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Case Report

Avulsion Fracture of the Tibial Tuberosity Requiring Meniscal Repair : A Case Report

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Abstract

Avulsion fractures of the tibial tuberosity are uncommon injuries. A 16-year-old male sustained injuries to his right knee joint after jumping from stairs and landed on his feet with his right knee forced into flexion. X-ray photographs showed a type III avulsion fracture of the tibial tuberosity. On the next day of the injury, open reduction and internal fixation, followed by arthroscopy was performed. The fracture fragment was fixed with three 5.0mm cannulated cancellous screws. The torn anterior portion of medial meniscus was repaired with 3-0 Polydioxanone (PDS) using outside-in sutures and the torn midportion of medial meniscus was repaired using the FasT-Fix meniscal repair system. Eight months after the injury, removal of the screws and arthroscopy were undertaken. The medial meniscus was completely healed. The range of motion was full at the knee joint. Meniscal suture should be strongly considered for type III avulsion fractures of the tibial tuberosity in adolescents.

Key words : Avulsion fracture · Tibial tuberosity · Open reduction and internal fixation · Meniscal repair

Introduction

Avulsion fractures of the tibial tuberosity are uncommon injuries, usually occurring in adolescents^{1)–4)}. The incidence has been reported to be 0.4% to 2.7% of all epiphyseal injuries and < 1% of all physeal injuries⁵⁾⁶⁾. The classification of these fractures has been discussed by several authors. Ogden et al⁷⁾, modified the classification of Watson-Jones⁸⁾, dividing it into three types. In type I, the fracture crosses the secondary ossification center level with the posterior border of the inserting patellar tendon. In type II, the fracture line runs along the junction of the primary and secondary ossification centers of the proximal tibial epiphysis. In type III fractures, the fracture line extends into the articular surface

across the primary ossification center. We herein report a case of a type III avulsion fracture of the tibial tuberosity that required meniscal sutures. Informed consent has been obtained from the patient or his family for publication, including any necessary photographs.

Case report

A 16-year-old male jumped from the stairs and landed on his feet with his right knee forced into flexion. He experienced sudden pain in the right knee and was unable to bear weight on his right leg. He was transferred to our hospital. On examination, the patient's right knee joint was found to be swollen with hemarthrosis and crepitation over the tibial tuberosity. X-ray images revealed an avulsion fracture of the tibial

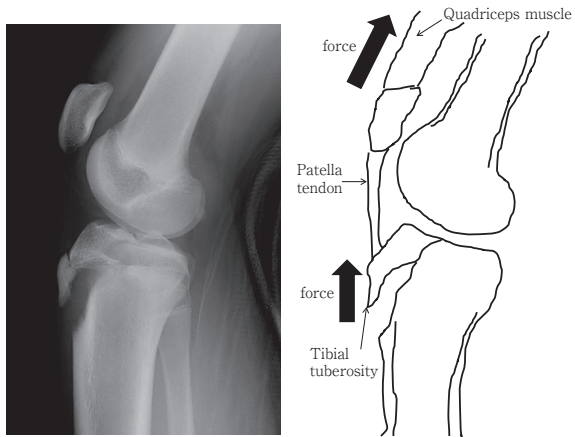


Fig. 1 X-ray photographs of the right knee joint on the day of the injury. The X-ray photographs revealed a type III avulsion fracture of the tibial tuberosity. The quadriceps muscle was contracted proximally during flexing the knee, therefore the tibial tuberosity was fractured (arrows).

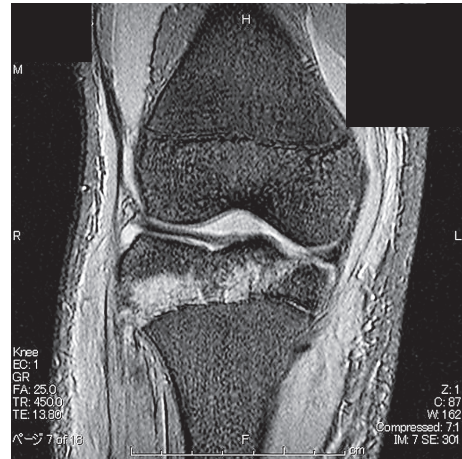


Fig. 2 MRI of the right knee joint on the day of the injury. A high-intensity area was detected in the medial meniscus.

