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APPLICATION OF BACK KICK TECHNOLOGY AND ACTION ANALYSIS OF BEIJING YOUNG MEN'S TAEKWONDO ATHLETES

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Abstract

The latest competition rules of taekwondo expand the score of turning technique and encourage athletes to use difficult techniques to increase the diversity of techniques and the appreciation of competitions. This paper obtains the characteristics of important action links of scoring technology from two aspects of technical and tactical application and technical action analysis. Back kick scoring technology mostly appears in the tactical state, is an important means of scoring. From the point of view of time characteristics, the speed of the back kick technique in the turning stage becomes the key to successful application, and there are major defensive hidden dangers in the kick reduction stage. The hip joint angle on one side of kicking leg of the kick scoring technique is less than that of the non-scoring technique in the knee lifting stage and the knee joint angle in the turning stage, and the knee joint angle of the non- scoring technique is less than that of the scoring technique in the knee lifting stage and kicking stage. Insufficient extension is an important factor that cannot score.

Keyword: back kick technique, movement characteristics, Taekwondo, three-dimensional kinematics analysis

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1. INTRODUCTION

The World Taekwondo Federation (WT) implemented the latest competition rules in June 2018. The new rules have greatly improved the score of the turning technique: the effective turning technique has increased the chest protection to 4 points; effective turn technique hits the head increased to 5 points. This paper focuses on the back kick technique in turn technique. Because the technique is relatively complex and difficult to defend after the action, the application and scoring of this technique in the game is not ideal. Therefore, this paper uses two means of technical statistics and technical action analysis, through the use of back kick technology in tactical state, summarizes the characteristics of the use of back kick scoring technology, and provides valuable reference for guiding training and temporary use.

In the past, there is little literature on the combination of technical statistics and technical action analysis in taekwondo project research. For example, Zhou Changtao uses SIMI motion video analysis system to analyze the three-dimensional image of the athletes and students ' splitting techni cal movements. The kinematic data such as the overall time of each athlete ’ s downward splitting te chnique, the time of each stage, the change of the relevant human joint angle and angular velocity, a nd the change of the human body center of gravity are analyzed and studied, without analyzing how

the technique is used in various tactics in the competition, and without technical statistical research. Scholars Lin Dashen, Gao Zhihong two major taekwondo finals as the research object for analysis. It is concluded that under the background of the new rules, the trunk scoring ability of Chinese athletes is weaker than that of foreign athletes, and female athletes are weaker than male athletes. The scoring ability of using rotary kick technology is similar at home and abroad. Rotating kick technology appears ' diversified ' combination trend ; technical and tactical integration trend, the study did not do technical action analysis. In this study, the use of back kick technology in the actual game is divided into two aspects, namely technical statistics and technical action analysis, so that people can more clearly understand how to use the back kick will be more effective score. In addition, the reason for choosing young athletes in Beijing as the research object is that they cannot collect competition videos elsewhere due to the impact of the new corona pneumonia epidemic, or because other competition levels are small and the sample size is not enough.

2. METHODS

The type of this study is descriptive. This study is applied to mathematical statistics. Based on probability theory, it uses statistical methods to analyze and study the data, and derives its conceptual regularity (namely, statistical law). Fastmove 3D motion analysis system is used to automatically parse the clipped video to obtain data. The obtained 3D coordinate data are smoothed by Butterworth digital filter in the cut-off frequency range of 5.8Hz ~ 9.3Hz. Smoothing index is based on ' kinematic comparison between back kick scoring technology and non- scoring technology '. The author uses this smoothing index to smooth the three-dimensional coordinate data of taekwondo athletes. Some unidentified connection points need to be manually completed. Then spss is used to process table data. In this paper, three-dimensional motion analysis software is used to analyze the obtained motion technology video and obtain the original kinematic data. After that, SPSS23.0 software is used to compare the differences between the kick scoring technology and the non-scoring technology in some kinematic parameters. Excel2003 is used to calculate the average and variance. Origin Lab2019b software is used to standardize the original data. Finally, the data are described to get the final conclusion.

