturbation (RAP); Pitch perturbation quotient (PPQ); Softened pitch perturbation quotient (sPPQ); Variation of f0 (vf0); **amplitude disturbance measures**: Shimmer in dB (SHDB); Shimmer percentage (Shim); Amplitude perturbation quotient (APQ); Softened amplitude perturbation quotient (sAPQ); Variation of amplitude (vAm); **measures of noise**: noise-harmonic ratio (NHR); Voice turbulence index (VTI); Soft phonation index (SPI) [3,4,11].

For spectrographic analysis, we used the Real Time Spectrogram (RTS) from Kay Pentax®, in broadband 100-point filter (646 Hz) and narrowband 1024-point filter (63.09 Hz) with 11 Hz sampling rate and 16 bit in 5 kHz[3].

In broadband spectroscopy (BBS), we assessed the degree of trace darkening: of formants (F) (F1, F2, F3 and F4), of high frequencies and all the spectrogram; the existence of noise around the entire spectrogram and at high frequencies; the definition and regularity of the trace of the F[3].

In narrowband spectrography (NBS), we assessed the degree of darkening of the trace: at high frequencies and across the spectrogram; the presence of noise between the harmonics and the replacement of harmonics by noise on the entire spectrogram, as well as at high frequencies; the definition and regularity of the trace of the harmonics; the presence of sub-harmonics and the number of harmonics[3].

Trace darkening degree could vary from strongly dark (black), equivalent to the largest amplitude of the sound wave and higher sound pressure, to a weak darkening (light gray) [3]. In which they could be ranked into higher darkening (improvement), lower (worse) or with no change. Noise is presented in the spectrogram as a shaded or dotted image, and, according to the degree of darkening of the shaded/dotted area, they could be classified in reduced darkening (improvement), increased (worsening) or unchanged[3]. The definition of F and harmonics was evaluated according to their visibility, demarcation and symmetry and could be considered as better defined (improvement), less defined (worsening) or unchanged. The regularity of trace is related to its continuity and stability and could be classified in more regular (improvement), less regular (worsening) or unchanged[3].

BBS and NBS prior and after the technique of each volunteer were matched for benchmarking and the couples were coded and randomized[3,11,19]. The auditory-perceptual analysis, based on MPT /a:/, was made by the RASATI scale (hoarseness, roughness, breathiness, asthenia, tension, instability) with gradation for each parameter: 0 for no change, 1 for mild alteration or doubt of change, 2 for moderate change, and 3 to intense[20] change. The pre and post technical issues were randomized and not coupled[21].

The spectrographic and auditory-perceptive reviews were conducted individually by three speech therapists with experience and Masters Degree in the voice area, none the study's authors, blinded in relation to the objectives and methodology of this work, aware only that the voices belonged to adult women[3,19]. As a result, the predominant responses of the evaluators were considered [3,10,19].

Statistical Analyses

Evaluators' similar responses were grouped, yielding 66.43% for auditory-perceptual voice analysis and 54.78% for spectrographic analysis.

When comparing the results of the auditory-perceptual voice analysis, spectrographic and vocal self-assessment among the four groups, the Kruskal-Wallis test was used and, in case of significance, post hoc test for multiple comparisons. For the verification of acoustic modifications of glottal source (MDVPA), comparing the results of this assessment among the four groups, we used the Analysis of Variance (ANOVA) with repeated measures. The significance index was 5%.

Results

Table 1 shows the NBS results for the groups, with significant reduction in noise at high frequencies in group IV compared to group II.

Table 2 shows the values of RASATI for groups with significant decrease of hoarseness and asthenia in group I when compared to groups II and III.

Table 3 depicts the results of vocal self-evaluation for the groups, showing best self-evaluation with no significance.

Table 4 shows results for the BBS with no differences among the groups.

Table 5 shows the average values of parameters of MDVPA with no differences among the groups.

