

Relationship between Functional Movement Screen Tests with Static and Dynamic Balances in Male Adolescent Volleyball Players of Golestan Province

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Abstract

Introduction: Functional movement screen test is a valid test for evaluation of functional impairment and diagnosis of asymmetric motor patterns. The aim of this study was to investigate the relationship between (FMS) test and static and dynamic balances in adolescent volleyball players. **Materials and Methods:** This study was a correlational research which involved 30 male volleyball players in the Golestan Province League. The FMS tests include: (shoulder mobility, straight leg raise, Trunk Balance Push-Up, Rotary Balance, In-Line Lunge, Deep Squat, Hurdle Step). As a measurement tool for sport injury prevention and to evaluate static and dynamic balances, the Stork stand and Y balance test were used. **Results:** The results showed that there was a significant relationship between FMS test and dynamic balance ($R^2=36.24$, $R=0.602$, $P=0.001$) and static balance ($R^2=19.62$, $R=0.443$, $P=0.001$). **Conclusion:** Given the moderate relationship between variables, other performance tests such as balance tests to prevent sports injury and the athlete's return to exercise after the injury have been introduced. Selecting the appropriate test for athletes to prevent injuries by coaches and sports professionals are required and can be effective in reducing the cost of treatment and increasing exercise levels.

Keywords: Dynamic Balance, Functional Movement Screening, Static Balance, Volleyball

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Introduction

Among sports, volleyball is considered as a popular one, and on the other hand, it is of high-risk. Available documentation shows that the prevalence of injury in this sport is from 1.7 to 4.2 per 1000 hours of competition (1) and it is considered as the fourth sport of high-risk and vulnerability to injury (2). Ankle sprain is considered as the most common acute injury in volleyball (1). Rahnema *et al.* reported that lower limb injuries (joint ankle imbalance, lack of deep-feelings in joints, especially the ankle, etc.) not only threaten the health of players, but also waste millions of euros from national funds annually. Due to the high prevalence of injuries, a lot of cost is being imposed to teams in order to recover the health of affected players. Also, in some injuries, injured players may have to take rest for more than a month to recover, which is not economically viable in today's sport (3).

Maintaining balance is one of the most important daily problems in human life and is considered as an important motor skill in standing position (4). Balance is the process of maintaining the center of gravity of the body within the range of leaning surface (5, 6), which plays a vital role in the physical and mental health of individuals (7). Balance plays an important role in the field of sport; in some sports where rapid displacement with maximum balance is required, better balance plays a determining and crucial role in athlete's success (8) which is both statically and dynamically. Static balance is the ability of an individual to maintain leaning surface by performing the smallest movement whilst dynamic balance is the ability of an individual to perform an activity while maintaining a stable state. This ability is influenced by three major factors: sensory information (visual, atrial and optic

systems), motor range of joints and muscular strength. This ability is responsible for the correct and regular performance of exercise skills and prevention of injury to athletes (9).

Functional tests are a group of physical and skill tests that are used for purposes of determining the athlete's ability to attend to an interested level in a sport, career, recreational activity, or to return to activities in a safe and convenient time without any functional limitations. Determining the athlete's ability to move in all the three planes and assessing individual's true ability to function, may include endurance, strength, power, speed, agility, flexibility, and balance (10).

With regard to pre-season screening and related factors, Cook *et al.* introduced functional movement screen tests (11). This test consists of 7 movement tests which can identify the limitations and changes in normal motor patterns. These tests are designed to interact between the functional kinetic chain movement and the sustainability necessary to implement functional and essential motor patterns. The primary objective of the FMS tests is to evaluate the body kinetic chain system; as it is thought, all parts of the body are interconnected and sometimes act proximal to distal direction, rather than initiating the movements. FMS tests provide valuable information about balance and mobility and ultimately lead to accurate movements in individuals (12).

In most of the studies conducted in the field of functional testing, we have tried to examine the results of this test in specific sports groups and disciplines (13-16). For instance, in a study, this test was performed in a group of long-distance runners and the scores obtained were assessed in different age ranges and gender (13). Econor *et al.* (17) and Sorensen *et al.* (18) and Minnick *et al.* (14) and Gribble *et al.* (19), tried to examine the internal validity of this test to investigate the role of FMS test in preventing sports injury. Minnick *et al.* evaluated the internal FMS credibility in 40 athletes using 4 testers and reported excellent agreement among testers (14).

