Laryngeal taping as a supportive tool to relieve voice fatigue: a pilot study.

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Abstract

Aim of this report is to perform a preliminary evaluation of the role of taping in the improvement of phonastenia among occupational voice users. Seven singers complaining voice fatigue underwent taping in the peri-larygeal areas of the anterior neck for 10 days. Taping effects were estimated by the evaluation of voice analysis parameters (jitter, shimmer, noise to harmonic ratio and singing power ratio) performed in M1 and M2 mechanisms with PRAAT software before and after treatment.In addition, a subjective assessment of phonastenia was performed using the Voice Fatigue Handicap Index (VFHI), a self-administrated questionnaire. According to the statistical analysis jitter and Noise to Harmonic ratio were the parameters mainly influenced. VFHI before and after treatment showed statistically significant values, possibly reflecting the overall positive enhancement of treatment. These encouraging results suggest possible beneficial effects of laryngeal taping on relieving voice fatigue. Since, the application of muscular taping in phoniatrics is still in its early stage, further studies and in particular, a standardized protocol of application could facilitate the spread of this technique, also offering help in comparing outcomes.

Keywords: laryngeal taping, phonastenia, voice, singer, VFHI

Introduction

The larynx is one of the main tools of human social interaction and a work instrument for many people.

Frequently professional voice users are prone to develop voice disorders and to complain of phonatory fatigue. The term "vocal fatigue" or "phonastenia" refers to a subjective voice weakness usually experienced after intense voice use, and include a variety of symptoms ranging from vocal tiredness to laryngeal discomfort, neck pain, strained voice, without clear organic origin.

Prevention, diagnosis, and treatment of voice disorders is crucial for an optimal voice performance.

Muscular taping, frequently referred as Kinesio-taping (KT), is a safe and well tolerated technique aimed to provide support during muscular activity. KT method, popularized by the Japanese chiropractor and acupuncturist Kenzo Kase in the'70s, is founded on the application to the skin of adhesive elastic tapes.[2]

In recent decades, especially after 2008 Olympics, this technique gained reputation among sport experts and allied healthcare professionals such as physiotherapists (Campolo 2013).

Up to date, various taping technique, intended to provide restraint, fixation, stability or decompression, are available with different supposed therapeutic effects depending on application methods (i.e. according to the original model of Kase, fascia, skin, energy or neuromuscular model or a combination thereof) (De Ru 2014, Parreira Pdo 2014).[3]

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[2] About Us. Kinesio Tape. https://kinesiotaping.com/about/. Accessed 3 Feb 2019.
[3] https://tapingneuromuscolare.eu/david-blow/

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Recently, few encouraging reports described the use of taping in perilaryngeal areas of the neck, as an assistive instrument to speech and language therapy (SALT) for the treatment and rehabilitation of swallowing and voice disorders (Park 2020).

The action of laryngeal and neck muscles plays a crucial role on voice production and tension of vocal cords. Therefore, the application of tapes on perilaryngeal areas of the neck, named laryngotaping (LT), may influence phonation quality.

Aim of this study is to propose LT as an additional support tool for singers, and potentially for other voice professionals, who experience phonastenia during and after their performance.

Patients and Methods

We present a case series of 7 active modern singers complaining of voice fatigue (phonoastenia), who underwent LT at the Phoniatric outpatient clinic of the University Hospital of Ferrara.

Each patient underwent a thorough assessment of the neurological, structural and functional state of the larynx. The presence of mucosal lesions or neuromuscular disease represented exclusion criteria for this treatment.

Voice Fatigue Handicap Index (VFHI), routinely utilized in our voice clinic, assessed the degree of functional, emotional, and physical phonastenia, for each patient. The VFHI, similar to the well-known Singing Voice Handicap Index (Baracca 2014) and Voice Fatigue Handicap Questionnaire, (Paolillo 2015) is a self-administered questionnaire designed by De Quarzo and Fussi in 2007 with the aim to evaluate the level of phonastenia in singers. The questionnaire is composed by 30 items subclassified in emotional, functional and physical. Based on the final scores, degrees of phonastenia were categorized as mild (0-30), moderate (31-60) and severe (61-120).

Objective measures included endoscopic laryngeal evaluation and assessment of vocal cords mucosal wave with videolaryngostroboscopy, while the acoustic voice analysis was carried out in both M1 and M2 mechanisms using the PRAAT software. (Murphy 2005)[4]

All measurements were performed before (time 0), immediately after (time 1) and at the end of the treatment (time 2).

All patients received counselling about vocal hygiene and were previously treated with sessions of SALT.

Acoustic analysis

Voice analysis was carried out at time 0, 1 and 2. Each subject recorded three audio samples.

Following this order, the singers were asked to record:

- a sustained /a/ vowel in singing voice for 2.5-3 seconds, at comfortable pitch and volume, according to the laryngeal register definition of Roubeau et al (Roubeau 2009). Two different recordings, one using M1 mechanism and one M2 mechanism were performed.
- a fragment of 'a capella' track chosen by the subject for 30 seconds.