ARTICLES

Table 1. Results of the evaluation of the narrow band spectrography for groups I, II, III and IV

	Group I			Group II			Group III			Group IV			p-value
	L	NC	I	L	NC	I	L	NC	I	L	NC	I	
Degree of trace darkening high f	2	3	7	3	2	7	3	2	7	1	4	3	0,9424
Degree of trace darkening all spectrogram	2	1	9	2	5	5	2	4	6	2	5	1	0,1556
Noise between h	4	6	3	4	7	1	6	6	0	1	3	4	0,0672
Noise Hight f	3	7	2	6	6	0	6	5	1	0	5	3	0,0203*
Replacement h by noise on the entire spectrogram	1	5	6	3	4	5	1	8	3	1	4	3	0,7744
Replacement h by noise high f	0	6	6	2	5	5	1	7	4	0	6	2	0,7042
Definition of h	3	0	9	3	2	7	3	4	5	1	3	4	0,6896
Regularity of trace h	3	0	9	2	3	7	3	5	4	1	3	4	0,5034
Number of h	3	2	7	3	3	6	3	4	5	3	0	5	0,7668
Sub-harmonics	1	10	1	1	11	0	0	11	2	0	6	2	0,2398

L: lower; NC: no change; I: Improvement; f: frequency; h: harmonic
Kruskal-Wallis test and, if significant, post hoc multiple comparison test * significant difference between Group II and IV

Table 2. Results of the RASATI scale for Groups I, II, III and IV

	Group I			Group II			Group III			Group IV			p-value
	L	NC	I	L	NC	I	L	NC	I	L	NC	I	
Hoarseness	0	3	9	2	10	0	1	11	0	2	4	2	0,0003*
Roughness	0	12	0	0	12	0	0	12	0	0	8	0	1,0000
Breathless	2	6	4	1	11	0	3	5	4	0	5	3	0,3984
Asthenia	0	10	2	3	9	0	0	12	0	2	6	0	0,0338**
Tension	0	11	1	12	0	0	1	9	2	0	8	0	0,8266
Instability	0	7	5	2	5	5	1	6	5	0	7	1	0,6932

L: lower; NC: no change; I: Improvement; f: frequency; h: harmonic
Kruskal-Wallis test, and in case of significance test of multiple post hoc comparisons
* significant difference between Groups I and II, I and III.
** significant difference between Groups I and II

Table 3. Results of vocal self-assessment for Groups I, II, III and IV

	Group I			Group II			Group III			Group IV			p-value
	L	NC	I	L	NC	I	L	NC	I	L	NC	I	
Self-assessment	0	0	12	1	2	9	0	1	11	1	1	6	0,2230

L: Lower, NC: No Change, I: Improvement
Kruskal-Wallis test

Table 4. Results of the Broadband Spectrography evaluation for Groups I, II, III and IV

	Group I			Group II			Group III			Group IV			p-valeu
	L	NC	I	L	NC	I	L	NC	I	L	NC	I	
Degree of trace darkeningF1	3	2	7	1	6	5	2	6	4	2	0	6	0,6649
Degree of trace darkening F2	2	1	9	2	6	4	1	5	6	2	4	2	0,2104
Degree of trace darkeningo F3	2	1	9	2	2	8	2	5	5	2	4	2	0,2237
Degree of trace darkening F4	2	1	9	0	6	6	1	3	8	2	4	2	0,2669
Degree of trace darkening high f	2	1	9	2	4	6	3	0	9	2	2	4	0,7137
Degree of trace darkening all of spectrogram	3	0	9	2	4	6	2	3	7	2	3	3	0,6427
Noise of all spectrogram	5	3	4	4	4	4	5	7	0	2	3	3	0,4672
High noise f	4	4	4	5	6	1	5	6	1	1	6	1	0,4883
Definition of trace F1	2	7	3	2	5	5	1	8	3	0	4	2	0,9039
Definition of trace F2	3	0	9	3	2	7	3	3	9	1	4	3	0,7404
Definition of trace F3	4	2	6	2	3	7	3	4	5	1	5	2	0,6922
Definition of trace F4	2	3	7	2	7	3	4	2	6	1	4	3	0,6926
Reguirity of noise	2	3	7	3	1	8	4	2	6	2	3	3	0,7428

