

2017 Doctoral Dissertation

The Effects of Expiratory Muscle Strength Training
on the Swallowing Function of the Elderly

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Abstract

Structure

This paper is composed of four chapters: Chapter I, II, III and IV. Background and purpose of this study are summarized in Chapter I. In Chapter II are explained the processes of reviewing and designing the evaluation system for swallowing functions. Study 1 reports our findings regarding the postural effects or the effects of head-neck angle on the swallowing functions of the community-dwelling elderly. Chapter III reports the findings of our study followed by the analyses of the effects of respiratory muscle trainings on the swallowing functions of the elderly using an outpatient rehabilitation center. Measurement methods as examined in the Study 1 were applied in the evaluation of the swallowing functions based on the main outcome indicators. Chapter IV summarizes and discusses the main findings of our studies.

Chapter I: Introduction

Expiratory muscle strength training (hereafter, EMST), known to strengthen respiratory muscles and improve the ability to cough, is expected to improve functions of swallowing and phonation. There is a strong likelihood that training of respiratory muscles contribute to the improvement of swallowing and phonation-related muscles. So far, the evaluations of swallowing functions following EMST have been conducted using as indicators the findings of video-fluoroscopic swallowing examination, of electromyogram values of swallowing-related muscles, or of the 30-second repetitive saliva swallowing tests. Those methods are useful in judging the presence or absence of accidental swallowing aspiration; however, they are not intended for use in the evaluation of post-training improvement. By adding time-measurement required for swallowing as an additional indicator, this study examined whether more specified evaluation could be done to be used for post-intervention evaluation.

Chapter II: Study 1

The Effect of Posture on the Swallowing Function of the Community-Dwelling Elderly -Analyses of Accumulated Time in Repetitive Saliva-Swallowing-

The purpose of the study was to determine the effects of positions of the trunk, head, and neck on the swallowing function in the Japanese elderly. Subjects included 19 elderlies who participated in the preventive long-term care service and 16 users of day-care services. The subjects were asked to take the thrice-repetitive saliva swallowing test. The findings of each test, and the accumulated time necessary for saliva swallowing were evaluated for : (1) two different positions -sitting, and

semi-sitting; and for (2) three postural changes of head and neck including thirty-degree flexion, zero and thirty-degree extension. Each positional and head-neck postural effects on the swallowing time were evaluated. The zero-degree head-neck sitting position was found to be the shortest; while thirty-degree head-neck extension in semi-sitting position was the longest. In thirty-degree head-neck posture, no difference was observed in the values of either sitting or semi-sitting positions. When evaluating the swallowing functions, the following enabled more accurate assessments; the sitting position with the zero degree of head and neck, and semi-sitting position with 30degree head-neck. Even for the bedridden, as long as the head-neck was adequately flexed, swallowing functions could be evaluated as accurately as in the traditional sitting position.

Chapter III: Study2

The Effects of Expiratory Muscle Strength Training on the Swallowing Function of the Community-Dwelling Elderly Using Outpatient Rehabilitation Center

The purpose of this study was to determine the effects of Expiratory Muscle Strength Training /EMST on the swallowing functions of the community-dwelling elderly receiving the training at the outpatient rehabilitation center. Subjects were recruited from among the community-dwelling elderly using the outpatient rehabilitation center. Of the applicants, 31 elderly were chosen for an intervention group and 15, for a control group. Threshold-PEP (Chest Co. Ltd) was used for training. One-set training consisted of five consecutive training of EMST with 75-percent maximum expiratory pressure load. The intervention group received this set of training five times a day for eight weeks. The measurements included: time required for swallowing

saliva; swallowing functions; tongue wetness and pressure; tongue state and functions; oral diadochokinesis /OD ; oral motor functions; maximum phonation time /MPT ; phonation functions; maximum expiratory pressure /PE max and maximum inspiratory pressure /PI max; and respiratory functions. Comparative analyses of pre-and post-intervention of both the intervention and control groups were done using *t*-test. In order to further identify effects of intervention, analyses were conducted using general liner model with adjustments for sex, age, and baseline values.

Thrice repetitive saliva swallowing time was shortened in the intervention group, and the difference was significant even after adjustments in sex, age, and baseline value. As for MPT, an average increase of 2.07 seconds were observed in the intervention group, while an average decrease of 0.22 seconds in the control group, and the difference was statistically significant between the two groups. As for PEmax, an average increase of 5.17cmH₂O was observed in the intervention group, while an average decrease of 3.5 cmH₂O in the control group with statistically significant difference between the two groups. As for PI max, the average increase of 3.24cmH₂O in the intervention group, while the average decrease of 4.58 cmH₂O in the control group was observed with significant difference.

These results suggest that EMST improves the oral and respiratory functions of community -dwelling elderly subjects. This may be explained by the fact that the pathway for swallowing is partially shared with that for phonation, which contributes to a shortened swallowing time by repeated suprahyoid muscle contractions.

Chapter IV: Conclusion

Effects of postures and/or head-neck angles on the time necessary for saliva swallowing in the elderly were evaluated using measurements of thrice repetitive saliva swallowing time. The findings indicated that swallowing time was prolonged in both sitting and supine positions with extended head-neck angle, showing that head-neck angle affects saliva swallowing time. Further, no difference was observed in the amount of time required for swallowing at head-neck flexion, either in sitting or supine positions. This means that tests can be done either in sitting or supine positions; however, when measuring the time required, sample subjects' positions should be uniform. The EMST, a respiratory muscle training, was found to improve swallowing, phonation, and respiratory functions in the community-dwelling elderly. The repetitive contractions of hyoid muscles lead to the shortened time required for swallowing, as the acts of swallowing, phonation, or respiration share partially the same air passage. The findings of our study contribute to verify the effectiveness and significance of home-training of EMST for the community-dwelling elderly.