THE EFFECTS OF EXERTION ON THE POSTURAL STABILITY IN YOUNG SOCCER PLAYERS

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ABSTRACT

Objective: Analyze the effects of physical exertion during a soccer match on the functional capacity and stability of the lower limbs of young soccer players. Methods: We analyzed 10 soccer players who underwent functional capacity assessment of the lower limbs by a Hop Test protocol and evaluation of the level of postural stability in the Biodex Stability System (Biodex, Inc., Shirley, NY) before and immediately after a friendly game lasting 45 minutes. Results: After the match, there was a decrease in overall stability index ($F_{(1,23)}$ = 7.29 P = .024) and anterior posterior index (APSI) ($F_{(1,23)}$ = 5.53 P = .043). Fatigue in the dominant limb was responsible for the significant deficit in OSI ($F_{(1,23)}$ = 3.16, P = .047) and APSI ($F_{(1,23)}$ = 3:49, P = .029), while the non-dominant limb did not cause any change in the pre and post-game. Conclusion: A football match can cause decreased stability and functional capacity of the lower limbs in young players. ***Level of Evidence III, Pre-test and Post-test Study (Case-control).***

Keywords: Soccer. Fatigue. Athletic injuries. Posture.

Citation: *Arliani GG, Almeida GPL, Santos CV, Venturini AM, Astur DC, Cohen M. The effects of exertion on the postural stability in young soccer players. Acta Ortop Bras. [online]. 2013;21(3):155-8. Available from URL: http://www.scielo.br/aob.*

INTRODUCTION

Soccer is undoubtedly the most popular sport in the world. This category currently has around 200,000 professional athletes and 240 million amateur players, approximately 80% of whom are male.[1,2]

The participation of the young population in soccer is of considerable importance in current public health programs, insofar as it increases the level of exercise and physical activity among youths. Nowadays it is an essential weapon in the battle against the high rates of obesity and child sedentarism.[3]

Soccer is among the sports with the highest growth rates in the number of players in the young population worldwide. Together with this increase there is an increment in injuries among young athletes related to this sport. Approximately 44% of soccer injuries are sustained by participants under 15 years of age.[4] In the United States, soccer injuries among young athletes present a peak of two injuries to every 1000 participants.[5]

The higher incidence of injuries occurring in the last 15 minutes of each half of a soccer match suggests that physical exertion can influence the alteration of neuromuscular control and the ability to stabilize the joints of the lower limbs. A possible hypothesis for this change would be the alteration in the postural stability of the lower limbs due to physical exertion.[6,7]

It is speculated that muscle fatigue may alter the proprioceptive and kinesthetic properties of the joints through an increase in the muscle spindle discharge threshold, interrupting the afferent feedback and changing the somatosensory input, causing neuromuscular control deficits. Such characteristics are visualized by the deficiency of postural control.[6]

Postural stability is a complex process that depends on proprioceptive stimuli originating from the visual and vestibular mechanoreceptors, and from the processing of this information in the central nervous system, generating an appropriate motor response.[6]

Previous studies investigated the effect of physical exertion on the functional stability and proprioception of the lower limbs in athletes. However, most of these studies used controlled fatigue protocols that do not reproduce the exact reality of a soccer match.

The primary goal of this study is to analyze the effects of physical exertion of a soccer match on the functional capacity and stability of the lower limbs in young soccer players.

MATERIAL AND METHODS

The study was submitted and approved by the Ethics Committee of our institution.

The study subjects were 12 male field soccer players, members of the Conjunto Desportivo Constâncio Vaz Guimarães team (16.3 ± 0.83 years of age; height 1.71 ± 0.8 cm; weight 64.4 ± 9.25 Kg; BMI 21.94 ± 2.09; 6.6 ± 2.95 years of practice; mean ± standard deviation). As an inclusion criterion for this study we selected under-18 male soccer players, with training

All the authors declare that there is no potential conflict of interest referring to this article.

