

Changes in postural control between 13- and 19-year-old soccer players: is there a need for a specific therapy?

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Abstract. [Purpose] To investigate how increased training participation time and intensity affect postural control in young soccer players. [Subjects and Methods] Variability and mean velocity of sway were compared in U14 and U20 players during two-legged and one-legged quiet stances on a force plate with the player's eyes open or closed. [Results] U20 players performed much better with vision, and eyes closure considerably deteriorated their performance. The increased reliance on vision in the older group most likely resulted from the longer exposure of the U20 players to strenuous exercise, overload, and cumulative residual effects of earlier contusions. [Conclusion] These specific postural deficits in apparently healthy soccer players were found only because of objective and sensitive posturographic tests. The results of this study suggest that such tests should be regularly performed to increase the efficiency and precision of motor control evaluation in athletes. The corresponding results may help therapists mitigate the indiscernible yet detrimental changes in postural control that predispose soccer players to injury and negatively affect their performance.

Key words: Motor development, Adolescence, Body balance

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INTRODUCTION

It has been documented that adequate postural control is crucial in soccer. Soccer players have better postural stability^{1, 2)}, rely less on vision³⁾, and develop different postural strategies³⁾ compared with untrained subjects. Soccer novices display an exceptional rate of postural control improvement⁴⁾. Even at the highest level of soccer participation, there are significant differences between international and national players. Nothing, however, is known about the changes in postural control in soccer players at the intermediate level of proficiency, i.e., between early and late adolescence. This is an important and difficult period of motor control development in soccer players because of the significant increase of the training load, fatigue, and participation in competitions. While increased training and tournament experience are expected to enhance postural performance, the longer exposure to strenuous exercise and overload with residual effects of earlier contusions may negatively influence the player's career progress. However, well-tailored balance exercises or ankle taping may improve postural control⁵⁾ provided that

athletes with a balance deficit are correctly identified.

The purpose of this study is to compare postural performance between two groups of young soccer players from one club, with significantly different age and sports experience but with a similar training regimen. According to existing knowledge on the role of balance in soccer performance, the older group was expected to surpass the younger group in all tests. Any departures from this hypothesis would shed light on problems that interfere with the optimal development of the older group, and require adequate action from therapists and athletic trainers.

SUBJECTS AND METHODS

Twenty-four young (age, 13.1 ± 0.6 years; U14) and 23 older (age, 18.8 ± 0.9 years; U20) players from a large top Polish soccer club participated in this study. The younger soccer players trained for 2 h twice a week between 7 and 9 years of age and 2 h three times a week from the age of 10 years. The older group participated in training for 2 h, five times a week. All subjects were systematically engaged in trainings and have not experienced, for at least 6 months, any serious injury that resulted in missed participation time. The study was approved by the local bioethics committee, and all subjects provided informed consent signed by their parents and/or themselves.

Postural stability was assessed during four 20-s quiet stance trials, first in bipedal stance with eyes open (EO) followed with eyes closed (EC), and after a 1-min break in

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Table 1. Intergroup comparison (†) of means (SD) of postural sway parameters between U20 and U14 soccer players and the effect of eyes closure (*) in two-legged (BIPEDAL) and one-legged (UNIPEDAL) stances

BIPEDAL	Eyes open		Eyes closed	
	U20	U14	U20	U14
VarML (mm)	2.0 (0.8)	2.8 (1.1)†	2.7 (0.9)*	2.5 (0.9)
MVelML (mm/s)	5.0 (2.5)	5.7 (2.9)	6.8 (2.8)*	5.6 (1.9)
VarAP (mm)	2.8 (1.1)	3.1 (1.1)	3.2 (0.8)*	3.2 (1.1)
MVelAP (mm/s)	5.5 (2.5)	6.4 (2.6)	7.3 (3.2)*	7.4 (2.0)
UNIPEDAL				
VarML (mm)	3.8 (0.9)	4.6 (1.0)†	12.0 (5.1)*	9.7 (2.8)*†
MVelML (mm/s)	20.9 (7.5)	23.7 (6.6)	55.4 (21.4)*	53.0 (14.1)*
VarAP (mm)	4.7 (1.4)	5.7 (1.9)†	13.1 (5.5)*	10.5 (3.7)*†
MVelAP (mm/s)	18.9 (6.3)	23.0 (6.2)	63.2 (38.6)*	53.9 (23.6)*

