

Case Report

Nonunion after avulsion fracture of the anterior tibial spine

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Abstract: Nonunion of an avulsion fracture of the anterior tibial spine is quite rare. It could be associated with significant instability of the knee as it involves the fixation of the anterior cruciate ligament. Some of the complications of this nonunion include pain in knee extension, loss of knee extension and a certain amount of anterior knee instability. So, loss of knee extension is often a direct result of the nonunion of the displaced fragment. The purpose of this report was to present a case of 14-year-old girl suffering a nonunion anterior spine avulsion fracture. The patient complained of persistent knee pain and loss of knee extension. Plain radiographs, computed tomography (CT) scans and magnetic resonance imaging (MRI) were carried out, which revealed a nonunion after avulsion fracture of the anterior tibial spine. The patient was treated by arthroscopic excision of the bony prominence. A final postoperative follow-up of 6 years and 11 months post-surgery, the patient had fully recovered and presented a normal function of the affected knee that she was able to return to sports without any symptoms.

Keywords: Anterior tibial spine, nonunion, avulsion fracture

Introduction

Avulsion fractures of the anterior tibial spine are rare injuries and can be associated with other intra-articular lesions. They are most often seen in children while adolescents are rarely affected. The etiology is equivalent to ruptures of the anterior cruciate ligament (ACL). Frequently they are the result of a sport, bicycle, soccer or skiing accident [1].

A classification of avulsion fractures of the anterior tibial spine was proposed by Meyers and McKeever [2]. The type I fracture produces slight elevation of the anterior margin of the intercondylar eminence; the type II fracture shows a beak-like deformity in the lateral radiograph, and a displaced anterior 1/3 to 1/2 of the avulsed fragment; the type III fracture shows the fragment completely separated from its bone bed; and the type III+ fracture shows the rotated fragment facing the raw bone of its bone bed by its cartilaginous surface. Zaricznyj [3] added a type IV in which the fragment is comminuted. For treatment of bone avulsions type I and II, closed reduction is possible fol-

lowed by a 6 to 12 weeks immobilization. For the type III and IV, a surgical treatment is usually indicated [2, 4].

Nonunion after avulsion fracture of the anterior tibial spine in the pediatric population is rarely reported. This report describes the case of a patient suffering from nonunion of an avulsion fracture of the anterior tibial spine. She was treated by arthroscopic excision of the nonunioned fragment, which achieved an excellent functional outcome. After being informed, the patient consented to having the data concerning her case be submitted for publication.

Case report

In January 2009, a 14-year-old girl presented to the Shengjing Hospital, China Medical University in Shenyang, China, with pain in the right knee. In January 2007, she fell off her bicycle and bruised her right knee. She was taken to the nearest hospital where she was diagnosed as having an acute avulsion fracture of the anterior tibial spine of the right knee. She was not able to recall neither the type of fracture nor



Figure 1. The anteroposterior radiograph of the right knee preoperative showed a small nonunited fragment at the intercondylar eminence of the tibia (arrow).

the details of the radiographs that were taken then. Unfortunately the radiographs got lost as her family moved twice since the accident. As a treatment, her right knee was immobilized for 6 weeks in an above knee cast. During the two years following the accident, she suffered persistent knee pain, knee locking and loss of knee extension. She felt clumsy when doing physical education. Six months prior to her presentation her symptoms got worse and her right knee began to feel increasingly painful. Though her symptoms persisted for the past two years, the patient received no other treatment.

On examination, the range of motion of the affected knee was 10°-0°-130°. Lachmann test and Pivot shift test were positive. Drawer sign and varus-valgus test were negative. The anteroposterior (AP) radiograph showed a small nonunited fragment at the intercondylar eminence of the tibia (**Figure 1**). Three-dimensional computed tomography (CT) scans subsequently confirmed the finding of the radiograph (**Figure 2A, 2B**). T1-weighted coronal view magnetic resonance image (MRI) preoperative showed a loose fragment at the intercondylar

eminence of the lateral tibial spine avulsion fracture (**Figure 3**).

Such arthroscopic surgery was performed to evaluate the extent of nonunion of the avulsion fracture, the status of the ACL, the menisci and the articular cartilage. During arthroscopy, a distal portion of the lateral bundle of the ACL was found to be slightly ruptured, and a small unstable fragment was located in the ending of the lateral bundle of ACL, in the area of attachment to the intercondylar eminence of the tibia. The fragment was found to be linked to the bone bed from which it had been avulsed via a fibrotic union and was unstable. By the traction with an arthroscopic probe, the ACL showed to be very firm and stable. No ACL reconstruction surgery was required. The cartilage and menisci were intact. A fractured tibial spine was noticed. Because this nonunited fragment was small, it was removed using arthroscopic scissors. After excision of the fragment the full extension of the knee was regained. The knee was placed in a brace with extension position for 1 week after which physical therapy was initiated. At the 4-week postoperative follow-up, the patient showed full range of motion of her right knee.

