

Research Paper

## Can Upper Y Balance and Davis Test Predict Upper Quarter Injuries among Volleyball Players?

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Received: 2022/07/13

Accepted: 2022/09/08

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### Abstract

**Introduction:** Volleyball is one of the most popular sports in the world, but the volleyball injuries are so prevalent.

**Methodology:** One hundred and thirty two teenage boys' and girls' volleyball players with an average age of  $15.78 \pm 1.83$  who competed in the premier league of the province participated in this prospective study. Before the start of the season, the athletes were evaluated by upper Y Balance and DAVIS test and their scores were recorded. All players were followed up for 6 months and their injuries were recorded during this period. Additionally, the number of training and competition hours of the players was recorded prospectively.

**Results:** The results of the Cox regression test showed that there is a significant relationship between the overall score of the upper extremity Y test and the injury rate of volleyball players. An increase of one score in this test increases the incidence of injury by 1% ( $P < 0.05$ ) (95% confidence interval = 0.01-0.36, Hazard Ratio = 0.06). Further, the results didn't show a significant relationship and correlation between DEVIS test score and injury rate in volleyball players

**Conclusion:** The findings of this research show that Y upper quarter tests can predict the injuries of volleyball players. Therefore, it is recommended to the medical staff, coaches and managers to use these tests in pre-season evaluations to identify players at risk and implement preventive measures.

**Keywords:** Functional tests, Volleyball injuries, Functional movements, Volleyball players

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## Introduction

Today, volleyball is one of the most popular sports in the world. According to the statistics of the World Volleyball Federation, about 800 million individuals in the world play this sport. Although volleyball is one of the popular sports and considered as a championship one in the international arena and has a significant impact on the physical growth and development of the players, its negative effects cannot be ignored (McKeown & Ball, 2013). The recent research shows that volleyball is one of those sports that has the highest amount of injuries. The athlete's absence from daily programs and sports activities, psychological and social destructive consequences and exorbitant treatment costs are only part of the consequences that the injured athlete faces (Imwalle et al., 2009). This issue prompts professionals to use injury prevention programs to reduce injuries as much as possible (Stasinopoulos, 2004). According to past studies, the prevalence of injuries in volleyball is 1.7 to 2.4 injuries per thousand hours of play. The ratio of damage to the lower limb is higher compared to the upper limb (Bele et al., 2015). Among the ways to prevent injuries are identification of common injuries in sports and the risk factors and causes of those injuries (Hootman et al., 2007). For example, Zuzalek et al. (2013) found that inability to resist trunk contraction and delay in trunk repositioning after rest predicted future knee injury in female athletes. Additionally, these researchers showed that the delay in the relaxation of the trunk muscles increases the risk of injury in the back and thoracic spine, showing that when the movement and flexibility are not optimal in the athlete, the injury increases and the optimal performance is jeopardized. Therefore, pre-season screening of athletes and injury prevention can be very important (Stasinopoulos, 2004). Recently, researchers have found that movement quality is related to sports performance and injury risk. Therefore, tests such as Y balance and Davis, which evaluate performance and movements, can give us useful information about the risk of injuries. (Hootman et al., 2007). One of the functional tests used to predict damage is the Davis test. This test examines muscle strength and endurance and the stability of the closed kinetic chain of the upper limb. This swimming test is modified by Davis and Halfman. The reliability of the test-retest is reported as 0.92 (Mitchell et al., 2015).

Balance is one of the factors of physical fitness that plays an important role in the performance of sports skills and helps the athlete to maintain proper posture and achieve his goals. The Y test (semi-dynamic balance) is used for this purpose.

Although these tests have been of interest to researchers for many years, the results of these studies are not the same and in some cases it has been reported that the functional test could not predict the risk of injury. Among the conducted



studies, few studies have used multiple performance tests to evaluate performance. Therefore, the present study is designed to determine whether a set of functional tests can determine the risk of injury in volleyball players prone to injury or not. The researcher intends to identify injury-prone athletes with performance evaluations and examine the relationship between performance test scores and the incidence of injury in volleyball players and take a step towards diagnosing and predicting injury before it occurs.

### **Methodology**

The present study is prospective relational research. The research samples were selected through the convenience sampling technique. In this research, a statistical sample of 132 young and teenage volleyball players, 101 boys and 31 girls, with the age group between 13 and 20 years, participated. After recording their scores through performance tests, they were followed for 6 months and their injuries were recorded during this period. The present study intends to measure the ability of each of the 2 performance tests in predicting injuries of athletes.

### **Ethical considerations**

All the participants in this study completed the written consent form after being fully informed about the objectives, methods and benefits of this research. The personal information of the participants was collected confidentially.

The research inclusion were all athletes have 1.5-2.5 years of professional sports experience. Their age range is 13-20 years. In the last six months, none of them have had a history of injury. All of them have been active in volleyball for the past six months. All of them have 3 sessions per week and 2 hours of volleyball activity in each session, and not having a history of surgery in the past year.

