J. Phys. Ther. Sci. 29: 1043–1044, 2017

The Journal of Physical Therapy Science

Original Article

Effects of pulling direction on upper trapezius and rhomboid muscle activity

Won-gyu Yoo[1)]

[1)] *Department of Physical Therapy, College of Biomedical Science and Engineering, Inje University: 607 Obangdong, Gimhae, Gyeongsangnam-do 621-749, Republic of Korea*

Abstract. [Purpose] This study examined the activation of the rhomboid muscle according to the angle of the arm. [Subjects and Methods] The current study was conducted on 15 healthy males. The participants performed the pulling exercise in 5 conditions. The surface electromyography system was used to measure the muscle activities of the rhomboid and upper trapezius. [Results] The activity of the upper trapezius in condition 5 was significantly increased compared to that in condition 4. The activity of the rhomboid in condition 4 was significantly increased compared to that in conditions 1 and 5. [Conclusion] This study showed that performing a pulling exercise with the arms raised above the head (shoulder flexion at 120°) is more effective for reducing upper trapezius tension, while also selectively strengthening the rhomboid muscle.
Key words: Electromyography, Rhomboid, Upper trapezius

(This article was submitted Jan. 17, 2017, and was accepted Mar. 20, 2017)

INTRODUCTION

Forward head posture with rounded shoulders due to a bad sitting posture leads to thoracic kyphosis[1)]. For this reason, those with forward head posture bend their upper cervical and atlanto-occipital joints to keep their eyes forward, thus contracting the back muscles of the head and neck and causing the upper cervical vertebrae to be relatively extruded[2)]. Janda reported that slouching down in a chair for a long period of time causes upper crossed syndrome (UCS), where the neck is tilted forward and the back is bent towards the rear[2)]. Those with UCS have a shortened neck flexor, trapezius lower fiber, and rhomboid (rhomboid and contracted trapezius upper fiber levator scapula, pectoralis major, and pectoralis minor)[1, 2)]. Changes such as these continuously increase muscle tone and stress in the neck and shoulder, causing pain, numbness, loss of function, and various symptoms in the nerve root, thereby affecting the function of the upper limbs[2, 3)]. The rhomboid muscles are needed to stabilize the scapula when the shoulder joints are contracted and extended[1, 2)]. Therefore, we chose to use scapular retraction resistance exercises with a Thera-Band to strengthen weakened rhomboids while minimizing muscle activation in a shortened upper trapezius. This study examined the activation of the rhomboid muscle according to the angle of the arm.

SUBJECTS AND METHODS

The current study was conducted on 15 healthy males (mean age = 25.44 ± 2.05 years; mean height = 169.69 ± 8.89 cm; mean weight = 65.56 ± 12.11 kg). Subjects with conditions that might affect trunk mobility, such as injury or neurologic deficits of the hip and lower extremities during the past year, were excluded from study. The study purpose and methods were explained to the subjects, who provided informed consent according to the principles of the Declaration of Helsinki before participating. The surface electromyography (EMG) MP150 system (BIOPAC Systems Inc., Goleta, CA, USA) was used to

Corresponding author. Won-gyu Yoo (E-mail: won7y@inje.ac.kr)

measure the muscle activities of the rhomboid and upper trapezius. A 360° goniometer was used to measure joint angles in each exercise posture, with participants in a sitting position. A green Thera-Band was used, where the resistance of the bands differs depending on their color (the resistance of the green band was 2.0 kg based on 100% of the coefficient of expansion; this is quite high but appropriate for adult males and females). A ruler was used to set the tension of the Thera-Band equally before the experiment. EMG data were obtained while participants performed a pulling exercise at shoulder width, maintaining shoulder flexion at 90° (condition 1); while doing an upper arm cross at shoulder width (condition 2); while opening the shoulders horizontally at 30° (condition 3); during shoulder flexion at 120°, maintaining shoulder width (condition 4); and during shoulder flexion at 60° (condition 5). The length of the Thera-Band was set at 30 cm to equally set the tension. The chair was moved in accordance with each subject's arm length, and the position of the shoulder was adjusted by changing the height of the chair. A stool was used to minimize compensatory movements, and constant monitoring was conducted to correct wrong posture. While holding the Thera-Band, forearm pronation was maintained to restrict the action of the biceps brachii, and a neutral ankle position was maintained. Each exercise was performed until the elbow joint was at the side of the trunk. An electromyogram was measured for 5 s while participants pulled the Thera-Band. Data were analyzed using SPSS for Windows software (ver. 20.0; SPSS Inc., Chicago, IL, USA). Repeated one-way analysis of variance (ANOVA) was used to assess differences in the upper trapezius and rhomboid muscle activities during the five exercise conditions, with the significance level set at $\alpha=0.05$.

