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Article

Analysis of the mechanical characteristics of progressive one-handed underhand shooting in basketball play through kinematics

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Abstract: Background: Progressive one-handed underhand shooting is not only a key movement in basketball but also a primary method of scoring. **Objective:** This paper aims to compare the mechanical characteristics of players at different levels while performing the progressive one-handed underhand shooting movement to guide training. **Methods:** Ten athletes were divided into an excellent group and an ordinary group. The shooting was conducted using two SONY cameras, and the kinematics data were acquired through re-analysis in the Simi 3D Motion system for comparative analysis. **Results:** The average number of successful shots per person in the excellent group was 8.12 ± 0.81, which was significantly different from the ordinary group. During ball holding, the first step length of the excellent group was 1.91 ± 0.03 m, showing a significant difference compared to the ordinary group. At the beginning of ball holding, the right elbow joint angle for the excellent group was 121.26° ± 0.58° and the right hip joint angle was 135.64° ± 0.78°, both significantly different from those in the ordinary group. At the end of holding the ball, the excellent group had a right shoulder joint angle of 51.26° ± 2.36° and a right elbow joint angle of 70.34° ± 1.68°, which was significantly different from the ordinary group. At the end of jump, the excellent group had a right shoulder joint angle of 80.16° ± 2.21° and a right elbow joint angle of 87.45° ± 1.68°, which was significantly different from the ordinary group. During the shooting phase, the excellent group had a shooting angle of 60.12° ± 2.36°, a shooting height of 2.92 ± 0.03 m, and a shooting speed of 4.12 ± 0.46 m/s, all showing significant differences compared to the ordinary group. Conclusion: The excellent group with more sufficient stride, push, and extension and better shooting parameters performed better in performing the movement of progressive one-handed underhand shooting.

Keywords: kinematics; mechanical characteristic; one-handed underhand shooting; shooting speed

1. Introduction

Under the influence of the continuous development and progress of competitive sports, basketball, as an antagonistic sport [1], is also a popular team sport [2]. Basketball has high requirements for athletes' overall qualities [3] and also carries a higher risk of injury [4]. The level of technical and tactical skills is an important factor that affects athletes' competitive performance [5]. In order to enhance the competitive performance of professional players further and achieve better teaching and guidance for beginners, the research on various technical movements in basketball has become more and more extensive [6]. Basketball judges win and lose based on scores. Shooting is one of the main scoring ways and a key technique of shooting [7]. The shooting accuracy is an important indicator to evaluate the ability of athletes [8]. According to different shooting methods, it can be divided into set shooting, progressive shooting, dunking, and so on [9]. Among them, the progressive one-handed underhand shooting is a commonly used and highly accurate shooting method in actual games. It has advantages such as quick release and high defensive difficulty. It is also a technical movement that athletes must master in their daily training. Therefore, the research on this movement has significant practical application value. Currently, there have been many applied methods for studying basketball shooting techniques [10]. Daub et al. [11] examined how mental fatigue affects basketball shooting tasks and discovered that it had a detrimental impact based on their experiment involving 15 elite male college basketball players. Suzuki et al. [12] investigated the correlation between basketball shooting distance and various shooting parameters, such as position, speed, and angle, by utilizing two high-speed cameras to track ball trajectory after release. Their analysis revealed that as the shooting distance increased, the distance from the shooting position to the release point gradually increased, but there was minimal change in release height. Lian et al. [13] developed an Internet of things wristband for analyzing basketball shots. Shot data were collected from 20 basketball players of varying skill levels using sensors. The experiment discovered that this wristband achieved an overall recognition accuracy rate of 98.5% for 18 different types of shot movements, making it suitable for quantitative guidance in basketball shot training. Sirnik et al. [14] analyzed the influence of visual attention on basketball shot performance and concluded through a meta-analysis that longer quiet eye durations and lower numbers of gaze fixations were correlated with improved shot performance, suggesting that quiet eye training could enhance one’s ability to shoot. Smajla et al. [15] studied the relationship between strength capacities of elbow extensor and volar flexors and basketball shooting performance. Through an evaluation of 23 male basketball players, it was found that the maximum isometric torque of the elbow extensor was significantly positively correlated with long-distance shooting performance, proving the important role of muscle ability in shooting performance. Currently, due to the complexity of basketball techniques, there has been limited research on the progressive one-handed underhand shooting movement, and its technical characteristics are not yet clear. In order to provide more targeted guidance for training this movement in practice, based on the current research, this article compared the mechanical characteristics of basketball players at different levels when performing the progressive one-handed underhand shooting motion. This paper provides theoretical basis for improving the level of this technical movement and also offers some references for further research on kinematic analysis in basketball technical movement analysis.

