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Research Paper

Effect of Core Stability Training Versus Plyometric Training on Dynamic Balance in Collegiate Soccer Players

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Abstract

Background and Objectives: Soccer is a globally renowned sport that has garnered immense popularity, with a growing number of participants and enthusiasts. It is an intermittent sport that requires different physiological components. In modern football, physiological considerations are increasingly essential to enhance optimal performance. A soccer player can produce varied high-speed actions that are known to have an impact on their performance. Dynamic balance relates to stability maintenance during the performance of dynamic movements. The objective of the study is to determine the effect of core stability training versus plyometric training on dynamic balance in collegiate soccer players.

Methods: An experimental study that included 30 soccer players who were selected based on the selection criteria and were divided into 2 groups. Players in Group A underwent Core Stability training whereas Players in Group B underwent Plyometric training along with their regular soccer training. Dynamic balance was assessed using the Y balance test. The total study duration is 6 months and each player received training for 4 weeks.

Result: The result showed that there was a significant difference between the pre-test and post-test values of the Y balance test (Anterior direction: 't' value = 16.20, Posteromedial direction: 't' value = 7.67, Posterolateral direction: 't' value = 12.61) among subjects of Group A than Group B.

Conclusion: The study concludes that Core stability training is more effective in improving dynamic balance than Plyometric training in Collegiate soccer players.

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1. INTRODUCTION

Soccer is characterized as an interval sport that involves a combination of low-intensity, medium-intensity, and high-intensity activities that will alternately take place throughout the entire game [1]. Individual player's performance and the overall team performance are highly influenced by various high-intensity related movements such as sprinting, jumping, and changing direction [2]. Soccer-related injuries predominantly affect the lower extremities, with the ankle and knee regions being the most susceptible. Extensive research has identified ankle sprains as one of the most prevalent sports injuries, with a reported incidence rate ranging from 15% to

45% during the football season [3]. A player has to act to perceive a teammate's behaviors, as well as those of a defender and the opposition. Interactions among players originate in co-adaptive behaviors, where players adjust their behaviors relative to the perceived actions of neighboring players to achieve performance goals [4]. Core stability is defined as the ability to control the position and motion of the trunk over the pelvis to allow optimum production, transfer, and control of force and motion to the terminal segment in integrated athletic activities. Core muscle activity can be best understood as the pre-programmed integration of local, single-joint muscles and multi-joint muscles to provide stability and produce motion [5]. Core training programs include processes that target muscle strengthening and motor control of the core musculature. Core strengthening exercise is very popular in rehabilitation programmes despite little scientific existing as to their efficacy in improving subsequent performance [6]. Core strength is particularly more important in sports because it provides "proximal stability for distal mobility" [5]. Core stability exercises appear to be especially important in cases of many different conditions involving spinal instability. It includes a warm-up, which focuses on stretches, and a short aerobic program. A core stability exercise program begins with recognition of the neutral spine position thought to be the position of power and balance for optimal athletic performance in many sports [7]. Plyometric exercise is a popular form of training commonly used to improve athletic performance. The stretch-shortening cycle, which involves the stretch of the muscle tendon unit immediately followed by shortening is integral to plyometric exercise. The stretch-shortening cycle enhances the ability of the muscle-tendon unit to produce maximal force in the shortest amount of time, prompting the use of plyometric exercise as a bridge between pure strength and sports-related speed [8]. Plyometric training is a technique used to increase strength and explosiveness. It consists of physical exercises in which muscles exert maximum force at short intervals to increase dynamic performance. In such training, muscles undergo a rapid elongation followed by an immediate shortening (stretch-shortening contraction), utilizing the elastic energy stored during the stretching phase. There is consensus on the fact that when used, Plyometric training contributes to improvement in vertical jump performance, acceleration, leg strength, muscular power, increase of joint awareness, and overall sport-specific skills. Consequently, Plyometric training which was primarily used by martial artists, sprinters, and high jumpers to improve performances has gained in popularity and has been used by athletes in all types of sports. Plyometric training consists of dynamic and rapid stretching of muscles (eccentric action) immediately followed by a concentric or shortening action of the same muscles and connective tissues. This training focuses on learning to move from a muscle extension to a contraction in a rapid or 'explosive' manner, such as in specialized repeated jumping. Exercises are of high-intensity, explosive muscular contractions combining strength and speed for the acquisition of benefits in power. Plyometric training involves hops and jumps used to capitalize on the stretch-shortening cycle of the muscle [9]. Soccer involves many vigorous activity changes such as jumping, passing, kicking, turning, sprinting, and change of direction [10]. During and after all these movements, the players need to stay in balance to pass to the next movement as well as to prevent injuries. The ability of the player to keep his center of gravity on the supporting surface is termed balance and it occurs due to coordinated actions of visual, vestibular, somatosensory, and neuromuscular feedback [11,12]. Balance can be divided into static and dynamic balance. Static balance can be defined as the ability to maintain the balance of the whole body in a certain place and position, whereas dynamic balance can be defined as the ability to maintain the whole body's balance during any motion [13]. Balance is an important factor for all athletes to improve their sports performance and prevent injuries [14].