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Article received on 6/7/2012 and approved on 9/20/2012.

frequency of more than 3 times a week, at least 9 hours of training per week and with more than 2 years of experience playing the game. The non-inclusion criteria were: goalkeepers; presence of knee and/or ankle injuries in the last 6 months; presence of mechanical or functional instability of the knee and/or ankle; history of previous orthopedic surgery on the knee and/or ankle; presence of spinal and/or hip injuries in the last 6 months and presence of cerebellar disorders. Two athletes were excluded from the study. One player presented a history of ankle sprain with a period of less than 6 months and the other previous reconstruction of the anterior cruciate ligament of the right knee. The 10 athletes included in the study played in the following positions: two center-backs, two outside backs, three midfielders and three strikers.

The athletes answered a questionnaire about anthropometric characteristics, previous injuries and information about the practice of soccer as a sport. The dominance of the lower limbs was determined through the leg reported by the athlete as that used predominantly to kick the ball. They were also submitted to an assessment of the functional capacity of the lower limbs through a Hop Test protocol and an evaluation of the level of postural stability through the Biodex Stability System (Biodex, Inc., Shirley, New York), before and immediately after each halftime of a friendly field soccer game lasting 45 minutes. The athletes were assessed during a series of 5 friendly matches held in the afternoon (3 pm) during the months of June and July, 2011.

Evaluation procedure

Hop Tests

The athletes were submitted to the following tests: Single Hop Test; Triple Hop Test; Cross-over Hop Test and Timed Hop Test. (Figure 1) The test execution sequence and the lower limb initially evaluated were randomized by drawing lots. Before the beginning of each sampling two practical trials were held for the participants to familiarize themselves with the tests, followed by three official tests with data recording. For the performance of the hop tests all the participants were instructed to keep their arms crossed in the region of the lumbar spine and told to jump according to the test in question, maintaining stability upon landing. For the Single Hop Test the participants hopped on one leg at a time, attempting to get as far as possible with a single hop; in the Triple Hop Test the participants made three consecutive hops with the same limb, aiming to cover the longest distance possible; In the Cross-Over Hop Test, the participants made three consecutive hops crossing a 15cm thick line previously marked on the ground; In the Timed Hop Test they hopped as quickly as possible until they reached a predetermined distance of 6 meters.[8] In previous studies, the interclass reliability coefficient for the Single Hop Test was 0.92-0.96; Triple Hop Test - 0.95-0.97; Cross-Over Hop Test - 0.93-0.96 and Timed Hop Test - 0.66-0.92.[9,10]

Postural stability level

The assessment was carried out at eight different levels of stability of the platform, with eight corresponding to the most stable level and one to the most instable level (covering 3.75 seconds at each level). The participants were allowed to rest for 60 seconds between tests. This platform was interconnected to a program (Biodex, version 3.1, Biodex, Inc.) that allowed an objective evaluation of postural stability through three indices: the overall stability index (OSI), anterior-posterior stability index (APSI) medial-lateral stability index (MLSI). (Figure 2) These indices are calculated through the degree of oscillation of the platform, where the lower the index the better the stability of the individual tested.[11] In a study by Salavati et al.[8] an interclass reliability coefficient of 0.77 and 0.99 was found with the same methodology used in the present study.[8]

