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Original Article

Dynamic balance asymmetries in pre-season injury-prevention screening in healthy young soccer players using the Modified Star Excursion Balance Test—a pilot study

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Abstract. [Purpose] The purpose of this preliminary study was to investigate whether young players with no history of injury, have developed early asymmetries in dynamic balance ability tested via the recommended for screening in sports, Modified Star Excursion Balance Test (MSEBT). [Participants and Methods] Twenty-four young healthy male soccer players participated in the study having at least 4 years of systematic soccer training. The Waterloo Footedness Questionnaire was used to discriminate the stability dominant leg (STAB) from the non-stability dominant leg (NSTAB). Dynamic balance was assessed via the MSEBT. Participants, after familiarization, made 3 attempts in each direction for both legs: a) Anterior (AN), b) Posterolateral (PL) and c) Posteromedial (PM). [Results] The sole statistically significant performance asymmetry was in the PL direction, in favor of the STAB (94.5 ± 13.3 cm vs. 98.1 ± 10.4 cm). [Conclusion] The results of this pilot study showed a potential for developing dynamic balance asymmetries, in soccer players at the age of 13–14 years. Since asymmetry was significant in only one direction, further long term monitoring would be helpful to evaluate whether this is a growing functional deficit, potentially involving any of the other two directions of testing or if it is alleviated with increasing training age. These asymmetries could comprise an injury risk factor.

Key words: Youth soccer players, Dynamic balance asymmetries, Injury prevention

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INTRODUCTION

The incidence rate of soccer injuries has been reported to be almost 18.75 injuries per 1,000 athlete-exposures in games and practices[1, 2)]. Most soccer injuries (68−88%) occur at the lower extremities[3, 4)]. In the ankle joint occur 14% to 17% of all soccer injuries[5)], as it absorbs the mechanical loads produced through the constant interaction of the player with the ground and the opponents[6)]. Participation in soccer practice and games has been shown to favor the development of strength asymmetries leading to a possible appearance of injury[11)]. Previous studies have proved that strength asymmetries are associated with lower-limb injuries in soccer[7, 8)] with the risk for injury to be alleviated with long professional training age in soccer[9)]. Conversely, soccer players with short training age are more susceptible to strength asymmetries increasing the injury risk[9, 10)]. Some studies have suggested that the use of an injury-screening tool related to dynamic balance may allow the identification of the risk of injury[1, 2, 12–15)]. Dynamic balance is defined as an individual's ability to maintain total body stability of center of mass during movement[16)]. It has been reported that dynamic balance varies according to the competitive level of the soccer

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players[16]. The purpose of this preliminary study was to investigate whether young soccer players have developed early asymmetries in dynamic balance ability.

PARTICIPANTS AND METHODS

Twenty-four healthy male soccer players without history of injury participated in the study (Age: 13.46 ± 0.59 years, Height: 1.64 ± 0.08 m, Body mass: 51.90 ± 8.23 kg, Right leg length: 91.15 ± 5.30 cm, Left leg length: 91.15 ± 5.30 cm), having at least 4 years of systematic soccer training. For the last two years, the young soccer players participating in our study, trained approximately for 10 months per year, 4 times per week (90 min in each training session) and a game per week length up to 80 min (for the first team). Exclusion criteria included history of severe injury to the lower limb, any injury regardless severity within the last 6 months and leg-length discrepancy more than 1 cm. The Waterloo Footedness Questionnaire[17] was used to discriminate the stability dominant leg (STAB) from the non-stability dominant leg (NSTAB). The questionnaire consists of 10 questions, five of which are responsible for identifying the stability leg. A positive sum of the answers indicated the right leg as the stability-dominant, while a negative sum indicated left leg dominance. Dynamic balance was assessed via the Modified Star Excursion Balance Test (MSEBT or Y-balance test)[12–18]. During this test, the toes of the tested extremity, was carefully placed on the intersection of a Y marked on the floor. Then, the athletes tried to reach as far as they could, without touching the floor, on each of the three directions, maintaining their balance according to the instructions. The distances were measured and recorded to the nearest centimeter. Initially, written consent was given by parents or guardians in order to allow children to participate in this study. Participants completed a medical history questionnaire to assess their suitability to participate in this study. Thereafter, the stability-dominant leg was identified via the Waterloo Footedness Questionnaire and the participants familiarized with the test, which was performed 3 times in each direction for both legs; Anterior (AN), Posterolateral (PL) and Posteromedial (PM). Subsequently, participants executed the test with counter-balanced and randomized order (STAB or NSTAB). The experimental design of this study was approved by the Ethics Committee of the Technological Educational Institute of Western Greece (School of Health and Welfare 26462/08-08-2017). Testing took place in the Human Assessment and Rehabilitation Laboratory of Technological Educational Institute of Western Greece. Paired t-test was used for side-to-side comparisons and the best score (both as absolute length and also normalized to the lower limb length) in each of 3 directions entered the analysis. Significance level was set to p=0.05.

RESULTS

The sole statistically significant asymmetry was in the PL direction, in favor of the STAB, this result was important either expressed as absolute distance (94.5 ± 13.3 cm vs. 98.1 ± 10.4 cm, p≤0.01, Table 1) or as a percentage of the length of the lower limb (103.8 ± 13.6% vs. 107.8 ± 11.4%, p≤0.01, Table 1). The other two directions showed non-significant asymmetry.

