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Dynamic Postural Control in Recurrent Ankle Sprain

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Abstract : Introduction: Ankle sprain is a common lower limb injury that has a high recurrence rate, the exact cause of recurrence is not yet clear. A history of at least one previous ankle sprain is the most common predisposing factor for recurrent lateral ankle sprain. Clinicians and rehabilitation therapists are more concerned with peripheral causes of injury; however, there is also another contributory factor as ankle sprain is often associated with poor postural control. **Objective:**To measure objectively dynamic balance in the recurrent ankle sprain patients and to compare patients with controls. **Materials and methods:** Fifteen subjects with recurrent ankle sprain (group A) and fifteen healthy control subjects (group B) participated in this study. Dynamic postural control was measured by the Biodex Balance System in both groups. **Results:** The statistical analysis revealed that there was a statistically non-significant difference in dynamic balance between patients with recurrent ankle instability versus normal subjects the data revealed overall stability index (p=0.083), anteroposterior stability index (p=0.160), mediolateral stability index (p=0.094). **Conclusion:**There is some evidence that on average the patient group appeared to be less stable than controls in all balance tests, although the difference did not reach statistical significance.
Keywords : ankle sprain, dynamic balance, postural control.

1. Introduction

Lateral ankle sprains are one of the most common injuries among athletes and other young active adults [1]. A history of at least one previous ankle sprain is the most common predisposing factor for recurrent lateral ankle sprain. The recurrence rate of this injury has been reported to be as high as 70%-80% whereas functional ankle instability (FAI) becomes evident in as many as 33% to 42% of the patients who suffer from an acute ankle injury[2,3].

Freeman et al.,[4], defined the FAI as "A tendency for the foot to give way after an initial ankle sprain". This definition included referral to the occurrence of recurrent ankle instability, as well as the sensation of joint instability due to proprioception and neuromuscular deficits ***(5)***.Two contributing factors to chronic ankle instability (CAI) are mechanical ankle instability (MAI) and FAI [6,7]. There is however numerous insufficiencies that lead to each type of instability. MAI include pathologic laxity, impaired arthrokinematics, synovial and degenerative changes. FAI include impaired proprioception, altered neuromuscular control, strength deficits, and diminished postural control [5].

Freeman et al.,[4], suggested that lateral ankle sprain is often associated with poor postural control which was defined as the inability to maintain stability above a narrow base of support during single limb stance. Postural control is classified as either as static (attempting to maintain a base of support with minimal

movement) or dynamic balance (attempting to maintain a stable base of support while completing a prescribed movement).

It is widely believed that the tendency for ankle sprains to reoccur is due to proprioceptive deficits [8]. The injury is a part of the pattern of chronic instability in which the patient does not "trust" his ankle and has a sensation of "giving way" at the specific activities[9]. Thus, chronic impairment of ankle function and early onset of degenerative ankle joint disease are main items to concern for clinicians in sports medicine following acute ankle and recurrent sprains[10].

Statement of Problem:

This study tried to answer the following question:

Does the ankle instability affect the dynamic postural control?

Purpose of the Study:

The purpose of this study was to investigate the effect of recurrent ankle instability on dynamic postural control.

Significance of the Study:

Lateral ankle sprain is an extremely common sports injury; it accounts for more than 80% and is also the most common single type of sport – related trauma among all body sites and types [11]. This injury results in pain, disability, time lost from work and activity resulting in an estimated 1.2 million physician visits per year, at a cost of $ 835- $ 1206 per patient with an annual cost of 3.8 billion dollars[12].

It is widely believed that the tendency for ankle sprains to reoccur is due to proprioceptive deficits[13]. The injury is a part of the pattern of chronic instability in which the patient does not "trust" his ankle and has a sensation of "giving way" at the specific activities[14]. Thus, chronic impairment of ankle function and early onset of degenerative ankle joint disease are main items to concern for clinicians in sports medicine following acute ankle and recurrent sprains[15].

Wyke [16] observed in cats that an injury of the joint capsule or ligaments influenced the activities of muscles located away from the site of injury and concluded from the study there is evidence that the motor system has a tendency to extend dysfunction into a larger area away from originally affected**.**

Delimitations:

This study was delimited to thirty active adult subjects. Ages of patients ranged from 18-35and Patients were diagnosed with recurrent ankle sprain.

Basic assumptions:

It was assumed that:

1. All patients would not receive any medical or physical therapy during the study period.
2. All participants would follow the instructions given by the researcher during the assessment.
3. All participants would exert their maximum effort during the testing procedures.

