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Anterior Cruciate Ligament Injury and Management

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ABSTRACT

Background: Anterior cruciate ligament is the most common knee ligament injury, and they are associated with several long term clinical consequences such as chondral lesions, meniscal tears, and early onset osteoarthritis. The injury can occur with direct contact or without as well. The diagnosis is made with history, special physical examination tests, and using imaging with MRI.

Aim of the work: this study was aimed to understand the mechanism behind anterior cruciate ligament injury, its diagnosis, and methods of management.

Methodology: we conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE from January 1971 to March 2017. The following search terms were used: Anterior cruciate ligament anatomy, knee ligament injury mechanism, diagnosis of knee ligament injury, management of anterior cruciate ligament injury.

Conclusion: Anterior cruciate ligament injury is a very common injury and requires quick diagnosis to control pain, further deterioration, and avoid long term morbidity. Management includes from conservative to surgical repair and reconstruction.

Keywords: knee ligament injury, sport injury, ligament tear repair, management of anterior cruciate ligament tear.

INTRODUCTION

Both ligamentous and neuromuscular joints restraints contribute (passively, and actively, respectively) in maintaining the dynamic stability of the knee. Of these ligaments, the anterior cruciate ligament (ACL) is considered the main passive structure that maintains the stability of the knee with the femur and the tibia. However, the anterior cruciate ligament is also the most usually damaged ligament during sports and other activities causing devastating sequelae, affecting the movement of the joint, the strength of muscles, and physical functions, and leading to effusion of the joint. This will sometimes cause the absence of the patients from a whole season or even more from the sport. Other than immediate sequelae, injuries of ACL are also associated with long term complications that include chondral lesions, post-traumatic osteoarthritis (OA), and meniscal tears [1].

In addition to its high liability to injury, ACL is considered to have a poor healing ability even after surgical interventions with sutures. The high failure rates following suture repair led to the stoppage of its use, especially after the introduction of ACL reconstruction. Since then, reconstruction have been the treatment of choice for ACL injuries, especially in cases where soon return to high-level activities is important, like athletes and young individuals. However, there has been some recent approaches to return to the use of ACL repairs. This has been mainly to the development of novel techniques in tissue engineering and regenerative medicine that use growth factors, and stem cells. The use of these techniques has provided promising results and led to more focus in research on ACL repair [2].

METHODOLOGY

- Data Sources and search terms

We conducted this review using a comprehensive search of MEDLINE, PubMed and EMBASE from January 1971 to March 2017. The following search terms were used: Anterior cruciate ligament anatomy, knee ligament injury mechanism, diagnosis of knee ligament injury, management of anterior cruciate ligament injury

- Data extraction

Two reviewers have independently reviewed the studies, abstracted data and disagreements were resolved by consensus. Studies were evaluated for

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quality and a review protocol was followed throughout.

The study was done after approval of ethical board of Imam Abdulrahaman Bin Faisal university

ACL Anatomy

The anterior cruciate ligament (ACL) constitutes of two bundles: the anteromedial (AM) and posterolateral (PL), which are named according the sites of insertion on the tibia. The borders of the ACL insertion on the femur are marked by two osseous ridges: the lateral bifurcate ridge and the lateral intercondylar ridge. During flexion, the AM bundle tends to be tenser than during extension. This makes AM the center of rotation in ACL that achieves translational stability along with rotational stability. On the other hand, the PL bundle becomes lax during flexion, allowing it to achieve relatively higher rotational stability. According to *Iriuchishima et al,* the cross-sectional area of ACL is smaller at the midsubstance when compared to the femoral and tibial insertions [3; 4].

Injury Mechanisms

Injury of ACL can occur through three main mechanisms. These are: noncontact injury, indirect contact injury, and direct contact injury. If the knee is stroke directly this will cause direct contact injuries. On the other hand, when another body part is stroke leading to force that will be transferred through the knee (a blow to the thigh for example) this will cause an indirect contact injury of the ACL. When it comes to the third type (noncontact injuries), these occur when the direction of the applied force is changed leading to tibial translation on the femur, and causing eventually failure of ACL. The latter mechanism is responsible for up to 70% of ACL damage [5; 6].

Examples of non-contact ACL injuries include landing after a jump in sports like soccer and basketball [7]. It has been suggested that defects in neuromuscular control are the most important cause of primary and secondary ACL injuries. These defects cause consequent failure of the ACL [8].

DIAGNOSIS

To reach an accurate diagnosis in ACL injuries cases, thorough history along with a proper physical examination are usually enough, without even further evaluation. In less than 10% of cases, the ACL injury is found isolate. Therefore, it is essential to further evaluate and look for additional injuries. In fact, injuries of the articular cartilage can be found in up to 46% of cases, subchondral bone injuries can be found in up to 80% of cases, meniscus injuries can be found in up to 75% of cases, and the presence of complete tears of collateral ligaments are found in up to 24% of cases [9; 10].

