Kinesio Taping Application in Dysphonic Singers

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Abstract: Introduction. Kinesio Taping (KT) application in speech therapy has been studied in a few works about dysphonia, facial nerve palsy, sialorrhea, atypical deglutition, postsurgical recovery after thyroidectomy and laryngectomy. The aim of this study was the evaluation of the possible role of KT in supporting speech therapy in singers complaining of dysphonia using singing voice handicap index (SVHI), fundamental frequency (F0), shimmer, jitter and harmonic to noise ratio (mean H/N).

Materials and methods. We enrolled consecutive singers and singing students complaining of dysphonia and voice problems. Control group (DG1) was composed of 15 individuals who underwent traditional speech therapy only, while Case group (DG2), also composed of 15 subjects, underwent traditional speech therapy associated with KT application. A computerized voice analysis was conducted using PRAAT software observing F0, jitter, shimmer and mean H/N before (t1), at mid (t2) and after (t3) the treatment. Moreover, each patient filled in the SVHI before (t1) and after (t3) the complete speech therapy treatment.

Results. The mean F0 and H/N measured before, during and after the logopedic treatment, showed a notable increase over time (P value <0.001) both for DG1 and DG2. However, no significant difference was found comparing the two groups. Jitter and Shimmer after treatment were clearly seen to be lower than before in both groups (P value <0.001), and followed a significantly different trend over time (P value <0.001). Moreover, unlike F0 and mean H/N, these parameters underwent a significantly greater decrease in DG2 compared to DG1. Lastly, SVHI improved at t_3 and although these reductions were clear in both groups, it was greater in DG2 than in DG1.

Discussion and Conclusions. Our findings are encouraging and suggest the possibility of using KT in case of vocal pathologies in singers. It is imperative to underline that the tape does not replace speech therapy, but could possibly enhance the effects of the treatment.

Key Words: Singing−Voice−Speech therapy−Kinesio taping−Professional voice.

Abbreviations: F0, fundamental frequency−mean H/N, mean harmonic-noise-ratio−KT, Kinesio Taping−DG1, dysphonic group 1−DG2, dysphonic group 2.

INTRODUCTION

Many professionals rely on communication daily to work and therefore need their voices to be in the best possible condition, with maximum effectiveness and efficiency and with as little strain as possible.

Voice quality and its preservation are essential especially for singers and research is constantly looking for new treatments, preventive strategies and management techniques that can guarantee vocal effectiveness and fast recovery after strain. This is an important goal for singers as well as speech pathologists, otolaryngologists, or vocal coaches. Kinesio Taping (KT) is recently been proposed as a component of comprehensive voice therapeutic programs.[1]

KT is an elastic tape that has become popular over the last 10 years, owing to its use by high-profile athletes. Its scientific basis is still to be completely understood but an evidence-based KT efficacy is given for pain reduction, range of motion improvement, better recruitment of muscle motor units, and increased lymphatic activity.[2] Furthermore, its application, combined with body movements, activates somatosensory and proprioceptive stimuli, inducing a reflex muscle response.[3]

KT is lightweight and approximately as thick as the epidermis thus reducing patient discomfort. It does not limit movement but supports it and activates the healing process. In addition, it is made of a hypoallergenic polymer elastic strand wrapped by 100% cotton fibers, which allows a fast evaporation of body moisture and drying; it is able to stretch up to 50% of its resting length, while its elasticity only follows the longitudinal direction. KT is latex free, 100% acrylic with heat-activated glue and can stay on the body for about 3−5 days—showers included—without compromising the adhesive quality. Its therapeutic effect is continuous during the 24 hours and partially persists for several weeks even after removal.[4]

Up to now, KT applications in speech therapy have been studied in a few works about dysphonia, facial nerve palsy, sialorrhea, atypical deglutition, postsurgical recovery after thyroidectomy and laryngectomy.[5−7] The aim of this study was the evaluation of the possible role of KT in supporting speech therapy in singing students and singers complaining of dysphonia using singing voice handicap index (SVHI) questionnaire as well as objective data obtained analyzing

Accepted for publication November 1, 2018.

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Journal of Voice, Vol. ■■, No. ■■, pp. ■■−■■
0892-1997

https://doi.org/10.1016/j.jvoice.2018.11.001

TABLE 1.
Distribution of the Dysphonic Groups According to Fiberoptic Examination

Results to Phoniatric Examination / Groups	Longitudinal Chink	Median-Posterior Triangular Chink	Bilateral Thickening or Median-Posterior Chink	Bilateral Nodules	Total
DG1 (%)	6.67 (%)	26.67 (%)	13.33 (%)	53.33 (%)	100 (%)
DG2 (%)	13.33 (%)	40 (%)	6.67 (%)	40 (%)	100 (%)
Total	20 (%)	66.67 (%)	20 (%)	93.33 (%)	

fundamental frequency (F0, Hz), shimmer (%), jitter (%) and harmonic to noise ratio (mean H/N, dB). These acoustic parameters were chosen because, if within the normal range, indicate good voice quality and allow numerical and objective quantification of vocal quality.[8]

MATERIALS AND METHODS

Between January 2017 and September 2017, we enrolled consecutive singers and singing students complaining of dysphonia and voice problems who came to the Otolaryngology Department of Policlinico S.M. alle Scotte, University Hospital Siena, and offered them the possibility to add KT on to traditional speech therapy. The decision to have the KT or not was made by the patients. After being briefed on the study, including any potential side effects, patients then volunteered to have the KT applied or if they opted out, they fell automatically into the control group.

