THE VOLLEYBALL APPROACH: AN EXPLORATION OF BALANCE

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INTRODUCTION

The approach is a critical component of a successful offense in volleyball. Ideally, the hitter will use the approach to achieve a high jump with minimal horizontal motion (Prsala, 1982). According to Dusault (1986), greater height in the jump is predicated on greater horizontal velocity in the approach. Evidently, the hitter should maximize horizontal velocity at touch-down and minimize it at take-off. How does the hitter arrest mobility? If mobility and stability are inversely related, can mobility be decreased through increases in stability? Do performers of distinct skill levels regulate the mobility and stability components of balance differently? The purpose of this study was to explore balance and skill in the volleyball approach and to gain insight into the preceding questions.

METHODS

Two young adult females served as subjects in this study. The advanced performer (ht = 180 cm; foot length (FL) = 30 cm; mass = 66 kg) was an intercollegiate volleyball player, and the intermediate performer (ht = 163 cm; FL = 25 cm; mass = 55 kg) was a recreational player with previous competitive experience. Each subject executed several approach jumps from a hard, rubber runway onto a Kistler force plate (40x60 cm). The starting location and a pseudo-net were adjusted until realistic jumps with both feet on the force plate were achieved. Force data were collected at 250 Hz and reduced with Bioware software. Because the direction of travel was not necessarily congruent with the long axis of the force plate, the braking force (BF) was calculated as the resultant horizontal force (Steele & Milburn, 1989). For comparison, forces were converted to units of body weight (BW).

Each approach was videotaped at 60 Hz, and a representative trial with good force data was analyzed for each subject. Segmental end points were digitized and optimally smoothed with the Butterworth filter option in the Peak5 software. Body segment parameters from Plagenhoef via Kreighbaum and Barthels (1990) were used to locate the position and velocity of the body's line of gravity (LoG). Given that motion was predominantly in the anteroposterior (A-P) plane, measurements of base of support (BoS) and LoG were made relative to this plane. BoS was operationalized as the distance between the most posterior and anterior points of contact with the force plate and expressed as units of FL. No attempt was made to measure actual BoS during initial heel contact (a nominal value of .1

FL was used) and toe-off (the full-foot value was used). The location of the LoG in the A-P plane also was expressed relative to FL with negative values being behind and positive values being ahead of the most posterior point of contact.

RESULTS AND DISCUSSION

The advanced performer (AdP) is depicted in the upper half of Figure 1 as she a) touched down with her right foot, b) bore weight with her right foot, c) touched down with her left foot, and d) reached minimum horizontal velocity. She used a step-close style of approach, and her total time on the ground was 0.37 s. While on the ground the AdP spent .19 s moving downward and .18 s moving upward. Her temporal data are comparable to the elite women subjects of Ridgway and Hamilton (1991), the elite male subjects of Samson and Roy (1976), and the step-close subjects of Coutts (1982). At take-off the AdP had a vertical velocity of 2.69 m/s which was about 13% less than the elite and 8% more than the recreational subjects of Ridgway and Hamilton.

In the lower half of Figure 1, the intermediate performer (ImP) is depicted as she a) touched down with her right foot, b) made the transition from moving down to moving up, c) completed about half of her extension, and d) reached minimum horizontal velocity. In contrast to the AdP, the ImP used a hop-style approach, and the delay between right-heel and left-toe contact was about .05 s. The ImP spent 0.28 s on the ground as she moved downward for .10 s and upward for .18 s. Her vertical velocity was 2.60 m/s at take-off. Temporally she was similar to the recreational women subjects of Ridgway and Hamilton (1991) and the hop-style subjects of Coutts (1982); her vertical velocity was about 5% more than the recreational subjects.

Because the AdP used a larger stagger between her feet, she had a larger BoS during two-foot contact (2.0 FL vs. 1.7 FL). The AdP was also more stable in terms of LoG. At initial touch-down her LoG was farther behind her BoS (-0.7 FL vs. -0.2 FL) and she maintained this advantage throughout the jump.

The horizontal approach velocities of the AdP (2.32 m/s) and the ImP (2.00 m/s) were about 12% less than those reported by Ridgway and Hamilton (1991) for elite and recreational players, respectively. The AdP was able to diminish her horizontal velocity to a minimum of .59 m/s but it rose again to .69 m/s at take-off. The ImP reached a minimum of .63 m/s but had a horizontal velocity of .66 m/s at take-off. Wielki (1985) also reported a slight increase in horizontal velocity just before take-off. These take-off velocities are about .2 m/s less than those shown by Samson and Roy (1976) for elite male subjects.

