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Prevention and Treatment Strategies for Knee Injuries in Basketball Players

Sizhe Wang[1,a,*]

[1]*Xi'an Xiguang Middle School, Xi'an, China*
a. shisimin@ldy.edu.rs
**corresponding author*

Abstract: In the strong and intense confrontation, due to the bone of the human body structure, the damage to the joints is great, especially in basketball, the players need to stop suddenly and some joint torsion actions, which is very easy to lead to the damage of joints and ligaments. This article provides a brief summary and overview of the different knee injuries in basketball and the different treatments for knee injuries. According to studies and surveys, in the analysis of thousands of injuries, the largest proportion of knee injuries is attributed to the femoral structure of the knee, especially ACL injuries and menisci injuries. Also, the mechanism of injury and how to prevent it before injury were discussed. Meanwile, this article focuses on how to manage the injury in acute injury, and how to achieve better treatment through non- surgical or surgical intervention in the case of anterior cruciate ligament and meniscus tears.

Keywords: Knee Injuries, Basketball Players, Prevention and Treatment

1. Introduction

Basketball is a fast-paced, high-intensity sport that places significant demands on players' lower bodies, particularly their knees. Knee injuries are one of the most common injuries, with potentially severe consequences for their performance and long-term health. Given the repetitive jumping, sudden directional changes, and physical contact involved in the game, the knees are subjected to significant stress. Knee injuries can be acute, occurring suddenly due to trauma, or chronic, developing gradually due to overuse. The impact of knee injuries on basketball players can be substantial, ranging from short-term impairment and missed games to long-term disabilities that can end careers. Consequently, understanding the causes and mechanisms behind these injuries, alongside appropriate prevention and treatment strategies, is crucial for ensuring the safety and longevity of athletes. This essay delves into the anatomy of the knee, the types of knee injuries, the causes and the mechanisms involved. It will also explore preventive measures and treatment strategies, both surgical and non-surgical, aimed at mitigating the risk of knee injuries in the basketball players.

2. Types of knee injuries and knee anatomy

Anterior Cruciate Ligament (ACL) Tears: ACL is crucial for stabilizing the knee during rapid changes in direction, jumping, and landing—actions frequently performed by basketball players. ACL tears often occur when the knee is twisted or hyperextended, typically during a sudden stop or pivot [1].

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Meniscus Tears: The menisci help cushion the knee and provide stability. A torn meniscus often occurs due to twisting or rotating the knee while bearing weight. Meniscus tears are common in basketball players who frequently pivot, land awkwardly, or experience direct impacts.

Patellar Tendonitis: This injury is caused by overuse of the knee joint, particularly in the activities involving repetitive jumping. It manifests as pain and inflammation in the patellar tendon, which connects kneecap to the tibia. While not as catastrophic as ligament tears, patellar tendonitis can lead to chronic pain and reduced performance if left untreated.

Medial Collateral Ligament (MCL) Injuries: MCL helps stabilize inner part of the knee and is often injured during collisions or falls. MCL injuries may range from mild sprains to severe tears.

Patellar Dislocation: The kneecap can dislocate when a player experiences a direct blow to the knee or lands awkwardly from a jump, causing the patella to move out of place.

3. Causes and mechanisms of knee injuries

3.1. Biomechanical aspects

Basketball is characterized by explosive movements such as cutting, pivoting, and rapid stops. These movements place significant stress on the knee ligaments, particularly the ACL, increasing the risk of injury. Non-contact ACL injuries, for example, often occur when players attempt to pivot or change direction quickly while the foot is planted on the ground. The repetitive jumping required in basketball puts tremendous pressure on the knees, particularly when players land awkwardly or on one leg. Improper landing mechanics, such as landing with the knees locked or in a valgus (inward) position, can increase the likelihood of ligament tears and meniscus injuries. Chronic knee conditions, such as patellar tendonitis, often result from repetitive stress on the knee joint due to overtraining or improper biomechanics. Without adequate rest or conditioning, overuse injuries can develop over time, leading to inflammation, degeneration of tissues, and chronic pain. Collisions with other players, falls, or being struck by the ball can result in traumatic knee injuries. Contact injuries, particularly to the MCL and patella, are common in the physical, high-speed environment of basketball [2].