Some studies have also been conducted to compare the results of the FMS test with some physical fitness factors [Hartikaan (15), Okada *et al.* (20)]. In a dissertation study that examined the effect of 8 weeks of central balance exercises on the scores of screening tests for motor performance in male students, it was concluded that, except for shoulder mobility and active straight leg raise stretching tests, there is a significant difference compared to pretest and posttest of other tests. The findings of this study showed that central balance exercises were effective in improving screening scores; therefore, it could be used as a corrective and exercise modality to identify individuals susceptible to injury and to prepare athletes in order to minimize the risk of injury (21).

Parchman *et al.* compared the relationship between the performance test and the performance of athletes nationally, and they reported that these tests are not suitable for determining the ability and the elitism of golfers (16).

Also, in another study by Sohrabi *et al.* who examined the relationship between functional motor test and dynamic and static balance in female athlete students, it was concluded that there is a significant relationship between functional motor test and dynamic and static balance (22). Therefore, considering that in most functional tests, central body balance plays a deterministic role and high levels of balance in athletes can reduce the risk of sport injury, and so it could be used as a corrective and exercise modality to identify individuals susceptible to injury and to prepare athletes in order to minimize injury risk, hence, this study, unlike previous studies, examines the relationship between functional motor test and static and dynamic balance in adolescent volleyball athletes in order to investigate the correlation between variables.

Materials and Methods

Participants

This study was correlational, whose subjects were 30 male volleyball athletes in the city of Kalaleh in Golestan province, volunteering and available in the study. Prior to conducting any research, consent form was given to participants in the research and their personal information including age, height, weight, sports, and history of injury were collected. Inclusion criteria included similar age range, lack of neuromuscular defect, nonparticipation in other rehabilitation programs, and exclusion criteria included history of lower limb injury, neuromuscular defect, and participation in another rehabilitation program (23).

Methodology

Functional motor screening tests (shoulder mobility tests, actively and straight leg raise, testing trunk balance push-ups, rotary balance, in-line lunge, deep squat, obstacle stepping) were used as an evaluation tool in the prevention of sports injury; to assess dynamic balance, Y balance test was used and Stork test (standing on one leg) was used to evaluate static balance, whose implementation prevalence is shown below.

The evaluation methodology of functional motor test

Functional motor test includes seven tests of shoulder mobility tests, actively and straight leg raise, testing trunk balance push-ups, rotary balance, in-line lunge, deep squat, and obstacle stepping. After completing these seven tests, athletes obtain a

Table 1. Anthropometric characteristics of the participants in the study

Variables	Mean (SD)
Age (year)	16.54 (1.04)
Height (cm)	178.76 (8.54)
Weight (kg)	66.96 (8.45)
Body mass index (kg/m ²)	20.83 (2.16)
Dynamic balance	80.67 (11.08)
Static balance	62.44 (15.77)
Functional motor test	16.69 (1.47)

Table 2. Pearson correlation test results between functional motor test and dynamic and static balance

Variable	Functional Performance Test		
	P-value	R-value	R ² value
Dynamic balance	<0.001	0.602	36.24
Static balance	<0.001	0.443	19.62

P: Significance level; R: Correlation coefficient; R²: Coefficient of determination

score of the total of these seven tests, whose score is being calculated from 21. To register a score, each of the 7 tests must have 3 points. If the person made the right movement, he would get a score of 3 points. If the movement is accompanied by a compensatory movement, a score of 2 points is recorded for the individual, and if the person cannot completely fulfill the movement, a score of 1 is recorded for him. If the person feels pain during a movement, he earns 0 points (16).

This test was performed by two people who became familiar with the procedure before performing the test and then performed the test. It should be noted that in order to prevent the effect of learning on the result, subjects entered the evaluation site as 5-person groups and the test was performed (24). Each of the 7 tests was performed three times and the person's score was recorded on a score sheet.

The method of balance measurement by Y method

Polyski *et al.* reported the validity of the Y balance test for the lower extremities in the correlation coefficient of the testers as ICC=0.91-0.85 and in the correlation coefficient between tester as ICC=0.99-0.80. To test the Y dynamic balance, the subject with both the dominant leg and the non-dominant leg (single-legged) stood on the cross-section plain of the three directions, and, as far as he did not make a mistake (did not move his leg from the cross-section plain of the three directions; did not lean on the leg on which he was reaching with; or the person didn't fall), performed the reaching with another leg in the direction that the tester randomly set, through the movement of indicators and then he stood normally on both legs, and the distances that the tester moved the indicator were recorded as his reaching distance. After warming up and performing stretching for 180 s, subjects were

allowed to practice reaching directions on the device. Each subject then performed each of the directions three times, and 120 s of rest was given to them between each of the attempts, and finally, the distance of each the three directions were recorded (25). This distance was divided by the length of the leg (anterior superior iliac spine to internal ankle), then multiplied by 100, in order to achieve the reaching distance by percentage of leg length, and this number was the score of the subject (26).