2. Subjects and methods

2.1. Study subjects

A total of 40 basketball players were selected as subjects. Twenty were in the excellent group, and they were second-class national athletes and had received more than five years of professional training. Another 20 were in the ordinary group, and they were ordinary students specializing in basketball and had received more than two years of professional training. All of them were male, with the right hand being the shooting hand, having no history of lower limb injury or surgery in the past six months, being in good physical condition, and not engaging in strenuous exercise within 24 hours. All participants comprehended the objective and methodology of the experiment and provided their informed consent by signing. The basic information is shown in **Table 1**.

Table 1. Basic data of subjects.

	Excellent group (*n* = 20)	Normal group (*n* = 20)
Age/years	22.36 ± 0.87	22.54 ± 0.68
Height/cm	183.87 ± 2.36	182.55 ± 2.47
Weight/kg	78.56 ± 3.12	77.94 ± 3.37

2.2. Research methods

2.2.1. Experimental procedure

(1) The subjects were checked. The basic information of these subjects was collected. They were required to dress uniformly. Subjects in both groups were required to do 10-minute jogging and do 10-minute exercises of progressive one-handed underhand shooting in the same period.

(2) The experiment was conducted in an indoor basketball gymnasium on campus, with natural lighting and an average temperature of 26 °C. The experimental site was arranged (**Figure 1**), and two SONY high-speed cameras (DSC-RX10M4) were used, with a shooting frequency of 60 frames/s. The lenses were perpendicular to the moving plane. The X-axis of the three-dimensional frame was perpendicular to the basketball court sideline, the lowest point was 0.8 m from the ground, and it kept a distance of 10 m with both cameras. The distance between the two cameras was 12 m, and the angle between the main optical axis was about 100°. The cameras were operated at a fixed point and with a fixed focus.

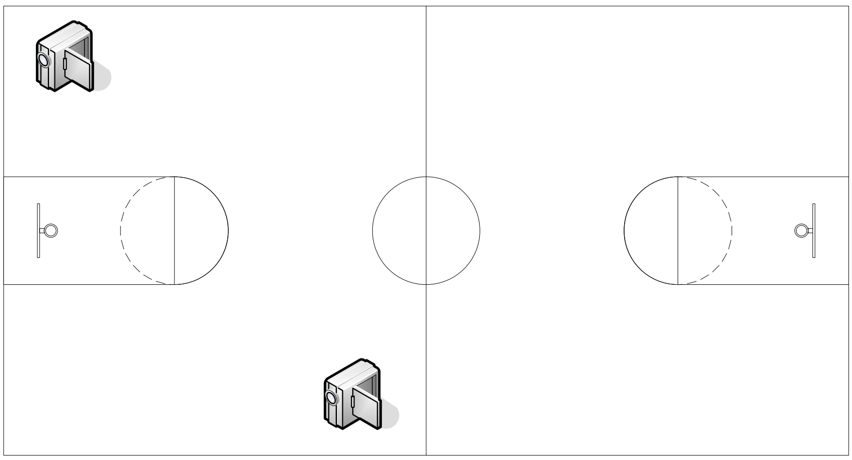

Figure 1. Experimental site.

