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Original Article

The relationship between postural stability, core muscle endurance and agility in professional basketball players

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Abstract

Aim: The purpose of this study was to identify relationships between postural stability, core muscle endurance and agility in basketball players.

Materials and Methods: 21 professional male basketball players [age: 17.±0.63 (years), body weight: 78.69±9.22 (kg), height: 186±7 (cm), BMI: 22.72±2.26 (kg/cm²)] were included to this study. Three balance variables were measured using Biodex Biosway™. Core muscle endurance was measured using three core endurance tests proposed by Mcgill. Agility was assessed by Hexagonal Obstacle Test (HOT).

Results: The analysis results showed that postural stability is associated with HOT (r: 0.457). In addition, the postural stability was related to extension muscle endurance test and side bridge test (respectively, r: -0.501 and r: -0.468). There is no correlation between HOT and core muscle endurance test in basketball players.

Conclusion: The athletes with good postural stability were better core muscle endurance and agility. It is important to apply exercise programs that enhance postural stability and increase core muscle endurance to improve sportive success.

Keywords: Postural stability; core muscle endurance; basketball.

INTRODUCTION

Basketball is a physically demanding sport requiring intense lateral, running, sprinting and jumping movements (1). The physiological requirements of basketball include aerobic and anaerobic performance as well as physical characteristics including muscle strength, power, endurance, flexibility, speed, agility and sport-specific abilities (2). To be able to play at the highest level, the athlete must have advanced high levels of agility, aerobic and anaerobic external muscular power output (1, 3). Moreover, it is expressed that a good postural stability can contribute to successful performance and plays a major role in many athletic activities as well as sport-specific postural control (4, 5).

Postural stability is the ability to maintain the center of gravity of the body on the support surface with minimal postural sway. The maintenance of the balance takes place through the interaction of three systems. First input is vestibular system. The second, balance coordinator is a proprioceptive system originating from somatosensorial receptors found in tendons and muscles in joints related to spatial awareness, body posture and kinesthetic sensation. The last one is a visual system that sends signals about body position (6). Maintaining postural stability depends on a complex relationship between visual, vestibular and sematosensorial systems to keep the center of gravity of the body in control over the base of support. The ability of maintaining of postural stability has significant influence on sport performance. Optimal core stability is also important for the performance of athletic movements resulting in body oscillations outside the support surfaces of the athletes (7). Major core muscles are transversus abdominis in anterior, multifidus in posterior, pelvic floor

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at the bottom and diaphragm at the upper side. Minor core muscles are latissimus dorsi, gluteus maximus and trapezius (6, 8). Core muscles are assumed to play a role to stabilize the lumbar region (9, 10). Core plays an important role in reducing the risk of injury and stabilizing peripheral joints, especially during intense physical activity (11).

Turner et al (12) defined agility as the ability to quickly change direction while maintaining stability without losing speed. As can be understood from this description, postural stability and agility are parameters that interact with each other. Balance and postural control are logically related to their apparent contribution to movements necessary in good agility. The ability to quickly change the direction and speed of the entire body center of gravity is the main locomotor ability in many sports (13). There are many studies described above in the literature that investigate the effects of core training on agility and balance (14, 15). However, there are very few studies in the literature that investigate the relationship between postural stability, core endurance and agility in basketball players. Therefore, we hypothesized that there is relationship between postural stability, core muscle endurance and agility in basketball players.

MATERIAL and METHODS

Subjects

This was a descriptive study conducted between January 2017 and April 2017. The study was carried out in Gazi University Faculty of Health Sciences Application Units. 21 basketball players who have been engaged in sports for at least 2 years and training 5 days a week (21 males, age: 17.0±0.63 years, Table 1) were included. Participant with previous lower extremity musculoskeletal injuries, those with low back pain, those with any upper extremity or lower extremity surgery, those with upper extremity and lower extremity deformities, those with neurological problems, those with vestibular disease and those with systemic disease were not included in the study. Participants were given permission from their coaches for those younger than 18 years old. Participants were questioned about age, gender, marital status, body weight, height, dominant side, occupation, level of education, team they played, any injuries, health history. Control group did not add to this study. Body mass index (BMI) was calculated according to body weight (kg) / height (m^2) equation (16). Approval of ethics committee was taken from Yıldırım Beyazit University (2016/12).

Testing Procedures

Postural stability was assessed using Biodex-Biosway™ (Biodex Medical Systems, Shirley, New York). The Biodex Balance System was designed to evaluate problems relating to balance, proprioception, and neuromuscular control. This testing machine consists of a multiaxial standing platform, which can be adjusted to provide varying degrees of platform instability. A static platform surface can be selected. With this surface, a static situation is created. The ability of the individual to maintain static postural balance on this stable platform is assessed (17). Balance evaluation with Biodex-BioSway™ was done with Postural Stability Test and Stability Limit Test (LOS). Before starting the test, the position of the feet of the individuals on the platform was recorded in the system with the coordinates. The tests were done with bare feet. Before the tests started, the individuals were told verbally how to do the tests. The postural stability test measures the person's ability to maintain the balance center. As a result of the test, the person's score shows deviations from the center. The test was done 3 times. During the test, the athletes were asked to keep the black spot in the center of the screen for 20 seconds. The test was first started on the dominant side and the test was repeated for both legs. The arms were positioned next to the body during the test. As a result of evaluations, anteroposterior and mediolateral deviations were determined. The performance of the athletes was recorded as a stability index (17). LOS measures the maximum limit that a person can reach vertically from his body without losing balance. The test can be done at 3 levels, expressed as easy (50%), medium (75%) and difficult (100%). For the athletes, the test was done in the middle (75%) level. The “actual” score was recorded, indicating the points on each side of the test obtained in the test result (17).

