

Analysis of Physical Principles in Basketball Free Throw Shooting

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Abstract: The analysis of free throw shooting from a mechanical point of view can be of great benefit to the improvement of basketball skills. Free throws are an important offensive tool in basketball, and most of the points in basketball are scored through shooting and free throws. Therefore, the analysis of the mechanics in free throw shooting can be of great benefit to basketball players. The analysis of basketball free throws from a mechanical point of view can help basketball fans to improve their game.

Keywords: Mechanical perspective; Basketball; Free throw shooting

1. Introduction

1.1 Research background and significance

Basketball has been developed for over 100 years since 1891. It is a sport where the basketball and the basketball are the centrepiece of a collective attack and defence by five players, characterised by high speed, high intensity and, on top of that, high accuracy and hitting percentage. Therefore, “fast” is the direction of basketball, while “accurate” is the purpose of basketball. This means that the game of basketball is all about speed and accuracy under high speed and high intensity conditions. Despite the fact that in the early days there were no restrictions on the number of courts or people and the equipment was very simple, basketball soon attracted a large number of sports basketball fans due to its strong spectator, popular, fitness and confrontation characteristics, and therefore became rapidly popular and developed throughout the world. With the continuous development and improvement of basketball equipment and rules, basketball is fast becoming popular. At the same time, the technical skills of the players and the tactical cooperation between them have been greatly enriched and improved, making the game more and more intense. However, the rules of the game are constantly changing and evolving in order to make the game more enjoyable and smoothly played, and to push the game in a better direction. Shooting is one of the most important scoring tools in basketball offense, and free throws can be the difference between winning and losing a game in critical moments. With regard to the mechanics of free throws, in this paper we analyse the transfer of power and the rotation of the ball during free throws. By analysing these two aspects, it is possible to reveal the difficulties and issues to be aware of when making free throws. By highlighting the analysis of free throws, basketball fans can be more aware of the direction of their training and strive to improve their sport.

1.2 Current status of domestic and international research

1.2.1 Abroad Research Status

The study of Jackie I. Hudson, “A biomechanical analysis by skill level of free throw shoot in basketball” showed that better stability in basketball (e.g. maintaining balance of the centre of gravity versus vertical tilt of the trunk) was associated with higher shooting technique. With respect to the player’s standing height, a higher shot height ratio is associated with higher shooting technique; basketball shooting angle and shooting speed, when considered independently, are not associated with shooting technique.

The study of the pre-shot kinematic state required to obtain a suitable shot in basketball is the aim of the paper by B. Pflanz, flying ball trajectories are anticipated in basketball throwing. It is made by selecting seven male sports students who each have different levels of basketball skills to shoot free throws. The flight trajectory of the basketball is recorded by a 3D motion analyser (Qualisys Motion Capture Camera, Sweden, 240 Hz). The parabolic trajectory of the centre of the basketball in flight in the air can be extrapolated to the front of the shot. The difference between the horizontal position and the vertical position with the recorded and extrapolated trajectory is processed on the computer at a fractional speed. Furthermore, the variation in the movement parameters at the time of each basketball shot was given an assessment. These variables were then put into comparison with those differences obtained from experience. It was found that for the shooting position, after 39% of the acceleration phase, the detected trajectory of the basketball was very similar to the expected flight trajectory (EFT). This means that for speed, for 61% of the detected trajectories, it takes 92% of the acceleration interval for the basketball to get the right speed for the shot to go in the basket. Tests have shown that the speed of the shot is an even more important parameter for hitting the basket than the state of the shot.

1.2.2 Domestic Research Status

Li Shen and Liu Shuzhi analyzed this in the article “Characteristics of the kinematics and myoelectricity of the starting action of good male long jumpers”^[1]. Objective: To explore the specific characteristics of neuromuscular work during the long jump. Meth-

ods: The long jump jumping technique was selected as the study action and tested simultaneously using a high-speed camera and wireless telemetry surface electromyography equipment. The kinematic and electromyographic data of the athletes during the jump were measured and analysed using human biology and biomechanics theory. Results: The muscles contribute differently to the jump at different stages of the jump, but there is a common pattern. The quadriceps, gluteus maximus and triceps calf are the main muscles that contribute during the jump. In the paper “Kinematic and electromyographic signal characteristics of the swing leg in different kicking styles”, Yifeng Bu et al. analysed the kinematics and muscle mechanics of the swing leg in terms of the inward stance of the instep, the forward stance of the instep, the medial stance of the instep and the lateral stance of the instep. The feature analysis method shows that the four basic kicking methods have different characteristics in terms of swing time, swing amplitude and swing speed. The excitability of the back swing lifting swing leg was better and the excitability of the front swing lifting swing leg differed significantly. There were also significant differences in biceps and joints during forward rotation. There is a relationship between the degree of control and the accuracy of the kick.