At the patient's final postoperative follow-up, 6 years and 11 months after the initial surgery, the patient recovered a normal function of the affected knee and was able to return to sports without any symptoms. Clinical examination of the right knee showed no abnormalities and a range of motion of 0°-0°-150° (**Figure 4A, 4B**). The Lachmann test, pivot shift test, drawer sign, and varus-valgus test were all negative. The AP radiograph of right knee showed a nearly normal imaging of knee joint (**Figure 5**). However the three-dimensional CT scans of that knee (**Figure 6A-C**) showed two small bony eminences located in the lateral tibial plateau of the concerned knee. The patient refused to undergo an arthroscopy to confirm the findings of the CT scans.

Discussion

An accurate incidence of nonunion after fracture of the anterior tibial spine has not been established because nonunion is rare. Only a few articles reported nonunion of avulsion fractures of the anterior tibial spine [4-8]. The clini-

Fracture of anterior tibial spine



Figure 2. CT scans of the right knee preoperative showed a small nonunited fragment at the intercondylar eminence of the tibia (arrows). A. Coronal view. B. Sagittal view.

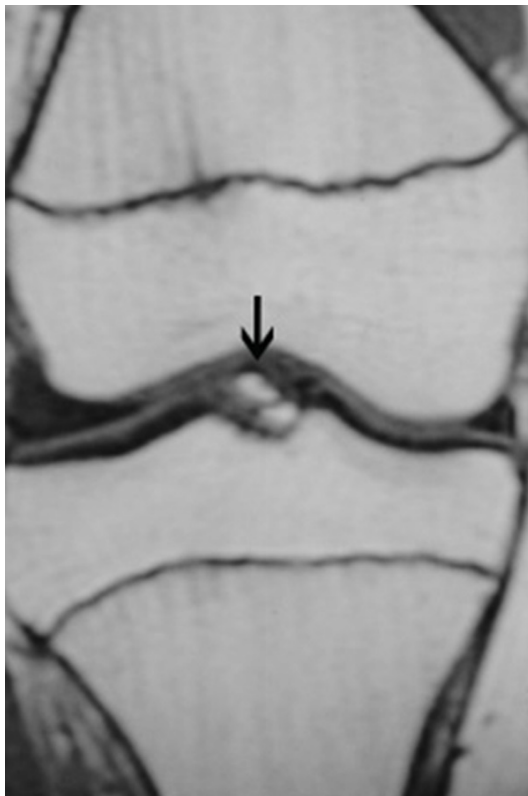


Figure 3. T1-weighted coronal view MRI preoperative showed a loose fragment at the intercondylar eminence of the lateral tibial spine avulsion fracture (arrow).

cal symptoms of a nonunion after avulsion fracture of the anterior tibial spine usually include pain at knee extension, loss of knee extension,

and some amount of anterior instability. These symptoms gradually become more serious with the enlargement of the avulsed fragment. The symptoms such as extension loss and pain at knee extension were directly related to a displacement and an impingement of the nonunited fragment or ACL at the intercondylar notch [6, 8]. In the presented case, the patient's symptoms gradually became more evident during the two post accident years. The avulsed fragment was responsible for her symptoms.

Diagnosis of nonunion after avulsion fracture of the anterior tibial spine is primarily based on plain radiographs. CT is superior to MRI with regard to diagnosis of bone lesions. MRI can reveal the combination of bone avulsion as well as injury of the ACL [9]. MRI could also identify an interposition of the intermeniscal ligament or the meniscus in the case of fracture of the anterior tibial spine. This interposition can limit the proper healing of the fracture. An interstitial injury of the ACL is very often associated with tibial eminence avulsion and can lead to persistent laxity despite anatomic reduction of the avulsion fracture of the anterior tibial spine [9-11].

The treatment of nonunion after fracture of the anterior tibial spine is difficult. The most common treatment is either open or arthroscopically assist reduction and internal fixation to the proximal tibia with the help of a Kirschner wire, a screw and a suture. One of the disadvantages with screw fixation is a possible breakage of the fracture fragment during insertion. This is particularly common with small fragments [5, 8, 11-16]. Vargas et al. [17] recommend the debridement of the scarring tissue associated with headless screws fixation in nonunion treatment of anterior tibial spine fractures. So far, the best method of treatment for this injury remains controversial and an ideal technique has not been instituted [5, 14, 18].

In the English medical literature, only a few studies have reported excision of the bony prominence as a treatment method for non-

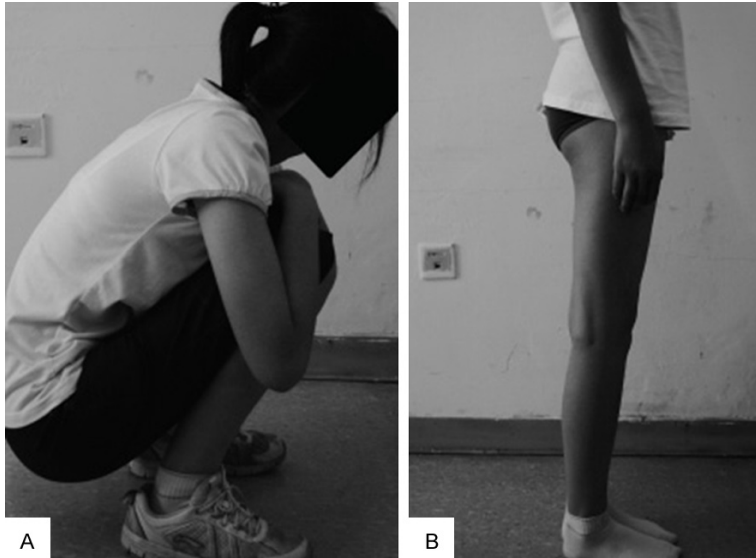


Figure 4. Clinical photographs taken during the final 6 years and 11 months post-surgery follow-up showing the range of motion of the right knee was 0°-0°-150°.



