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Patellar Sleeve Fracture: What You Need to Know About

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Mini Review

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Mini Review

Development of the patella

The patella develops as an aggregation of the deeper three –fifths of the quadriceps substance. The patella is thus an intramuscular element which has secondarily acquired a free articular surface [1]. The patella in children is particularly cartilaginous with ossification only beginning between 3-6 years of age [2]. Ossification occurs in small islands that expand to the periphery.

The immature patella can withstand trauma impact and tactile force; this is due to a protective surface cartilage layer and increased mobility compared to the developed patella [3].

Incidence

Patellar fractures are uncommon, accounting for only 2% of all fractures [4]. Sleeve fractures were first reported in 1978 by Houghton and Ackroyd and occur predominantly in children. This fracture results in the inferior sleeve of articular cartilage being avulsed along with the periosteum and retinaculum from the patella. Inconsistently the avulsed fragment can contain a small bony component [5]. Sleeve fractures occur only in the paediatric population due to the cartilaginous composition of the patella. The sleeve is avulsed more frequently than tendon rupture as this is felt to be the weaker component, with the tendon collagen fibres at insertion being indistinct from the cartilaginous sleeve [6].

Types of Sleeve Fracture

Sleeve fractures have been described from the superior boarder of the patella although this injury is classically from the inferior pole [3,7]. These fractures occur almost exclusively in children and adolescents with a peak incidence at 12.7 years [2]. They are rare, accounting for only 1-6.5% of all paediatric fractures [2]. A study examining patellar fractures in children found that sleeve fractures was the most common type of patellar fracture observed, and accounting for 57% of paediatric patellar fractures [8]. The incidence in the younger age group is thought to be due to the osteochondral change and growth pattern of the patella as well as an increased involvement in sporting activity [9]. It is typically a non-contact injury [6].

Superior sleeve fractures are very uncommon in comparison to inferior fractures. On a literature search only eight papers documenting cases of superior fracture were found in English literature and two in German and Belgian papers since 1991 [3,9-17]. These cases include adults as well as children due to various aetiology.

Diagnosis of Sleeve Fracture/Avulsion

The diagnosis of a sleeve fracture can be easily missed. A combination of history, examination and radiological studies has proven to be most effective. On examination patients present with local pain, tenderness, swelling and an inability to fully extend the knee actively. Haemarthrosis is a common finding [3,18].

Plain film x-ray is important in the diagnosis however with small fragments or avulsions with a large cartilaginous component, the injury can be difficult to visualise [2,3,19]. Soft tissue swelling may be visible indicating a haemarthrosis and significant trauma which should be investigated further [7]. Several papers have examined other imaging methods and concluded that magnetic resonance imaging (MRI) and ultrasonography (USS) are of benefit [20,21].

Although sleeve fractures typically occur as the result of a non-contact injury, it can also occur as the result of falls and trauma as seen in this case [10,17]. The classical mechanism of injury for inferior fractures is thought to be due to forceful quadriceps contraction with flexion of the knee, resulting in separation of the sleeve from the patella. However, in superior sleeve fractures Klerx-Melis et al postulated that certain knee flexion causing more force to be transmitted through the superior pole compared to the inferior pole [14]. Jumping sports such as hurdles, high jump and basketball are all associated with sleeve fractures affecting the take-off leg [5,7].

Sleeve fractures can be easily missed on plain film x-rays due to the bony component being either very small or not present; further imaging is recommended especially in uncertain cases with high clinical suspicion. MRI and USS have both been demonstrated to be of use in diagnosis. In MRI, T2 weighted images can be used to evaluate the extent of the injury to the cartilaginous sleeve and assist in planning further management. Bates et al demonstrated the sleeve avulsion successfully and was able to define inter-articular involvement of the injury using MR imaging [20].

Other than sporting injuries some studies have suggested association of sleeve fractures with post-surgical recovery from certain procedures as well as with certain chronic medical conditions. Brennan, et al. [12] postulated that there was a link between patellar stabilization surgery and compromised vascularisation to the proximal pole of the patella resulting in an increased risk of this injury in the post-operative period. This has not been formally researched and Brennan et al state that this is unlikely due to these fractures being so rare compared to the instability treatment group and may be more likely linked to post-surgical immobilization instead [11]. Kumar and Knight similarly presented a case of superior sleeve fracture which occurred following a fall soon after removal of cylinder cast for patellar dislocation [3].

Some adult cases have been presented in patients with osteogenesis imperfecta and in patient following cast immobilisation, however it is controversial as to whether this is a true sleeve fracture due to the patella having fully ossified in the mature skeleton [22,23].

Conservative and surgical management plans have been proposed. Casting and immobilization in several cases have demonstrated poor functional outcomes [2,15]. Complications associated with conservative management are due to ossification from the avulsed sleeve, residual extensor lag, and weakness. This can result in patellar elongation, patella magnum and bone deposits within the quadriceps tendon (in extreme cases patellar duplication). These can all result in reduced range of movement and pain [5].

Surgical management of sleeve fractures constitutes open reduction and internal fixation. Several successful methods have been documented including suturing and bone anchors, tension banding, and figure eight suturing [3,10,11]. Hunt and Somashekar [2] noted that fixation was less certain when no osseous component was present [2]. However, there is no randomised controlled trial to give us guidance on the best modality of fixation in this particular kind of injury. It is mainly based on the surgeon's preference.

Conclusion

In summary, superior sleeve fractures are a very rare injury but should be considered in children and adolescents who present with pain, effusion and extensor weakness in both non-contact and contact trauma. In cases with inconclusive plain film imaging, due to the small bony fragment and larger cartilaginous component associated with this type of injury, MRI and USS have been demonstrated to be of clinical use in managing these cases and determining the extent of the injury. Following a review of previous literature, operative management with internal fixation is recommended to prevent complications associated with conservative management, such as quadriceps weakness, patella elongation or duplication and long term mobility issues.

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