L: lower; NC: no change; I: Improvement; f: frequency; F: Former
Kruskal-Wallis test and, if significant, post hoc multiple comparison test

Table 5. Results of acoustic analysis of glottal source for Groups I, II, III and IV

	Group I		Group II		Group III		Group IV		p-value
	$\dot{x}$ pre- FK	$\dot{x}$ pós- FK	$\dot{x}$ pre- FK	$\dot{x}$ pós-FK	$\dot{x}$ pre-FK	$\dot{x}$ pós-FK	$\dot{x}$ pre-FK	$\dot{x}$ pós-FK	
f 0 (Hz)	205,6	216,7	209,8	211,4	214,7	222,8	206,9	217,5	0,805
fhi (Hz)	223,3	245,3	222,2	225,0	228,0	237,6	228,4	232,4	0,721
flo (Hz)	194,8	204,5	206,2	200,6	197,3	199,7	191,6	196,2	0,873
STD (Hz)	3,830	3,101	2,504	5,181	2,970	3,087	3,611	4,574	0,7293
Jita **(us)**	73,03	53,74	51,48	65,94	50,26	61,14	78,76	81,88	0,2198
Jitt **(%)**	1,538	1,176	1,088	1,375	1,045	1,305	1,607	1,801	0,1656
RAP (%)	0,935	0,717	0,661	0,833	0,632	0,785	0,990	1,094	0,1473
PPQ (%)	0,887	0,679	0,629	0,825	0,616	0,76	0,914	1,061	0,1990
sPPQ (%)	0,995	0,761	0,730	1,066	0,696	0,836	1,039	1,206	0,2269
Vf0 (%)	1,817	1,423	1,183	2,428	1,453	1,464	1,770	2,116	0,754
ShdB (dB)	0,321	0,299	0,323	0,296	0,322	0,323	0,423	0,306	0,5765
Shim (%)	3,662	3,370	3,652	3,406	3,622	3,655	4,809	3,495	0,537
APQ (%)	2,605	2,384	2,581	2,387	2,736	2,671	3,330	2,472	0,590
sAPQ (%)	4,272	4,097	4,277	3,947	4,876	4,499	5,593	4,318	0,467
vAm (%)	14,55	12,79	12,04	11,12	17,39	15,14	16,01	14,31	0,109
NHR	0,130	0,122	0,121	0,116	0,129	0,121	0,135	0,131	0,664
VTI	0,035	2,607	0,045	0,036	0,047	0,044	0,045	0,044	0,4631
SPI	16,93	10,68	13,15	17,65	8,36	10,56	14,60	17,32	0,2484

$\dot{x}$: mean; M1: moment before the execution of the technique; M2: moment immediately after the execution of the technique; M3: moment five minutes after the execution of the technique; SD: Standard deviation; f0: frequency;fhi: f0 maximum; flo: f0 minimum; STD: Standard deviation of f0; Jita: absolute jitter; Jitt: Jitter percentage; RAP: average relative perturbation; PPQ: pitch perturbation quotient; sPPQ: softened pitch perturbation quotient; vf0: variation of f0; SHDB: Shimmer in dB; Shim: Shimmer percentage; APQ: amplitude perturbation quotient; sAPQ: Softened amplitude perturbation quotient; vAm: variation of amplitude; NHR: noise-harmonic ratio; VTI: voice turbulence index; SPI: soft phonation index
Variance Analysis Test (ANOVA) with repeated measurements

Discussion

In this study, the NBS, which highlights the glottal source, showed decreased noise at high frequencies in group IV compared to group II (Table 1), partly differing of the results found in a study with baseline and sonorous vibration of tongue, where 3min were enough to generate many acoustic improvements of glottal source, but they have not been evaluated by espectrography[18]. Another study using the voiced vibration technique of tongue with 43 women with normal larynx, has also concluded that the technical execution time of 3 minutes was enough for improving aspects of jitter and shimmer[2], measures closely associated with the presence of noise and voice instability[14,18], partially diverging from the results of this study, once the analysis instrument was different.

