

# The effects of increased shooting distance in the basketball jump shot

[Stuart Miller](#) & [Roger M. Bartlett](#)

Three-dimensional video techniques (50 Hz) were used to obtain images of basketball jump shots from one of three distances - short range (group 1,  $n = 5$ ); medium range (group 2,  $n = 5$ ); long range (group 3,  $n = 5$ ) - from the basket, as performed by members of the men's quarter-finalist teams at the games of the XVI Universiade in Sheffield in 1991. Fifteen sequences were digitized, beginning 20 frames prior to take-off to 10 frames after release. To facilitate analysis, the sequences were rotated about the ball position in the final frame so that the shot direction was parallel to one of the pre-defined orthogonal axes.

Mean (+1 s.d.) ball release speed was found to increase with distance from the basket (group 1 =  $3.04 \pm 0.65$  m s<sup>-1</sup>, group 2 =  $4.71 \pm 0.74$  m s<sup>-1</sup>, group 3 =  $6.24 \pm 0.80$  m s<sup>-1</sup>), while mean release angles were similar for all groups (group 1 =  $48.8 \pm 10.1^\circ$ , group 2 =  $47.8 \pm 5.8^\circ$ , group 3 =  $51.9 \pm 5.5^\circ$ ). The increased impulse necessary for the ball to reach the basket at increased shooting distances was derived from both an increase in angular velocity of the elbow joint of the shooting arm and an increased velocity of the centre of mass in the direction of the basket at release. Centre of mass speed at take-off was found to be influenced to a greater extent by the angular velocity of the ankle joint than that of the knee or hip joints. Rotation of the hip and shoulder axes, facilitated by the forward placement of the foot on the side of the shooting arm (antero-posterior separation values: group 1 =  $0.17 \pm 0.11$  m, group 2 =  $0.10 \pm 0.14$  m, group 3 =  $0.09 \pm 0.09$  m) was utilized by all except one subject. All subjects also used an amount of medio-lateral foot separation which, along with antero-posterior separation, promoted stability.

All the subjects released the ball while airborne. Both the maximum jump height and the height of the jump at release tended to decrease as shooting distance increased. For short-range shots, release occurred after the peak of the jump, but increasingly prior to the peak as shooting distance increased.

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