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TECHNICAL NOTE

Combined arthroscopic techniques in the treatment of non-union of the anterior tibial spine

Stefan CLOCKAERTS, Lieven DOSSCHE

From the University Hospital of Antwerp, Antwerp, Belgium

We report a non-united tibial spine fracture with instability of the anterior cruciate ligament in a twenty-year-old soccer player. The patient underwent arthroscopy with debridement of scar tissue around the fracture site, reduction and fixation of the bony insertion of the ACL using screw and washer, and femoral notchplasty. More than one year after the initial surgery, the patient fully recovered knee stability and function. We have demonstrated that the additional problems caused by a non-union of a tibial spine fracture can be dealt with in one arthroscopic session.

Keywords : tibial spine fracture ; non-union ; refixation ; arthroscopy ; notchplasty.

INTRODUCTION

Tibial spine avulsion fractures are uncommon ; they are most likely to be seen in children. They are frequently caused by bicycle, soccer or skiing accidents. Traffic accidents are the major cause in adults (*2,21*). In most cases, these fractures affect the anterior portion of the tibial spine, where they can result in significant instability of the anterior cruciate ligament (ACL), loss of knee extension and pain in extension. Anterior avulsion fractures of the tibial spine are classified into three types according to Meyers and McKeever. Type I fractures show a slight elevation of the anterior margin of the intercondylar eminence. In Type II fractures, the anterior third to one half of the tibial spine is involved and the avulsed fragment is much more elevated on a posterior hinge, producing a beak-like deformity on a lateral radiograph. In Type III fractures, the fragment is completely separated from its bone bed without apposition (*15*). Fractures in which the fragment is rotated, and the cartilaginous surface is oriented towards the raw bone of its bone bed are classified as Type III + fractures. Zaricznyj (*23*) added a Type IV fracture in which the fragment is displaced and comminuted (*2,12,14*). Type I or Type II fractures with minimal displacement (< 2 mm) can be treated conservatively. Type II fractures with severe anterior elevation, Type III and Type IV fractures require surgical fixation (*1,15,22*).

Various arthroscopic or open surgical methods are being used to treat non-united anterior tibial spine fractures, and a standard treatment method has not been established.

We successfully treated a non-union of a tibial spine fracture using an arthroscopic technique with fracture debridement, fracture fixation and superior femoral notch enlargement.

■ Stefan Clockaerts, MD, Resident in Orthopaedic Surgery.
■ Lieven Dossche, MD, Orthopaedic Surgeon.
■ *Department of Orthopaedic Surgery and Traumatology and Department of Sports Medicine, University Hospital of Antwerp, Edegem, Antwerp, Belgium.*
Correspondence : Stefan Clockaerts, Wilrijkstraat 10, 2650 Edegem, Belgium. E-mail : Stefan.Clockaerts@ua.ac.be

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Fig. 1. — Anterior posterior radiograph showing the tibial spine fracture of a 20-year-old male patient after a fall on his right knee while playing soccer.

OPERATIVE TECHNIQUE

A 20-year old male soccer player was heavily tackled and fell on his right knee in flexion. He was admitted to a hospital with a swollen knee, along with major flexion and minor extension deficits. Radiological investigation showed a Type II tibial spine fracture with minimal displacement (Fig. 1). The patient was initially treated with plaster cast immobilisation in extension for one week, after which the knee was immobilised with a brace in full extension without weight bearing. The brace was regularly adapted to allow increased flexion, and physiotherapy was started. Slight symptoms of pain and impaired function persisted after seven months. Clinical examination revealed flexion of 130°, a positive Lachman sign and a positive pivot shift test, although the patient did not mention any giving way. The patient's score on the Tegner Activity Scale was 6, and the Lysholm knee score was 90. A CT scan showed signs of delayed union of a tibial spine fracture. MRI ruled out concomitant soft-tissue injuries and showed an intact ACL. Based on these findings, we concluded that surgical treatment was necessary to treat the non-union of the tibial spine fracture.