Hypotheses:

It was hypothesized that there is no significant difference in dynamic postural control between the recurrent ankle sprain patients and control group.

2. Experimental

Thirty participants (15 with recurrent ankle sprain, 15 controls) between the ages of 18 and 35 years were recruited. ankle sprain patients were recruitrd from the outpatient orthopedic clinic and under graduate student from faculty of physical therapy in Cairo University. Inclusion criteria were : (1) The patient with recurrent ankle sprain must have had at least one acute ankle sprain that resulted in swelling, pain, and temporary loss of function; however, ankle sprained must not have been experienced over the past three months prior to the study.(2) A positive history of multiple episodes of the ankle "giving way" over the past 6 months.(3) The non-injured healthy subjects must have been free of any previous lower limb injury for the past 6 months prior to this study. Patients were excluded if they had: (1) Any musculoskeletal dysfunction, trauma or disease affecting the lower extremity. (3) Any pathological condition that could affect balance such as middle ear, vestibular system problems or any neurological disorder. None of the patients was undergoing physical therapy in the 30 days preceding the study.

The selection of the control group was based on the same exclusion criteria as for the patient group. Healthy subjects were matched with patient's age, height and weight.

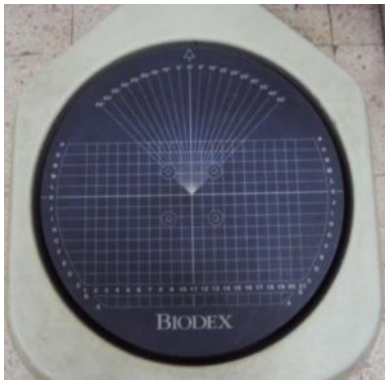
Balance testing

Balance measures were carried out by using the BBS (Biodex medical system. inc., Brook Baren R & D plaza, 20 Ramsey road, box 702, Shirley, New York 11967 – 0702). **Finn et al.,**[17] concluded that the biodex balance system provides valid, reliable and repeatable objective measures of a patient's ability to balance on unstable surface. **Cachupeet al.,**[18] examined the reliability of measures of dynamic balance obtained using the BBS and found that measures obtained across 8 trials indicated that the BBS produced reliable measures considering the overall stability index (OASI), anteroposterior stability index(APSI) and mediolateral stability index(MLSI).

The BBS consists of movable balance platform, which provides up to 20˚ of surface tilt in 360˚ range and is interfaced with a micro-processor based actuator. This actuator controls the manually preset degree of surface instability, which ranges from incomplete firm surface (stability level 8) to a very unstable surface (stability level 1) [19]. The stability level simply indicates the predetermined stability or stiffness of the balance platform. The degree to which the platform tilts during a balance assessment is indicated by the patient's balance ability [20].The biodex balance system provides an objective, reliable with ICC (.69)

The Biodex Balance System assesses neuromuscular control by quantifying the ability to maintain dynamic postural stability on an unstable surface. The support platform of the BBS can be placed at 8 levels. The resistance of the foot platform changes at each level. A setting of 8 is the most stable foot platform setting, and a setting of 1 is the least stable setting. At any level, the foot platform can move a full 20° in any direction .The measure of postural stability is the OASI, APSI and MLSI. The stability indices represent the standard deviation of platform deflection in degrees from the level position during a test. A high number indicates substantial movement away from the subject's center of balance and less stability; a low number indicates minimal movement during the test and better balance scores [21].

Participants were asked to place one leg on the central region of the platform while the other leg was in a position of slight hip flexion/abduction and 90º of knee flexion. The foot coordinates were recorded for the first time and were maintained throughout the testing trials of each participant. Participants were asked to look straight ahead and place their arms crossed over the chest and to keep the platform as motionless as possible for 20secbalance testing consisted of 3 trials



Fig(1): Biodex balance system

3. Results

Mean and ±SD of OASI, APSI and MLSI was compared between group A and group B as between group's comparison using T-test. All analyses were done using the SPSS software with the alpha level set on 0.05 using MNOVA as a part of large data analysis.

General Characteristics of the Subjects:

A total of thirty subjects (10 males and 20 females) participated in this study. Subjects were assigned into two groups (group A &B) based on the presence or absence of recurrent ankle sprain.

As presented in table (1) and illustrated in figure (1, 2, 3). The study group (group A) consisted of 15 patients with recurrent ankle sprain with a mean age was 19.5 ($\pm$ 3.26) years, mean weight was (57.7 $\pm$ 10.62) kg and mean height was (162.76 $\pm$ 7.20) cm.

