CASE REPORT

Delayed osteochondral fracture fixation of the knee in a pediatric patient

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ABSTRACT

The frequency of osteochondral fractures in the knee joint in the pediatric population is not clearly known. Although fragment fixation is generally considered to be the ideal treatment method in acute injuries, the data of the results of late fixation in neglected and/or late-diagnosed cases are very limited. In this paper, we report our findings regarding the fixation of a delayed large osteochondral fracture in lateral femoral condyle in a pediatric patient.

Keywords: Late fixation; neglected fracture; osteochondral fracture; pediatric fracture.

INTRODUCTION

The osteochondral fractures (OCF)s were described long ago, but there is still no precise information about the prevalence of the OCFs in pediatric age group. OCFs around the knee joint usually occur due to an acute major injury or repetitive microtrauma. The potential causes include torsional injury of the knee and patellar dislocation. Direct radiological diagnosis may be challenging because the bone component of the osteochondral fragment can be a very thin layer.[1]

Although there are several publications in the literature describing different methods for early surgical treatment of OCFs, there is no consensus on the surgical treatment of late-diagnosed cases. Moreover, excision of the osteochondral fragment was classically performed in cases diagnosed later than two weeks.[2–4]

In this paper, we report good radiological and excellent functional results with fragment fixation of a neglected lateral femoral condyle OCF in a pediatric patient at postoperative 30th months.

CASE REPORT

A 16-year-old female patient was admitted to our orthopedic out-patient clinic with pain, limited range of motion and locking in the left knee. The patient had a history of torsion injury in a handball match 2.5 years ago. After her initial evaluation in the emergency department of another institution, the patient was told to have a structural abnormality in knee joint and was advised to rest and use topical non-steroids. The patient was not able to participate in competitive sports in the following period. One year after the first injury, she had a sudden onset of knee pain and a simple fall while dancing. The patient thought the pain was caused by 'her structural abnormality' and did not seek medical attention until her complaints started to limit daily activities.

The patient applied to our center suffering increased limitation of movement and painful locking in her knee, which adversely affects her daily life activities. Her physical examination revealed that the first 30 degrees of active knee flexion were pain-free. There was a sharp pain and locking in

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30 degrees of flexion. The patient was able to achieve full flexion after unlocking her knee with tibial external rotation. X-ray and MRI evaluation showed a displaced osteochondral fracture at the posterior aspect of the lateral femoral condyle (Fig. 1). Surgery was planned for further diagnosis and treatment.

Surgical Technique

Surgery started arthroscopically and intraarticular structures were evaluated. A large grade 4 osteochondral defect (approximately 35x35 mm) covered with fibrotic tissue was detected in the posterior aspect of the lateral femoral condyle. A free osteochondral fragment was observed adjacent to the popliteus tendon in the posterior aspect of the lateral compartment and taken to the lateral compartment with grasper (Fig. 2). The debridement of the fibrous tissue over the osteochondral defect revealed that the defect area was wider than the fragment size (OCF measured as 30x30 mm). Lateral arthrotomy was performed to provide ideal reduction and stabilization. The osteochondral fragment was then fixed with two headless compression screws.

Postoperative Care

The patient was evaluated clinically and radiologically in the follow-up controls at 3, 6, 12 and 24 weeks after surgery. Immobilization with a long leg cast splint was applied for three weeks postoperatively. Then, the range of motion gradually increased with an angle-adjusted brace for the next three weeks. At the end of the sixth week, the patient was allowed for partial weight-bearing with the angle-adjusted brace and full weight-bearing achieved at three months after surgery. The patient was allowed to return to sportive activities with a full range of motion at six months and called for office controls annually (Figs. 3 and 4). Informed consent was obtained from the patient's parents for medical publication purposes.

Figure 1. The displaced osteochondral fracture at the posterior aspect of lateral femoral condyle on X-Ray and MRI.

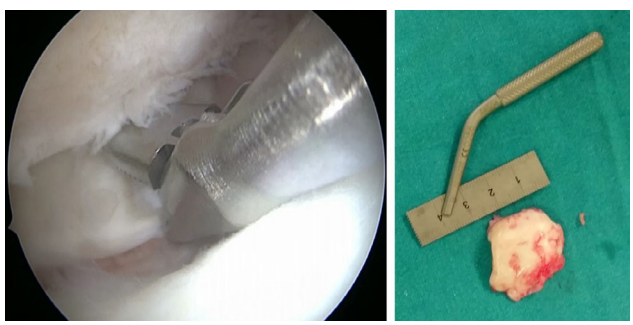

Figure 2. The arthroscopic and macroscopic views of the osteochondral fragment.

