

## The Effect of Fatigue Protocol on Dynamic Balance in Soccer Players with Functional Ankle Instability

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**Abstract: Background and Aim:** Research consistently demonstrates that ankle and knee injuries are the most common injury suffered in the athletic population. Ankle injuries are among the main prevailing injuries that occur in football game players. The aim of this study was to investigate the Influence of fatigue protocol on dynamic postural-control task in soccer players with functional ankle instability. **Methods:** In these study twenty-nine soccer players who were selected by convenience sampling method and were randomly divided into two experimental groups (n=13) and control groups (n=16) with (age: 22.3±2.1 years and height: 176.5±4.4 cm) volunteered as subjects. Semi dynamic by Biodex balance system (BBS) and dynamic balance by Star Excursion Balance test (SEBT) were taken before and after semi-soccer fatigue protocol. For comparison of means groups Repeated measures (GLM-ANOVA) were used and the results were determined within the significance level of ( $P \leq 0.05$ ). **Results:** After fatigue program, semi-dynamic balance on the positions of overall, anterior-posterior and Medial-lateral in both groups reduced significantly ( $P < 0.05$ ). Moreover, the variations of between groups were significant on the all directions of semi-dynamic balance ( $P < 0.05$ ). Also, After fatigue, The Dynamic balance score on the all directions of star Excursion Balance test in both groups reduced significantly ( $p < 0.001$ ). The variations of between groups were significant on the all directions of dynamic balance ( $P < 0.05$ ). **Conclusions:** At the end of soccer game, the fatigue can significantly reduce semi dynamic and dynamic balance, especially in players with functional ankle instability and probably enhances risk of injury.

**Key words:** Fatigue, Dynamic Balance, Ankle Instability, Soccer player.

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### INTRODUCTION

Soccer, otherwise known as football, is a ball game which involves two teams of eleven players each who attempt to propel the ball through a set of goal posts while preventing the other team from doing the same (Online Encyclopedia, 2007). It is played by kicking, heading, or using any part of the body except the arms and hands with only the goalkeeper allowed using hands and arms. The game consists of two halves of 45 minute each, with a 15 minute rest interval between the two halves (Putukian, 2000). This game requires bursts of speed and power and includes frequent collisions with other players, the ball and the playing surface (Larson, Pearl, Jaffet, Rudawsky, & . 1996). Hence, it is not surprising that as a result of its high intensity and amount of collisions among players as well as the playing surface that the amount of injuries sustained will be high. It has been estimated that on average, every elite male soccer player sustains approximately one performance limiting injury each year (Junge & Dvorac, 2004). A majority of the studies into the prevalence of injury observed that the lower extremities of the bodies of soccer players were the most affected especially the ankle joint (Junge, Dvorak, & Graf-Baumann, 2004). Hence, Junge and Dvorac (2004) reported that, the majority of soccer injuries are caused by trauma. Based on the fact that the knee and ankle joint have been observed to be the most affected body parts, traumatic sprains to the ankle and knee were the most frequently encountered injuries (Arnason, *et al.*, 2004). In a study conducted by Surve *et al.* (1994) to investigate the incidence of ankle sprains during one season among senior soccer players, it was observed that the use of ankle orthosis had no effect in players

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without previous ankle sprains, but significantly lower incidence of ankle sprains was observed in players with previously history of ankle sprain. Mattacola and Lloyd (1997) in their study reported that 6-week strength and proprioception training program on measures of dynamic balance: a single-case design effective in improving dynamic balance abilities assessed on a single-plane balance device.

Osborne *et al* (2001) stated that balance training Ankle-disk training (15 min/d for 8 wk), injured side only can decreased anterior tibialis muscle latency in both trained and untrained extremities, suggesting a proprioceptive crossover effect. McGuine *et al* (2000) assessed balance through single leg stance measures and found that subjects who displayed poor balance had nearly seven times more ankle injuries than subjects with good balance. Ankle sprains are consistently the most common musculoskeletal injury that occurs accounting for 10% to 28% of total injuries. Ankle sprains also are the most common lower extremity injury in athletes at the high school level, with high soccer players demonstrating the most (Nelson, Yard, & Fields, 2007).

Aspects of neuromuscular control could also be quantified through measures of postural control. postural control may be defined as either static, semi dynamic or dynamic (Winter, Patla, & Frank, 1990). Fatigue is a very complex phenomenon that is not entirely understood. as any reduction within the neuromuscular ability to produce strength (Rozzi, Yuktanandana, Pincivero, & Lephart, 2000) could be a usual phenomenon in resistance sports and is a common experience within the daily activities (Johnston, Howard, Cawley, & Lossee, 1998).