The control group (group B) consisted of 15 normal subjects. The mean age was 19.36 ($\pm$ 2.41) years, weight was (60.53 $\pm$ 8.81) kg, and height was (162.63 $\pm$ 5.42) cm.

There were no significant differences between the control and study groups regarding the age, weight and height of the subjectswhere P-values were (p-values were 0.9, 0.7 and 0.9, respectively).

Between groups (group A versus B) comparisons showed no significant differences in overall stability index (p=0.083), anteroposterior stability index (p=0.160) and mediolateral stability index (p- value=0.094).

Table (1): Descriptive and parametric statistics comparing the age, weight and height of the study and control group subjects. Values are expressed as means± Standard Deviation (SD).

Variables	Group A (n=15) Sprain (15)	Group B (n-15)	p-value
Age (years) Mean± **SD**	19.5 ±3.26	19.36 ±2.41	0.96
Weight (kg) Means ± **SD** SD	57.7 ±10.62	60.53 ±8.81	0.74
Height(cm) Means ± **SD**	162.76 ±7.20	162.63 ±5.42	0.93

*Significant level is set at alpha level <0.05

Table (2): Mean ±SD, P values of the overall stability index, anteroposterior stability index and mediolateral stability index between group (A) and group (B)

	Group (A)	Group (B)	p-value
Overall stability index	4.04 ±2.13	2.93±1.05	0.083
Anteroposterior stability index	3.32±2.35	2.43±.9230	0.160
Mediolateral stability index	2.04 ±.628	1.64 ±.6130	.094

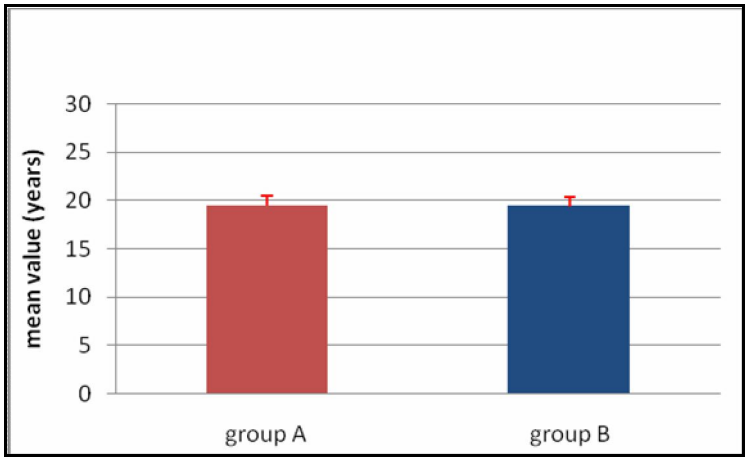


Fig. (2): Mean ±SD values of the age in both groups.

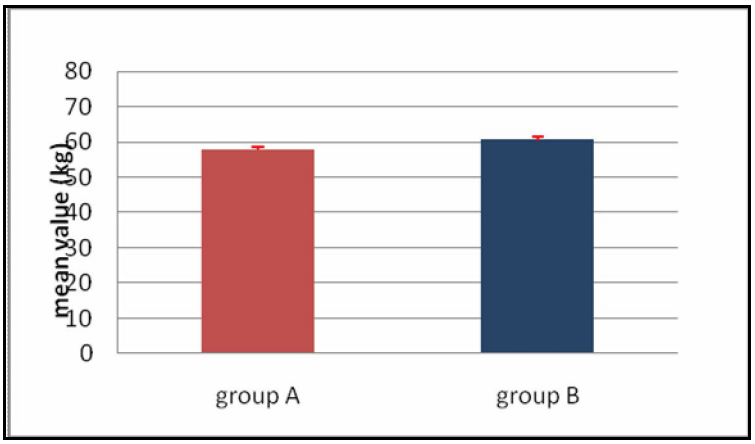


Fig. (3): Mean ±SD values of the weight in both groups.

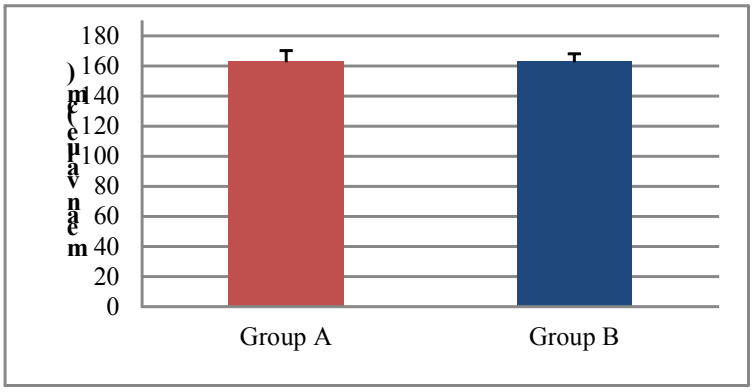


Fig. (4): Mean ±SD values of the height in both groups.

