ISSN: 2349 - 4891

International
Journal of Recent Research and Applied Studies

Biomechanics Investigation of Spiking in Volleyball

Dr.K.Rajendran

Assistant Professor, Department of Physical Education and Sports Sciences, Annamalai University, Chidambaram, Tamilnadu, India.

Received 30th June 2014, Accepted 25th July 2014

Abstract

The purpose of this study was to identify, analyze and compare the kinematic parameters involved in short set and high set front row spike in volleyball. Eight interuniversity male volleyball players participated in this study as subjects. Spiking action was filmed by a digital video camera operated at 24fps. Power DVD software was used to analyze the selected kinematic parameters of the recorded movements. The results indicated that the short set front row spike had a greater approach speed and shorter spike time than that of high set front row spike. The high set front row spike, on the other hand, had a greater mean values for approach length, vertical velocity, rising of Cg. and ball impact height than those of short set front row spike

Keywords: Volleyball, Front Row Spike, Kinematic.

Introduction

Volleyball is one of the most popular games of the world. The game has a number of fundamental techniques of which the spike is one of the most difficult to master but demanding for high performance. The athlete is expected to jump and hit the ball with maximum force and accuracy at the approximate peak of the jump. Analysis of this technique has become the focus of attention of biomechanical research for last a few decades. **Prsala (1982)** identified four phases of the spike technique: the approach, preparation, hitting, and landing. The approach involves two or three controlled running strides, a transitional last step to prepare for the transfer of horizontal momentum to vertical momentum, and a double footed vertical jump. In the preparatory phase, the striking arm is swung upward in an abducted and laterally rotated position. The elbow is flexed at approximately 90 degrees and the wrist is hyper-extended. During hitting phase, the shoulder is elevated; the upper arm is inwardly rotated and adducted; the forearm is extended at the elbow and the wrist is flexed. The athlete absorbs the downward momentum by flexing the joints of the lower extremities when landing. **Coleman et al. (1993)** studied on ten male international male volleyball players who spiked the ball in the front row at the 1991 World Students Games. They reported the mean vertical velocity of the centre of mass (COM) at take off was 3.59 m/s and height of the jump was 0.62m. **Saunder (1980)** studied the effects of approach speed on one and two-foot vertical jump performances. He found that vertical velocities of two-foot jump peaked when the approach speed was up to 50-60 % of maximum sprint speed and the vertical velocities of one-foot jumps were up to 60-70 % of maximum sprint speed. It is important to understand the mechanical factors, which contribute to the successful spiking action. The purpose of this study was to analyze the selected kinematic factors - length of approach, approach speed, vertical velocity at take off, angle of COM at take off, spike height and spiking time in front row spike performed by male volleyball players.

Correspondence
Dr.K.Rajendran,
E-mail: drkr978@gmail.com, Ph: +9194436 51364

Methods

The purpose of this study was to identify, analyze and compare the kinematic parameters involved in short set and high set front row spike in volleyball. Eight interuniversity male volleyball players participated in this study as subjects. Spiking action was filmed by a digital video camera operated at 24fps. Eight university level male volleyball players representing Annamalai and Periyar universities at south zone Inter- University Volleyball tournaments were selected as subjects for the present study. All statistical analysis was calculated by the SPSS statistical package. The results are reported as mean and standard deviations (SD). The collected data was evaluated using t test. The $p < 0.05$ was considered as statistically significant.

Results

The data collected prior to and after the experimental periods were analysed and presented in the following tables.

Table I. Mean age, height and weight of the subjects (n=8)

parameter	minimum	maximum	mean±sd
Age (year (kg)s)	19.00	25.00	22.00± 2.00
Height (cm)	185.00	170.00	178.00 ± .04
Weight	58.70	79.18	65.09 ± 6.83

The front row spiking action of the subjects was filmed by a video camera operated at 24fps. Each subject performed five front row spikes for short and high set ball. Experimental set up has been shown in Figure-1. Only the successful spiking action was analyzed to measure the selected kinematic parameters with the help of appropriate software. Approach length, speed of approach, vertical velocity attack off for spiking, lifting of cg., vertical height achieved for spiking and the duration of flight were the selected kinematic parameters for analysis.