Before being enrolled in the study all patients underwent an otolaryngologist examination (flexible laryngeal videoendoscopy and stroboscopy) and speech pathologist assessment collecting anamnesis and risk factors for voice disorders and evaluating posture at rest and posture during phonation.

Inclusion criteria for this study: having worked as a professional singer or having studied singing for at least 3 years, endoscopic detection of functional anomalies or subjects with absence of organic lesions but with perceptual audible voice changes and complaints.

The exclusion criteria for this study: presence of organic alterations detected through a laryngostroboscopy examination at any level of the upper airways that would not benefit or be improved through speech therapy. Thus, since vocal fold nodules are sensitive to the logopedic treatment, patients with nodules were included in the study. Similarly, patients who showed symptoms or objective findings related to gastroesophageal reflux were excluded.

Furthermore, we decided to exclude individuals aged 50 or over to avoid any interferences related to aging and presbyphonia.[9]

At the end of the selection process the dysphonic group 1 (DG1) was composed of 15 individuals (14 women and 1 man), with a mean age of 26.0 years, who underwent traditional speech therapy only. Dysphonic group 2 (DG2), was also composed of 14 women and 1 man, with a mean age of 25.3 years, who underwent traditional speech therapy alongside KT.

Our sample group was composed of adults of both genders, aged between 18 and 38. The fiberoptic examination revealed: bilateral nodules and median-posterior triangular chinks, longitudinal chinks, bilateral thickening, or median-posterior chinks distributed as shown in Table 1.

Acoustic analysis

The computerized voice analysis was conducted using PRAAT software,[10,11] and the sample chosen for analysis was the emission of the vowel /a/ ruling out the beginning and the end of the emission and observing the following: F0, disturbance measures (jitter, shimmer), and mean H/N. All these evaluations were performed before (t_1), at mid (t_2) and after (t_3) the treatment.

The PRAAT software was only used for the multiparametric analysis of the voice through the "Pulses" button and by collecting the results contained in the "Voice Report"; its other functions were omitted.

The standard range recommended by P. Boersma and D. Weenink is from 75 Hz to 500 Hz. As advised, for the analysis two different pitch ranges were set:

- one specifically for female voices (100 Hz−500 Hz);
- the other specifically for male voices (75 Hz−300 Hz).

Speech therapy session

Each subject had 10 voice therapy sessions with an experienced speech pathologist for a total period of 2 months, as included in the standard Italian National Health Care System protocol.

Speech therapy included vocal hygiene counseling which focused on each subject's education of normal voice production, identification of individual vocal abuse patterns, education on how to reduce or eliminate vocal abuse, the importance of hydration and sleep, the adverse effects of irritants and medications, the influence of laryngopharyngeal reflux, speaking and singing in the appropriate vocal range and learn vocal warm-up and cool-down techniques. As a reminder, a list of all the aforementioned was given to each participant (Table 2).[12]

TABLE 2.
Vocal Hygiene Recommendations

Vocal Hygiene
Drink at least 2 liters of water a day
Avoid balsamic or overly sugary candies
Avoid air-conditioned, overly humid or dusty rooms
Avoid aerosols with steroids, try with natural-based fumigations
Avoid shouting or whispering; in the case of, try to decrease the phonation speed
Avoid raclage, in the case of, try to cough
Tobacco and alcohol are harmful to the professional's voice; if possible avoidance is recommended
Follow a healthy and balanced diet
Avoid scenarios that cause excessive phonatory tension, such as talking at great distance, in noisy environments or during physical effort

The logopedic treatment applied was a combination of standard models[13,14] and was specifically designed for these patients (Table 3). The speech therapy techniques applied varied according to the phonatory behavior of the patient and aimed to reduce associated hyperkinetic behavior and to obtain the best possible vocal fold vibration.[15] Therapy was directed toward progressive development of optimal breathing, abdominal support, and gentle improvement of intrinsic muscle strength and agility, without supraglottic hyperfunctional compensation. Abdominal breathing technique was practiced to maintain appropriate subglottic air pressure, avoiding upper chest breathing, and phonation on residual air. Humming, nasal resonance exercises, yawning-sigh technique, labial and lingual trills, ascending and descending shift were the techniques more frequently applied.[16,17]

Finally, every patient filled in the singing voice handicap index (SVHI)[18] before (t_1) and after the complete speech therapy treatment (t_3).