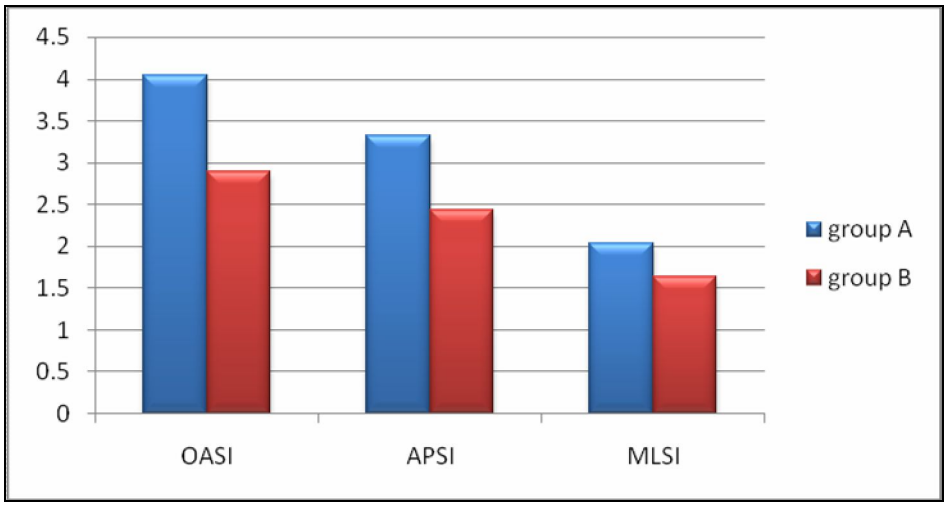


Fig (5): Mean ±SD, P values of the overall stability index, anteroposterior stability index and mediolateral stability index between group (A) and group (B)

4. Discussion

The statistical analysis revealed that there was a statistically non-significant difference in dynamic balance between patients with recurrent ankle instability versus normal. This non-significant difference is supported by the findings of **Cachupe,** [22] who investigated twenty seven male and female college-aged athletes; fifteen subjects with no previous ankle sprain, and twelve subjects with previous ankle sprains. Dynamic balance was measured by OASI obtainedfrom the BBS at level 2 resistance. There was no significant difference between tested groups.

On the other hand, the findings of the current study is opposed by the findings of **Akbari et al.,** [23], who examined thirty male athletes aged 20 to 35 years with right dominant side and traumatic ankle sprain and measured the sway index and limits of stability by BBS under different conditions. In addition, those authors tested Functional Balance via the functional reach test and SEBT. Their results showed that balance ability in patients with acute lateral ankle sprain was significantly weaker than normal subjects.

Also, **Olmsted et al.,** [24] investigated the dynamic balance through SEBT on 20 subjects with unilateral CAI and 20 uninjured subjects. Subjects with CAI demonstrated significantly decreased reach distance while standing on injured limb compared to uninjured limb and control group. This significantdifference in dynamic balance contradicts with the result of current study.

Freeman [4] noted balance deficits based on the participant and examiner reports of impaired postural control in single limb stance in those with CAI. Objective reports of postural impairments associated with CAI through theBalance Error Scoring System have also shown promise in detecting differences between those with and without CAI. The Balance Error Scoring System is used to evaluate how many postural errors a person commits in attempting to maintain postural control over a period of time on stable and unstable surfaces in single-leg and tandem-leg stance. Examining postural control that leads to failure in CAI may be more beneficial than examining when individuals succeed.

In a true prospective study, **Evans et al.,** [25] identified postural control deficits present in both the injured and uninjured limbs of individuals after unilateral ankle sprains. Comparisons to baseline preinjury measures revealed that postural control deficits resolved at the second follow-up (7 days) for the uninjured limbs but remained for at least 4 weeks after injury in the injuredlimbs. The impairments seen in the injured limbs were greater than those seen in the uninjured limbs. Fridenet al15 found diminished postural control in the injured and uninjured limbs of athletes after acute ankle sprains compared with a reference group. Diminished postural control in both limbs of individuals after acute ankle sprain helps to explain the inconsistencies in side-to-side deficits.

