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The Effect of Kinesiology Taping on Suprahyoid Muscles Activity in Community-Dwelling Elderly People

Background: The therapeutic exercise method using kinesiology taping (KT) has been reported to be effective in activating the suprahyoid muscle in healthy adults. However, its applicability and effectiveness are not known to the physically vulnerable elderly.
Objectives: To investigate the effects of kinesiology taping on the activity of suprahyoid muscles in community-dwelling elderly people.
Design: Repeated measure design.
Methods: We enrolled 23 healthy elderly adults (age range 60-75 years) with no history of neurologic disease. Participants performed five consecutive spontaneous swallowing actions at 5-second intervals under three conditions (KT with 80% stretch, placebo-KT, and non-KT. Activation of the suprahyoid muscles during swallowing in the three conditions was measured using surface electromyography (sEMG). In addition, a 0-10 numerical rating self-report scale was used to evaluate the required effort and the resistance felt during swallowing.
Results: KT with 80% stretch were significantly higher in sEMG mean value, peak value, required effort, and resistance felt during swallowing compared to other two conditions ($P<.05$, all). KT with 80% stretch required the most effort during swallowing and, consequently, has a positive effect on increasing suprahyoid muscle activation.
Conclusion: Our results could be taken into consideration in therapeutic exercise method for suprahyoid muscle in dysphagia rehabilitation.

Keywords: *Aging; Kinesiology taping; Suprahyoid muscle; Surface electromyography*

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INTRODUCTION

Aging is accompanied by several pathophysiological changes, especially in swallowing, resulting in decreased tissue elasticity, oral sensation, and oral moisture; oropharyngeal swallowing disorder because of muscle loss; and changes in the anatomy of the head and neck.[1-3] Sarcopenia is an age-related condition, which is characterized by gradual and generalized loss of skeletal muscle mass and strength, resulting in apparent muscle weakness or poor physical performance.[4-6] Such age-related changes in swallowing are called presbyphagia.[7] Although the swallowing function is preserved, the older adult shows subtle symptoms of swallowing impairment and a tendency for swallowing to decline as aging progresses.[8-10]

Any rehabilitation associated with sarcopenia involves physical exercise, such as resistance training, with adequate nutrition. Exercise is mainly applied to specific muscles showing dysfunction to improve altered physiological mechanisms and help restore function.[11,12] Therapeutic resistance training in swallowing rehabilitation includes tongue strengthening

exercises,[13–15] chin tuck against resistance,[16,17] chin-to-chest exercise[18] and head lifting exercises[19,20] to strengthen the suprahyoid muscles. Although the evidence is insufficient, it can have a positive effect on decreasing sarcopenic dysphagia. Nevertheless, the development of new safer, more effective and efficient therapeutic methods for strengthening suprahyoid muscles consisting of the geniohyoid, mylohyoid, digastric, and stylohyoid muscles is still needed.

Among recent therapeutic applications is kinesiology taping (KT) of the infrahyoid muscles as a resistance training intervention to strengthen the suprahyoid muscles.[21] The principle is to use the elasticity of the tape to pull the muscles downward from the hyolaryngeal complex and attach them it to the sternum and clavicle on both sides, making spontaneous swallowing difficult. In other words, KT was applied to provide resistance by loading the suprahyoid muscles during swallowing. Consequently, the swallowing action is performed by overcoming the resistance of the tape; this increases muscle activation and strength in the process. Park et al.[21] demonstrated a significant increase in suprahyoid muscle activation during swallowing when KT with 80% stretch was applied below the hyolaryngeal complex in the anterior neck of healthy adults, suggesting a potential therapeutic approach. Nevertheless, studies examining the use KT as a method of resistance training lack clinical evidence (e.g., sample size, healthy adult). Hence, the application and therapeutic potential of KT in older adults who are vulnerable to swallowing difficulties remain questionable. Therefore, this study investigated the applicability and effectiveness of the new therapeutic method using KT to community-dwelling elderly.

