Additional Effect of Foot Core Stability on Active Single Leg Stance (ASLS) for Dynamic Balance Athlete with Chronic Ankle Instability (CAI)

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Additional Effect of Foot Core Stability on Active Single Leg Stance (ASLS) for Dynamic Balance Athlete with Chronic Ankle Instability (CAI)

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Abstract

Background : Foot core stability and active single leg stance (ASLS) combination are exercise concept to build muscle contraction synergistically which be used to increase dynamic stability. In previous study, positive result for increase dynamic stability after six weeks intrinsic foot muscle exercise. The active single leg stance (ASLS) is an exercise to facilitate recrutment postural muscle as movement background.
Purpose : This study aims to to investigate combination effect of foot core stability and active single leg stance (ASLS) for dynamic balance athlete with chronic ankle instability (CAI). Material/Methodes : Experimental pre and post test design, 23 volley athletes consisting of 6 females and 17 males were randomly divide into 3 groups. One control group and two intervention group. The control group consisted of 7 peoples, group 1 and 2 consisted of 8 peoples. The intervention was given in four weeks three times a week and meassured by star excursion balance test (SEBT).
Results : The foot core stability and active single leg stance (ASLS) combination showed significant dynamic stability improvement for all indicators, anterior (p= 0.000), anterolateral (p=0.001), anterolateral (p=0,00), lateral (p=0.00), posterolateral (p= 0.007), posterior (p= 0.016), posteromedial (p= 0.002), medial (p= 0.004), and anteromedial indictors (p= 0.002).
Discussion : Dynamic balance improvement of all indicators in group 2 were influenced by intrinsic foot muscle contraction, form a localized stability, which spread before the occurence of joint motion. Foot core stability create synergistic connection with pelvic core, together form optimal posture and build dynamic stability.

Keywords : chronic ankle instability (CAI), active single leg stance (ASLS), foot core

1. Introduction

The feet are complex structures that have important function for postural control, static and dynamic balance for dailiy activity. Composed of three systems with different function, the systems are active (intrinsic, extrinsic foot muscle and tendon), passive (ligament, bones and joint capsule) and neural subsytem (receptors what located on fascia, ligaments, joint capsule, muscle and tendon). The receptors will send every stimulation to medulla spinalis and brain, build integrated orientation, motoric plan and motoric responses (McKeon et al., 2015). The intrinsic muscle weakness correlates with lower limb risk problem such as flat

foot, plantar fascitis, ankle sprain, anterior cruciate ligament injury and knee arthritis (Pabón-Carrasco et al., 2020). Ankle sprain becomes the most injury encountered in sport such as sprinter and marathon 25%, volley ball and basket ball 19% and soccer 14%, increase about 15% every year and much faster in female athletes (10-14 years old) than male athletes (15-19 years old) (Herzog et al., 2019). Several studies show that 74% people with ankle sprain have chronic problems, like dynamic balance problem, disorientation of movement, foot pressure disfunction, foot mallalignment and muscle weakness, named chronic ankle instability (CAI). CAI has more severe level of damage than ankle sprain, associated with multifactorial condition, neuromuscular disfunction which is often defined as sensory motor deficits (Storm et al., 2016). The phenomenon of CAI is difficult to identify, because its considered same problem as ankle sprain. CAI are complex and chronic injury phenomenon, requires more detail analysis and complex exercise that aims to improve dynamic stability. Not only on feet but the exercise must be work synergistically to improve dynamic balance at the level above it (Forsythe, 2011).

Materials and Methods

Study Design

Experimental pre and post test design, divide in one control group and two intervention (group 1 and 2) groups.

Subjects

23 volley athletes consisting of 6 females and 17 males were randomly divide into 3 groups. The control group consisted of 7 peoples, group 1 and 2 consisted of 8 peoples.

Inclusion criteria : male or female volley athlete, 16-20 years old, unilateral chronic ankle instability, idFAI score 11 or > 11, positive anterior and tallar tilt test (Gurav, Ganu and Panhale, 2014).

Exclusion criteria : balance problem beacause of vestibular and central system disfunction, using implant in lower limb, post surgery of joint capsule, ligament, muscle, nerve reconstruction, post fracture and hyperlaxity condition.

Measurement

Initial data obtained by measuring dynamic balance using star excursion balance test (SEBT) and then be evaluated in fourth week.