A history of a non-contact trauma, the early presence of swelling (that indicate hemarthrosis), the presence of a 'pop', and the failure of further physical activities, are all considered highly suggestive of a diagnosis of an ACL tear. As these signs and symptoms are not usually seen in cases of collateral ligament tears, meniscus tears, or posterior ligaments tear.

After proper history, the physical examination will include specific maneuvers like the pivot test and the Lachman test. These two are beneficial in assessing and evaluating the tear. A meta-analysis that included 28 studies found that the Lachman test has a sensitivity of 85% and a specificity of 94% in detecting an ACL tear. On the other hand, the pivot shift test was found to have a higher specificity (98%) but a significantly lower sensitivity (24%). MRI is the modality to confirm a diagnosis of ACL injury and has high sensitivity and specificity; 86% and 95%, respectively. However, it is optional after proper history and physical examinations, and will only be performed before the reconstruction surgery [11; 12].

Management

The repair of ACL was historically conducted by re-approximating the ruptured ligament's end with sutures. This procedure was first performed in 1900s by Robson, and later detailed by O'Donoghue et al [13]. Then, in 1970s the long-term effects of ACL were reported and revealed that 90% of ACL repair failed within five year of the surgery [14]. Later studies further confirmed these high failure rates. These high rates of failure made physicians stop the use of suture repair surgeries and turn into reconstruction for ACL injuries [15].

Reconstruction procedures include the surgical removal of ACL tissue from the knee, followed by replacing it with a tendon that may be taken from the middle third of the patellar tendon or the medal

hamstrings. This procedure has become the treatment of choice for symptomatic ACL injuries to restore physical functioning. However, this is still associated with significant complications and problems.

First of all, the conventional surgery for ACL reconstruction does not achieve complete restoration of normal joint movements. This is mainly due to ligaments insertion and alignment non-anatomically, the loss of neurosensory and proprioception functions, and the degeneration and defects of the graft tissue. Reconstruction is done either by using tissue from the knee or from another person. Both are associated with later significant morbidities and mortalities and biological incorporation failures, along with disease transmission. On the long term, patients still have a relatively high risk of developing osteoarthritis that can reach 100% even after undergoing surgery. ACL reconstruction was not found to decrease or slow the development of osteoarthritis [16; 17].

Surgical reconstruction has been developing by several approaches like altering tunnel position and applying double-bundle reconstruction. These developments caused joint stability that is higher in translational and rotational aspects, and are much closer to the normal healthy knee. A recently-published trial that studied 130 patients with ACL injuries, found that anatomic double-bundle reconstruction positively improved the IKDC score but still did not decrease the risk of developing osteoarthritis [18; 19].

Other than previously mentioned long term problems, undergoing ACL reconstruction is also associated with significant surgical-related complications, which resulted in an increase interest in the use of bio-enhanced techniques for ACL repair. This raises another concerning question which is to find the reason that caused the previous ACL repair to fail. Understanding of this will ease the process of developing a method to regenerate and repair torn ACL. Therefore, researchers have been trying to reach an answer that provides a thorough understanding of this. Interestingly, ACL injuries are different from other injuries like the medial collateral ligament (MCL), which have high liability to regenerate and heal. It was suggested that the environment that hosts the synovial fluid may play a significant role in this differences between sites. Differences in tissues response to injuries and resulting metabolic reactions, the deficiency of intrinsic cell enzymes, the different vascular supply, and the differences in weight bearing, are all also suggested to participate in this discrepancy [20; 21].

REHABILITATION

In a recent pooling of data from more than fifty trials, techniques for rehabilitation and assistive devices was evaluated thoroughly. This huge study concluded that knee functions would not negatively impacted by the immediate weight bearing after surgeries [22]. A self-directed home-based program proceeded by sufficient patient education and followed by proper patient monitoring, is as effective as physical therapy when dealing with motivated patients. Machines that provide continuous passive motion were found to provide no improvement at all. Similarly, it was concluded that postoperative bracing did not cause improvement in functions. On the other hand, exercising with planting foot on the floor (like leg press or squat) was found to provide higher stability than exercising without planting foot on the floor (like knee extension). Lastly, this study found that delayed rehabilitation programs and accelerated rehabilitation programs (which allow for sport continue in a period that is as short as six months) did not have any differences in outcomes regarding knee laxity [23].

CONCLUSION

Evaluation of knee injury is essential through proper history and physical examination especially among athletes and when ACL injury is suspected. Clinical suspicion should be raised in the presence of a pop, a history of a noncontact trauma, or immediate swelling following trauma. Lachman test and pivot shift test are used to help diagnose and assess ACL injuries. When diagnosis is not certain an MRI should be indicated, which will also help detect associated injures and tears. Reconstruction surgery for ACL is considered when the patient wants to reparticipate in future sports or want to practice physical activities that require proper functions. Rehabilitation professionals should supervise rehabilitation programs, and these should include weight bearing using crutches, and exercise programs with closed chains. These programs will usually aim at restoring function within six months.

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