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Kinematic Comparison of Free Throw Shooting Between Amateur and Intermediate Basketball Players

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I. Introduction

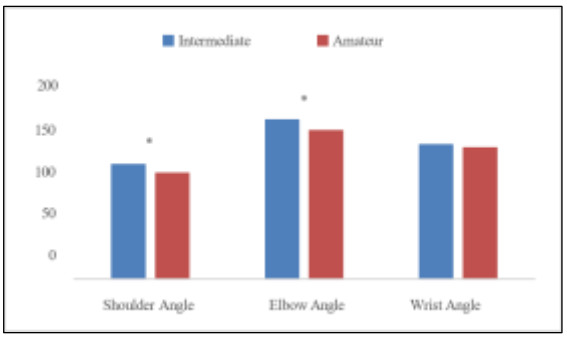
Shooting efficiency is widely recognised as a critical determinant of game success in basketball across all competitive levels, from amateur to professional play [1]. Previous research has extensively examined the biomechanical factors associated with optimal shooting performance, with particular emphasis on joint kinematics, release mechanics, and coordination patterns [2]. Despite this growing body of literature, limited evidence exists regarding how shooting mechanics differ according to players' skill and experience levels [3]. A clearer understanding of these differences is necessary to inform coaching strategies and performance development. Therefore, the present study aimed to investigate variations in kinematic characteristics of the free throw between amateur and intermediate basketball players.

II. Methods

A total of 12 male basketball players, comprising 6 amateur and 6 intermediate players aged between 18 and 24 years, participated in this study. All participants performed 10 free throw trials from the regulation free throw distance. Kinematic variables during the ball release phase, specifically shoulder, elbow, and wrist joint angles, were recorded using a two-dimensional video analysis approach. A smartphone camera was positioned perpendicular to the sagittal plane to ensure accurate movement capture. Recorded videos were subsequently analysed using Kinovea motion analysis software. Each participant completed 10 attempts, resulting in a maximum possible score of 50 points. Independent-samples t-tests were conducted to determine differences in kinematic variables and shooting accuracy between amateur and intermediate players.

III. Results and Discussion

Significant differences were identified between amateur and intermediate players in shoulder and elbow joint angles during free throw shooting. Intermediate players demonstrated greater shoulder elevation and elbow extension at ball release compared with amateur players. In contrast, no significant difference was found in wrist angle between the two groups.



*$p < 0.05$

Fig. 1 Comparison between skill levels on shooting kinematics and accuracy

Previous research indicates that skilled shooters exhibit distinct shoulder and elbow mechanics compared with less skilled players, reflecting more refined proximal joint coordination with experience [1]. Differences in joint positioning between performance levels suggest that skill development is associated with improved control of shoulder and elbow movement during the release phase. Upper limb biomechanical analyses further highlight the dominant role of the shoulder and elbow in regulating release mechanics. Shoulder rotation contributes substantially to the vertical component of release velocity, whereas elbow and wrist actions primarily influence horizontal velocity and ball backspin [5]. In contrast, wrist mechanics appear less sensitive to differences in skill level. Evidence on coordination variability suggests that distal joint motion, particularly at the wrist, remains relatively stable across performance groups, while proximal joint coordination at the shoulder and elbow serves as a clearer marker of shooting proficiency [6].

IV. Conclusions

This study identified biomechanical differences between amateur and intermediate basketball players during free throw shooting. Significant differences were found in shoulder and elbow joint angles, while wrist angle did not differ between groups. These findings indicate that skill progression is mainly associated with changes in proximal joint mechanics rather than distal joint movement. Practically,

coaches should focus on improving shoulder alignment and elbow extension to enhance shooting efficiency, particularly among amateur players.

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