SUBJECTS AND METHODS

Subjects

This study enrolled 23 healthy elderly people (male 10, female 13, age range 60-75 years) living in the community without a history of neurologic disease. Exclusion criteria included difficulty or inability in voluntary swallowing, hypertension, orofacial pain including trigeminal neuropathy, toothache, significant malocclusion or facial asymmetry, unstable breathing and pulse, head/neck surgery, speech or swallowing deficits, dermatological issues in the anterior neck, and allergies to tape. This study was approved by the Ethics Committee of the Seoul medical center in South Korea (2019-09-011). We described the complete details of this study to all participants and obtained their informed consent to participate.

Methods

Participants were requested to perform the swallowing action under the following three conditions: 80% stretch with KT, placebo-KT, and non-KT. The actions were performed randomly using a lot system. A break of 5 minutes was provided between each condition.

The experiment was conducted based on the previous Park et al.[21] trial method. All participants performed one saliva swallowing after hearing the system alarm in 5 seconds; then, they rested for 5 seconds and sometimes water of small amount was provided to help perform the action of natural swallowing. Swallowing was performed a total of five times. To investigate the effects of KT, we used surface electromyography (sEMG) to measure the activity of the suprahyoid muscles (Figure 1).

In all conditions, the sEMG was recorded only when the task was being performed and not during the rest time. The area under the chin of participants was first cleaned with alcohol and cotton. They then sat comfortably on a chair with both arms placed on a desk in front. Wireless sEMG electrodes were attached to both sides of the midline under the chin with an inter-electrode distance of 1 cm.

sEMG data were measured using the Noraxon TeleMyo-DTS (Noraxon, Inc., Scottsdale, AZ). The signals were amplified, band-pass filtered (10-500 Hz), notch filtered (60 Hz), and digitally recorded at 1,500 Hz on Noraxon TeleMyo-DTS. The measured sEMG data were then analyzed using MATLAB software (MathWork, Natick, MA), processing them into a signal envelope using the Hilbert transform function. The two sEMG values were depicted in microvolt root mean square (RMS).

Kinesiology taping application

The kinesiology tape (BB Tape; WETAPE Inc., Seoul, Korea) was designed and applied by an experienced occupational therapist. The KT application method was applied based on the Park et al,[21] and the detailed method is as follows. KT was applied using an I shape and a reverse V shape with participants sitting in neutral position.[21] The front of the neck was cleaned using an alcohol swab for firm attachment of the tape. KT was applied as follows: first, the insertion