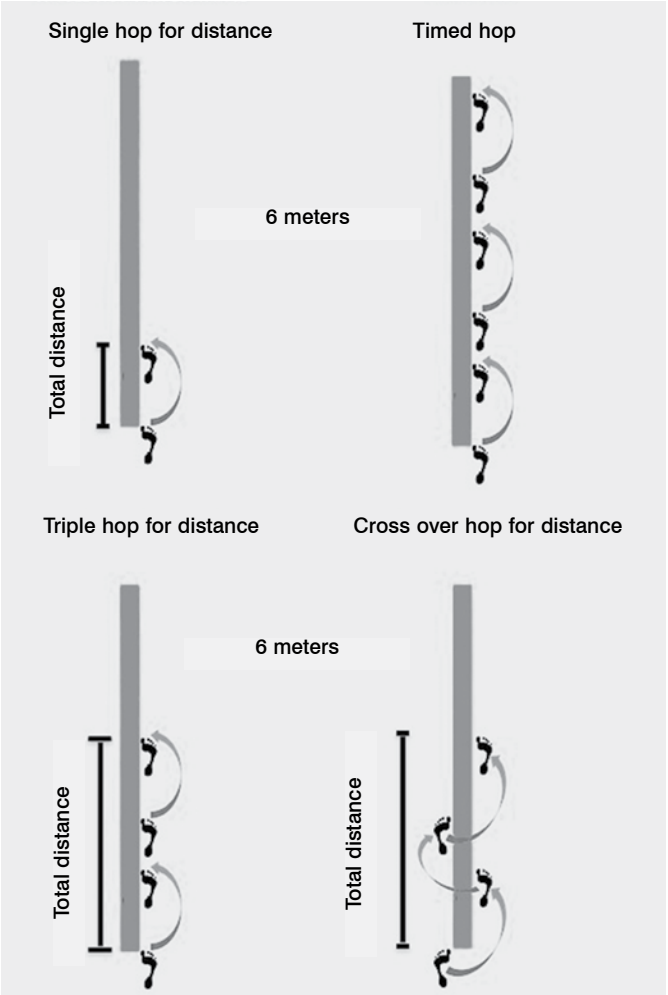

Figure 1. Explanatory illustration for performance.

The test protocol performed was unipodal, composed of two periods of adaptation to the apparatus and three consecutive assessment tests. The test order was randomized by drawing lots and the athletes were positioned with their arms parallel to the longitudinal axis of the body, keeping their hands in contact with their thighs, eyes open and fixed on a point on a white wall at a distance of 1m from the equipment, with their knees between 10º and 15º of flexion and keeping the hip in neutral position.

After the three tests the software of the apparatus issued the stability index based on the degree of oscillation of the platform during the assessments.

Statistical analysis

First of all, the Kolmogorov-Smirnov test was used to verify data normality. Then ANOVA was used with two factors and repeated measurements in the two factors (2 x 2) to examine

Figure 2. Athlete during performance of assessment on the Biodex platform.

the differences between the limbs (Dominant and Non-Dominant) and the Condition (Pre and Post-match) in OSI, APSI, MLSI and in the four Hop-Tests. When significant interactions were identified the Bonferroni post-hoc test was used. The significance level accepted for this survey was 5% ($P < .05$). We used SPSS 17.0 software for Windows (Statistical Package for the Social Sciences Inc., Chicago, IL, USA).

RESULTS

Using the ANOVA test a significant interaction (Time X Limb) was found in the overall stability index (OSI) ($F_{(1.23)} = 7.29$ $P = 0.024$) and anterior-posterior index (APSI) ($F_{(1.23)} = 5.53$ $P = 0.043$), yet without significant alterations in the medial-lateral stability index (MLSI) and in the four Hop-tests. (Table 1) The Bonferroni post hoc test identified that fatigue in the dominant limb was responsible for the significant deficit in the OSI ($F_{(1.23)} = 3.16$, $P = .047$) and APSI ($F_{(1.23)} = 3.49$, $P = .029$), while the non-dominant limb did not generate any alteration in the pre- and post-game condition.

DISCUSSION

The main finding of this study was the decrease in overall and anterior posterior stability and in the functional capacity of the lower limbs after a match involving young soccer players.

Previous studies on the topic conducted on a wide variety of populations exhibit controversial results.[12-14]

As regards elderly individuals, some studies showed that muscle fatigue in the lower limbs alters the joint position sense and balance in this population.[13] Another study with a similar sample demonstrated the absence of an association between postural stability and performance of moderate physical activities.[12] These results show the importance of the intensity of exertion imposed on the musculature of the lower limbs in the post-exercise stability assessment.

Table 1. Mean and standard deviation of the stability indices and of the functional tests in pre- and post-game conditions[a].

