

Malpractice of Epiphyseal Cannulated Screw Fixation in a Child with Avulsion Fracture of the Tibial Eminence Complicating with Lack of Knee Extension and Distal Femoral Fracture

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Avulsion fracture of the tibial eminence is rare in children. This report describes a case of a 9-year-old boy who had been treated previously with an epiphyseal cannulated screw and washer, but without notchplasty, for an avulsion fracture of the tibial eminence. The patient subsequently presented with extension block and knee stiffness. After removal of the implants and manipulation, an iatrogenically-induced distal femur fracture was observed postoperatively with callus formation noted at follow-up. This case serves to illustrate the importance of identifying and treating screw head impingement during fixation surgery, of avoiding vigorous manipulation during removal of fixation devices, and of consulting radiographs after any manipulation.

Key words: avulsion fracture, tibial eminence, cannulated screw, washer

INTRODUCTION

Tibial eminence fractures resulting from chondroepiphyseal avulsion are relatively uncommon in children. A system for classifying chondroepiphyseal avulsion fractures has been proposed by Meyers and McKeever¹. According to this system, a nondisplaced fracture is classified as type I, a partially displaced fracture is classified as type II, and a fully displaced fracture is classified as type III. Zaricznyj² added a type IV displaced fracture in which the fragment is comminuted. For displaced tibial eminence fractures, open reduction and fixation of the fragment with screws or through use of suturing methods is usually indicated. This report describes two complications arising from mismanagement of an avulsion fracture of the tibial eminence in a child: lack of knee extension resulting from improper fixation and distal femoral fracture resulting from subsequent manipulation.

CASE REPORT

A 9-year-old boy presented with swelling and tenderness of the left knee after suffering a fall from a bicycle three months earlier. Initially, he was sent to a local hospital where he was diagnosed as having a fracture of the tibial eminence. The fracture was classified as Meyers and McKeever type II but maintaining a posterior attachment (Figure 1). Open reduction and internal fixation with an epiphyseal cannulated screw and washer was therefore performed (Figure 2). A long-leg splint was applied for 6 weeks postoperatively.



Fig. 1 Tibial radiographs of a 9-year-old boy three months before surgery. Radiograph showed type II tibial eminence fracture with partially displaced but maintaining a posterior attachment.

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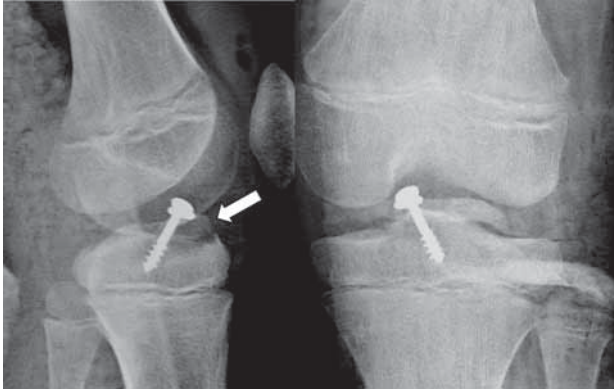


Fig. 2 Immediate post-operative radiograph in local hospital. The fragment was reduced (see arrow) at that time.

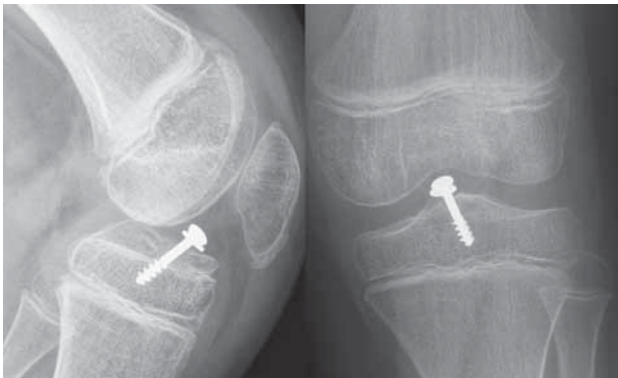


Figure 3. Over three months after surgery, the radiograph showed a bony union without screw loosening.

Three months later, he complained of persistent and increasing knee pain and stiffness and was referred to our center. Physical examination of the affected knee showed a limited range of motion and stiffness, with 15° extension and 120° flexion. The radiograph (Figure 3) revealed a bony union without screw loosening.

Under the impression that the lack of knee extension was the consequence of mismanagement of the previous cannulated screw fixation, arthroscopic-assisted removal of the screw and washer was performed. During this procedure impingement of the screw and washer, which had been placed without performing notchplasty, was found to be the cause of the extension block (Figure 4). After removal of the screw and washer, manipulation was performed resulting in full extension of the affected knee. However, a neglected iatrogenically-induced fracture of the distal femur was identified postoperatively (Figure 5). At two months post-surgery, fracture healing with callus



Fig. 4 Arthroscopic image showing impingement of the screw and washer, which had been placed without performing notchplasty, was found to be the cause of the extension block. Partial wear of the femoral condylar cartilage was observed.