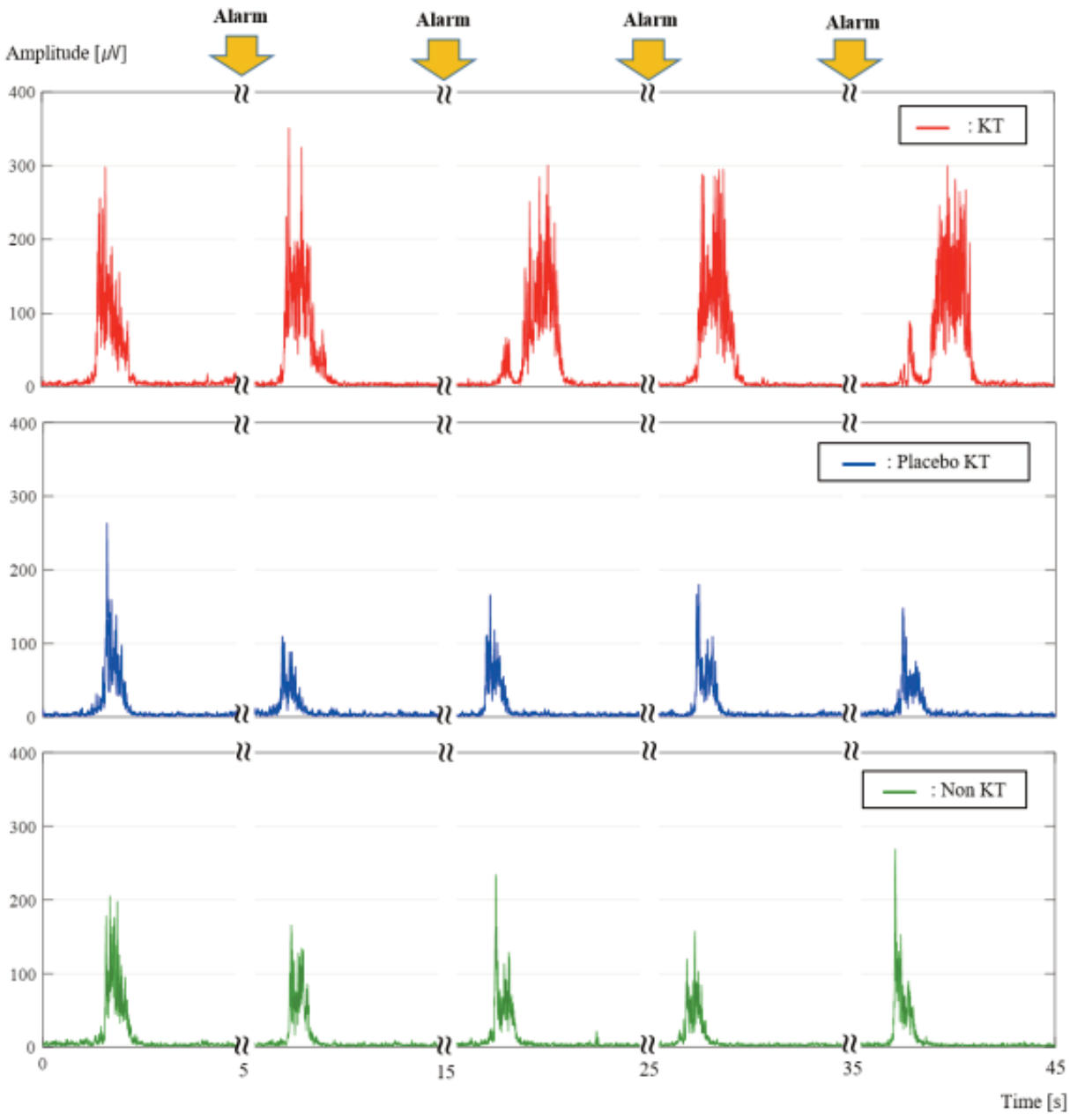

Figure 1. sEMG wave of according to KT conditions

and origin sites of the tape attachment were marked using a permanent marker. Second, an I-shaped tape with approximately 80% stretch was pulled down from the level of the thyroid notch, wrapping the thyroid cartilage, to the center of the sternum. Third, a reverse V-shaped tape again providing approximately 80% stretch was pulled downward from the hyoid bone and attached to the medial superior surface of both clavicles (Figure 2). The principle was to use the elasticity of the tape to pull the muscles of the hyolaryngeal complex downward by applying the I- and reverse V-shaped tape. In the placebo-KT condition, the I- and reverse V-shaped tapes were applied without providing stretch. In the non-KT condition, the swallowing action was performed without using KT.

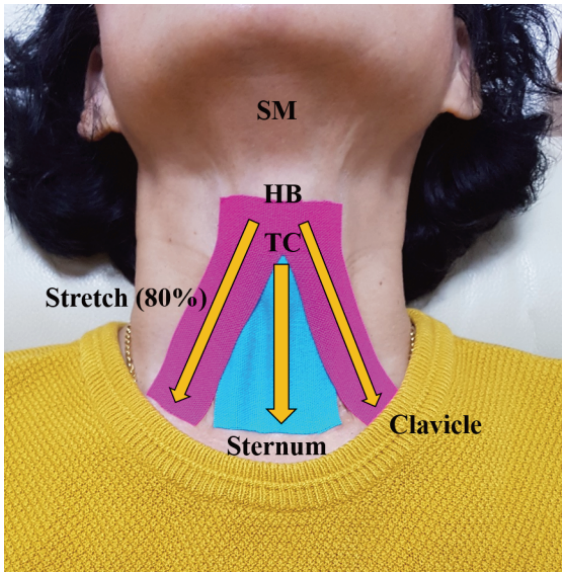

Figure 1. Kinesiology taping methods
SM: Suprahyoid muscles, HB: Hyoid bone
TC: Thyroid cartilage

Outcome measurement

The primary outcome measure of this study was to obtain increased activity of the suprahyoid muscles during swallowing. The activity of the suprahyoid muscles was measured with participants performing five consecutive swallows in three conditions, and the mean and peak amplitudes were recorded. The secondary outcome of this study was to measure the effort required of the participants during swallowing using a 0-10 numerical rating self-report scale (NRSS). A score of 10 indicated a higher effort during swallowing. All interventions and evaluations were performed by only one experimenter.

