

PalArch's Journal of Archaeology of Egypt / Egyptology

EFFECTS OF SANDY GROUND QUADRUPEDAL WALKING TRAINING ON THE RATIO OF SERRATUS ANTERIOR AND UPPER TRAPEZIUS MUSCLE ACTIVITY

Byoung-Ha Hwang¹, Dae-Hyun Kim², Tae-Ho Kim^{3}*

^{1,2,3}Department of Rehabilitation Science, Graduate School, Daegu University, Korea

Corresponding author E-mail: ^{*3}ptkimth@daegu.ac.kr

Byoung-Ha Hwang, Dae-Hyun Kim, Tae-Ho Kim. Effects Of Sandy Ground Quadrupedal Walking Training On The Ratio Of Serratus Anterior And Upper Trapezius Muscle Activity-- Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(10), 918-923 ISSN 1567-214x

Keyword: Quadrupedal Walking, Sand Surface, Serratus Anterior.

ABSTRACT

This study aimed to identify the immediate effects of quadrupedal walking on sand and general ground as well as the activity ratio of the serratus anterior, and upper trapezius muscles in healthy adults. 34 healthy adults were randomly assigned to the 2 groups based on the exercises they performed the sand group (n = 18), the general group (n = 16). For the baseline measurements prior to the experimental exercises, the activities of the serratus anterior, and upper trapezius muscles were measured using surface electromyography of the shoulder movement at 90° flexion. The same measurements were taken after the 30-minute exercise trial, and the results were compared. A paired t-test was used to assess the differences between the effects of the pre- and post-exercise on scapular muscle activation in each group.

Based on the results, the quadrupedal walking sand group demonstrated significantly increased serratus anterior activity in the post-exercise measurements of the shoulder flexion at the 90°. Thus, quadrupedal walking on the sand surface is proposed as an effective exercise in improving serratus anterior muscle activity, and also upper trapezius / serratus activity ratio increase through various movements of the shoulder.

INTRODUCTION

The Shoulder pain is one of the most common types of clinical musculoskeletal problem. These Shoulder Pain is caused by repeated stress in

the biased movement of the scapular due to the wrong posture and lifestyle [1,2]. These repeated stresses make changes in scapular alignment and changes in the length of the surrounding muscles, making the shortened muscles strong and the lengthened muscles weak [3].

The serratus anterior muscle are very important contributors to normal and abnormal scapular movement and control [4,5]. Also the serratus anterior and upper trapezius muscles synergic action that allows for an appropriate scapula thoracic rhythm. This is essential to the maintenance of the length and tension relation of scapula humeral muscles and to the normal biomechanics of the shoulder during shoulder flexion movements [5,6].

Rehabilitation programs have included exercises performed on an unstable surface. It has been suggested that training with this type of exercise reduces the injuries and improves joint proprioception [7,8]. However, little has been studied about the effects of using an unstable base of support on electric activity of upper extremity muscles [9,10]. Quadruped walking exercise is a method of moving with a slowly moving speed but very high stability because it supports the ground with the remaining three feet while stepping on one foot [11].

Sandy ground is one of unstable ground, which is used to improve walking and balance ability as a ground environment that can lead various muscle activity by providing wide and continuous unstable ground unlike walking mats and general tools used for balance training [12]. Therefore, the purpose of this study was to determine the change in the muscle activity of serratus and upper trapezius muscles and the ratio of upper trapezius /serratus muscle evaluate quadrupedal walking on sandy ground.

MATERIALS AND METHODS

Subjects

The general characteristics of the subjects of this study are as follows. Among the 34 subjects, the control group consisted of 5 males and 11 females. The mean height of the control group was 165.25 ± 7.54 cm, the mean weight was 61.56 ± 11.65 kg, and the mean age was 21.68 ± 1.88 years. The experimental group consisted of 5 males and 13 females. The average height of the experimental group was 166.38 ± 7.62 cm, the mean weight was 63.55 ± 11.01 kg and the mean age was 22.11 ± 3.64 years. There was no statistically significant difference between the control and experimental groups ($p < .05$). All participants were informed about the purpose and method of the study before participating in the study and voluntarily agreed. This study was conducted after approval by the Bioethics Committee of Daegu University (1040621-201611-HR-008-02).