1.3 The role of free throws in the game of basketball

According to the rules of basketball, we consider that free throws play a more important role in contemporary basketball.

From the 1950s to the 1980s, the technical and tactical development of basketball was still in the phase of joint defence and attacking defence. Offensive and defensive confrontations were not particularly intense and the number of fouls was not high. At that time, the rules provided for fouls in the last three minutes before free throws. After the 1970s, the offensive and defensive confrontations in basketball became more intense and man-to-man defensive strategies developed rapidly.^[2] The number of fouls in the game increased in relative terms. With a series of changes to the rules of basketball, 10 free throws committed in the first half became 8 free throws. After the seven fouls of the 1990s, basketball rule number 7 is still “1+1”. In a 2+20 game, when a player commits seven fouls at half-time, all subsequent fouls are two free throws. In a 4+12 minute game, when a player commits 4 fouls, the number of free throws will be the same. Because fouls increase free throws, free throws become more and more important and by focusing only on free throws and training more, the game will be more likely to be won.

Secondly, the rules have a new definition of shooting, which makes free throws even more important in the game. The rule is: if the player is standing in the air, the ball leaves the player’s hand and the player’s foot returns to the ground, the shot is completed. Clearly, the definition of the player’s shooting action is primarily in the air and the old rule has been extended. Therefore, whenever a jumper commits a foul before landing, i.e. a penalty, then they should be penalised with a free throw, so that the number of free throws increases and the free throw is related to the eventual winner.

In addition, Rule 48 of the Code states that violations of the Code of Sporting Ethics shall be punished by a penalty shot by the non-offending team. The Rule states that the player shall throw a cross at the penalty line and at the ends of the penalty line behind the finish line. This gives players the opportunity to grab the basket and shoot straight away, increasing the number of fouls. The number of free throws will increase.^[3] It provides for shooting, crossing the finish line, unsportsmanlike conduct, an increased number of game fouls and an increased foul penalty. In other words, there will be more free throws. Scoring free throws plays an important role in the final outcome of the game and free throws play a key role in the game. Therefore, teachers and athletes should pay special attention to free throw training in future training to improve the shooting percentage and strive for free throws.

2. Analysis of free throws from the angle of the shoot and the bending angle

In the game of basketball, with the constant development of modern basketball and the revision of the rules of the game, free throws have become an important part of the game and a very important part of scoring. There is a great deal of interest in this. Basketball is an open sport. Free throws are the only direct scoring in basketball that is uninterrupted by the opponent and unaltered by movement. In this chapter, 50 college students majoring in physical education were used to study the shooting angle, knee angle and their relationship with basketball free throw rate to provide reference data for future basketball and basketball training and to further increase the awareness and attention of athletes to free throws. Throwing the ball is of great significance to the development of basketball.

3. Conclusion

In conclusion, for basketball players of different heights, we cannot always assume which curve is necessarily better; we have to make free throws according to our own ability. The lower the starting point, the higher the shooting percentage and the higher the starting point, but playing the ball is not easy^[4]. In practice, coaches are used to asking players to shoot from the outside with no defence, so the hitting rate is usually high. In close games, against tough defences, the hit rate is much lower. Players can only be good basketball players if they score at a high rate from all angles, and many stars set the example for us.

References:

- [1] Liang Shuli, Xu Peng, Zhang Lin, et al. Research on the optimal shot parameters of penalty baskets based on mechanical analysis[J]. Journal of Liaoning University of Science and Technology, 2019, 42(3):6.
- [2] Zhang Jian, Yan Xia, Zhang Hong, et al. Comparative analysis of lower limb strength and correlation of mechanical parameters between basketball and football players during in-situ vertical jump[J]. 2021(2016-3):278-282.
- [3] Han Yunduo. Using mechanics to improve basketball shooting percentage[J]. Literature and Science Navigation: Educational Research and Practice, 2019(1):1.
- [4] Bao Chunyu, Meng Qinghua, Yan Mingming. Biomechanical characterization of the ankle joint in basketball players’ jumping action[J]. Journal of Applied Mechanics, 2019(2):8.

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