

Effects of Basketball Shooting Distance on Release Angle

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ABSTRACT- Basketball, as one of the most popular sports worldwide, has attracted approximately 450 million participants. Studies show that nearly half of the points scored in a game come from jump shots, making it an indispensable scoring method in matches. The present study aimed to evaluate the shooting distance and its relationships to shooting release angle of basketball athletes. 10 basketball athletes participated in the study. Ball kinematics shooting from 5 and 6.8m was evaluated. Shooting distance did not significantly affect the release angle.

KEYWORDS- Basketball, Release Angle, Shooting Trajectory, Kinematics

I. INTRODUCTION

Basketball, as one of the most popular sports worldwide (1), has attracted approximately 450 million participants (<http://www.fiba.basketball/>). Shooting, as an effective scoring method in basketball, is considered the most critical and commonly used skill (2,3). Among all shooting techniques, the jump shot stands out as the most effective (4) and is the most widely applied technique in games (5). Studies show that nearly half of the points scored in a game come from jump shots (6,7), making it an indispensable scoring method in matches. Therefore, mastering the jump shot technique is extremely important for players, regardless of the role they play on the team. In basketball games, athletes often need to shoot from multiple distances (2) to expand the offensive space and implement tactics (5), thereby achieving effective scoring. As the shooting distance increases, to accommodate the higher basketball release velocity, athletes adjust their joint motion patterns during shooting (8,9). This includes an increase in shoulder angular velocity (8), an expansion of the shoulder and wrist range of motion (10), and an increase in elbow extension (11). In actual games, 4.6 meters and 6.75 meters, representing mid- and long-distance, are frequently used (2,12,13), making it crucial to thoroughly understand and master jump shot strategies at these distances to enhance athletes' performance in matches.

The basketball throw could be explained by a function of angle, speed and spin at release. A successful shot could be evaluated by combinations of angle, speed, and spin. Among the three variables, angle might be affecting the shooting distance greatly. The present study aimed to evaluate the

shooting distance and its relationships to shooting release angle of basketball athletes.

II. METHOD

A. Participants

A total of 10 subjects. All participants shot right-handed. In addition, the subjects were fully informed of the purpose and necessity of the study procedure before the experiment. For accurate study results, subjects were advised to avoid excessive exercise or physical activity and to get plenty of rest before the experiment. They had no history of musculoskeletal injuries in the previous 6 months prior to the examinations. Their characteristics are followed (Table 1).

Table 1: Age and Experience

	N=5
Age(yr)	22.3±1.6
Height(cm)	185.8±4.3
Weight(kg)	78.7±5.7
Experience(yr)	5.7±1.3

B. Procedure

During experiments, 6 infrared cameras (Prime 17W, OptiTrack, Natural Point, Inc., Corvallis, OR, USA) were used to capture the basketball kinematic data for each participant at a sampling rate of 120 Hz. In the experiment, matching markers were 14 mm reflective markers. The ball data were achieved through Motive (OptiTrack, Natural Point, Inc., Corvallis, OR, USA). Then, the collected data were analyzed using Microsoft Excel.

Before the actual experiment, all participants introduced to the test protocol and the objective of the present study. Then, personal information was collected and no one had injuries in the past 6 months (Table 1).

A size 7 basketball was used for all shooting. Each subject shot 3 times for each distance (5m and 6.8m) in random orders. The participants wore their own basketball shoes. Markers were placed on the basketball to compute the center of mass of the ball.

Statistical analysis(Paired sample T-test) was performed using R software version 4.3.2, with data presented as mean ± standard deviation. Prior to analysis,

the normal distribution of all datasets was confirmed using the Shapiro-Wilk test.

III. RESULTS

Paired -T-test results suggested that there was no significant difference in the release angles when the distance increased although slight increases were found as the distance increased.

