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The Effects of Core Stabilization Training on Postural Control of subjects with Chronic Ankle Instability

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ABSTRACT

The aim of this study was to determine effects of core stabilization training in postural control of subjects with chronic ankle instability. Thirty three male students were enrolled. Samples of this study composed of subjects with (n=22) and without (n=11) chronic ankle instability groups and also from samples with instability 11 persons select as a control group. Core stabilization training was performed for eight weeks by study groups. Star excursion balance test (SEBT) used for evaluation of subjects postural control. For statistical analysis the Repeated Measure ANOVA and POSTHOC bonfferoni tests were used (P≤0.05). The results revealed that core stabilization training make increase in postural control in healthy and chronic ankle instability subjects. Because the important role of core stabilizer muscles in control of extremities distal parts, it's proposed that for rehabilitation of ankle sprain we should implement preventive exercise for body total kinetic chain.

Key words: postural control, core stabilization training, chronic ankle instability

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INTRODUCTION

Ankle sprain is one of the most common injuries among athletic participations [1, 2]. The most common predisposing factor in experiencing an ankle sprain is a previous history of ankle sprain [3, 4]. It was hypothesized that when an injury to the ankle occurs, differentiation of the afferent nerves may result which could contribute to chronic ankle instability (CAI) [3, 4].

The main deficits associated with CAI include deficits in proprioception, neuromuscular control, strength and postural control [3, 4]. Subjects with CAI commonly showing impaired postural control and Functional deficits in postural control [4, 5]. Postural control deficits are most probably derived by a combination of impaired neuromuscular control and proprioception [5]. Several studies have been carried out on CAI and postural control and most of them have examined the influence of foot mechanics on proximal structures Because of the closed chain nature of athletic activities, researchers are widening their focus on both distal and proximal joints mechanics [6-9]. The effects of foot mechanics on proximal structure have been studied extensively [6-9]. However the influence of proximal stability on lower stability structure and pathology remains largely unclear. Kibler [10] suggests that stabilization of trunk and pelvis is required for all movements of the extremities. Hodges and Richardson [11, 12] identified trunk muscle activities before the activity of the lower extremities. In fact, they assumed that stiffening of spine is essential to provide foundation for functional movements.

Numerous studies support the theory that CAI subjects use proximal muscles to compensate their distal neuromuscular deficits [4, 5, 7, 11]. Activation of biceps femoris, gluteus maximus and gluteus medius have been reported to be altered in CAI subjects compared to healthy subjects [2, 9-12]. Although all these studies support the idea that proximal muscle contraction patterns are altered in CAI, these studies are not consistent and their other results have complexity.

Core stabilization training is thought to improve balance, postural control, and reduce the risk of lower extremity injuries [13]. This theory is supported by the fact that subjects with a history of lower extremity injuries required greater trunk muscle recruitment to stabilize the body during dynamic tasks compared to healthy subjects [13].

Different tasks have been used to evaluate the relationship between CAI and proximal muscles [14-17]. Some of the tasks used were a prone leg extension, single-leg perturbation, maximal voluntary contraction, and single leg drop on forceplate platform [14-17]. Mckoen and Hertel [18] recommended SEBT as a more dynamic postural control task and promised this task will detect functional performance deficits associated with rehabilitation in CAI subjects. Due to the complexity of the above-mentioned findings the purpose of current study is to examine the effects of 8-week core stabilization trainings on subjects with and without CAI. Furthermore, we chose to use SEBT to evaluate postural control. We hypothesized that 8-week core stabilization training has positive effects on postural control and we think that training the proximal muscles to the ankle may improve postural control.

MATERIALS AND METHODS

This study was a randomized controlled trial in which individuals with self-reported CAI were randomly assigned to control and CAI groups. The CAI and healthy groups underwent 24 supervised core stabilization training sessions during 8-wek period. The control group maintained the same level of activity before study enrollment for the duration of 8 wk. measures of dynamic postural control were taken before and after 8-wk intervention in healthy, CAI and control groups.

Thirty-three male students including 22 CAI subjects (height 172±8 cm, weight 72.6±11.32 kg and age 22.5±3.6yr) with self-reported CAI and 11 healthy (height 178±10 cm, weight 76.6±11.32 kg and age 21.7±2.8yr) The subjects were free of any self-reported lower extremity injury in the previous 6 months. Subjects in the CAI group were free from injury to the lower extremity other than the ankle in the previous 6 months; had a history of at least 1 acute ankle sprain that resulted in swelling, pain, and temporary loss of function (but none in the previous 3 months); and a history of multiple episode of the ankle "giving way" in the past 6 months.

