CASE REPORT

Two Years of Follow-up Magnetic Resonance Imaging for Osteochondral Injury of the Lateral Femoral Condyle in an Adolescent Basketball Player

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Abstract : Chondral and osteochondral injuries of the femoral condyle are rare, and relatively few cases have been reported. Therefore, the mechanism, treatment, and findings on follow-up of these injuries are not well described. Here, we report the case of an adolescent basketball player who sustained a sports-related traumatic osteochondral injury of the lateral femoral condyle. He was treated with open reduction and internal fixation with the pull-out suture technique. Two years later, he was able to resume sporting activities at his pre-injury level with no symptoms. Magnetic resonance imaging (MRI) confirmed survival of the fixed osteochondral fragment and restoration of the congruity of the articular cartilage with no sign of delamination. This report describes the clinical outcome of this osteochondral injury of the lateral femoral condyle as seen on MRI at the 2-year follow-up and discuss the mechanism and treatment of this injury. J. Med. Invest. 66 : 213-217, February, 2019

Keywords **:** *Osteochondral injury, Lateral femoral condyle, Magnetic resonance imaging, Sport, Adolescent player*

INTRODUCTION

Chondral and osteochondral injuries of the femoral condyle are rare (1-3) and occur mainly in adolescents. These injuries result from direct exogenous injuries or indirect endogenous injuries, such as rotation, compression, or shear forces (4-8). According to the current literature, the preferred treatment for these chondral and osteochondral fractures is open reduction and internal fixation (ORIF) to restore the congruity of the articular surface. Several treatment methods for these fractures have been reported (1, 8-23), but there are still no reports of postoperative follow-up using magnetic resonance imaging (MRI).

Here we report the case of an adolescent boy with indirect traumatic osteochondral injury of the lateral femoral condyle that was treated with ORIF using the pull-out suture technique. This article describes in detail the MRI findings at the 2-year follow-up and discusses the mechanism and treatment of this injury.

CASE PRESENTATION

A 13-year-old boy experienced sudden pain in his left knee after landing on the floor during basketball practice. He visited a local hospital because of pain and swelling in the affected knee and was diagnosed as having osteochondral injury of the left lateral femoral condyle on the basis of MRI findings. He was referred to our department for further examination and treatment.

The range of motion at his left knee was $0^\circ - 120^\circ$ with pain. There was no joint effusion or ligamentous laxity and no patellar instability or apprehension. A lateral plain radiograph showed irregularity of the subchondral bone at the lateral femoral condyle (Fig. 1a). Computed tomography revealed a subchondral bone defect in the anterior part of the lateral femoral condyle (Fig. 1b). Fast spin-echo T2-weighted MRI of the left knee showed a full-thickness cartilage defect on the lateral femoral condyle with a displaced fragment (Fig. 1c). There were no other abnormal findings.

Arthroscopic removal of an osteochondral fragment and ORIF were performed 1 month after the injury. During arthroscopy, we found an osteochondral fragment in the suprapatellar pouch (Fig. 2a) and a large full-thickness chondral defect on the lateral femoral condyle (Fig. 2b). The surface of the bed of the subchondral bone was covered with scar tissue. The injury was assessed as Outerbridge-Brittberg grade IV. No meniscal or ligamentous lesions were observed. An osteochondral fragment measuring 2.5 cm × 2 cm was removed arthroscopically (Fig. 3a). Macroscopically, the composition of the fragment was mostly cartilage with a minimal bone component. The chondral defect and bed of the subchondral bone were exposed after arthrotomy (Fig. 3b). The chondral fragment was trimmed to match the defect and fixed via pull-out using monofilament nylon yarn after curettage of the bed accompanied by bone marrow stimulation (Fig. 3c). Bone tunnels were created using a tibial drill guide for reconstruction of the anterior cruciate ligament. The tip of the tibial drill guide was placed from the bed of the subchondral bone to the lateral wall of the lateral femoral condyle. We pulled the suture thread out to the lateral wall of the lateral femoral condyle through the bone tunnels and tied off the entire circumference of the fragment (Fig. 4).