2. MATERIALS AND METHODS

It is a pre-test and post-test experimental study design. This study was conducted on 30 collegiate soccer players at the playgrounds of K.G. College of Physiotherapy, Saravanampatti, Coimbatore under the supervision of a team trainer. The purpose of the study was explained to each player. A clear explanation was given about the procedures and written consent was obtained from each player. The players were included in this study based on the inclusion criteria (Collegiate soccer players who have been playing soccer for 1-year, male soccer players, age group of the players ranging between 18-26 years, players who were not involved in any specific training program for the past 6 months) and exclusion criteria (Players with cardio-respiratory disorders, players with orthopedic and neurological impairments, unwilling and uncooperative players). The players were divided into two groups of 15 in each based on the purposive sampling method. Players in Group A underwent Core stability exercise along with their regular soccer training whereas players in Group B underwent Plyometric training along with their regular soccer training. All players underwent training for 1 hour per day for 5 days in a week for 4 weeks. The total study duration is 6 months. Dynamic balance was measured using the Y balance test. Pre and post-test evaluation of dynamic balance was analyzed.

3. RESULTS

The demographic characteristics of all players including their age, height, weight, and body mass index are included in Table 1. A comparison of the Y balance test scores measured at the baseline and during the final training session for both groups revealed that Group A (players who received Core stability training) has a significant increase in Y balance test scores in all directions when compared with Group B (players who received Plyometric training) ($p<0.05$). A significant ($p<0.05$) increase in Dynamic balance was observed by the end of the training session in both groups (Table 2) (Figure 1).

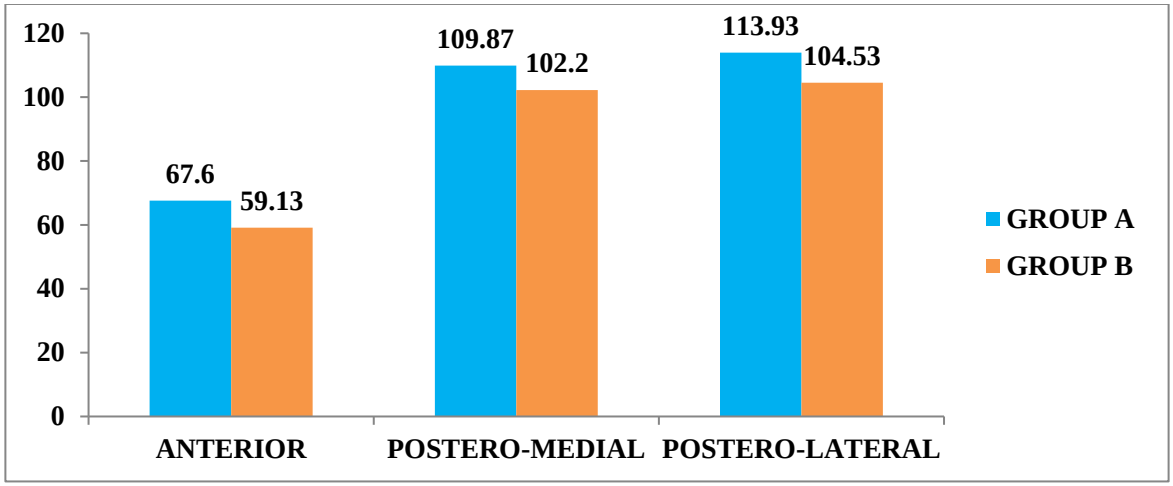
Table 1: Comparison of demographic characteristics of subjects in the Group A and Group B