Once informed consent was obtained, Subjects were placed into 3 groups: healthy, CAI and control that each group consists of 11 subjects. The SEBT has demonstrated high intersession reliability and had been shown to be a valid in detecting deficits associated with CAI Subjects were positioned and aligned with a tape measure secured to the floor in accordance with Hertel [19]. Subjects maintained a single-limb stance while reaching as far as possible along a cloth tape measure secured to the floor in the relevant line of direction with their opposite limb, made a light touch on the line, and returned to the starting position [19]. The reach distances of three trials of the A, the PM, and the PL directions were recorded for each limb [19]. These directions have been shown to assess unique aspects of dynamic postural control. A trial was discarded and repeated if a subject placed excessive weight on the reaching limb, removed the stance foot from the starting position, or lost balance [19]. Reach distance was normalized to the subject's leg length in accordance with previously established methods [19]. The mean of three trials for each direction was used for analysis. Subjects in CAI and healthy groups participated in 24 supervised training sessions, three sessions per week. Each session lasted about 30 min. the progressive core stabilization training was designed to strengthen core muscles. The procedures for select core stability exercises included five types of exercise (i.e. semi sit-ups, sit-ups with rotation, lateral bridge, prone bridge, and four levels of lower body strength exercises) which are presented in table 1.

These trainings include Side-Bridge, Prone-Bridge, Curl-up, Squat with Swiss Ball and Seated Medicine Ball Rotation. Subjects performed all these exercises 2 set in first week and each week Side Bridge 2set and each side 10 second and prone bridge 10 second all these exercise performed at the first week

Statistical analysis

Subjects' distribution in groups was normal according to Kolmogorov-Smirnov test. Descriptive statistics, repeated measure analysis of variance, and one-way ANOVA were applied to examine and compare the effects of core stabilization training on dynamic postural control of subjects at the P level of 0.05. One-way ANOVA was used on each varying levels of within-subjects factor; for further analysis repeated-measure ANOVA used to examine changes in each group over the Y balance tests (within group) at the P level of 0.05.

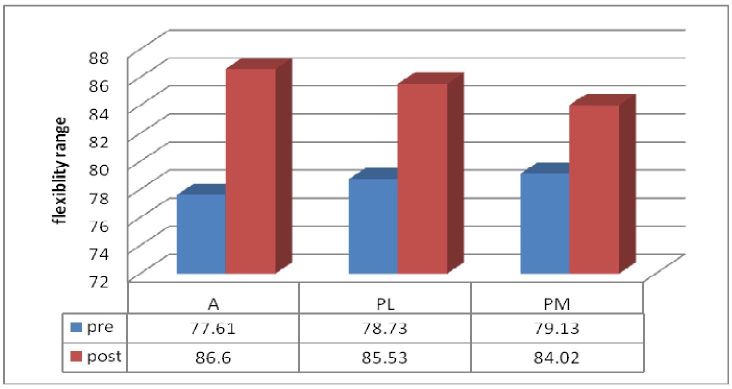
Table 1: The profile of select core stability exercises

First Week	Repetition	Fifth Week	Repetition
Lower Abdominal Series – Level One	2 sets with 10 repetitions	Lower Abdominal Series – Level Four	2 sets with 10 repetitions
Semi sit-ups	2 sets with 10 repetitions	Semi sit-ups	2 sets with 20 repetitions
Lateral Bridge	2 series with 10 repetitions	Lateral Bridge	2 series with 20 repetitions
Sit-Ups with Rotation	2 sets with 10 repetitions	Sit-Ups with Rotation	2 sets with 20 repetitions
		Prone Bridge	3 sets with 20 repetitions
Second Week	Repetition	Sixth Week	Repetition
Lower Abdominal Series – Level One	3 sets with 10 repetitions	Lower Abdominal Series – Level Four	3 sets with 10 repetitions
Semi Sit-Ups	3 sets with 10 repetitions	Semi sit-ups	3 sets with 20 repetitions
Lateral Bridge	3 sets with 10 repetitions	Lateral Bridge	3 sets with 20 repetitions
Sit-Ups with Rotation	3 sets with 10 repetitions	Sit-Ups with Rotation	3 sets with 20 repetitions
		Prone Bridge	2 15-second series
Third Week	Repetition	Seventh Week	Repetition
Lower Abdominal Series – Level Two	2 sets with 10 repetitions	Lower Abdominal Series – Level Five	2 sets with 10 repetitions
Semi Sit-Ups	2 sets with 15 repetitions	Semi sit-ups	2 sets with 25 repetitions
Lateral Bridge	2 sets with 15 repetitions	Lateral Bridge	2 sets with 25 repetitions
Sit-Ups with Rotation	2 sets with 15 repetitions	Sit-Ups with Rotation	2 sets with 25 repetitions
		Prone Bridge	3 15-second sets
Fourth Week	Repetition	Eights Week	Repetition
Lower Abdominal Series – Level Two	3 sets with 10 repetitions	Lower Abdominal Series – Level Five	3 sets with 10 repetitions
Semi Sit-Ups	3 series with 15 repetitions	Semi sit-ups	3 series with 25 repetitions
Lateral Bridge	3 series with 15 repetitions	Lateral Bridge	3 series with 25 repetitions
Sit-Ups with Rotation	3 series with 15 repetitions	Sit-Ups with Rotation	3 series with 25 repetitions
Prone Bridge	2 10-second series	Prone Bridge	4 15-second series