In keeping with their different styles of approach, these players had different patterns of BF. The AdP had an initial peak force of .67 BW with right-foot touch-down and a second peak force of .9 BW with left-foot touch-down. Her average BF was .36 BW during single-foot contact and .64 BW during two-

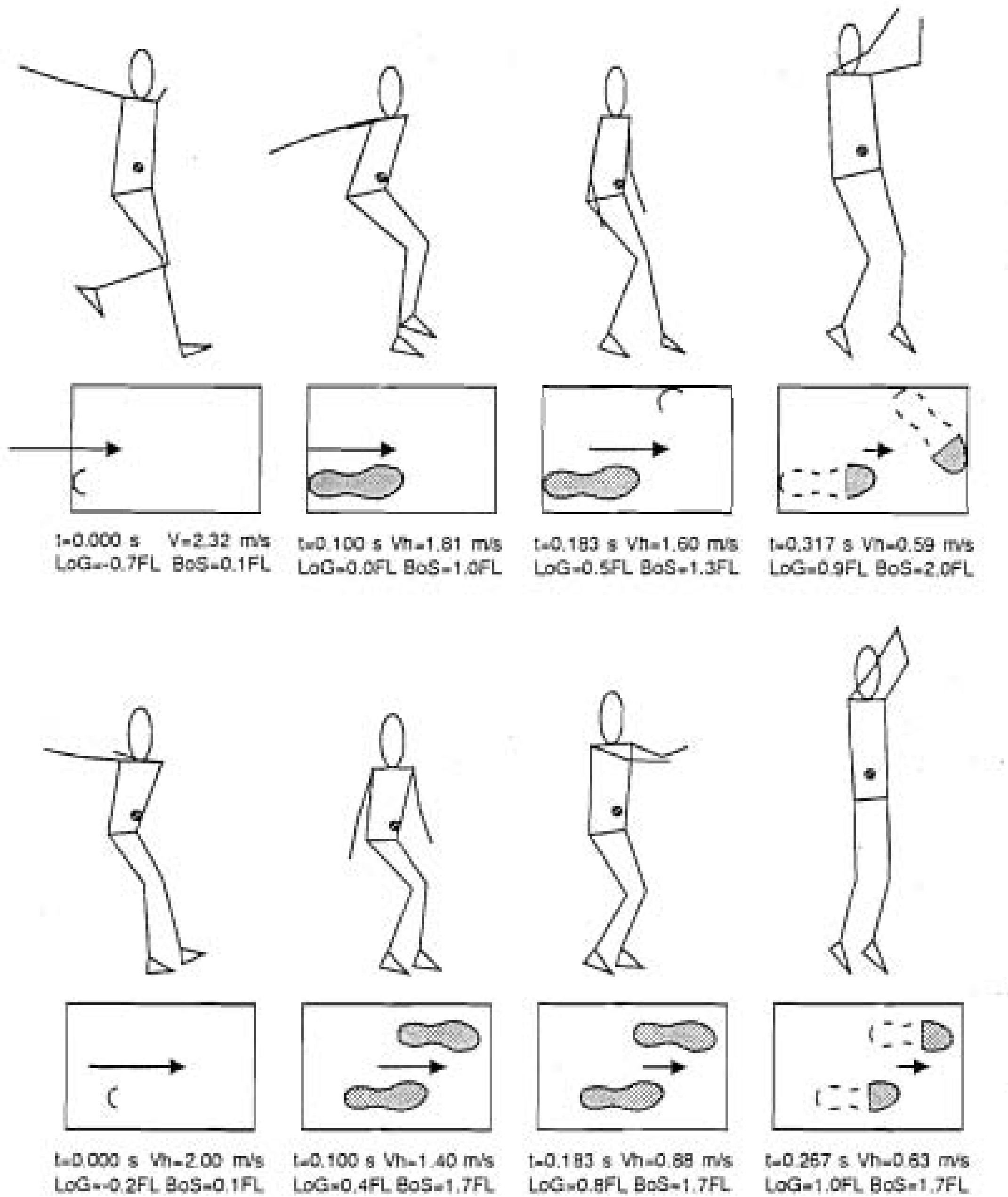

Figure 1. Key positions of the advanced performer (above) and intermediate performer (below) in the volleyball approach. The body's line of gravity is denoted by ⊕ and the tail of the arrow. Horizontal velocity of the body (Vh) is denoted by the length of the arrow. Partial footprints are depicted during touch-down and take-off phases.

foot contact. The ImP had an initial peak force of 1.0 BW and an average force of .45 BW. These maximum BFs were at the low end of the range of 1.0-1.5 BW reported by Coutts (1980) for elite male players.

CONCLUSIONS AND APPLICATIONS

Because the AdP had greater stability and was better able to decrease mobility, there appears to be an inverse relationship between stability and mobility in the approach. Given that both players had less horizontal and vertical velocity than comparable subjects in the literature, both should try to increase horizontal velocity at touch-down. This should require greater BF (Neal & Sydney-Smith, 1992) and probable adjustments in stability. Both players, but especially the ImP, could move the LoG farther back relative to the BoS at touch-down. If the AdP could arrest mobility with a smaller BoS, she might be in a better position to apply vertical force for a higher jump.

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