TEMPORAL STRUCTURE OF A LEFT-HAND TOSS VS. A RIGHT-HAND TOSS OF THE VOLLEYBALL JUMP SERVE

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The volleyball jump serve has emerged as an offensive attack skill when used effectively during a game. The player who jump serves can produce greater velocities, decrease trajectory angles, and diminish the time for receivers to react (Strohmeyer, 1991). The jump server utilizes a high toss, modified four step approach, plant phase. armswing, ball contact, and landing similar to a spike but moving horizontally onto the court rather than vertically near the net. Because of the technique, timing and accuracy problems occur more frequently during the jump serve than during a conventional overhand serve.

Despite very little research on the jump serve, the toss of the ball and timing of the jump have been identified as important parameters for a successful serve. Strohmeyer (1991) suggested that the toss for the serve should be with one hand to keep all forces acting in the intended direction of flight However, as observed with elite volleyball players, the toss has been made with the hitting hand, non-hitting hand, and both hands.

The purposes of this study were to investigate the temporal structure of a left-hand toss versus a right-hand toss volleyball jump serve, and to determine the practical application of the jump serve during a volleyball match.

METHODOLOGY

Two Division I female intercollegiate volleyball players served as subjects for this investigation. Subjects were filmed from the sagittal view with a video camera set at 1/1000 shutter speed. Each subject performed 3 jump serves with tosses from each hand after sufficient warm-up. Videorecords were digitized with a Logitech mouse interfaced to a 386 PC microcomputer and video cassette recorder operating at 60 Hz. Spatial x,y coordinates of 18 points were analyzed and the raw data smoothed with a Butterworth second-order low-pass digital filter set at 10 Hz (Noble, Zollman, & Yu. 1988).

Kinematic parameters of displacements, velocities, and accelerations as well as the temporal parameters of timing delays and shared positive contributions between adjacent segments were investigated to determine segmental interactions. Segmental absolute angles were determined for the trunk(TR), upper arm(UA), forearm(FA), and hand(HN) on both sides of the body (see Figure 1).

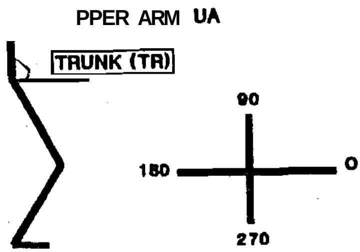

Figure 1. Segmental angles

RESULTS

Because of the limited number of subjects and trials, descriptive statistics and trends in the data were evaluated for practical applications. Resultant ball velocities were 17.5 m/s (+ 1.0) and 17.0 m/s (+ 2.1) for theright-hand toss (RT) and the left-hand toss (LT), respectively. An increased toss time of 0.68 s (RT) compared to 0.56 s (LT) was observed, however, total time was similar, 1.66 s (RT) and 1.62 s (LT).

Increased range of motion for both the hitting and non-hitting arms was identified during the RT (see Table 1). Because a three-dimensional motion was filmed in two-dimensional space, perspective error could have influenced the angles measured during the motion. Maximum angular velocities(MAV) of both the hitting and non-hitting arm segments were greater for the RT (see Figure 2). The time each segment reached MAV was 1.1, 1.14, 1.32, and 1.56 seconds for the TR, UA, FA, and HN of the right-hand toss. With a LT the times were shorter with 0.9, 1.10, 1.24, and 1.40 seconds for the TR, UA. FA, and HN, respectively.

