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Knee joint injuries in football players: types of injuries, etiology, diagnostics and prevention

Rafał Makuch

Medical University of Lodz, al. Tadeusza Kosciuszki 4, 90-419 Lodz, Poland

rafalmakuch@icloud.com

<https://orcid.org/0009-0001-8192-7662>

Adam Kucharski

Medical University of Lodz, al. Tadeusza Kosciuszki 4, 90-419 Lodz, Poland

adam.kucharski14@gmail.com

<https://orcid.org/0009-0000-7210-2426>

Konrad Pilarski

Medical University of Warsaw, ul. Zwirki i Wigury 61, 02-091 Warsaw, Poland,

konradpilarski9@gmail.com

<https://orcid.org/0009-0000-6730-1332>

Alicja Chrościcka

Medical University of Lodz, al. Tadeusza Kosciuszki 4, 90-419 Lodz, Poland

a.z.chroscicka@gmail.com

<https://orcid.org/0009-0003-8985-890X>

Kamil Gała

Medical University of Lodz, al. Tadeusza Kosciuszki 4, 90-419 Lodz, Poland

kamilkem5@wp.pl

<https://orcid.org/0009-0006-3498-6746>

Andrzej Czajka

Provincial Specialized Hospital in Zgierz Parzęczewska 35, 95-100 Zgierz, Poland

andrzej.czajka0509@gmail.com

<https://orcid.org/0009-0008-8888-3982>

Paweł Lenard

Medical University of Lodz, al. Tadeusza Kosciuszki 4, 90-419 Lodz, Poland

Pawellenard@gmail.com

<https://orcid.org/0009-0008-7421-3400>

Sara Michalska

Medical University of Warsaw, ul. Zwirki i Wigury 61, 02-091 Warsaw, Poland

saramichalska1@gmail.com

<https://orcid.org/0009-0009-4184-3366>

Martyna Dewicka

Medical University of Lodz, al. Tadeusza Kosciuszki 4, 90-419 Lodz, Poland

m.dewicka@gmail.com

<https://orcid.org/0009-0008-9282-1231>

Alicja Maria Wawrzyniak

Medical University of Lodz, al. Tadeusza Kosciuszki 4, 90-419 Lodz, Poland

alicja.wawrzyniak@stud.umed.lodz.pl

<https://orcid.org/0009-0000-5397-363X>

Abstract

Introduction

Football stands as the most widely embraced organized sport globally, boasting a staggering participation of over 200 million males and 21 million females officially registered under the auspices of the Fédération Internationale de Football Association (FIFA). Knee injuries are one of the most common health issues among soccer players at various levels of expertise. They arise from the intense nature of the game, which requires quick turns, running, jumping, kicking, and sudden changes in direction. These stresses can lead to strains and injuries in the structures of the knee joint, including ligaments, meniscus, tendons, and other soft tissues. This study gathers information about the most common types of knee injuries in soccer players, including situations in which these injuries occur, methods of diagnosis, treatment options, and strategies for injury prevention.

Aim

The aim of this study is to gather and analyse the studies about knee injuries in soccer players at various levels of expertise.

Materials and Methods

Review and summary of research studies available in databases on Google Scholar and PubMed. Databases such as PubMed and Google Scholar were searched using the keywords: ‘soccer knee injuries’, ‘soccer injuries’, ‘ACL tear’, ‘MCL injury’, ‘meniscus injury’, ‘PCL and LCL tear’.

Summary

Soccer, as a high-contact sport, inherently carries a significant risk of various injuries, particularly to the knees. The prevalence of knee injuries, such as ACL, MCL, and meniscus tears, underscores the importance of effective prevention strategies. Proper warm-ups and

specialized preventive exercises, such as those in the FIFA 11+ program, are crucial in reducing the incidence of these injuries.

Injuries can severely impact a player's career, leading to long-term health consequences. Therefore, timely and accurate diagnosis, along with appropriate treatment, is essential for recovery and career longevity.