However, these findings differ from a research that found gradual and significant increase in f0 starting at 1 min on the execution of tongue sonorous vibration up to 5 min, with slight reduction after 7 min [10]; significant reduction of noise from 1 min of technique execution, maintaining up to 7 min, and increased values of *Glottal to Noise Excitation Ratio* (GNE) from 3 minutes, up until 7 min. In this present study, no significant changes were observed in the acoustic measures of glottal source evaluated by the MDVPA.

It is important to emphasize that the analysis instruments and vocal techniques performed in the cited works were different from those used in this research, restricting the comparisons, since there is no similar work with FK in the literature, suggesting that, in addition to the execution time, the type of vocal technique can influence the acoustic results.

Also, since the mucosa of the vocal folds is highly involved in the production of the complex sound wave, the generation of higher harmonic energy and the decrease of noise in the high frequencies of NBS (Table 1) suggest a greater flexibility and regularity of vibration of this structure after a longer time exercise with FK.

The higher incidence of type IIa fibers, mixed metabolism, and type I fibers in the laryngeal muscles characterizes as highly trainable to obtain high resistance to fadiga[1,2,12,22] what appears to be confirmed by the results of this work in which, even with the longest drilling (group IV), no loss of high frequency harmonics (Table 1), usually the first to be damaged in case of problems with the glottal source such as fatigue, for example.

Yet, as the mucosa of the vocal folds is highly involved in the production of complex sound wave, the generation of higher harmonic energy and the reduction of noise at high frequencies of NBS (Table 1) suggest greater flexibility and regularity of vibration of the structure after the longest time of FK execution.

Such auditory-perceptual results are corroborated by a research conducted with the sonorous tongue vibration technique, also SVTE, as FK, in 27 women with vocal nodules, comparing results with ten women who underwent placebo exercise, with execution times of 0, 1, 3, 5 and 7 min. The best auditory-perceptual time result was 5 min, and after 7 min there was an increase in laryngeal tension and vocal worsening[10].

Another work with men and women free of laryngeal disorders, using the same comparison of the above, showed improved vocal projection of women comparing 1 and 3 min, and worsening comparing 5 and 7 min[8], converging with the findings of this study, the same with the experiment with 1 min of FK technique, showing that this time was not enough to generate auditory-perceptual results[8].

As for vocal self-assessment, most participants reported better voice in all groups, but no significant difference among groups (Table 3). However, it is interesting to note that even the smallest execution time was able to generate positive sensations and the longest time did not generate negative feelings, which may be related to positive proprioceptive effects that are described in several studies with SVTE [3,8,9,13,14,19-22].

FK execution time difference for obtaining improvements seen in the results of auditory-perceptual voice analysis and NBS (both showing the glottal source), reinforced by the findings of vocal self-assessment, should be seen as evidence of the need for more studies with larger samples. However, it is clear that a longer execution time with FK (SVTE), unlike the few studies made to this day[2,9,10], did not lead to negative feelings or perceptual and acoustic worsening and, instead, to improved noise at high frequencies, which suggests muscle resistance[1,2,14] and more regular mobilization of mucosa[18].

It is necessary to point out that there was no significant difference between the groups in the

BBS and glottic source acoustic analyzes (table 4 and 5). It is known that acoustic analysis is highly sensitive to the minor changes in the glottic signal, unlike the human ear [14,18]. However, it still does not provide exact matches between its measurements and the auditory or physiological perceptual aspects of vocal production, and it is included as a complement to the perceptive-auditory vocal evaluation, considered a superior instrument in voice evaluation [9,10,18]. This fact, together with the small size of the subgroups analyzed and the agreement of a little more than 50% among the judges of the spectrographic evaluation may have influenced the absence of significance in BBS and MDVPA, being considered limitations of the research.

Conclusion

This work was unable to establish an ideal execution time of FK, but there were differences regarding the effects generated by the technique in subjects who underwent the same number of repetitions with improved auditory-perceptual voice with up to 5 min of FK, and spectrographic improvement only from 10 min. Qualitative improvement of vocal self-perception was noted in all groups.

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