KT application

During speech therapy, patients in DG2 underwent KT application. The literature on KT application in speech therapy is still in its infancy; thus, we found a very limited number of studies to look up while deciding on tape placement and duration of placement. We took into consideration the fact that the voice is the product of the synergic work of internal and external muscles (supra and infrahyoid) and the role of the cricothyroid muscle. This muscle stretches and tenses the vocal ligaments, and it is fundamental for the creation of forceful speech. The cricothyroid muscle originates from the anterolateral aspect of the cricoid cartilage and attaches to the inferior margin and inferior horn of the thyroid cartilage. As very few studies and guidelines addressed the issue of tape placement, we decided to apply KT in the anterior part of the neck considering both the anatomy and the physiology of the cricothyroid muscle, thus giving the tape a "y"-shape to be attached over the anterior region of the neck, around the muscle and supporting its work. The very same KT shape and application was already used in our clinic with beneficial results, as published in a previous work.[7] The base of the "y"-shaped tape was applied at the superior margin of the manubrium of the sternum, while the upper bars reached the lateral portion of the hyoid bone. These were the "anchor points", not subjected to tension. The two flaps, on the contrary, were applied with minimal tension (20%), promoting the activation of the muscular fibers and inhibiting the overactive musculature[19,20] (Figure 1).

Statistical analysis

At t_1, t_2, and t_3 the four parameters F0, Jitter, Shimmer, and mean H/R as well as standard deviations were computed for both DG1 and DG2. Statistical analysis was performed to evaluate any significant differences before, during, and after speech therapy (*P* value). The descriptive analysis was carried out through tables divided by group, DG1 (Table 4)

TABLE 3.
Main Exercises Used During Speech Therapy Treatment

Breathing and Muscular Relaxation	Vocal Exercises
Proprioceptive exercises	Humming with continuous sound and frequency changes, through ascending and descending stairs and glissades
Mobilization of cervical spine	Association of humming-chewing method
Diaphragmatic breathing exercises	Lingual and labial trills performed with continuous sound and frequency changes, with detached sound and through ascending and descending scales and glissato
	Glissato, ascendants and descendants in the extension of two octaves, with high vowels: / i / or / u /
	Yarn (voice call), proceeding both to high vowels and to low vowels, filato
	Sound yawns and sighs followed by ascending and descending glissates
	Sunglass reading of words and phrases
	Vocal fry

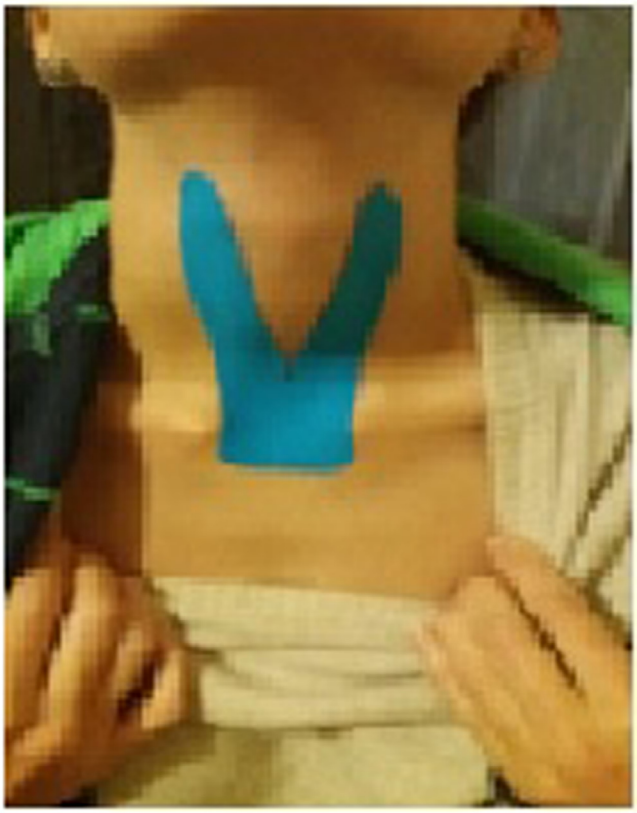

FIGURE 1. KT application on the neck.

and DG2 (Table 5). The inferential analysis was carried out through the analysis of the variance for repeated measurements (using a significance level $\alpha = 0.05$), comparing the mean values of the parameters measured at different times (t_1, t_2, t_3). The assumption for the inferential analysis was that the two groups, DG1 and DG2, had similar characteristics at t_1.

In addition the SVHI questionnaires filled in at t_1 and t_3 were analyzed (Tables 6 and 7) performing two consecutive tests for each group (Fisher test and *t* test).

RESULTS

The inferential analysis revealed that all four parameters underwent changes during time of observation.