Keywords

knee injuries in soccer; soccer players injuries; ACL tear; MCL injury; meniscus injury; PCL and LCL tear;

The Significance of the Knee Joint: Impact of Injuries on the Careers and Quality of Life of Football Players

The importance of the knee joint for footballers is fundamental. Football is a contact sport that requires agility, relying on running, jumping, kicking and rapid changes of direction. All of these activities place considerable stress on the knee joint, which, combined with the high intensity of the game, can lead to both minor and serious injuries that can affect a player's career. Risk factors for knee injuries can be divided into modifiable and non-modifiable factors. Modifiable factors include fitness, strength, muscle development, balance, flexibility and motor coordination [1]. Non-modifiable risk factors include age and female sex. Poor motor coordination and age >28 years for men and >25 years for women increase the risk of knee injury [2,3]. Female athletes have a 3 to 5 times higher risk of serious knee injuries, such as ACL tears, than men [4,5,6,7]. The most serious injuries, such as ACL tears, can affect a footballer's quality of life and career progression. Even with ACL reconstruction and proper rehabilitation, athletes may have impaired strength, proprioception, neuromuscular control and an increased risk of future re-injury [8,9,10]. Some are unable to return to their pre-injury level of performance [11]. Up to 70% will develop radiographic osteoarthritis, 16% to 19% will have a symptomatic form of the disease, and 13% to 15% will require knee replacement surgery in the future [12].

Anatomy and biomechanics

The knee joint is primarily a hinge joint functionally. It allows for movements of flexion and extension. It is involved in supporting the body's weight and has an effective locking mechanism, thereby minimizing the amount of energy expended by muscles to maintain the knee joints in a standing position. It consists of a synovial joint between the femur and tibia and a synovial joint between the patella and femur. It is reinforced by collateral ligaments. Two very strong cruciate ligaments connect the adjacent ends of the tibia and femur, maintaining their opposing positions during movements. The knee joint structure includes two menisci: lateral and medial. Their role is to facilitate the fitting together of the femoral and tibial condyles during flexion and extension movements. The main ligaments associated with the knee joint are: patellar ligament, lateral collateral ligament, medial collateral ligament, and anterior and posterior cruciate ligaments. The anterior cruciate ligament prevents anterior displacement of the tibia relative to the femur, while the posterior cruciate ligament limits posterior displacement. [13]

Understanding the biomechanics of the knee joint is essential for guiding the rehabilitation process and implementing appropriate exercises in the case of knee injuries. Among the most common daily activities are running, walking, climbing stairs, and rising from a seated position. In all these activities, the knee joint supports the body weight, absorbs shocks, and assists in the movement of the lower limbs.[14] Running is an integral part of soccer competition. The predominant direction of movement of the knee joint occurs in the sagittal plane. According to previous studies, the passive range of motion of the knee joint flexion is 160 degrees.[15,16,17] Flexion and extension movements in the knee joint are a combination of rolling and sliding. In the first phase of flexion, up to 20 degrees, the condyles of the femur roll on the tibial surface. In the second part, rolling is replaced by sliding motion, with subsequent changes in the location of loading of the femoral condyles. The active range of motion of knee flexion is about 130 degrees.[22] The role of the knee during running is very similar to that during walking. During the support phase, it dampens shocks by absorbing body mass, while during the swing phase, it supports flexion and extension, foot positioning, and assumes the load of the next step.[18,19,20] The range of motion for the knee joint during running is from 60 to 115 degrees.[21]

ACL tear

The ACL serves as the primary stabilizing ligament of the knee. It starts from the back of the femur, running medially, and attaches to the front of the tibia.

In soccer, one of the most serious knee injury is the tearing of the anterior cruciate ligament (ACL). It poses a serious threat to both the career and quality of life of football players. [23]

Approximately 70% of ACL injuries occur in a minimal to non-contact manner, while the remaining 30% are contact injuries. [24]. Existing research indicates that biomechanical factors in the sagittal plane, such as a small knee flexion angle, significant posterior ground reaction force, and high quadriceps muscle force, serve as primary mechanisms for ACL loading. The majority of these injuries happen during sudden deceleration, landing from a jump, as well as pivoting maneuvers, which are frequently executed during gameplay. [25]

Patients with ACL injuries frequently describe hearing a popping sound, followed by immediate pain and swelling of the knee. This is typically accompanied by a sense of instability limiting their ability to continue physical activities. Hemarthrosis may also occur within two hours following the injury [26,27]

To return to full pre-injury function, football players are advised to undergo surgical reconstruction of the torn ligament using a tendon autograft or synthetic graft, followed by postoperative rehabilitation. Some strategies also include preoperative rehabilitation. [28,29]