At examination under anaesthesia twelve months after the initial injury, the knee was lax in the anterior direction. Arthroscopy conducted through standard anterolateral and anteromedial portals, showed that the ACL was intact and covered with an intact synovial sleeve. The diagnosis of non-union of the fracture fragment was confirmed. Further inspection showed no cartilage defects and intact menisci.

The avulsed fragment was mobilised using a small chisel through the anteromedial portal. The fibrous tissue was removed using an arthroscopic grasper and arthroscopic shaver. A fresh cancellous bone bed was created with an arthroscopic bur, and the bony fragment was fixed in place with an additional superolateral portal, using one 4.0 mm cannulated screw and washer. A superior femoral notchplasty completed the intervention, as the anterior tibial spine abutted the roof of the intercondylar notch when the knee was extended (Fig. 2).

The knee was placed in a brace with an extension deficit of -10° for two weeks, and the patient was allowed to bear full weight. The brace was then adapted to full extension for another four weeks. Range-of-motion exercises were initiated the day after surgery.

At three months, the patient had no pain or other complaints. Clinical examination showed full extension, full flexion and a negative Lachman test.

The screw and washer were removed in a second arthroscopy seven months after the first surgical procedure. Physical examination showed no significant laxity of the ACL.

Two years after the initial surgery, the patient was free of pain, had no giving way and had a full range of motion. Tegner and Lysholm scores had improved to 9 and 100 respectively, and the patient was able to resume his sports activities.

DISCUSSION

Open reduction and internal fixation, arthroscopic debridement, arthroscopic notchplasty and reconstruction of the ACL are treatment options in the management of non-union of tibial spine fractures (*5,7,11,13,18*). To our knowledge, arthroscopic debridement with bony fixation of the ACL and femoral notchplasty has not been mentioned in

Fig. 2. — Postoperative lateral radiograph showing reduced and refixated fracture fragment with screw and washer, and femoral notchplasty.

literature. Panni *et al* recommend debridement of the tibial spine, with or without femoral notchplasty, in patients with a malunited but stable non-union of avulsed fragments and no anterior instability (*18*). In these cases, when the ACL is still functionally active, femoral notchplasty alone can be sufficient to relieve symptoms for some patients, although concern has been expressed that this procedure could enhance instability and pivoting of the knee (*13,18*). Instability of the knee results in permanent ACL insufficiency and excludes the participation in intensive sports activities.

A primary arthroscopic ACL reconstruction after removal of the fracture fragment can be performed in case of complete ligament insufficiency (*10*), although this also does not lead to a full recovery of knee mobility (*20*). We therefore decided to perform debridement, along with reduction and fixation of the fracture fragment, as MRI and arthroscopic inspection showed an intact ACL and this would enable the patient to resume his sports activities. We observed notching in extension of the re-fixated ACL and therefore performed femoral notchplasty within the same procedure. Extension deficits and pain are the result of impingement of the ACL or the avulsion fragment at the femoral notch (*18*). Arthroscopic fixation of the avulsed fragment can be performed using screws or wires. Consistent with other authors, we believe that the use of screws is more suitable in the chronic phase, in which a rigid fixation and compression across the fracture site is necessary to achieve healing of the anterior tibial spine fracture. Screws can cause the fracture fragment to break. This is an unlikely complication with wires, which can be suitable for acute avulsion fractures of the tibial spine, but which do not reach the same compression and rigid fixation that can be achieved with screws. In addition, several authors mention that arthroscopic fixation with wires is difficult and time consuming (*8,21*).

Open surgery can be necessary for small or rotated fracture fragments, although some cases may require a later arthroscopic femoral notchplasty for impingement of the ACL in the femoral notch (*7*). The major advantages of the arthroscopic approach are that it allows these techniques to be combined in a single session and that it avoids the morbidity associated with open techniques (*7,16,17*).

In conclusion, non-union of a fracture of the anterior tibial spine was treated successfully in a single arthroscopic session involving debridement of the fibrous non-union, reduction and fixation of the bony fragment with screw and washer and a femoral notchplasty in order to prevent impingement. The fracture healed and the patient was able to resume high-intensity sports activities.

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