



Videographical Analysis of Arm Swing on Spike Jump Performance of Two Different Functional Classes' Volleyball Players

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Abstract:

With the aim to determine the differences between intervarsity and intercollegiate male volleyball players in their arm swing of spike jump performance the present study was undertaken. Fourteen (8 Intersvarsity and 6 Intercollegiate level) male volleyball players were selected from Aligarh, India, as subjects for this study. All subjects in this study were right-handed. For acquiring two-dimensional biomechanical data, each subject was asked to warm-up for at least 15 minutes by stretching all major muscle groups for jump performance and practicing several normal spike jumps. After the warm-up each subjects was asked to perform volleyball spike jump. A setter was used to set the ball for volleyball spikers. Each player spikes 3 times and each repetition was recorded. There were breaks of 2-3 minutes between each spike movement. Two-dimensional coordinate data from one side of the body were obtained with a high speed Canon Legria HF S10 camcorder operating at 1/2000 with a frame rate of 60 frames per second. Data were collected from the movement onset until the peak of the spike jump. The camcorder was placed on a tripod at the height of 5 feet on the right angle i.e. perpendicular to the centre-line at a distance of 10 meters away to the side-line. Coordinate data were

digitized with the help of Silicon Coach Pro7 motion analysis software. The kinematic variables for this were taken as the jump height (JH), range of motion (RoM), angular velocity (AV), hyperextension joint angle at shoulder joint (HJASJ) and duration of arm swing (DAS). The one tailed t-test was used for statistical analysis of the data. Results of study indicated that there is a significant difference between intervarsity and intercollegiate level male volleyball players in their volleyball spike jump performance.

Key words: Volleyball, arm swing, spike jump, intervarsity, intercollegiate

Introduction

Amendments of rules completely change the structure of modern volleyball game and make attack (spiking) the main tactic to score (Mondal & Bhowmick 2013). In spiking the height of hand and ball is a relevant parameter for success (Tillman, Haas, Brunt & Bennett 2004). A higher ball impact location allows more possibilities for technical and tactical variation. When the spiking ball reaches the height at which a volleyball player is able to jump, this is of great concern from the mechanics point of view. Success in attack is more likely to depend on the higher jumping ability of the player because increasing the jump will increase the area of opposition court open to the attacker (Hussain, Khan & Mohammad 2011; Enoka 1971) and it also increases the time during which attack is possible (Baudin 1980). Therefore, the optimization of jump height is in the focus of research. In the literature, coherencies between different parameters of lower limb to the jump height were analyzed (Wagner, Tilp, Duvillard, & Mueller 2009; Tilp, Wagner & Muller 2008; Kensaku et al. 1999; Coleman, Benham, & Northcott 1993; Coutts 1982). Several studies showed that arm swing has a significant influence on jump height (Wagner et al. 2009; Moore et al. 2007; Baudin 1980). These studies indicated that an arm swing increases the

angular velocity and torque at lower extremity joints, the centre of mass height, and velocity at takeoff for a countermovement jump (Benedicte et al. 2010; Kensaku et al., 1999). Additionally, Hsieh and Heise (2006) found that arm swing was one of the most important factors which contributed to volleyball spike jump height. These studies examined the effect of arm swing on jump height, while few of them have examined the performance of the arm swing in different skill level players (Endo & Masumura 2007; Ridgway & Hamilton 1991; Marquez, Masumura & Ae 2005). Additionally, the volleyball coaching texts adequately explain the importance of arm swing for the volleyball spike jump. The reason for one player's ability to perform a volleyball spike jump more successfully than another is not generally obvious. The complexity of this skill demands the isolation of component variables which must then be evaluated as to (a) their contribution to the resulting jump and (b) the importance of this contribution.

Thus, this study was designed to examine the arm swing which influences the volleyball spike jump performance, on selected kinematic factors at intervarsity and intercollegiate level male volleyball players.

Methods and materials

Participants

A total of fourteen (8 Intervarsity and 6 Intercollegiate level) male volleyball players were taken as subjects for the study from Aligarh, a district of Uttar Pradesh, India. The intervarsity player's mean age, height and body weight were recorded as 22.5 years (± 2.14), 177.50 cm (± 5.61) and 69.50 kg (± 9.21), respectively, whereas intercollegiate players' mean age, height and body weight were recorded as 18.33 years (± 1.71), 166.5 cm (± 3.30) and 57.17 kg (± 7.93), respectively. All subjects in this study were right-handed volleyball players

(spikers). They all were healthy and did not have any injury reported within the last year.

Apparatus and Equipment used for the Study

One Canon Legria HF S10 camcorder with tripod, measuring tap, portable weighing machine, Silicon Coach Pro7 motion analysis software, SPSS-16 software and volleyball were used in this investigation.