The average period of layoff after ACL reconstruction was 6.6 months to return to training and 7.4 months to resume match play. [30]

The likelihood of injury appears to be elevated among defenders and strikers compared to goalkeepers and midfielders. It has been reported that female athletes experience noncontact ACL injuries at a rate two to eight times higher than male athletes. [1,31]

This injury, improper treatment, and return to high-risk sports pose a risk of re-rupture of the reconstructed ligament, articular cartilage damage, and the onset of early osteoarthritis [28,32]

MCL tear

The medial collateral ligament (MCL) is a crucial stabilizer of the knee joint. It is an 8-10 cm long ligament located on the inner side of the knee and consists of superficial and deep layers.

In football, injuries to the medial collateral ligament (MCL) are prevalent, constituting the most frequent traumatic knee injury, with three-quarters of incidents attributed to contact mechanisms. The MCL injury most commonly occurs due to a valgus impact on the lateral knee or a combination of valgus force and external rotation of the tibia - two most common playing situations were being tackled and tackling. [33]

This injury rarely requires surgical intervention. It is most commonly treated conservatively, utilizing early rehabilitation procedures and orthopedic knee braces. The diagnosis of an MCL injury can be reliably made based on clinical history and physical examination. In cases of uncertainty, imaging studies such as MRI can be used. The prognosis is very favorable, and exclusion from sports typically lasts only a few weeks. [34]

LCL and PCL tear

The lateral collateral ligament (LCL), also known as the fibular ligament, is one of the primary stabilizers of the knee joint. It originates from the lateral femoral epicondyle and attaches to the head of the fibula.

The posterior cruciate ligament (PCL) attaches to the inner surface of the medial femoral condyle. It runs obliquely downward and laterally, with its final attachment located in the posterior intercondylar area of the tibia.

Injuries to the LCL and PLC are among the least common knee injuries. These uncommon ligament injuries typically occur during games and are associated with contact mechanisms. In sports, the most common mechanism for a PCL injury is knee hyperflexion - often due direct impact to the front of the knee, causing the tibia to move backward. An LCL injury, on the other hand, usually results from a high-energy impact to the anteromedial knee, which combines hyperextension and a significant varus force. In football, these situations most commonly occur during tackles and collisions with other players, while the most frequent non-contact situation involves turning or twisting. The recovery time after an injury is approximately 2 to 4 weeks. Depending on the extent of damage to the ligament structures and their attachments, treatment can involve either conservative management or surgical-orthopedic reconstruction. [35,36,37]

Meniscus injuries

Meniscus injuries are a common problem among professional football players. According to available data, they can account for up to 8% of all injuries over the course of a season [38]. A meniscal injury can occur through contact events, sudden pivots and non-contact scenarios involving rotational movements. Compression of the meniscus and subsequent tears typically

result from a rapid transition from hyperflexion to full knee extension combined with axial or torsional forces [39]. The management of such injuries at professional football level is challenging. The significant pressure to return to play quickly often leads to the use of meniscectomy. This procedure quickly relieves the symptoms associated with the injury and allows a quicker return to the field. However, many data suggest that meniscectomy predisposes individuals to chronic pain and early onset of knee osteoarthritis and degeneration [40,41,42,43]. Following partial meniscectomy, players generally return to pre-injury levels within 6-8 weeks [44]. For younger players with better regenerative capacity, surgical meniscal repair appears to be a more rational treatment option. Recent study results indicate that approximately 83% of players return to play within 4 to 8 months after meniscal repair, both in isolation and in combination with ACL reconstruction [45,46,47,48]. In cases of meniscal deficiency, meniscal transplantation (MAT) can also be used. With this treatment, the return to play rate is 92% at 10.3 months and 100% at 11.8 months [49,50]. However, this treatment should be considered as a last resort.

