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Basketball and Rugby Ankle Sprain Causes and Preventive Strategies

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Abstract. Under the development of competitive sports, acute ankle sprain has become one of the most commonly seen injury types in basketball and rugby, with a high incidence rate. This type of injury will not only lead to absence in short-term training and matches, but its high recurrence rate will also lead to chronic ankle instability. This research aims to compare and analyze the causes and risk factors of injuries in basketball and rugby. Previous studies have shown that ankle injuries in basketball belong to non-contact injuries, mostly happen during jump landing and direction change; in contrast, rugby injuries mostly happen because of strong physical collision and forced rotation. The two sports share common internal risk factors including previous injury, weak muscle strengthening, poor balance and worse proprioception, while differing in injury mechanism, field environment and movement patterns. Effective prevention includes 12-week progressive neuromuscular training, various external support such as ankle braces and tape, and equipment optimization based on environmental factors. This study provides scientific evidence for reducing injury risk and has significant meaning in extending athletes' professional longevity.

Keywords: Basketball, rugby, ankle sprain, risk factors, preventative strategies.

1. Introduction

With the rapid development of competitive sports, basketball and rugby have become worldwide team sports with high athletic demand and wide participation. However, movement patterns with high-intensity, frequent physical confrontation, on-going acceleration, deceleration, and rapid direction change in the two sports lead to a high incidence rate of acute ankle sprain [1,2]. As the most commonly seen type of musculoskeletal injury in field sports, ankle sprain often causes acute pain, short-term training absence and competition absence with a high recurrence rate [2,3]. In the long term, repeated ankle sprain will further develop into chronic ankle instability, joint degeneration, and even lead to post-traumatic osteoarthritis and seriously damage athletic performance, physical health, and sports career [3,4]. As a result, studying the injury mechanism, risk factors, and prevention strategy of ankle sprain in basketball and rugby has high theoretical value and practical significance.

In recent years, scholars at home and abroad have done a lot of epidemiological studies about ankle injuries in sports. Available evidence has shown that there is a difference in ankle sprain injury mechanisms between basketball and rugby. Basketball contains loads of vertical jumping, landing,

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sudden stops, and cutting movements. As a result, ankle sprain is mostly a non-contact injury highly related to unstable landing or landing on another player's foot [1,2]. By contrast, rugby is a typical type of high-contact sport, including frequent tackling, body collision, scrum, and forced twisting, so ankle sprain is a common contact injury that often happens with syndesmotic injury [5]. Previous studies have revealed that rugby and basketball sports contain common risks, including previous injury history, lack of peroneal muscle, worse balance ability, reduction in proprioception, insufficient warm-up, and lack of external protection like ankle brace and tape [3,4]. At the same time, neuromuscular training and external support have been proven to be effective in reducing ankle injury risk [4].

Although there is a significant amount of single-sport research about ankle sprain, systematic comparative analysis between basketball and rugby is insufficient. The two sports differ in field environment, court type, movement characteristics, and confrontation intensity, but they share similar internal risk factors and external risk factors. Till now, a comprehensive comparison of injury mechanisms, risk factors and prevention focus between basketball and rugby is still insufficient, while this analysis is beneficial to build universal prevention rules and targeted strategies.

As a result, this study focuses on athletes in basketball and rugby fields, systematically comparing the etiological characteristics, injury mechanism, and risk factors of ankle sprain, and building a scientific preventative strategy based on summarizing similarities and differences. The framework contains three parts, including etiological analysis. Similarity and difference comparison and prevention strategy construction. This research aims to reduce ankle injury risk, develop sports medical protection levels, and provide evidence-based references for extending sports careers.

2. Etiological analysis of ankle sprains in basketball

In basketball, most ankle sprains belong to non-contact injuries, which often happen in the process of direction change, jumping, landing or foot stepping [6]. In rugby, ankle sprain mainly comes from physical collision, tackle or unstable landing on an outdoor grass field [7]. The recurrence rate of these kinds of injuries is very high, and they are closely related to sport-specific movement [8]. These cases offer solid evidence for our further exploration of causes and prevention.