RESULTS

Repeated-measure ANOVA results on Y balance test showed significant interaction between time (five tests) and groups (two experimental groups) ($F_{4, 112} = 70.65$, $p \leq 0.05$). Furthermore, the main effect of time ($F_{4, 224} = 92.95$, $p \leq 0.05$) was significant. Average changes in this test during different times shown in Figure 1.

Figure 1: Average for Y balance test changes of three groups.



DISCUSSION AND CONCLUSION

The purpose of this study was to determine the effects of core stabilization training on postural control in CAI participants measured by Y balance test. After 8 weeks training, the results showed significant increase in mean reach distance of control and CAI groups in all directions. The change in the mean reach distance in healthy and CAI participants verified the effects of strengthening core stabilizer muscles on postural control. As predicted before and in line with previous research, the CAI participants have lower postural control in comparison to the healthy participants.

King [20] defines the "core" as a cylinder that extends inferiorly from the superior rib cage to the inferior aspect of the pelvis. Others include the spine, pelvis, proximal lower extremity, and abdominal structures as parts of the core. Akuthota and Nadler [21] defined the superior portion of the core as the diaphragm, pelvic girdle inferiorly, the abdominal muscles anteriorly, and the paraspinal and gluteal muscles posteriorly.

Kibler [10] states that strengthening deeper muscles have further effects on stabilization in trunk region. The abdominal muscles consist of the transverse abdominus, internal and external obliques and rectus abdominus [10]. Contracting the transverse abdominus increases intra-abdominal pressure and tensions the thoracolumbar fascia [10]. The transverse abdominus have been shown to be critical in stabilization of the lumbar spine [10]. Abdominal muscle contractions help create a rigid cylinder, enhancing the stiffness of the lumbar spine [21]. Rectus abdominus and oblique abdominals are activated in direction-specific patterns with respect to limb movements, thus providing postural support before limb movements. Some researches claimed that core stabilization training may result in better patterns of activation for trunk muscles [21, 22]. In addition, spine stability and the importance of proper activation of core muscles have been addressed. In this study, we found increase in the mean postural control in different directions measured by Y balance test. It may mean that core stabilization training made better activation and greater strength in trunk muscles. Based on the Kibler's findings, activation of core muscles in extremities movement pattern caused better postural control, and core muscle activation can be used to generate rotational torques around the spine. In performing Y balance test, when the participants stay on one leg and use other leg for reach for keeping balance, activation of rectus abdominus and oblique muscles should be done before movement. In addition, the activation of multi fidus and transverse abdominus by supporting the spine assisted to gain balance in performing lower extremities movement.

Marshal and Murphy [23] showed that core stabilization training resulted in upper level activation muscles of lumbo-pelvic region in performing functional activities.

Rehabilitation of sport injuries through the years changed from traditional method to the neuromuscular training that consisted of proprioceptive and balance training for achieving functional movement in kinetic chain reaction.

Freeman [24-26] hypothesized that an injury to the ankle may result in deafferentiation of the afferent nerves contributing to CAI. Other researchers have observed decreased proprioception, joint position sense, balance, postural control strength, and increased peroneal muscle latency coordination, in CAI subjects [3-9].

