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Original Article

Scapulothoracic Muscle Activity during Use of a Wall Slide Device (WSD), a Comparison with the General Wall Push up Plus

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Abstract. [Purpose] The purpose of this study was to evaluate the effect of the wall slide device on activation of the scapulothoracic musculature. [Subjects] We recruited 15 healthy male subjects. [Methods] The subjects performed the general wall push-up plus (WPUP) and the wall slide with device (WSD) exercises. During the exercises, the muscle activities of the upper and lower trapezius (UT, LT), middle and lower serratus anterior (MSA, LSA), and pectoralis major (PM) were measured. [Results] The normalized muscle activity data of the WSD were significantly higher in UT, MSA and LSA than the WPUP. [Conclusion] Our results suggest that exercise using the WSD can more effectively activate the scapulothoracic musculature than the general WPUP
Key words: Exercise, Serratus anterior, Upper extremity

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INTRODUCTION

Abnormal scapular alignment and kinematics during arm elevation, disturbs normal shoulder kinematics[1, 2)]. Therefore in rehabilitation, retraining the scapulothoracic musculature is necessary for regaining normal alignment of the shoulder girdle and for functional shoulder movement[1–3)]. Closed kinetic chain exercises for the upper extremity are known to activate both the scapulothoracic and shoulder musculatures[3, 4)]. A recent finding suggested that the wall push up plus exercise is an appropriate closed kinetic exercise for those requiring low-level strengthening exercise[5)]. However, the general wall push up plus exercise is unable to stimulate proprioception of the shoulder joint receptors due to reduced tension, and simply introducing scapular protraction movement is questionable, since it is a less functional exercise than excises including an arm elevation component[6)]. In clinical practice, there are few devices for activating the musculature of the upper extremity. Although the shoulder press, pull down, and cross cable device are common exercise machine, these devices are not portable, and are not easy for individual to adjust patients. Therefore, the present study investigated the effect of a newly developed device which provides tensile resistance and induces an arm elevation component to scapulothoracic exercise.

SUBJECTS AND METHODS

Fifteen male subjects who were right-arm dominant participated in this study. They were aged 20 to 26 years (21.9±2.8), and their mean height and weight were 174.9±0.0 cm, and 66.5±5.3 kg, respectively. Subjects were excluded if they had a history of upper extremity injury within the last 6 months. Each subject provided his informed consent before participation in this study. This study was approved by the Inje University Faculty of Health Sciences Human Ethics Committee. Electromyographic (EMG) recordings of the upper trapezius (UT), lower trapezius (LT), middle serratus anterior (MSA), lower serratus anterior (LSA), and pectoralis major (PM) were performed using a Trigno wireless system (Delsys, Boston, MA, USA). Electrode placements and the procedure for measuring maximal voluntary contraction (MVC) were followed recommendations in the literature[7, 8)]. We designed a wall slide device (WSD), which is an adaptation of the standard push up bar. We added four wheels to the base to provide instability and reduce friction. Handle bars are connected to the trunk belt by a detachable Theraband (Fig. 1). Each subject performed three trials of general wall push-up plus (WPUP) and wall slide with device (WSD) exercises. In the WPUP, subjects stood at arms length from the wall, and pushed against the wall to push their back backward maximally. In the WSD exercise, subjects grasped the WSD bar and elevated the arm from 90° to 120°. The two exercises were performed

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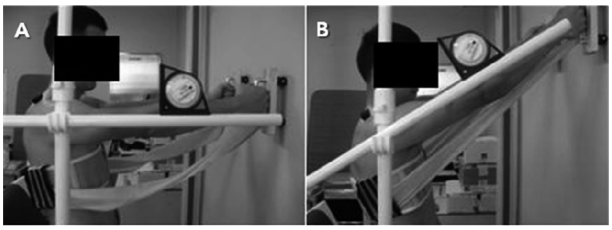

Fig. 1. Wall slide device (A: Initial posture, B: Terminal posture)

in a random order. Three minutes of rest time were allowed between trials. Three seconds of EMG data during the exercises were analyzed and then averaged. The data were expressed as % MVC to normalize the data[3]. The paired t-test was conducted to examine the significance of differences. Significance was accepted for values of $p<0.05$, and SPSS version 18.0 was used for statistical analyses.

RESULTS

During the WSD exercise, the averaged %MVC data of UT, MSA, and LSA were 25.2±17.5, 63.5±31.4, and 56.4±16.7, respectively. The %MVC data of the WSD were significantly higher than those of the WPUP ($p<0.05$), which were 10.4±13 for UT, 43.1±16 for MSA, and 38±16.3 for LSA. There were no significant differences in %MVC data of LT and PM between the WPUP (11.6±12.5 for LT, 12.3±12.9 for PM) and the WSD (16.1±18.79 for LT, 9±5.61 for PM) exercises ($p>0.05$).

DISCUSSION

A previous study categorized the level of %MVC into 4 levels: low, 0–20%; moderate, 21–40%; high, 41–60%; very high, > 60%[9]. Following this criteria, the WPUP of our present induced moderate levels of muscle activation in MSA and LSA. While WSD induced a moderate level of UT activation as well as high levels of MSA and LSA activation. This suggests that the newly designed WSD exercise activates the scapulothoracic musculature more efficiently and more harmoniously than the WPUP. Although some previous reports have cautioned against excessive activation of the UT[5, 7], it contributes to upward rotation of the scapulae, and one previous study demonstrated that loss of UT function causes reduced scapular upward rotation[10]. In the case of a patient with shoulder disability, strengthening exercises are necessary for regaining upper extremity function. Although previous studies have suggested using unstable surfaces and changes of body position to increase muscular activation[7, 11], providing controlled resistance and inducing functional movement cannot be easily adjusted to suit the patients. The newly designed WSD includes wheels to reduce friction resistance during the wall slide exercise, and resistance to raising the arms can be easily controlled by changing the length or type of Theraband. Futher comparisons of the WSD exercise with other exercise devices and exercise methods are required. Our present results suggest that exercise using the WSD can more effectively activate the scapulothoraic musculature than the general WPUP.

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