Anterior Cruciate Ligament Injury

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The most common surgical procedure in Siriraj orthopaedic sports injury clinic is an arthroscopic anterior cruciate ligament (ACL) reconstruction. ACL injury is a common serious sports injury. Most ACL tears occur in athletes who involved in athletic activities that require rapid stopping, starting, and pivoting such as football, basketball, tennis, and rugby. In this article, a clinical approach and plan of management will be presented.

Anatomy

The ACL is one of four major ligaments along with posterior cruciate ligament (PCL), medial collateral ligament (MCL), and lateral collateral ligament (LCL) that are important in stabilizing the knee. The ACL connects the distal femur to the proximal tibia. The ACL comprises two bundles, anteromedial and posterolateral bundles. The main function of the ACL is to prevent excessive anterior tibial displacement on the femur, increasing stability of the knee. The ACL especially the posteromedial bundle stabilizes the knee during rotation

Mechanism of injury

The mechanism of injury gives the physician a clue to diagnosis which ligaments are at risk in the knee. Injury to the ACL tends to occur when there is a sudden anterior displacement of the tibia in relation to the femur. There are a number of different mechanisms that result in ACL injury, both noncontact and contact.

ACL injuries are frequently caused by noncontact mechanisms. Noncontact mechanisms involve rotational either internal or external and translational stress at the joint line, occurring when an athlete is trying to decelerate and change direction quickly. Anterior shear forces in the sagittal plane, valgus force in the coronal plane, or internal/external rotation in the transverse plane are all mechanisms of ACL injury.

In sports, this may be the result of a sharp turn or quick change of direction to avoid an opponent while running, planting the foot and pushing off, pivoting while slowing down from a sprint, or landing from a jump.

Contact mechanisms involve externally applied forces across the joint such as tackling. If the applied force can results in excessive tibial translation, ACL is damaged. Complete tears of the ligament produce a predictable pattern of mechanical instability and a variable degree of functional instability.

Gender

Studies suggest that ACL injury occur more common in female than male. There is a four to six fold increase in ACL injuries in female athletes compared to males playing the same sports.[1] The reason for this discrepancy is not clearly understood. Factors like joint laxity, differences in limb alignment, hormonal influence, muscle strength, and skill development are thought to play a role in the risk of ACL injury.

However, woman participation in sports activities is much less than man in Thailand. This may be the reason why in our practice more than 75 percent of ACL injury patients are male.

Diagnosis

Clinical presentation

The patient often experiences an audible "pop" at the time of injury, followed by severe pain. The audible "pop" is characteristic of a tear of the ACL. Neither the medial collateral nor the capsuloligamentous structures tear with the pop. Severe pain is a characteristic of these injuries. However, many patients are able to walk off the field. There are very few athletes will continue to play after sustaining a complete ACL tear, a feeling of instability while weight bearing will limit and stop their participation. The knee swelling can be appreciated by physical examination within 4-12 hours.

The presence of an acute hemarthrosis usually indicates a cruciate ligament injury, either ACL or PCL, although it may also be associated with chondral fracture, patellar dislocation, peripheral meniscal tear, or intraarticular fracture. If effusion develops immediately after injury, osteochondral fracture should be suspected.

In isolated ACL injury, improvement of symptoms will often occur within a ten-day period, and patients may perceive that they have fully recovered from their injury. If they do not get a correct advice, they will subsequently experience a re-injury. Many of ACL injuries were overlooked and diagnosed as a first-degree ligament sprain and got poor results.[2]

In my experience many Thai patients thought that their knee injuries were mild knee sprain that would recovered by taking rest for a couple weeks and they did not visit any medical services. These patients would complain of chronic unstable knees or other further injured structures in the knee such as meniscal injury.

Physical examination

After systematic physical examination by inspection, palpation, and movement, there are specific clinical tests of ACL function include the Lachman test, pivot shift test, and anterior drawer test. These tests rely on assessing the anterior translation of the tibia when force is applied, with the contralateral knee serving as baseline.