ML: medial/lateral plane; AP: anterior/posterior plane; Var: sway variability; MVel: sway mean velocity; * or † $p < 0.05$.

unipedal stance with EO and EC on an AMTI (Accusway) force plate. The subjects were instructed to stand barefoot, with the hands at their sides and their feet parallel and 10 cm apart. The sampling rate was 20 Hz and the sampling time was 20 s, resulting in 400 sampling segments in each recorded center-of-pressure (COP) time series in both the anterior/posterior (AP) and medial/lateral (ML) planes. Each recording started 10 s after the subject was ready for testing to eliminate possible transients in the COP data. The dependent variables were sway variability (COP standard deviation [SD]) and mean velocity (MV = the total COP path length divided by the sampling time).

The data were tested for normal distribution and homogeneity of variances. All dependent variables were subjected to within (two visual conditions \times two planes) \times between (two groups) ANOVA (Statistica 10.0) to evaluate the hypothesized main effects and possible interactions. Comparison of postural performance and strategies between the two groups was performed by means of contrast analysis. The level of significance was set at $p < 0.05$.

RESULTS

Although we did not find the main effect of group, intergroup differences were observed in the interactions that were found in specific trials (Table 1). In the bipedal stance, the COP SD showed a vision \times group interaction ($F(1, 45) = 4.71, p = 0.035$), which accounted for different effects of vision on postural stability in both groups. EC significantly increased the sway amplitude in the older group without any effect in the younger group. There was also a three-way plane \times vision \times group interaction ($F(1, 45) = 4.23, p = 0.046$) for the COP SD, which indicated that this difference in the reliance on vision between the two groups was larger in the ML than in the AP plane. Moreover, it was in the ML plane only that postural performance with EO, as measured by using the COP SD, was better in the older than in the younger group ($p < 0.05$). The COP mean velocity showed similar results. There was a three-way plane \times vision \times group interaction ($F(1, 45) = 4.47, p = 0.04$) that may be interpreted in the

same way as the measures of COP amplitude.

In the one-legged stance, there was a vision \times group interaction ($F(1, 45) = 7.58, p = 0.009$) for the COP SD. This result confirmed a larger disadvantageous effect of EC on postural stability in the older than in the younger group, which was already shown in bipedal stance. Post-hoc analysis revealed between-group differences in postural stability in both the ML and AP planes. With EO, the older soccer players had lower COP SD than the younger players. In contrast, with EC, the older soccer players had larger COP SD than their younger counterparts (Table 1).

DISCUSSION

The purpose of this study is to compare postural control between two groups of young soccer players with significant differences in age and training experience. We predicted better postural performance and decreased reliance on vision in the U20 group. The results supported the former prediction in both planes in the one-legged stance and in the ML plane in the bipedal stance. Still, the reliance on vision, in contrast to the latter prediction, was lesser in U14 than in U20 soccer players. Roughly speaking, adult athletes preserved their ability to improve their postural performance with EO; however, they definitely lost this advantage with EC. Although there are no precise data on the development of postural control between early adolescence and young adulthood, it is well established that balance performance is significantly better in young adults than in early adolescents⁶. Furthermore, diminished reliance on vision during balance activities is a widely recognized factor associated with the achievement of a proficient sports level. Thus, the overreliance on vision found in this study in U20 players indicates that either the somatosensory^{7, 8}) and/or vestibular system⁹) of this group was affected by adverse factors associated with soccer training and game participation.

The most common injuries in soccer that significantly contribute to postural control deterioration are ankle sprains and concussions¹⁰). Yet, such antecedents were not applicable in this study because of the medically confirmed good

health status of our subjects, despite having some residual effects of much earlier strains and contusions, which are the most common injury types¹¹⁾. Also, it is possible that the new challenges of longer training and match exposure¹²⁾ placed on the U20 players exceeded their tolerance threshold to overload and fatigue. However, our aim here was not to determine the actual reasons for the suboptimal postural control, but rather to demonstrate that balance assessment may be an important and effective way to detect concealed symptoms of postural control that may jeopardize athletic performance. On the basis of the high sensitivity of the contemporary postural control tests, we believe that regular balance assessment may be used as a means for the early detection of even slight deficits in postural control¹³⁾. Finally, proper selection of stability measures and adequate design of an experimental setup may help identify possible causes for these deficits. This, however, warrants further investigations to determine the optimal structure of such tests to increase their specificity.

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