Timing delays and percentages of shared positive contributions (Hudson. 1986) between adjacent segments indicated a simultaneous forward swing of the non-hitting arm and a proximal to distal sequential pattern for the hitting arm (see Figure 3). During the RT, greater overlap occurred between the TR/UA and less overlap occurred between

Table 1
Range of Motion (° ± SD)

	RT		LT	
	Right-side	Left-side	Right-side	Left-side
TR	51 (2.5)	50 (1.7)	54 (3.9)	60 (4.3)
UA	108 (3.8)	39 (2.6)	91 (4.1)	35 (3.2)
FA	73 (1.6)	18 (2.4)	70 (2.1)	27 (2.8)
HN	81 (2.7)	13 (1.4)	70 (3.4)	5 (1.1)

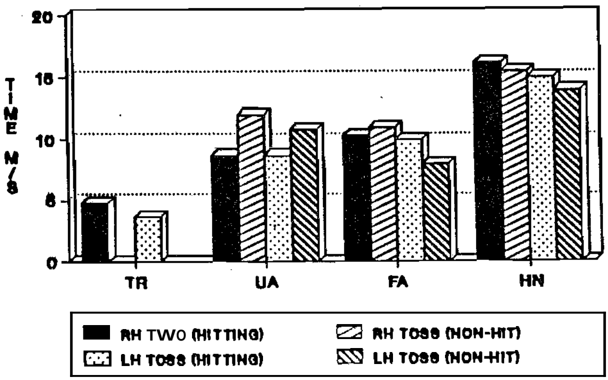

Figure 2. Maximum angular velocities

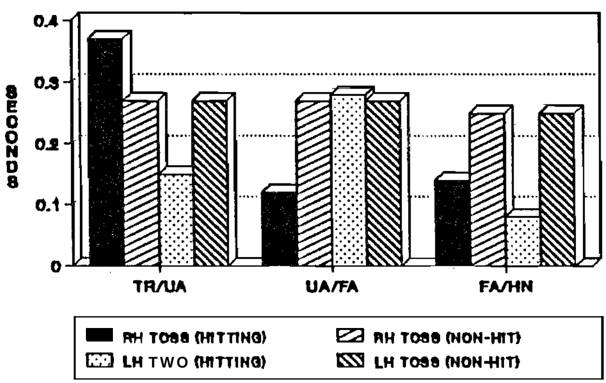

Figure 3. Segmental overlaps

the UA/FA of the hitting arm. However, less overlap between the TR/UA and greater overlap between the UA/FA of the hitting arm was noticed with a LT. Overlap between the FA/HN of the hitting arm was comparable between the tosses.

DISCUSSION

During the jump serve the performer attempts to develop high speed with accuracy at the end of the hitting arm. Additionally, the performer adds a horizontal component with the total body onto the court creating a greater force without necessarily increasing the armswing velocity.

The results of this study seem to indicate that a RT for these subjects, or same hand as hitting arm toss, produced maximum benefits. A RT jump serve utilized increased range of motion of the hitting arm and greater overlap of the TR/UA. These actions use a longer lever arm and greater mass to create optimum velocity at the hand. The performer appeared to contact the ball at the peak height of the jump with a RT, but on the way down of a LT.

Because a simultaneous pattern was demonstrated by the non-hitting arm, regardless of tossing hand, a ball tossed from the non-hitting hand seemed to affect the use of the segments in producing maximum velocity at the end of the segment. Less overlap should aid in increasing velocity at the end of the segment. The subjects in this study were familiar with the same hand as hitting arm toss (RT), therefore, the results may have been influenced by playing preference. Additionally, the rotation at the trunk and shoulder was not determined. Obtaining this information would be valuable in the determination of the temporal structure of the jump serve.

CONCLUSIONS

As a coach/teacher the jump serve seems to be a natural progression from the spike. Wedaman, Tant and Wilkerson (1988) found a sequential pattern of the hitting arm for good performers during the spiking motion. However, no research exists as to the comparisons of the two techniques. The hand from which the ball should be tossed slightly favors the same hand as hitting arm for the subjects of this study. This might reduce the concern for tossing the ball across the body while initiating a vertical jump. Because this skill is new to the sport, it appears that the technique could be learned at an early age. The performer's ability level, strength, and flexibility would be important considerations on the part of the coach before attempting to instruct the jump serve. Further research in three-dimensional space with increased subject numbers at higher filming rates should enhance our understanding of the temporal structure of a volleyball jump serve.

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