Research and Analysis on Knee Joint Injury and Rehabilitation of Badminton Players

Baoqiang Li

Department of Sports, Xi'an Polytechnic University, Xi'an, 710048, Shaanxi, China

Keywords: Badminton; Knee joint; Injury

Abstract: Badminton is a sport with high physical and technical requirements. The bearing capacity of each joint is limited. When an action exceeds the limit that the body can bear, the body will suffer various acute or chronic injuries. Through investigation, it is found that the probability of knee joint injury of badminton athletes is relatively high. With the continuous popularity and improvement of badminton, knee joint injury has become a psychological obstacle to badminton enthusiasts to play their technical level. In view of the continuous development and improvement of badminton skills and tactics, diversified technical means are also applied to test and guide badminton training. This paper analyzes the causes, types and treatment methods of knee joint sports injuries in badminton, aiming to provide theoretical basis for badminton enthusiasts to prevent and treat sports injuries.

1. Introduction

Badminton is one of the traditional sports in our country, which integrates athletics, fun, fitness and entertainment. It can enhance the functions of human circulation, respiration and other systems, and improve the body's speed, strength, endurance, flexibility, sensitivity, coordination and other qualities [1]. Make the body develop in an all-round way and achieve the aim of strengthening body constitution and promoting health. Badminton belongs to the skill-oriented type of net-separated competitive event group, and has the characteristics of intense antagonism, high intensity of sports, no time limit for competitions, etc. [2]. The ability of human body joints to bear load is limited. When an action exceeds the limit that the body can bear, the body will suffer various acute or chronic injuries [3]. Badminton players need to make various complicated technical moves on the court. Although there is no direct physical confrontation of the athletes, the complexity, suddenness and continuity of the exercise steps are very strong [4]. Some problems in badminton technology, such as the lack of force in the previous quotation and force action, will directly affect the accuracy of the shot [5]. With the continuous popularization and improvement of badminton, the injury of the knee joint has become a psychological obstacle to the technical level of badminton enthusiasts.

In the air, the trajectory and the change of the landing point of the badminton are changing rapidly. This requires the badminton player's lower limbs to have the explosive force of rapid take-off and the fast moving and braking ability to move forward, backward and to the sides. To reach about 22 meters per second [6]. From the perspective of sports footwork, the lower limb movements of badminton players on the field have emergency stop, rush, retreat, take off, etc. [7]. In badminton competitions and training, the changes in the ball path are irregular and the transition between offense and defense is rapid. In this process, the participants often perform sudden start, change before and after, and so on in the abnormal state [8]. In view of the continuous development and improvement of badminton techniques and tactics, diversified technical means are also used to test and guide badminton practice training [9]. Based on his own experience in badminton teaching and training, this paper analyzes the characteristics of knee joint movement and the causes of injury in badminton sports, and proposes preventive measures for knee joint injury.

2. Special Characteristics and Damage Characteristics of Badminton

In badminton training and practice, excessively practicing too many times or repeating exercises

  DOI: 10.25236/issetc.2019.013

for a certain exercise is too long, beyond the scope of the body, which will lead to chronic strain or acute damage to the joint. The human body is structurally connected by various joints, so the human body can be simplified into a chain of links when studying human motion [10]. When the end of the link chain produces great strength and speed, the form of motion of the limb often appears to accelerate and brake from the proximal end to the distal end. The speed of each link also appears from the proximal end to the distal end. increase. During training and competition, technical movements change quickly, change directions more and respond more. If athletes do not protect themselves, they will be easily injured. Footwork occupies the core position in badminton technical movements, and it is also the starting movement of most technical movements of badminton. Flexible mastery of badminton footwork can enable badminton players to quickly change positions to move to the best position to finish hitting the ball and return to the preparation position or move to the next position to prepare opponents to return to the ball.

It takes a certain time for athletes to recover from knee injuries. If they are trained too early, acute injuries can turn into chronic injuries, so the timing of training should be grasped. The subjects were professional badminton players. All the subjects were right-handed and had no history of disease. They were in good physical condition and had no intense exercise within hours. Details are shown in Table 1.