(3) After the warm-up, the subjects were asked to complete ten progressive underhand shots with only one hand. The shooting percentage was recorded.

(4) The researchers pasted markers for the subjects. The paste positions are shown in **Table 2**.

Table 2. Marker paste position.

Name of paste location	Paste location
Vertex	The highest point when the human body is upright
Left and right shoulder points	Outermost projection point of acromion
Left and right elbow points	External epicondyle of humerus
Left and right wrist points	The midpoint of connection between the styloid process of the ulna and styloid process of the radius
Left and right anterior superior iliac spine points	Anterior superior iliac spine
Left and right external knee points	The most outer protruding point of the lateral condyle of the femur
Left and right medial knee points	The most outer protruding point of the medial condyle of the femur
Left and right lateral malleolar points	The most outer protruding point of the lateral malleolus
Left and right medial malleolar points	The most outer protruding point of the medial malleolus
Left and right toe points	The midpoint of the second and third phalanx
Left and right heel points	Calcaneal tuberosity

(5) The pre-experiment was carried out to confirm that both cameras could synchronize and completely capture the movements of the subjects and would not move during the shooting process.

(6) The subjects performed the progressive one-handed underhand shooting movement one by one. They started near the free-throw line and shot the ball. A movement was determined as effective only when the ball was thrown into the basket. Each person repeated three times. The specifications for this movement are as follows.

The subject spread his legs apart as wide as his shoulders, slightly bent his body, stared at the basket, caught the ball while taking the first step with his right foot, lifted the ball to a position in front of him on the right side, pushed off the ground and jumped upward while taking the second step with his left foot, picked up his wrist and moved his fingers while approaching the basket to make the ball roll forward and fall into it. In the subsequent analysis, this movement was divided into three stages: holding, jumping, and shooting.

(7) The most standard movement was analyzed in the Simi 3D Motion capture system [16]. The Hanavan human body model [17] was selected for analysis, and the video was cropped, synchronized, automatically tracked, marked, and synthesized into three-dimensional data in the software. Kinematic data such as time and joint angle were obtained using a built-in data parsing system. The mechanical characteristics of players at different levels were compared when performing this movement.

2.2.2. Mathematical statistics and analysis

The data collected were organized using Excel and expressed as mean ± standard deviation. Statistical analyses were performed in SPSS 26.0 software. Based on the Shapiro-Wilk test [18], a normality test was conducted to confirm that the sample follows a normal distribution, and then an independent samples *t*-test [19] was performed. The data of the two groups were compared, and the significance level was set at 0.05. The effect size was calculated [20]. The relevant charts were drawn in Excel.

3. Results and analysis

The average number of successful shots per person in both groups is shown in **Table 3**.

Table 3. Comparison of the average number of successful shots per person.

	Excellent group (*n* = 20)	Ordinary group (*n* = 20)	*P* value	Cohen's d
The average number of successful shots per person/n	8.12 ± 0.81	6.45 ± 1.03	0.015	1.255

According to **Table 3**, the average number of successful shots per person in the excellent group was 8.12 ± 0.81, while it was 6.45 ± 1.03 in the ordinary group. Comparing the two groups, $p < 0.05$ and Cohen's d = 1.255, indicating a large effect size, i.e., significant differences.

The time taken for the three stages was compared between the two groups (**Table 4**).

Table 4. Comparison of time consumed by different stages.

