Technical Note

Arthroscopic Reattachment of an Avulsion Fracture of the Tibial Insertion of the Posterior Cruciate Ligament

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Abstract: We describe an arthroscopic technique for the treatment of isolated avulsion fracture of the tibial insertion of the posterior cruciate ligament. Arthroscopic examination of the injured joint permits visualization of the intra-articular structures and lavage of the joint. Such an approach reduces the risk of injury to the posterior neurovascular complex. K-wire fixation affords anatomic and rigid internal fixation while minimizing the potential for further damage to the osseous fragment.
Key Words: Arthroscopy—Posterior cruciate ligament avulsion—K-wire fixation.

The posterior cruciate ligament (PCL) acts as a primary restraint against posterior displacement of the tibia on the femur. It acts with the anterior cruciate ligament (ACL) to regulate the 'screw home' mechanism of the knee—external rotation of the tibia at terminal extension.[1]

PCL disruption may represent up to 20% of all knee ligament injuries. An avulsion fracture of the tibial insertion of the PCL is 1 of a spectrum of injuries to this ligament.[2] It is reported to be more commonly found in the younger age group.[3] The tibial origin lies in a fovea 1 cm below the tibial surface and is approximately 13 mm in cross-sectional area.[4] The most commonly reported mechanism of injury is a posteriorly directed blow to the anterior aspect of the proximal tibia with the knee flexed at 90°resulting in a midsubstance tear of the ligament.[5] Injury may also be caused by sudden hyperextension in conjunction with an associated valgus or varus force or hyperflexion of the knee.[6] This may cause disruption of the femoral origin of the PCL. Sporting injury and motor vehicle accidents account for the majority of injuries. In the context of a dashboard accident with a posteriorly directed blow to a flexed knee, the injury is often overlooked because it frequently presents in association with a posterior dislocation of the femoral head. Isolated injury will cause the patient to experience a swelling at the posterior aspect of the knee, the inability to fully bear weight, and bruising at the anterior aspect of the knee related to the direct impact. Further clinical examination confirms a posterior sag and a positive posterior drawer test.[7]

Surgical reconstruction is usually performed through an open technique with the patient in the prone position. In this article, we describe a novel approach to internal fixation that avoids such potentially injurious exposure while minimizing soft-tissue dissection.

A 19-year-old girl slipped on ice while walking and fell directly onto the ground. She reported immediate difficulty with weight bearing and noticed swelling at both the anterior and posterior aspects of the knee. Plain radiography of the injured knee confirmed the clinical impression of a displaced avulsion fracture of the tibial insertion of the PCL (Fig 1).

OPERATIVE TECHNIQUE

The patient was positioned supine. A single 1-g dose of intravenous cephalothin sodium was adminis-

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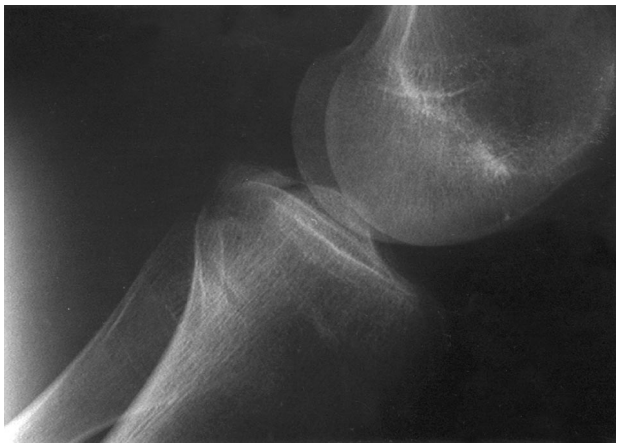

FIGURE 1. Lateral radiograph of flexed knee identifying avulsed distal insertion of PCL.

tered before inflation of a high thigh tourniquet at 300 mm Hg. Examination under anesthesia confirmed a posterior sag with a soft end point. Midcentral anterolateral, midcentral anteromedial, posteromedial, and posterolateral portals were used. A separate 1.5-cm longitudinal incision 1-cm medial to the tibial tuberosity was used for insertion of the 1.25-mm diameter K-wires in an anteroposterior direction with cephalic tilt.

At arthroscopy, a frank hemarthrosis was drained. An osteochondral fracture of the posterior tibial plateau involving the insertion of the PCL was found. The ligament itself was uninvolved. Through the posteromedial portal, the PCL and its attached fragment were pushed laterally into the joint. The soft tissue and hematoma about the cancellous crater was removed using a 4.5-mm arthroscopic shaver (Smith & Nephew Dyonics, Andover MA). Three K-wires were passed percutaneously to the fragment crater of the tibia until their tips were visible. The fragment was then reduced and held. The K-wires were drilled through the fragment to beyond 1 cm under direct vision. A similar technique for an avulsion of the ACL is illustrated in Fig 2. The wires were turned into a U shape by grasping the free ends with a needle holder inserted through the posterolateral and posteromedial portals. The K-wires were then withdrawn anteriorly, thus capturing the fragment. The wires were bent 12° anteriorly and held with a needle holder. By a series of sharp blows directed away from the anterior tibial cortex, the posterior osseous fragment was impacted into the fovea and anatomic reduction maintained. The wires were bent to an acute angle to lie against the anterior tibial cortex. The wires were trimmed so as to lie flush with the tibia subcutaneously. Hemostasis was secured after release of the tourniquet. Postoperative radiographs in both anteroposterior and lateral views confirmed satisfactory positioning of the internal fixation (Figs 3 and 4).

