BASKETBALL COURSE OPTIMIZATION BASED ON MECHANICAL CHARACTERISTICS

OTIMIZAÇÃO DO CURSO DE BASQUETE COM BASE EM CARACTERÍSTICAS MECÂNICAS

OPTIMIZACIÓN DEL CURSO DE BALONCESTO EN FUNCIÓN DE LAS CARACTERÍSTICAS MECÁNICAS

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ABSTRACT

Introduction: Currently, college basketball lacks evaluation criteria, making the teaching of many classes reduced to the study of superficial movements, preventing the optimization of the sport's intrinsic mechanical characteristics. Objective: Optimize the methodology of the basketball course by implementing the kinematic analysis of its key movements. Methods: Four elite athletes were selected as research subjects. Infrared reflective balls were used as markers on the right elbow joint, right shoulder joint, left hip joint, right knee joint, right ankle joint, and left ankle joint, among other areas. The mechanical characteristics of the possession preparation phase, the ground takeoff phase, the takeoff stage, and the landing phase were compared, classified, and analyzed kinematically by APA software. The data were processed by SPSS software. Experimental data were classified and analyzed using independent variance, considering significant differences for $P < 0.05$. Results: Differences in sports habits, physical conditions, and mechanical characteristics of elite athletes resulted in distinct joint angles, although within a common range. Conclusion: When optimizing the basketball course, teachers should fully study the experience of professional athletes and update and optimize the basketball course for students from a more scientific and technical point of view for a better orientation in the sports teaching of the basketball course. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Biomechanical Phenomena; Basketball; Academic Training.

RESUMO

Introdução: Atualmente, o basquete universitário carece de critérios de avaliação, tornando o ensino de muitas classes reduzido ao estudo de movimentos superficiais, impedindo a otimização das características mecânicas intrínsecas do esporte. Objetivo: Otimizar a metodologia do curso de basquete pela implementação da análise cinemática dos seus principais movimentos. Métodos: Quatro atletas de elite foram selecionados como sujeitos de pesquisa. Bolas reflexivas infravermelhas foram utilizadas como marcadores na articulação do cotovelo direito, articulação do ombro direito, articulação do quadril esquerdo, articulação do joelho direito, articulação do tornozelo direito, articulação do tornozelo esquerdo entre outras áreas. As características mecânicas da fase de preparação da posse de bola, a fase de decolagem do solo, a etapa de decolagem e a fase de pouso foram comparadas, classificadas e analisadas cinematicamente pelo software APA. Os dados foram processados pelo software SPSS. Dados experimentais foram classificados e analisados por meio de variância independente, considerando diferença significativa para $P < 0,05$. Resultados: As diferenças de hábitos esportivos, condições físicas e características mecânicas dos atletas de elite resultaram em distintos ângulos articulares, ainda que dentro de uma faixa em comum. Conclusão: Ao otimizar o curso de basquete, os professores devem estudar plenamente a experiência dos atletas profissionais, atualizar e otimizar o curso de basquete aos alunos do ponto de vista mais científico e técnico, para uma melhor orientação no ensino esportivo do curso de basquete. ***Nível de evidência II; Estudos terapêuticos - investigação dos desfechos do tratamento.***

Descritores: *Fenômenos Biomecânicos; Basquete; Formação Acadêmica.*

RESUMEN

Introducción: En la actualidad, el baloncesto universitario carece de criterios de evaluación, lo que hace que la enseñanza de muchas clases se reduzca al estudio de movimientos superficiales, impidiendo la optimización de las características mecánicas intrínsecas del deporte. Objetivo: Optimizar la metodología del curso de baloncesto mediante la aplicación del análisis cinemático de sus principales movimientos. Métodos: Se seleccionaron cuatro atletas de élite como sujetos de la investigación. Se utilizaron bolas reflectantes infrarrojas como marcadores en la articulación del codo derecho, la articulación del hombro derecho, la articulación de la cadera izquierda, la articulación de la rodilla derecha, la articulación del tobillo derecho y la articulación del tobillo izquierdo, entre otras zonas. Las características mecánicas de la fase de preparación de la posesión, de la fase de despegue en tierra, de la fase de despegue y de la fase de aterrizaje fueron comparadas, clasificadas y analizadas cinemáticamente por el software APA. Los datos se procesaron con el software SPSS. Los datos experimentales fueron clasificados y analizados por varianza independiente, considerando la diferencia significativa para $P < 0,05$. Resultados: Las diferencias en los hábitos deportivos, las condiciones físicas y las características mecánicas de los atletas de élite dieron lugar a distintos ángulos articulares, aunque dentro de un rango común. Conclusión: A la hora de optimizar el curso de baloncesto,

los profesores deben estudiar a fondo la experiencia de los deportistas profesionales, actualizar y optimizar el curso de baloncesto para los alumnos desde el punto de vista más científico y técnico, para una mejor orientación en la enseñanza deportiva del curso de baloncesto. ***Nivel de evidencia II; Estudios terapêuticos - investigación de los resultados del tratamiento.***