The research exclusion was absence of more than 3 training sessions per month.

### **Instruments**

In this research, the Y kit tool and the Y and Davis score registration form as well as the athlete's profile registration form were used. One form was used to record athletes' injuries and another form was used to record their training hours. A tape measure was also used to measure the length of limbs with an accuracy of one tenth of a meter. Further, a Seka brand height meter and a GS brand digital scale made in Germany with an accuracy of 100 grams were used to measure height and weight.

### **Y dynamic balance assessment kit**

Dynamic balance measurement tool Y was used to evaluate dynamic balance. This kit includes a main center plate and three graduated plates. One plate is in the front and two other plates are at an angle of 135 degrees to the vertical plate.

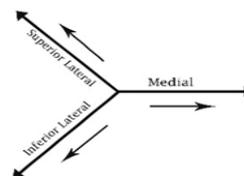


In order to participate in the present study, the subjects were first checked through the information registration form (age, height, weight, arm length, leg length and history of previous injury). During the test sessions, the examinees expressed their satisfaction with the test with a written consent form. In addition, in the first meeting, a written consent test was obtained from the coach and supervisor of the volleyball teams. The athletes were taught how to perform performance tests in a group, and finally, the athletes entered the tests after 5 minutes of warm-up and stretching exercises.

### Y test

Dynamic balance is the ability of a person to perform an activity while maintaining a stable posture (61).

**Upper body balance:** This test has a significant relationship with arm length. Therefore, the length of the hand was measured from C6 (The C6 spinal vertebra is part of the cervical spinal cord, located in the lowest region of the neck) to the tip of the third finger while the hands are open to the sides using a tape measure. The test kit was placed on the ground according to the figure. The subject is placed in the space between the front panel and the rear panel of the kit and in a position similar to push up on the floor. So that one hand is placed on the central screen of the kit and the other hand guides the moving screen to the farthest possible point on the graduated screen (62). In order to minimize the learning effect, each subject performed this test at least once, after that each person performed the test 3 times and his average in three measurements was recorded as the final score.



### How to perform the Y test and the direction of movement of the hands

#### *Davis test*

In performing the Davis test, two pieces of sports band were placed at a distance of 90 cm. The subjects were asked to swim in the space between the two bands, then cross their hands at full speed for 15 seconds. This task was repeated three times and the final score of the test was the average of three tests (7).





### **How to perform the Davis test**

After recording the test scores of each player, the researcher met with the players every week at a certain time and evaluated their physical conditions regularly for 6 months. In this way, every week, the information related to the health and injury of each player was recorded separately in a questionnaire called injury registration questionnaire. In cases of suspected injury, a practical evaluation was done in addition to registering the questionnaire. Another questionnaire under the title of recording the activity time of the players was also recorded every week by the researcher and with the help of the supervisor and coach of the team for all the teams so that the activity hours of the athletes are fully recorded every week. After six months of evaluating and monitoring the players, the amount of injuries that occurred in each player was checked.

To analyze the data, SPSS software version 23 and the Cox regression method were used.

### **Results**

#### **Demographic characteristics of the participants**

In this prospective study, the data of 132 players were analyzed. Table 1 shows the anthropometric variables such as age, height, weight, and body mass index of the subjects at the beginning of the study.



**Table 4-1 Anthropometric characteristics of the players participating in the study (mean ± standard deviation)**

Players	Variable
1.83± 15.78	Age(year)
7.07± 176.30	Height(cm)
6.18±67.56	Weight(kg)
1.63± 21.74	BMI

The results of the Cox regression test showed that there is a significant relationship between the score of the Y test in the inner direction of the right hand and the injury rate of volleyball players, so an increase of one score in this test in the inner direction reduces the injury rate by 4% (0.21-0.74, 95% confidence interval, 0.40 =Hazard Rati) (P<0.05).

Moreover, there is a significant relationship between the Y test score in the lower external direction of the right hand and the injury rate of volleyball players, so an increase of one score in this test in the lower external direction reduces the injury rate by 4% (68- 0.19-0.0, 95% confidence interval, 0.36 =Hazard Ratio)(P<0.05)

On the other hand, there is a significant relationship between the score of the Y test in the upper outer direction of the right hand and the incidence of injuries of volleyball players, so the increase of a score in this test in the superior external direction reduces the incidence of injury by 4% (0.19-0.68, 95% confidence interval, 0.36 =Hazard Ratio) (P<0.05)

Also, there is a significant relationship between the overall score of the right hand Y test and the injury rate of volleyball players. This means that reducing one score in this test increases the incidence of injury by 12 times (2.56-63.39, 95% confidence interval, 12.74 =Hazard Ratio). (P<0.05)

