



Sleeve Fracture of the Patella

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We present an 11-year-old male child without any underlying disease. He was admitted to the emergency room after having felt severe pain in his right knee on kicking the ground while falling down earlier that day. Radiography showed an avulsion fracture of the lower pole of the patella and a high-riding patella. At the next day after the injury, we performed open reduction and internal fixation surgery. After surgery, the recovery of the patient was good.

Key words: Sleeve fracture, patella sleeve fracture, pediatric sleeve fracture

INTRODUCTION

Patella fractures are relatively rare injuries in children, representing <1% of all pediatric fractures.¹ The patella is a sesamoid bone and considered part of the quadriceps extensor mechanism. The incidence of patellar fractures in skeletally immature patients is low; however, among skeletally immature children, sleeve fractures of the patella are the most common type of patellar fractures. Sleeve fractures are caused by rapid muscle contraction and mostly affect children between 8 and 12 years of age.¹ This fracture often involves the lower pole of the patella in the form of an osteochondral avulsion. The reasons can be explained that the immature osteochondral junction in the child is more vulnerable to injury than the enthesis of the fully ossified adult patella, which leads to a sleeve of avulsion pulled off the main bony patella, usually from the lower pole. It can be easily missed on plain radiographs since only a small fragment of bone may be seen. In many cases, a high-riding patella on a plain radiograph may be the only and most prominent sign. In severely displaced sleeve fractures, open reduction and internal fixation are needed to achieve good clinical results.^{2,3} Conservative management may result in weakness of the extensor mechanism due to the high-riding patella and ossification of the patellar tendon. We present a case of sleeve fracture of the patella in a child and discuss the diagnostic modalities and treatment options for such fractures.

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CASE REPORT

An 11-year-old male child was admitted to the emergency room after having felt severe pain in his right knee on kicking the ground while falling down earlier that day. Knee swelling, tense hemarthrosis, and periarticular tenderness were noted. On physical examination, an extension lag of 15° was observed. The active range of motion of the injured knee was 45°–60° of flexion. Radiography showed an avulsion fracture of the lower pole of the patella and a high-riding patella [Figure 1]. The injured knee had an Insall-Salvati ratio of 1.48. Sleeve fracture of the patella was diagnosed clinically based on the signs of a high-riding patella and a gap in the extensor mechanism at the lower pole of the patella. At the next day after the injury, we performed open reduction and internal fixation surgery.

During surgery, we found that half of the articular cartilage of the patella and a corresponding portion of the patellar retinaculum were avulsed, together with a small fragment of bone. Initially, we tried to perform open reduction with tension band wiring, but the distal bony fragment was too small to be laced by Kirschner wire. We subsequently sutured the patella tendon from the distal to proximal portion with polyester suture thread (No. 5 ETHIBOND®), similarly to a Bunnell method, and inserted a needle into two sites of the distal bony fragment. We made two bone tunnels in the direction of the long axis

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on the proximal bony fragment and can each thread through these bone tunnels [Figure 2a]. We confirmed the distal bony fragment to be reduced and in a good position and performed knot-tying on the upper pole of the patella. Finally, we sutured the patellar retinaculum as reinforcement. The postoperative Insall-Salvati ratio was 0.91 [Figure 2b].

The knee joint was immobilized in a cylinder cast for 4 weeks after surgery. Physical rehabilitation was started, and eventually, the patient made a successful recovery. At 9 months after surgery, there was no extension lag, and the active range of motion of the injured knee was 0°–140° of flexion. Callus formation over the fracture site and bone union was confirmed [Figure 3]. To date, he had no further symptoms and has been able to carry out all types of physical activities, including jumping. The patient and his parents were asked if data concerning the case could be submitted for publication, and they consented.

DISCUSSION

We presented a case of sleeve fracture of the patella in a child and described its successful treatment with open reduction with transosseous tunneling. The incidence of patella fractures in children is much lower than that in adults, which may be due to either a lower number of children sustaining knee injuries or due to special anatomic characteristics of the knee in children. Children have softer and more flexible ligaments, as well as articular capsule and cartilage, and thus, more joint laxity is provided to keep the patella from injury. Furthermore, the patella is mainly composed of cartilage, allowing the bony component of the patella to avoid fracture.⁴

Patella sleeve fractures represent a uniquely pediatric type of patella fracture.⁵ The mechanism of injury is common a sudden deceleration or eccentric contraction of the quadriceps mechanism. Sleeve fractures usually occur in individuals involved in explosive acceleration activities such as jumping, although high-energy sports such as skateboarding are now also considered common causes.³ Because the distal bony fragment in sleeve fractures is often very small, the correct diagnosis may be delayed or missed altogether. Thus, we think that it is important to listen carefully the clinical history, which generally involves a sudden onset of severe pain after an explosive acceleration such as jumping rather than a fall, and the symptoms, which include pain and a swollen knee. Moreover, we think two clinical signs were very important: First, a palpable gap at the lower pole of the patella, and second, a high-riding patella. If there is no gap or high-riding patella, magnetic resonance imaging can be useful to identify avulsion of the lower pole of the patella,^{6,7} and the diagnosis can be confirmed by ultrasound.⁸ Although diagnosis may