The Lachman test is the high sensitive and specificity physical examination maneuver for ACL tears. Its sensitivity and specificity were 86% and 91%.[3] It is performed with the patient lie supine with the knee flexed 20-300 and neutral rotation. The femur is held still while the tibia is translated anteriorly. A positive test is a soft end point with increased translation or laxity more than 2 mm. when compared with the contralateral side.

The anterior drawer test is less sensitive for ACL ruptures than the Lachman test. Its sensitivity and specificity were 62% and 88%.[3] The anterior drawer test is performed while the patient lie supine and the knee flexed to 80-900, the tibia is translated anteriorly on the femur while the examiner sits on the foot to prevent its motion and thigh muscles relaxed. A positive test is excessive anterior translation more than 2 mm. when compared with the contralateral side.

In case of posterior cruciate ligament injury, initial posterior sagging will give a sense of anterior translation of the tibia during a Lachman or anterior drawer test and mislead the examiner but the posterior drawer test is positive. Associated injuries, such as a bucket handle meniscal tear, can cause the knee to lock, and mask a positive Lachman test.

The pivot shift test is the most specific maneuver for an ACL injury. Its sensitivity is 97-99%.[3] However, it can be difficult to perform secondary to patient discomfort and guarding such as in acute injury. While the patient lie supine and the knee extended, the tibia is internally rotated. A valgus force is then applied, and the knee is slowly flexed through 400. A positive test is found when the knee is subluxed forward in full extension, then reduces at approximately 30-400 of flexion, producing the pivot or clunk.

In most cases, the correct diagnosis of an ACL tear can be inferred from the clinical history and physical examination. Clinical examination performed by experienced examiners is the most powerful diagnostic test as compared to magnetic resonance imaging (MRI) and arthrometry.[4,5] If a physician has obtained a history suggestive of ACL injury and the physical examination is compatible with this impression, additional diagnostic studies are not routinely needed. Nevertheless, accuracy of clinical diagnosis depends on the clinician's experience and expertise in evaluation. Execute these clinical ACL tests and interpret the findings by clinicians sometimes are equivocal. These tests require keen sensitivity on the examiner's part. Subjective interpretation may lead to differences in reporting the results. Hartnett et al report that, of 70 patients with ACL tears, only 16% were diagnosed correctly at their first doctor visit, and 36% visited three or more doctors before an accurate diagnosis was made.[6]

Imaging

Radiographs may be entirely normal or may demonstrate bony injuries such as avulsion fracture of ACL, osteochondral fracture, and tibial plateau fractures. The anterolateral tibial margin minor avulsion fracture, Segond fracture, is associated with a complete ACL tear. This fracture itself needs no treatment; the treatment is directed to the ACL problem.

MRI can verify a complete ACL tear in most cases but is more important for evaluating associated injuries. There is a wide spectrum of meniscal and osteochondral pathology associated with ACL tears, which may influence subsequent management and planned surgical intervention. Magnetic resonance imaging is extremely helpful to differentiate between partial and complete ACL tears and to demonstrate any associated meniscal, ligamentous, and osteochondral injuries.

In case of non-operative treatment for ACL injury, MRI is indicated to rule out other associated injury that may change plan of non operative treatment such as asymptomatic meniscal injury. The reported sensitivity of MRI for detecting ACL injury is in excess of 90% to 95%.[7,8]

Treatment

An injured patient with hemarthrosis and a suspected ACL tear should be referred to an orthopaedist to verify the extent of the injury. The menisci are often concomitantly injured with the ACL. Chondral injuries are also commonly found in the evaluation of the ACL disrupted knee. Development of late degenerative arthritis in the ACL injured knee is controversial. The natural history of ACL deficiency is not completely understood. Most patients with isolated ACL injury do well with activities of daily living. They typically can participate in limited sporting activities that do not require cutting, pivoting or lateral motion such as jogging, running, and swimming but will have difficulty with vigorous activity.