The core muscle endurance was assessed by three core endurance tests generated by McGgill (18). It was shown that the intrarater reliability of these tests was moderate reliability. McGill endurance tests are trunk flexor test, trunk extensor test and side bridge test. The trunk flexor test was performed while the body was 60° in flexion, knees and hip were 90° in flexion. The arms were joined diagonally on the chest. Participants were wanted to protect this position as long as it is possible. The test was terminated when the individual could not maintain this position. The trunk extensor test was performed on the treatment table in a prone position. Pelvis, hip and knees were fixed to the treatment table up to spina iliaca anterior superior level. The body and upper extremities were supported with a chair at the same height as the surface of the table. Then the chair was removed and the individual tried to keep the horizontal body position as long as possible while crossing the arms on the chest. The test was terminated when the person fell below the horizontal position. The side bridge test was performed on the dominant side on the mat. Because no difference between the left and right side has been previously reported, only the dominant side was evaluated (10). Knees of the participants were on the extensions with same line of feet. Body weight was supported only by the lower elbows and feet while lifting her hips on the mat. The test was terminated when the side-lying position deteriorated and the hip fell. The measurement results of McGill endurance test recorded in seconds (19).

Agility was assessed by Hexaganol Obstacle test (HOT) (17). The test was done with the aid of a hexagon drawn at the floor. Each side of the hexagon was 66 cm and the

angle of each corner was 120°. The participants started the test with both feet in the middle of the hexagon, with the frontal faces facing towards the front line. The participants jumped to the other side of the line with the 'Start' command, then went back to the middle point of the hexagon on the same line again. As feet and faces continued to look forward, they leaped to the other side of the side line and returned to the center of the hexagon. The participants continued this pattern until three rounds completed and were tested clockwise. The total test duration was recorded in seconds (20). The test was repeated twice and the best value was recorded.

Statistical Analyses

Statistical analysis was performed using SPSS version 22.0. Demographic data were presented as mean and standard deviation. The normal distribution fitness of the parameters was examined using histogram and probability plots and analytical methods (Kolmogorov-Smirnov / Shapiro-Wilk tests). The statistical significance for correlations were analyzed by Spearman correlation analysis. The statistical significance was accepted as 5%.

RESULTS

Demographic data of the all participants was showed in Table 1. According to the analysis made on basketball players; there was a moderate positive correlation between the HOT and the right postural stability anteroposterior index (r: 0.457, p<0.05, Table 2). There was a moderate negative correlation between the HOT and the LOS actual score (r:-0.437, p<0.05, Table 2). There was moderate negative correlation between the trunk extensor test and right postural stability mediolateral index (r: -0.468, p<0.05, Table 2). There was a moderate negative correlation between the side bridge test and the right postural stability mediolateral index (r: -0.501, p<0.05, Table 2). There was no correlation between the trunk flexion test and other parameters (p> 0.05, Table 2). In addition, there was no relation between HOT and core muscle endurance tests.

Table 1. The demographic characteristics of basketball players

	x±sd (n=21)
Age (years)	17.00±0.63
Height (cm)	186±7
Body Weight (kg)	78.69±9.22
BMI (kg/m²)	22.25±2.91

x±sd: mean ± standart deviation

Table 2. The correlation of postural stability, core muscle endurance, agility and anaerobic performance in basketball athletes

		HOT	RPSAP	RPSML	LPSAP	LOS
HOT	r	1	0.457*	-0.029	-0.103	-0.437*
	p		0.037	0.899	0.657	0.048
Flex	r	0.288	0.131	0.102	0.011	0.106
	p	0.320	0.572	0.658	0.963	0.646
Ext	r	-0.166	0.112	-0.468*	-0.193	0.232
	p	0.472	0.628	0.032	0.401	0.311
Side	r	-0.265	0.016	-0.501*	-0.124	0.315
	p	0.245	0.944	0.021	0.591	0.164

HOT: Hexagonal obstacle test, Flex: Flexion endurance test, Ext: Extansion endurance test, Side: Side bridge test, RPSAP: Right postural stability anteroposterior index, RPSML: Right postural stability mediolateral index, LPSAP: Left postural stability anteroposterior index, LOS: Limits of stability, *Statistically significant association (p<0.005)

DISCUSSION

According to the results of this research which was planned to show the relationship between postural stability, core muscle endurance and agility in basketball players, there was a correlation between postural stability and core muscle endurance. Also, it was shown a correlation between agility and postural stability.