Population & Sample

Beijing youth male taekwondo athletes kickback technology application and action characteristics. Using on-site shooting method, select the 2020 Beijing Youth Taekwondo Championships in 17-18 years old (born 2002-2003) of young men 's games, with a total of 38 games kicking technology.

Instrument

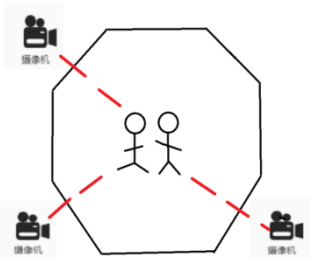
By retrieving the keywords of 'Tae Kwon Do', 'back kick technology', 'technology application' and 'three-dimensional kinematic analysis' in CNKI and Wanfang database, this paper retrieves relevant literature, summarizes and summarizes relevant journals and papers on Tae Kwon Do technology application and technical action analysis, and provides certain theoretical basis and research ideas for this paper. Fastmove-3D-Motion AI three-dimensional motion analysis system uses image recognition and deep learning technology to realize the unmarked automatic identification and three-dimensional motion analysis of human key points. It provides the worlds leading data analysis content for athletes and coaches, and provides digital support solutions for sports researchers. By analyzing multiple positions at the same time, the correct analysis data can be automatically selected and optimized, and the three-dimensional rotation data can be synthesized to reduce the error rate of rotation action recognition.

Procedure

The three-dimensional video analysis method is used to capture the images of athletes using kickback technology in actual combat, and then the video editing software is used to synchronize them.

Finally, the data is imported into Fastmove3DMotion software for analysis, which lays the foundation for the conclusion.

Three JVC high-speed cameras (shooting frequency:1080 Hz) were used to shoot at a fixed point and focus simultaneously. The tilt angles of the three cameras were about 45°, and the height from the ground was about 1.7 m. Camera exposure time is 1 / 800s, frequency is 50 frames / s, and manually focus. Use Adobe Premiere Pro2018 to synchronize clips from three angles. In the later stage, 20 human joints were selected according to the research. Through the use of Fastmove3D Motion 3D AI motion analysis system, artificial intelligence automatic marking and manual correction were carried out on the back kick technology. After obtaining the original data of related kinematics, 10 smoothing coefficients were selected for smoothing, and then kinematics analysis was carried out, including the time characteristics of each action stage and the change of joint angle.



Picture1 Site layout sketch

The whole process of back kick technical action is divided into four stages : turning stage ; knee lifting stage ; kicking stage ; post-kick restore phase. The back kick action process is divided into four moments in time : P1 : the starting point of the turning stage-the moment before the performer turns the body. P2 : The starting point of the knee-lifting stage-the moment when the implementer is about to lift the knee. P3 : End of the knee-lifting phase - minimum calf angle. P4 : the end of the kicking stage-kick foot completely hit the other player moment. P5 : Kick the end of the reduction phase-after the fight to restore the actual combat preparation posture moment. The specific division is as follows :

Picture2 -P2

Picture1-P1

Picture3 -P3

Picture4 -P4

Picture5 -P5

Data Analysis

By means of SPSS23.0, the differences between back kick scoring technique and non- scoring technique in some kinematic parameters are compared, the average value and variance are calculated by Excel 2003, and the original data are standardized by Origin Lab2019b software, so as to lay a scientific foundation for summarizing meaningful conclusions.