Intervention

Each group were doing eversion and ankle dorsi flexion strengthening using the theraband 600 x50 x0,7 mm, 12 repetitions in 4 sets. Foot alignment was set on 7° ankle abduction (meassured by goniometer) and sitting with 90° knee flexion. Every intervention was carried out without using footwear. Group 1 was doing active single leg stance (ASLS), throw and catch the ball for 2 minutes. The researcher facilitated anterior superior iliac spine (ASIS) position close to posterior pelvic tilt or closer with throcanter. This intervention aims to stimulated pelvic core muscle (transversus abdominis and internal oblique muscles). When the abdominal muscle contraction well subject ordered to lift one leg and throw catch the ball for 2 minutes. Group 2 was doing combination of foot core stability (12 reps in 4 sets), active single leg stance (ASLS), throw and catch the ball for 2 minutes. After ankle strengthening, the subject stay at same position, ordered to pull the fingers toward to hell (anterior and posterior) without finger flexion above dry towel 30x70 cm. Foot core stability holded for 6 seconds and 12 repetions.

Statistical Analysis

The data have obtained were analyzed by SPSS 21 version and level of significance was p <0,05. Paired t test (distribution normal data) and wilcoxon (upnormal distribution data) were used to analyses intervention effect each group.

Result

Table 1. Mean, standard deviation and homogenity of subject characteristics.

Characteristic	Mean±SD			
	Control	Group 1	Group 2	p
Age (years)	15.86± 0.38	16.38± 0.52	16.13± 0.35	0.13
Leg length (cm)	87.93± 7.36	88.50± 3,55	87.88 ± 5.25	0.97
N		8		

From table 1, there was significantly differences (levene test) p> 0.05, N= the number of subject in one group.

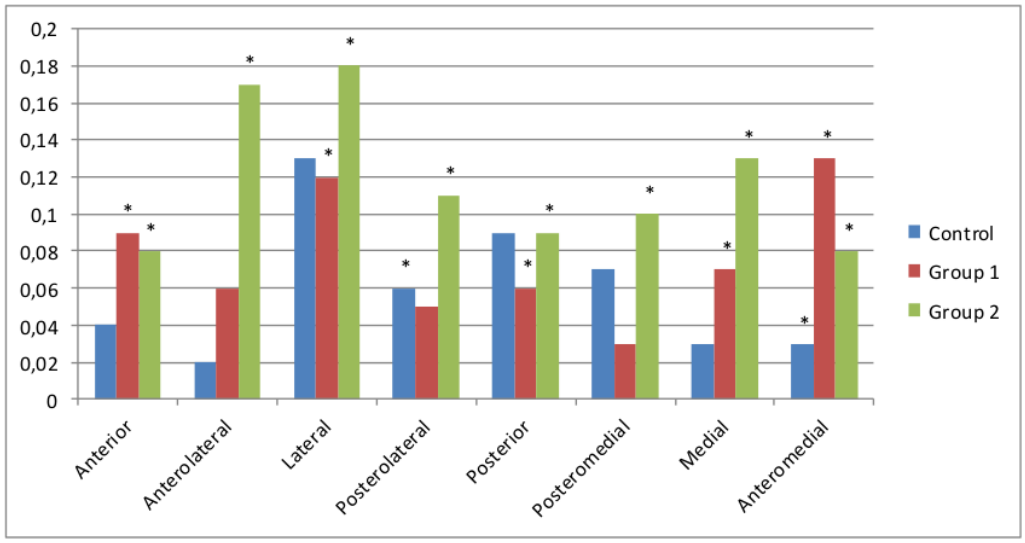
The homogenity test of all groups used levene test and all data were homogeneous, for normality using shapirowilk test and the results were upnormal distributed data in control group (anterior indicator) and group 1 (posterolateral and posteromedial indicators). Paired T test was used to normaly distributed data, and wilcoxon was used to not normaly distributed data.

Table 2. Dynamic balance difference before and after intervention in each group (SEBT data has been normalized).