Joint dynamic restraints results from feedforward and feedback neuromotor controls over the skeletal muscles across the joint [10, 11]. Feedforward controls are preparatory actions occurring before the sensory information is detected, while feedback controls are a corrective response, which adjusts to coordinate muscle activity after sensory information is detected [12]. Movement in ankle results in higher awareness of CNS somatosensory, and then message will send to muscles around the ankle as a response to the movement, while the response from proximal to distal refers to the strengthening of the proximal muscles assisting the prevention or the cure in CAI.

Final conclusion

Based on the results of this study, 8 weeks core stabilization training changed postural control in CAI and healthy subjects. Core stabilization training with increase in feedforward mechanism made progress in neuromuscular function and kinetic chain movement in lower extremity. Our results revealed that CAI participants use feedforward and feedback in keeping postural control. This study verified the importance of proximal muscles training for the prevention and decreasing the incidence of CAI. These suggest that abdominal training may improve neuromuscular function down the lower kinetic chain by potentially enhancing the capabilities of feedforward mechanisms. The results were consistent with the hypothesis that CAI subjects used feedforward and feedback mechanisms to maintain postural control. This study demonstrated the importance of training muscles proximal to the ankle in an attempt to prevent and reduce CAI. Not only athletic trainer and Clinicians must train the foot and lower leg musculature following an ankle sprain, but they should also consider training the entire kinetic chain.

REFERENCES

[1] Delahunt E.*J Body Move Ther.* **2007**; 11(3): 203-213.
[2] Ryan L. *Australian Journal of Physiotherapy*. **1994**; 40(1): 41-47.
[3] Fu ASN, Hui-Chan CWY. *Am J Sports Med.* **2005**; 33(8): 1174- 1182.
[4] Willems T, Witvrvouw E, Verstuy J, Vaes P, De Clercq D. *J Athl Train.* **2002**; 37(4): 487-493.
[5] McGuine TA, Keene JS. *Am J Sports Med.* **2006**; 34(7): 1103-1111.
[6] Docherty CL, Valovich McLeod TC, Shultz SJ. *Clin J Sports Med.* **2006**; 16(3): 203-208.
[7] Brown C, Ross S, Mynark R, Guskiewicz KM. *J Sport Rehabil.* **2004**; 13: 122-134.
[8] Hale SA, Hertel J, Olmstead-Kramer LC. *J Ortho Sports Phys Ther.* **2007**; 37(6): 303-311.
[9] Pintsaar A, Brynhildsen J, Tropp H. *Br J Sports Med.* **1996**; 30: 151-155.
[10] Kibler WB, Press J, Sciascia A. *Med.* **2006**; 36(3): 189-198.
[11] Hodges PW, Richardson CA. *Exp Brain Res.* **1997**; 114: 362-370.
[12] Hodges PW, Richardson CA. *Phys Ther.* **1997**; 77(2): 132-144.
[13] Nadler SF, Malanga GA, DePrince M, Stitik TP, Feinberg JH. *Clin J Sports Med.* **2000**; 10: 89-97.
[14] Plisky PJ, Rauh MJ, Kaminski TW, *Journal of Orthopaedic & Sports Physical Therapy*. **2006**; 36(12): 911-919.
[15] Akbari M, Karimi H, Farahini H, Faghihzadeh S. *J Rehabil Res Dev.* **2006**; 43(7): 819-824.
[16] Olmstead LC, Carcia CR, Hertel J, Schultz SJ. *J Athl Train* **2002**; 37(4): 501-506.
[17] Robinson RH, Gribble PA. *Archives of Physical Medicine & Rehabilitation.* **2008**;89(2): 364-370.
[18] McKeon PO, Hertel J. *BMC Musculoskeletal Disorders.* **2008**; 9: 76-76.
[19] Hertel J. *Clin Sports Med.* **2008**; 27(3): 353-370.
[20] King MA. *ATT.* **2000**; 5(2): 6-13.
[21] Akuthota V, Nadler SF. *Arch Phys Med Rehabil.* **2004**; 85(1):S86-S92.
[22] Zeller BL, McCrory JL, Kibler WB, Uhl TL. *Am J Sports Med.* **2003**; 31(3): 449-456.
[23] Marshall P, Murphy B. *J Electromyogr Kinesiol.* **2003**; 13: 477-489.
[24] Freeman MAR. *J Bone Joint Surg Am.* **1965**;47B(4): 669-677.
[25] Freeman MAR, Dean MRE, Hanham IWF. *J Bone Joint Surg Am.* **1965**; 47B(4): 678-685.
[26] Freeman MAR, Wyke B. *Brit J Surg.* **1967**; 54(12): 990-1001.