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Five-week sensory motor training program improves functional performance and postural control in young male soccer players – A blind randomized clinical trial☆

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ABSTRACT

Sensory motor training programs are used in the rehabilitation and prevention of injuries among soccer players. Inconsistencies are found in the literature regarding the duration of the protocols and the exercises and equipment used.

Objective: To evaluate the benefits of a five-week sensory motor training program on the functional performance and postural control of young soccer players.

Methods: The study sample comprised 22 young male soccer players who were evaluated using: the Figure-of-Eight Test (F8), Side Hop Test (SHT), Star Excursion Balance Test (SEBT), and a force platform. The players were randomly divided into a control group ($N = 10$), who continued their soccer practice sessions and an intervention group ($N = 12$), who continued their soccer practice sessions and were also enrolled in a supervised five-week sensory motor training program.

Results: After the five-week training program, the intervention group obtained significant results in the F8, SHT and SEBT, as well as in the following parameters: area of pressure of sway center (COP), mean velocity and mean frequency of COP.

Conclusion: The five-week sensory motor training program, carried out with easily available and low cost equipment, was effective at improving functional performance and postural control in young soccer players.

1. Introduction

There are more than 200 million soccer players throughout the world. Most soccer injuries occur in the lower extremities (Wong & Hong, 2005), especially in the ankles and knees (Lam, Snyder Valier, & Valovich McLeod, 2015). Sudden stops, jumps and dribbling are generally associated with high injury rates (Barrett & Bilisko, 1995; Garrick, 1997) which can potentially affect the future ability of the athlete to participate in sports. In addition, these lesions can cause long-term physical impairment and have a major impact on health care costs (American Academy of Orthopaedic Surgeons).

Plisky, Rauh, Kaminski, and Underwood (2006) and Hrysomallis (2007) reported that proprioceptive loss and impaired neuromuscular skills may influence the risk of injuries. Consequently, sensory motor training, widely used for the rehabilitation of injuries in sport, is also an important part of prevention programs (Bahr, Lian, & Bahr, 1997; Wester, Jespersen, Nielsen, & Neumann, 1996).

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Prevention strategies have been employed from experiences with ‘The 11’, *Prevent Injury and Enhance Performance programme* (‘PEP’) (Gilchrist et al., 2008; Mandelbaum et al., 2005), and other programs that include preventive exercises (Caraffa, Cerulli, Projetti, Aisa, & Rizzo, 1996; Heidt, Sweeterman, Carlonas, Traub, & Tekulve, 2000; Hewett, Lindenfeld, Riccobene, & Noyes, 1999; Söderman, Werner, Pietilä, Engström, Alfredson, 2000). “The 11” was further developed (2006) to produce a more comprehensive program: “11+” to be performed as a standard warm-up. This began in Switzerland and New Zealand and its implementation has led to a significant decrease in injuries in recreational athletes (Barengo, Meneses-Echávez, Ramírez-Vélez, Cohen, Tovar, & Bautista, 2014; Junge et al., 2011), gaining recognition throughout the world. In 2009, FIFA began the dissemination of ‘FIFA 11+’ in its 209 Member Associations. The national Football Associations of Spain, Japan, Italy, Brazil and Germany have integrated the ‘FIFA 11+’, which has influenced other countries that want to be part of the international soccer scenario (Bizzini, Junge, & Dvorak, 2013).

However, the majority of these studies focused on prevention using variables related to exercises (running, stretching, proprioceptive exercises, trunk stabilization, postural control and strength), and in some cases the evidence was not able to specify which exercises or factors were responsible for the positive effects observed. Moreover, the prevention protocols were developed with inaccessible equipment, including controlled oscillation plates, electronic unstable platforms, balance treadmills, trampolines and steps, among others (Eils, Schröter, Schröder, Gerss, & Rosenbaum, 2010; Emery, Rose, McAllister, & Meeuwisse, 2007; Olsen, Myklebust, Engebretsen, Holme, & Bahr 2005) in addition to being applied for different periods of time (Emery et al., 2007; Gilchrist et al., 2008; Heidt et al., 2000).

The present study aimed to contribute to the literature and the standardization of protocols for prevention of soccer injuries through the evaluation of the benefits of a five-week sensory motor training program on the functional performance and dynamic postural control of young male soccer players.

2. Materials and methods

This is a blind, randomized clinical trial in the area of physical exercise, postural control, biomechanics and sports. This study was approved by the Research Ethics Committee (case no. 085/2013) and registered as a clinical trial (Clinical trials. NCT02097940).