The knee was immobilized using a brace for 3 weeks. Range of motion exercises were initiated 2 weeks postoperatively. Partial weight-bearing was allowed at 3 weeks, followed by full weight-bearing at 6 weeks. Jogging was allowed at 3 months, with return to

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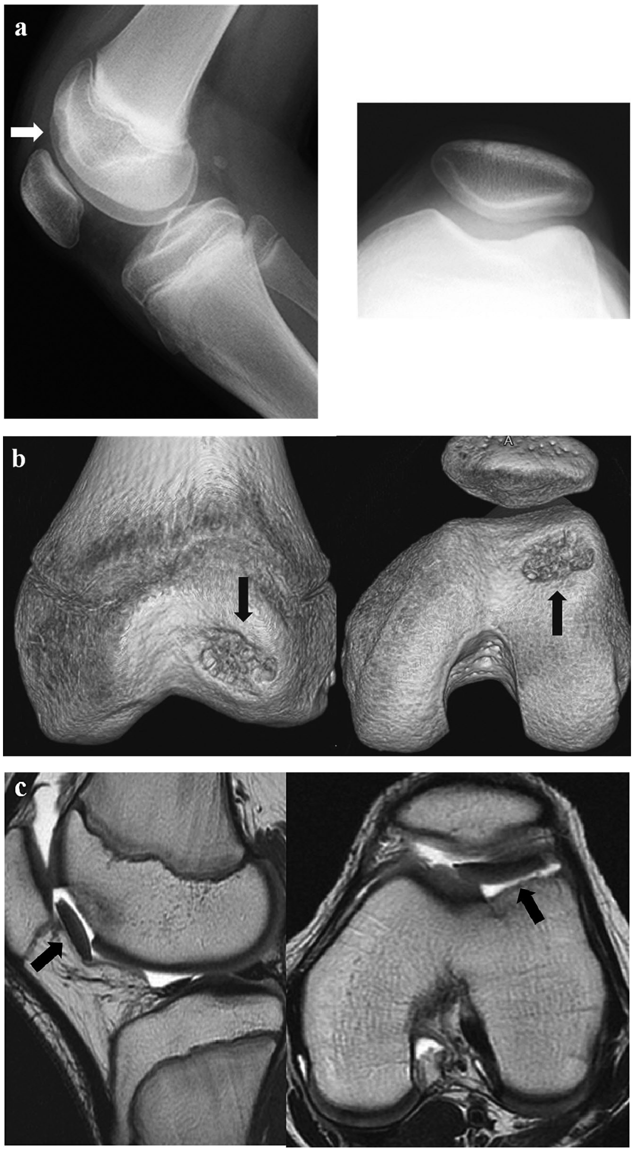

Fig. 1 Imaging findings in a 13-year-old boy with osteochondral injury of the left lateral femoral condyle. **a** Lateral and axial plain radiographs of the knee. Lateral view showing irregularity of the subchondral bone at the lateral femoral condyle (arrow). **b** Volume rendering reconstruction from three-dimensional computed tomography of the knee showing a subchondral bone defect at the lateral femoral trochlea (arrow). **c** Fast spin-echo T2-weighted magnetic resonance image showing a cartilage defect on the lateral femoral condyle with an intra-articular fragment (arrows).

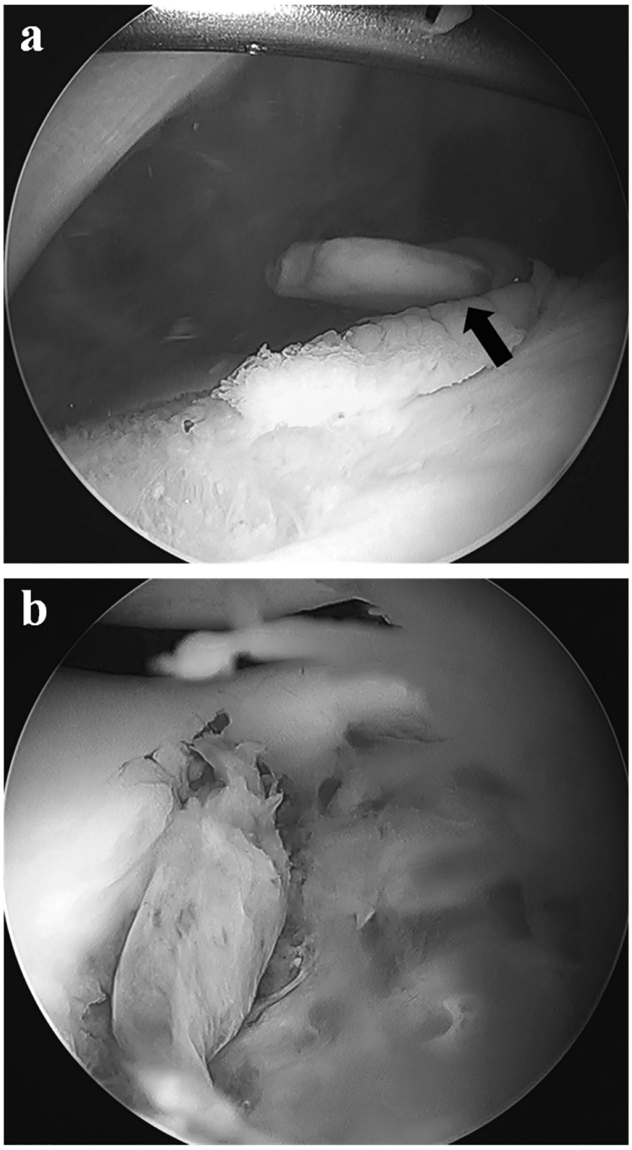

Fig. 2 Findings on arthroscopy. **a** Chondral fragment in the suprapatellar pouch (arrow). **b** Full-thickness chondral defect on the lateral femoral condyle.

previous sporting activities at 6 months.