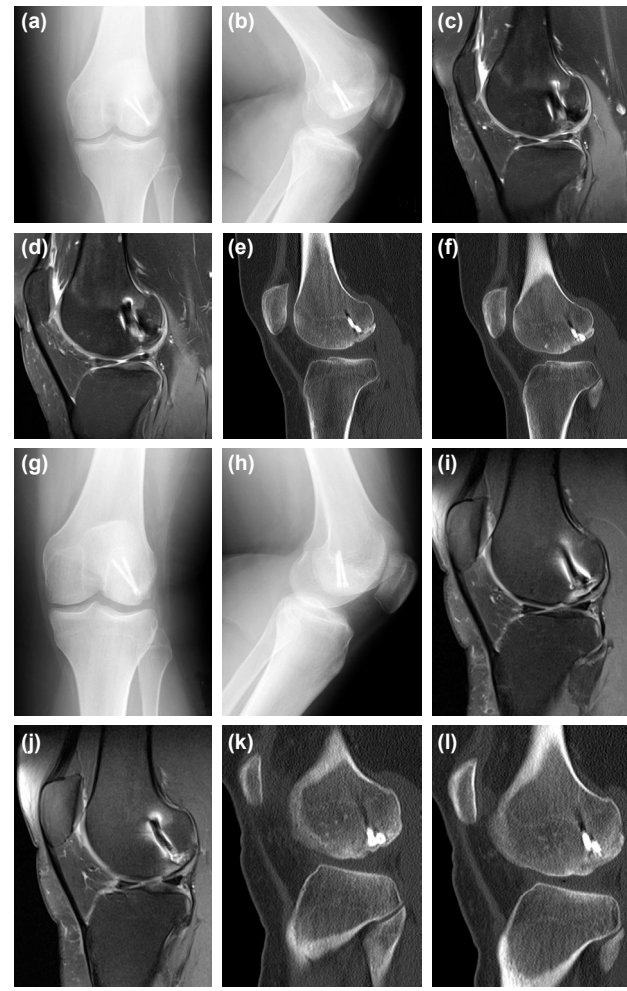

Figure 3. The X-Ray **(a, b)**, MRI **(c, d)** and CT **(e, f)** images of the patient at postoperative 6th months and the X-Ray **(g, h)**, MRI **(i, j)** and CT **(k, l)** images of the patient at postoperative 30th months.

Figure 4. The ROM and the functional outcome at postoperative 30th months.

DISCUSSION

Osteochondral fractures are injuries that involve the cartilage covering the joint surface and the subchondral bone underneath. König named free bodies in the joint space as 'osteochondritis dissecans' [OCD] and the trauma that led to cartilage fracture was addressed in the etiology.[5,6] However, the traumatic OCF was first described by Milgram in 1943.[7] The most common sites for OCF are the joint surfaces of bones that are prone to injury, such as the talus, femur, patella and glenoid. Although traumatic injuries frequently play a role in the OCF etiology, conditions like Ahlbäck's disease may be considered an atraumatic variant. Different mechanisms may cause OCFs depending on the location of the lesion. The relatively low sensation of pain in the subchondral bone makes it difficult to understand what mechanism exactly causes the fracture. The most common injury mechanism includes the shearing, rotation or impaction of the joint and excessive tangential loading on the joint surface.[8]

The frequency of OCFs around the knee joint is not clear. Current literature suggests that OCFs are more frequent in the pediatric age group (especially in children that take part in high performance activities – gymnastics and dance) than in the adult population.[2,9,10] Generalized joint laxity and patellar dislocation are reported as accompanying conditions.[10–14] In patellar dislocation, the lateral femoral condyle is exposed to the high pressure during the relocation of the patella due to contracted quadriceps muscle and often results with OCF.[8] Flachsmann et al.[15] aimed to explain the mechanism of OCF in immature cartilage and found low resistance to shear forces of the osteochondral component in adolescents. Broom et al.[16] reported that the fracture resistance of the osteochondral junction was higher in adults. These results showed that osteochondral junction injuries in adults resulted in cartilage delamination and well-defined cartilage disruption. However, due to the finger-like extensions of the cartilage through the subchondral bone these injuries led to OCFs in the adolescents.

The diagnosis of OCFs in pediatric patients around the knee joint may be challenging. The diagnosis of OCF with a small bony fragment can be missed; the actual size of the cartilage component may be underestimated or falsely assessed as an accessory bone. The actual size of the osteochondral lesion and the severity of the injury can be more clearly determined using MRI.[10]

The major factors affecting the treatment of osteochondral lesions in young patients' knee include location, size and stability of the lesion and the severity of symptoms.[17] Most authors agree that fragment fixation is the gold standard for the treatment of OCFs. However, the effects of the patient's age, the size of the fragment, and the period between initial injury and diagnosis over the success of surgical treatment have not been clearly defined.[18] Current literature suggests operative treatment for patients with osteochondral injuries, including injuries in weight bearing surfaces, lesions larger than 2 cm^2 and in the presence of mechanical symptoms.[19] Good clinical and radiological results were reported with osteosynthesis of acute OCF in pediatric age group.[10,17,20–23] This can be explained with the superior regeneration potential of the pediatric age group using good fusion in the defect site with the finger-like chondral extensions of the osteochondral fragment.[9,16] In the surgical treatment of late-diagnosed cases, excision of the fragment was often applied as the fragment was accepted as a loose body.[2–4,23] The remaining defect area after the excision of the osteochondral fragment leads to early degeneration of the knee.[24,25] Similarly, in untreated cases, the intraarticular free osteochondral fragment may cause additional cartilage injury and results in degenerative arthritis. Thus, even in neglected or late-diagnosed cases, fixation gains the highest priority among the treatment options.

