International Journal of Research in Medical and Basic Sciences
Volume 4 Issue 9, September 2018 ISSN: 2455-2569 Impact Factor: 4.457
Journal Homepage: http://mbsresearch.com, Email: mbsresearchp@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

TO COMPARE RECTUS ABDOMINIS AND EXTERNAL OBLIQUE MUSCLE ACTIVATION DURING VARIOUS EXERCISES PERFORMED ON FLAT SURFACE VERSUS SWISS BALL

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Abstract

The Swiss balls is a conventional exercise programs has recently been adopted. Swiss balls are an unstable surface which may result in an increased need for force output from abdominal muscles to provide adequate spinal stability or balance. The aim of the study was to determine To compare rectus abdominis and external oblique muscle activation during various exercises performed on flat surface versus swiss ball. Does rectus abdominis and external oblique muscle activation differ during various exercises performed on flat surface versus swiss ball.

Methods

The myoelectric activity of abdominals was quantified during the performance of upper body resistance exercises while seated on both a stable (exercise bench) and labile (swiss ball) surface. Participants performed the Supine Bridge,prone bridge , Side Bridge , Push up Data was analyzed by using SPSS Version -17.00. Paired t- test was used to compare the result of rectus abdominis and external oblique muscle activation during various exercises performed on flat surface versus swiss ball.

Results & Discussion

The results of present study indicate that core stability muscles recruit higher while performing exercises on unstable surface than on flat surface. An efficient core allows for the maintenance of optimum length-tension relationships of functional agonists and antagonists, which makes it possible for the body to maintain optimum force-couple relationships in the lumbo-pelvic-hip complex. Maintaining optimum length tension relationships and force-couple relationships allows for the maintenance of optimum joint arthrokinematics in the lumbo-pelvic-hip complex during functional kinetic chain movements.Hence findings of the study may help or guide therapists and trainers to organize training and rehabilitation programe in a progressive efficient manner. Healthy population may be educated to maintain recruitment of abdominal muscle which in turn may prevent or reduce the risk of musculoskeletal problem in lower back.

Keywords

Exercise; Spine Stability; Swiss Balls; Rehabilitation; Low Back Pain

Background

The term "core" has been used to refer to the lumbopelvic-hip complex, which involves deeper muscles, such as the internal oblique, transversus abdominis, transversospinalis (multifidus, rotatores, semispinalis), quadratus lumborum, and psoas major and minor, and superficial muscles, such as the rectus abdominis, external oblique, erector spinae (iliocostalis, spinalis, longissimus), latissimus dorsi, gluteus maximus and medius, hamstrings, and rectus femoris[1]. The core can be described as a muscular box with the abdominals in the front, paraspinals and gluteals in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom. Within this box are 29 pairs of muscles that help to stabilize the spine, pelvis, and kinetic chain during functional movements. Without these muscles, the spine would become mechanically unstable with compressive forces as little as 90 N, a load much less than the weight of the upper body. When the system works as it should, the result is proper force distribution and maximum force generation with minimal compressive, translational, or shearing forces at the joints of the kinetic chain. The core is particularly important in sports because it provides proximal stability for distal mobility. A major advance in our understanding of how muscles contribute to lumbar stabilization came from recognizing the difference between local and global muscles. Global muscles are the large, torque-producing muscles, such as the rectus abdominis, external oblique and the thoracic part of lumbar iliocostalis, which link the pelvis to the thoracic cage and provide general trunk stabilization as well as movement. Local muscles are those that attach directly to the lumbar vertebrae and are responsible for providing segmental stability and directly controlling the lumbar segments during movement.These muscles include lumbar multifidus,Psoas major, quadrates lumborum,the lumbar parts of iliocostalis and longismus,transverse abdominis,the diaphragm and posterior fibers of internal oblique.

Methods

Number and source of subjects

30 subjects were included in the study from the college.

Inclusion criteria

- 30 healthy individuals.
- Both male and female individuals.

Young individuals within the age group of 18-28 years

INSTRUMENTATION

- EMG device (**Neurotrac**myoplus)
- Measuring tape
- Stop watch
- Goniometer
- Swiss ball and exercise mat

OUTCOME MEASURES

- EMG score of rectus abdominis
- EMG score of external oblique.

PROCEDURE

Potential subjects were appraised of the procedure and its potential risks, benefits and the evaluation was done. Subjects those fulfill the study's inclusion criteria and gave their informed written consent form were included in the study.

TESTING PROCEDURE

Skin Preparation and Electrode Placement

Skin was prepared by shaving (when necessary) and cleansing the skin with alcohol solution prior to applying the electrodes to reduce skin impedance. Sites for electrode placement: -

(1) rectus abdominus (RA) 3 cm lateral to the umbilicus

(2)) For the External oblique (EO) muscle 15 cm lateral to the umbilicus

MVIC Testing

Subjects were made to perform maximum voluntary isometric contractions for the trunk musculature one day prior to actual data collection. Subjects were required to perform a 3 second maximal supine isometric trunk curl up against an manual resistance applied by therapist with resistance provided at the shoulders in the trunk extension direction to maximally recruit the rectus abdominis. Second, the subjects were asked to perform an isometric contraction for the external oblique. The subjects were in supine position with hips flexed and knees flexed 90°, feet supported on the ground. Subject performed trunk curl up rotated to the left side against resistance applied at the shoulder by therapist pushing in the trunk extension and right rotation directions