The way of measuring the static balance by Strok method

To measure static balance, Strok balance test was used. The subject placed his hands on the waist, while his non-reliant foot was on inside the thigh of the reliant foot beside the knee, by keeping the position, leaned on foot sole as much as possible. During the test, the subject looked at the sign that was located in front of his face at a distance of 4 m. The time to maintain this position was recorded as his score. Each subject performed three attempts to record the best time as subject's score (27). Before measuring, the subject was first taught how to perform the test, after which each subject exercised the test three times and with a 15-second rest period so as to eliminate the effect of learning and warming up. When measuring, after the test condition was taken, as the subject lift his heel from the ground, using a timer, the tester recorded the time of standing on one foot until the moment this position was collapsed to a hundredth of a second (27).

Statistical methods

To statistically analyze the obtained data, descriptive statistics (mean and standard deviation) and inferential statistics (Pearson correlation coefficient) were used. All evaluations were also performed at the significance level of 0.05 and with SPSS version 24.

Results

The sample studied included 50 male adolescent volleyball players with a mean age of 16.56 ± 1.04 years, height of 178.76 ± 8.54 cm, and weight of 66.96 ± 8.45 kg and BMI of 20.83 ± 2.16 kg/m², functional test of 16.69 ± 1.47 , Y dynamic balance of 80.67 ± 11.08 and static balance of 62.44 ± 15.77 which are presented in Table 1. The results revealed that there is a correlation and significant relationship between functional motor test and dynamic balance ($R^2=36.24$, $R=0.602$), and also a correlation is obtained between the functional motor test and static balance ($R^2=19.62$, $R=0.443$) which showed a significant relationship with each other, which are presented in Tables 1 and 2 and Graphs 1 and 2.

Discussion

The results of this study showed that there is a significant relationship between the score of functional motor tests and dynamic balance test and static balance test. The dynamic balance test has a higher correlation with the functional motor tests than the static balance test, although its relationship is moderate, but it can be concluded that the higher the individual balance is, the higher the functional motor test, and vice versa.

The results of this study were consistent with Sohrabi *et al.*, who examined the relationship between functional screening tests with dynamic and static balance in female athlete students (22). Okada *et al.* compared this test to the performance of athletes and muscle strength of the central area of the body. In this study, it was pointed out that the assessment of the central area of the body is a static evaluation, while the functional motor test is a functional evaluation. Consequently, due to the low correlation between these two tests, the results of this study were not consistent with this study (20).

Hartikaan *et al.*, who examined the relationship between the score of the movement screening test of Launch's test with strength, speed, and balance, concluded that there was no significant relationship between any of these variables, which was not consistent with the results of this study (14). This study was also in line with the study by Saki who investigated the relationship between functional motor screening scores and chosen factors of physical fitness in taekwondo boys, and concluded that there was a significant relationship between physical fitness factors of flexibility, lower extremity strength with combined scores of motor screening tests (28). It should be noted that in all studies conducted in the field of functional motor test and its relationship, this evaluation of functional test components has been performed with physical fitness tests. Given that compensatory movements in sporting movements

can increase the risk of sports injury, other performance tests such as balance tests were introduced to prevent sports injury and the athlete's return to sport after the injury period.

Regarding the correlation between these two variables, this test can be used as an evaluation tool in preventing injury and return of athlete to sport, as well as other functional tests, and people with better balance will get better scores. One of the reasons for the relationship between functional motor tests and dynamic and static balance functional tests is that the static and dynamic balance tests performed in this study are identical in the implementation and application of muscles and joints with some components of functional motor tests. For instance, in the dynamic balance test, the positioning and application of the joints are very similar to those two functional tests (obstacle stepping test and launch test). The static balance test in body positioning is similar to that of deep squat. Tests and measurements are a prerequisite for the development of rehabilitation and training programs. A test is appropriate to well measure individual abilities. Because the body acts as a dynamic unit in daily life and sports activities, clinical evaluation of muscle strength and joint mobility alone cannot provide the information needed for functional evaluation of abilities and efficiency (29).

Conclusion

With regard to the significant relationship between the scores of functional motor tests and the dynamic balance test and the static balance test in adolescent volleyball players and the correlation between the variables, this choice of appropriate test seems necessary for athletes to prevent sport injury by coaches and sports professionals and it can reduce treatment costs and improve the level of exercise.

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