3.2. Physical fitness

Muscle Imbalances and Weakness, weakness or imbalances in the muscles surrounding the knee, particularly the quadriceps, hamstrings, and glutes, can increase stress on the joint. For example, insufficient hamstring strength relative to the quadriceps can destabilize the knee and increase the risk of ACL injuries [3].

3.3. Environmental factors

Poor playing surfaces, inadequate footwear, and other environmental conditions can also contribute to knee injuries. Playing on hard or uneven surfaces can increase the impact on the knees, while improper footwear may fail to provide adequate support and stability during quick movements.

4. Prevention of knee injuries

Prevention of knee injuries in basketball players involves a multi-faceted approach that includes strength and conditioning, proper biomechanics, injury education, and appropriate equipment. Implementing these strategies can significantly reduce the risk of both acute and chronic knee injuries.

Strength Training: Developing strong muscles around the knee joint, particularly the quadriceps, hamstrings, and glutes, is crucial for stabilizing the knee and reducing stress on the ligaments and tendons. Strengthening the core muscles is also important for maintaining balance and control during

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rapid movements. Regular strength training exercises such as squats, lunges, and leg presses can help reduce the likelihood of injury.

Plyometric and Jump Training: Plyometric exercises, which involve explosive movements like jumping, help athletes improve their landing mechanics and overall neuromuscular control. Teaching players how to land properly—keeping the knees aligned over the toes and avoiding excessive inward collapse—can help prevent injuries related to improper landing.

Agility and Balance Training: Incorporating agility drills and balance training into a player's routine can enhance coordination, body awareness, and control during dynamic movements. This can reduce the risk of non-contact injuries like ACL tears, which often occur due to poor body positioning and balance during sudden stops or pivots.

Flexibility and Stretching: Maintaining flexibility in the muscles surrounding the knee can prevent tightness and imbalances that contribute to injury. Regular stretching of the quadriceps, hamstrings, and calves is essential, particularly after intense physical activity.

Proper Warm-Up and Cool-Down: Engaging in a thorough warm-up before games or practices helps increase blood flow to the muscles, improves flexibility, and prepares the body for the physical demands of the sport. Similarly, cooling down with stretching and light activity can help reduce muscle stiffness and aid recovery.

Load Management and Rest: Overtraining and insufficient rest are major contributors to overuse injuries like patellar tendonitis. Monitoring players' workloads and ensuring adequate recovery time between games and practices is essential for preventing chronic knee problems. Load management strategies, such as reducing playing time or modifying training intensity, can help protect athletes from injury.

Appropriate Footwear and Equipment: Wearing basketball shoes with adequate ankle support, cushioning, and grip can help prevent knee injuries by improving stability and absorbing shock during jumping and running. Additionally, knee braces or sleeves may provide extra support for players recovering from previous injuries.

5. Non-surgical treatments

5.1. Rest, Ice, Compression, Elevation (RICE) and physical therapy

For mild to moderate knee injuries, the RICE protocol is often the first line of treatment. Resting the injured knee, applying ice to reduce swelling, using compression bandages, and elevating the leg can help both manage pain and the inflammation in the early stages of injury [4].

Rehabilitation exercises aimed at restoring strength, flexibility, and range of motion are essential components of non-surgical treatment. Physical therapy helps players regain stability in the knee and prevents further injury by addressing muscle imbalances and improper movement patterns. For overuse injuries like patellar tendonitis, eccentric strengthening exercises are particularly effective in promoting tendon healing.