Figure I. Experimental Set Up

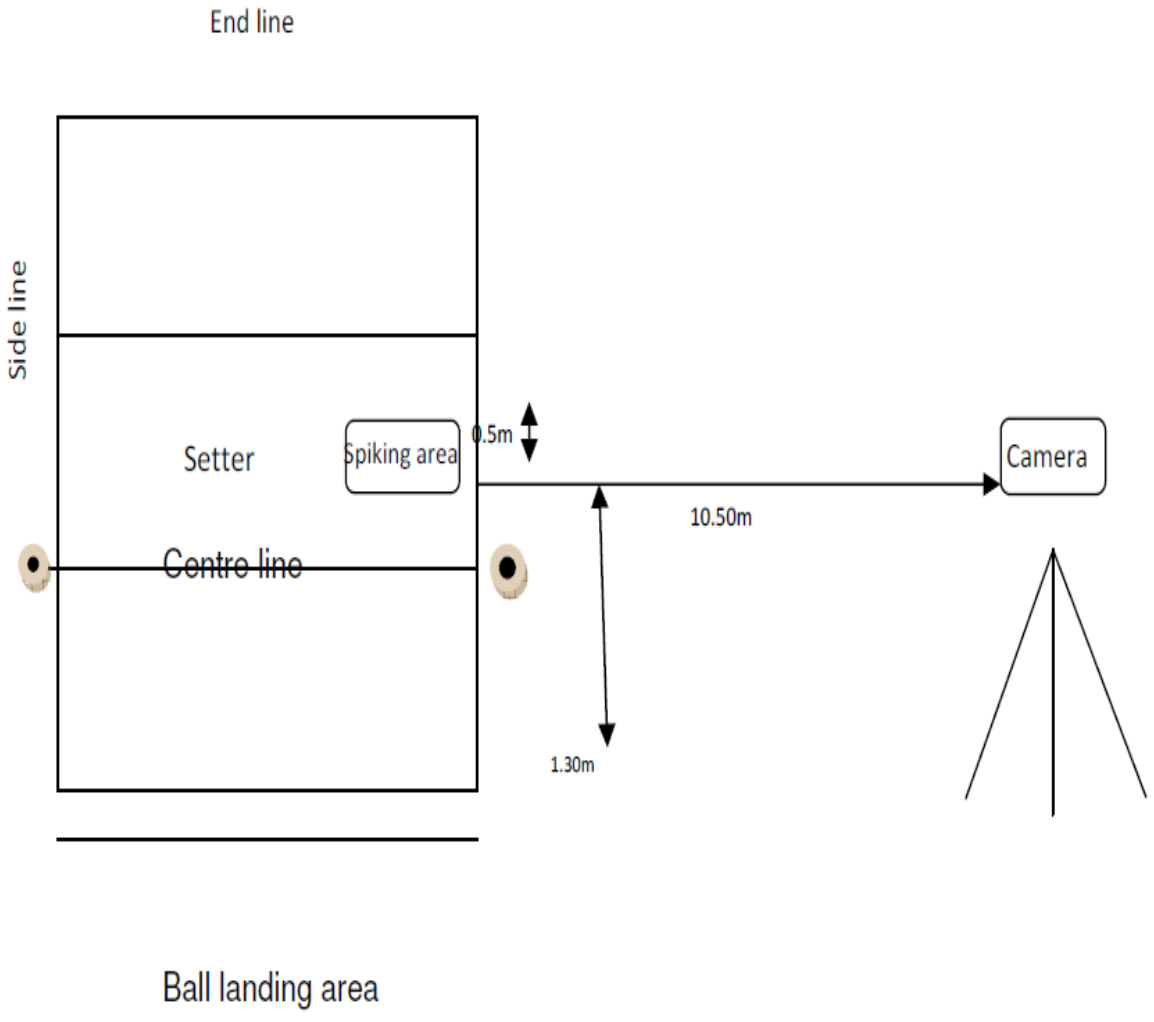

Table II. Selected kinematic parameters for front row spike

Subject	Spike	Approach Length(m)	Approach Speed(m/s)	Vertical Velocity(m/s)	SpikeTime (s)	Raisingof Cg. (m)	Greatest Height(m)
1	Short	3.12	3.94	2.16	0.34	1.22	3.74
	High	3.50	3.36	2.88	0.34	1.42	3.85
2	Short	3.17	3.45	3.60	0.35	1.05	3.45
	High	4.32	3.70	2.16	0.35	1.38	3.51
3	Short	3.85	4.01	2.16	0.34	1.26	3.99
	High	4.14	3.01	2.16	0.36	1.41	4.08
4	Short	3.35	3.65	3.60	0.29	1.05	3.69
	High	3.75	3.57	4.32	0.34	1.60	3.84
5	Short	3.38	4.05	3.60	0.29	1.38	3.75
	High	4.45	4.64	4.76	0.35	1.32	3.87
6	Short	3.03	3.16	4.32	0.29	1.20	3.69
	High	3.70	2.48	5.04	0.35	1.20	3.90
7	Short	3.15	3.02	4.32	0.35	0.99	3.75
	High	3.73	2.48	3.60	0.36	1.38	3.96
8	Short	3.56	3.56	2.88	0.32	1.32	3.72
	High	3.40	2.26	4.32	0.35	1.46	3.84

Table III. Testing significance of difference between short set and high set front row spike