3. RESULT

Table 1 Statistical Table of Beijing Youth Taekwondo Male Athletes ' Technical Use in Competition

Technology	Use times (number)	Utilization rate (%)	Number of successes (number)	Success rate (%)	Scores (points)	Score rate (%)
Back kick	10	0.87	4	40.00	16	3.53
Back kick	15	1.33	2	13.33	8	1.87
Whirlwind kicking	4	0.30	0	0.00	0	0
Horizontal kick	749	65.54	87	11.62	181	40.04
Push kick	184	16.12	22	11.96	44	9.70
Straight fist	43	3.76	9	20.93	9	2.00
Bottom splitting	130	11.30	64	49.23	192	42.44
Double flying kick	6	0.54	1	16.67	2	0.42
kicking	2	0.24	0	0.00	0	0
Total	1143	100	189	——	452	100

Note: Utilization rate = number of technical use / total number of technical use. Success rate = number of technical successes/number of technical use. Score rate = a technical score / total score of using technology.

Through the above table, it is concluded that the male athletes in this competition have the highest utilization rate of horizontal kick technology, followed by push kick technology. Turning techniques are less used, but the use of back kicks is relatively high. In terms of success rate, the bottom-splitting technique has the highest success rate, followed by the back kick technique. In terms of scoring rate, back kick technology has become the fourth leg method after horizontal kick, split and push kick. It can be seen that this kind of technology is indispensable in the competition.

Table 2 The application of back kick in different tactical stages

Tactical stage	Use times (number)	Utilization rate (%)	Number of successes (number)	Success rate (%)	Scores (points)	Score rate (%)
Main attack stage	2	20	0	0	0	0
Attack stage	7	70	4	57.14	16	100
Counterattack stage	1	10	0	0	0	0
Attack and defense stage	0	0	0	0	0	0
attachment stage	0	0	0	0	0	0
Total	10	100	4	57.14	16	100

It is concluded from the above table that the use of male athletes ' back kick technology in this competition is most in the attack stage, and the success rate is high. Since the back kick technique belongs to the rotary kick technique, its action range is large and the time is long, which is the main reason why it is difficult to score in the active attack stage and is easy to be predicted by the opponent in advance. Back kick technology in the attack, not only can effectively crack the opponent ' s attack, but also due to the more penetrating force in the stage of kicking the opponent ' s attack center of gravity caused serious damage.

Table 3 Time Characteristics of Athletes ' Accomplishment of Kick Techniques (Units : Seconds)

Type of technology	Turning stage	Knee lifting phase	kicking stage	Recovery phase after kick	Total time
All technologies	0.41±0.13	0.13±0.02	0.15±0.03	0.79±0.34	1.55±0.39
Score technology	0.31±0.01	0.11±0.01	0.17±0.01	0.68±0.02	1.27±0.05
Non-score technique	0.44±0.13*	0.13±0.02	0.15±0.04	0.81±0.38*	1.62±0.41

Note : * Indicates a significant difference between scoring techniques and non-scoring techniques at $P < 0.05$

Through the above table, the average time for male athletes to use the back kick technique in this competition is (1.55 ± 0.39) seconds. The stages from long to short are : restoration stage after kicking, turning stage, kicking stage and knee lifting stage. Among them, the reduction stage after kicking accounts for almost half of the total dynamic action. The time of each stage of back kick scoring technique is shorter than that of non-scoring technique. There are certain differences in the use time of the scoring technique and non- scoring technique in each stage, among which there are significant differences in the turning stage and the reduction stage after kicking.