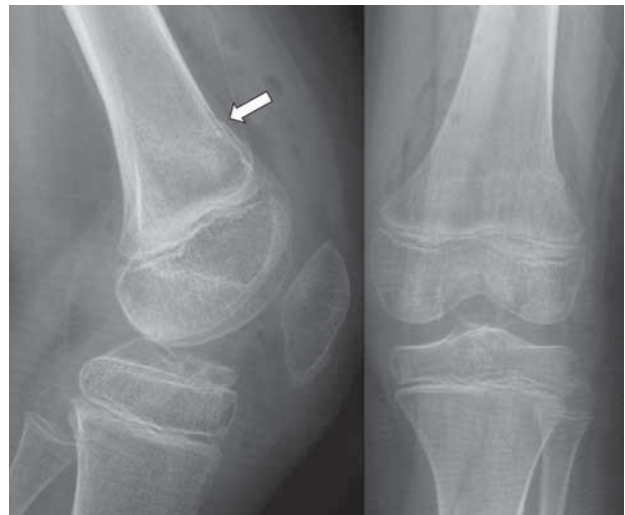


Fig. 5 After removal of the screw and washer, manipulation was performed. A neglected iatrogenically-induced fracture (see arrow) of the distal femur was identified postoperatively

formation was noted at follow-up in the outpatient department (Figure 6).

DISCUSSION

Avulsion fracture of the tibial eminence in children is

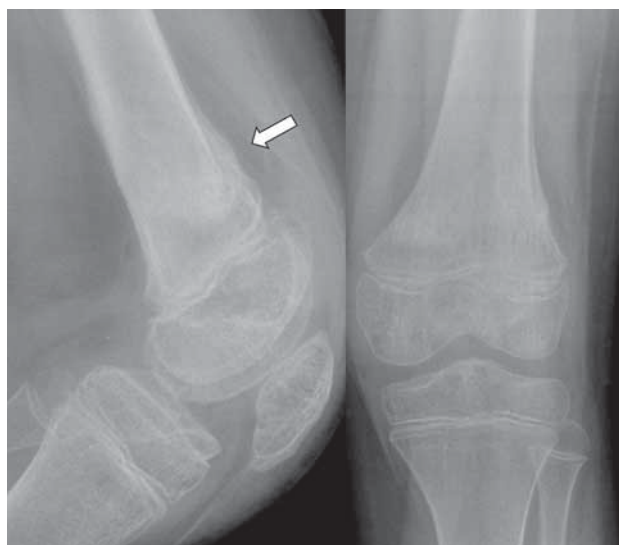


Fig. 6 At two months post-surgery, fracture healing with callus formation was noted (see arrow) at follow-up in the outpatient department

relatively uncommon, occurring in 3 per 100,000 children per year³. This injury occurs most often between the ages of 8 and 14 years⁴, with bicycle accidents and athletic activities reported to be the most common causes¹. The most common mechanism underpinning tibial eminence fracture is forced valgus and external rotation of the tibia. This type of fracture may also occur in response to a direct blow to the distal femur when the knee is flexed⁴.

The integrity of structures of the internal joint, such as the anterior cruciate ligament, may be compromised in avulsion fractures of the tibial eminence. Tibial eminence fractures result from chondroepiphyseal avulsion of the anterior cruciate ligament insertion on the anteromedial tibial eminence. In adults, this stress can cause an isolated tear of the anterior cruciate ligament. In children, however, the incompletely ossified tibial eminence is generally weaker and more sensitive to tensile stress than the ligament, and failure occurs via the cancellous bone beneath the subchondral bone of the tibial eminence⁵. Accordingly, no evidence for ligament rupture was observed in our case.

Treatment of avulsion fractures of the tibial eminence depends on the appearance of the fracture. Displaced avulsion fractures of the tibial eminence result in eventual instability and notch impingement, leading to loss of extension^{2,6}. Therefore, reduction with internal fixation is recommended for all Meyers and McKeever^{1,2} classification type III and IV fractures and should be considered for all displaced type II fractures⁷.

Various fixation devices, such as epiphyseal cannulated screws, staples, wires, pull-out sutures, and suture anchors, are currently used to manage avulsion fractures of the tibial eminence⁸⁻¹⁷. Fixation with a cannulated screw over the threaded guide wire is simple and is considered more effective in obtaining rigid fixation and compression across the fracture site. A disadvantage of screw fixation is breakage of the fracture fragment during insertion. For comminuted or small size fragments, both suture fixation^{10,16} and screw fixation with a toothed washer¹⁵ are being utilized.