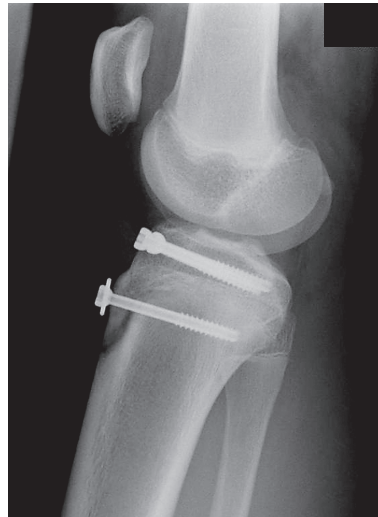


Fig. 3 X-ray photographs of the right knee joint after surgery.

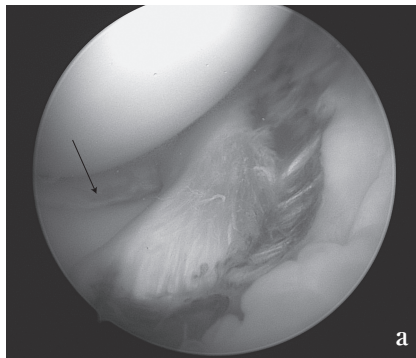


Fig. 4 a The medial meniscus was torn longitudinally in the red-white zone in the pars intermedia. The fracture line was identified using arthroscopy (arrows).

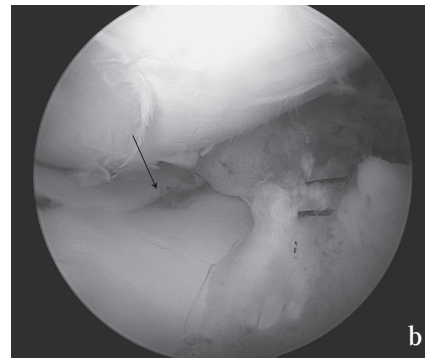


Fig. 4 b The torn medial meniscus was sutured with 3-0 PDS using outside-in sutures and the FasT-Fix meniscal repair system. The fracture was reduced and fixed anatomically (arrows).



Fig. 5 Eight months after the injury. The medial meniscus had completely healed.

tuberosity with anterior and superior displacement of the fracture fragment (Watson-Jones type III, Ogden III A). (Fig. 1). Magnetic resonance imaging (MRI) revealed a high-intensity area in the medial meniscus (Fig. 2).

The day after the injury, open reduction and internal fixation followed by arthroscopy was performed. An examination conducted under anesthesia found the following findings : a negative Lachman test, a negative anterior drawer sign, a negative varus and valgus instability. A 7-cm skin incision was made along the medial border of the patella tendon. A fragment of the tibial tuberosity was displaced anteriorly and superiorly. Provisional fixation was undertaken using Kirschner wires, and the fracture fragment was fixed with three 5.0-mm cannulated cancellous screws (Fig. 3). Arthroscopy showed a longitudinal tear in the red-white zone in the pars intermedia of the medial meniscus and a fracture line parallel to the coronal plane through the medial joint surface. The fracture line was found through the cartilage of the medial and lateral tibial plateau and under the torn medial meniscus. The direction of the fracture line was perpendicular to the direction of the meniscal tear. The anterior cruciate ligament, posterior cruciate ligament and lateral meniscus were shown to be intact. No obvious injury of the capsular avulsion or coronary ligament was detected. The torn

anterior portion of medial meniscus was repaired with 3-0 Polydioxanone (PDS) (Johnson & Johnson, New Brunswick, NJ, USA) using outside-in sutures and the torn midportion of medial meniscus was repaired using the FasT-Fix meniscal repair system (Smith & Nephew Endoscopy, Andover, MA, USA) (Fig. 4 a, b). Postoperatively, the patient's knee was immobilized in a long leg cast. Continuous passive motion (CPM) was initiated starting the day after surgery. Partial weight bearing and resistive exercises of the quadriceps and hamstring muscles were allowed six weeks after surgery. Full weight bearing was allowed 10 weeks after surgery. Bone union was achieved six months after surgery, and the joint alignment was good.

Three months after surgery, the range of motion in the right knee was 135 degrees in flexion and 0 degrees in extension and the McMurray test was negative. Eight months after the injury, removal of the screws and arthroscopy were undertaken. Arthroscopy showed that the torn medial meniscus had completely healed (Fig. 5). One year after the first surgery, the patient's range of motion at the knee joint was 140 degrees in flexion and 0 degrees in extension. Epiphyseal arrest of the proximal tibia was not detected.

Discussion

Avulsion fractures of the tibial tuberosity are uncommon injuries. They usually occur during athletic events in adolescents. These injuries have been described as resulting from sudden forced flexion of the knee against a strongly contracted quadriceps or sudden violent quadriceps contraction acting across a flexed knee during which the foot stabilizes concentrated forces in the area of the tibial tuberosity⁹⁾.