Explanation Procedure

Description of Exercise Movement

No subject had prior experience in performing the 4 swissball exercises,but all subjects had some experience in performing the bridging exercise and push ups. Participants practiced theexercises one day prior to actual data collection for MVIC to make them familiarized with the protocol. During the pre test session,each subject received instructions from a physical therapist that explained and demonstrated proper execution of each exercise. After being instructed subjects were asked to perform ten repetitions of jumping jacks and light jogg for 5 minutes for the purpose of warm up. All subjects performed two repetitions of each task and sequence of the tasks was same for each subject with 5 minutes rest period between each exercise. The four exercises were modified to be performed in a total of 8 separate movement tasks:-

1.a) . Supine Bridge – Subjects begun by lying supine on the floor with their feet flat on ground, knees bent 90 degrees, toes facing forward and hands on the floor by their sides, palms facing down. Pushing through the heels, subjects lift their pelvis off the ground to form a plank.

1.b) Supine Bridge with Swiss Ball – The same procedure was applied as in task 1(a), however, in this variation the individuals placed their feet flat on a swiss ball

2.a) Prone Bridge – Subjects assumed a prone position on the floor, and when instructed they establish a prone plank position with elbows placed beneath the shoulders and upper arms perpendicular to the floor. In this position only the feet and the forearms were touching the floor.

2.b) Prone Bridge with Swiss Ball – The same procedure was applied as in task 2(a), however, in this variation the individual's forearms were placed on a swiss ball.

3a) Side Bridge – Subjects assumed a side plank position with elbows under shoulder and upper arm perpendicular to the ground.

3b) Side bridge with Swiss ball - Activity was same as in 3 (a) however in this subjects placed their elbows and forearm on swiss ball.

4a) Push up -with hands and feet on exercise mat.

4b) Push up - with hands flat surface and feets on swiss ball.

DATA ANALYSIS

Data was analyzed by using SPSS Version -17.00. Paired t- test was used to compare the result of rectus abdominis and external oblique muscle activation during various exercises performed on flat surface versus swiss ball.

Results AND DISCUSSION

The primary aim of this study was to determine if performing various exercises on a swiss ball rather than the flat surface resulted in any changes in trunk muscle activity. The result of the study shows that there is a significant effect on muscle activation of rectus abdominis and external oblique when exercises were performed on two different sufaces i.e.flat surface and on swiss ball. Results of the study showed that effect on muscle activation of rectus abdominis was highly significant in all the three activities i.e. supine bridge(t-value= -5.651, p-value=0.01), prone bridge(t-value=-2.844,p-value=0.01) and push up (t-value= -3.440,p- value=0.05) on different surfaces.Similar results have been observed in the study of Gregory J Lehman,Wajid Hoda[20] that investigated trunk muscle activity during bridging exercises on and off a swissball and results showed that during prone bridge the addition of an exercise ball resulted in increased myoelectric activity in rectus abdominis. Findings of the current study is consistent with a previous study by Snarr RL et al[43.]In that the rectus abdominis was activated to a significantly greater extent during suspension push up in comparision to standard push up on flat surface and abdominal supine crunch.

Effect on muscle activation of external oblique was also highly significant during supine bridge (t-value= -6.730,p value=0.001). Significant changes were found in the muscle activation of external oblique during prone bridge (t-value= -2.316,p value=0.05) on two different surfaces. Similar results have been observed in the study of Gregory J Lehman,Wajid Hoda[20] that investigated trunk muscle activity during bridging exercises on and off a swissball and results showed that during prone bridge the addition of an exercise ball resulted in increased myoelectric activity in rectus abdominis.

The influence of surface stability on muscle activity appears to be muscle and exercise dependent. It may be argued that the increase in activation levels of the external oblique and the rectus abominis during prone bridging appear to be caused by decreases in surface stability and not different biomechanical demands due to the body's position relative to gravity. This finding agrees with the Vera-Garcia et al study that investigated trunk curl up exercises. While there were differences in the body's position relative to gravity between the ground exercise and the ball exercise during prone bridging, performing the bridge on a ball finds the participant in a more vertical position.

An important observation from all exercise tasks was the large variability in muscle activity between subjects that can greatly influence the interpretation of these results. It is possible that some subjects volitionally contracted their trunk muscles to provide stability while some others may have not. It is possible that individuals may be able to influence their trunk muscle activity either through verbal encouragement. Additionally, the variability may have been due to slight variations in participant posture or task performance. While exercise standardization was sought through verbal correction of form, it is possible that differences in task performance between the subjects still occurred. From the results of the study it can be sought that addition of swiss ball is capable of influencing the core muscle activation and may be used to help guide core stability training and rehabilitation, using a variety of Swiss ball and traditional abdominal exercises.The result of this study will assist health care professionals to better understand the “core”, to improve rehabilitation methods, and to assist in the prevention of injury.

Conclusion

It can be concluded from the present study that the change in muscle activation of rectus abdominis was highly significant during supine bridge, prone bridge and push up exercises. Change in muscle activation of external oblique was highly significant during supine bridge and significant during prone bridge.

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