Statistical analysis

The statistical analyses were performed using SPSS version 15.0 (IBM Corporation, Armonk, NY). Descriptive statistics are presented as means with standard deviations. A repeated-measures analysis of variance (ANOVA) was used to assess the effects of loads and repetitions using sEMG and NRSS. Scheffe test were conducted as post hoc tests. Statistical significance was set at $P<.05$.

RESULTS

Peak and mean amplitudes of sEMG

The suprahyoid muscles showed significantly greater mean (45.56±13.62 mV) and peak (322.3±79.40 mV) amplitudes in the KT condition than that in the placebo-KT (mean; 29.05±6.40 mV, peak; 236.94±49.79 mV) and non-KT (mean; 31.04±7.44 mV, peak; 272.03±65.34 mV) conditions ($P<.001$). There was no significant difference in mean and peak amplitudes between placebo-KT and non-KT conditions ($P=.770$ and .178) (Table 1).

Value of NRSS

Both the resistance felt and required effort during swallowing in the KT condition were significantly higher than that in the placebo-KT (2.89±.73 and 2.92±.66) and non-KT (2.80±.70 and 2.80±.57) conditions ($P<.001$). There was no significant difference in the resistance felt and required effort during swallowing between placebo-KT and non-KT conditions ($P=.946$ and .840) (Table 2).

Table 1. Mean and peak sEMG values of three conditions

Measurements	KT 80%[a]	Placebo KT[b]	Non-KT[c]	F	*P*	Post hoc comparisons	
						Scheffe	*P*
Mean [mV] ± SD	45.56 ± 13.62	29.05 ± 6.40	31.04 ± 7.44	21.62	< .001*	a > b	< .001*
						a > c	< .001*
						b = c	.770
Peak [mV] ± SD	322.31 ± 79.40	236.94 ± 49.79	272.03 ± 65.34	10.55	< .001*	a > b	< .001*
						a > c	.031*
						b = c	.178

*$P<.05$, KT: Kinesiology taping

Table 2. Numeric rating self-report scale (Resistance felt and required effort during swalloing)

Measurements	KT 80%[a]	Placebo KT[b]	Non-KT[c]	F	*P*	Post hoc comparisons	
						Scheffe	*P*
Resistance felt ± SD	6.25 ± 1.16	2.89 ± .73	2.80 ± .70	122.22	< .001*	a > b	< .001*
						a > c	< .001*
						b = c	.946
Required effort ± SD	6.56 ± .88	2.92 ± .66	2.80 ± .57	221.69	< .001*	a > b	< .001*
						a > c	< .001*
						b = c	.840

*P<.05, KT: Kinesiology taping

DISCUSSION

Park et al.[21] recently introduced a new method using KT as a resistance mechanism to strengthen the suprahyoid muscles and proved to be effective for increasing the activity of the suprahyoid muscles. The activity increased in proportion to the degree of stretch provided by KT. However, the effectiveness of the resistance training method using KT is debatable, and its applicability and effects are not well known in elderly patients who are vulnerable to swallowing difficulties or in patients with neurological disease. Therefore, this study investigated the effect of KT as a resistance mechanism on suprahyoid muscle activity in community-dwelling elderly people.

This study compared the activity of the suprahyoid muscles during swallowing under three conditions (KT, placebo-KT, and non-KT). It was observed that in the KT with 80% stretch condition, the suprahyoid muscle activity was significantly greater than that in the placebo-KT and non-KT conditions. There was no significant difference in suprahyoid muscle activity between the placebo-KT and non-KT conditions. In other words, based on the principle of loading, it is possible to induce myophysiologic changes by repeated training using KT with 80% stretch.