	Excellent group (*n* = 20)	Normal group (*n* = 20)	*P* value	Cohen's d
Holding stage	0.49 ± 0.05	0.51 ± 0.07	0.056	0.245
Jumping stage	0.19 ± 0.02	0.18 ± 0.02	0.077	0.233
Shooting stage	0.33 ± 0.05	0.26 ± 0.04	0.062	0.241
Total time/s	0.99 ± 0.08	0.96 ± 0.07	0.055	0.252

Based on the data presented in **Table 4**, there were no notable disparities observed between the two groups regarding the duration spent in various stages and overall time allocation ($P > 0.05$ and the value of Cohen's d was small). In comparison, the time of the excellent group in the holding stage was 0.49 ± 0.05 s, which was slightly lower than that of the ordinary group; the time of the jumping and shooting stages were 0.19 ± 0.02 s and 0.33 ± 0.05 s, respectively, which were slightly higher than that of the ordinary group; the total time of the excellent group was 0.99 ± 0.08 s, which was also slightly higher than that of the ordinary group.

In the holding stage, the subject took a step with the right foot and then took another step with the left step to support the subsequent jump. The length of these two steps and flight duration were compared (**Table 5**).

Table 5. Step length and duration of flight in the holding stage.

		Excellent group (*n* = 20)	Normal group (*n* = 20)	*P* value	Cohen's d
The first step	Step length/m	1.91 ± 0.03	1.81 ± 0.03	0.012*	1.012*
	Duration of flight/s	0.14 ± 0.03	0.15 ± 0.04	0.845	0.315
The second step	Step length/m	1.78 ± 0.06	1.76 ± 0.06	0.517	0.336
	Duration of flight/s	0.04 ± 0.01	0.06 ± 0.02	0.156	0.374

Note: * means $p < 0.05$.

As can be seen from **Table 5**, the length of the first step of the excellent group was 1.91 ± 0.03 m, while that of the ordinary group was 1.81 ± 0.03 m ($p < 0.05$ and Cohen's d = 1.012, i.e., a large effect size). In terms of the duration of flight, the two groups were 0.14 ± 0.03 s and 0.15 ± 0.04 s, respectively ($p > 0.05$ and Cohen's d = 0.315, i.e., a small effect size). In terms of the second step, there were no notable distinctions observed between the two groups.

The joint angles of the two groups in the holding stage are presented in **Table 6**.

Table 6. Joint angles in the holding stage.

		Excellent group (n = 20)	Normal group (n = 20)	P value	Cohen's d
The beginning of the holding stage	Right shoulder	32.36 ± 0.07	35.84 ± 0.12	0.456	0.287
	Right elbow	121.26 ± 0.58	85.67 ± 1.09	0.001*	1.207*
	Left hip	164.21 ± 0.67	165.56 ± 0.45	0.077	0.335
	Right hip	135.64 ± 0.78	107.64 ± 1.12	0.013*	1.112*
	Left knee	95.64 ± 0.87	117.88 ± 0.35	0.417	0.212
	Right knee	146.33 ± 0.65	141.26 ± 0.78	0.067	0.233
	Left ankle	115.32 ± 0.67	121.36 ± 1.12	0.325	0.314
	Right ankle	81.26 ± 0.56	82.36 ± 0.74	0.421	0.336
The end of the holding stage	Right shoulder	51.26 ± 2.36	87.64 ± 3.15	0.012*	0.925*
	Right elbow	70.34 ± 1.68	85.33 ± 1.97	0.011*	1.023*
	Left hip	173.64 ± 0.56	165.34 ± 1.36	0.125	0.252
	Right hip	157.32 ± 0.56	154.26 ± 0.49	0.325	0.263
	Left knee	128.64 ± 1.21	131.77 ± 1.36	0.451	0.271
	Right knee	155.36 ± 0.67	152.47 ± 1.21	0.635	0.284
	Left ankle	136.84 ± 0.45	112.67 ± 0.66	0.385	0.238
	Right ankle	96.67 ± 0.88	102.34 ± 0.76	0.627	0.277

Note: unit: °; * means $p < 0.05$.