Postural stability is crucial for maintaining body balance during locomotion, standing and any other activities that require a high degree of stability (21). There are many methods used to evaluate postural stability. In our study, postural stability was assessed using Biodex-Biosway™. This device has been shown to be valid and reliable when measuring the ability of the patient to balance on foam and/or firm surface (22). In the postural stability test, low scores indicate less deviation. Therefore, low scores indicate better postural stability than high scores. In the LOS, a low score of 'actual' means that the person's stability limit is reduced.

Agility can be defined as the ability to control and maintain the correct body position while rapidly changing direction during a series of movements. HOT is one of the field tests used to evaluate agility. ICC (Intraclass Correlation Coefficient) for this test is between 0.86 and 0.95, according to Reiman and Manske (23). Those who complete the HOT in less time are considered more agile. So, the athlete who decrease postural oscillations and increase balance ability can supply to better sudden direction changes in different directions.

Postural control has a significant role in many sports, and ability in postural control may identify successful performance (21, 24). The ability of the athlete to move his body quickly in different directions without losing trunk control requires good postural stability. It has been shown that balance can contribute to successful performance and play a major role in many athletic activities as well as sport-specific postural control (4, 5, 24). Prospective studies have shown that by enhancing balance and control of body positions during movement, agility theoretically should improve (4, 25, 26). When literature is looked, many studies have shown that the performances of athletes in different sports are related to postural stability. Sanborn et al emphasized in their work that balance skills are related to speed, agility and rhythm (27). Behm at al showed that balance ability is significantly related to rifle and arrow shooting accuracy and maximum skating speed in ice hockey (28). In the study performed by Okudur et al on tennis players, it was stated that the agility performance has a significant relationship with the total balance points of double leg posture, single leg posture and foam surface (29). Our study showed that the agility of those with good postural stability was better according to the relationship between the HOT and the right foot postural stability anteroposterior index. Also, it was shown that the agility of athletes who could take their body farther away in a controlled way was better according to the relationship between the HOT and LOS. An athlete with little postural oscillations will maintain the gravity center much better and respond quickly to sudden changes in direction. According to this result, it can be said that the agility of basketball players with better postural stability is also better.

The core stability minimizes the loads on the proximal joints while it activates body mechanisms that allow it to maximize its power in sports. The gains in strength and endurance of the core muscles is important in reducing disability as they maintain and stabilize the spinal segments during activity as well as against external forces (30). The relationship between core muscle endurance and postural stability was shown in many different studies (6, 31, 32). In 2009, Suri et al found moderate correlation between trunk muscle endurance and balance in their study in which they evaluated the relationship between endurance and balance of trunk muscles in the elderly (31). Ambegaonkar et al found an insignificant positive correlation between the side bridge test and balance in the study of female athletes. In this study, the balance was evaluated by the star excursion balance test and the correlation only between the posteromedial direction and the side bridge test was determined. These results were attributed to the activation of the lower extremity muscles in the star excursion balance test (32). In our study, we found that those with higher core muscle endurance had better postural stability of the dominant side. A strong core structure allows less postural oscillations through torcholumbar fascia. The athlete has better postural stability and balance. These results are consistent with the findings of Barati et al obtained from male students and the results of a comparison of core muscle endurance and static balance (6). Many scientific data on core exercises refer to similar findings (33, 34, 35). On the other hand, in another study by Ambegaonkar et al on dancers, they found no relationship between balance and core muscle endurance (36). Gordon et al also did not find any correlation between core endurance (as measured by the Bent Knee Lowering test) and balance (as measured by the SEBT) in female lacrosse players (37). These differences in the literature may be due to the reduced use of standardized and objective measurement methods.

In theory, it is accepted that core stability and performance are interrelated. But there is a inconsistency in the literature regarding this issue. In 2008, Nesser et al investigated the relationship between balance and agility in soccer players. They reported that there is a moderate negative correlation between pro-agility test and core muscle endurance test (38). Aytar et al showed that there is no relationship between balance and core endurance in amputee soccer player (39). In a study conducted in 2011, Sharrock et al investigated relationship between core stabilization and athletic performance in male and female collegiate athletes. They showed that there was no correlation was found core stability test and T test (40). Similarly in our study, there was no relationship between core stability and HOT.

This study has several limitations. Firstly, our study are low sample size. The other is that the population

of our research is done only on male athletes.

CONCLUSION

This study reveals that there is a relationship between postural stability, muscle endurance and agility in basketball players. It can be interpreted that the agility of the athletes who can take their body farther away in a controlled way is better. Moreover it can be considered that the postural stability of the athletes with high core muscle endurance is higher. Therefore, it is important to apply exercise programs that enhance postural stability and increase core muscle endurance to improve sportive success. It should be design exercise programs that improve endurance and subsequently balance as an integrated part in optimal performance of athletes.

Future studies, comparisons can be made by adding a control group. In addition, the research group core postural stability and muscle endurance exercise programs that increase be regarded by applying the chronic effects of exercise.

Competing interests: The authors declare that they have no competing interest.

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