A COMPARISON OF THE BASKETBALL SET SHOT AND JUMP SHOT AT TWO DIFFERENT DISTANCES

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INTRODUCTION

In the sport of basketball the main objective is to score points. This requires mastery of the key skill in the sport, shooting the basketball. There are numerous types of shots but Allsen (1967) reported that the jump shot or set shot are used over 88% of the time. This indicates the importance of both shots to the game of basketball.

Walters et al. (1990) examined shooting techniques from three different distances and concluded that all used a push pattern of coordination, releasing the ball while ascending with high wrist angular velocities at release. Yates and Holt (1982) found that successful jump shooters demonstrated a greater angle at the shoulder at ball release, used more elbow flexion at the start of the shot, imparted greater backspin during ball flight, and demonstrated a closer alignment of the upper arm with the vertical at release. Most of this research, however, concentrated on identifying the kinematic variables associated with successful shooting while largely ignoring how these variables either change or remain invariant with changing distance from the goal. The purpose of this study was to examine kinematic and temporal variables of both the basketball set shot and jump shot at distances of 3 m and 6 m.

METHODOLOGY

Ten female, Division I, intercollegiate basketball players were filmed while performing both a set shot (SS) and a jump shot (JS) at 45° to and 3 m and 6 m distances from the basket. Two-dimensional (2D) kinematic data were collected using a Panasonic AG-450 video camcorder with a shutter speed of 1/500 s and nominal frame rate of 30 Hz. The subjects were filmed from the sagittal view in both the 3 m and 6 m conditions.

After filming, the Ariel Performance Analysis System, AST 386 computer, and Panasonic 7300 VCR set at 60 Hz were used for analyzing the nine joint data points. One successful shot from each distance for each subject was captured and digitized. The 2-dimensional coordinates of each view were then scaled by a multiplier and transformed. The data were smoothed with a digital filter smoothing package with a cut-off frequency set at 10 Hz.

The shots were divided into a preparation, execution, and follow through phase to determine pecentages of relative time in search of invariant temporal patterns. The preparation (RTP) phase began with the ball held horizontal to the floor until the upper arm moved parallel to the floor. The force (RTF) phase began at this point and continued to ball release with the follow through (RTFT) occurring after ball release. An ANOVA randomized blocks design with the Scheffe post hoc procedure was used to determine significant differences between conditions.

RESULTS AND DISCUSSION

The goal during both the SS and the JS was to generate the correct amount of velocity and direct this velocity at the correct angle to propel the ball through the hoop (Fiqure 1). The amount of velocity generated depends on the ranges of motion (ROM) of the joints and the angular velocities of the segments (Table 1). A significant difference ($p<0.05$) was found between the SS3 and SS6 in the wrist range of motion (WRM). There were no significant differences between the SS3 and SS6 or the JS3 and JS6 in the ROM at the elbow (ERM) and shoulder (SRM). These results indicated that the WRM may be the most important upper-body kinematic variable in determining the success of the SS. The significance of the WRM was less during the JS, possibly due to the influence of the lower-body segments when jumping.

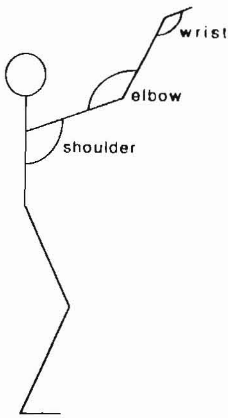

Figure 1. Angle conventions of shoulder, elbow, and wrist.

Table 1. Joint angles at release and range of motion (°).

	SS3	SS6	JS3	JS6
Release				
Shoulder	130.9	125.7	125.0	124.0
Elbow	157.8	160.6	145.4	165.3
Wrist	175.2	170.0	173.1	174.4
ROM				
Shoulder	63.9	72.1	62.1	68.8
Elbow	122.5	129.9	123.7	124.6
Wrist	33.6	49.4	33.4	43.1

There were no significant differences between any shot conditions for joint angles at release for the wrist (ARWR), the elbow (AREL), or the shoulder (ARSH), with the exception of the AREL between the two jump shots. The angle of velocity direction appears very similar between the shots (Table 1). The difference in the AREL for the JS3 and JS6 may mean that increased elbow extension was important for delivering additional horizontal velocity necessary during the longer JS. The horizontal velocity for the JS must come from upper-body segments because the lower-body segments were used to produce vertical velocity for the jump.

Significant differences were found in the temporal structures of the various shots (Table 2). The SS6 had greater total movement time (TMT) and relative time of follow-through (RTFT) compared to SS3, while SS3 had greater relative time of force (RTF). The JS6 had a significantly greater RTFT than the JS3.

No significant differences were found when comparing the temporal sequence of peak segmental angular velocity with respect to ball release (Table 3). For all shot conditions the upper arm (UPA) reached peak angular velocity approximately 100 ms before the forearm (FAR) and hand (HND). The FAR reached peak angular velocity only slightly before the HND, with the HND reaching peak angular velocity at ball release.

Table 2. Temporal structure of the phases of the shots.

	SS3	SS6	JS3	JS6
TMT (s)	0.83	1.28	1.01	1.09
RTP (%)	31.8	24.9	33.5	22.4
RTF (%)	32.5	18.7	25.5	21.6
RTFT (%)	35.5	56.2	40.8	55.9

Table 3. Time of peak angular velocity from ball release.

	SS3	SS6	JS3	JS6
UPA (s)	0.13	0.12	0.12	0.11
FAR (s)	0.03	0.03	0.02	0.03
HND (s)	0.00	0.00	0.01	0.01

(times measured from ball release at 0.00 s)

CONCLUSIONS

The WRM may be the most important upper body ROM variable in determining velocity generation during the SS. A longer shot requires increased WRM. The significance of the WRM is less during the JS, possibly due to the influence of the lower body segments during the jump.

The greater joint angle at release of the elbow AREL for the longer JS may indicate that increased elbow extension is important for delivering additional horizontal velocity during longer jump shots. The lower body produces vertical velocity during the jump, and once airborne all horizontal velocity must be produced in the upper body.

Although significant differences do exist, the performance of the SS and the JS are actually very similar when comparing upper-body kinematic and temporal variables. This is especially true when comparing the SS3 and JS3 or the SS6 and JS6. These findings may indicate the existence of an invariant pattern of upper-body performance for both the SS and JS. This pattern may be altered more by distance from the basket than by the choice of SS or JS.

The documentation of an invariant shooting pattern becomes very important from a practical standpoint because such a pattern may be used in the formulation of teaching/coaching models like those put forth by Satern and Knudson. More research is needed to confirm the existence of an invariant pattern and to develop this shooting pattern for both upper and lower body segments.

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