As can be seen from **Table 6**, at the beginning, remarkable differences between the two groups were shown in the right elbow and right hip. The excellent group exhibited a significantly higher right elbow joint angle of 121.26° ± 0.58° compared to the ordinary group ($p < 0.05$, Cohen's d = 1.207, i.e., a large effect size); the right hip joint angle of the excellent group was 135.64° ± 0.78°, which was significantly greater than that of the ordinary group ($p < 0.05$, Cohen's d = 1.112, i.e., a large effect size). There was no remarkable difference in the other joints. Then, at the end of this stage, the right shoulder joint of the excellent group was 51.26° ± 2.36°, which was remarkably smaller than that of the ordinary group (57.64° ± 3.15°) ($p < 0.05$, Cohen's d = 0.925, i.e., a large effect size), and the right elbow joint was 70.34° ± 1.68°, which was also remarkably smaller than that of the ordinary group (85.33° ± 1.97°) ($p < 0.05$, Cohen's d = 1.023, i.e., a large effect size). There was no remarkable difference in the other joints.

The height of the body's center of gravity at the moment of landing and jumping was compared between the two groups (**Table 7**).

Table 7. Height of body center of gravity at the moment of landing and jumping.

		Excellent group (*n* = 20)	**Ordinary group (*n* = 20)**	**P value**	**Cohen's d**
Moment of landing	X-axis	0.79 ± 0.02	0.81 ± 0.01	0.562	1.203
	Y-axis	0.64 ± 0.02	0.52 ± 0.02	0.412	1.221
	Z-axis	0.96 ± 0.01	0.95 ± 0.01	0.326	0.232
Moment of jumping	X-axis	0.26 ± 0.02	0.21 ± 0.01	0.412	0.216
	Y-axis	0.66 ± 0.02	0.51 ± 0.02	0.127	0.219
	Z-axis	1.26 ± 0.01	1.24 ± 0.01	0.654	0.226

Note: unit: m.

From **Table 7**, it can be found that, at the moment of landing, the height of the body center of gravity of the excellent group on the X-axis was 0.79 ± 0.02 m, slightly lower than that of the ordinary group; the Y-axis and Z-axis were 0.64 ± 0.02 m and 0.96 ± 0.01 m, slightly higher than that of the ordinary group ($p > 0.05$); then, at the jumping moment, the height of the body's center of gravity of the excellent group on the X-axis, Y-axis, and Z-axis was 0.26 ± 0.02 m, 0.66 ± 0.02 m, and 1.26 ± 0.01 m, respectively, which were slightly higher than the ordinary group ($p > 0.05$ and the effect size was small).

Table 8 shows the joint angles of the two groups at the end of the jump.

Table 8. Joint angles at the end of jump.

	Excellent group (*n* = 20)	**Normal group (*n* = 20)**	***P* value**	**Cohen's d**
Right shoulder	80.16 ± 2.21	135.15 ± 3.12	0.001*	1.203*
Right elbow	87.45 ± 1.68	155.67 ± 2.07	0.002*	1.221*
Left hip	168.45 ± 0.87	165.33 ± 0.51	0.255	0.232
Right hip	162.34 ± 0.56	157.35 ± 0.64	0.325	0.216
Left knee	137.21 ± 0.24	134.26 ± 0.37	0.521	0.219
Right knee	156.44 ± 0.36	155.21 ± 0.45	0.451	0.226
Left ankle	131.21 ± 0.64	121.17 ± 0.54	0.365	0.225
Right ankle	101.25 ± 0.86	105.77 ± 0.72	0.258	0.258

Note: unit: °; * means p < 0.05.

At the end of the jump, notable disparities were observed primarily in the joints of the right shoulder and right elbow among the two groups. The right shoulder joint angle of the excellent group was 80.16° ± 2.21°, which was remarkably lower than that of the ordinary group (135.15° ± 3.12°) ($p < 0.05$, Cohen's d = 1.203, i.e., a large effect size); the right elbow joint angle was 87.45° ± 1.68°, which was remarkably lower than that of the ordinary group (155.67° ± 2.07°) ($p < 0.05$, Cohen's d = 1.221, i.e., a large effect size).