Ankle sprain is the most common and typical injury of basketball athletes [1]. Basketball contains a lot of explosive and repetitive activities, such as jumping, landing, sprinting, direction change, sudden stop, and cutting with rotation, which all induce repetitive and great mechanical stress on the ankle joint [1]. Most of the basketball-related ankle sprains are non-contact injuries, which do not occur when another athlete or player is directly contacted [1]. Usually, this kind of injury will cause lasting pain, competitive absence, and even long-term chronic ankle instability [2,3].

Firstly, movement-related factors are the direct causes of ankle sprain in basketball. Athletes need to complete many rapid directions change activities, vertical jump, and land with an unstable body weight distribution during training and competition [1]. It has been reported that half of the ankle sprains happen during the landing phase, especially when another athlete's foot is stepped on or when the athlete lands with incorrect posture [2]. If the excessive ankle inversion happens when a basketball athlete is landing, the sudden and intense stretching of the lateral ankle ligaments will happen and then a sprain of the lateral ankle ligaments will occur directly [3]. Sudden stop and cut also reduce the stability of the ankle joint and greatly increase the risk of injury [1].

Secondly, athletes' intrinsic physical factors will further increase the risk of injury. Many athletes do not have adequate muscle strength around the ankle joint, especially the peroneal muscle, which can cause incorrect posture and injury. In addition, balance and proprioception are also important factors that increase the risk of injury to the ankle joint. Athletes with poor balance will have a high

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risk of injury when they are landing and moving [3]. A previous history of ankle injury is another important risk factor for ankle joint injury. It has been reported that athletes with a history of ankle sprain will have five times higher injury risk than other athletes without any history of injury because the previous trauma will induce chronic ankle instability [2].

Thirdly, extrinsic factors will also trigger the occurrence of ankle sprain. Lack of adequate warm-up before training and a match is very common. Many athletes do not complete sufficient dynamic warm-up and target stretching before training or a match, which will make their muscles and ligaments too tight, slow down their neural reaction speed and increase the risk of sprain [3]. Lack of proper and suitable shoes will also increase the risk of injury to the ankle joint; for example, basketball shoes with air cushioning on the air cushioning of heel will decrease the stability of the ankle joint and affect the active control of the ankle joint [2]. In addition, most athletes do not use any external protection on their ankle joint, such as an ankle brace or athletic tape. If the ankle joint does not have any mechanical external protection, it will be much more likely to be injured during repetitive and high-intensity dynamic movement [3].

In summary, ankle sprain in basketball is the result of the combination of movement factors, physical factors and insufficient external protection. High frequency movement, such as landing, direction change and jumping, will create continuous pressure on the ankle joint, which becomes the fundamental basis for the occurrence of ankle sprain. Weak muscle strength, poor balance and previous injury history will further increase the injury risk. At the same time, external problems like insufficient warm-up, inappropriate shoes and lack of protective equipment can make the ankle joint unstable during high-speed movements. These risk factors together explain why there is always a high injury risk in the ankle joint in basketball athletes [1-3].

3. Etiological analysis of ankle sprains in rugby

Ankle injury is one of the most common lower extremity injuries seen in rugby [7]. As a typical example of high-contact, rugby contains physical movements like frequent physical collision, tackle, scrum, rapid direction change, sudden twisting and landing from jumping [5,7]. Different from basketball, ankle sprain in rugby is more related to forced twisting under contact or physical confrontation [7]. The risk factors of rugby ankle sprain can be divided into three main categories: movement and contact factors, internal physical factors and external environmental and training factors [3,9].

First, movement patterns and contact behaviors are the most direct risk factors of rugby ankle sprain. The most typical injury mechanism in rugby is forced dorsiflexion, and eversion, forced rotation and excessive inversion of the ankle joint during collision and tackle [7]. During the process of tackling, athletes' ankle joints are often squeezed or stepped on by their competitors, which may lead to acute ligament sprain and even syndesmotic injury [5]. Existing research indicates that rotational movements and physical contact are the top two injury mechanisms for lower extremity injuries in rugby, with the ankle joint being the most commonly affected anatomical site [7]. In addition, rapid direction change during high-speed running, sudden stop and unstable landing will also cause non-contact ankle sprain when the athlete is fatigued or in poor ankle joint control [7,9]. These types of injuries often happen due to excessive traction on the lateral ligament when there is a fixed foot or rapid lower limbs rotation [3,5].