F0

The mean F0 measured before, during and after the logopedic treatment, showed a significant increase over time (*P* value <0.001) both for DG1 and DG2 (*P* value = 0.017). However no significant difference in F0 (*P* value = 0.384) was found when comparing the two groups (Figure 2).

Jitter

The Jitter, in both groups, after treatment was significantly lower than before (*P* value <0.001), and had a distinctly different trend over time (*P* value <0.001). Moreover, unlike F0, this parameter underwent a notably greater decrease in DG2 compared to DG1, from an average of 0.539133% −0.234% (*P* value = 0.016) (Figure 3).

Shimmer

The Shimmer progressively decreases at the three times (*P* value <0.001). Moreover, the trend of this parameter in the two groups is significantly different (*P* value <0.001), as well as its final value (*P* value <0.001). Shimmer undergoes a greater decrease in DG2 than in DG1, from an average value of 6.5558% to an average value of 3.031133% (Figure 4).

TABLE 4.
DG1 Data: Descriptive Analysis

DG1	Minimum	Maximus	Average	Standard Deviation
F0 T_1	134.341 Hz	256.334 Hz	202.7877 Hz	30.50267
F0 T_2	135.685 Hz	260.768 Hz	218.1931 Hz	31.90145
F0 T_3	145.824 Hz	346.403 Hz	271.2766 Hz	47.28684
JITTER (%) T_1	0.398 %	0.701 %	0.5188 %	0.094531
JITTER (%) T_2	0.212 %	0.686 %	0.453 %	0.123923
JITTER (%) T_3	0.153 %	0.491 %	0.313867 %	0.092479
SHIMMER (%) T_1	5.789 %	9.101 %	6.879333 %	1.039883
SHIMMER (%) T_2	3.216 %	8.129 %	6.232867 %	1.378069
SHIMMER (%) T_3	2.850 %	5.872 %	4.356 %	0.838528
MEAN H/N T_1	11.299 dB	15.606 dB	13.85653 dB	1.322528
MEAN H/N T_2	12.624 dB	17.895 dB	15.14553 dB	1.471242
MEAN H/N T_3	17.921 dB	26.768 dB	21.9898 dB	2.568737

TABLE 5.
DG2 Data: Descriptive Analysis

DG2	Minimum	Maximus	Average	Standard Deviation
F0 T_1	120.802 Hz	233.040 Hz	197.9875 Hz	26.27747
F0 T_2	139.522 Hz	289.671 Hz	246.4206 Hz	35.22022
F0 T_3	141.671 Hz	321.201 Hz	255.9433 Hz	39.1863
JITTER (%) T_1	0.367 %	0.810 %	0.539133 %	0.128332
JITTER (%) T_2	0.185 %	0.419 %	0.280 %	0.069946
JITTER (%) T_3	0.101 %	0.318 %	0.234 %	0.062531
SHIMMER (%) T_1	5.479 %	8.602 %	6.5558 %	1.028984
SHIMMER (%) T_2	1.998 %	4.681 %	3.694 %	0.724289
SHIMMER (%) T_3	1.737 %	4.230 %	3.031133 %	0.737482
MEAN H/N T_1	10.945 dB	15.989 dB	13.88567 dB	1.541633
MEAN H/N T_2	15.529 dB	25.461 dB	18.51533 dB	2.693061
MEAN H/N T_3	18.483 dB	26.841 dB	21.79527 dB	2.553627

TABLE 6.
SVHI Questionnaire Results at t_1

	Total Number of Patients	Min. Score	Max. Score	Average	Standard Deviation
DG1	15	15	77	50	16,54862964
DG2	15	10	56	41,93	12,74736201

Mean H/N

Mean H/N after treatment is notably increased compared to when measured at the beginning for both groups (P value <0.001). However this trend, although different for the two groups (P value = 0.001), does not lead to significantly different values at T3 (P value = 0.082) (Figure 5).

SVHI

The Fisher test for DG1 allowed us to reject the hypothesis of variance between t_1 and t_3 (P value = 0.981607031).

This enabled us to perform the one-tail t test for samples with the same variance. The test revealed that after therapy SVHI decreased significantly (confidence level of 95%; P value = 0.042827176).

Likewise, we carried out the same analysis for DG2.

Also in this case the Fisher Test gave the same result (P value = 0.627933) and the one-tailed t test for samples with the same variance allows us to state that SVHI results considerably lower after treatment (P value = 0.00302).

As shown in Figure 6, the difference between t_1 and t_3, although clear in both groups, was greater in DG2 than that in DG1. This hypothesis was also confirmed by the value of the P value of the second test which was closer to zero (0.00302) than the P value of the first group (0.042827176).