Table 1 Specific circumstances of athletes

	Number of cases	Height (cm)	Age	Weight (kg)
Male	300	175±3	25±2	70±10
Female	300	168±3	25±2	105±10

During badminton training and competition, participants often perform repeated advances, retreats, and twists in a short distance, and the knee joints are subjected to a large load. The quality of the frontcourt is largely determined by the outcome of the game. The frequency of the footwork used by the badminton team members in the competition was summarized. As shown in Table 2.

Table 2 Frequency of footwork used by players in the competition

Name of footwork	Male	Female
Step by step	1261	647
Step forward	612	339
Cross step	432	278

When the load exceeds the limit it can bear, it will cause acute or chronic injury to the knee joint. From the point of view of sports mechanics, for the foot flexion movement that rapidly pushes off the ground, the joint that finally occurs must be the metatarsophalangeal joint. Its flexion and extension features can have an important impact on the running and jumping movements of the human body, especially on the stare-off effect at the later stage of support. Some coaches emphasize the training of the flexor and extensor muscles of the toe joint in training, especially in sprints, jumps and other events with the toe joint kicking off the ground. In these projects, the strength of flexor and extensor of the toe joint increases, which can make the heel more stable off the ground. Recent studies have shown that the metatarsophalangeal joint also plays an important role in foot movement. The change of the flexion characteristics of the metatarsophalangeal joint can have an important impact on the kick-off effect in the later period of running and jumping support. When the receptors distributed in the attachment of ligaments and bones are stimulated by this stimulus, they will send out signals to regulate the movement of the body through the central nervous system, thus playing a protective role on the vulnerable parts and avoiding their damage.

3. Analysis of Knee Joint Injury Mechanism Based on the Characteristics of Badminton Events

1) Master the Correct Technical Actions

Badminton is a highly skilled sport. Incorrect technical movements cause rapid, variable and

strained changes in knee joint injury training and competition. If athletes do not protect themselves, they will easily be injured. Badminton action consistency refers to the basic consistency of technical action before hitting, but in different hitting techniques, the moment before hitting shows the slight difference of hitting point, hitting time, batting racket surface and hitting direction in strength, speed and direction. The consistency of action is based on the integrity of action. As long as the action is complete, the difference between the action and the action will be reduced, and the technique of each technical action will be close to the same. In order to increase the efficiency of badminton players' footwork, badminton shoes are constantly updated on the basis of defining the characteristics of badminton footwork, so as to achieve the effects of increasing wearing comfort, improving footwork movement performance and protecting feet, thus preventing injuries. In fact, the higher the level in the competition, the chance in attack is often created by the confrontation of balls in the middle section.

If the fast ball is played quickly, the physical strength will be greatly consumed. According to the characteristics of badminton, medial collateral ligament of knee joint is more easily injured, followed by sprain of anterior cruciate ligament of knee joint. Table 3 shows the characteristics of elbow angle changes in the two stages when the subject hits the drop ball and kills the ball.

Table 3 Characteristics of elbow joint angle changes in two stages when hanging the ball and killing the ball

Defeat type	First stage	Second stage
Drop the ball	20.16±2.18	26.33±1.99
Kill the ball	36.92±3.24	40.04±2.72

2) Creating a Good Sports Environment

Wedge structures with different heights are added to the front sole of badminton shoes, which extend and increase to the distal end at the metatarsophalangeal joint, increasing the dorsiflexion angle of the existing toe joint, thus affecting the muscle movement state. We will study whether this specially designed badminton shoe can improve badminton athletes' athletic performance and how the wedge-shaped structure of the front palm will affect lower limb movements. In the whole process from landing to landing in the stride of the left front field, different shoes have no influence on the time from landing to landing, the time of buffering and stretching, and the proportion of stretching time to landing time. As shown in table 4.

Table 4 Time for different shoes to land to ground, buffering and stretching time and stretching time

Action type	Shoe a	Shoe b	Shoe c
Support time (ms)	565.2	565.7	565.5
Buffer time (ms)	247.8	248.1	247.9
Extension time (ms)	315.9	317.4	316.2

At touchdown time, the knee flexion angle of the left forward pedal stride is significantly larger than that of the right forward pedal stride. And the plantar flexion angle of ankle joint is significantly larger than that of stride ankle joint in front of right field pedal. The touchdown angle at touchdown time is significantly smaller in the left frontcourt than in the right frontcourt. The angle between the lower leg and the ground when the left front ground step is also significantly smaller than the angle between the lower leg and the ground when the right front ground step touches the ground. Many students didn't realize the difficulty of learning badminton skills and the importance of mastering correct skills ideologically. They only relied on their enthusiasm for badminton, resulting in wrong technical movements, which are most likely to cause injuries in sports. We should grasp the opportunity of training and avoid repeated or multiple injuries. At the same time, we should strengthen the education of prevention of sports injuries and popularize the knowledge of prevention and treatment of sports injuries.