There are few reports of avulsion fractures of the tibial tuberosity treated with meniscal repair (Table 1)^{5), 10) ~ 12)}. Type III avulsion fractures of the tibial tuberosity are intra-articular fractures of the proximal tibia. Therefore, it is necessary to conduct thorough physical and MRI examinations

Table 1 Cases of avulsion fracture of the tibial tuberosity with meniscal tears

Author, year	age	Gender	Fracture type (Ogden classification)	mechanism	Injury lesion	Treatment of meniscus
Choi, 1999	15	Male	III	Slip on stairs	Medial meniscus (midportion)	Repair with absorbable sutures
Fasler, 1992	15	Male	II	Slip during taking off for a jump	Lateral meniscus (posterior horn)	suture
Lipscomb AB, 1984	16	Male	III A	Basketball injury	Medial meniscus (anterior horn)	Repair with multiple interrupted sutures
Bolesta MJ, 1986	17	Not listed	III B	Basketball injury	Lateral meniscus, coronary ligament	repair
Bolesta MJ, 1986	14	Not listed	III B	Basketball injury	Peripheral lateral meniscus	repair

in order to determine whether meniscal and ligament injuries are combined or not¹³⁾. If there is any suspicion of a combined injury of the knee, arthroscopy should be performed. Our case highlights the need for a high index of suspicion of meniscal tears when treating avulsion fractures of the tibial tuberosity.

The most common mechanism of meniscal injury is a twisting injury with the foot anchored on the ground. However, the relationship between the injury mechanism and the pattern of meniscal tear in avulsion fractures of the tibial tuberosity is still unknown. Meniscal tear may occur in both medial and lateral side in avulsion fractures of the tibial tuberosity. The medial meniscus is more commonly injured than the lateral meniscus in sports activity. The difference of injury mechanism between medial meniscal tear and lateral meniscal tear associated with avulsion fractures of the tibial tuberosity is still unknown.

Meniscal suturing has been reported to obtain good clinical outcomes^{14)~19)}. Avulsion fractures usually occur in adolescents, and meniscal tears in skeletally immature adolescents have greater reparative potential. Therefore, attempts at meniscal repair should be strongly considered in patients with type III avulsion fractures of the tibial tuberosity. Fixation of the avulsion of the

tibial tuberosity is generally performed using screws²⁾⁸⁾¹⁰⁾. We performed rigid fixation of the fracture using three cannulated screws. Therefore, we were able to initiate CPM the day after surgery.

Howarth et al²⁰⁾ reported that a tibial tubercle avulsion fracture types III or V will likely have intra-articular pathology, specifically capsular avulsion or coronary ligament disruption and less commonly meniscal tears. He described the repair of capsular avulsion or coronary ligament disruption using suture anchors. In our case, no obvious capsular avulsion or coronary ligament was detected, therefore, medial meniscal repair was undertaken using sutures and the FasT-Fix meniscal repair system.

In conclusion, we herein reported a case of a type III avulsion fracture of the tibial tuberosity that required meniscal sutures. Arthroscopic treatment is mandatory for type III avulsion fractures of the tibial tuberosity.

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(和文抄録)

内側半月板損傷を合併した脛骨粗面骨折の1例

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我々は、内側半月板断裂を合併した脛骨粗面骨折の1例を経験したので報告する。

症例：16歳男性。階段3段を飛び下りた際に転倒し受傷した。膝関節痛を自覚し、歩行不能となり、同日受診となった。X線にて脛骨粗面骨折（Watson-Jones III型）の診断であった。MRIにて内側半月板損傷を疑う所見を認めた。

受傷翌日、骨接合術ならびに関節鏡手術を施行した。骨折部は5.0mm CCS 3本にて固定した。続いて関節鏡視を行うと、内側半月板の前節・中節部の実質部に縦断裂を認めた。中節部はall inside法で縫合し、前節部は3-0PDSを用いてoutside-in法で縫合した。ACL, PCLには明らかな断裂は認めなかった。術後6週間より部分荷重を開始し、術後10週目より全荷重とした。術後8ヶ月時点で、膝関節可動域は屈曲140°、伸展0°と改善し、抜釘術ならびに関節鏡を施行した。縫合した内側半月板は修復していた。

脛骨粗面骨折に半月板損傷を合併した報告は少ない。本症例では、骨折型とMRI所見から内側半月板損傷を診断し、縫合術を行った。Watson-Jones III型の脛骨粗面骨折では半月板縫合を考慮する必要がある。