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THE EFFECT OF CORE AND BALANCE TRAINING ON SINGLE-LEG SWAY PARAMETERS AND WELL-DIRECTED KICK OF MALE SOCCER PLAYERS

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Abstract:
The aim of this study is to examine the effect of eight-week core and balance training on single-leg sway parameters and well-directed kick of male soccer players. 24 male players of an amateur soccer club aged 14 to 15 participated in the study. The participants were randomized into an experimental group (EG, n=12) performing core and balance trainings with soccer training and a control group (CG, n=12) performing only their routine soccer training programs for 8 weeks. Biodex Balance SD (Biodex Inc., Shirley, NY) device was used to measure single-leg sway parameters and Mor–Christian general aptitude soccer test was used to evaluate well-directed kick. EG athletes showed statistically better results in well-direct kick and dominant-leg-sway parameters than CG athletes ($p < 0.05$) while there was not seen any changes on non-dominant leg sway parameters ($p > 0.05$). When classical soccer practice supported by core and unstable surface exercises, possible developments in balance affects dominant and non-dominant legs of athletes to achieve in soccer the necessary skills more easily so it can be concluded that regular soccer training with core and balance exercises would be particularly effective in improving balance parameters and soccer skills.

Keywords: soccer, kick performance, postural sway, single leg static balance

1. Introduction

The match results in soccer is determined by multiple factors and soccer is characterized by the interaction of technical, tactical, physical, physiological, and

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psychological components (Praça et al., 2015, Chmura et al., 2014). Players must accelerate the game, use the energy economically and use the ball efficiently. Therefore, improving force, power, speed, agility, technical skills and running economy are important, because soccer contains all of these skills (Kesler et al., 2003, Bozdoğan et al., 2014) however, few studies have investigated the relationship between these factors in soccer players (Praça et al., 2015, Chmura et al., 2014, Ali, 2011).

Soccer players cover between 10 and 12 km during a match. The breakdown of the movements performed within this displacement is as follows: 37% jogging, 25% walking, 11% sprinting, 20% submaximal movements, 7% backwards running (Bangsbo et al., 2006). It is necessary for the soccer players to use the ball well and to score while perform these physical activities.

The requirements of technical skill vary depending on the sports branch. In order to display advanced athletic performances, an athlete must improve his technical skills. The value of the player is determined in terms of talent by the factors such as making assists, scoring, passing and defencing (Şaşmaz Ataçocuğu and Zelyurt 2016). However, technical skills evolve progressively. To develop these skills, long training sessions are required. Therefore, it is very important to include technical training in practice sessions (Plainos et al., 2011).

The word balance is used to describe training designed to create movement symmetry between the right and left sides of the body and to promote a balance of mobility and stability within the body. Mobility and stability should be the starting point for a training program. Although mobility and stability may sound as if they are opposites, they must exist together to form an effective foundation for movement and activity. If testing reveals poor mobility and stability, you must focus on an effective fundamental mobility and stability program before any other kind of training. This type of training, when done correctly, will greatly improve movement awareness, especially between the right and left sides of the body (Cook, 2003).

Balance, pelvic stability and posture are all heavily influenced by sensory information from the foot. The sole of your foot is sensitive for a good reason: it is constantly sending information into your central nervous system so that you can instantly and unconsciously adjust your body's alignment (Roll et al., 2002).

Balance can further be broken down into three aspects: steadiness, symmetry, and dynamic stability. Steadiness refers to the ability to maintain a given posture with minimal extraneous movement (sway). The term symmetry is used to describe equal weight distribution between the weight-bearing components (e.g., the feet in a standing position, the buttocks in a sitting position), and dynamic stability is the ability to move within a given posture without loss of balance (Deborah, 1997).

Soccer is a sport requiring a plethora of technical skills as well as static, semi-dynamic and dynamic balance. Being able to hit the ball and different technical movements in soccer require posture on one foot. In addition, the stability of the support foot is important in order to be able to perform the hitting motion as correctly as possible. Therefore, the postural control of soccer players is assessed during one-leg stance depending on specific situations in soccer (Şimşek & Ertan, 2011). Balance plays a pivotal role in the harsh conditions, such as pushing opponents, slippery grass, changes to the ball's orbit, moving, etc. facing soccer players during a soccer game (Evangelos et al., 2012).

