



Original Article

Effect of orbicularis oris muscle training on muscle strength and lip closure function in patients with stroke and swallowing disorder

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Abstract. [Purpose] We aimed to investigate the effect of resistance training of the orbicularis oris muscles on lip muscle strength and closure function in patients with swallowing disorder with facial palsy after stroke. [Participants and Methods] This study recruited 10 patients with swallowing disorder and facial palsy after stroke. All the participants received orbicularis oris muscle training at an intensity of 70% of 1 repetition maximum by using an Iowa oral performance instrument. Muscle strength and lip closure function were evaluated after orbicularis oris muscle training. [Results] After the intervention, the orbicularis oris muscle strength showed a statistically significant increase from 20.5 ± 5.15 to 25.3 ± 4.2 kilopascal. Lip closure function showed a statistically significant improvement from 2.6 ± 1.5 to 1.2 ± 1.0 . [Conclusion] This study recommends to train at an intensity of 70% of 1 repetition maximum for 4 weeks to increase the orbicularis oris muscle strength and improve lip closure function.

Key words: Orbicularis oris muscle, Stroke, Swallowing

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INTRODUCTION

The orbicularis oris muscle is one of the orofacial muscles and plays an important role in swallowing and speech. This muscle is responsible for lip closure and prevents food from spilling out of the lips during swallowing¹⁾. However, various neurological diseases can cause facial paralysis, which results in difficulty in proper closure of the lips. Inadequate lip closure during swallowing causes food to leak out of the lips and reduce intraoral pressure, negatively affecting swallowing²⁾. Therefore, maintaining proper lip closure function after a neurological disease is important for safe swallowing. However, among orofacial muscle training, most of the previous studies are related to tongue muscle training^{3, 4)}. Only few studies have been conducted on resistance training of the orbicularis oris muscles. Therefore, we aimed to investigate the effect of resistance training of the orbicularis oris muscles on lip muscle strength and closure function in patients with swallowing disorder and facial palsy after stroke.

PARTICIPANTS AND METHODS

For this study, we recruited 10 patients with swallowing disorder and facial palsy after stroke. The patient selection criteria were as follows: 1) those with facial palsy after stroke, 2) those diagnosed as having a swallowing disorder, 3) those with inappropriate lip closure function, and 4) those within 6 months of stroke onset. The study purpose was explained to the participants before enrollment, and informed consent for participation was obtained in accordance with the principles of the Declaration of Helsinki.

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All the participants underwent traditional rehabilitation therapy (e.g., sensory stimulation, muscle strengthening) and additionally received resistance training of the orbicularis oris muscles. The resistance training method of the orbicularis oris muscles is as follows: place a rubber bulb, which acts as a pressure sensor for the oral performance instrument (IOPI), between the disposable tampon and the lips. After this, 1 repetition maximum of the orbicularis oris muscles of the patient is measured to confirm the maximum muscle strength. The lip closure training was performed at 70% of 1 repetition maximum. The intervention was performed 30 times per week for 5 times a week for 4 weeks. After the intervention, the maximum muscle strength of the orbicularis oris muscles was measured using the IOPI. After three consecutive measurements, the mean and maximum values were recorded. The measurement method was based on the method of the previous study⁵). Intraclass correlations indicated moderate-to-strong reliability for anterior (0.58–0.77) and posterior (0.77–0.84) tongue strength⁶). Lip closure was evaluated on the basis of the videofluoroscopic swallow study (VFSS) image as a lip closure item among the mouth items of the videofluoroscopic dysphagia scale. The lip closure items were divided into three points, namely intake, inadequate, and none⁷). The participants' characteristics were analyzed using the IBM SPSS Statistics version 20 (IBM Corp., Armonk, NY, USA). The Wilcoxon signed-rank test was used to compare the differences in outcome measurement before and after intervention.

RESULTS

After the intervention, the orbicularis oris muscle strength showed a statistically significant increase from 20.5 ± 5.15 to 25.3 ± 4.2 kilopascal ($p < 0.05$). Lip closure function showed a statistically significant improvement from 2.6 ± 1.5 to 1.2 ± 1.0 ($p < 0.05$).