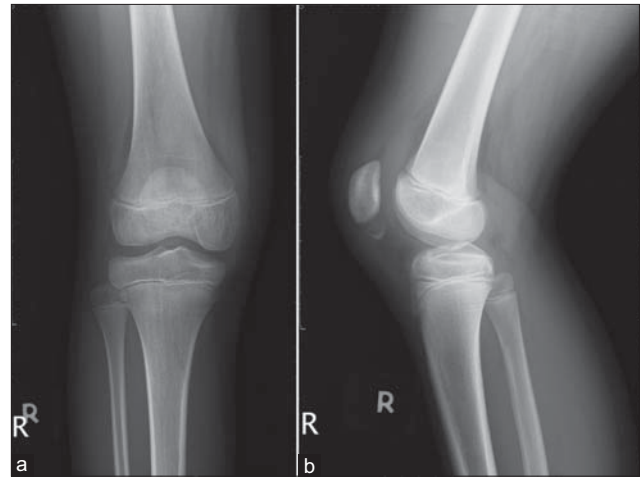


Figure 1: (a and b) Preoperative X-ray

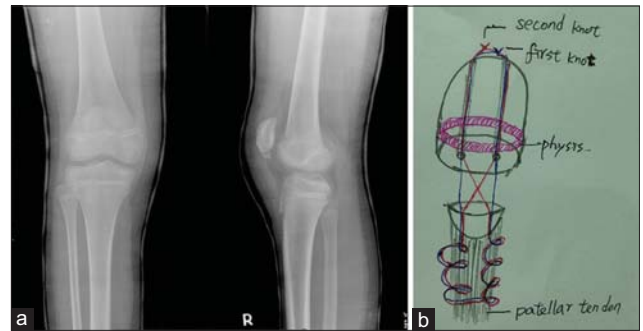


Figure 2: (a) Tunnels. (b) Postoperative X-ray

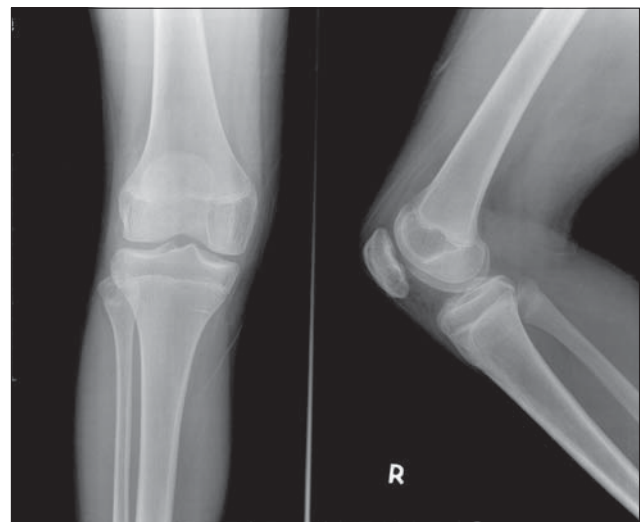


Figure 3: X-ray, 9 months after surgery

be difficult in the presence of pain and tense hemarthrosis, an awareness of the injury together with the characteristic radiological features should confirm the diagnosis. The



Figure 4: (a) Normal range of motion, 10 years after surgery. (b) Normal range of motion, 10 years after surgery. (c) Normal range of motion, 10 years after surgery

treatment for sleeve fractures of the patella is anatomical reduction and reconstruction of the extensor mechanism. If a bony fragment is visible on radiography and the displacement is <2 mm, conservative treatment with cast immobilization in the extended position of the knee joint is indicated. However, the results of conservative treatment are often unsatisfactory.^{3,9} If surgery is performed properly without delay, the good results have been reported, except the slight limitation of the knee flexion.^{4,10} The surgical repair method is generally selected dependent on the surgeons' personal preference. Large transosseous sutures are simple and efficient,¹¹⁻¹³ and a modified tension band wire system or even intraosseous anchors can moreover be used. Here, we performed open reduction and internal fixation with a polyester suture thread; these procedures were shown to be effective in our case.

CONCLUSION

There was no extension lag after following for 10 years, and the active range of motion of the injured knee was 0° – 140° of flexion [Figure 4]. Callus formation over the fracture site and bone union were confirmed. To date, he had no further symptoms and has been able to carry out all types of physical activities.

Although sleeve fractures of the patella in children are uncommon, we should think one of the differential diagnoses, in cases of acute knee injuries, especially when the injury was caused by an explosive force such as jumping. Because the diagnosis can be often missed, especially in fractures with a very small avulsed bony fragment, we suggest that early surgical intervention achieved a satisfactory result for the displaced sleeve fractures of the patella.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient's parents have given their consent for his images and other clinical information to be reported in the journal. The patient's parents understand that his name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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