	Pre-Game		Post-Game	
	Dominant	Non-Dominant	Dominant	Non-Dominant
OSI (degrees)[b]	7.58 1.26	7.18 ± 1.12	6.87 ± 1.35	7.33 ± 1.72
APSI (degrees)[b]	6.34 ± 1.19	5.84 ± 1.34	5.56 ± 1.21	5.81 ± 1.66
MLSI (degrees)	4.32 ± 0.60	4.49 ± 1.12	4.17 ± 0.8	4.57 ± 0.88
Single-Hop (m)	1.77 ± 0.18	1.82 ± 0.16	1.72 ± 0.17	1.77 ± 0.15
Triple Hop (m)	5.05 ± 0.28	5.05 ± 0.50	4.96 ± 0.35	5.05 ± 0.42
Cross-Hop (m)	4.38 ± 0.30	4.47 ± 0.51	4.45 ± 0.27	4.54 ± 0.43
Timed-Hop	2.23 ± 0.34	2.14 ± 0.31	2.12 ± 0.18	2.18 ± 0.31

[a]OSI, Overall Stability Index; APSI, Anterior- Posterior Stability Index; MLSI, Medial- Lateral Stability Index.
[b]Significant difference ($P < .05$) between the pre- and post-game.

In young soccer players, Gioftsidou et al.[15] demonstrated that there is no difference in the balance of these athletes after a soccer training session or match. Thus, it was concluded that muscle fatigue in the lower limbs is probably not the cause of the greater incidence of injuries at the end of soccer training sessions and matches. However, in this study, the training or game time is not specified and the authors justify the maintenance of balance after exertion to the absence of severe muscle fatigue after training sessions. On the other hand, the present study found differences in the overall stability of these athletes after exertion. The results may have been different due to different loads to which the athletes were exposed and to different local weather conditions. In this study all the young players were assessed before and after the first half of a 45-minute friendly soccer match, not training sessions, and the study was conducted in the city of São Paulo, Brazil, where the average temperature is normally higher than that found in Greece (20°x16°), where the other study was conducted.

Other previous studies also concluded that muscle fatigue of the lower extremities, particularly of the proximal muscle groups, affect postural stability.[8,16]

In relation to stability of the dominant limb when compared with the non-dominant limb, we did not find any difference in the overall stability. The same result was obtained by Thorpe et al.[17] and Teixeira et al.,[18] who in a study with 12 and 11 soccer players, respectively, did not find differences in balance between the dominant and non-dominant limbs.

Another important finding of the study was the difference in functional capacity between the dominant and non-dominant limbs in the pre- and post-game condition in the Single Hop Test and Triple Hop Test. Swearingen et al.[19] demonstrated similar findings in a study with healthy patients of both sexes and age averaging 24 years. However, van der Harst et al.,[20] in a study with healthy individuals who practice sport, did not find any difference between the dominant and non-dominant limbs in the evaluation of the Single Hop Test and in the Timed Hop Test. However, no pre and post-exercise tests were carried out in either study.

Although we used 4 Hop test evaluations, a recent study conducted with non-operatively treated patients after anterior cruciate ligament tear, demonstrated that the Single Hop Test can be used separately as a predictor of knee functionality.[21]

One of the weak points of our study was the small sample and the absence of isokinetic evaluation for determination of the degree of fatigue imposed on the musculature of the lower limbs of the athletes after exertion. Another limitation of the study was the lack of standardization of the players by position in the sport, since the athletes' degree of exertion varies a great deal according to their position (outside back, center-back, midfield, striker), which can be considered a bias as the players were not exposed to the same physical strain. However, we opted to use a soccer match and to assess players in different positions with the intention of making the study characteristics resemble the true reality of the sport as closely as possible.

CONCLUSION

The results of this study show that a decrease occurs in the stability and functional capacity of the lower limbs after a match with young soccer players. These results can position muscle fatigue of the lower limbs as a possible factor in the presence of a greater incidence of injuries occurring in the last 15 minutes of each half of a soccer match.

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