Figure 5. Anteroposterior radiograph of the right knee taken at the final 6 years and 11 months post-surgery follow-up showed a nearly normal imaging of the knee joint.

union after avulsion fracture of anterior tibial spine [2, 4, 19, 20]. Meyers and McKeever [2,

19] reported four patients having had arthroscopy and excision of the avulsed fragment and the anterior cruciate ligament. At follow-up, all patients exhibited excellent results and there were no signs of instability. Panni et al. [4] reported a series of ten cases of malunion or nonunion following avulsion fractures of anterior tibial spine. They were treated with arthroscopic debridement and abrasion of the elevated fragment combined with notchplasty to recover full extension. Anteroposterior stability of the knee could be maintained after arthroscopic excision of the bony fragment. Shelbourne et al. [20] presented seven patients who underwent arthroscopic excision of

the bony prominence in the treatment of avulsion fracture of the anterior tibial spine. All seven patients achieved normal knee extension; six patients achieved normal knee flexion, whereas one patient had nearly normal flexion. The results of arthroscopic excision of the bony fragment are positive, with good stability [20].

In the case of the presented patient, it was recognized that a small portion of the attachment of the ACL had been disrupted, which could have potentially lead to the altered knee kinematics. The fixation of the fragment to the bone bed would have been very difficult to perform because the fragment was very small and loose. In addition, the ACL of this patient had sufficient tension. So arthroscopic excision of the nonunited fragment was thought to be the first choice of treatment. This procedure would also eliminate any impingement in the intercondylar notch and therefore make it possible to regain full knee extension. The latest CT of the patient's right knee showed two small bony eminences located in the lateral tibial plateau. We cannot explain this phenomenon.

Arthroscopic femoral notchplasty is also a choice of treatment for nonunion after avulsion fracture of anterior tibial spine. Horibe et al. [7] reported a failed case of nonunion treated with open reduction and internal fixation, was successfully treated with arthroscopic femoral notchplasty to eliminate the impingement of

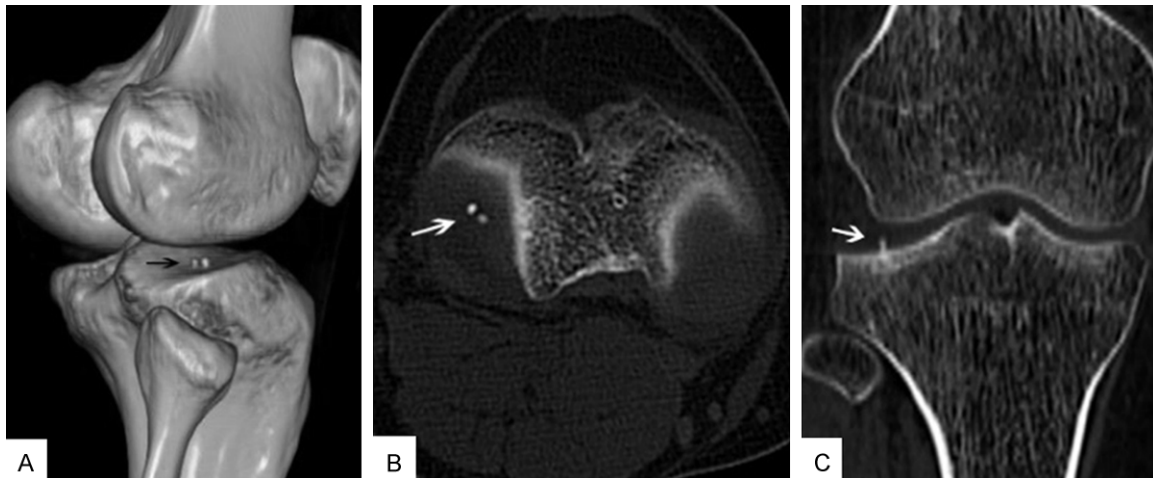


Figure 6. The latest CT scans of the right knee taken at the final 6 years and 11 months post-surgery follow-up showed two small bony eminences located in the lateral tibial plateau (arrows). A. The three-dimensional CT scan. B. Horizontal view. C. Coronal view.

the ACL at the roof. Luger et al. [21] have also recommended arthroscopic femoral notchplasty for treatment of malunited and nonunited avulsion fractures of the anterior tibial spine when the ACL remained functionally stable.

Disclosure of conflict of interest

None.

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