Therefore, the muscular fatigue can be the result of a failure in any process involved in the muscular contraction (Johnston, *et al.*, 1998). Fatigue results from an interruption in the chain of events from the CNS to the muscle fiber. Although all of authors seem to agree on the basic definition, there is still a lot of debate on whether fatigue is purely metabolic, or purely neuromuscular related, or a combination of both (Mcardle, Katch, & Katch, 2001). Previous researches have shown muscular fatigue has a negative impact on balance and control of the body position (Simoneau, Bégin, & Teasdale, 2006). The study of dynamic balance control system helps us to be able to have a better understanding of how the body functions in the fatigue and unstable conditions. Therefore, the purpose of this study was the effect of fatigue protocol on dynamic balance in soccer players with functional ankle instability.

## MATERIALS AND METHODS

### **Subjects:**

This research was semi-experimental. Twenty-nine physically active subjects (13 experimental, 16 control; mean age 22.3±2.1 years, height: 176.5±4.4 cm) volunteered as subjects. All individuals signed an informed agreement form approved by the university's institutional review board. Volunteers with self-reported delicate head injury or vestibular disorders among the previous six months were excluded from the study. The control group was freed from any self-reported lower extremity injury within the previous six months. Subjects within the chronic ankle instability (CAI) experimental group was release from hurt to the lower extremity besides the ankle during the previous six months; had a history of at least one acute ankle joint sprain that caused temporary loss of perform, pain, and swelling (but none inside the previous three months).

### **Protocol:**

After the obtained information from questionnaires including; individual background, health history and Cumberland ankle joint Instability Tools with internal reliability ( $\alpha=.83$ ) (Hiller, Refshauge, Bundy, Herbert, & Kilbreath, 2006). Semi dynamic by Biodex balance system (BBS) and dynamic balance by Star Excursion Balance Test (SEBT) were taken before and after semi-soccer fatigue protocol (Bangsbo protocol). One of the most common samples of these soccer-specific endurance tests is the protocol proposed by Bangsbo (1994). This test consists of 20-m shuttle runs of increasing speed interspersed by ten s of active recovery till exhaustion, following acoustic signals recorded on a compact disk. Measurements were taken from the subjects' dominant lower extremities. Leg dominance was concluded by request volunteers what leg they would use to kick a soccer ball.

### **Biodex Stability System Test:**

Biodex Stability System Test (Biodex, Shirley, New York, USA) and Star Excursion Balance were used in this study. Biodex Stability System has a circular platform that is free to move about the anterior-posterior (AP) and medial-lateral (ML) axes simultaneously. The BSS software sampled the deviations in the AP and ML directions at a rate of 20 Hz and calculated the anterior/posterior index (API), medial/lateral index (MLI), and overall balance index (OBI) using the following formulas. It was reported that these indexes are reliable and precise measures for postural stability. The intra-tester reliability of BBS was 0.82 and 0.96, and the inter-tester reliability was 0.70 for OBI (Schmitz & Arnold, 1998).

### **Star Excursion Balance Test Performance:**

The Star Excursion Balance test Performance was performed with the subjects standing inside the center of a grid formed by eight lines created with subjects tape stretching out at 45 degree from each other. For this

Status, athletics were only reaching within the posterior, medial and anterior directions. Each volunteer was requested to realize the maximum amount as possible along the line, create a light-weight touch on the line, and come back the reaching leg come back to the center, although supporting a single-leg stance with the another leg within the center of the grid. The subjects were touch to create a light-weight contact on the ground with the foremost distal a part of the reaching foot and come back to a double leg stance whereas not permitting the contact to have an effect on the base of support. Volunteers were educated to hold their hands on their hips and to remain temporarily the heel of the stance leg on the ground at all times (Gribble, Hertel, Denegar, & Buckley, 2004). Reach distances were recorded by putting a mark on a length of subject tape on the ground corresponding to the touchdown purpose of the subject. We have a tendency to record the reaching distance as a result of the distance from the center of the grid to the point of maximum excursion of the reaching leg.

Supported our examination, twenty nine reach distances were divided by leg length and increased by a hundred to calculate a dependent variable that represents reach distance as a percentage of leg length (MAXD). A test was discarded and repeated if the examiner felt the subject used the reaching leg for a substantial amount of support at any time, removed the foot from the center of the grid, or was unable to take care of balance on the support leg throughout the trial (Gray, 1995; Gribble, *et al.*, 2004).

