Effect of singing training on total laryngectomees wearing a tracheoesophageal voice prosthesis

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The aim of this study was to assess the effect of a program of singing training on the voice of total laryngectomees wearing a tracheoesophageal voice prosthesis, considering the quality of alaryngeal phonation, vocal extension, and the musical elements of tuning and legato. Five laryngectomees wearing a tracheoesophageal voice prosthesis completed the singing training program over a period of three months, with exploration of the strengthening of the respiratory muscles and vocalization and with evaluation of perceptive-auditory and singing voice being performed before and after 12 sessions of singing therapy. After the program of singing voice training, the quality of tracheoesophageal voice showed improvement in the persistence of the general degree of dysphonia for the emitted vowels and for the parameters of roughness and breathiness. For the vowel “a,” the pitch was displaced to grave in two participants and to acute in one, and remained adequate in the others. A similar situation was observed also for the vowel “i.” After the singing program, all participants became in tune and most of them showed the presence of legato. The vocal extension improved in all participants. Singing training seems to have a favorable effect on the quality of tracheoesophageal phonation and on singing voice.

Keywords: alaryngeal voice; voice training; vocal extension; singing training; laryngectomy
Perceptive voice pitch and loudness represent aspects of the dynamics of the spoken or singing voice that can be explored and used as expressive resources for the rehabilitation of individuals submitted to ablative larynx surgery due to cancer. The spoken voice differs from the singing voice in terms of the utilization of vocal resources resulting from specific adjustments for different emissions that may help promote the quality of life and the refinement of speech of total laryngectomees.

The multidisciplinary conduct in cases of surgical oncology should favor not only the excision of the tumor and oncologic control, but also the rehabilitation of the individual for life in society (Blom 2000). Thus, multidisciplinary work involving the head and neck surgeon, a speech therapist, and a singing teacher is relevant for total laryngectomees speaking with a tracheoesophageal prosthesis in order to favor their oral communication and to elicit or refine the musical profile of those who have it, contributing to their quality of life. The process of alaryngeal voice rehabilitation needs to advance in terms of the quality of communication, permitting the acquisition and utilization of a satisfactory alaryngeal emission capable of reproducing the intentional and emotional aspects of these individuals during conversation with their interlocutors.

The objective of the present study was to evaluate the effect of a program of singing training on the tracheoesophageal voice of total laryngectomees rehabilitated with a tracheoesophageal prosthesis, considering the quality of alaryngeal voice, the vocal extension, and the musical elements of tuning and legato.

**METHOD**

**Participants**

Five total laryngectomees aged on average 49.8 years (two women and three men, ranging from 33 to 63 years old), completed the program of singing training.

**Materials**

The voice material of all laryngectomees was collected and recorded using a Sony® digital video camera adapted to a tripod. After recording the voice for perceptive-auditory analysis, each total laryngectomee had their singing voice recorded while using a Yamaha® PSR E403 keyboard.
Procedure

*Evaluation of tracheoesophageal voice quality*

The participants were instructed to emit the prolonged vowels “a,” “i,” and “u” after inspiration in the maximum phonation time with habitual vocal intensity, velocity, and pitch. The validated categorical scale GIRBAS (Dejonckere et al. 1996) was used to characterize the voice quality of total laryngectomies wearing a tracheoesophageal prosthesis. The pitch parameter was rated as adequate (A), grave (Gr), or acute (Ac) for gender and age, with Gr and Ac being accompanied by the degree of severity of deviation, i.e. mild (1), moderate (2), or severe (3).

*Evaluation of singing voice*

To determine the vocal extension within one octave, i.e. a scale of eight notes (do, re, mi, fa, sol, la, ti, do), each participant was instructed to emit the vowels “a,” “i,” and “u” after inspiration, in the same tone presented on the keyboard. The type of breathing was evaluated visually during the emission of the vowels “a,” “i,” and “u” during the training session. Next, the participant was asked to sing *Happy Birthday* for analysis of the musical elements of tuning and legato. These parameters were characterized before and after the 12 training sessions as “Absent,” “Present,” or “Present Plus.”

*Singing voice training*

Each total laryngectomiee was submitted to singing training consisting of a weekly trial of 30 minutes for a period of three months (12 sessions) based on the following hierarchically arranged techniques: (1) exercises for the strengthening of respiratory muscles for singing and (2) training to perform the vocalizing exercises executed within a musical scale of eight notes (do, re, mi, fa, sol, la, ti, do), accompanied by the keyboard.