Surface EMG recording and data processing

To measure changes in muscle activities in the Shoulder of each subject between the different intervention methods, electromyography was obtained using a TeleMyo DTS (Noraxon Inc., Scottsdale, AZ, USA) from Two muscle the Serratus anterior, Upper trapezius of which play important roles in shoulder flexion. The electrode attachment regions were shaved, cleaned three times using alcohol swabs, and sufficiently dried before the electrodes were attached. EMG data were normalized using the Reference Voluntary Contraction(RVC) of the Serratus anterior, Upper trapezius separately. The measurement positions for the RVC were chosen according to a study by Kendall [3].

RVC values reflected the average RMS after three trials. EMG data were used for the three seconds of keep the end range for five seconds and expressed as a percentage of RVC (%RVC).

Experimental procedure

The muscle activity of both group in the state shoulder flexion at 90 degrees was measured and used as data. By installing a horizontal bar, the arm was stopped at 90 degrees and stopped for 5 seconds to measure muscle activity in serratus anterior and upper trapezius muscle. Repeated three times in the same manner and the average value was used as the data. The quadrupedal walking exercise was divided into a sand ground group and a general ground group, and the distance of 5m was crawled forward and backward. Total Exercise were during 30min.

Statistical analyses

Paired t-tests were conducted to compare values obtained before and after the intervention.

Independent t-tests were conducted to compare average values between the control and experimental groups. Statistical analyses were conducted with IBM SPSS ver. 18.0 (Armonk, NY, USA), and the statistical significance threshold was set at 0.05. Data deemed to have errors resulting from individual patient characteristics were excluded from statistical analyses.

RESULTS

The shoulder flexion at 90° muscle activity was significantly increased only Serratus anterior muscle in the experimental group before and after the intervention ($p<0.05$) (Table 1), a ratio of upper trapezius/serratus anterior was significantly increased only in the experimental group($p<0.05$) (Table 2). But there was no significant difference in the between each group.

Table 1. Comparison of changes in muscle activity at shoulder flexion (unit:% RVC).

Group	Muscle	Pre	Post	t	p	ratio of upper trapezius/serratus anterior
G (n=16)	SA	19.42±6.85	23.69±7.92	-3.951	.001*	
	UT	14.17±12.68	12.96±11.64	.681	.507	
SG (n=18)	SA	19.61±6.49	24.71±8.53	2.15±1.57	.045*	
	UT	14.20±12.21	13.20±12.21	.634	.534	
Values are presented as mean±standard deviation.						
SG, Sand ground group; G, General ground group; SA, Serratus anterior; UT, Upper trapezius						
*P<0.05						

DISCUSSION

This study was to investigate the immediate effect of the serratus anterior and upper trapezius muscle activity changes through shoulder complex movement not selective movement of serratus anterior on quadruped walking between general and sandy ground in normal adults. Subjects performed during shoulder flexion 90° serratus anterior and upper trapezius muscles activity were measured. and both group muscle activity was re-measured after quadruped walking exercise on each different surface.

As a result, the muscle activity of the sand surface group serratus anterior muscle activity was significantly increased. These results are that the upper body during quadruped walking was absorbed shock energy for decelerating [13]. Therefore When quadruped walking on sandy ground, sand characteristic can control the speed. The peri-scapula muscle absorb shock during the movement of arm flexion and horizontal abduction and might play a role to control slide on sandy ground. Therefore, Increased serratus muscle active through quadruped walking on sandy ground might activity more to control the 90° shoulder flexion. These results consistent with previous studies that the strength exercise for serratus anterior muscle on unstable surface induced the proprioceptive stimulation was more effective exercise [14]. Also consistent with previous studies that using a sling which was created artificial vibration,

made unstable environment was confirmed its muscle activity increase [15].

In the control group also, there was also a significant increase in the muscle activity of serratus anterior after intervention. These results are thought to be the result of the quadrupedal walking that is similar to the push up plus exercise, which is well known as serratus anterior muscle selective activation.

The result for a ratio of upper trapezius/serratus anterior muscle was significantly increased only sandy group. These results are believed to have resulted in increased muscle activity of serratus anterior through unstable surface exercise, resulting in relatively lower muscle activity of upper trapezius resulting in a higher rate. Also consistent with the Ludewig's study a ratio of upper trapezius/serratus anterior signified that the serratus anterior was highly activated, proportionately to the upper trapezius being minimally activated [6].