KT application

Since the patients were self-selected they quite gladly accepted KT application. Every time the KT was applied/removed the speech therapist inspected the skin looking for redness or any sign of dermatological issue, but no one was detected. Furthermore, she asked the patients to report any problems related to the tape. No major complaints were reported; a couple of patients referred a mild itchiness

TABLE 7.
SVHI Questionnaire Results at t_3

	Total Number of Patients	Min. Score	Max. Score	Average	Standard Deviation
DG1	15	12	63	39,2	16,6527561
DG2	15	10	50	28,93	11,17053948

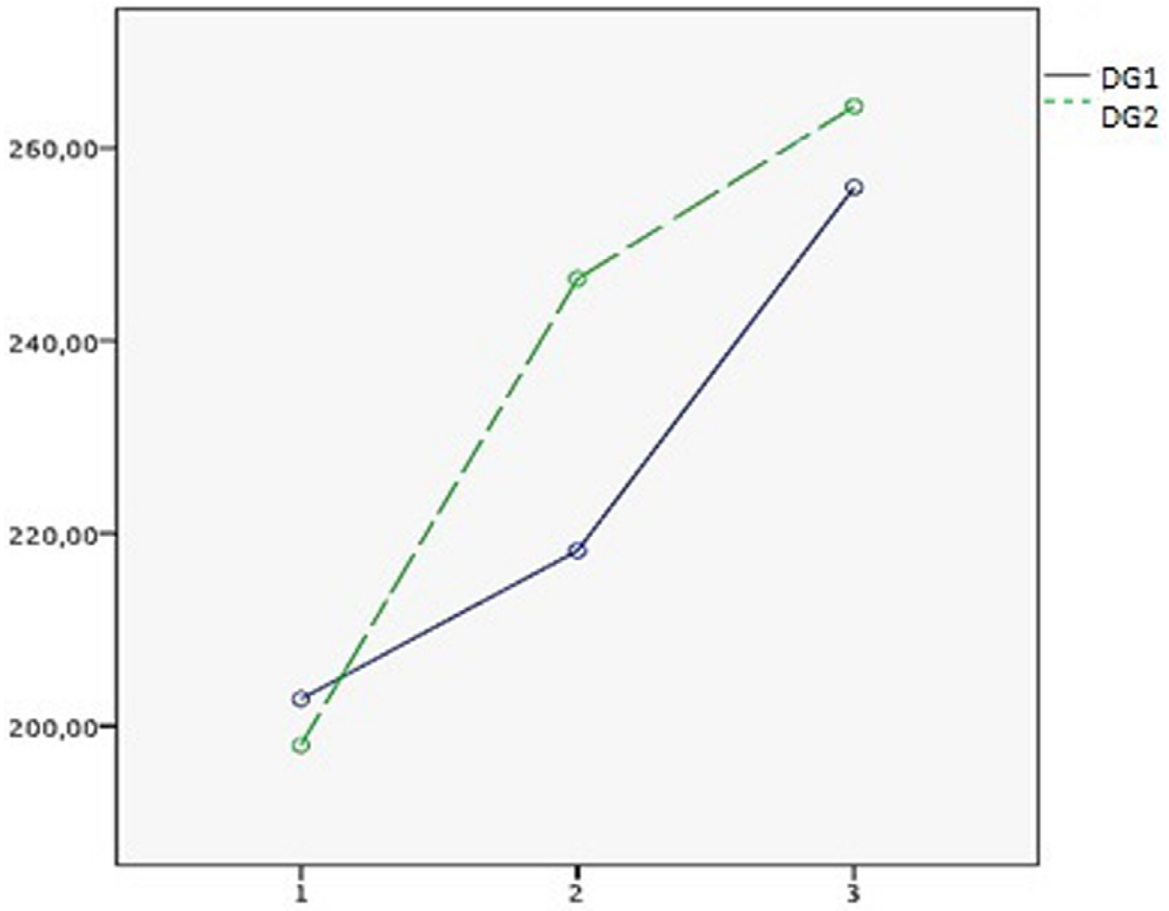

FIGURE 2. F0 for DG1 and DG2 at t1, t2, and t3.

alongside sweat during hot summer days and a few complained that with the tape during summer they could not go to the beach because they did not want to have white tan lines on their neck.

DISCUSSION

After treatment, either with or without KT, all patients reported symptom regression and performance improvement. Overall, this should be due to the beneficial effects related to speech therapy as well as the fact that, during the period of observations, all participants might have grown more conscious about their vocal behavior, thus avoiding vocal abuse and strain, taking a better care of their vocal apparatuses. However, the main difference between the two groups was found in jitter and shimmer values as well as SVHI questionnaire results, which were lower in DG2 compared to DG1.

Physiologically jitter indicates the perturbations in the fold vibration; its value increases in case of pathology and/or dysphonia and decreases after speech therapy. In our study, we observed a notable decrease in both groups, but the decrease was significantly lower in DG2 compared to DG1: this suggests that the use of KT in association with traditional treatment had a positive and more powerful effect on the regulation of the vibratory cycle.