**Statistical Analysis:**

Finally, all the data were analyzed using SPSS software version 16 (SPSS, Chicago, Illinois). Results reported as mean ± standard deviation. All data were tested for normality and Homogeneity of variances using the Shapiro-Wilk's test and Levene's test respectively. Repeated measures (General Linear Model-ANOVA) were applied to compare the semi-dynamic and dynamic balance before and after fatigue program. The probability level for all the tests was set at 0.05 to indicate significance.

**Results:**

The position of overall, anterior-posterior and Medial-lateral in semi-dynamic balance (Biodex system) after fatigue program on functional ankle stability and instability in both groups reduced significantly. Moreover, the variations of between groups were significantly in overall (p=0.038), anterior-posterior positions (p=0.040) in both groups (Table 1).

**Table 1:** Comparison of semi-dynamic balance (Biodex system) before and after fatigue program on Soccer Players with functional ankle stability and instability.

variables	Groups	stages3		Within Groups	Interaction (Groups ×stages)	Between Groups
		Pre-test** (M±SD)	Post-test** (M±SD)	P-Value	P-Value	P-Value
Overall (unit)	Fan1 (n=16)	1.08±0.29	1.78±0.65	<0.001*	0.038*	<0.001*
	Fai2 (n=13)	2.14±0.57	2.45±0.42	0.021*		
An. Posterior (unit)	Fan (n=16)	0.97±0.31	1.25±0.40	0.037*	0.040*	<0.001*
	Fai (n=13)	1.24±0.29	1.84±0.28	<0.001*		
Medial-lateral (unit)	Fan (n=16)	0.80±0.25	1.21±0.50	0.005*	0.778	0.001*
	Fai (n=13)	1.33±0.54	1.80±0.48	<0.001*		

1. Functional ankle stability (Fan) 2. Functional ankle instability (Fai) \*\*Values are mean ± standard deviation. The mean difference is significant at the .05 level

The results of dynamic balance, Star Excursion Balance Test (SEBT) after fatigue program on functional ankle stability and instability observed Anterior (p=0.001), Anteromedial (p=0.001), Medial (p=0.001), Posteromedial (p=0.001), Posterior (p=0.001), Posterolateral (p=0.001), Lateral (p=0.001) and Anterolateral (p=0.001) in both groups reduced significantly. Moreover, the variations of between groups were significantly in Anterior (p=0.043), Posteromedial (p=0.033) in both groups (functional ankle stability and instability groups) (Table2).

**Discussion:**

The aim of this study was to evaluation the influence of fatigue protocol on dynamic postural-control task in soccer players with functional ankle instability and to identify a SEBT normalized cut-off score that would imply injury risk to individuals that scored below it. According to the results of the data collection, the results of dynamic balance, Star Excursion Balance Test (SEBT) after fatigue program on functional ankle stability and instability observed Anterior (p=0.001), Anteromedial (p=0.001), Medial (p=0.001), Posteromedial (p=0.001), Posterior (p=0.001), Posterolateral (p=0.001), Lateral (p=0.001) and Anterolateral (p=0.001) in both groups reduced significantly. Moreover, the variations of between groups were significantly in Anterior (p=0.043), Posteromedial (p=0.033) in both groups (functional ankle stability and instability groups). Thus, these findings correspond with findings from Olmsted *et al* (2002) found similar results once comparison the performance of these with unilateral chronic ankle instability with matched control subjects throughout completion of all eight reaching directions of the Star Excursion Balance test.

**Table 2:** Comparison of dynamic balance by Star Excursion Balance test (SEBT) before and after fatigue program on Soccer Players with functional ankle stability and instability.