**RESULTS**

The perceptive-auditory evaluation of the quality of tracheoesophageal voice after the program of singing voice training revealed improvement or permanence of the general degree of dysphonia (G) for the vowels emitted as well as for the parameters of roughness (R) and breathiness (B). Asthenia (A) continued to be absent after the proposed training, and strain (S) was found to be worse only for the emission of the vowel “i.” After singing training the insta-
bility parameter (I) was found to be moderate for all participants during the emission of the vowel “i.”

Before singing training, the pitch parameter was characterized as adequate for most of the participants according to the speech therapist raters. After training, pitch shifted to grave (Gr2) for the vowel “a” in two participants and to acute (Ac2) in one, continuing to be adequate in the remaining ones. A similar situation was also detected for the vowel “i,” with one case of acute pitch (Ac2) and one case of grave (Gr1) pitch, and the remaining ones being adequate after training. An acute pitch was not detected only for the vowel “u.”

Regarding the evaluation of the musical elements, before singing training, good tuning was considered to be absent in three individuals and present in two. After the singing program, all participants presented good tuning. Before training, legato was present in three participants and absent in two. After the training program, three participants showed a greater presence of legato and only one individual continued not to present it according to the evaluation of singing voice.

The mean extension obtained for the vowels “a” and “u” was 14.7 semitones and the mean extension obtained for the vowel “i” was 15.7 semitones.

**DISCUSSION**

For the participants who completed the program of singing voice training, the perceptive-auditory evaluation demonstrated maintenance or improvement of the parameters of the general degree of dysphonia, roughness, and breathiness after the 12 sessions of singing therapy. This fact suggests that the program offered was favorable for these vocal parameters, influencing the new anatomical conformation of the sound source, considering the individual clinical characteristics that might have influenced the distinct responses of improvement, such as time of surgery, radiotherapy, and cervical dissection.

A worsening of vocal strain for a minority of participants was identified only for the vowel “i” after the singing program, justified by the greater difficulty of the pharyngeal musculature to adapt to the conditions necessary for its production, with excessive contraction and with an effort in the reproduction of the sound compared to a higher pitch. A similar situation was also observed regarding vocal instability in the production of the vowel “i,” which appeared to require more in terms of the behavior of the new sound source to reach phonatory balance. Thus, it would be necessary to evaluate the therapeutic limits versus the duration of the singing program; in other words, the 12 sessions possibly were not sufficient for some of the participants, or they
were sufficient but the anatomophysiological conditions of the subjects represented a limitation.

In the pre-training condition, most of the participants presented adequate pitch, with a minority being characterized as Gr1, as commonly observed in the literature, which demonstrates that the pitch of this population is more grave (Oliveira et al. 2005, Hilgers et al. 2006). Because this is a new sound source and because it is necessary to understand its behavior during the emission of the different sounds, the vowels “a,” “i,” and “u” were contemplated for the analysis of the vocal parameters explored in the present study, based on the basic physiology of laryngeal phonation.

After singing voice training, the emission of the vowel “u” did not present acute pitch in any of the participants, probably due to the more grave nature of its production and possibly due to the anatomical conformation favorable for this behavior. However, for the remaining vowels there was a characterization of pitch Ac2, possibly related to the greater effort of the pharyngoesophageal muscles for its production, resulting in vocal strain and in more acute pitch perception.

Perhaps the analysis of the type of breathing and air pressure threshold of total laryngectomees before and after singing may contribute to the quality of the vocal findings.

Singing training had a favorable effect on pitch modulation and vocal extension, showing the importance of this work with pitch for the adapted behavior of the new sound source, the digestive tract, for the production of sound with an appropriate pitch adjustment during conversation, and with the voice being no longer monotonous. There is no literature regarding the vocal extension of total laryngectomees for comparison with our data, with studies in this area being necessary since this is an important parameter for the evaluation of the physiological limits of the vocal mechanism (Speyer et al. 2003, Costa et al. 2006).

Despite the improvement achieved with singing voice training, vocal extension was lower compared to literature data, which report values of 4.5 to 5 octaves for individuals with intact vocal folds (Vargas et al. 2005, Rocha et al. 2004).

Both legato and tuning improved, with most participants showing “Present Plus” characterization after singing voice training. Legato was absent in only one participant after training, perhaps owing to his anatomofunctional limitations after complementary radiotherapy following surgery.

The present proposal led to a reduction of the degree of roughness and to improved pitch in the subjects studied, in addition to permitting the inclusion
of a total laryngectomee in the choir of the local church formed by individuals with an intact larynx.

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References