RESULTS

Comparison of changes in muscle activities in the horizontal posture showed no significant difference between the rhomboid and upper trapezius muscles. The activity of the upper trapezius in condition 5 (29.3 ± 19.5% maximum voluntary contraction [MVC]) was significantly increased compared to that in condition 4 (15.9 ± 10.5%). The activity of the upper trapezius in conditions 2, 3, and 4 was 18.9 ± 13.1%, 20.9 ± 17.7%, and 19.9 ± 16.1%, respectively. The activity of the rhomboid in condition 4 (31.2 ± 9.8%) was significantly increased compared to that in conditions 1 and 5 (22.5 ± 11.0% and 21.1 ± 10.8%, respectively). The activity of the rhomboid in conditions 2 and 3 was 27.2 ± 13.2% and 24.9 ± 10.7%, respectively.

DISCUSSION

Good alignment of the scapula is essential to maintain a comfortable posture, and for proper functioning of the arms while moving[3, 4]. The rhomboid muscle stabilizes the scapula against the traction of the posterior deltoid, the long head of the triceps brachii, and the serratus anterior. Therefore, among the abovementioned muscles that displayed weakening, we used a Thera-Band to strengthen the rhomboid, which acts primarily to stabilize the scapula when the shoulder joint is contracted and flexed, while minimizing activation of the contracted upper trapezius[2, 5]. Comparison of changes in muscle activities in the horizontal posture showed no significant difference between the rhomboid and upper trapezius muscles. When the upper trapezius activity was compared among the different vertical postures, the activity was higher during shoulder flexion at 60° versus that at 120°. When the muscle activity of the rhomboid was compared among the different vertical postures, the activity was higher during shoulder flexion at 120° versus that at 90°, and was significantly higher during shoulder flexion at 120° versus that at 60°. The muscle activity was lowest during shoulder flexion at 60° and was the highest in the upper trapezius. The muscle activity of the rhomboid was highest during shoulder flexion at 120° and was the lowest in the upper trapezius. For these reasons, we believe that shoulder stabilization exercises work best during shoulder flexion at 120°. Our results demonstrate that when performing a shoulder stabilization exercise, the joint angles are more clinically significant when the posture of the arms is changed in the vertical rather than horizontal plane[5]. This study showed that performing a pulling exercise with the arms raised above the head (shoulder flexion at 120°) is more effective for reducing upper trapezius tension, while also selectively strengthening the rhomboid muscle. A limitation of this study was the small sample size. In addition, participants were not accustomed to exercises, and fatigue was purposefully minimized.

REFERENCES

1) Neumann DA: Kinesiology of the musculoskeletal system: foundations for physical rehabilitation. St Louis: Mosby, 2009.
2) Page P, Frank CC, Lardner R: Assessment and treatment of muscle imbalance: the Janda approach. Champaign: Human Kinetics, 2010.
3) Caneiro JP, O'Sullivan P, Burnett A, et al.: The influence of different sitting postures on head/neck posture and muscle activity. Man Ther, 2010, 15: 54–60. [Medline] [CrossRef]
4) Hébert LJ, Moffet H, McFadyen BJ, et al.: Scapular behavior in shoulder impingement syndrome. Arch Phys Med Rehabil, 2002, 83: 60–69. [Medline] [CrossRef]
5) Yoo WG: Effect of shoulder flexion angle and exercise resistance on the serratus anterior muscle activity during dynamic hug exercise. J Phys Ther Sci, 2016, 28: 278–279. [Medline] [CrossRef]