The parameters of the two groups at the shooting stage were compared (**Table 9**).

Table 9. Shooting parameters.

	Excellent group (n = 20)	Normal group (n = 20)	P value	Cohen's d
Angle/°	60.12 ± 2.36	67.34 ± 2.12	0.012*	0.985*
Height/m	2.92 ± 0.03	2.81 ± 0.04	0.013*	1.021*
Speed/(m/s)	4.12 ± 0.46	3.65 ± 0.21	0.012*	1.207*

Note: * means $p < 0.05$.

As shown in **Table 9**, the shooting angle of the excellent group was 60.12° ± 2.36°, which was remarkably smaller than that of the ordinary group (67.34° ± 2.12°). The shooting height was 2.92 ± 0.03 m, demonstrating a statistically significant increase compared to the ordinary group (2.81 ± 0.04 m). The speed was 4.12 ± 0.46 m/s, which was significantly larger than that of the ordinary group (3.65 ± 0.21 m/s) ($p < 0.05$ and the effect size was large). These results indicated that the two groups had significant differences in shooting parameters.

4. Discussion

With the development of technological means, the use of sensors [21], cameras [22], surface electromyography [23], virtual animation [24], three-dimensional motion capture systems [25], and other means in sports is also increasing. Kinematics [26], dynamics [27], and muscle activity [28] are also playing an increasingly important role in the study of sports movements. One-handed underhand shooting is a commonly used movement in basketball. This paper mainly analyzed the mechanical characteristics of athletes at different levels when they performed this movement from the kinematics perspective.

The comparison of the shooting percentage between the two groups suggested that the excellent group performed better than the ordinary group when performing the progressive one-handed underhand movement. The comparison of the time consumed in different stages suggested that there was no remarkable difference between the two groups. Although the excellent group was slightly larger than the ordinary group in the time consumption of the jumping and shooting stages and the total time, $p < 0.05$. In the shooting stage, the time consumed by the excellent group and the ordinary group was 0.33 ± 0.05 s and 0.26 ± 0.04 s, respectively, which suggested that the excellent group obtained a higher flight duration after obtaining a larger jumping height.

The comparison of step length parameters in the holding stages showed that the players quickly got rid of the defense by taking a larger step in the first step and stabilized the center of gravity by taking a smaller step in the second step. According to **Table 3**, both groups showed the characteristic of "a big step in the first step, a small step in the second step", and the flight duration of the first step was higher than that of the second step. The length of the first step in the excellent group was 1.91 ± 0.03 m, which was significantly higher than 1.81 ± 0.03 m in the ordinary group, but the second step showed an insignificant difference in the step length and similar flight duration. These results indicated that in the holding phase, players should take a larger step length during the first step and then actively land after the second step to prepare for the subsequent jumping.

The comparison of the angles of various joints in the holding stage showed that the difference in mechanical characteristics between the two groups of athletes in this stage was mainly reflected in the upper limb joints. At the beginning, the excellent group had a larger elbow joint angle to realize the full stretch and utilization of the upper limb muscles and generate a forward force. Moreover, the larger joint angle of the right hip indicated that the excellent group pushed off the floor more fully and obtained a larger first step length. In the end, the angle of the left joint of the lower limb in both groups was greater than that of the right. At this moment, the left leg played the main supporting role, and the right leg swung up. In comparison, the angles of the left and right hip joints in the excellent group were greater than those in the ordinary group, indicating that the trunk tilted back more. The comparison of the right shoulder and elbow joint angles suggested that the upper limb joint angles of the excellent group were smaller, indicating that the upper limb muscle was contracted to match the lower limb force. In the comparison of the dynamic and kinematic characteristics of shooting techniques in proficient and non-proficient players' two-point and three-point shots, Cabarkapa et al. [29] found that professional players demonstrated greater elbow flexion and less hip joint flexion during shooting. The former is consistent with the research findings of this article, while the latter is inconsistent. This may be due to differences in the shooting movement studied.