At the 2-year follow-up, the patient had no complaints of knee problems, and physical examination revealed no loss of function. Four follow-up MRI studies performed postoperatively confirmed survival of the fixed chondral fragment and a smooth articular surface without any sign of delamination, suggesting successful healing (Fig. 5).

DISCUSSION

Chondral and osteochondral fractures of the lateral femoral condyle are rare injuries. They were first reported by Makin in 1951 (24) and then by Rosenberg in 1964 (25) and Kennedy *et al*. in 1966 (4). In a later epidemiological study, Matthewson *et al*. (26) identified 20 patients with a diagnosis of osteochondral fracture of the femoral condyle over a 10-year period. More recently, Uchida *et al*. (9) reported the 10-year incidence of these injuries to be 3 in 6000 cases (0.05%). Adolescents are predisposed to osteochondral injuries of the knee (27) and those with ligamentous laxity of the knee tend to have osteochondral fractures of the lateral femoral condyle (10). Our patient had a fracture of the lateral femoral condyle but no ligamentous laxity. The diagnosis, which is often impossible to make radiographically, is best obtained by performing arthroscopy or MRI (5). In our case, we used MRI to secure a definitive diagnosis.

There have been several reports on the mechanism of injury (4-8, 26, 28). Kennedy *et al*. (4) classified the injury into two main clinical groups according to the following mechanism : exogenous fractures resulting from direct injury and endogenous fractures resulting from a combination of rotation and compression forces. Huegli *et al*. (5) reported that most traumatic cartilage defects at the trochlear groove included both a flexion and a rotational

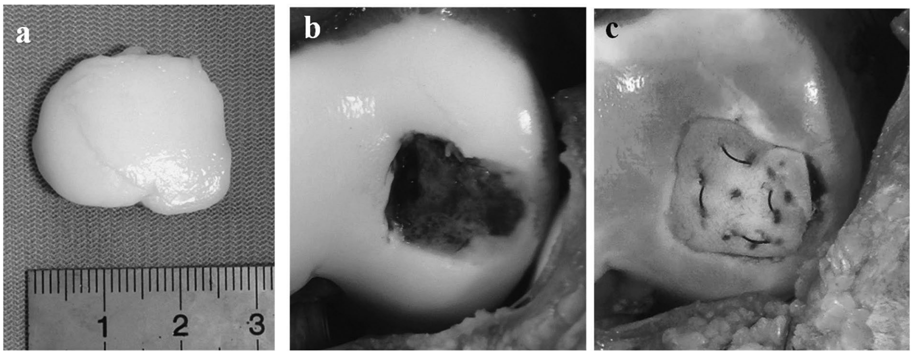

Fig. 3 Chondral defect and fragment. **a** Chondral fragment measuring 2.5 cm × 2 cm. **b** Macroscopic view shows the full-thickness chondral defect of the lateral femoral condyle and the surface of the bed covered with scar tissue. **c** The chondral fragment was trimmed to match the defect and fixed using the pull-out suture technique after curettage of the bed.

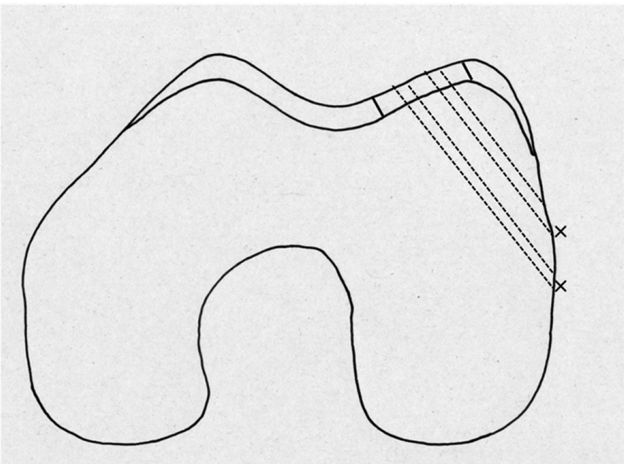

Fig. 4 Operative procedure for fixation using the pull-out suture technique.

component, and that the majority of patients with this condition sustained an indirect twisting injury. Oohashi *et al*. (8) reported a certain mechanism in a case that differed from the usual osteochondral fracture, whereby shear force was transmitted by the patella to the convex surface of the trochlea during rapid extension of the weight-bearing knee from a flexed position. Consequently, the cartilage of the trochlea was avulsed proximally. In our patient, the injury occurred while the knee was in the flexed position. Furthermore, the osteochondral fragment of the lateral femoral condyle was seen to be displaced distally on MRI. Therefore, in our patient, the fracture was caused by simultaneous twisting and compression forces. Chondral fracture of the trochlea has been reported to involve the lateral trochlea (6), potentially because of certain anatomical features. The lateral facet of the trochlea is larger and more prominent than the medial facet, so may be more easily impinged on by the patella.