In the previous study suggested, in patients with a upper trapezius/serratus imbalance, that selective activation of the serratus anterior while minimizing activation of the upper trapezius may be advantageous, allowing selective serratus anterior strengthening to reduce the imbalance [16-18].

In this study showed that There was significantly increased serratus anterior muscle activity in quadruped walking on sandy ground group. These results can be effect result of the quadruped walking exercise on the sand, which led to a reduction in a ratio of the upper trapezius /serratus anterior through serratus anterior muscle activation. Therefore, the sand surface quadruped walking exercise is proposed as serratus anterior muscle activation and a ratio of the upper trapezius /serratus anterior reduction movement.

ACKNOWLEDGEMENT

This research was supported by the Daegu University Research Grant, 2019.

Conflicts of interest: The authors declare no conflicts of interest.

REFERENCES

- Ludewig PM, Reynolds JF. "The association of scapular kinematics and glenohumeral joint pathologies." *J Orthop Sports Phys Ther*, 2009;39(2):90-104.
- Sahrmann SA. *Diagnosis and treatment of movement impairment syndromes*. Elsevier Health Sciences 2001.
- Kendall FP, McCreary EK, Provance PG, et al. *Muscles, testing and function: with posture and pain*. Baltimore, MD: Williams & Wilkins. 2013.
- Dvir Z, Berme N. "The shoulder complex in elevation of the arm: a mechanism approach." *J biomech*, 1978;11(5):219-225.
- Inman VT, Saunders JB, Abbott LC. "Observations of the function of the shoulder joint." *Clin Orthop Relat Res*, 1996;330:3-12.

- Ludewig PM, Hoff MS, Osowski EE, et al. "Relative balance of serratus anterior and upper trapezius muscle activity during push-up exercises." *Am J Sports Med*, 2004;32(2):484-493.
- Verhagen E, Van der Beek A, Twisk J, et al. "The effect of a proprioceptive balance board training program for the prevention of ankle sprains: a prospective controlled trial." *Am J Sports Med*, 2004;32(6):1385-1393.
- Naughton J, Adams R, Maher C. "Upper-body wobbleboard training effects on the post-dislocation shoulder." *Phys Ther Sport*, 2005;6(1):31-37.
- Anderson KG, Behm DG. "Maintenance of EMG activity and loss of force output with instability." *J Strength Cond Res*, 2004;18(3):637-640.
- Lehman GJ, MacMillan B, MacIntyre I, et al. "Shoulder muscle EMG activity during push up variations on and off a Swiss ball." *Dyn Med*, 2006;5(1): 7-13.
- McGhee RB, Frank AA. "On the stability properties of quadruped creeping gaits." *Math Biosci*, 1968;3:331-351.
- Hwang BH, Kim TH. "The effects of sand surface training on changes in the muscle activity of the paretic side lower limb and the improvement of dynamic stability and gait endurance in stroke patients." *J Exerc Rehabil*, 2019;15(3):439-444.
- Hanna JB, Polk JD, Schmitt D. "Forelimb and hindlimb forces in walking and galloping primates." *Am J Phys Anthropol*, 2006;130(4):529-535.
- Park SY, Yoo WG. "Differential activation of parts of the serratus anterior muscle during push-up variations on stable and unstable bases of support." *J Electromyogr Kinesiol*, 2011;21(5):861-867.
- Kim TH, Lim JY. "The effects of wall slide and sling slide exercises on scapular alignment and pain in subjects with scapular downward rotation." *J Phys Ther Sci*, 2016;28(9):2666-2669.
- Ludewig PM, Cook TM. "Alterations in shoulder kinematics and associated muscle activity in people with symptoms of shoulder impingement." *Phys Ther*, 2000;80(3):276-291.
- Seok JH, Kim TH. "The effects of scapular alignment exercise and nerve mobilization on pain and muscle activity in subjects with scapular depression alignment." *J Musculoskelet Sci Technol*, 2020;4(2):58-65
- Kim TH, Park HK. "The comparison for serratus anterior muscle activity during protraction in open chain and closed chain exercises in healthy adults." *J KEMA*. 2018;2(1):1-5