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Review article

Manangement of ACL tear in paediatric age group: A review of literature

Manish Diwakar

Shankus Medicity Hospital, Mehsana, India

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ABSTRACT

The anterior cruciate ligament (ACL) is a stabilizing structure to both anterior translation of the tibia with respect to the femur as well as rotation of the knee joint. The incidence of ACL tears is rising in the pediatric and adolescent populations as these individuals succumb to traumatic and non-traumatic athletic injuries. Pediatric ACL injuries are typically seen in several forms: tibial avulsion fractures, partial ACL tears, and full thickness ligament tears. Management of this condition in the skeletally immature patient poses a challenge and is controversial.

Operative reconstruction carries the concern for damage to the physis with resultant limb length inequality and angular joint deformity but provides stability to the knee and allows return of function in most patients. On the other hand, nonoperative treatment has been shown to carry an increased risk of meniscal and articular cartilage damage. Several factors must be considered during pediatric and adolescent ACL reconstruction, including: status of the physis, reconstruction technique, and graft source.

This paper aims to address the natural course of ACL injuries in the skeletally immature patient, treatment options with associated complications, and current preventive strategies.

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1. Introduction

Anterior cruciate ligament injuries can be a devastating injury, with significant time lost from sport as well as potential degeneration of the knee in the future.[1] The treatment of anterior cruciate ligament (ACL) injuries has spawned a great deal of

E-mail address: manish.diwakar@gmail.com (M. Diwakar).

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research. However, the majority of the literature on the topic deals with adults. Far fewer studies have focused on the management of this condition in the pediatric and adolescent patient. Consequently, the management strategy for ACL injuries in this population is not as clearly elucidated as it is for their skeletally mature counterparts.

There are several factors that can make treating a pediatric or adolescent ACL injury more challenging. Making an accurate diagnosis can be difficult as there is a spectrum of injuries including tibial avulsions, partial ACL tears, and complete tears, and there can be multiple barriers to performing an accurate examination in this patient population. If surgery is chosen, there is debate over the appropriate technique as well as graft choice. Finally, the pediatric and adolescent population may have difficulty adhering to a detailed rehabilitation protocol.

Historically, significant debate regarding the proper management of ACL injury in the skeletally immature patient has existed. Two basic options are available, surgical reconstruction and conservative management, each with their own potential sequelae. Theoretically, there has been concern that operative management would violate the growth plate resulting in concomitant growth disturbance and angular or rotational deformity of the limb.[2–6] Consequently, many patients have been treated conservatively via activity modification and bracing with postponement of surgery until skeletal maturity.[7–9] Yet conservative treatment is not without risk.

The prognosis of the ACL&HIPHEN;deficient knee in young active individuals is poor because of secondary meniscal tears, persistent instability and early-onset osteoarthritis. The aim of surgical reconstruction is to provide stability while avoiding physeal injury. Techniques of reconstruction include transphyseal, extraphyseal or partial physeal sparing procedures.

Several “physeal sparing” and “physeal respecting” ACL reconstruction techniques have been developed for use in skeletally immature patients to minimize the risk of growth disturbance, with favorable clinical outcomes. ACL injury prevention strategies include neuromuscular conditioning and may be performed to prevent both initial ACL injury as well as reinjury and injury of the contralateral ACL after reconstruction.In a recent systematic literature review, Vavken and Murray[10] identified only 1 study with level II evidence and 10 with level III evidence on this topic. This understates the need for further prospective studies on the subject.

This paper aims to discuss ACL tears in the skeletally immature patient, specifically focusing on the natural history, nonoperative management, operative management including complications, and prevention of these injuries.

2. History

Most commonly, ACL tears are non-contact injuries caused by a pivoting mechanism with the knee partially flexed and the foot planted.[11] A hyperextension of the knee with a valgus or rotational force has also been described. Patients will typically report an audible “pop” in the knee, followed by relatively quick (12–16 h) development of a hemarthrosis, and inability to return to sport. Weight bearing may be challenging initially, but typically is regained shortly after the injury.

In the pediatric and adolescent patient, the location of the ACL injury is an important determinant of management. Common in this population, tibial spine avulsion injuries, if nondisplaced, can be treated nonoperatively with satisfactory outcomes. However, displaced avulsion injuries require arthroscopic reduction and internal fixation.[12,13] Similarly the extent of the ACL tear is important to differentiate. Nonsurgical management of partial tears may yield acceptable results in this population when paired with a structured rehabilitation program. However, children and adolescents with greater than 50% tears of the ACL have been shown to have poor outcomes if not surgically reconstructed and may progress to a complete tear.[14]

3. Examination

In children with a history of trauma to the knee, radiographs should be performed first to rule out tibial eminence fracture. Once this has been ruled out, a more standard knee examination can be performed. While the Lachman maneuver has classically been the test of choice for examination of ACL, the pivot shift may actually be a better determination of whether the knee is stable and the ACL is functioning.[15] Patellar dislocations can mimic ACL tears, and thus patellar stability must be assessed. Also, a complete ligamentous examination should be performed.

4. Diagnosis

AP and lateral radiographs should be obtained to rule out any bony injury. Special attention should be used to assure a perfect lateral radiograph, as this is often the best way of evaluating for and classifying tibial eminence fractures. Examination in the acute setting may be difficult, and thus MRI may have a more important role in a child or adolescent with a traumatic hemarthrosis. While MRI can be a useful adjunct in making an accurate diagnosis with a complete ACL tear, reports have shown poor sensitivity of MRI in detecting partial ACL tears.[16,17] MRI can also be useful in diagnosis of tibial eminence fractures, especially non-displaced, type I fractures.

5. Management

5.1. Partial ACL tear

Partial ACL injuries should be treated based on the degree of instability in the knee. If the knee is grossly unstable with a positive pivot shift on examination, then reconstruction should be offered to the patient. In a patient where no pivot shift can be elucidated, a trial of non-operative care consisting of a physical therapy program as well as proprioception/neuromuscular re-education program can be prescribed.[11]

Partial ACL tears in patients with symptomatic instability that have failed conservative management can be taken to the operating room for an examination under anesthesia. The patient should be consented for and the surgeon should be prepared to perform an ACL reconstruction. A pivot shift should be performed with the patient relaxed to determine the status of the ACL. The remainder of the ligament examination of the knee should be performed, including varus and valgus stress testing at 0° and 30° of flexion, as well as dial testing at 0° and 90°. If there is a 2+ pivot shift, meaning a true shift is felt rather than a glide, the surgeon should proceed with reconstruction of the ACL.[18] Intraoperatively, if only 1 bundle of the ACL is disrupted, some authors are reporting excellent results with reconstruction only of this injured bundle.[11]

5.2. Tibial avulsion fractures

Type I, non-displaced, tibial eminence fractures are typically treated with cast immobilization, yet there is some disagreement amongst authors regarding the degree of flexion. During arthroscopy, one can see the ACL taking up tension as the knee is brought into full extension. Cadaveric work has found the greatest ACL tension at 0° or at 45° of flexion [19]; therefore, many authors recommend immobilization with casts at 10°–20° of flexion.[20–22] However, when each ACL bundle is examined independently, the

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