Shimmer indicates short-term amplitude disturbances and increases, similarly to jitter, in case of vocal pathologies. Its value depends on the interaction between subglottic pressure and glottic resistance.[21] After treatment the parameter underwent a substantial decrease in both groups. However its value was significantly lower in DG2. This allows us to hypothesize that the tape had a positive effect also on the respiratory mechanisms, minimizing the intensity variations indicated by the shimmer. Shimmer is influenced by the perturbations related to the frequency, thus by the jitter; in fact the decrease of the shimmer that we observed correlates and is consistent with that of the jitter.[22]

Compared with previous studies,[7] subjects had to keep the KT in place as long as possible and its application was renewed at each therapy session; in addition, the sample group was made up of singers, who, in theory, should be much more sensitive to minimal vocal variations and more motivated to recovery than nonprofessional dysphonic subjects. Moreover, throughout this study, we decided to evaluate the patient before, during, and at the end of therapy, thus we added an intermediate evaluation during therapy, directly after the fifth session (t_2), to assess the possible action of KT as an accelerator.

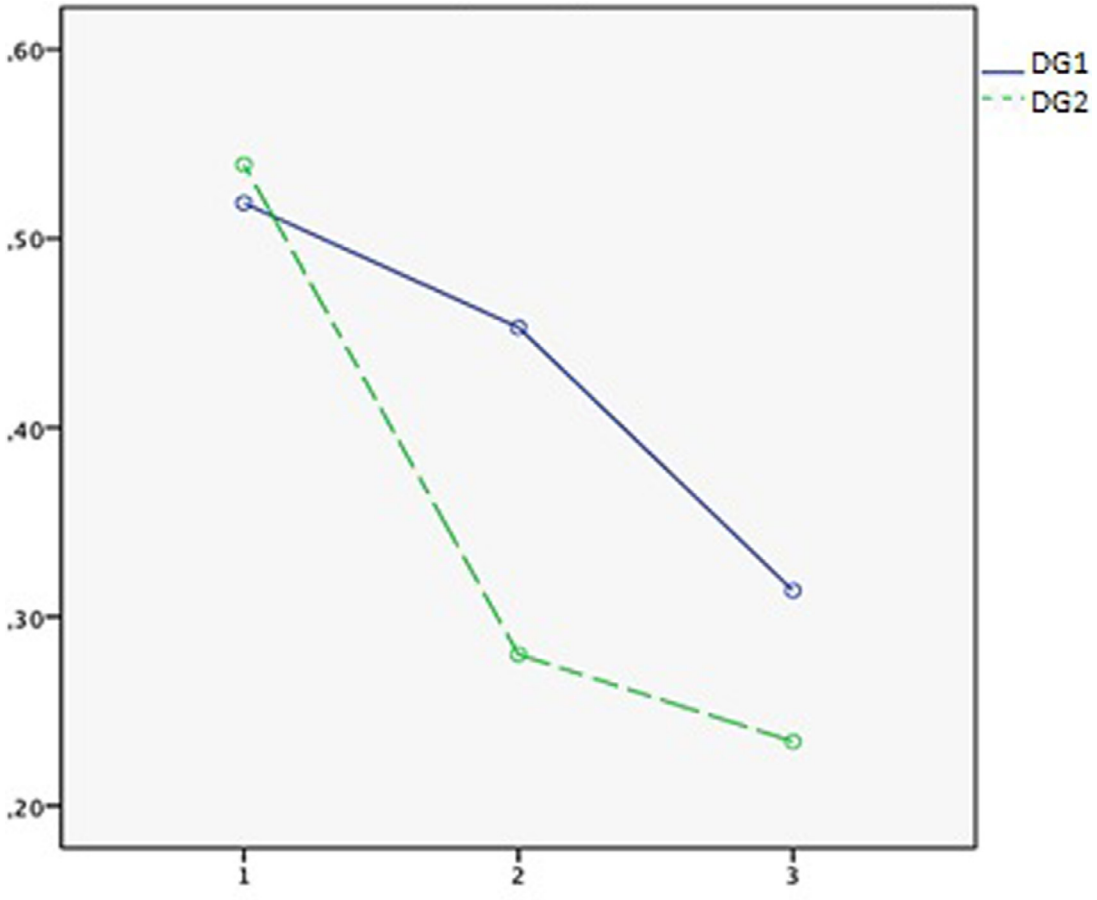

FIGURE 3. Jitter for DG1 and DG2 at t1, t2, and t3.

This had already been hypothesized by Bertini et al.[1] that concluded that KT application in association with traditional speech therapy, could accelerate the time of recovery. Their idea led us to perform an evaluation at t_2 to check the progress made over a short period of time in DG1 and DG2.

The results showed a relevant difference in favor of DG2: the value of F0 halfway through treatment tended to be higher in this group. Similar results were also obtained for mean H/N. On the contrary, jitter and shimmer were lower in DG2 compared to DG1.

These findings seem to imply that the application of KT accelerates the time needed for functional recovery.