Recordings took place in a quiet environment (<40 dB), with a mouth-to-microphone distance of 20 cm and constant gain. A Shure SM48 microphone (Shure Incorporated, Niles, Illinois) connected via M-audio (Cumberland, Rhode Island, United States) sound card to a MacBook Pro computer (Apple, Cupertino, NY) was employed. Recordings were saved in 16 bit digital format and acquired with a sampling frequency of 44.100 Hz.

Acoustic analysis was carried out with PRAAT software (Version 5.3.57 for Mac, Boersma & Weenink, University of Amsterdam, Amsterdam, Netherlands).

Acoustic parameters selected for this study were: the perturbation parameters jitter (% Jitt), shimmer (% Shimm) and noise-to-harmonic ratio (NHR), extracted from the sustained /a/ vowel both in M1 and M2 and the Singing Power Ratio (SPR) to evaluate changes in voice resonance. SPR was calculated on the extraction of the LTAS (Long Term Average Spectrum) from the song fragment. The latter was computed with a bandwidth of 100 Hz and a frequency range between 0 and 24.99 kHz. (Fantini 2017)

[4] Boersma, P. Wenink, D: Praat: doing phonetics by computer [Computer program]. Available at: http://www.praat.org.

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Tape application

Very few studies and guidelines addressed the issue of tape placement.

Our team decided to follow the neuromuscular taping method developed by David Blow for the treatment of neuro-muscular-skeletal problems. (Blow 2012, Marcolin 2017, Camerota 2015, Camerota 2014).

This specific technique is supposed to generate sensorimotor and proprioceptive feedbacks by lifting of the skin overlying the target muscles and consequently to improve the blood circulation and lymphatic drainage. In our specific application the ultimate goal was the downregulation of suprahyoid and infrahyoid muscular tension.

The tape application was performed according the following protocol (figure 1):

- 4 "I" - shaped tapes, 0,8 cm wide;
- Application of the tapes in four parallel lines on the anterior region of the neck;
- Anchor points of 2 lateral tapes: inferior margin of the mandible and the ideal line 5 cm below the clavicle, crossing the lateral edges of thyroid cartilage;
- Anchor points of 2 medial tapes: inferior margin of the mandible and the ideal line 5 cm below the sternoclavicular joint;

Tapes were left in place for 10 days.

Skin application allowed physiological neck movement and phonation.

Figure 1. Tape Application.

Statistical analysis

The mean values and standard deviation (SD) were calculated at time 0, 1 and 2, for the following parameters: %jitt M1, %jitt M2, %shimm M1, %shimm M2, NHR M1, NHR M2 and SPR. Kolmogorov-Smirnov test was used to define the normality of the distributions. T test was performed to detect significant statistical differences between measurements before (time 0) and after (time 1 and time 2) the application.

The same statistical procedures were applied to the VFHI scores, before (time 0) and after (time 2) the application. An alpha of 0.05 was considered for the statistical procedures. Statistical analysis was carried out with *GraphPad InStat software* (Version 3.06 for Windows, San Diego, CA, USA).

Results

Participants were 7 singers, 2 females and 5 males. Subjects mean age was 34,14 ± 11,67 years old. Their mean F0 was 128,86 ± 38,94 and their mean MPT was 17,71 ± 6,68 sec. Endoscopic evaluation revealed the presence of posterior glottic chink in 3 over 7 subjects, while 4 patients presented mild signs of laryngo-pharyngeal reflux. No organic lesions were detected.

Treatment was well tolerated by all patients.

Acoustic analysis

Statistical significance was found comparing time 0 and time 2 mean values for % Jitt in M1 mechanism ($P = 0,03$). The comparison of NHR mean values in M2 at time 0 and time 2 revealed a nearly statistical significance ($P = 0,05$). Mean and Standard Deviation (SD) are illustrated in Table 1.

Self-Assessment Evaluation

The VFHI results were analyzed comparing subcategories and total scores at time 0 and time 2. The emotional ($P < 0,01$) and functional subcategories ($P < 0,01$) and the total score ($P < 0,01$) showed statistically significant values. Mean and SD of VFHI scores are shown in Table 2.

Despite the small number of subjects involved in this study, we observed an overall positive impact of the LT method.

In particular, the subjective assessment of voice fatigue revealed improved scores after treatment in all patients.

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Table 1. Mean values and Standard Deviation (SD) of the investigated acoustic parameters before (time 0) and after (time 1 and 2) taping application.