The core which is strong and efficient is crucial to maintain in balance is located in center of gravity of body and it contributes all movements. Core stability is necessary to maintain the integrity of the spinal column, provide resistance to perturbations, and furnish a stable base for movement of the extremities and core training is the kind of exercises done with the individual's own body weight and aiming to strengthen the lumbo pelvic muscles and deep muscles that keep the spine balanced (Williams and Wilkins, 2008; Atan, 2013).

Core and balance exercises have gained tremendous interest in recent years and have become an integral part of training programs (Prieske et al., 2016; Yaggie and Campbell 2006). In literature, it has been concluded that core training prevents occurrence of some injuries and yields positive results for performance (Karacabey et al., 2016). Likewise, Caglayan et al., 2015 reported that neuromuscular and balance exercises were also effective on performance, not just on lower extremity injuries. The focus of this article has been investigating the effect of core and balance training on single-leg sway parameters and well-directed kick of male soccer players.

2. Material and Methods

2.1 Participants

The sample size of this study is determined as 24 male soccer players, who are between 14 to 15 years of age, have no health problems, were not injured in the last 6 months, played soccer actively at least for 3 years, trained 3 days a week and 1.5 hours daily and have similar levels of athletic activity.

2.2 Practice

Pre- and post-test models were used in this study. Based on the pre-test results, the participants were divided into control (n=12) and experiment (n=12) groups. For dominant leg determination, the participants were asked firstly which foot they will be

using for kicking. All soccer players' pre and post single-leg sway parameters and well-directed kicks were measured two months apart. Anthropometric measurements of all participants were taken in this day (body weight, height). Pre and post balance tests were measured in force measurement laboratory. A day before tests, soccer players were asked to rest and they were asked to eat at least two hours before the exercises. Field tests took place in sports clubs pitch.

2.4 Balance and Core Training Program

In balance training, each movement lasts 20 seconds. A 10-second rest was given between each movement. Two sets were performed. At the end of the balance track, 2-minute active rest was given before the core track was performed.

A. Balance training exercises: Flamingo stance- Single leg squat- Double leg jump and standstill- Passing on bosuball- Single leg jump from one bosuball to another (1.5 meter distance with each bosuball).

B. Core training exercises: Vertical Leg Crunch (Upper abdominals), 2 sets, 10 repeats. A 30-second rest between each movement and a 1.5-minute rest between the sets.

Side Plank (Obliques), 20 seconds on one side, 20 seconds on the other side. A 30-second rest between each movement and a 1.5- minute rest between the sets.

Superman (Glutes and back), 2 sets, 10 repeats. A 30-second rest between each movement and a 1.5-minute rest between the sets.

Bird Dog (Upper and lower abdominals, glutes), 2 sets, 10 repeats. A 30-second rest between each movement and a 1.5-minute rest between the sets.

2.5 Mor–Christian General Ability Soccer Test (Well-directed Kick)

Generally, it is used as a test battery for measuring dribbling, passing and kicking in soccer but in this study, it was used for measuring only well-directed kick. In the test to be applied, the well-directed kick and scores were saved. The kick was performed 11 meters away from the goal. Four kicks were performed and total points were taken. The soccer players could kick the ball with their preferred leg. Four times kick was performed to four circle targets. Total ball kicking was sixteen. If the athlete kicked the correct target, he earned ten points. If the ball went to the wrong target, the athlete received 4 points. If the ball went directly towards the target, the kick was considered successful, and other kicks were not added to the score. Resulting score consists of the sum of the points of 16 tests (Psotta and Martin 2011).

2.6 Single-Leg Sway Parameters Measurement

Balance Measurements were applied with Biodex Balance SD (Biodex Inc., Shirley, NY) device. BBSD includes a circular platform providing simultaneous free movement in the anterior-lateral and medial-lateral axes. The platform can be fixed for static balance measurements, or the platform can be moved for dynamic measurements. "Postural Stability" was used for measuring single-leg sway parameters. Two tests were performed on single-leg with dominant and non-dominant leg. During the test, the athletes were able to simultaneously follow the position of the center of gravity from the screen so they received visual feedback. In the test, the athletes were asked to keep their center of gravity at the center of the target on the screen for 30 seconds with minimum sway.

2.7 Data Analysis

Statistical analyses of findings were performed with SPSS (Statistical package for Social Sciences) Windows 16.0 program. The Shapiro Wilks test was used to determine the distributions of the variable and it was determined that the distributions were not normal. Nonparametric Wilcoxon Two-Sample test was used to determine the significance of the difference between the pre and post tests of each group. Nonparametric Mann Whitney U test was used to determine the difference of average between the groups. Level of significance was determined as ($p < 0.05$).