Indicators			
	Control	Group 1	Group 2 (a)
Pre anterior & post anterior	0.017* (b)	0.001* (a)	0.000*
Pre anterolateral & post anterolateral	0.153 (a)	0.053 (a)	0.001*
Pre lateral & post lateral	0.076 (a)	0.001* (a)	0.000*
Pre posterolateral & post Posterolateral	0.02 (a)	0.018* (b)	0.007*
Pre posterior & post posterior	0.369 (a)	0.005* (a)	0.016*
Pre posteromedial & post posteromedial	0.085 (a)	0.011* (b)	0.002*
Pre medial & post medial	0.17 (a)	0.042* (a)	0.004*
Pre anteromedial & post anteriomedial	0.001* (a)	0.001* (a)	0.002*
N			8

From table 2, *there was significantly differences (p< 0.05), a= paired t test and b = wilcoxon signed rank test , N= the number of subject in one group.

Graph 1. Dynamic balance improvement before and after intervention of control, group 1 and 2.



From graph 1, *there was significantly differences ($p < 0.05$).

Paired t test show that there was significantly differences in control group after being ankle strengthening with theraband in posterolateral ($p = 0.02$) and anteromedial ($p = 0.001$) indicators. The group 1 after being ankle strengthening with theraband, active single leg stance (ASLS), catch and throw the ball for 2 minutes in anterior ($p = 0.001$), lateral ($p = 0.001$), posterior ($p = 0.005$), medial ($p = 0.042$) and anteromedial indicators ($p = 0.001$). The group 2, there was an significantly differences after being ankle strengthening with theraband, foot core stability and active single leg stance (ASLS) combination, catch and throw the ball for 2 minuets for all indicators. Wilcoxon show that there was significantly differences in control group posterolateral indicator ($p = 0.017$), and group 1 posterolateral ($p = 0.018$) and posteromedial indicators ($p = 0.11$).

DISCUSSION

The increasing dynamic balance in group 1 because of active single leg stance (ASLS) will recruit diaphargm, abdominal, paraspinal, hip (gluteal) and pelvic floor muscle, that components sinergistically build the natural corset to make trunk, spine, pelvic stabilization and synergy with ankle (Huxel Bliven and Anderson, 2013). Biomechanically, performance of core muscle group will affect pelvic alignment which will be used as an important component of postural function. The posture muscles contracted before a movement occurs (antycipathory mechanism) (Hodges and Richardson, 1999). Active single leg stance with throw and catch the

ball will provide multiple input to the brain. The first input from sensory (somatosensory and propioceptive) which comes from one foot standing on the floor. This input use to build orientation about posture and dynamic balance. The second input from distraction of ball moving (vestibular and visual), this condition use to facilitate posture and movement control, in other words if someone is able to control posture, they will be able do double task in stable condition. Several previous study showed that single limb balance exercise for four weeks with three times a week improve dynamic stability in the anterior, posteromedial and posterolateral direction (Anguish and Sandrey, 2018). This result explained that active single leg stance (ASLS) have direct effect to improve dynamic balance. The other study explained that single limb balance change motor control on the brain (evaluated by transcranial magnetic stimulation), this study can be basic a concept of brain plasticity (Terada et al., 2020). Strong input from active single leg stance will change brain activity, make orientation and motor planning to build optimal movement.

In group 2, the results of increasing dynamic balance for all indicators were influenced of intrinsic foot muscle contraction will form a localized stability, spread before the occurence of joint motion. Intrinsic foot muscles have alot of function, as shock absorber, load sharing regulation, driving and stabilizing a motion, where all of these function will form a dynamic bulding that remains stable when moving. Foot core stability create synergistic connection with pelvic core, where these components will form optimal posture and build dynamic stability. The other benefit is an abduction position of ankle causes anterior metatarsal have a wider area than calcaneal, this position will cause distribution of body weight relatively equal on lower limb (Neumann, 2010). Many study explained that foot core stability was an concept which adopt short foot exercise. The differences of both concept were short foot exercise use all the finger to flexion from anterior to posterior, while the foot core stability exercise dont flexion the finger, but both of the concept have similar puposes were improve intrinsic foot muscle contraction, build orientation about movement and improve balance. The previous study showed that short foot exercise for eight weeks with three times a week improved joint position sense, balance stability on anterior, posterior and mediolateral indiactors (Lee et al., 2019). The other study showed that intrinsic foot muscle for six weeks improve dynamic balance subjek with chronic ankle instability (CAI) (Lee and Choi, 2019).

Conclusion

There is an effect of active single leg stance (ASLS) in group 1. Another effect was also found in the combination foot core stability and active single leg stance (ASLS) in group 2. The foot core stability and active single leg stance (ASLS) combination will improve dynamic balance volleyball athletes with chronic ankle instability better.

Acknowlegment

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