	Acoustic Parameter	Pre-treatment Mean values and SD	Post-treatment Mean values and SD	P value*
Δ Time 1–Time 0	Jitt (%) M1	0,42 ± 0,24	0,25 ± 0,12	0,06
	Jitt (%) M2	0,24 ± 0,23	0,27 ± 0,27	0,84
	Shimm (%) M1	2,47 ± 1,55	1,85 ± 1,05	0,092
	Shimm (%) M2	1,28 ± 0,56	1,47 ± 0,67	0,09
	NHR M1	0,051 ± 0,074	0,005 ± 0,003	0,38
	NHR M2	0,002 ± 0,002	0,002 ± 0,002	0,16
	SPR	16,46 ± 3,73	15,43 ± 3,37	0,12
Δ Time 2–Time 0	Jitt (%) M1	0,42 ± 0,24	0,29 ± 0,20	0,03†
	Jitt (%) M2	0,24 ± 0,23	0,17 ± 0,16	0,56
	Shimm (%) M1	2,47 ± 1,55	2,45 ± 2,17	0,98
	Shimm (%) M2	1,28 ± 0,56	1,08 ± 0,51	0,54
	NHR M1	0,051 ± 0,074	0,004 ± 0,002	0,14
	NHR M2	0,002 ± 0,002	0,001 ± 0,001	0,058
	SPR	16,46 ± 3,73	16,30 ± 3,30	0,89
* T test † Significance				

Table2. Mean values and SD of VFHI scores before (time 0) and after (time 2) taping application.

VFHI	Time 0 Mean values and SD	Time 2 Mean values and SD	P value*
Emotional	16 ± 8,89	11,29 ± 8,56	< 0,01†
Physical	13,28 ± 9,16	10,71 ± 9,52	0,09
Functional	11,71 ± 5,28	8,43 ± 4,28	< 0,01†
Total Score	41 ± 22,50	30,43 ± 21,32	< 0,01†
* T test † Significance			

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Discussion

The scientific literature about taping in phoniatrics appears encouraging, despite the fact that it is very scant.

So far, three reports are available about LT and voice disorders, while more papers are available about its application on swallowing disfunction, especially in stroke patients with dysphagia. (Park 2016, Lin 2016, Heo 2015). Taping application on respiratory muscles has also been described, with reported positive effects on pulmonary function, respiratory muscle strength and functional capacity. (Tomruk 2020, Gallagher 2018)

Mezzedimi et al. published in 2017 and 2018 the first Italian reports about the use of KT alongside SALT in dysphonic patients and professional voice users, such as singers. The therapy was based on a "y"-shaped tape placed in the peri laryngeal areas. Patients treated with both SALT and KT noticed general amelioration of voice and beneficial impact on life quality. In particular, a positive impact on voice quality was highlighted by a statistically significant improvement of acoustic parameters jitter and NHR in dysphonic patients. (Mezzedimi 2017) The harmonic-to-noise ratio (HNR), an assessment of the ratio between periodic and non-periodic component of voice, was examined in singers, with notably improved value after treatment. (Murphy 2005, Mezzedimi 2020)

The acoustic parameters selected for our analysis were the perturbation parameters jitter, shimmer and NHR to estimate the regularity of sound wave and vibratory cycle (De Colle 2009, Fussi 2003) and the Singing Power Ratio (SPR) to evaluate changes in voice resonance's quality. (Watts 2006)

Jitter especially is a measure of the cycle-to-cycle variations of fundamental frequency, while NHR represents the average ratio of the disharmonic spectral energy components (noise) to the harmonic spectral energy components.

A jitter reduction implies a better regularity of glottic vibration. In our case, jitter improvement in M1 at time 2 suggest that the 10 days treatment allowed the enhancement of vocal efficiency. The underline mechanism may be related to a reduction of dissipation energy, consequent to a decreased muscle tension, of the thyroarytenoid muscle action, dominant in M1. (Hirano 1974, Wilhelmsen 2018) In addition, these findings are consistent with the nearly statistically significant improvement of the NHR in M2. Improved scores of VFHI reflect the benefits effects on objective measures.

Wilhelmsen et al. in 2018 proposed KT for treatment of hyper functional dysphonia in 10 patients. Tapes were placed over the suprahyoid, infrahyoid muscles, and sternocleidomastoid muscles and the thyroid cartilage. Voice Handicap Index and evaluation of larynx by palpation, according to L. Mathieson scale, before and after the therapy confirmed KT positive effect on normalization of muscular tone and improvement of voice quality.

All the reports, as well as our preliminary case series, showed the positive impact of LT beside SALT on voice quality and performance.

Our report was the first to focus on LT as a supportive tool to SALT for improvement of voice fatigue among singers. These promising results may represent the first step for a wider spread of this technique among occupational voice users.

Adverse effects were not reported in any series. The overall positive acceptance of this approach showed by all patients may influence the perceived effect of LT. Therefore, randomized control trials with larger groups are required to full assess the results and particularly to rule out possible placebo effects.

In the future, a standardized protocol for LT is could be helpful, either to encourage the spread of this technique, either to facilitate comparison among reports. Also, the simultaneous placement of tapes on peri laryngeal areas and on respiratory muscles (i.e. diaphragm) should be investigated, in order to investigate the possible positive impacts on pneumo-phonatory coordination.

Conclusion

Laryngotaping (LT) represents a cheap, feasible and well tolerated supportive method to SALT. In addition to the postulated

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therapeutic effects, LT may help to increase patient's awareness regarding laryngeal actions, perception and potential negative behaviours that affect its function. Since the literature on this topic is scant, future studies are welcome in order to enhance the application of this technique.

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