A toothed washer was used in the present case to pull the fragments and the ligament fiber together, to prevent the screw head from being buried under the ligament fiber, and to facilitate finding the screw when removal was indicated. However, use of a toothed washer may cause bulging of the screw head and lead to extension impingement. In this circumstance, notchplasty is indicated to recover full knee extension. In the present case, notchplasty was not performed and extension impingement followed.

In conclusion, any pediatric patient with a displaced avulsion fracture of the tibial eminence should receive surgical fixation of the detached fragment. Such surgery permits early mobilization and is conducive to good outcome. However, as is illustrated by our case, patients should be examined intra-operatively for the possibility of screw head impingement which, if present, should be treated by notchplasty to recover full extension of the knee. This case also illustrates that overly vigorous manipulation during removal of a fixation device should be avoided to prevent iatrogenic fracture and that consultation of radiographs after each manipulation is essential. In the case of our patient, a neglected fracture of the distal femur occurring during surgical removal of implants and manipulation was found postoperatively, and callus formation was noted at follow-up.

REFERENCES

1. Meyers MH, McKeever FM. Fracture of the intercondylar eminence of the tibia. *J Bone Joint Surg Am* 1970;52:1677-1684.
2. Zaricznyj B. Avulsion fracture of the tibial eminence: treatment by open reduction and pinning. *J Bone Joint Surg Am* 1977;59:1111-1114.
3. Skak SV, Jensen TT, Poulsen TD, Sturup J. Epidemiology of knee injuries in children. *Acta Orthop Scand* 1987;58:78-81.
4. Accousti WK, Willis RB. Tibial eminence fractures. *Orthop Clin North Am* 2003;34:365-375.

5. Zionts LE. Fractures around the knee in children. *J Am Acad Orthop Surg* 2002;10:345-355.
6. Kendall NS, Hsu SY, Chan KM. Fracture of the tibial spine in adults and children. A review of 31 cases. *J Bone Joint Surg Br* 1992;74:848-852.
7. Lubowitz JH, Elson WS, Guttman D. Part II: arthroscopic treatment of tibial plateau fractures: intercondylar eminence avulsion fractures. *Arthroscopy* 2005;21: 86-92.
8. Berg EE. Pediatric tibial eminence fractures: arthroscopic cannulated screw fixation. *Arthroscopy* 1995;11:328-331.
9. Jung YB, Yum JK, Koo BH. A new method for arthroscopic treatment of tibial eminence fractures with eyed Steinmann pins. *Arthroscopy* 1999;15:672-675.
10. Kogan MG, Marks P, Amendola A. Technique for arthroscopic suture fixation of displaced tibial intercondylar eminence fractures. *Arthroscopy* 1997;13:301-306.
11. Lehman RA, Jr., Murphy KP, Machen MS, Kuklo TR. Modified arthroscopic suture fixation of a displaced tibial eminence fracture. *Arthroscopy* 2003;19:E6.
12. Oohashi Y. A simple technique for arthroscopic suture fixation of displaced fracture of the intercondylar eminence of the tibia using folded surgical steels. *Arthroscopy* 2001;17:1007-1011.
13. Osti L, Merlo F, Liu SH, Bocchi L. A simple modified arthroscopic procedure for fixation of displaced tibial eminence fractures. *Arthroscopy* 2000;16:379-382.
14. Reynders P, Reynders K, Broos P. Pediatric and adolescent tibial eminence fractures: arthroscopic cannulated screw fixation. *J Trauma* 2002;53:49-54.
15. Senekovic V, Veselko M. Anterograde arthroscopic fixation of avulsion fractures of the tibial eminence with a cannulated screw: five-year results. *Arthroscopy* 2003;19: 54-61.
16. Yip DK, Wong JW, Chien EP, Chan CF. Modified arthroscopic suture fixation of displaced tibial eminence fractures using a suture loop transporter. *Arthroscopy* 2001;17:101-106.
17. In Y, Kim JM, Woo YK, Choi NY, Moon CW, Kim MW. Arthroscopic fixation of anterior cruciate ligament tibial avulsion fractures using bioabsorbable suture anchors. *Knee Surg Sports Traumatol Arthrosc* 2008;16:286-289.
18. Tsukada H, Ishibashi Y, Tsuda E, Hiraga Y, Toh S. A biomechanical comparison of repair techniques for anterior cruciate ligament tibial avulsion fracture under cyclic loading. *Arthroscopy* 2005;21:1197-1201.