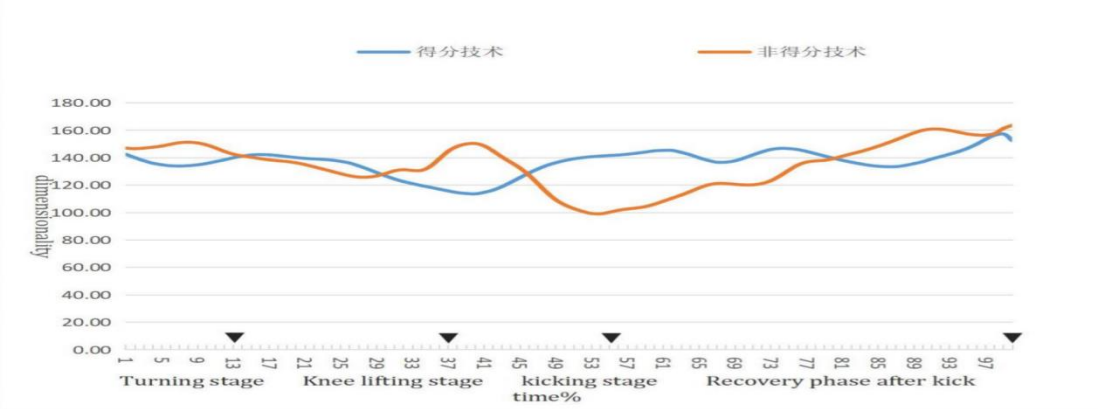
Table 4 Statistical table of hip joint angle at the end of each stage of kicking technique

Type		Turning stage	Knee lifting phase	kicking stage	Recovery phase after kick
Score technology	X	138.26	121.12	133.81	152.38

Non-score technique	S	8.30	5.09	8.70	15.38
	X	136.74	128.49*	130.78	163.76*
	S	9.22	5.41	9.14	26.73

Note : In this competition, the kicking leg of the back kicking technique is the right leg ; * indicates that there is a significant difference between P < 0.05 score technology and non-score technology ; x represents mean, S represents variance

From the above table, it can be seen that the hip joint angle of the kicking leg side of the post-kick scoring technique is greater than that of the non-kick scoring technique at the turning stage and the final moment of the kicking stage, and the hip joint angle of the kicking leg side of the non-kick scoring technique is greater than that of the scoring technique at the knee lifting stage and the kicking recovery stage. It shows that the hip angle of kicking leg side is smaller in knee lifting stage and recovery stage after kicking, which is more conducive to scoring.



Grapic 1 After kick score and non-score technology kick leg side hip angle contrast schematic diagram

By observing the above figure, it is found that the hip joint angle of the kicking leg side of the back kick non-scoring technique is too large in the knee lifting stage, resulting in kicking deviation and premature hip turning, which reduces the accuracy of kicking. The back kick scoring technique can extend the hitting range by extending the hip and extending the hip in the kicking stage. It requires the athlete to quickly aim at the target with residual light at this stage, so that the hip joint can be adjusted to a suitable angle. In addition, the conscious decrease of hip joint angle is conducive to the recovery after kicking and reduces the probability of being hit back.

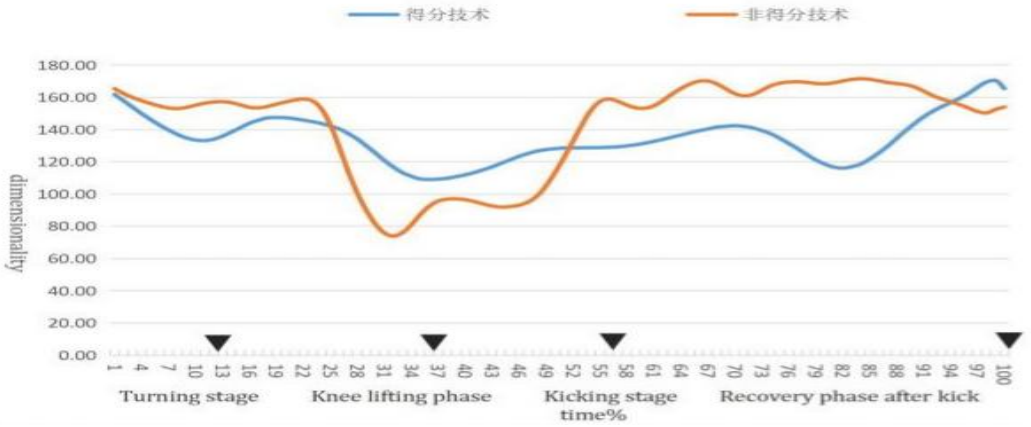
Table 5 Statistical table of knee joint angle of kicking leg side at the last moment of each stage of back kicking technology