Procedure of Data Acquisition

To obtain two-dimensional videographical data a high speed Canon Legria HF S10 camcorder operating at shutter speed of 1/2000, with a frame rate of 60 frames per second was used. The camcorder was placed on a tripod at the height of 5 feet on the right angle i.e. perpendicular to the side-line at a distance of 13 meters away from the point of jump (see Figure 1). Prior to acquiring data each subject was asked to warm-up for at least 15 minutes by stretching all major muscle groups for performance and practicing several normal spike jumps. After the warm-up subjects were asked to perform volleyball spike jump. A setter was used to set the ball for spike. Every player spikes at an interval of 2-3 minutes and their performance was recorded. Data were collected from the onset of movement until the peak of the spike jump. Recorded data were downloaded in computer and coordinate data were digitized with the help of Silicon Coach Pro7 motion analysis software. The variables for this study were taken as the jump height (JH), range of motion (RoM), angular velocity (AV), hyperextension joint angle at shoulder joint (HJASJ), and duration of arm swing (DAS).

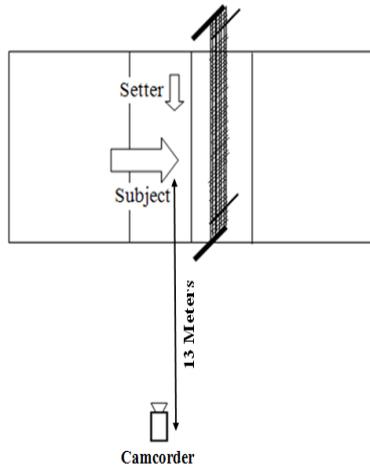


Figure 1: Experimental setup showing of subject, setter and camcorder position

Statistical Analysis

To infer any endeavour there is a requirement of an appropriate statistical treatment. In this study a t test was used to analyze the data and to infer the difference between intervarsity and intercollegiate male volleyball players.

Results

Results of any practice or exercise are important since a result of any endeavour (scientific investigation) tells us what is the truth or fact regarding any practice or exercise. The results of this investigation are presented in the preceding table.

Table 1: Indicating mean, SD, mean differences (MD) and calculated t of biomechanical variables of arm swing performance between two different functional classes male volleyball players.

Variables	Intervarsity Players		Intercollegiate Players		MD	Cal. t
	Mean	SD	Mean	SD		
JH	0.66 m	± 0.09m	0.47 m	± 0.06 cm	0.19 m	2.85*
RoM	234.88°	± 27.03°	167.33°	± 28.35°	66.55°	3.13*

AV	460.00°	± 53.30°	361.83°	± 81.15°	98.17°	5.85*
HJASJ	102.00°	± 24.05°	71.33°	± 25.01°	30.67°	4.44*
DAS	0.30 sec	± 0.05 sec	0.21 sec	± 0.05 sec	0.09 sec	4.75*

*Significant at 0.05 level of significance with 12 df

Tab. t = 1.78

The results of statistical analysis of arm swing variables' viz. jump height (JH), range of motion (RoM), angular velocity (AV), hyperextension joint angle at shoulder joint (HJASJ) and duration of arm swing (DAS), between intervarsity and intercollegiate level male volleyball players revealed that there is a statistical significance difference between all the variables considered (For JH the cal. t was 2.85, for RoM the cal. t was 3.13, for AV the cal. t was 5.85, for HJASJ the cal. t was 4.44 and for DAS the cal. t was 4.75 reported). All the calculated t concerning selected variable of arm swing was found more than tabulated t (1.78) at 0.05 level of confidence with 12 degree of freedom, which shows significant differences between both experimental groups.

Figure 3: Illustration showing the mean difference of jump height between intervarsity and intercollegiate male volleyball players

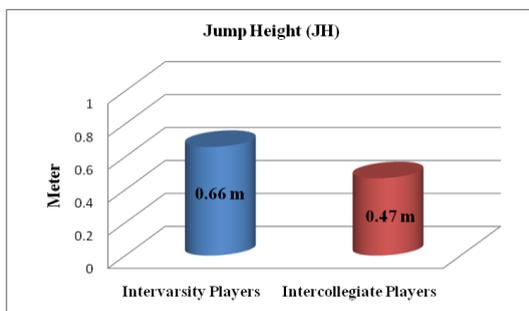


Figure 4: Illustration showing the mean difference of range of motion between intervarsity and intercollegiate male volleyball players

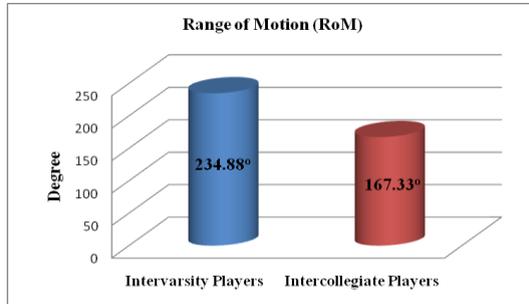


Figure 5: Illustration showing the mean difference of angular velocity between intervarsity and intercollegiate male volleyball players