With regards to SVHI, this questionnaire was introduced in 2007[23] and is considered a valuable instrument to assess self-perceived handicaps associated with singing voice problems. It has been validated also for non native English speaking singer populations[23–25] and for the purpose of our study we referred to its Italian version by Baracca et al.[18]. Since SVHI has demonstrated to be responsive to singing voice improvements related with treatment,[26] DG1 and DG2 results suggest that speech therapy as well as the speech pathologist consultation should have had a beneficial effect on singing voice issues. Moreover, although DG1 patients had an average SVHI at t_1 higher than subjects in DG2, the reduction of the SVHI at t_3 was greater in DG2 compared to DG1, thus encouraging us to further elaborate our studies on KT application.

Participants volunteered for KT application and did not report any complaints regarding its use; they all said that they were overall satisfied with the experience and results obtained. Since this was patient led, the overall SVHI results could have been affected due to the fact that they willingly took part in this treatment and therefore possibly minimized the negative side effects. The possible placebo effect could have led the subjects to form a bias in favor of the treatment. This lack of randomization due to patients being offered the choice to take part is one of the limitations of our study and should be taken into consideration in future studies.

According to the results of this study, we can assume that KT could play an important role in speech therapy; moreover, its cost (it can be bought for 6–10€) should not be a problem for the Health Care System or any patient.

Last but not least, it is necessary to address the fact that KT has gained a lot of visibility thanks to its use by famous professional sportsmen; this could influence patients who may request KT treatment while not fully knowing its purpose and effectiveness and reporting improvements due to the placebo effect.

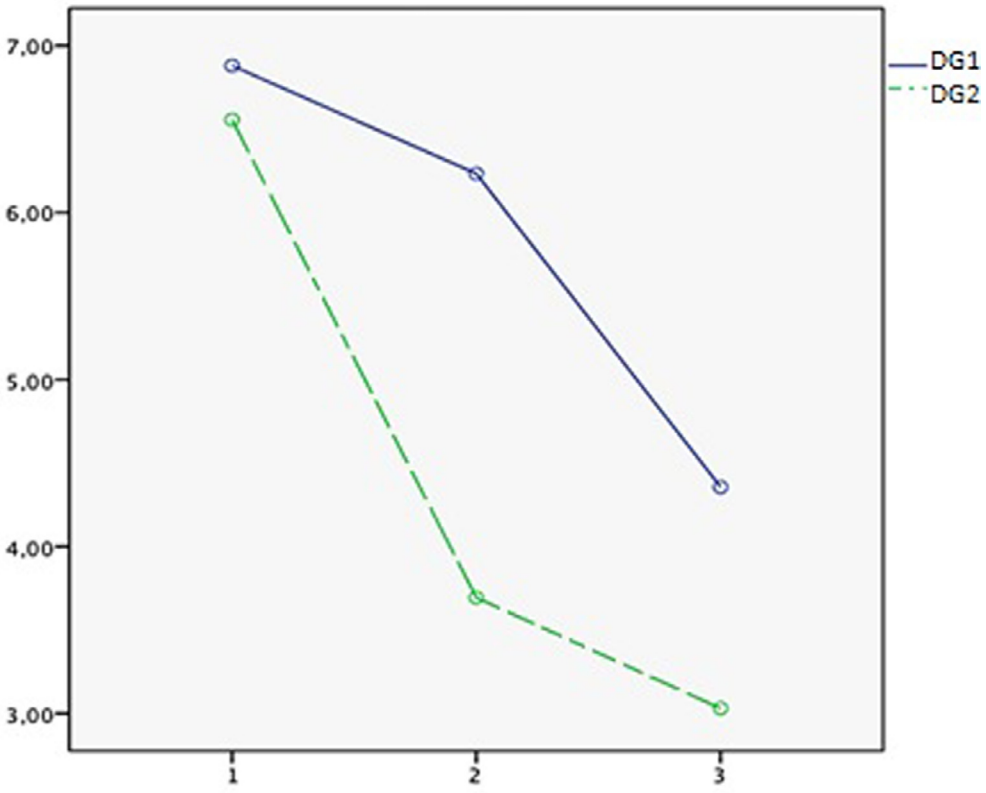

FIGURE 4. Shimmer for DG1 and DG2 at t1, t2, and t3.