Table 2 shows how many participants have asymmetries between lower extremities at least 4 cm in each direction and a composite asymmetry score higher than 12 cm. The composite score was estimated according to Gonell et al[18].

Table 1. The results of MSEBT in each direction for the 24 young soccer players who participated in the study

Absolute distances (cm) in each direction of the MSEBT

Parameter (cm)	Anterior direction (AN)	Posterolateral direction (PL)	Posteromedial direction (PM)
STAB (Mean ± SD)	77.9 ± 7.7	98.1 ± 10.4*	100.2 ± 12.2
NSTAB (Mean ± SD)	79.1 ± 7.8	94.5 ± 13.3	99.5 ± 13.6

Normalized distances to the lower-limb length (%) in each direction of the MSEBT

Parameter (%)	Anterior direction (AN)	Posterolateral direction (PL)	Posteromedial direction (PM)
STAB (Mean ± SD)	85.6 ± 8.1	107.8 ± 11.4#	110.0 ± 12.8
NSTAB (Mean ± SD)	86.9 ± 8.1	103.8 ± 13.6	109.3 ± 14.7

*p≤0.01 between STAB and NSTAB in Posterolateral Direction (PL) for absolute distances (cm) of MSEBT.
#p≤0.01 between STAB and NSTAB in Posterolateral Direction (PL) for normalized distances to the lower-limb length (%) of the MSEBT.

Table 2. The number of participants in each direction presented >4 cm asymmetries between lower extremities and a composite asymmetry score >12 cm

Total number of participants (n)	Anterior direction (n)	Posterolateral direction (n)	Posteromedial direction (n)	Composite Score (n)
24	11	12	17	13

DISCUSSION

The present pilot study showed the existence of dynamic balance asymmetry among young soccer players aged 13–14 assessed via the MSEBT. Asymmetry was present only in the postero-lateral direction, indicating a possible deficit in stability when the heavy lower limb moves away from the supporting leg, creating a big leverage. In terms of the destabilizing moment, this appears to be the most demanding among the three directions and this could pose a potential risk factor. Dynamic balance has been show to improve as the competitive level increases and considerable asymmetries tend to be eliminated as the training age of soccer players increases[16]. This finding with regard to dynamic balance, is in accordance with strength-studies which found that strength asymmetries were alleviated in soccer players with longer training age, potentially reducing injury risk[9, 10].

Determining normative values of dynamic balance for different competition levels may be helpful in identifying injury-risk thresholds and return-to-activity criteria after lower extremity injury[16]. Knapik et al.[19] found that athletes with directional (right vs. left) knee flexion strength asymmetries exceeding 15% were 2.6 times more likely to suffer lower extremity injury than participants with a lesser degree of asymmetry. It seems that all kinds of asymmetries increase the injury risk during soccer practice. A long-term participation in soccer leads to the development of various degrees and modes of functional asymmetry. The asymmetrical loads imposed on the musculoskeletal structure along with the long-term adaptations may predispose the soccer players to alterations in the kinematic patterns[11].

The present pilot study found a dynamic balance asymmetry to PL direction in young soccer players. To our knowledge, this is the first report for MSEBT scores being reported for 13–14 years old soccer players. This result may indicate a trend for developing dynamic balance asymmetries during soccer practice on young soccer players increasing the risk of injury. This is a pilot-study, intending to detect the potential existence of a significant effect of the soccer practice on the dynamic balance of young players.

Based on previous results[16] the existence of dynamic balance asymmetries increase the risk of injury. Soccer players with asymmetries exceeding 4 cm in the posterolateral direction were 1.59 times more likely to sustain a lower extremity injury[18]. In the same study, side-to-side differences of more than 12 cm, in the composite score of the three directions, were connected with 1.92 times increase in non-contact injuries. As shown in Table 2, eleven participants in this study presented asymmetries in anterior direction, 12 participants in posterolateral direction and 17 participants in posteromedial direction exceeding 4 cm between lower extremities. Also, 13 participants had a composite asymmetry score in all directions >12 cm. Based on the study by Gonell et al.[18], these participants are at higher risk for injury. Another study showed that, ACL reconstructed athletes with at least 4 cm deficit in the anterior direction of the Y-test, performed at 12 weeks postoperatively, tended not to reach the usual critical level of 90% in single and triple leg hop tests, for the affected limb in order to safely return to sports[20]. However, in the former study, the participants were all adults, while in the latter they had a mean age of 17.2 years and they were not homogenous in terms of sports participation. It would be interesting to investigate which would be an equivalent limit of asymmetry for pre-adolescent soccer players and the respective risk connected to this limit.

Until then, the possible existence of dynamic balance asymmetries should be investigated in young athletes in order to be on the safe side concerning doubts regarding functional asymmetries and susceptibility for injury. In conclusion, this study revealed the presence of statistically significant asymmetry in MSEBT test performance, on the young soccer players who participated. Further research is needed to clarify whether this asymmetry is associated with injuries to the lower extremities and whether this predisposes the tendency towards perpetual asymmetries or it is alleviated as training accumulates over the years. Further long-term monitoring would be helpful to evaluate whether this is a growing functional deficit potentially involving any of the other two directions of testing or it is alleviated with increasing training age.

Conflict of interest

None.

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