This study attempts to use KT as an external force to provide resistance to the swallowing action by suppressing the upward movement of the hyoid bone and larynx during swallowing. That is, the contractile force of KT provided loading to induce activation of the suprahyoid muscles during swallowing. Therefore, the participants attempted a labored swallowing action to overcome the resistance generated by the tape's contractile force. Consequently, KT increased the activation of the suprahyoid muscles during swallowing, indicating increased motor unit activation in the peripheral nervous system.[22] This also implies an increase in recruitment of motor units or discharge rate of the motor units because of the increase in the effort required for swallowing.[23] Previously, Park et al.[21] demonstrated that KT is an effective method to increase activation of the suprahyoid muscles during swallowing in normal adults and that the amount of activity depends on the degree of stretch provided by KT. This means that the higher the stretch provided by the KT, the greater the contractile force, and the higher the loading provided to the suprahyoid muscles during swallowing. In this study, we used KT at 80% stretch and it showed a significant increase in suprahyoid muscle activity in older adults compared with that in placebo KT and non-KT conditions, which is consistent with previous studies.

In addition, this study compared the effort and resistance required during swallowing using NRSS. It was observed that both effort and resistance required to swallow were higher in the KT condition than that in the placebo-KT and non-KT conditions. Thus, this study matched the trend and findings of Park et al.'s study.[21] The NRSS finding in this study indicate that KT required more resistance and effort during swallowing, which supports the sEMG finding of this study.

This study confirmed that the resistance to KT during swallowing was effective in increasing suprahyoid muscle activity in the elderly. These results suggest its therapeutic potential for application in both healthy adults as well as the elderly who may be vulnerable to swallowing. However, there are important points to consider when applying this method on such a population. The increase in suprahyoid muscle

activation depends on the extent of KT stretch. This study applied KT at 80% stretch; however, less KT stretch should be considered for elderly people with severe muscle weakness and atrophy.

This study has some limitations. First, this study only confirmed results of KT with 80% stretch; we could not compare the changes in activity with variation in the magnitude of stretch. Therefore, in future studies, there must be variation in stretches according to the patient's physical condition.

Second, since only immediate effects were measured using sEMG, the effect on the oropharyngeal swallowing function cannot be guaranteed. Finally, the possibility of error with 80% stretch cannot be excluded. Therefore, it is considered that future studies will require research to investigate the effects of this intervention method on oropharyngeal swallowing function.

CONCLUSION

This study demonstrated that KT applied as resistance during swallowing is an effective method for increasing suprahyoid muscle activity in the elderly. The authors of this study recommend training using KT as a new therapeutic exercise method that is easy, safe, cost-effective, and can be performed without the help of a professional practitioner

CONFLICT OF INTEREST

The author declares that there are no conflicts of interest.