4. Conclusion

In sports training, attention should be paid to the arrangement of content and load according to physical characteristics, training level and training period. Ideological education for athletes should also be strengthened to establish a correct outlook on life and world outlook. The prevention of knee joint injury can be realized by improving the strength, flexibility and endurance of the knee joint. Before training or exercise, the knee joint should be well prepared, and vigorous energy should be maintained during exercise. When physical strength decreases and body fatigue occurs, great exercise exercises should be avoided as much as possible to prevent injury. On the basis of not affecting the action sensitivity, the torsion resistance of the forefoot of badminton shoes should be properly increased to reduce the turnover of the forefoot, thus reducing the load to move inward. In badminton teaching, making full use of electronic equipment for teaching is conducive to students'self-examination and self-correction, and more targeted to optimize their own technical posture. At ordinary times, strengthen knee strength exercises, such as squatting, squatting and so on. In the training process of elite badminton players, excessive pursuit of rigid technical specifications and neglect of specific physical fitness training may be a major misunderstanding of elite athletes'training. Strengthening the special physical training of elite badminton players is the key to improve the technical details.

References

[1] Myer G D, Ford K R, Foss K D B, et al. A Predictive Model to Estimate Knee-Abduction Moment: Implications for Development of a Clinically Applicable Patellofemoral Pain Screening Tool in Female Athletes [J]. Journal of Athletic Training, 2014, 49(3):389-398.

[2] Sugimoto D, Alentorn-Geli E, Mendiguchía, Jurdan, et al. Biomechanical and Neuromuscular Characteristics of Male Athletes: Implications for the Development of Anterior Cruciate Ligament Injury Prevention Programs [J]. Sports Medicine, 2015, 45(6):809-822.

[3] Slater A, Campbell A, Smith A, et al. Greater lower limb flexion in gymnastic landings is associated with reduced landing force: a repeated measures study.[J]. Sports Biomechanics, 2015, 14(1):45-56.

[4] Lam K C, Thomas S S, Valier A R S, et al. Previous Knee Injury and Health-Related Quality of Life in Collegiate Athletes [J]. Journal of Athletic Training, 2017, 52(6):534-540.

[5] Lam K C, Markbreiter J G. The Impact of Knee Injury History on Health-Related Quality of Life in Adolescent Athletes [J]. Journal of Sport Rehabilitation, 2017:1-17.

[6] Geng B, Wang J, Ma J, et al. Narrow Intercondylar Notch and Anterior Cruciate Ligament Injury in Female Nonathletes with Knee Osteoarthritis Aged 41-65 Years in Plateau Region[J]. CHINESE MEDICAL JOURNAL, 2016, 129(21):2540-2545.

[7] Cvetkovic S, Jakovljevic N, Simic D, et al. Popliteal artery injury following traumatic knee joint dislocation in a 14-year-old boy: A case report and review of the literature[J]. Vojnosanitetski Pregled, 2014, 71(1):87-90.

[8] Beynnon B D, Hall J S, Sturnick D R, et al. Increased Slope of the Lateral Tibial Plateau Subchondral Bone Is Associated With Greater Risk of Noncontact ACL Injury in Females but Not in Males: A Prospective Cohort Study With a Nested, Matched Case-Control Analysis[J]. The American Journal of Sports Medicine, 2014, 42(5):1039-1048.

[9] Marouane H, Shirazi-Adl A, Hashemi J. Quantification of the role of tibial posterior slope in knee joint mechanics and ACL force in simulated gait[J]. Journal of Biomechanics, 2015, 48(10):1899-1905.

[10] Ferenc Hermán, Kálmán Magyar, Katalin Kovács, et al. Combined Effects of Fatigue and Surface Instability on Jump Biomechanics in Elite Athletes[J]. International Journal of Sports Medicine, 2017, 38(10):781-790.