Case report

Greater trochanter apophyseal avulsion in the adolescent managed conservatively: A case report of a sporting injury presenting with knee pain

Duncan Macdonald a,*, Fahd Mahmood b, Paul Allcock a

a Department of Orthopaedics, Royal Alexandra Hospital, Corsebar Road, Paisley PA2 9PN, UK
b Department of Orthopaedics, Glasgow Royal Infirmary, Castle Street, Glasgow G4 0SF, UK

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1. Introduction

Pelvic apophyseal avulsion injuries in the adolescent can occur at several sites. They are often related to sporting activity or injury. Avulsion of the greater trochanter apophysis is rare, but can be a potentially devastating injury if avascular necrosis of the capital femoral epiphysis subsequently occurs. This injury has been reported in cases of direct trauma. There is debate as to whether the management should be operative or surgical. We present a case of greater trochanter avulsion with delayed presentation which was successfully managed nonoperatively.

2. Case presentation

A 14 year old male developed left knee pain during a session of breast stroke swimming. Although he was a keen footballer and keep fit enthusiast, he was an unaccustomed to regular swimming. He presented to a physiotherapist who diagnosed him with iliotibial band syndrome and performed ultrasound and massage therapy around the lateral aspect of his knee. After two weeks his symptoms improved slightly and he attempted to return to playing football but noticed pain on running, restricting continued participation. A further week later, three weeks after the initial onset of symptoms he presented to the orthopaedic department complaining of worsening left knee pain, keeping him awake at night. He had great difficulty weight bearing. Knee examination was normal but he had localised tenderness over the greater trochanter and pain on active hip abduction as well as passive internal rotation. X-ray revealed an avulsion of the greater trochanter apophysis. He was managed with six weeks of protected weight bearing with crutches. Serial radiographs showed no displacement and at three months he was able to run without pain. X-ray showed that the avulsion had radiologically healed. At twelve months no radiological evidence of avascular necrosis (AVN) of the femoral head was evident. Clinical follow up at two years demonstrated a full pain-free range of movement at the hip. The patient was asymptomatic, regaining full fitness and participating in competitive football; further X-ray was not felt to be clinically indicated (Figs. 1 and 2).

3. Discussion

3.1. Pelvic apophyseal avulsion

Pelvic apophyseal avulsion is a well recognised injury in the adolescent athlete. In a comprehensive review of pelvic injuries in the adolescent patient group over a 22 year period Rossi and Dragoni identified 203 cases of pelvic apophyseal fractures from 1238 patients who had radiographs taken for focal traumatic symptoms.7 The sites affected were ischial tuberosity (109 cases), anterior inferior iliac spine (45) anterior superior iliac spine (39), pubic symphysis (7) and iliac crest (3). Notably there were no cases of greater trochanter avulsions. Hence, it is difficult to define a prevalence of this injury as reports in the literature are limited to single case reports or small case series. One common feature is that the pelvic apophyseal avulsion generally has a benign course and a positive outcome can generally be expected. However, the reports of greater trochanter avulsion point to a high rate of subsequent development of avascular necrosis of the femoral head.

3.2. Greater trochanter apophyseal avulsion

The largest series of greater trochanter apophyseal avulsion is that of three cases presented by Wenger.10 Two of the cases were due to direct trauma. One of these developed avascular necrosis of the femoral head following open reduction and internal fixation. The third case had an unknown mechanism of injury with symptoms occurring on sporting activity. The second and third cases were managed with more minimal surgical approaches and both had successful outcomes.

The earliest reported case of adolescent greater trochanter avulsion came from Denmark. This case was managed nonoperatively and the 13 year old developed avascular necrosis of the femoral head within 5 months.8 O'Rourke and Weinstein reported two cases secondary to trauma; one treated with closed reduction...
and percutaneous fixation and the other being minimally displaced with nonoperative treatment. Both cases subsequently developed avascular necrosis of the entire femoral head at 6 and 8 months following injury. Two further single case reports showed the development of femoral head avascular necrosis following fixation of the avulsed greater trochanter. Wood et al. reported on a case of a 15 year old who fell from a banana boat ride. The avulsed greater trochanter was successfully managed with open reduction and screw fixation. They reported a successful short term outcome, with no follow up data beyond six weeks. A more recent case of nontraumatic avulsion treated with percutaneous in situ lag screw fixation demonstrated fusion of the trochanteric physis at 18 months with a full recovery.

The available evidence demonstrates that the outcome of greater trochanter apophyseal avulsion is unpredictable. The cases reported in the literature give the impression this injury carries a poor prognosis. We identified 10 cases in total, two of which were managed nonoperatively. Four of the surgically managed cases developed avascular necrosis and four surgically managed cases had a good outcome. Due to the rarity of the injury we do not know its true prevalence or incidence; nor is it possible to accurately determine how many greater trochanter apophyseal avulsions are treated successfully. A reporting bias may exist, with good outcomes less likely to be presented for publication; but the risk of avascular necrosis of the femoral head following this injury remains undeniable.