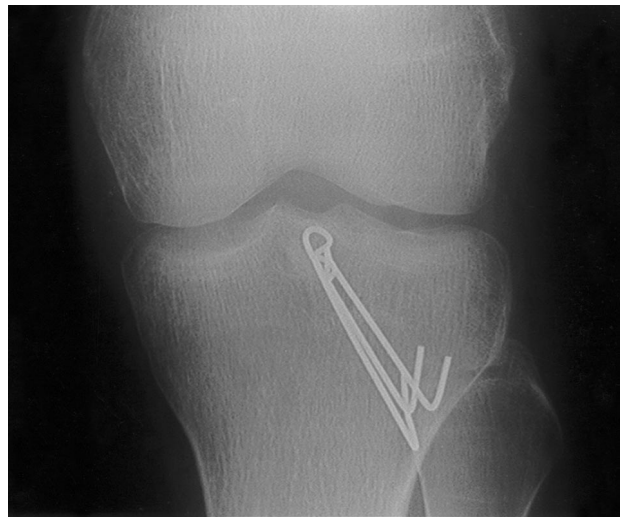

FIGURE 3. Postoperative anteroposterior radiograph confirming anatomic reduction.

Skin sutures were removed 1 week postoperatively. The patient was allowed to commence immediate quadriceps exercises and remained partial weight

FIGURE 2. Operative photograph showing K-wires capturing osseous fragment.

bearing for 4 weeks. At 6 weeks, the K-wires were removed by opening the tibial incision and withdrawing the wires by constant force, straightening them in the process of withdrawal. Examination under anesthesia confirmed a stable joint. The patient made an uneventful recovery. At 2 years, she was asymptomatic and had returned to competitive sport.

DISCUSSION

Avulsion fractures of the tibial insertion of the PCL represent a small subgroup of the spectrum of injuries to this ligament and are believed to occur more frequently in the younger patient.[7] Most authors agree that acute surgical reconstruction is the treatment of choice even for minimal displacement of the fragments.[8] Conservative treatment, with distraction of the fracture components, commonly results in nonunion and may predispose to late functional instability of the knee.[8]

FIGURE 4. Postoperative lateral radiograph confirming anatomic reduction.

Surgical exposure to achieve open reduction and internal fixation is most commonly performed through a posterior approach.[9] A lazy S incision centered on the popliteal fossa allows for direct visualization of the neurovascular structures. A limited distal arthrotomy exposes the fracture and allows for direct reattachment of the avulsed component. However, such surgical exposure is not without risk. The complex anatomy in the popliteal fossa is at risk of direct injury during dissection. Postoperative swelling as a result of tissue edema or from venous bleeding may generate increased interstitial pressure with the development of a compartment syndrome. Retraction of the soft tissues at surgery may inadvertently lead to a traction neurapraxia of the common peroneal nerve. Arthroscopic reattachment of the fracture avoids such posterior soft-tissue dissection and thus minimizes the risk of injury to the posterior structures. Direct visualization of the tibial insertion bed and docking of the avulsed fragment may be achieved with the use of arthroscopic portal placement.

An avulsion fracture of the PCL may not be an isolated finding. Femoral and patellar chondral defects, and concomitant tears of the ACL and menisci have been found in association with tears of the PCL.[10,11] Arthroscopic repair, unlike the open posterior approach, permits full exploration of the knee joint, fulfilling the principle of thorough joint examination at the time of surgery for a ligament injury.

Reattachment of the avulsed segment may be performed using a screw, 1 or more K-wires, wire suture, or staple.[8,12-18] Previous work has confirmed excellent results with any of these methods. We have identified 2 published case reports of an arthroscopic approach for this injury.[19,20] In both cases, lag screw fixation was used. However, a precondition of this technique is the presence of a sufficiently large avulsed fragment so as to enable adequate screw purchase and fragment capture. No such precondition is necessary with the described technique. We used K-wire fixation because it provides secure fixation with minimal risk of damage to the avulsed osseous fragment. The wires were sequentially bent over themselves to form a U shape and were pulled forward. A further bend anteriorly over the tibial cortex prevented subsequent migration of the wires. Lee[15] has proposed augmenting surgical fixation with plication of the PCL to the capsular tissue. We do not feel that this is necessary since our patient was mobilized immediately without subsequent damage to the ligament.

We consider this technique to be an effective method of reduction and fixation for this fracture

pattern. It has been used successfully in a further 6 cases. Avoiding dissection of the posterior soft tissue substantially minimizes the risk of damage to the neurovascular structures, as can happen in open surgery, and eliminates potential morbidity from a posterior knee wound.

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