The cartilage component of the free intraarticular osteochondral fragment may survive in vivo by diffusion from the synovial fluid, but the same situation is not valid for the bony component. It is presumed that the bony component will lose vitality over time and the healing capacity will decrease. However, the bony component will maintain its potential role to act as a scaffold for creeping substitution.[3] By restoration of the osteochondral defect and subchondral bone interface, healing is achieved by bone marrow-derived cells and a normal transition from the deep layer of cartilage to the subchondral bone is established.[26,27] Although the time between the initial injury and surgical treatment in our case was 2.5 years, the achievement of an excellent functional outcome at 30 months after fixation supports this hypothesis.

There is no evident information in the literature about the size of the bony component of OCF defined as an indication for fixation. Besides that, a recent study conducted by Fabricant et al.[28] reported successful results in 90% of 10 young athletes with a median age of 12.5 years treated for chondral-only shear fractures with bioabsorbable implants or absorbable sutures. Additionally, there are publications suggesting that good results can be achieved with the use of fibrin sealant and tissue glue if the osteochondral fragment is large enough to fix and lacks of bony component to secure fixation with implants.[29,30] Schlechter et al.[17] reported good functional outcomes and a low revision rate with bioabsorbable fixation in 32 young patients, in which 17 had OCFs (53%). They used bioabsorbable screws and darts for fragment fixation and the mean lesion size in their study was 299 mm^2 for OCFs. Hsu et al.[31] reported a case of a pediatric patient with neglected osteochondral fracture dislocation and recommended the use of headless cannulated screws in fragments larger than 3 cm^2. In the light of above-mentioned studies, we may conclude that the size of osteochondral fragment is important to determine the treatment method (conservative or operative), whereas the size of the bony component is important to determine fixation option (e.g., headless screw, rod, suture and adhesives). There are only

two case reports of a pediatric patient who was treated after a late diagnosis.[31,32] To our knowledge, our paper is the only one in the literature that reports good short to middle-term radiological and functional outcomes after late fixation of a neglected OCF in a pediatric patient.

The untreated defective area in pediatric osteochondral fractures is expected to grow as the patient continues to grow. In addition, the fibrotic tissue that develops over the bony part causes the osteochondral fragment sizes to decrease during debridement for reduction. Incongruity may occur between the fragment and the defect with relative growth of the defect and/or decreased size of the fragment and this may result in poor reduction. In our case, the complete anatomic reduction was impossible because the size of the defect was larger than the size of the fragment. However, when we evaluate our results at postoperative 30 months, we may presume that complete anatomic reduction is not a requirement for osteosynthesis in the late cases. In the literature, the metallic implants used for fixation are suggested to be removed later.[22] We evaluate our patient in annual controls to prevent any potential damage to articular cartilage.

Conclusion

Traumatic OCF's of the femoral condyles in the pediatric patient group may be challenging for orthopedic surgeons. These include the difficulty of radiological diagnosis, the technical challenges of fixation due to the size of the fragment and its location, and the concerns about healing in late-diagnosed cases. The aim of fragment fixation is to maintain articular integrity and promote healing between the osteochondral bony component and subchondral bone interface. Other treatment options, including microfracture, bone marrow stimulation drilling, osteochondral autograft transfer and matrix-associated autologous chondrocyte implantation, may be used as an alternative to OCF fixation. However, these alternatives may also be used as secondary procedures if the fragment fixation fails. Given the superior healing potential of the pediatric population, we suggest fixation of the osteochondral fragment in patients with mechanical symptoms if the injury involves the weight-bearing surface and the fragment is larger than 2 cm^2.

Informed Consent: Written, informed consent was obtained from the patient's family for the publication of thís case report and the accompanying images.

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OLGU SUNUMU - *ÖZET*

Pediatrik hastada diz osteokondral kırığının geç fiksasyonu

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Pediatrik hasta grubunda diz eklemindeki osteokondral kırık sıklığı kesin olarak bilinmemektedir. Fragman fiksasyonu akut olgularda ideal tedavi yöntemi olarak kabul edilse de, ihmal edilmiş ve/veya geç tanı konmuş olgulardaki geç fiksasyon sonuçlarına ait bilgi son derece kısıtlıdır. Bu yazının amacı, pediatrik bir olguda lateral femoral kondildeki geç tanı konulmuş büyük bir osteokondral kırığın fiksasyon sonuçlarını bildirmektir.

Anahtar sözcükler: Çocuk kırığı; geç fiksasyon; ihmal edilmiş kırık; osteokondral kırık.

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