Subject Characteristics	Group A Mean ± Standard Deviation	Group B Mean ± Standard Deviation
Age (years)	23.00 ± 2.54	22.40 ± 3.02
Height (cm)	177 ± 4.82	178.27 ± 4.23
Weight (kg)	80.47 ± 3.74	81.73 ± 5.56
Body Mass Index	23.31 ± 1.17	23.91 ± 1.07

Directions – Y Balance Test	Group A Mean ± Standard Deviation	Group B Mean ± Standard Deviation
Anterior	67.60 ± 1.72	59.13 ± 1.06
Postero-medial	109.87 ± 3.38	102.20 ± 1.08
Postero-lateral	113.93 ± 2.63	104.53 ± 1.19

Table 2: Comparison of Y balance test scores between Group A and Group B using the independent t-test

Figure 1: Comparison of the pre-test and post-test values of Y balance Test Scores in Group A and Group B



4. DISCUSSION

Core stability can be defined as the force produced and sustained by core muscles [15]. It is accepted that core muscle strength improves performance in skill-related components such as balance, coordination, and speed and health-related components such as flexibility and strength. The previous studies that investigated the effect of core stability training on dynamic balance, there is a consensus that dynamic balance performance has been increased after core stability training [16]. It has been concluded that four weeks of core stability training for male soccer players will increase dynamic balance efficiency [13]. Core stabilization exercises target specific deep core muscles. The nervous system sends signals from the brain to the muscles via motor neurons, leading to muscle contractions. During core exercises, Proprioceptive feedback from muscle spindles and Golgi tendon organs informs the nervous system about muscle length, tension, and joint position. This feedback allows for adjustments in muscle activation to maintain balance and stability during exercises [17]. Core stabilization exercises often involve co-contraction, where both agonist and antagonist muscles around a joint contract simultaneously. Co-contraction enhances joint stability, reduces shear forces on the spine, and helps to maintain optimal spinal alignment. Central pattern generators are neural circuits in the spinal cord responsible for generating rhythmic patterns of muscle activation without direct input from the brain and play a role in coordinating muscle activity during movements [18]. It has been demonstrated that Plyometric training in soccer players increases performance. Following plyometric training jumping and kicking performance was increased in adolescent soccer players and it was reported that low-intensity plyometric training for 3 sessions per week for four weeks would provide this effect [19]. Plyometric training affects the muscle spindle, Golgi-tendon organ, joints, tendons, balance, and body position control, these changes may occur due to neuromuscular adaptations. Plyometrics are exercises that involve the enhancement of muscle performance. Most of the training in sports involves jumping, hopping, and skipping movements these exercises also facilitate sturdy muscle activities, and energetic activities, during which the movement would come with a stretch of the muscle instantly by an explosive modification of the muscle. Most researchers and practitioners share a common view that plyometric training is one of the approaches in every field often used for athletes, notably those with the stretch-shortening cycle. These training are designed to improve explosiveness and dynamic efficiency. Previous studies have shown that through plyometric training, jumping and sprinting capabilities and specific trajectory activities could be improved. An effective technique for boosting the running economy, joint stability, and the severity of knee injuries was also found [20]. Both groups had a better outcome because of the training regimen, but Core stability training has shown greater improvement in dynamic balance both clinically and statistically than Plyometric training in collegiate soccer players. The limitations of the study are as follows. The study was conducted on a smaller sample size and it included only male collegiate soccer players. The scope of the study was limited due to its short duration, it focused on two training techniques, and one outcome measure was analyzed.

Further studies are recommended to include female players. A larger sample size and different training programs can be included. Elite soccer players can be included in further studies. Other parameters like Agility and Flexibility can also be included.

5. CONCLUSION

In conclusion, Core stability training is more effective in increasing dynamic balance than Plyometric training in collegiate soccer players.

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