Second, intrinsic physical factors significantly increase the risk of ankle sprains in rugby players. Limited ankle dorsiflexion range of motion is a strong predictive factor for non-contact ankle sprains in this population [9]. Athletes with smaller dorsiflexion will have worse movement ability, as being more easily injured in rapid direction change and landing [9]. Athletes with higher body

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weight and BMI will have higher ankle loading during confronting and landing, hence increasing injury risk [3,9]. Previous ankle injury history is one of the most important risk factors [3,7,9]. Athletes with previous ankle injury history tend to have a higher possibility of experiencing chronic ankle instability, leading to a higher recurrence rate [3,7]. In addition, insufficient muscle strength, especially weak peroneal muscles, poor balance and proprioception, will further weaken ankle joint stability and increase injury risk [3,9].

Third, extrinsic causes, including training protocol, environment and protection, are also the reasons for ankle injury in rugby players. Insufficient preseason training and warm-up make the muscles and ligaments stay in a stiff state and respond slowly, and then the incidence of injury will be enhanced [9]. It is reported that athletes who accept more intensive preseason training may have a higher risk of injury. The training volume is increased, and the physical confrontation is fiercer in the preparatory stage [9]. In addition, improper rehabilitation after injury and re-injury due to hasty return to competition after ankle injury are also important reasons for repeated ankle injury [7,9]. Also, lack of protective gear matters. If not wearing an ankle brace or tape, the protection of the ankle joint will be weakened [3,7]. Besides, if the grass is slippery and the field is uneven, the balance of players will be lost when running and tackling, and then the ankle injury will occur [7].

Furthermore, match fatigue and high-intensity confrontation in rugby games will further enhance the risk of injury [7,9]. As a sport with long match duration and continuous physical consumption, athletes' muscle control ability and joint stability will be reduced during the late stage of matches [9]. Fatigue-related movement deformation and slow response will result in untimely adjusting body position after tackling or landing and further cause ankle injury [7,9]. Previous studies also confirm that professional rugby players face higher injury risk than amateur athletes, owing to greater competitive intensity and faster movement speeds [7,9].

To sum up, ankle sprain in a rugby player is a result of high-intensity confrontation, violent twisting movements, physical weaknesses and lack of external protection and training management [3,5,9]. Forced rotation, squeezing and stepping on during collision and tackling are the most direct injury mechanisms. Limited dorsiflexion, high body weight, previous injury history and weak muscle strength make up the intrinsic risk factors. External causes include insufficient warm-up, inappropriate rehabilitation, lack of protection and poor field conditions. Understanding these factors helps develop targeted prevention plans, enhance physical training and movement techniques, and complete protection and rehabilitation management, which reduce ankle injury in rugby [3,7,9].

4. Similarities and differences in ankle sprain risk factors between basketball and rugby

This section systematically compares the similarities and differences of the risk factors of ankle sprain in basketball and rugby. Athletes in both sports have to frequently complete direction change, sudden stop, jump and landing, which creates relatively high mechanical stress to the ankle joint [1,6,7]. Previous ankle injury history is a significant risk factor in both sports, which can increase the rate of chronic ankle instability and recurrent sprain [2,3,7]. At the same time, lack of muscle strength, poor balancing ability and proprioception contribute to ankle injuries in both sports. Moreover, insufficient warm-up, lack of ankle brace or tape and inappropriate rehabilitation after injury can also increase injury risk [2,3,9].

However, similar injury mechanisms and contacts cannot be ruled out. Most of the ankle injuries in basketball are closely related to indirect contact or unstable landing. The most frequently encountered injury patterns are landing awkwardly and landing on another player's foot. Purely non-contact injuries account for a small proportion of the total number of injuries [2,6,8]. In contrast,

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most rugby ankle sprains occur following direct physical confrontation and happen mostly during high-risk tackles, body collisions, forced twisting, crushing and stepping incidents [5,7]. Rugby-related ankle injuries frequently present with concurrent forced dorsiflexion, eversion and syndesmotic injury, which is very uncommon in basketball [5,7]. In addition, the two sports have different playing surface conditions, as basketball is usually played on hard indoor wooden courts, while rugby is played on outdoor natural grass, which may be uneven and slippery [2,7-9]. In terms of movement loading, basketball players need to explosively jump, cut and shoot, while rugby players experience more intense body contacts and greater body mass-induced joint loading [1,6,7,9]. Furthermore, different preseason training effects have been reported in the two sports. An increase in preseason training volume decreases the injury risk in basketball, while higher preseason injury risk is associated with greater preseason intensity because of increased physical confrontation in rugby [1,2,9].