Descriptores: *Fenómenos Biomecánicos; Baloncesto; Técnica Formativa.*

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INTRODUCTION

Basketball has unique sports forms, auxiliary equipment and sports rules. Invented by Naismith, basketball has been roughly divided into two forms, the normal form of confrontation and the form of street basketball with performance.[1] The development of basketball is mature and the base of sports population is huge. All countries also have their own professional leagues, and basketball players have become professional. At present, China is accelerating from a big sports country to a powerful sports country, with multi-directional development of professional sports, campus sports and mass sports.[2] With the development of basketball, professional sports invent and create more technical actions and sports rules, improve the playability and interest of basketball, and make basketball more competitive; Basketball courses are carried out in Colleges and universities to attract more fans. Through the communication power of colleges and universities, the professional guidance of physical education teachers and the competition among colleges and universities, the activity of basketball projects is maintained and improved; For basketball lovers, while the project is developing, they urgently need to learn the technical movements and theoretical knowledge of basketball.

Basketball is a competitive sport combining attack and defense. The accuracy of shooting is very important to the competitive results. Sports biomechanics is a basic science with strong practicality. It guides sports practice. Basketball is a systemic antagonistic sport with physical, technical, wisdom and coordination requirements. The competition results are determined by the scores of both sides. Therefore, the scoring ability, technical characteristics, physical fitness of athletes and the tactical game of coaches and personnel allocation are particularly important.[3] Standardizing the use of basketball technical actions can score efficiently in the competition. The research on sports biomechanics of basketball technical actions is the basis of the development and progress of basketball projects.[4] Through the analysis and comparative analysis of biomechanics, it can provide effective technical action norms and professional theoretical system for athletes.[5] In order to further strengthen the scientific teaching of basketball, this paper starts with the biomechanical characteristics of basketball, obtains and analyzes the data of excellent basketball players, so as to scientifically optimize and improve the basketball course, in order to obtain better basketball education effect.[6]

METHOD

Through the registration and screening of volunteers, four athletes, numbered ABCD, were finally selected as the research object. The study and all the participants were reviewed and approved by Ethics Committee of huaiyin normal university (NO.19HUNUZ05). In terms of the selection of experimental instruments, the marker infrared reflective ball is selected and pasted in multiple areas including the right elbow, the right shoulder, the right hip, the left hip, the right knee, the left knee, the right ankle and the left ankle as the base point of data capture. Then, the tripod, camera, video processing software and APAs software are used to collect the obtained video, and according to the moving track of marker infrared reflective ball, the data is obtained to obtain the joint and mechanical characteristics of the four main stages of basketball, which is convenient for the later research.

In this paper, a large number of data are obtained through many experiments, and then the data are processed by SPSS software. The experimental data are sorted and analyzed by means of independent variance t-test. If $P > 0.05$, there is no significant difference, and if $P < 0.05$, there is significant difference.

RESULTS

Analysis on mechanical characteristics of ball holding preparation stage

Ball holding preparation is a common action in basketball and the basic action of many basketball action combinations. Therefore, firstly, the mechanical characteristics of ball holding preparation stage are analyzed. Through the integration of data, the results are as follows.

As shown in Table 1, in the preparation stage of holding the ball, athletes with different sports habits have certain differences in each joint angle.

The right elbow angle of athlete a is 146.1301 ± 3.8375 °, the right shoulder angle is 30.4687 ± 5.8239 °, the right hip angle is 102.1021 ± 5.8042 °, the left hip angle is 112.4178 ± 4.1966 °, the right knee angle is 103.7273 ± 3.8386 °, the left knee angle is 101.1743 ± 3.6372 °, the right ankle angle is 58.7457 ± 1.8236 °, and the left ankle angle is 53.2428 ± 4.8184 °.

The right elbow angle of athlete B is 142.0856 ± 4.3696 °, the right shoulder angle is 36.2826 ± 4.8194 °, the right hip angle is 108.8622 ± 2.7269 °, the left hip angle is 103.1631 ± 5.8409 °, the right knee angle is 94.9834 ± 3.6273 °, the left knee angle is 96.3665 ± 3.6343 °, the right ankle angle is 58.1893 ± 5.4903 °, and the left ankle angle is 56.1267 ± 2.7194 °.

The right elbow angle of athlete C is 142.5572 ± 3.8164 °, the right shoulder angle is 36.2559 ± 2.2447 °, the right hip angle is 103.2698 ± 1.4291 °, the left hip angle is 108.8477 ± 2.8378 °, the right knee angle is 101.6779 ± 1.8296 °, the left knee angle is 107.7590 ± 5.8429 °,

Table 1. Angle of each joint during ball holding preparation (unit: °).