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REFERENCES

1. de Lima Alvarenga EH, Dall'Oglio GP, Murano EZ, Abrahao M. Continuum theory: presbyphagia to dysphagia? Functional assessment of swallowing in the elderly. *Eur Arch Otorhinolaryngol*. 2018;275(2):443-449.
2. Mulheren RW, Azola AM, Kwiatkowski S, et al. Swallowing Changes in Community-Dwelling Older Adults. *Dysphagia*. 2018;33(6):848-856.
3. Di Pede C, Mantovani ME, Del Felice A, Masiero S. Dysphagia in the elderly: focus on rehabilitation strategies. *Aging Clin Exp Res*. 2016;28(4):607-617.
4. Smith L, Tully M, Jacob L, et al. The Association Between Sedentary Behavior and Sarcopenia Among Adults Aged ≥ 65 Years in Low- and Middle-Income Countries. *Int J Environ Res Public Health*. 2020;17(5):1708.
5. Wakabayashi H. Presbyphagia and Sarcopenic Dysphagia: Association between Aging, Sarcopenia, and Deglutition Disorders. *J Frailty Aging*. 2014;3(2):97-103.
6. Muhle P, Wirth R, Glahn J, Dziewas R. Age-related changes in swallowing. Physiology and pathophysiology. *Nervenarzt*. 2015;86(4):440-451.
7. Namasivayam-MacDonald AM, Riquelme LF. Presbyphagia to Dysphagia: Multiple Perspectives and Strategies for Quality Care of Older Adults. *Semin Speech Lang*. 2019;40(3):227-242.
8. Iyota K, Mizutani S, Oku S, et al. A Cross-Sectional Study of Age-Related Changes in Oral Function in Healthy Japanese Individuals. *Int J Environ Res Public Health*. 2020;17(4):1376.
9. Miyashita T, Kikutani T, Nagashima K, Igarashi K, Tamura F. The effects of sarcopenic dysphagia on the dynamics of swallowing organs observed on videofluoroscopic swallowing studies. *J Oral Rehabil*. 2020;47(5):584-590.
10. Pongpipatpaiboon K, Inamoto Y, Saitoh E, et al. Pharyngeal swallowing in older adults: Kinematic analysis using three-dimensional dynamic computed tomography. *J Oral Rehabil*. 2018;45(12):959-966.
11. Papa EV, Dong X, Hassan M. Resistance training for activity limitations in older adults with skeletal muscle function deficits: a systematic review. *Clin Interv Aging*. 2017;12:955-961.
12. Schoenfeld BJ, Ogborn D, Krieger JW. Effects of Resistance Training Frequency on Measures of Muscle Hypertrophy: A Systematic Review and Meta-Analysis. *Sports Med*. 2016;46(11):1689-1697.

13. Park T, Kim Y. Effects of tongue pressing effortful swallow in older healthy individuals. *Arch Gerontol Geriatr*. 2016;66:127-133.
14. Hwang NK, Kim MJ, Lee G, Yoon T, Park JS, Jung Y. Effect of tongue-strengthening training combined with a tablet personal computer game in healthy adults. *J Oral Rehabil*. 2020;47(5):606-612.
15. Yano J, Yamamoto-Shimizu S, Yokoyama T, Kumakura I, Hanayama K, Tsubahara A. Effects of Tongue-Strengthening Exercise on the Geniohyoid Muscle in Young Healthy Adults. *Dysphagia*. 2020;35(1):110-116.
16. Park JS, Lee G, Jung YJ. Effects of game-based chin tuck against resistance exercise vs head-lift exercise in patients with dysphagia after stroke: An assessor-blind, randomized controlled trial. *J Rehabil Med*. 2019;51(10):749-754.
17. Kim HH, Park JS. Efficacy of modified chin tuck against resistance exercise using hand-free device for dysphagia in stroke survivors: A randomised controlled trial. *J Oral Rehabil*. 2019;46(11):1042-1046.
18. Hughes T, Watts CR. Effects of 2 Resistive Exercises on Electrophysiological Measures of Submandibular Muscle Activity. *Arch Phys Med Rehabil*. 2016;97(9):1552-1557.
19. Park JS, Hwang NK, Oh DH, Chang MY. Effect of head lift exercise on kinematic motion of the hyolaryngeal complex and aspiration in patients with dysphagic stroke. *J Oral Rehabil*. 2017;44(5):385-391.
20. Poorjavad M, Talebian Moghadam S, Ansari NN. Effects of the head lift exercise and neuromuscular electrical stimulation on swallowing muscles activity in healthy older adults: a randomized pilot study. *Clin Interv Aging*. 2019;14:1131-1140.
21. Park JS, Jung YJ, Kim HH, Lee G. A Novel Method Using Kinesiology Taping for the Activation of Suprahyoid Muscles in Healthy Adults: A Preliminary Research. *Dysphagia*. 2020;35(4):636-642.
22. Farina D, Merletti R, Enoka RM. The extraction of neural strategies from the surface EMG: an update. *J Appl Physiol* (1985). 2014;117(11):1215-1230.
23. Wheeler KM, Chiara T, Sapienza CM. Surface electromyographic activity of the submental muscles during swallow and expiratory pressure threshold training tasks. *Dysphagia*. 2007;22(2):108-116.