Type		Turning stage	Knee lifting phase	kicking stage	Recovery phase after kick
Score technology	X	143.77	113.36	123.38	165.45
	S	2.35	10.12	12.21	7.46

Non-score technique	X	157.81	81.55	**87.20***	154.03
	S	9.68	9.01	7.37	6.87

Note : * Represents a significant indigenous difference between P < 0.05 score technology and non-score technology

From the above table, it can be seen that there are certain differences in the knee joint angles on one side of the kick at the last moment of each stage between the scoring technique and the non-scoring technique. After kick scoring technique only at the end of the turn stage scoring technique kick leg side knee angle is less than non scoring technique. Non- scoring technology in the turn stage, knee angle, resulting in too large and slow. There is a significant difference between the two in the kicking stage. In this stage, the knee joint angle on one side of the kicking leg is too small, which is not conducive to scoring, indicating that the kicking of the thigh is insufficient, resulting in insufficient space for kicking of the thigh. This is the main reason why technology does not score. This is related to the speed of turning, the timing of legs and the distance from the opponent.



Graphic 2 Comparison of knee angle between back kick score and non-score kick technique

When the back kick turns, the thighs and legs begin to fold, which is conducive to the action score. If the knee angle is too small in the kicking stage, it will make the thigh and calf do not have enough space to stretch, which is the key factor that cannot score successfully. In the recovery stage after kicking, athletes should consciously reduce the knee angle and fold the thighs and calves, which is conducive to the rapid recovery after kicking.

4. DISCUSSION

At present, athletes in China and abroad use less back kick technology in competitions, whi ch is due to its large action range and long time use, and this technology is mostly used in counteratt ack and attack tactics, which is consistent with the conclusion of this paper. Scholar Luo Zhongxian t ook the application of later kicking technology in the Rio Olympic Games as the research object, and studied the utilization rate and scoring rate of later kicking in different tactics.It is concluded that the backkick skills mainly appear in the counterattack and offensive tactics.When the score widens, the athletes will use fake to match the post-attacking kick.Accurate use of the technique can affect the c ompetition results.At present, most of the literature studies single movements, such as running, fenc ing, speed skating, and few studies have been conducted on complex movements. In the field of taek wondo is no exception, its research content includes the temporal and spatial characteristics of tech nology. The shooting process is carried out in the laboratory or training field, and there is no precede nt for obtaining data directly on the field, resulting in a certain blank in the study of difficulty technol ogy in actual combat. This paper realizes the acquisition of kinematics data on the real field, and mak es up for the blank of difficulty technology research.In addition, this study applied the artificial intelli gence system in the processing of data, which was more efficient. However, at the same time, the ap

plication of this technology in this paper also had some shortcomings. Artificial intelligence could not be completely accurate in identifying various joints of the human body, which needed manual calibr ation. However, it was undoubtedly a major breakthrough in the research method of taekwondo, an d the subsequent research needed to improve its efficiency.

5. CONCLUSION

1. The use of back kick technology in the game is relatively small, but the success rate is high. It is the main scoring technology in the game. The use and success scores are mostly in the state of attack tactics. 2. In terms of the time characteristics of the completed kick technique, the time spent in the turn stage is the key to scoring and non- scoring techniques. Both scoring and non- scoring techniques are used too long in the recovery stage after kicking, and there is a risk of being attacked after action. 3. The hip joint angle on one side of kicking leg of scoring technique is less than that of non- scoring technique in the knee lifting stage and knee joint angle in the turning stage, and the knee joint angle of non- scoring technique is less than that of scoring technique in the knee lifting stage and kicking stage. Insufficient extension is an important factor that cannot score.

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