Effect of shoulder flexion angle and exercise resistance on the serratus anterior muscle activity during dynamic hug exercise

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Abstract. [Purpose] The primary aim of this study was to determine the effect of shoulder flexion angle and exercise resistance on the serratus anterior muscle activity during dynamic hug exercise. [Subjects] Ten men aged 22–32 years were recruited. [Methods] The subjects performed dynamic hug exercise at different shoulder flexion angles and under resistance weight conditions. Serratus anterior muscle activities were measured by using the surface electromyographic system during the dynamic hug exercises. After performing the exercise, each subject described the exercise intensity by using the Borg rating of perceived exertion (RPE) scale. [Results] The normalized serratus anterior muscle activity increased significantly in the order of Conditions 1 and 4 < Condition 3 < Condition 2. The Borg RPE scale increased significantly in the order of Condition 1 < Condition 2 < Condition 3 < Condition 4. [Conclusion] The results suggest that dynamic hug exercise with the use of a multi-air-cushion biofeedback device is an effective scapular stability exercise.

Key words: Borg RPE, Dynamic hug exercise, Scapular stability

INTRODUCTION

Considering that better mobility should be based on better stability, various exercises have been suggested for strengthening the scapulothoracic musculatures, which are considered to increase stability of the shoulder joint. Balanced and tuned scapulothoracic musculature appropriately positioned the scapulae during functional arm elevation movement.

In recent reviews, dynamic hug exercise was recommended for effective strengthening of the scapulothoracic musculature. Excessive force production of the upper trapezius, combined with a relatively weak lower trapezius and serratus anterior, could contribute to an abnormal scapular motion such as superior translation. On the other hand, dynamic hug exercise has a component for scapular protraction, which could activate the serratus anterior selectively. The primary aim of this study was to determine the effect of the shoulder flexion angle and exercise resistance on the serratus anterior muscle during the dynamic hug exercise.

SUBJECTS AND METHODS

Ten men aged 22–32 years, with a mean height and weight of 172.5 ± 6.7 cm and 68.2 ± 6.8 kg, respectively, participated in this study. The subjects had no history of musculoskeletal disorders or pain associated with the upper extremity in the past 6 months. The purpose and methods of the study were explained to the subjects before their inclusion in the study, and they provided consent according to the principles of the Declaration of Helsinki. Electromyographic signals were collected for 30 seconds, sent to the data acquisition unit of a MP150 system (Biopack System, Santa Barbara, CA, USA), and expressed...
relative to the maximum voluntary contraction (MVC). The surface electrodes were attached to the right serratus anterior muscles. Dynamic hug exercise horizontally adducts the humerus until the hands touch together. The subjects performed the dynamic hug exercise by using a pulley station. Axis of the pulley was placed at the level of a subject’s acromion by inserting plastic plates under the feet. The subject stood with the feet shoulder-width apart, elbows flexed at 90° and internally rotated at 90°, and shoulders abducted at 90°. The subject pushed the handle using horizontal shoulder adduction and elbow extension. Condition 1 was the application of a pulley weight of 10% of the body weight. Condition 2 was the application of a pulley weight of 20% of the body weight. Conditions 3 and 4 were elevation of the shoulder to 120° with 10% and 20% body weight, respectively. Subjects were asked to position their hands apart at shoulder width. The velocity of movement was controlled by using a metronome. A successful trial was determined by completion of a movement without exceeding the required velocity. They performed the dynamic hug exercise under the 4 conditions described. The test order was randomized. For identifying the subjective difficulties of exercises, each subject was asked to describe the intensity of the exercise by using the Borg rating of perceived exertion (RPE) scale after exercise. The scores ranged from “no exertion at all” as 6 to “maximal” exertion as 20.

The normalized serratus anterior muscle activity was increased significantly in the order of Conditions 1 and 4 (29.1 ± 11.8% and 32.0 ± 13.7%) < Condition 3 (36.2 ± 12.9%) < Condition 2 (41.2 ± 15.2%, p < 0.05). The Borg RPE scale was increased significantly in the order of Condition 1 (5 ± 2.0) < Condition 2 (8 ± 4.2) < Condition 3 (10 ± 1.5) and < Condition 4 (14 ± 2.5, p < 0.05).

DISCUSSION

Decker et al. described dynamic hug as a combined movement involving horizontal shoulder adduction and scapular protraction. In recent reviews, the dynamic hug exercise was recommended for strengthening the scapulothoracic musculature. This result showed that the increase in the normalized serratus anterior muscle activity was greatest during standard dynamic hug exercise with a pulley weight of 20% of the body weight. These results could be interpreted as floor effect, which is a combination between light exercise conditions and light resistance. Low resistance was not enough to provide resistance during dynamic hug exercise. The second effective exercise for the serratus anterior muscle was Condition 3. Clinical literature demonstrated that the lower trapezius and lower serratus anterior muscles were activated to stabilize the inferior angle of the scapulae during scapular upward rotation. Adjusting resistance was a common method for inducing greater muscular activation during exercise. However, applying resistance such as a dumbbell or one’s bodyweight against gravity could be inappropriate for patients with shoulder disability. This result showed that in Condition 3, the serratus anterior muscle activity increased more significantly than in Condition 4. The subjective exercise intensities were assessed based on the Borg RPE scale, which were greater in the order of Condition 2 < Condition 3. Therapists should consider not only resistance weight but also exercise position or method at the early state of rehabilitation. Proper selection of these factors would provide more appropriate exercise for individual patients. In addition, clinicians and practitioners should consider the above-mentioned disadvantages for generating exercises that are more functional in the progressive rehabilitation stage.

REFERENCES