In summary, basketball and rugby have similar intrinsic risk factors, including previous injury, muscle weakness and poor balance, and extrinsic risk factors, including insufficient warm-up and lack of protection [3,9]. However, the two sports contain significant differences in injury mechanism, field environment, movement pattern and training factor [5-9]. These similarities and differences show that ankle sprain is commonly and jointly determined by physical weakness, sport-specific movements and confrontation characteristics [3,6,7,9].

5. Preventive strategies for ankle sprains in basketball and rugby

Relevant content in establishing a scientific and systematic preventive system for ankle sprain in basketball and rugby. An effective preventive strategy can not only reduce the incidence of acute ligament injury but also prevent the occurrence of chronic ankle instability. According to the National Athletic Trainers' Association (NATA), preventive strategies should include neuromuscular training, external support and scientific load training [4].

5.1. Neuromuscular training

Neuromuscular training plays a vital role in preventing lower extremity injury. A lot of jumping and landing, and quick direction change make basketball loaded with lower extremity injury. Therefore, the athlete's nerve system should be able to work well and recruit muscle to stabilize the ankle joint [1]. The main idea of proprioceptive training is to improve the spatial joint awareness and feedback of neural information. Research proved that protective muscle reflex could be enhanced through training on an unstable surface, such as the balance board or foam pad [5]. A classic study based on basketball player proposed a 12-week progressive training plan: during the initial phase, athlete stands on hard ground by single-leg to maintain the stability of center of gravity; the advanced phase involves interfering factors, such as dribbling or shooting on uneven surface, to improve dynamic balance; finally, the sport-specific phase imitate match scenarios which requires athlete to complete complicated movement like cutting and sudden stop during fatigue. This progressive method can significantly increase the strength of the peroneal muscles and provide enough resistance when inversion happens [10].

5.2. External support

In high-contact sports like rugby, the use of extra-support devices such as athletic tape and ankle braces provides important mechanical support to the ankle joint [5]. When the rugby players were

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tackling and scrumming, the lateral force and stress on the ankle were very heavy. Research has found that non-elastic athletic tape can prevent the ankle from over-rotation and reduce the probability of injury [5]. The elasticity of the tape around the ankle will indeed weaken slightly after continuous use, but athletes get psychological security from the tape, and the proprioception from the tape also gives them extra information [4]. Most of the basketball athletes would rather wear an ankle brace to prevent recurrent injuries. Research has found that compared to soft brace, the semi-rigid brace can more effectively prevent excessive inversion torque without influencing vertical jump height [1]. It has been proven that athletes who have experienced an ankle injury can reduce the risk of re-injury by 50% when they wear the braces for the long term [5]. The protective function of external support does not simply improve mechanical restraint but also improves neural control by enhancing the athlete's skin pressure, adding extra proprioceptive feedback to the central nervous system and improving the athlete's sensitivity to the angle change of the ankle joint [4]. Therefore, it is recommended that we use tape or braces regularly for all high-intensity training and competitive sessions in the two sports.

5.3. Fine adjustment of equipment and environment management

The third way to protect from ankle injuries is to make wise selections of sports apparatus. Lateral stability in basketball is greatly influenced by shoe-making construction. Modern basketball shoes often feature anti-rollover support and a heel counter to prevent ankle injuries from occurring during lateral slide and direction change movements [5]. In rugby, the state of the outdoor field varies greatly, which brings difficulties to injury prevention. When playing rugby, athletes should choose cleats with proper length and degree of traction according to the wetness of the grass and the hardness of the soil. When rotating, excessive traction can cause the foot to be stuck in the turf and increase the risk of ligament tear [7]. Therefore, it is important to evaluate the flatness of the field routinely and choose appropriate shoes carefully to reduce the risks brought by environmental injuries.