variables	Groups	stages3		Within Groups	Interaction (Groups ×stages)	Between Groups
		Pre-test** (M±SD)	Post-test** (M±SD)	P-Value	P-Value	P-Value
Anterior (cm)	Fan1 (n=16)	81.5±5.8	75.5±5.5	<0.001*	0.033*	0.006*
	Fai2 (n=13)	75.2±3.7	70.7±4.4	<0.001*		
Anterior-medial (cm)	Fan (n=16)	81.7±4.9	78.9±4.9	<0.001*	0.454	0.003*
	Fai (n=13)	76.6±3.2	73.4±3.6	<0.001*		
Medial (cm)	Fan (n=16)	83.8±4.0	78.4±5.1	<0.001*	0.227	<0.001*
	Fai (n=13)	76.0±3.4	71.7±3.8	<0.001*		
Posterior-medial (cm)	Fan (n=16)	84.0±4.5	79.2±4.5	<0.001*	0.033*	<0.001*
	Fai (n=13)	76.2±3.8	72.9±4.1	<0.001*		
Posterior (cm)	Fan (n=16)	80.6±3.9	77.1±4.2	<0.001*	0.678	<0.001*
	Fai (n=13)	74.5±2.5	70.8±2.4	<0.001*		
Posterior-lateral (cm)	Fan (n=16)	80.3±3.9	76.3±3.7	<0.001*	0.549	<0.001*
	Fai (n=13)	71.2±3.4	67.0±3.6	<0.001*		
Lateral (cm)	Fan (n=16)	63.0±4.2	60.4±4.0	<0.001*	0.856	<0.001*
	Fai (n=13)	56.3±2.8	53.9±3.8	<0.001*		
Anterior-lateral (cm)	Fan (n=16)	76.8±4.4	73.3±4.2	<0.001*	0.280	<0.001*
	Fai (n=13)	69.3±3.9	66.4±3.7	<0.001*		

1. Functional ankle stability (Fan) 2. Functional ankle instability (Fai) \*\*Values are mean ± standard deviation. The mean difference is significant at the .05 level

Our results show that decreased in knee and hip joint angles for chronic ankle joint instability occurred at the same time with reduced MAXD, a recommended between performance on the SEBT and changed neuromuscular control at the hip and knee as a results of ankle joint injury. A study by Hadzic *et al* (2009) determined that decreased dorsiflexion range of motion along with increased plantar flexion strength increased the relative risk of sustaining an ankle sprain by 22% among female volleyball players. McLeod *et al* (2009) found that their training program improved scores on the Balance Error Scoring System (BESS) and on SEBT reach distances. This study, along with the other two McKeon *et al* (2008), and McGuine *et al* (2000), prove that traditional balance training interventions can improve the dynamic stability and balance over a short-term program of six weeks or less. It has additionally been noted that balance being created better enhancements are still seen up to one year when the completion of the intervention as this improved balance can result in a reduced risk of injury. An injury that interrupts joint integrity, like chronic ankle instability, is theorized to damage afferent pathways that give maintenance of proprioception and eventually neuromuscular control. Most subjects who have tested this development have focused on neuromuscular impairments just at the injured joint complicated. Although this is often a viable means that of responsive questions of damaged neuromuscular function relying whole on single-joint neural systems, purposeful activities of the lower extremity don't involve single-joint movements however rather coordinated actions throughout the complete lower kinetic chain.

According to this research, the position of overall, anterior-posterior and Medial-lateral in semi-dynamic balance (Biodex system) after fatigue program on functional ankle stability and instability in both groups reduced significantly. Moreover, the variations of between groups were significantly in overall (p=0.038), anterior-posterior positions (p=0.040) in both groups. Thus, these findings correspond with findings from Nelson *et al* discovered that ankle injuries occurred more frequently in sports that involved both running and jumping with the highest injury to exposure rates occurring in football, soccer, and basketball respectively (Osborne, Chou, Laskowski, Smith, & Kaufman, 2001). Where balance refers to control of the cognitive in reference to the limits of stability (i.e. the base of support), postural control refers to task specific control of posture that is unconscious and stems from the acquisition, integration and processing of afferent signals and the resulting efferent response (Lephart, Riemann, & Fu, 2000). This definition, instead of focusing on a result, describes a mechanism. Of a condition control refers to the continuous feedback loop that is the foundation of one's ability to balance, however, postural control is not limited to one's ability to balance. The mechanism of control is used in any situation where a segment of the body is maintained against gravitational forces and is not necessarily singular to instances that directly affect alterations in cognitive movements (Lephart, *et al.*, 2000).

**Conclusions:**

Finding of this study showed that at the end of soccer game play, the fatigue will considerably decreased semi dynamic and dynamic balance, particularly in players with functional ankle instability and subsequently the player is prone to Injury. Currently there are four major factors that have effect on postural control: Injury, chronic ankle instability, foot abnormalities, and fatigue. Although debate exists on whether the functional instability that results is due to mechanical instability or proprioceptive deficits, it is clear that injury to the ankle and other areas of the lower extremity can affect postural control. In a general conclusion, changes in balance strategy were obvious during the latter stages of match-play, which might be increase injury risk. It is good to

recommend that soccer players perform proprioceptional trainings during their training and rest periods to develop neuromuscular control.

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