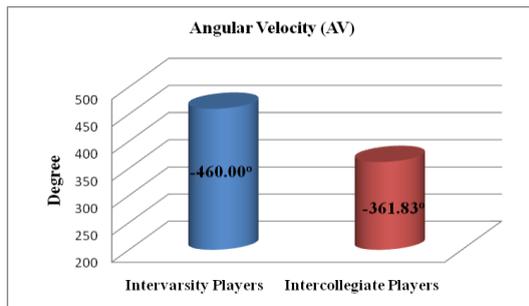


Figure 6: Illustration showing the mean difference of hyperextension joint angle at shoulder joint between intervarsity and intercollegiate male volleyball players

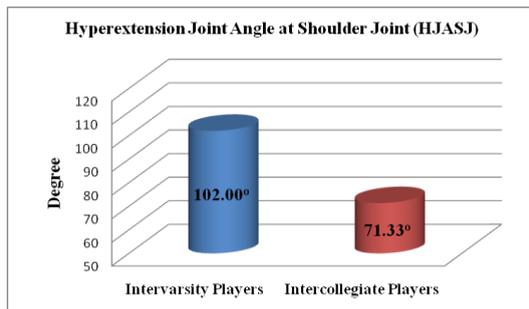
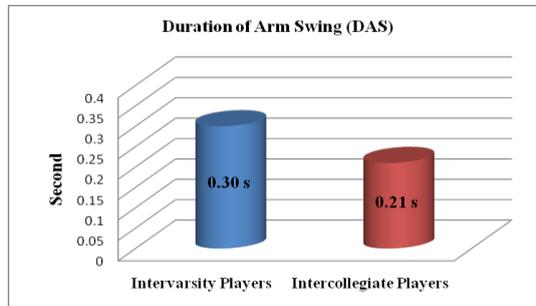


Figure 7: Illustration showing the mean difference of coordination between intervarsity and intercollegiate male volleyball players



Discussion

A successful volleyball spike jump performance demands different factors concerning spike jump. An appropriate amount of concerning factors or we can say balanced combination of those variables results in optimum performance level. Arm swing of spike jump was taken into account as one of these variables (Romer & Kuhlmann 2008; Hsieh & Heise 2006).

Results of this study indicated that intervarsity level volleyball players have better level of spike jump performance in comparison with intercollegiate level. The findings of the study supported by the contemporary investigators as Hussain, Mohammad and Khan (2011) investigated kinematic factors and volleyball spike jump performance of two national and state level male volleyball players and reported insignificant difference. In a different study Hsieh and Heise (2008) investigated the arm swing of volleyball spike jump performance between advanced and recreational female players and found advanced players performed significantly higher than recreation players. Marquez, Masumura and Ae (2005) biomechanically analyzed the spike motion of average, top and lower skill levels groups of male volleyball players and reported in their findings that top skill level players exhibited better

spike motion in comparison with other two skill level groups players. Ridgway and Hamilton (1991) in their study examine the spiking technique of elite and recreational female volleyball players and found that spiking technique of elite volleyball players were far better than intercollegiate volleyball players.

The results of the study further verify that the jump height, which is an influential variable of spike jump performance, was much higher in the intervarsity level volleyball players in comparison with intercollegiate level volleyball players. The reason might be the arm swing which is a requisite to enhance the jump height, this being reported as higher in the intervarsity level volleyball players, which automatically increase the range of motion as well as angular velocity. One of the main reasons for a significant difference between intervarsity and intercollegiate level volleyball players in their arm swing performance is the higher hyperextension of joint angle at shoulder joint which results in the increase of duration of arm swing as when the duration of arm swing increase is provided higher range of motion as well as angular velocity, which increases the spike jump performance.

During the approach phase, intervarsity players brought the arm back farther and earlier prior to the impact of both feet when compared to intercollegiate players. This process assists the arm to store and release the energy from the muscle and tendon at lower extremities, meanwhile helping the trunk to move upward (Hsieh & Heise 2006). That is, the increased range of motion for the arm swing in addition to the earlier time of initiation allowed the arm to generate more energy, which is transferred to various body parts to improve vertical jump performance (Li-Fang & Gin-Chang 2008). The use of arms was found to increase the jump height of the intervarsity level male volleyball players significantly more than that of intercollegiate level players. The differences are swings in jumping movements, which affect intervarsity and

intercollegiate players differently. The greater increase in arm swings in jump height for higher level players could be because of greater upper body strength compared to lower level players (Benedicte et al. 2010; Moore et al. 2007).

Conclusions

On the basis of the results obtained from the present empirical investigation the following conclusions can be drawn:

- The volleyball player should put more emphasis on the greater range of arm swing, which increases the jump height for spiking performance.
- The player should increase the speed (faster) of the arm swing which would improve their spike performance.
- Increase in shoulder hyperextension joint angle at earlier onset of arm swings enhances the duration of arm swing which optimizes the ball velocity.

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