DISCUSSION

This study investigated the effects of lip closure training on orbicularis oris muscle strength and lip closure function in stroke patients. We found that orbicularis oris muscle training was effective in increasing muscle strength and lip closure function. The skeletal muscles respond effectively to resistance training; thereby, skeletal muscle strength is increased⁸). Previous studies showed that resistance training is required for at least 4 weeks to induce physiological changes in the skeletal muscles⁹). The present study supports this result in that the orbicularis oris muscles require at least 4 weeks of resistance training, just like the skeletal muscles. Proper training intensity is also important for effective resistance training. If the intensity is too high, relative muscle fatigue can result. Conversely, low training intensity cannot cause physiological changes in muscles. The increase in muscle skeletal muscle strength depends on the training intensity. For effective and effective resistance training, an intensity of 60–80% of 1 repetition maximum is recommended¹⁰). This study was conducted with an intensity of 70% of 1 repetition maximum, which is considered appropriate to increase the muscle strength of the orbicularis oris, which are the muscles responsible for lip closure. Proper lip closure prevents food from spilling out of the lips. Therefore, contraction of orbicularis oris muscles is important for proper lip closure. This study evaluated lip closure in the oral phase by using VFSSs and found a significant improvement in lip closure. This suggests that the improvement in lip closure function as a result of the resistance training of the orbicularis oris muscles may have had a positive effect. Therefore, this study recommends training at an intensity of 70% of 1 repetition maximum for 4 weeks to increase the orbicularis oris muscle strength and improve lip closure function. This study has some limitations. First, the small sample size may have influenced the results. Second, the absence of follow-up after the intervention did not allow for determination of the durability of the effects.

Conflict of interest

None.

REFERENCES

- 1) Park JS, You SJ, Kim JY, et al.: Differences in orofacial muscle strength according to age and sex in East Asian healthy adults. *Am J Phys Med Rehabil*, 2015, 94: 677–686. [Medline] [CrossRef]
- 2) Oh DH, Park JS, Kim WJ: Effect of neuromuscular electrical stimulation on lip strength and closure function in patients with dysphagia after stroke. *J Phys Ther Sci*, 2017, 29: 1974–1975. [Medline] [CrossRef]
- 3) Honki H, Iida T, Komiyama O, et al.: Effect of a repeated tongue-lift motor task for tongue function. *Eur J Oral Sci*, 2016, 124: 540–545. [Medline] [CrossRef]
- 4) Rogus-Pulia NM, Larson C, Mittal BB, et al.: Effects of change in tongue pressure and salivary flow rate on swallow efficiency following chemoradiation treatment for head and neck cancer. *Dysphagia*, 2016, 31: 687–696. [Medline] [CrossRef]
- 5) Clark HM, Solomon NP: Age and sex differences in orofacial strength. *Dysphagia*, 2012, 27: 2–9. [Medline] [CrossRef]
- 6) Adams V, Mathisen B, Baines S, et al.: Reliability of measurements of tongue and hand strength and endurance using the Iowa Oral Performance Instrument with elderly adults. *Disabil Rehabil*, 2015, 37: 389–395. [Medline] [CrossRef]
- 7) Han TR, Paik NJ, Park JW, et al.: The prediction of persistent dysphagia beyond six months after stroke. *Dysphagia*, 2008, 23: 59–64. [Medline] [CrossRef]
- 8) Alcazar J, Guadalupe-Grau A, Garcia-Garcia FJ, et al.: Skeletal muscle power measurement in older people: a systematic review of testing protocols and adverse events. *J Gerontol A Biol Sci Med Sci*, 2018, 73: 914–924. [Medline] [CrossRef]
- 9) Moritani T, deVries HA: Neural factors versus hypertrophy in the time course of muscle strength gain. *Am J Phys Med*, 1979, 58: 115–130. [Medline]
- 10) Park JS, Kim HJ, Oh DH: Effect of tongue strength training using the Iowa Oral Performance Instrument in stroke patients with dysphagia. *J Phys Ther Sci*, 2015, 27: 3631–3634. [Medline] [CrossRef]