Joint name	Athlete A	Athlete B	Athlete C	Athlete D
Right elbow joint	146.1301±3.8375	142.0856±4.3696	142.5572±3.8164	142.5870±5.1124
Right shoulder joint	30.4687±5.8239	36.2826±4.8194	36.2559±2.2447	46.1338±4.8402
Right hip joint	102.1021±5.8042	108.8622±2.7269	103.2698±1.4291	104.2590±2.8283
Left hip joint	112.4178±4.1966	103.1631±5.8409	108.8477±2.8378	105.9623±3.3861
Right knee joint	103.7273±3.8386	94.9834±3.6273	101.6779±1.8296	68.6536±3.6661
Left knee joint	101.1743±3.6372	96.3665±3.6343	107.7590±5.8429	75.2617±4.8257
Right ankle joint	58.7457±1.8236	58.1893±5.4903	52.3768±4.5397	52.9861±4.6399
Left ankle joint	53.2428±4.8184	56.1267±2.7194	48.6147±3.6382	49.3802±3.6153

the right ankle angle is 52.3768 ± 4.5397 °, and the left ankle angle is 48.6147 ± 3.6382 °.

The right elbow angle of athlete D is 142.5870 ± 5.1124 °, the right shoulder angle is 46.1338 ± 4.8402 °, the right hip angle is 104.2590 ± 2.8283 °, the left hip angle is 105.9623 ± 3.3861 °, the right knee angle is 68.6536 ± 3.6661 °, the left knee angle is 75.2617 ± 4.8257 °, the right ankle angle is 52.9861 ± 4.6399 °, and the left ankle angle is 49.3802 ± 3.6153 °.

According to the research in Table 1, due to the differences in physical characteristics, sports habits and other aspects of different athletes, the joint angles are different in the preparation stage of holding the ball, but they are kept within a certain range as a whole.

Analysis of mechanical characteristics in the stage of kicking off

As shown in Table 2, in the state of kicking off, the time for athlete a to kick off is (0.5312 ± 0.0100) s, and the total time for technical action is (1.1385 ± 0.0100) s, with a proportion of about 46.6434 ± 0.8620; The time taken by athlete B to take off from the ground is (0.3909 ± 0.0200) s, and the total time taken by technical action is (0.8589 ± 0.0200) s, with a proportion of about 46.6635 ± 0.2308; The time for the athlete to take off from the ground with C pedal is (0.2696 ± 0.0100) s, and the total time for technical action is (0.8327 ± 0.0300) s, with a proportion of about 33.8076 ± 0.4415; The time for athletes to take off on the ground with D is (0.3512 ± 0.0100) s, and the total time for technical action is (1.0324 ± 0.0100) s, with a proportion of about 34.0582 ± 0.6421.

As shown in Table 3, the forward and backward force of athlete a is (0.6214 ± 0.1198) n / kg, the transverse force is (0.0903 ± 0.0100) n / kg, and the vertical force is (34.8846 ± 0.0802) n / kg in the state of kicking off; The forward and backward force of athlete B is (0.1704 ± 0.0601) n / kg, the transverse force is (0.8189 ± 0.0300) n / kg, and the vertical force is (23.3335 ± 0.1505) n / kg; The forward and backward force of athlete C is (0.1198 ± 0.0200) n / kg, the transverse force is (0.1706 ± 0.0501) n / kg, and the vertical force is (27.0220 ± 0.0799) n / kg; The forward and backward force of athlete D is (0.1198 ± 0.0100) n / kg, the transverse force is (0.5217 ± 0.0401) n / kg, and the vertical force is (40.9540 ± 0.0599) n / kg.

Analysis of mechanical characteristics in the stage of taking off

In order to improve the shooting percentage of athletes, it is necessary to analyze the shooting angle and speed of athletes in the stage of taking off:

As shown in Table 4, in the empty hand state, the hand angle of athlete a is (56.3653 ± 0.5192) ° and the hand speed is (6.3646 ± 0.5112) m / S; The release angle of athlete B is (64.1672 ± 0.4793) ° and the release speed is (6.1308 ± 0.2486) m / S; The release angle of athlete C is (45.5445 ± 0.8553) ° and the release speed is (5.7813 ± 0.2105) m / S; The release angle of athlete D is (63.7375 ± 0.7617) ° and the release speed is (5.8612 ± 0.1492) m / s.