Most cases of chondral or osteochondral fracture are treated surgically. Depending on the size, condition, and location of the lesion, the appropriate method should be selected and should include reduction of the osteochondral fragment with internal fixation or excision and cartilage resurfacing (27). Kayaoglu and Binnet reported that internal fixation was the most effective method

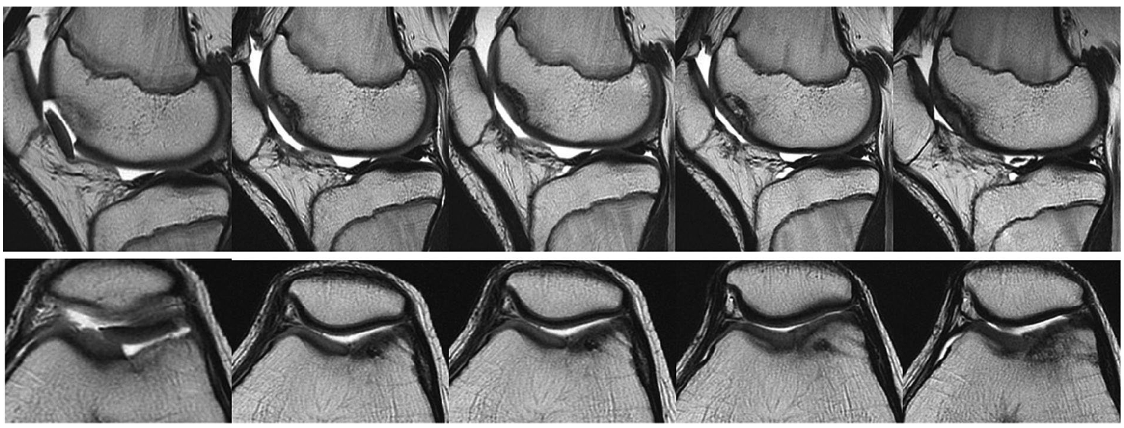

Fig. 5 Follow-up fast spin-echo T2-weighted magnetic resonance images of the lateral femoral condyle (sagittal view). Imaging studies at 2 years postoperatively showing that the articular surface remains smooth with no sign of delamination, suggesting successful healing.
a Preoperative state and postoperative state at **b** 3 months, **c** 7 months, **d** 1 year, and **e** 2 years.

for managing these fractures (29). ORIF is required in order to restore the congruity of the articular surface and to rigidly fix the fragment. Several reports have described use of a bioabsorbable implant to fix the osteochondral fragment with good clinical outcomes (9-14). There have also been several reports of articular cartilage damage with joint effusion and pain caused by pins that protruded from the bone or by catching of osteochondral fragments by the pins after fixation (30, 31). Other methods used for fixation of osteochondral fractures have included drilling into the subchondral bone (1, 8, 15), bone peg fixation (21), fixation using compression screws (22), suture bridge fixation (16, 23), and use of fibrin adhesive (17). Recently, Song *et al.* (20) reported on three cases of osteochondral fractures of the lateral femoral condyle that were treated using three different methods : autologous bone pegs, headless screws, and transplantation of cultured chondrocytes. The most favorable outcome was obtained using autologous bone pegs. In our case, we attempted pull-out fixation of the osteochondral fragment. This technique can anatomically reduce the fragment, compress the fragment into the subchondral bed, and provide enough fixation to allow immediate passive motion with comparatively less invasion of the articular cartilage. This method has the further advantages of being inexpensive, not needing removal of implants, and allowing for postoperative MRI to be performed without the presence of metal artifact. Several reports have described the use of suture fixation for acute osteochondral fractures (16, 23, 32-34).

Our patient was able to resume sports activity at his pre-injury level without knee pain, and follow-up imaging 2 years after surgery showed restoration of the congruity of the articular cartilage. This favorable outcome indicates that our method is a viable alternative to other accepted means of fixation for the treatment of osteochondral fragments in the knee. We will continue to follow up the patient to monitor the clinical outcomes in the long term.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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Ethical approval

All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from the parents of the patient presented in this report.

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