5.4. Control of load and proper warm-up

Fatigue management and evidence-based rehabilitation are the key links of complete injury prevention. Muscle fatigue will delay the protective neural plegic and greatly increase the non-contact injury rate. A scientific warm-up should be dynamic stretching and sport-specific technical links. They can increase muscle temperature, improve the stretching of ligaments, and make the ankle joint more efficient at dissipating sudden impact forces [5,10]. Especially, athletes who had experienced an earlier ankle injury should adhere to the standardized one-for-return-to-play criteria. The criteria should be a functional agility test and the range of ankle dorsiflexion to prevent the recurrence of injuries [4,10]. In a nutshell, a effective method to prevent ankle sprain for basketball and rugby players is a systematic method, which includes neuromuscular training, external support, equipment improvement and scientific clinical adjustment. Implementing the strategies can decrease the acute injury rate of the ankle and ensure the long-term career of athletes [4].

In order to compare the ankle injury of these two sports, preventive strategies should be adapted to the injury mechanism of these two sports. The main reason for basketball-related ankle sprains is the non-conformity of movement. That is, the basketball athlete suffered from excessive inversion when the foot landed awkwardly, stepped on the foot of the opponent, or landed in an improper way [1,2]. Compared with basketball, external forced loading mainly causes ankle injuries in rugby. The ankle joint will often experience forced dorsiflexion and rotational torque in the process of tackle

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and repeated scrum [7,5]. In addition, the playing surface is also one of the key differences. The outdoor grass used in rugby is either slippery or uneven, which directly reduces the balance and stability of athletes, while the wooden court used in basketball is always the same [7-9].

Due to these various risk profiles, we propose some specific preventive initiatives. Finally, for both sports, we strongly recommend the adoption of a 12-week progressive proprioceptive and balance training programme. It helps to enhance peroneal muscle strength and proprioception with regard to unsafe landings during basketball jumps and complex dynamic movements during rugby [5,10]. All sportsmen and sportswomen should adopt adequate external support. Non-elastic tape provides an increase in sportsmen's psychological security and proprioception; however, its stability decreases as the athlete performs a high-level activity, so that its use with braces is recommended for high-intensity activities [5]. Basketball players should prioritize the use of semi-rigid ankle braces to prevent excessive inversion torque [1,5]. All athletes should avoid the use of shoes with excessive heel air cushioning. Rugby players should adjust the length of their cleats according to real-time situations of the grass to avoid either a lack of enough traction or too much [9]. Finally, fatigue is also a very important variable. Long-lasting activity leads to muscular fatigue, slows the speed of the neural response and decreases joint protection, so that the adoption of scientific warm-up protocols and real - time load monitoring is mandatory. A strict adherence to return-to-play criteria, including the assessment of dorsiflexion range and functional agility tests, is mandatory in order to prevent the appearance of recurrent injuries [4,10].

6. Conclusion

This paper focuses on the comparative analysis between ankle sprain in basketball and rugby and systematically shows the injury cause, risk factors and prevention strategy in the two sports. The result has shown that ankle sprain in basketball is mainly a non-contact injury that mostly happens when jumping landing, direction change, sudden stop and landing on another player's foot; while ankle sprain in rugby focuses on contact injury because of physical collision, tackle, stepping on and forced twisting. These two sports have common intrinsic risk factors, including previous injury history, insufficient muscle strength, poor balance and proprioception deficit and extrinsic risk factors, including insufficient warm-up and lack of external protection. However, the two sports differ in aspects like injury mechanism, field environment, movement pattern and training load response. Effective prevention includes neuromuscular training, external support, equipment optimization and scientific load management. This study increases cognition in sport-specific ankle sprain injury and provides evidence-based suggestions for coaches and athletes, which is necessary in reducing the rate of ankle sprain, avoiding chronic ankle instability, protecting body condition, and extending athletic career. The limitation of the research is the lack of prospective data and biochemical testing. Future outlook contains further longitudinal tracking research and establishing an injury warning model, which can increase the effectiveness of prevention.

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