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A STUDY ON THE IMMEDIATE EFFECT OF QUADRUPEDAL WALKING EXERCISE OF SANDY GROUND TO REPLACE PUSH UP PLUS EXERCISE

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ABSTRACT

This study aimed to identify the immediate effects of quadrupedal walking on sandy and general ground as well as and the activities of the serratus anterior muscles in healthy adults. 34 health adults were randomly assigned to the 2 groups based on the exercises they performed the sandy group (n = 18), the general group (n = 16) For the measurements prior to the experimental exercises, the activities of the serratus anterior muscles were measured using surface electromyography of during push-up plus end of motion. 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 and independent t-test was used to assess the differences between the each group. In EMG activity of the serratus anterior compared with the quadrupedal walking on sandy and general ground ($P < 0.05$). The serratus anterior showed increased activation on sandy ground, which required more joint stability than did the general ground.

Based on the results, the quadrupedal walking sandy group demonstrated significantly increased serratus anterior activity in the push up plus exercise. As proved by the quadrupedal walking on sandy exercise, the shoulder complex exercise was stabilizing the serratus anterior muscle therefore quadrupedal walking on sandy exercise can be to replace push up plus exercise.

INTRODUCTION

The shoulder joint has the largest range of motion among various joints of the human body, and many muscles form a complex relationship to provide stability of the upper arm and produce various and complex movements of the upper arm [1]. As the use of computers and smartphones increases, shoulder disease is one of the most common musculoskeletal diseases in humans, and most shoulder diseases are known to be caused by abnormal movements and misalignment of the scapular [2,3]. The scapular is providing the proximal stability for distal motility and controlling the function that allow the various function of the hand and arm [4]. As a result of abnormal alignment of the scapular, the shoulder horizontal adductors and the serratus anterior become weak and the ability to control the nerve of the upper arm decreases [5].

The function of the serratus anterior makes the scapular upward rotation as to the various movements of the upper arm and place the scapular to the rib cage appropriately as major stabilizer in humeroscapular joint and provide the dynamic stabilization [6]. It also plays a role in maintaining the proper position and scapular stability [7]. There have been actively studying the exercise methods to increase the serratus anterior activity. The most effective strength exercise for serratus anterior is push up plus [8]. However, there is a need for an easily accessible alternative for those who do not follow the push up plus exercise accurately.

Quadrupedal walking is a method of moving with a slow moving speed but very high stability because it supports the ground with the remaining three feet while stepping on one foot [9]. Therefore, we attempted to confirm the increase in muscle activity by making selective contraction of serratus anterior muscle using distal movement through quadrupedal walking.

MATERIALS AND METHODS

Subject

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 ㎝, 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 165.61 ± 7.68 ㎝, the mean weight was 61.27 ± 9.27 kg and the mean age was 21.50 ± 1.24 years. There was no statistically significant difference between the control and experimental groups ($p>0.05$). 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

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Surface EMG recording and data processing

The electromyography was obtained using a TeleMyo DTS (Noraxon Inc., Scottsdale, AZ, USA) from Serratus anterior of which play important roles in shoulder stability.

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 maximal voluntary isometric contractions (MVIC) of the Serratus anterior separately. The measurement positions for the MVIC were chosen according to a study by Kendall [10]. MVIC 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 MVIC (%MVIC).

Experimental procedure

In order to compare the changes of muscle activity of the serratus anterior muscles during push-up plus exercise, The activity was extracted in push-up plus end of motion, and the average value was used as the data by repeating the three times. The quadrupedal walking exercise was divided into a sandy 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 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

As a result of comparison of muscle activity of Serratus anterior muscle at the final point of push-up plus exercise after quadrupedal walking exercise according to the ground, the muscle activity was significantly increased in the sandy-ground exercise group($p=0.00$). But there was no significant difference in the control group ($p>0.05$). Comparing the differences between the two groups also showed significant differences ($p<0.05$)(Table 1).

Table 1. Comparison of changes in serratus anterior muscle activity during

push-up plus exercise. (unit:%MVIC)				
Group	**pre**	**post**	**t**	***p***
G (n=16)	49.37±21.03[a]	51.37±21.90	.464	.649
SG (n=18)	46.35±13.73	62.90±15.26	-5.076	.000*
[a]Mean±Standard deviation. SG, Sand ground group; G, General ground group; *P<0.05				

DISCUSSION

This study was to investigate the immediate effect of the serratus anterior muscle activity changes on quadruped walking between general and sandy ground in normal adults. Subjects were measured serratus anterior muscles activity in performed push-up plus. The serratus anterior muscle activity was significantly increased only in sandy group.

Sandy ground exercise is known to reduce the ground reaction force which promotes the stretch reflex , which induces more joint motility due to the increase of the angular velocity of the joint, thereby improving the stabilization of distal joints [11]. Therefore This study result is consistent with previous studies that using a sling which was created artificial vibration, made unstable environment was confirmed its serratus anterior muscle activity increase [12]. The exercise on the unstable sand surface requires more stability of the scapula. Because the stabilization of the scapular is required by the continuous mobility of the wrist, elbow, and shoulder joint in the process of securing the stability of the arm which is continuously changed by reducing the ground reaction force when the distal part touches the ground.

Instability recruits shoulder muscles in a more general way and thus promotes greater stability and proprioception and also this makes exercises on an unstable surface less harmful to the joint and possibly more advantageous than those performed on a stable surface [13].

This study proved the complex motion of shoulder complex with quadruped walking on sandy ground is effective in serratus anterior muscle activity. Through this results, a new approach to the serratus anterior function improvement exercise that can improve its strength and function through quadruped walking using unstable ground such as sandy ground is suggested to the subjects who are not easy to selectively contract the serratus anterior.

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

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