3. Results

Table 1: Mor-Christian General Soccer Ability Test Intra-Group Change Pre and Post Tests

	Experimental Group			**Control Group**		
	Pre-Test	**Post Test**	**P**	**Pre Test**	**Post Test**	**P**
Well-directed Kick	98.88±6.17	114.6±7.34	**0.008**	106±14.3	112±16.7	**0.049**

Both groups were shown significant differences on well-directed kick after a 8-week core and balance training period in groups ($p<0.05$).

Table 2: Mor-Christian General Soccer Ability Test Inter-Group Change

	Experimental Group	**Control Group**	**P**
Well-directed Kick	15.72±2.42	6±0.82	**0.032**

There was significant differences on well-directed kick after a 8-week core and balance training period between the groups ($p<0.05$).

Table 3: Dominant Leg Sway Parameters Intra-group Change, Pre and Post Test

	Experimental			Control		
	Pre Test	**Post Test**	**P**	**Pre Test**	**Post Test**	**P**
Overall	2.93±1.40	1.31±0.57	**0.02**	1.76±0.62	1.54±0.65	0.62
A-P	1.26±0.75	0.69±0.45	**0.03**	0.81±0.18	0.68±0.22	0.66
M-L	2.44±1.31	0.74±0.30	**0.02**	1.38±0.69	1.20±0.66	0.86

While control group was shown no differences on dominant-leg sway parameters after a 8-week training period, experimental group was shown differences in pre and post tests ($p<0.05$).

Table 4: Dominant Leg Sway Parameters on Inter-Group Change

	Experimental Group	**Control Group**	**P**
Overall	1.62±0.37	0.22±0.32	**0.02**
A-P	0.57±0.18	0.13±0.01	**0.04**
M-L	1.7±0.88	0.18±0.3	**0.01**

There was significant differences on dominant-leg sway parameters after a 8-week core and balance training period between the groups ($p<0.05$).

Table 5: Non-Dominant Leg Sway Parameters Intra-group Change, Pre and Post Test

	Experimental	**Group**		**Control Group**		
	Pre Test	**Post Test**	**P**	**Pre Test**	**Post Test**	**P**
Overall	1.36±0.72	1.21±0.78	0.24	1.56±0.82	1.42±0.75	0.26
A-P	0.84±0.28	0.74±0.33	0.21	0.96±0.43	0.9±0.37	0.28
M-L	0.89±0.69	0.8±0.70	0.3	0.88±0.34	1.8±0.49	0.23

Both groups were shown no differences on non-dominant leg sway parameters after 8-week core and balance training period in pre and post tests ($p>0.05$).

Table 6: Non-dominant Leg Sway Parameters on Intra-group Change

	Experimental Group	**Control Group**	**P**
Overall	0.15±0.06	0.14±0.08	0.62
A-P	0.1±0.02	0.06±0.09	0.92
M-L	0.09±0.03	0.08±0.11	0.73

There was no difference between groups on non-dominant leg sway parameters.

4. Discussion and Conclusion

The movements with the ball in soccer are diverse. Despite this diversity, the duration of playing with the ball is on average about 2 minutes per player during a 90-minute match. The physical and technical requirements must be carefully assessed to perform the ball movements although the players have so little time to play with the ball (Erdem, 2005).

Soccer is a sport requiring a plethora of technical skills as well as static, semi-dynamic and dynamic balance. Most of these skills, such as passing, juggling the ball in the air, dribbling or receiving the ball, are achieved through standing on one foot. To be able to hit the ball and perform different technical movements in soccer, posture on one foot is required especially while kicking the ball. In addition, the stability of the support foot is important in order to be able to perform the optimally effective motion. For this reason, postural control of soccer players is assessed during one-leg posture depending on the specific situation of soccer (Evangelos et al., 2012).

In a study on the importance of balance in soccer, Paillard et al, 2006 investigated the postural performance and strategies of soccer players with different levels of competition (national and international) during a one-leg stance. As a result of the research, it was observed that national soccer players had better postural performance than the regional soccer players with different postural strategies within the laboratory duties. National soccer players are more balanced than regional players and use proprietary and visual information in different ways.