5. References

1. Hale S and Hertel J: Reliability and sensitivity of the foot and ankle disability index in subjects with chronic ankle instability. J Athl Train.40:35-40. 2005.
2. Bernier, J. and Perrin, H: Effect of coordination Training on Proprioception of the Functionally Unstable Ankle. J Orthop Sports Phys Ther.27 (4): 264-275, 1998.
3. McKay, G., Goldie, P., Payne, W and Oakes, B.,: Ankle injuries in basketball: injury rate and risk factors. Br J Sports Med.35, 103-108, 2001.
4. Freeman, M: Instability of the foot after injuries to the lateral ligament of the ankle. J Bone Joint Surg Br; 47: 669-677, 1965.
5. Hertel J: Functional instability following lateral ankle sprain. Sports Med.29,361-371. 2000.
6. Hertel, J: Functional anatomy, pathomechanics, and pathophysiology of lateral ankle instability. J Athl Train. 37, 364-375, 2002.
7. Vaes, P., Duquet, W and Gheluwe: Peroneal reaction times and eversion motor response in healthy and unstable ankles. J Athl Train. 37:475-480, 2002.
8. Refshauge, K., Kilbreath, S., and Raymond, J: The effect of recurrent ankle inversion sprain and taping on proprioception at the ankle. Med Sci Sports Exerc.32,10-15, 2000.
9. Stasinopoulos, D: Comparison of three Preventive methods in order to reduce the incidence of ankle inversion sprains among female volley ball . Br J Sport Med . Vol (38), p 182- 185, 2004.
10. Valderrabano, V., Hintermann, B., Horisberger, M., and Fung T : Ligamentous Posttraumatic ankle Osteoarthritis . Am J Sport Med . Vol (34), p 612-620, 2006.
11. Ferran, N., and Maffulli, N: Epidemiology of sprains of the lateral ankle ligament complex. Foot and Ankle Clinics, 11(3), 659-662., 2006.
12. Gerber, J., Williams, G., Scoville, C., Arciero, R., and Taylor, D: Persistent disability associated with ankle sprains: a prospective examination of an athletic population. Foot and Ankle International. 19, 654–660. Geriatrics, 15(1), 21-33, 1998.
13. Refshauge, K., Kilbreath, S., and Raymond, J: The effect of recurrent ankle inversion sprain and taping on proprioception at the ankle. Med Sci Sports Exerc.32,10-15, 2000.
14. Stasinopoulos, D: Comparison of three Preventive methods in order to reduce the incidence of ankle inversion sprains among female volley ball . Br J Sport Med . Vol (38), p 182- 185, 2004.
15. Valderrabano, V., Hintermann, B., Horisberger, M., and Fung T : Ligamentous Posttraumatic ankle Osteoarthritis . Am J Sport Med . Vol (34), p 612-620, 2006.
16. Wyke, B: The neurology of joints. Ann R CollSurgEngl; 41: 25-50, 1976.
17. Finn, et al: Southern Connecticut State Univ. Stability Performance Assessment Among Subject of Disparate Balance Abilities, 1999.
18. Cachupe, W., Shifflett, B., Kahanov, L. &Wughalter, E.: Reliability of Biodex Balance System measures. Measurement in Physical Education and Exercise Science. 5(2), 97-108, 2001.
19. Shirley N:Biodex system operation and service manual. Biodex med sys, inc. P245-300, 1996.
20. Rozzi, S., Lephart, S., Sterner, R., Kuligowski, L: Balance training for persons with functionally unstable ankles.J Orthop Sports PhysTher, 29(8):478-486, 1999.
21. Carl G, David H, Bruce M, Joe H, Ethan Nand Frank C: Strength, Functional Outcome,and Postural Stability After Anterior Cruicate Ligament Reconstruction. J AthlTrain.37(3), 262-268, 2002.
22. Cachupe, C.: Effect of previous ankle sprain on dynamic balance among athletes, published master thesis,1-83, 2000.
23. Akbari M, Karimi H, Farahini H, Faghihzadeh S.: Balance problems after unilateral ankle sprains. J Rehabil Res Dev.43, 819–24. 2006.
24. Olmsted C., Carcia R., Hertel J, Shultz J.Efficacy of the Star Excursion Balance Tests in Detecting Reach Deficits in Subjects With Chronic Ankle Instability, J Athl Train. 37(4), 501–506, 2002.
25. Evans, T., Hertal, J., and Sabastinelli, W: Bilateral Deficits in Postural Control Following Lateral Ankle Sprain. Foot Ankle Int. 25(11), 833-839. 2004.

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