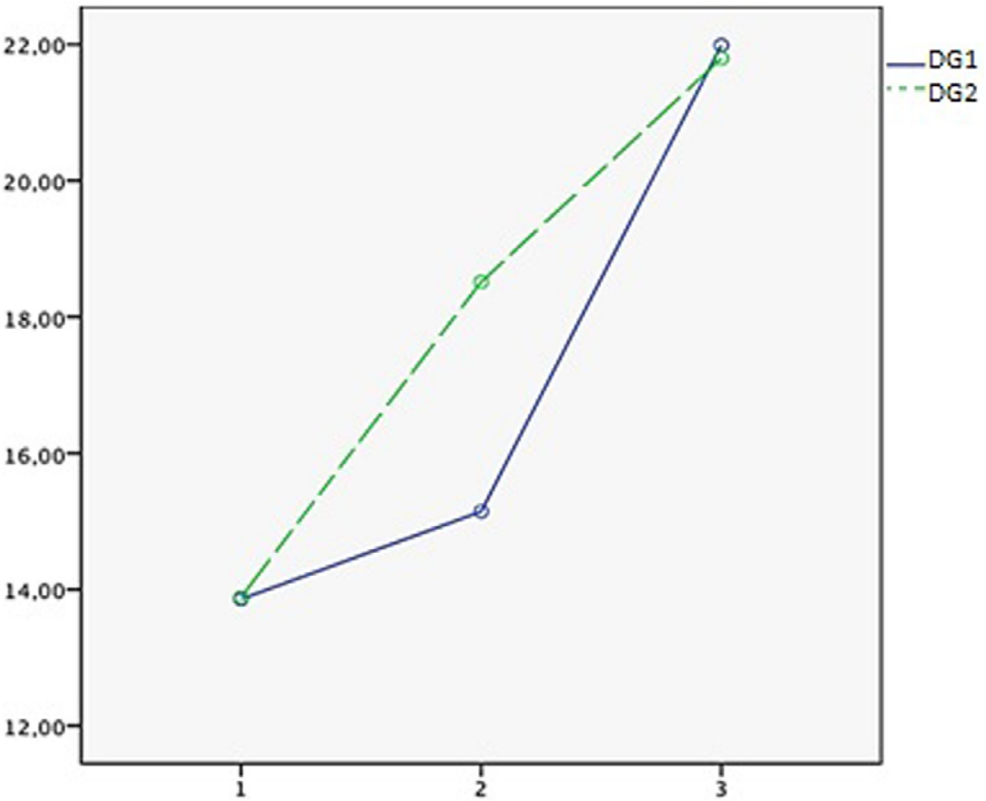

FIGURE 5. Mean H/N for DG1 and DG2 at t1, t2, and t3.

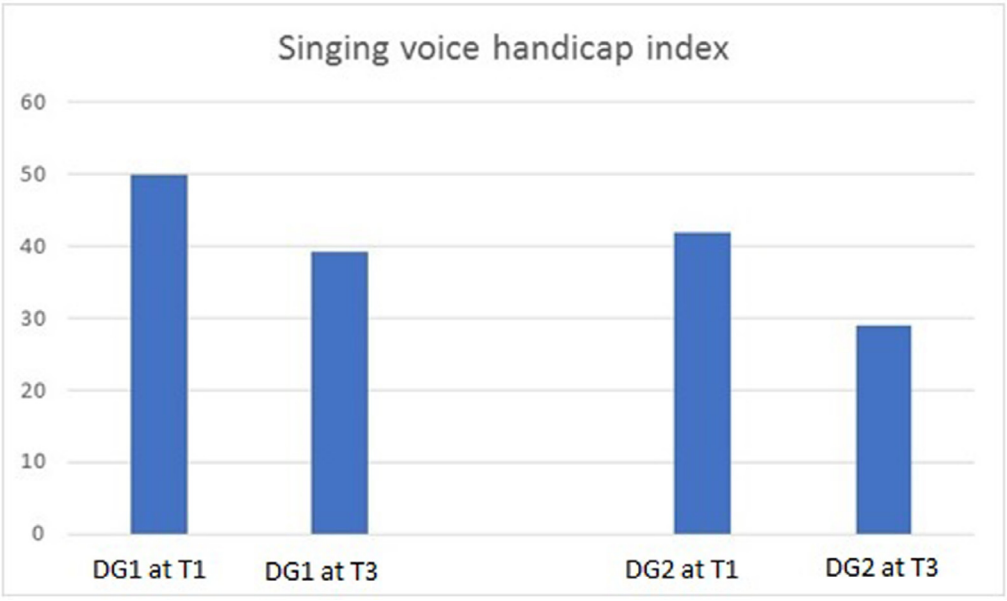

FIGURE 6. SVHI for DG1 at t1 and t3 and for DG2 at t1 and t3.

CONCLUSIONS

Dysphonia is a very real issue for voice professionals that often come to otolaryngologists and speech pathologists looking to solve this problem in the shortest time possible and with the best results. Our study allowed us to better understand and analyze the use of KT as a support for speech therapy treatment.

Our findings are encouraging and suggest the possibility of using this new innovative aid in cases of vocal pathologies in singers, where the components of tension and proprioceptive muscle play a significant role. It is imperative to underline that the tape does not replace speech therapy, but could possibly enhance the effects of the treatment.

It would be advisable to properly randomize the case and the control groups and to continue the study with the aim to define the effects of long-term tape application and verify that the results are long lasting. In addition, further studies are required to better define the positioning of the tape and the frequency and duration of application.

Acknowledgment

The authors want to express their gratitude to all the participants in the study for giving their consent, time, and enthusiasm.

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