The results of the Cox regression test showed that there is a significant relationship between the score of the Y test in the inner direction of the left hand and the injury rate of volleyball players. Therefore, a decrease of one score in this test in the inner direction increases the injury rate 3 times (1/37-5/08, 95% confidence interval, 2/64=Hazard Ratio) (P<0.05)

Besides, there is a significant relationship between the score of the Y test in the lower external direction of the right hand and the injury rate of volleyball players. Therefore, reducing one score in this test in the lower external direction increases the incidence of injury 3 times (1.44-5.47, 95% confidence interval, 2.81 =Hazard Ratio) (P < 0.05)

On the other hand, there is a significant relationship between the score of the Y test in the upper outer direction of the right hand and the injury rate of volleyball players, so a decrease in this test score in the upper outer direction increases the



injury rate 3 times (1.54-54.83, 95% confidence interval, 3.00=Hazard Ratio (P<0.05)

However, there is a significant relationship between the overall score of the left hand Y test and the injury rate of volleyball players, this means that an increase of one score in this test increases the injury rate by 1% (36/36- 0.01-0, 95% confidence interval, 0.06=Hazard Ratio)(P<0.05)

The results of the Cox regression test showed that there is no significant relationship between the DEVIS test score and the injury rate in volleyball players (0.83-1.03, 95% confidence interval, 0.92 =Hazard Ratio)(P < 0.05)

## Conclusion

Dynamic movement testing during the pre-participation examination is gaining popularity as a component of musculoskeletal screening with the goal of identifying increased injury risk. Because of limitations of other testing procedures, the Upper Quarter Y Balance Test (YBT-UQ) was developed. The YBT-UQ is a tool that allows for the quantitative analysis of an athlete's ability to reach with the free hand while maintaining weight bearing on the contralateral upper limb. And the report of a study about reliability reveals that: Test-retest reliability ranged from 0.80 to 0.99 for the tests. Inter-rater reliability was 1.00 for all tests. The reach direction that produced the highest test-retest reliability was the superolateral direction (0.92–0.99), whereas the reach direction that produced the lowest test-retest reliability was the inferolateral direction (0.80–0.96). All tests of reliability were adequate based on the criteria defined a priori (Gorman et al., 2012).

The Davis test challenges the stability of upper limb strength and flexibility in the closed kinetic chain. The results of the Cox regression test showed that there is no significant relationship between the Davis test score and the injury rate in volleyball players. Among the studies that are different from the current research, we can mention Minunjad et al.'s research, which states that there is a positive and significant relationship between the score obtained from the functional movement screening test (FMS) and the Davis test (7). However, according to the result obtained from the Cox regression test in the present study, no significant relationship was observed between the DEVIS test score and the injury rate in volleyball players, . There are very limited studies related to the aforementioned functional test, so more studies are needed in this field.

The upper quarter Y-balance test (UQYBT) has been proposed as a CKC assessment of upper quarter mobility and stability using a functional testing device (Gorman et al., 2012). In this study, the result of cox regression showed that there is a significant relationship between overall score of left and right hands y balance test and upper quarters injury rate. However finally, there is a



need to expand normative data using the YBT-UQ on varied populations (e.g., professional, high school, youth athletes in multiple sports).

The findings of this study showed that the Y test is a valid tool for predicting upper limb injuries. Because volleyball players are always active in the muscles of the upper limbs and it seems that this test is also useful for the predicting of upper limb injuries. However, the results of this study cannot be attributed to non-athletes or sports such as football, which does not emphasize the muscles of the upper body, especially the shoulder. However, more studies are needed in this field. As a conclusion of this study, it is possible to refer to the pre-season screening of volleyball players as well as sports such as handball and basketball that have a lot of activity in the upper limbs. In this case, the athletes prone to upper limb injuries are identified and preventive measures can be taken before the occurrence of injuries.

### **Compliance with Research Ethical Guidelines**

The present study has done all the ethical considerations such as obtaining personal consent from the participants and parents as well as fully explaining the purpose and conditions of the study to all the participants

### **Authors' Contributions**

SH.S. Conceptualization, Designing Research, Data Analyzing, Interpreting the Data, Writing- Original draft preparation, Supervision. SH.S.: Conceptualization, Designing Research, Conducted Experiments, Data Recording, Interpreting the Data, Writing- Original Draft Preparation. M.H.: Conducted Experiments, Data Recording. SH.S. Writing- Reviewing and Editing. SH.S. Writing- Reviewing and Editing. M.H. prepared figures 1-16. All authors reviewed the manuscript.

### **Conflicts of Interest**

The authors have no conflicts of interest relevant to this article.

### **Acknowledgements**

The authors would like to thank all the volleyball players and coaches of the team who helped us in the implementation of this research.

The results of the present study do not constitute endorsement of the product by the authors or the National Strength and Conditioning Association. No funding was received for this work from any organization.

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