

2021 Doctoral Dissertation(Abstract)

Study on intervention methods for swallowing motor factors in the elderly

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I . Background and purpose

Swallowing is more than just a means of nutrition. It is associated with improved quality of life and the ability to deter serious illnesses such as aspiration pneumonia. Swallowing efforts are said to have a great significance in protecting human dignity and life and are considered as abilities that should be actively improved. In this study, "swallowing" can be divided into the oral, pharyngeal, and esophageal stages, and "swallowing disorders" refer to any impairment on any part of these stages. Exercise items that affect swallowing-related muscle groups and swallowing are called "motor factors."

Swallowing disorders can occur with or without damage to the swallowing center in the brain. Typical examples of the latter include aging and unilateral cerebral hemisphere disorders. However, it has been speculated that some of these may also involve impaired motor factors.

Therefore, in the master's course, we examined the motor factors related to swallowing disorders in a cross-sectional study and reported that the muscle strength of the suprahyoid muscles, cervical range of motion (extension), and kyphosis were all related factors in swallowing disorders. It is important to clarify effective treatment methods for these related factors in intervention studies. In this study, we decided to intervene by focusing on the suprahyoid muscle group.

This study is a compilation which consists of a first and a second study. In the first study, we investigated the exercise method in which the suprahyoid muscles were the most active in elderly people. In the second study, we intervened in the elderly patient population using the method clarified in the first study and examined its effect.

II . First study: An examination of the efficacy of head-raising exercise methods for guiding suprahyoid muscle activity

1. Purpose

Head -and -neck elevation movements consist of three kinematic types: head, neck, and combined head -and -neck flexion. However, it is unclear which of these three types is the most effective in activating the suprahyoid muscles. Therefore, we examined and compared the effects of the three types of flexion on the suprahyoid muscles.

2. Methods

A total of 25 healthy elderly individuals aged 65 years and older were recruited for this study. We determined the electromyographic activities of the suprahyoid and sternocleidomastoid muscles during head, neck, and combined head -and -neck flexion of the participants. Each task was measured twice, and there was a 30 s break between each task. The analysis interval was set to 3 s after the stabilization of the elevation. An average amplitude of over 3 s was determined. The larger of the two mean values was used as the representative value. The muscle activity during head flexion was normalized to 100%, and the rate of change for the neck and combined head -and -neck flexion were calculated. The muscle activity during each task was compared using Friedman's test and multiple comparisons. The significance level was set at 5%.

3. Results

The suprahyoid muscle activation rates were as follows (median [interquartile range]): head flexion, 100%; neck flexion, 68.8% [51.7%–97.8%]; and combined head -and -neck flexion, 64.4% [46.8%–95.6%]. Suprahyoid muscle activity during head flexion was significantly higher than that during neck flexion and combined head -and -neck flexion. The sternocleidomastoid muscle activities were as follows (median [interquartile range]): head flexion, 100%; neck flexion, 173.3% [105.9%-255.0%], and head-and-neck flexion, 144.3% [118.0%-255.0%]. The muscle activity during head flexion was significantly lower than those during neck and head-and-neck flexion.

4. Conclusion

Head flexion is the most effective type of head -raising movement in activating the suprahyoid muscles. We plan to investigate its effects on swallowing in future interventional studies.

III. Second study: The effects of head flexion on the swallowing ability of elderly patients: A quasi-randomized controlled trial

1. Purpose

We enrolled elderly patients and asked them to perform head flexion exercises and investigated its effects on swallowing ability.

2. Methods

The subjects were alternately assigned to either the intervention or the control group based on the order of their hospitalization. The intervention group underwent repeated head flexion exercises in the supine position for two weeks. Conversely, the control group was only limited to regular rehabilitation without interventions for swallowing ability or function. The primary outcome was the successful repetitive swallowing of saliva at least three times. The secondary outcomes were tongue pressure, jaw-opening force, and the General Oral Health Assessment index (GOHAD). When normality was observed, the interaction was examined by an analysis of variance by repeated measurements of the two factors. When an interaction was observed, a paired t-test was used to test for the differences before and after intervention. If normality was not observed, the differences before and after each group was examined using the Wilcoxon signed-rank test.

3. Results

The repetitive swallowing of saliva at least three times was normal. As a result of the repeated measures analysis of variance of the two factors, an interaction was observed. The mean values in the intervention group were 7.9 ± 2.4 s before the intervention and 6.1 ± 1.8 s after the intervention, and the mean values in the control group were 7.2 ± 1.6 s before the intervention and 7.0 ± 1.5 s after the intervention. When the values before and after the intervention in each group were examined using the paired t-test, a significant decrease was observed only in the intervention group. The tongue pressure was normal. As a result of the repeated measures analysis of

variance of two the factors, an interaction was observed. The mean values in the intervention group were 23.5 ± 7.0 kPa before the intervention and 27.5 ± 7.3 kPa after the intervention, and the mean values in the control group were 25.0 ± 6.8 kPa before the intervention and 26.0 ± 8.3 kPa after the intervention. No normality was found for the jaw-opening force. The median (interquartile range) of the intervention group garnered 3.8 (3.0-4.5) kg before the intervention and 4.1 (3.7-5.2) kg after the intervention. The control group garnered 3.8 (3.1-5.4) kg before the intervention and 3.8 (3.4-5.3) kg after the intervention. When the values before and after the intervention in each group were examined using the Wilcoxon signed-rank test, a significant increase was observed only in the intervention group. No normality was observed in the GOHAI scores. The median (interquartile range) of the intervention group was 59.0 (55.0-60.0) before the intervention and 59.0 (55.0-60.0) after the intervention. When the values before and after the intervention in each group were examined using the Wilcoxon signed-rank test, no significant difference was observed between the two groups.

4. Conclusion

Head flexion exercise has been shown to be an effective exercise method to for improving swallowing ability.

IV. Overall discussions

In the first study, surface electromyography was used to measure the muscle activity of the suprahyoid muscles using the three head elevation methods. The method of elevation with the highest suprahyoid muscle activity was head flexion. The limitations of the first study were the lack of assessment regarding the effects of fatigue and compensatory movements and that frequency analyses were not been performed. It is beneficial to investigate the effects of fatigue and compensatory movements in more detail in the future.

In the second study, we investigated the effects of head flexion exercises on the improvement of the swallowing ability when providing intervention in elderly patients. As a result, a decrease in the time needed for the repetitive swallowing of saliva at least three times and an increase in tongue pressure and jaw-opening force were observed. It has been shown that head flexion exercise is an effective exercise method for improving swallowing ability, and it is suggested that this useful information may be applicable to use as in intervention methods targeting elderly patients with dysphagia.

The limitation of the second study was the use of subjective exercise intensities as the basis for exercise load. It is necessary to consider the objective methods of setting the exercise load in the future. In addition, since our subjects were elderly patients, it may also be necessary to conduct intervention studies targeting healthy elderly people in the future.