Available online at www.sciencedirect.com

SCIENCE DIRECT

The Knee 12 (2005) 3–7

THE KNEE

www.elsevier.com/locate/knee

Review article

A review of sleeve fractures of the patella in children

David M. Hunt*, Naresh Somashekar

St. Mary's Hospital, London W2, UK

Received 15 April 2004; accepted 18 August 2004

Abstract

Patella fractures are rare in children and the sleeve fracture is a particular form of fracture that only occurs in children where it is the most common patella fracture. It is caused by rapid muscle contraction. Diagnosis may be difficult both clinically and on the X-ray which may look normal if there is no bony fragment. Patella alta is the best sign and ultrasound is very helpful. Awareness of the existence of the injury is all important. This fracture differs from straightforward avulsion because of the "sleeve" of periosteum which is pulled off the patella and will continue to form bone if not treated thus enlarging or even duplicating the patella. Treatment involves prompt reduction and, usually, internal fixation of the disrupted patella tendon.

Keywords: Patella; Sleeve; Periosteum; Osseo-chondral; Ultrasound

Contents

1. Patellar sleeve fractures in children . . . 3
2. Incidence . . . 3
3. Pathogenesis. . . . 4
4. Classification of patella fractures . . . 5
5. Mechanism of injury . . . 5
6. Clinical presentation. . . . 5
7. Investigations . . . 5
8. Treatment . . . 6
9. Outcome. . . . 6
10. Conclusion . . . 6
Acknowledgements . . . 6
References . . . 6

1. Patellar sleeve fractures in children

A patella fracture in a child is a sufficiently rare occurrence to send trainees to the textbooks and the literature with the idea of producing a case report. It is no surprise then that the literature comprises a haphazard collection of case reports and reviews. In the textbooks, sleeve fractures are included in a general discussion of patella fractures and it is not always pointed out that it is the most common form of patella fracture in the under 16's [1].

2. Incidence

Patella fractures make up 1% of all fractures in children which is actually the same as in adults, although they are

* Corresponding author. Tel.: +44 207 886 1394.
E-mail addresses: david.hunt@St-Marys.nhs.uk, davidhunt@uk-consultants.co.uk (D.M. Hunt).

0968-0160/$ - see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.knee.2004.08.002

usually thought to be less common in children [1,3]. Of all patella fractures, less than 2% occur in the skeletally immature. They are, then, rare. In children, approximately half the patella fractures are sleeve fractures. A review of the literature of the last 25 years indicates that sleeve fractures make up 57% of all patella fractures in this age group [2,4].

Adolescents are most susceptible, probably related to the intensity of sporting activity, rapid growth with osseo-chondral transformation at the periphery of the patella and relative patella instability. The peak incidence is 12.7 years (range 8–16) [2]. It is more common in boys occurring at a ratio of 3:1.

3. Pathogenesis

The patella begins to ossify at the age of 3. There are multiple small ossification centres in the middle of the patella, possibly as many as six and ossification progresses peripherally with growth [1]. This leaves a rim of soft, intense osseo-chondrous transformation all around the growing patella. In keeping with other parts of the immature skeleton, where ligament or tendon attaches to growing bone, the cartilage blends directly with the collagen of the tendon rather than by the distinct Sharpey's fibres found in the adult. Injury in the form of a powerful separating force is then more likely to pull cartilage or bone off rather than rupture the tendon. Hence patellar tendon disruption in children is at the proximal or distal end by avulsion rather than a mid-substance tear [5]. This is also seen, for example, in avulsion of the epicondyles of the elbow, the tibial tuberosity or even avulsion of the tibial insertion of the anterior cruciate ligament. It is, of course, in keeping with the pain seen in repetitive stress conditions such as Osgood Schlatter's disease, Sinding–Larsen–Johansson disease or the avulsed fragments seen in children with fixed flexion deformities such as in cerebral palsy or arthrogryposis [6].

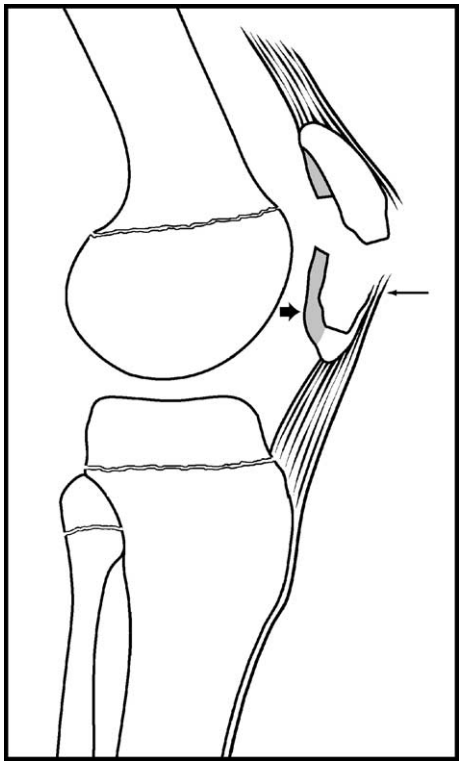

Fig. 1. Diagramatic representation of a sleeve fracture. Broad arrow indicates articular cartilage; thin arrow, periosteum and cartilage.

Fig. 2. X-ray of sleeve fracture with new bone forming in the disrupted patella mechanism.

What is unique about the sleeve fracture is that it is a complete sleeve or cuff of osseo-potent tissue that is pulled off from the full circumference of the patella. This is articular cartilage on the deep surface and periosteum and cartilage on the superficial surface. This is often not shown clearly in diagrams (Fig. 1). The disruption of the periosteum occurs over the body of the patella. It slides distally taking osseo-potent transformation zone cells from the osseo-chondral zone of the patella with it. This may not result in complete disruption of the quadriceps mechanism but an elongation. The tissue can be all cartilage and periosteum and so will not be visible on X-ray. It means that there is a collection of potent bone-forming tissue at the lower pole of the patella which will go on forming bone resulting in enlargement or even duplication of the patella (Fig. 2) [7]. This differentiates the sleeve fracture from the avulsed osteochondral fragment seen on the medial or lateral side of the patella [8]. The insertion of vastus medialis is so strong and directly into the osseo-chondral zone that cartilage and bone is pulled off. The difference here is that the insertion is transverse or oblique to the line of the fibres of the periosteal sleeve surrounding the patella and a fragment of cartilage and bone is avulsed without the disruption of the periosteal sleeve which occurs with the