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The mechanism and diagnosis of a sleeve fracture of the upper pole of the patella in children

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Abstract

Sleeve fracture is one of the commoner types of patellar fracture in children. It is an avulsion of an osteochondral fragment at the periphery of the immature patella due to trauma associated with rapid quadriceps muscle contraction. It occurs usually at the inferior pole of the patella, but rarely the superior pole of the patella is affected. The sleeve fracture may be occult on plain X-ray, especially if the ossification centre is small and only a cartilaginous avulsion occurred, yet if not diagnosed and treated at the time of the injury it may cause permanent disability.

A case of superior pole sleeve fracture is presented with a review of the previously reported cases in the literature. Our objective was to look for a pattern (in terms of mechanism of injury and clinical features), which may predispose to superior pole sleeve fracture and to provide insight in the radiological signs, which may be helpful to diagnose a sleeve fracture soon after injury.

We found that the sleeve fracture of the superior pole of the patella occurs in the under 16's. The mechanism of injury is a rapid quadriceps contraction with the knee in a certain degree of flexion, for example forced flexion due to a fall.

In all cases the plain X-ray showed abnormalities, although these were initially missed in half of the cases. The key radiological features are a joint effusion; anterior tilt of the patella and a shell of bone lying proximally to the patella. Ultrasound is very helpful in diagnosing a sleeve fracture of the patella, differentiating it from a quadriceps rupture and in the follow-up of a sleeve fracture.

Keywords: Child; Patella; Sleeve fracture; X-ray; Ultrasound

1. Introduction

Fractures of the patella are common in adults, but rare in children. The sleeve fracture is a particular form that occurs especially in children, where it is one of the commoner patellar fractures, usually affecting the inferior pole of the patella, very rarely the superior pole [1]. A case of superior pole sleeve fracture is presented and reviewed in the light of the world literature. Our objective was to look for a pattern (in terms of the mechanism of injury and clinical features), which may predispose to superior pole sleeve fracture. It is important that a sleeve fracture of the patella is diagnosed soon after injury since it may cause permanent disability if not treated immediately [2]. However, the diagnosis may be difficult clinically and on X-ray, which may appear normal. We describe how the patient's history, physical examination, conventional X-ray and ultrasound can be useful in the diagnosis and follow-up of sleeve fractures of the patella.

2. Patients

2.1. First case (the presenting case)

A 15-year-old girl was seen at our hospital with right-sided patellar dislocation after a fall. Plain X-ray of the knee, following closed reduction, showed a normal knee without evidence of a fracture, even in retrospective review. Her knee was immobilized in a cylinder cast for 6 weeks. The cast was removed and she started full mobilization immediately. Two days later she injured her right knee again by making a sudden turn with her body while her right foot was fixed

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Fig. 1. Lateral X-ray of the right patella after the second episode of injury. The image has been manipulated photographically to enhance the abnormalities, which were largely obscured on the original. Note the ill-defined margin of the upper pole of the patella and a shell of bone proximal of the patella (arrow head).

on the floor. Her right knee was in flexion during the injury. She presented with a painful swollen knee and was unable to raise her leg in extension. The knee could only be flexed and extended actively with difficulty. Plain X-rays of both knees were taken (Fig. 1). These were interpreted initially as normal. A possible rupture of the quadriceps tendon was considered clinically and an ultrasound scan was performed. The ultrasound (Toshiba 16 MHz 38 mm linear array) showed an irregular contour of the superior pole of the patella, an avulsed cortical fragment displaced cranially some 8 mm but an intact quadriceps tendon with a small haematoma adjacent to it (Figs. 2 and 3). Retrospective review of the plain X-rays revealed a normal patellar position; no joint effusion in the suprapatellar pouch; an ill-defined margin of the superior pole of the patella and a shell of bone lying proximal to the patella on the right side (Fig. 1). Her knee was re-immobilized in a cast. Ultrasound was performed 1 week and 1 month after the injury. These examinations revealed a decreasing distance between the avulsed fragment and the superior pole of the patella together with increasing echogenicity in the gap suggesting callus formation. After 2 months the cast was removed and the patient started mobilizing with the help of a physiotherapist. Six months later she could use her leg without any apparent disability.

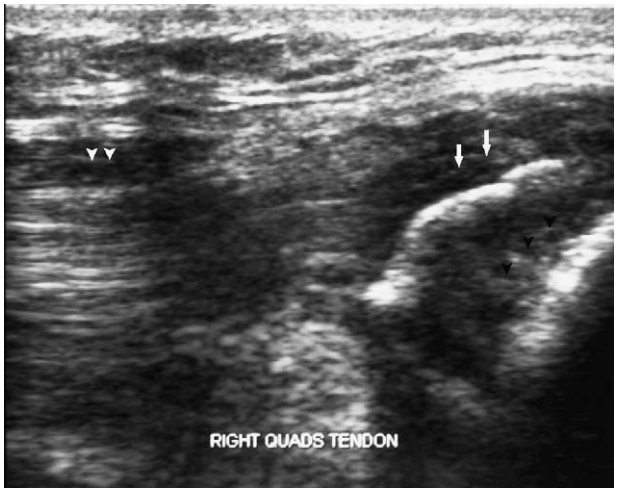

Fig. 2. Ultrasound. Longitudinal section through the insertion of quadriceps tendon to the superior pole of the patella. The fibres of the quadriceps tendon (white arrow heads) are intact. Attached to the tendon is a shell of bone (arrows), which is avulsed and displaced from the superior pole of the patella (black arrow heads).

2.2. *Second case (Kumar and Knight [3])*

A 14-year-old girl presented initially with a history of lateral dislocation of her patella, which was treated by immobilization in a cylinder cast for 1 month. Two days after removal of the cast she stumbled when descending the stairs, causing forced flexion of the knee. Plain X-rays revealed an anterior tilt of the patella with a shell of bone lying superior to the patella. Clinical examination confirmed disruption of the extensor mechanism. She was admitted for surgery. The bony fragment was re-fixed with sutures. After surgery the knee was immobilized in a cast for 6 weeks. Four months later, the patient had regained full, painless function of the knee.

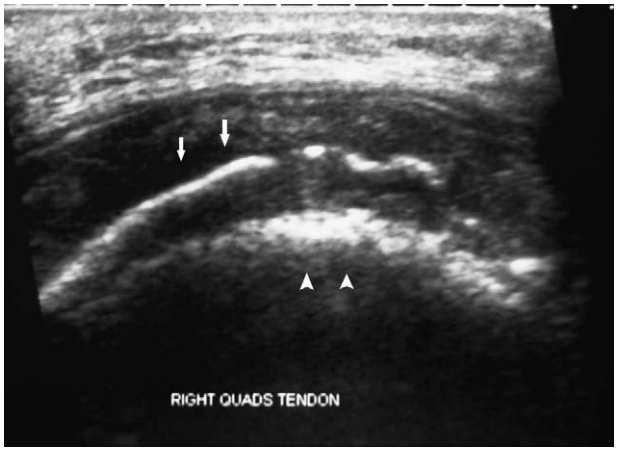

Fig. 3. Ultrasound. Transverse section through superior pole of the patella. An irregular contour of the superior pole of the patella (arrow heads) and sleeve fragment above it (arrows) are shown.