	Short Set Spike (N=8)		High Set Spike (N=8)		Calculated "t"-Value	P value	Remarks
	Mean	S.D	Mean	S.D			
Approach Length(m)	3.36	±0.32	3.88	±0.38	2.86	0.024	Significant
Speed of Approach(m/s)	3.60	±0.39	3.19	±0.79	1.87	0.104	Not Significant
Take of Velocity(m/s)	3.33	±0.86	3.66	±1.14	0.93	0.379	Not Significant
Spiking Time(s)	0.32	±0.03	0.35	±0.01	3.21	0.014	Significant
Raising of Cg.(m)	1.18	±0.14	1.40	±0.11	2.96	0.021	Significant
Greatest Height Reached(m)	3.72	±0.15	3.85	±0.16	7.04	0.000	Significant

Required value for being significant – 0.05 = 2.36 and 0.01 = 3.50

From table -III values it is clearly seen that the difference in mean values between two types of spiking was statistically significant for approach run, spiking time, raising of cg and the vertical height achieved during spiking only. The mean difference was not statistically significant for speed of approach and take-off velocity. Difference in approach run might be due to the fact that greater approach run was required for increasing the vertical reaction force from the ground to achieve higher vertical velocity for high set ball. It is clearly noted that there was differences in mean values of speed of approach for short and high set ball spiking but this difference was not statistically significant.

This result was perhaps due to the fact that in this case the length of approach was considerably small in the case of spiking. The vertical velocity was greater for high set ball spike than that for short set ball spike. The mean vertical velocity for front row spiking was 3.49m/s which is similar to the values reported by Samson and Roy (1976) with 3.5m/s and Colemal et al. (1993) with 3.59m/s. For high set ball front row spike greater raising of Cg was perhaps because of the fact that the ball was set more than 4ft. above the net for spiking high set ball. In order to get the ball and to spike it forcefully, the spikers had to achieve the greater vertical height than the short set ball spiking.

The achieved vertical height was more for high set ball spike than the short set ball spike. Similar results have been reported by other leading researchers. The mean vertical height for front row spiking in this study

was 3.78m and the ball impact height for the front row spiking was 3.28m as reported by Masanao Masumura et al. (2007). The short set ball spike had a shorter spike time than that of the high set ball front row spike. The mean spike time for front row spiking was 335ms which was very similar to the value reported by Chenfu Huang et al. (1999) as 342ms for one foot spike and 403ms for two foot spike.

Conclusion

On the basis of the results obtained in the present study, the following conclusions were drawn:

1. The short set front row spike involves a greater approach speed and a shorter spike time than those of high set front row spike.
2. The high set front row spike has a greater rising of Cg. than that of short set front row spike.
3. The high set front row spike has a greater vertical velocity and ball impact height than short set front row spike.

References

1. Bunn, J.W: Scientific principles of coaching, 2nd Ed. Englewood Cliffs, New Jersey Prentice Hall, Inc.,1973
2. Samson. J. and Roy, B. (1976). Biomechanical analysis of the volleyball spike. In Biomechanics V-B (edited by P. Komi), pp.332-336. Baltimore, MD. : University Park Press.
3. Dyson, G.H.G (1977). The Mechanics of Athletes (7th ed.). New York, New York: Holmes & Meier.
4. Saunder, H. L. (1980). A cinematographically study of the relationship between speed of movement and available force. Unpublished doctoral dissertation, Texas A & M University, College Station.
5. Hay, J.G, Reid, J.G (1982). The Anatomical and Mechanical Bases of Human Motion. Englewood Cliffs Nz: Prentice-Hall,
6. Prsala, J. (1982). Improve your spiking in volleyball. Volleyball Technical Journal, 7 (2), 57-64.
7. Coleman, S., Benham, A., Northcott, S. (1993). A Three-Dimensional Cinematographical Analysis of the Volleyball Spike. Journal of Sports Sciences 1 1, 259-302.
8. Hay, J.G, Reid, J.G (1982). The Anatomical and Mechanical Bases of Human Motion. Englewood Cliffs Nz: Prentice-Hall,
9. Prsala, J. (1982). Improve your spiking in volleyball. Volleyball Technical Journal, 7 (2), 57-64.
10. Coleman, S., Benham, A., Northcott, S. (1993). A Three-Dimensional Cinematographical Analysis of the Volleyball Spike. Journal of Sports Sciences 1 1, 259-302.
11. Coleman, S. (1997). A 3D kinematic analysis of the volleyball jump serves. Proceedings of the XV International Symposium on Biomechanics in Sports. Denton, Texas Women University, Texas, USA.
12. Huang, C. F., Liu, G. C., & Sheu, T. Y. (1999). Kinematic analysis of the volleyball back row jump spike. In R. H. Sanders & B. J. Gibson (Eds.), Proceedings of the XVII International Symposium on Biomechanics in Sports (pp.49-52). Perth, Australia: Edith Cowan University.