2.1. Sample

The sample size was calculated based on the results obtained in terms of anthropometry, physical fitness and technical performance of under-19 soccer players by competitive level and field position (Rebelo et al., 2013). The program Power and Sample Size was used with a 95% confidence interval, 5% alpha level and 80% statistical power. Considering the results obtained and the follow-up losses, 24 volunteers were recruited (12 in each group). Therefore, the sample consisted of 24 male soccer players, between the ages of 14 and 16 years. The inclusion criteria were as follows: players with a minimum of three years of soccer training; participation in state and national competitions; training five times a week; and achieving the maximum score in the Lower Extremity Functional Scale (LEFS). The LEFS is a patient-reported lower limb function questionnaire applicable to a wide spectrum of outpatients with a lower limb musculoskeletal condition. The LEFS consists of 20 items, each scored on a 5-point scale (0–4). The total score varies from 0 to 80, with higher scores representing better functional status (Metsavaht et al., 2012; Pereira, Dias, Mazuquin, Castanhas, Menacho, & Cardoso, 2013). The exclusion criteria were: players who had previously undergone surgery; experienced muscle and joint injuries in the lower limbs in the three months prior to the study; and those who needed stabilizers to perform the functional tests during data collection.

2.2. Procedures

All players, their parents or legal guardians, signed a free and informed consent, provided demographic data (age, weight, height, training frequency and duration) and answered the LEFS questionnaire (Metsavaht et al., 2012).

Postural control was evaluated using an AMTI® force platform (OR6- 7-2000 analog-digital amplifier MX Giganet Vico system®, Vicon Nexus® software (version1.8), with an acquisition frequency of 100 Hz, fourth-order low pass Butterworth filter with a cut-off frequency of 10 Hz, and digital data transferred to a computer via a USB universal cable). Values were set for the area of pressure of sway center (A-COP in cm^2), Mean Velocity (MV) sway of COP and Mean Frequency (MF) sway of COP, for both anteroposterior (AP) and mediolateral (ML) directions.

In order to establish which lower limb to start the data collection on the force platform, the athletes were required to select from sealed, opaque envelopes. The dominant lower limb (DLL) was the leg used for kicking a ball, versus the non-dominant limb (NDL). The athletes stood barefoot on the force platform and received instructions about the test, following which data collection started, with the athletes in a single leg stance on the previously selected lower limb, eyes open, contralateral knee at 40°, hips in a neutral position and arms crossed with hands resting on the shoulders. All the athletes repeated the assessment position several times, in order to minimize the learning effect. During the test, the athletes were instructed to remain as still as possible. The evaluation on the force platform was performed by a blind rater. The procedure was performed for 30-s and was repeated three times for each lower limb, with 30-s intervals between each attempt for the athlete to sit and rest. If the flexed lower limb touched the ground before the end of the 30 s procedure, the attempt was canceled and repeated. The same protocol was repeated subsequently with the eyes closed.

A one day rest interval was observed after the analysis on the force platform to avoid muscle fatigue. The same evaluation sequence for the lower limbs was used for the application of the Side Hop Test (SHT) – with lateral jumps (Fig. 1A), Figure of Eight Test (F8) – with jumps forward and rotation (Fig. 1B) (Caffrey, Docherty, Schrader, & Klossner, 2009) and Modified Star Excursion Balance Test (mSEBT) – one-leg balance (Fig. 1C) (Filipa, Byrnes, Paterno, Myer, & Hewett, 2010; Shigaki et al., 2013). The Modified Star Excursion Balance Test was applied (Plisky et al., 2006) and the calculation for data normalization was established according to Filipa, Byrnes, Paterno, Myer, and Hewett (2010).

Prior to starting the protocol, training was given in the functional tests to minimize the learning effect and followed the sequence: mSEBT, SHT and F8, applied by a blind rater. The procedure was repeated three times for each lower limb, barefoot, eyes open and a 30- second rest interval was given between each trial, with the athlete sitting in a chair. The mean of the three functional tests was considered for the results.

Following the evaluations, the participants were randomly divided into an intervention group (n = 12) and a control group (n = 12). For the randomization process, sealed, opaque envelopes containing the names of both groups were used. The intervention group performed soccer training together with the five-week sensory motor program. The control group performed only soccer training; however during these five weeks, two athletes were injured and excluded from the sample. Therefore, the intervention group comprised 12 athletes and the control 10 athletes (Fig. 2).