5.2. Bracing and support

For moderate ligament sprains or instability in the knee, wearing a knee brace can provide additional support and prevent further damage. Knee braces can also be used as a preventive measure for players who are recovering from a previous injury. MCL and LCL Level 1 injury recovery takes 2-4 weeks, Level 2 injury recovery takes 4-6 weeks, Level 3 injury recovery takes 6-8 weeks. PCL Level 1 injury recovery takes 4-6 weeks, Level 2 injury recovery takes 6-8 weeks, and Level 3 injury recovery takes 8-12 weeks. ACL depend on functional recovery, usually from a few months to 9-12 months a year [4-8].

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6. Surgical treatments

6.1. ACL

Before the popularization of arthroscopy, the most common surgical option for treating ACL tears was open primary repair (PR). This provided good short-term outcomes but was associated with long-term problems, including high re-rupture and reoperation rates and postoperative complications [9,10]. ACL reconstruction (ACLR) is currently considered to be the gold standard for surgical treatment of ACL injuries, and ACLs can be divided into autologous transplantation, allograft transplantation and synthetic transplantation according to different graft sources. Autologous graft is removed from the patient's own local tendon tissue and fixed in the knee joint after braiding to replace the function of ACL. Its advantages are that it has no antigenicity and no risk of disease transmission. At the same time, it has comparable biomechanical properties of ligaments and can achieve biological healing after transplantation. At present, autologous tendons such as bone-patellar tendine-bone, hamstring tendon, quadriceps tendon and fibula long tendon are commonly used. With the development of technology and the reconstruction of ACL [11,12].

Despite several comparative studies, it is still unclear which is the best surgical method for ACL rupture. Previous meta-analyses have compared clinical outcomes of the different types of ACLR. The study by Li et al showed the performance of the autograft and hybrid graft was similar in graft failure, graft diameter, and reoperation ratio [13]. Meanwhile, the study by Sun et al also revealed no difference in long-term outcomes and failure risk after cruciate ligament reconstruction with either autograft or synthetics; however, autografts were found to be inferior to synthetics in dealing with restoring knee joint stability and were associated with more complications [14]. Several clinical trials have reported functional outcome scores and revision rates after PR [13,14]. More recent studies showed that compared with ACLR, PR had a comparable failure rate and provided an earlier return of range of motion, most likely resulting from the less invasive nature of the surgery [15-17]. However, there are few randomized controlled trials (RCTs) or systematic reviews that have compared the efficacy and safety of the various types of ACLR and PR, which need to be further explored.

6.2. Meniscus tear

Meniscal resection is the most common treatment for the meniscal tears, including the total meniscectomy and partial meniscectomy. The former is suitable for patients with serious injury of meniscus parenchyma and can not heal, and its fracture seriously causes serious dysfunction of knee joint. The latter is suitable for barrel handle tear, longitudinal tear or transverse tear. Only the central part of the tear was removed, leaving a relatively stable peripheral semilunar suet or edge, which had a significant stabilizing effect on the enterofemoral joint [2].

7. Conclusion

Knee injuries are a significant concern for basketball players, given the physical demands and explosive movements involved in the sport. Understanding the types of knee injuries, their causes, and the biomechanics behind them is critical for effective prevention and treatment. Preventive measures such as strength training, proper biomechanics, flexibility, and appropriate footwear can substantially reduce the risk of knee injuries. However, when injuries do occur, early intervention through non-surgical or surgical treatments is essential for a successful recovery. By implementing comprehensive injury prevention strategies and providing appropriate treatment, basketball players can reduce the likelihood of debilitating knee injuries and prolong their athletic careers. In basketball, joint problems are the ones that should not be underestimated the most, especially the knee joints. For the protection of knee joint, it is necessary to enhance knee joint stability through training and carry

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out reasonable rehabilitation activities under the guidance of a doctor to ensure a future return to the game. It is believed that with the continuous progress of research and increasing awareness of knee injury, clinicians will be able to develop individual prevention and treatment programs for each patient.

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