Diagnostic methods

The physical examination should be conducted as soon as possible, however, knee pain and swelling can limit this. Besides observing the patient's gait, positions that alleviate pain, and joint asymmetry, assessment should include specific tests for particular injuries such as the Lachman test or the anterior drawer test, allowing for a diagnosis ACLs tears, with very high accuracy reaching up even to 82% sensitivity and 94% specificity. [51] An excellent test for PCL tears is the posterior drawer test, with the sensitivity and specificity of this test ranging from 90% to 99%. [52,53]

The simplest imaging test that can aid in diagnosing injuries is, of course, the knee X-ray in multiple views, such as the AP and lateral projections. However, it has been proven to be less effective in treating acute knee injuries, and there is significant potential to reduce the use of radiograms. [54]

The gold standard among non-invasive imaging tests is magnetic resonance imaging (MRI). MRI can be used not only to assess the extent of damage but also to plan the course of surgery and evaluate prognosis. It is also characterized by high sensitivity and specificity, particularly for ACL injuries, with rates of 86% and 95%, respectively. [26, 55] A minimally invasive examination of the knee joint is also arthroscopy, which allows us to precisely view the injuries by using a scope to directly observe the structures of the joint. Arthroscopy can be both diagnostic and therapeutic, as it enables the repair of injuries during the procedure. [56]

Prevention of knee joint injuries

Knee joint injuries represent a significant issue among soccer players. The most serious of these, namely anterior cruciate ligament (ACL) rupture, exclude the player from the game for a long time and are complicated to treat [57,58,59]. Many players are unable to return to their original level of performance even after a proper reconstruction and rehabilitation process [11]. Adequate prevention would reduce the financial burden on the healthcare system and improve the quality of life for many players. Developing an appropriate prevention program requires understanding the mechanisms of ACL and other knee joint structures, identifying injury risk factors, and adapting to the training, lifestyle, and time constraints among professional players, whose daily rigor is demanding [60]. Warm-up and proper regeneration are extremely important in prevention. Regeneration consists of elements such as proper nutrition, hydration, the use of cold or hot baths to reduce inflammation, adequate sleep, sports massages, and stretching [61]. Each team, along with its medical staff, should have a strategy for preventing and reducing the number of injuries. In response to the need for injury prevention among players, FIFA's Medical Assessment and Research Centre (F-MARC), in collaboration with the Santa Monica Sports Medicine Foundation (SMSMF) and the Oslo Sports Trauma and Research Centre (OSTRC), has developed a warm-up program called FIFA11+, consisting of three stages and including exercises focusing on trunk stabilization, thigh muscle development, proprioception, plyometrics, and stabilization. Reports indicate that implementing the program can reduce the number of injuries by 30% [62]. There have also been many ACL injury prevention programs that emphasized different aspects of exercises, varying in duration and application. However, their effects were inconclusive due to the limitations of these studies. It was not clear which risk factors were affected by specific exercises and which mechanisms of ACL loading they were meant to counteract [60].

Conclusion

Knee injuries are among the most common injuries football players experience, leading to forced breaks from play and exposing football clubs to significant financial losses. These injuries also have far-reaching consequences for the players' careers, health, and quality of life. Properly developed preventive techniques can help reduce the number of injuries, making their implementation crucial for football players. This will pose a significant challenge in the coming years due to the increasing demands in professional football, both among adults and at the junior level, as well as the difficulties in conducting reliable studies to verify the types of exercises and risk factors for injuries that they aim to mitigate. The vast number of structures that can be

damaged during highly contact-intensive team sports like football makes early detection of specific injuries using available diagnostic tests extremely important. Additionally, selecting appropriate therapeutic processes for effective treatment is crucial. Often, choosing the method of treatment poses a dilemma between the possibility of a quicker return to the field and avoiding long-term health consequences, affecting the player's career trajectory or quality of life in retirement. Further work on treatment strategies and rehabilitation processes will allow for the quickest return to play and minimize health consequences for the players themselves.

Author's contribution

Conceptualization: Rafał Makuch and Alicja Wawrzyniak; Methodology: Alicja Wawrzyniak; Software: Alicja Chrościcka; Check: Andrzej Czajka and Kamil Gała; Formal analysis: Konrad Pilarski and Martyna Dewicka; Investigation: Paweł Lenard and Sara Michalska; Resources: Kamil Gała; Data curation: Alicja Chrościcka; Writing - rough preparation: Adam Kucharski and Rafał Makuch; Writing - review and editing: Adam Kucharski and Konrad Pilarski; Visualization: Martyna Dewicka; Supervision: Sara Michalska; Project administration: Rafał Makuch and Paweł Lenard; Receiving funding - no specific funding.

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Conflict of interest

The authors report no conflict of interest.

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