Numerous variables influence the decision-making process for nonsurgical or surgical management of these injuries. Patient age, activity level, knee instability, and associated injuries all play a role in the choice of management. Fu et al outlined several indications for ACL reconstruction:[9]

1. Patients who are athletically active and prefer to continue activities at a high level.
2. Patients who experience clinical instability that interferes with daily activities.
3. ACL tear associated with reparable meniscus tears.
4. ACL tear associated with grade III tears of other major knee ligaments (PCL, MCL, and LCL).

Nonoperative treatment

The goal of nonoperative treatment of ACL injury is to return functional stability to the knee and prevent further injury and degeneration. Activity modification and physical therapy are the cornerstones of nonoperative management. Physical therapy initially is centered on regaining pain-free motion. Once motion is regained, rehabilitation should focus on strengthening of both the

quadriceps and hamstrings and proprioceptive training. Once sporting activities are resumed, they need to be modified to avoid high-risk, jumping, pivoting, and hard cutting behaviors. The role of functional bracing, overall, is controversial.

Operative treatment

ACL reconstruction is a complex procedure that involves replacing the ACL ligament with another graft. Two alternatives include various autograft and allograft options. However, allograft for ACL reconstruction is not available in Thailand at present. The most common autograft choices include autogenous hamstring, patellar tendon, and quadriceps tendon grafts. The selection of a graft is based on various patient factors including patient age, activity level, and co-morbidities as well as surgeon philosophy and training. The biomechanical properties of the graft, fixation strength, donor site morbidity, and return-to-play guidelines differ with each graft choice and should be considered for each individual patient. An informed discussion between the surgeon and patient of the advantages and disadvantages of each graft should guide the ultimate decision.

ACL reconstruction in the acute period immediately following injury has been associated with an increased incidence of arthrofibrosis and decreased range of motion following surgery. Surgery should be deferred until the acute inflammatory period has passed, range of motion has returned, and strong quadriceps activation is present.

In general, a minimum of 6 to 9 months is considered a reasonable time frame for return to sport. In the hands of an experienced surgeon the success rate following surgery approaches 90%.

CONCLUSION

ACL injury is a common serious sports injury, and often results in clinical knee instability and dysfunction. Incidence of associated injuries with ACL injury is high. Both nonoperative and operative treatment of ACL injury can be successful in appropriately selected patients.

REFERENCES

1. Hewett TE, Myer GD, Ford KR. Anterior cruciate ligament injuries in female athletes: Part 1, mechanisms and risk factors [review]. Am J Sports Med. 2006 Feb;34(2): 299-311.
2. Strand T, Sorensen F, Solheim E. Undiagnosed anterior cruciate ligament rupture. A common problem with poor prognosis. Ann Chir Gynaecol. 1997;86(3): 244-7.
3. Scholten RJ, Opstelten W, van der Plas CG, Bijl D, Deville WL, Bouter LM. Accuracy of physical diagnostic tests for assessing ruptures of the anterior cruciate ligament: A meta-analysis. J Fam Pract. 2003 Sep;52(9): 689-94.
4. Gelb HJ, Glasgow SG, Sapega AA, Torg JS. Magnetic resonance imaging of knee disorders: clinical value and cost-effectiveness in a sports medicine practice. Am J Sports Med. 1996 Jan-Feb;24:99-103.
5. Liu SH, Osti L, Henry M, Bocchi L. The diagnosis of acute complete tears of the anterior cruciate ligament: comparison of MRI, arthrometry, clinical examination. J Bone Joint Surg Br. 1995 Jul;77(4):586-8.
6. Hartnett N, Tregonning RJ. Delay in diagnosis of anterior cruciate ligament injury in sport. New Zealand Medical Journal. 2001 Jan;114 (1124): 11-3.
7. Larson RL, Tailon M. Anterior cruciate ligament insufficiency: Principles of treatment. J Am Acad Orthop Surg. 1994 Jan;2(1):26-35.
8. Munshi M, Davidson M, MacDonald PB, Froese W, Sutherland K. The efficacy of magnetic resonance imaging in acute knee injuries. Clin J Sport Med. 2000 Jan;10(1):34-49.
9. Fu FH, Schulte KR. Anterior cruciate ligament surgery: State of the art? [review] Clin Orthop Relat Res. 1996 Apr;(325):19-24.