Analysis of mechanical characteristics in landing stage

In the process of basketball, landing does not mean the end of the game, but to complete one action and prepare for the next action. Therefore, the landing of basketball also has certain skills. In order to make a more scientific understanding of this aspect, this paper analyzes the mechanical characteristics of the landing stage from three aspects: forward and backward force, transverse force and vertical force:

As shown in Table 5, at the moment of landing, the forward and backward force of athlete a is (0.6392 ± 0.0799) n / kg, the transverse force is (0.8528 ± 0.0100) n / kg, and the vertical force is (43.9128 ± 0.0502) n / kg; The forward and backward force of athlete B is (0.1103 ± 0.0499) n / kg, the transverse force is (0.0401 ± 0.0100) n / kg, and the vertical force is (45.9003 ± 0.1304) n / kg; The forward and backward force of athlete C is (0.4114 ± 0.1099) n / kg, the transverse force is (0.7818 ± 0.0902) n / kg, and the vertical force is (31.4790 ± 0.1204) n / kg; The forward and backward force of athlete D is (1.1137 ± 0.0301) n / kg, the transverse force is (0.5813 ± 0.0100) n / kg, and the vertical force is (36.4925 ± 0.1104) n / kg.

DISCUSSION

Scientific teaching should pay attention to the publication and distribution of basketball related teaching materials, use the Internet to spread professional knowledge, and update advanced technical actions and basketball concepts in real time. Professional sports events should learn from athletes through media communication or design professional basketball columns. Sports schools should have a professional regular talent training system to guide athletes. Amateurs should learn relevant theoretical knowledge as much as possible to ensure scientific and high-quality basketball. They should cultivate a professional coach team, provide relevant technical guidance for sports, customize different training plans for different athletes, focus on basic training and physical ability training, and ensure that athletes maintain a good competitive state. Basketball amateurs have a high-quality basketball experience.

Different technical and psychological teaching is carried out for different age groups and different student groups. Due to different training purposes of different groups, the exercise intensity is also different. Through professional technical teaching, it is necessary to ensure the technical action norms of each group and avoid sports injury.

For college students, their minds are not mature enough. At the same time of teaching technology, we should do more psychological counseling, emphasize basketball as a team competitive sport, pay attention to cooperation, strengthen cooperation, cultivate college students' correct collective values, cultivate college students' positive

Table 2. Analysis on time-consuming characteristics of landing and take-off stage (unit: s).

Option	Athlete A	Athlete B	Athlete C	Athlete D
Time for kicking off	0.5312±0.0100	0.3909±0.0200	0.2696±0.0100	0.3512±0.0100
Total time of technical action	1.1385±0.0100	0.8589±0.0200	0.8327±0.0300	1.0324±0.0100
Proportion	46.6434±0.8620	46.6635±0.2308	33.8076±0.4415	34.0582±0.6421

Table 3. Analysis of mechanical characteristics at the moment of kicking off (unit: N / kg).

Option	Athlete A	Athlete B	Athlete C	Athlete D
Front and backward	0.6214±0.1198	0.1704±0.0601	0.1198±0.0200	0.1198±0.0100
Horizontal force	0.0903±0.0100	0.8189±0.0300	0.1706±0.0501	0.5217±0.0401
Vertical force	34.8846±0.0802	23.3335±0.1505	27.0220±0.0799	40.9540±0.0599

Table 4. Analysis of mechanical characteristics in the stage of empty release.

Option	Athlete A	Athlete B	Athlete C	Athlete D
Show angle (°)	56.3653±0.5192	64.1672±0.4793	45.5445±0.8553	63.7375±0.7617
Show speed (m / s)	6.3646±0.5112	6.1308±0.2486	5.7813±0.2105	5.8612±0.1492

Table 5. Analysis of mechanical characteristics at the moment of landing (unit: N / kg).

Option	Athlete A	Athlete B	Athlete C	Athlete D
Front and backward	0.6392±0.0799	0.1103±0.0499	0.4114±0.1099	1.1137±0.0301
Horizontal force	0.8528±0.0100	0.0401±0.0100	0.7818±0.0902	0.5813±0.0100
Vertical force	43.9128±0.0502	45.9003±0.1304	31.4790±0.1204	36.4925±0.1104

state and sense of winning or losing, and avoid negative psychological state in daily life caused by negative competition.

CONCLUSION

This paper studies the mechanical characteristics of elite basketball players in several main stages of basketball, so as to have a more scientific cognition and understanding of basketball. The research results show that in basketball, different sports habits and their own physical conditions will make certain deviations in all aspects of mechanical characteristics, but the overall maintenance is within a range, and these professional athletes can make full use of their own advantages and reduce the impact of disadvantages on their own shooting and competition, so as to obtain a better competitive state. This knowledge can facilitate college physical education teachers to absorb experience when teaching basketball to college students, and optimize the basketball curriculum in a scientific way in combination with the actual situation of students, so as to make the college basketball curriculum better link with professional and professional sports under the condition of fitting the basis of students, so as to obtain a more professional teaching level and better teaching effect.

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