Table 2. Data and Summary in Release Angles
(unit: angle, N=10)

Mean \pm SD (4.8m)	Mean \pm SD(6.75m)	P Value	Cohen's d
53.03 \pm 5.77	54.8 \pm 3.51	0.12	0.55

IV. DISCUSSION

This study aimed to investigate the effect of shooting distance on the release angle of basketball shots. We found that shooting distance does not significantly affect the release angle, consistent with the findings of Miller and Bartlett, who compared the release angles of jump shots at various distances (short distance: 3.66 meters; mid-distance: 3.66 to 5.49 meters; long distance: over 5.49 meters) and observed that an increase in shooting distance does not significantly alter the release angle (11). Compared to previous studies, the mid and long distances in this study were set at 4.8 meters and 6.75 meters, respectively, which are more common in basketball games and thus more representative (2,12,13). This phenomenon could be explained by the fact that professional athletes, through long-term training and game experience accumulation, have developed a stable shooting technique pattern, including maintaining a relatively fixed release angle to enhance shooting accuracy and predictability (14). Based on this, athletes may adjust the force and speed of the joints to adapt to different shooting distances (3). While this study provides insights into how shooting distance affects the basketball release angle, it has certain limitations. Specifically, the examination of athletes' release speed and joint force performance at different shooting distances was not included, limiting our ability to deeply understand the phenomenon. Future research that considers factors such as release angle, speed, and joint force collectively will offer a more comprehensive understanding of how shooting distance influences basketball shooting techniques comprehensively.

V. CONCLUSION

This study demonstrates that changes in shooting distance do not significantly affect the release angle of the athlete's shot. This implies that when guiding novice athletes, their personal physical characteristics should be considered to help them establish a stable shooting release angle, thereby improving shot accuracy and predictability.

VI. RESEARCH QUESTION

1. What will be other factors influencing shooting performance besides angles?
2. What will happen to shooting angle and release velocity

if years of experience differ?

3. Will fatigue decrease the level of release angles?

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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REFERENCES

- [1] Li B, Xu X. Application of artificial intelligence in basketball sport. *Journal of Education, Health and Sport*. 2021 Jul 8;11(7):54–67.
- [2] Okazaki VHA, Rodacki ALF. Increased Distance of Shooting on Basketball Jump Shot. *J Sport Sci Med*. 2012 Jun 1;11(2):231–7.
- [3] Okazaki VHA, Rodacki ALF, Satern MN. A review on the basketball jump shot. *Sports Biomech*. 2015 Apr 3;14(2):190–205.
- [4] Knudson D. Biomechanics of the basketball jump shot—six key teaching points. *Journal of Physical Education, Recreation & Dance*. 1993 Feb;64(2):67–73.
- [5] James G. *The biomechanics of sport techniques*. Prentice-Hall, Inc; 1999.
- [6] Tang WT, Shung HM. Relationship between isokinetic strength and shooting accuracy at different shooting ranges in taiwanese elite high school basketball players. *Isokinetics and Exercise Science*. 2005 Jan 1;13(3):169–74.
- [7] Erčulj, F., and Štrumbelj, E., "Analiza izvedbe metov na koš v Evroligi in 1. slovenski ligi," *Sport: Revija Za Teoreticna in Prakticna Vprasanja Sporta*, vol. 61, 2013.
- [8] Satern MN. Kinematic Parameters Of Basketball Jump Shots Projected From Varying Distances. *ISBS - Conference Proceedings Archive [Internet]*. 1993 [cited 2024 Jan 4]; Available from: <https://ojs.ub.uni-konstanz.de/cpa/article/view/1736>
- [9] Liu S, Burton AW. Changes in Basketball Shooting Patterns as a Function of Distance. *Percept Mot Skills*. 1999 Dec;89(3):831–45.
- [10] Elliott BC, White E. A kinematic and kinetic analysis of the female two point and three point jump shots in basketball. *The Australian Journal of Science and Medicine in Sport*. 1989;21(2):7–11.
- [11] Miller S, Bartlett RM. The effects of increased shooting distance in the basketball jump shot. *Journal of Sports Sciences*. 1993 Aug 1;11(4):285–93.
- [12] Nakano N, Fukushima S, Yoshioka S. The effect of increased shooting distance on energy flow in basketball jump shot. *Sports Biomechanics*. 2020 May 3;19(3):366–81.
- [13] França C, Gouveia ÉR, Silva MJC e, Gomes BB. A kinematic analysis of the basketball shot performance: Impact of distance variation to the basket. *Acta Bioeng Biomech*. 2022;24(1):159–66.
- [14] Okazaki VHA, Rodacki ALF, Dezan VH, Sarraf TA. *Coordenação do arremesso de jump no basquetebol de crianças e adultos*. 2006