

# FRONT AND PIPE SPIKES IN FEMALE ELITE VOLLEYBALL PLAYERS: IMPLICATIONS FOR THE IMPROVEMENT OF PIPE SPIKE TECHNIQUES

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**KEY WORDS:** volleyball, pipe spike, female, trunk twist, 3D motion analysis.

**INTRODUCTION:** The pipe spike was recently incorporated in offensive combinations increasing the complexity of volleyball tactics and making games more sophisticated. Such combinations are now seen in female games as a strategy of feinting to overcome the block more effectively. Although some investigations analysed front spike techniques, no study has been done on the pipe spike motion for female elite players in official games. Therefore, the purpose of this study was to compare the kinematics of front and pipe spikes of female elite volleyball players, and obtain insights into the techniques for pipe spike motion.

**METHODS:** The front and pipe spikes of four elite players ( $181.6 \pm 7.1$  m,  $69 \pm 3.9$  kg) who frequently used front and pipe spikes in games were recorded by two high-speed VTR cameras (250 Hz, 1/2000 s) during six official games of the Volleyball World Grand Prix 2008, in Japan. The ball and 25 points on the body were digitized and three dimensional coordinate data were reconstructed using a DLT method. The coordinate data were smoothed with a Butterworth digital filter at optimum cut-off frequencies (5~12Hz) based on a residual method. The angles and angular velocities of the right shoulder were the primary variables analysed. The velocity of the ball and right hand, relative velocity between segment endpoints, and kinematics of the trunk and whole body centre of gravity (CG) were also computed.

**RESULTS:** The horizontal velocity of CG at the toe-off tended to be larger in the pipe than in the front spike, while the ball velocity and jump height were likely to be larger in the front than in the pipe spike. Figure 1 shows forward and lateral lean, and twist angles of PI and MK's front and pipe spikes, as typical examples. PI largely twisted the trunk in both types of spike, while MK used small trunk twist. MK's ball velocity of the pipe spike was much smaller ( $65.5 \text{ ms}^{-1}$ ) than that of the front spike ( $79.8 \text{ ms}^{-1}$ ).

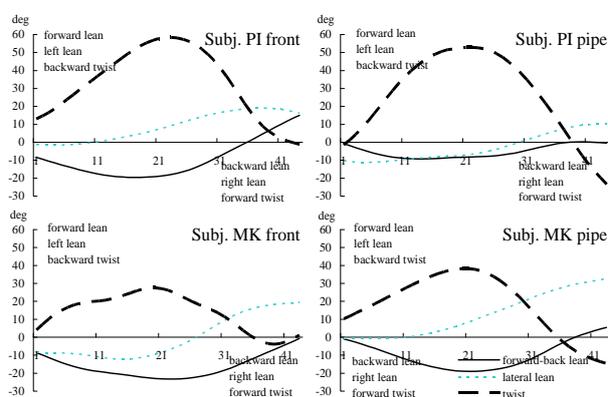


Figure 1 Changes in the trunk angles during the airborne phase

**DISCUSSION:** Masumura et al. (2008) reported the horizontal velocity of CG at the toe-off of pipe spike was larger than that of front spike in all elite male players studied. In the present study, a similar trend was observed in the female players. This may have occurred due to jumping forward to cover a large distance and hit the ball. Furthermore, PI relied on a large trunk twist to apply force to the ball in both spikes, while MK relied more on forward and lateral leans. Based on these results, as it was already seen in males (Masumura et al. 2008), the trunk twist in the airborne phase seems to contribute to the ball velocity also in female players.

**CONCLUSION:** It was presumed that a fast forward trunk twist is more effective than trunk leaning motion to produce a powerful pipe spike.

## REFERENCES:

Masumura, M., Marquez, W. Q., and Ae, M. (2008). A biomechanical analysis of pipe spike motion for elite male volleyball players in official games. *Proceedings of XXVI ISBS Congress*, 723-726.