The comparison of the height of the body's center of gravity showed that at the moment of jumping, the height of the three axes of the excellent group was greater than that of the ordinary group, but there was no significant difference ($p > 0.05$). From the perspective of a three-axis comparison, at the moment of landing, the body's center of gravity on the Z-axis was higher and the Y-axis was lower in both groups. When jumping, the center of gravity on the Z-axis was higher, and the X-axis was lower. The results revealed that the movement height of the body in the direction of the Z axis was larger when players performed this movement.

In the jumping stage, the joint angles of the lower limbs of both groups increased, and the lower limbs were fully extended to obtain effective force and reaction force. In the comparison of the joint angles of the lower limbs, the two groups showed no obvious difference, and the difference in mechanical characteristics was also reflected in the right shoulder and elbow joint angles. The right shoulder and elbow joint angle of the excellent group was significantly smaller than that of the ordinary group. At this moment, the right shoulder and elbow joint angles in the excellent group were close to 90°, i.e., the ball was slightly higher than the head, while the right shoulder and elbow joint angles of the ordinary group were too large, approaching full arm extension, which made it vulnerable to defense.

In the shooting stage, the difference in the shooting angle may be related to the jump speed and the degree of arm extension, and the higher shooting height and faster shooting speed are more conducive to getting rid of the interference of the defender and improving the probability of the ball entering the basket. From the comparison of the shooting parameters, it can be found that the excellent group got higher height and faster speed after jumping from the ground. Caseiro et al. [30] pointed out in their study on basketball shooting technique that the most meaningful improvement for training jump shot is to increase the release height of the ball, jumping higher, and shooting near the peak of the jump. Slegers et al. [31] found in their research that shooting performance is closely related to release speed and not influenced by shooting angle. Considering both our findings and existing literature, it is certain that shot parameters have an impact on shooting performance in basketball.

Based on the above results, in order to enhance the technical level of the ordinary group during the practice of the progressive one-handed underhand shooting movement, the following methods can be used: (1) Enhance training for explosive power and coordination in lower limbs to properly allocate shooting stride; (2) Strengthen training for core muscle groups and lower limb muscles to fully utilize force transmission for shooting; (3) Get as close as possible to the basket before releasing the shot during the release phase and increase release height; (4) Enhance training for small muscle groups in the wrist and forearm to increase release speed and achieve quick shooting.

The study in this article demonstrates the mechanical differences in the execution of the one-handed underhand shooting movement among athletes of different skill levels, providing insights for improving the technical proficiency of this movement. However, there are still some limitations, such as only considering the influence of skill level on this movement and having certain restrictions in participant selection. Moreover, the research was solely conducted from a kinematic perspective. In future work, expanding the sample size for further experiments, analyzing the effects of factors like gender and age, and incorporating electromyographic analysis to gain a deeper understanding of the key force generation points in this movement will be pursued.

5. Conclusion

This paper analyzed the mechanical characteristics of players with different levels when performing the progressive one-handed underhand shooting movement from the kinematics perspective. It was found that:

(1) the excellent group had a higher shooting percentage;

(2) in the holding stage, the first step length of the excellent group was 1.91 ± 0.03 m, which was remarkably higher than that of the ordinary group ($p < 0.05$);

(3) in the holding stage, the mechanical characteristics of the two groups were mainly manifested in the right shoulder and right elbow joints;

(4) in the jumping stage, the right shoulder and right elbow joints in the excellent group were significantly smaller than those in the ordinary group ($p < 0.05$);

(5) in the shooting stage, the excellent group had a smaller shooting angle and larger shooting height and speed ($p < 0.05$).

The analysis of the mechanical characteristics of the two groups can provide some targeted guidance for future training, thereby further enhancing the technical level of players.

Ethical approval: Informed consent was obtained from all subjects involved in the study.

Conflict of interest: The author declares no conflict of interest.

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