When the results of our study were evaluated, it was seen that EG athletes performing balance and core exercises had better statistical significance than CG athletes on dominant leg sway parameters ($p<0.05$). The results shows that studies on unstable surfaces are more effective than classic soccer training methods. As the reason for this, it can be considered that the muscle and nervous system, which is trying to maintain balance under more difficult conditions, have an effect on the reduction of the oscillation. In a paper supporting our work, Yaggie and Campbell (2006) have shown that balance studies affect proprioceptive input, reaction time, and muscle strength by improving postural control mechanisms, enhancing neuromuscular adaptation. They indicated that, the dynamic power and sway parameters are improved as a result of training with Bosu ball, but that the effect of these skills on performance in competitive or recreational sports is uncertain. In another study supporting our study in the

literature, Gioftsidou et al., 2006 demonstrated positive effects of balance exercises on postural sway reduction.

The clear aim of a soccer match is to score more goals than the opposing team. Therefore, one of the most highly valued and important skill elements within the game is the ability to score goals (Jinshen et al., 1991). Goal-shooting tests are usually part of a battery of skill tests designed to assess overall soccer playing performance (Ali 2011, Rösch et al., 2000; Haaland and Hoff, 2003).

In our work, we have also assessed the accuracy of the soccer players' shooting abilities. Skills such as passing and shooting at the right time and with the right intensity are the factors that determine the athlete's performance. Although regular soccer practice is effective in improving skills (Jakobsen et al., 2010), additional core and balance trainings are thought to result in increased sense of position when the athlete is on one leg during the shot, reduction of the use of muscular strength for balance to minimum, increase in reaction time and good postural control.

As well as many motoric and technical skills, sudden reactions, awareness, actions taken milliseconds before the opponent by taking the correct position and remaining balanced in the critical positions are important for scoring or blocking the goal while performing a difficult trick in soccer. These momentary moves and reactions are factors that play a role in the positive outcome of years of training on technical, tactical and physical skills and performance. This state of balance where all these critical moves are made facilitates the finishing move that the soccer players will make at that moment. Performing a skill in a difficult situation, in an unexpected moment by realizing the optimal body position is related to the development of the neuromuscular system and the proprioceptive characteristic of the body.

Today, vestibular senses related to balance and movement and proprioceptive trainings related to the body position and perception of the body parts are neglected in the youth setup (Topkaya 2013). The purpose of plyometric exercises is to increase the power of subsequent movements by using both the natural elastic components of muscle and tendon and the reflex (Potash and Chu 2008; Fabricius, 2011). With the implementation of such training programs the high velocity impacts in the eccentric and concentric transitions of the plyometric exercises can be reduced, the falling techniques can be improved and the necessary responses can be given to perform even under the most difficult conditions (Wilson and Flanagan 2008). Also, the improvement in the single leg sway values of the dominant leg in favor of the EG suggests the importance of balance training. This is because the non-dominant leg is used for balance while the dominant leg is used for the movements with ball in soccer game.

The high development seen in the EG dominant leg in the present study is important in terms of optimum performance when considering that both legs should be used effectively in the soccer. Those who advocate training on unstable surfaces suggest that these practices improve balance, kinesthetic sense, proprioception and performance through the gradual increase or decrease of strength, and assert that all movements require both stability and mobility, and that it is important to operate both of these qualities at the same time. These trainings aim to improve the afferent activity in order to reduce the risk of injury and improve performance, which may help to reinforce smooth agonist-antagonist contraction in order to increase joint strength and strength development. Effective afferent function is crucial for neuromuscular stimulation, and potential developments involve faster proprioceptive aggregation, information transfer to the central nervous system (CNS), and information processing by the CNS (Cressey et al., 2007).

The results of our study showed that well-directed kick results of EG players doing core exercises and unstable surface training were statistically significant compared to the athletes doing classical soccer practice. Although in a study Güllü, 2013 noted that the kicking skills of children aged 11 to 12 years who had been learning basic soccer for 6 months had improved, likewise (Nikolaidis and Karydis 2011), in research of Ölçücü, et al., 2010 on 10-14 age group, has found that the balance exercises given to soccer players of U-13 age group improved their soccer skills (passing, shooting, dribbling) positively.

When classical soccer practice supported by unstable surface exercises, possible developments in dominant and non-dominant legs will help athletes to achieve in soccer the necessary skills more easily in complex situations where abilities such as coordination, agility and balance are very important. Especially improved at a young age, with more ergonomic presentation of the bio-motor features, balance trait can contribute to young soccer players becoming elite players in later years, by enabling them to better perform the technical skills specific to soccer. So it is possible to say that, in line with the research findings, the workouts performed with core and balance training improved the single-leg sway parameters and well-directed kick of soccer players.

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