Previous successful outcomes have been obtained with open reduction and internal fixation and have led some authors to advocate this as the preferred management. This is the first case report of a successful outcome with nonoperative management of the injury. In our case, the delayed and insidious presentation encouraged us to pursue nonoperative management. This case demonstrates that a minimally displaced greater trochanter apophyseal avulsion can be successfully managed without surgery.

3.3. Blood supply and aetiology of avascular necrosis

It is hypothesised that muscular forces acting on the greater trochanter cause a tension band effect through a muscular sling. This is created by a fibrous connexion between the hip abductors and vastus lateralis which, in turn, is intimately connected by fibrous tissue to vastus intermedius. It is proposed that this tension band effect minimises the risk of avulsion; hence the rarity of the greater trochanter apophyseal avulsion.

It is believed that avascular necrosis of the femoral head is a risk following greater trochanter apophyseal avulsion in patients where the intramedullary blood supply to the head is not yet established. This occurs once the capital femoral physis has fused. The blood supply to the developing proximal femur has been well studied and it is understood that, whilst the physis is still open, the main blood supply to the femoral head is via the lateral ascending cervical artery; a single vessel which crosses the base of the capsule at the junction of the greater trochanter and base of the femoral neck. This vessel corresponds to the lateral epiphyseal artery described by True et al and the posteroseptal retinacular vessels described by Ogden. The vessel supplies the majority of blood to the femoral epiphysis after the age of four; before the development of an intramedullary blood supply. The Medial Femoral Circumflex Artery (MFCA) also supplies vessels to the greater trochanter and anastomotic vessels to the superior gluteal artery. Thus if the greater trochanter is avulsed, there is likely to be traction on the MFCA which itself may be tethered by its branch to the LFCA. It is possible that the MFCA could be disrupted at this point in this injury. The other possible causes of compromise to the blood supply to the femoral epiphysis in the adolescent greater trochanter apophyseal avulsion include intracapsular haematoma or iatrogenic damage to the lateral retinacular vessels at the time of surgery.

No consensus exists in the literature as to the most appropriate management plan for adolescent greater trochanter avulsion. We believe that, if nonoperative management is pursued, the patient should be allowed to weight bear as nonweight bearing would probably act to increase the pull of the abductors on the greater trochanter and may lead to further displacement. This could compromise the MFCA, affecting the blood supply to the femoral epiphysis. It would also be prudent to adopt a careful surgical technique to avoid damage to the femoral epiphyseal blood supply if the surgical option is chosen.

3.4. Mechanism of injury

The history in our case suggests the greater trochanter apophyseal avulsion occurred during the breast stroke swimming session and was then aggravated by attempting to return to playing football two weeks later. Breast stroke swimming requires forceful abduction and extension of the legs and therefore exerts traction on the greater trochanter. Traction apophysitis of the greater trochanter due to repetitive motion has never been reported in the English literature. The previous reports of greater trochanter avulsion, where the mechanism was known, resulted from significant impact.

Fig. 1. AP pelvis radiograph showing avulsion of the left greater trochanter apophysis. The medial aspect of the trochanter was thought to be angulated rather than displaced, perhaps allowing some protection to the vessels through intact periosteum.

Fig. 2. AP pelvis radiograph showing no further displacement of the greater trochanter with evidence of healing and a normal capital femoral epiphysis.
3.5. Knee pain

The presenting complaint of knee pain is also noteworthy. It is not uncommon for adolescents to present with knee pain when the hip is the site of the pathology. In this instance the patient had already been treated for a presumptive diagnosis of iliobial band syndrome around the knee, when careful examination would have revealed the hip to be the site of the injury. With such a presentation in a patient in this age group a diagnosis of slipped capital femoral epiphysis must always be considered and on this basis alone careful examination and radiological assessment of the pelvis is mandatory. This is probably well recognised by the orthopaedic community but needs to be understood by the all health care practitioners who deal with adolescent trauma or sports injury.

4. Conclusion

To our knowledge, this is the first known report of greater trochanter apophyseal avulsion treated successfully with nonoperative management. It is also the only documented report of avulsion following an overuse type of injury rather than single impact trauma. It is an opportune reminder that the adolescent presenting with knee pain must have hip pathology excluded. Due to the rarity of this injury there is no consensus in the literature as to its appropriate management. This case demonstrates that with minimally displaced avulsions conservative management is possible with a positive outcome.

Conflict of interest statement

This statement confirms that none of the authors of this piece have any financial or personal relationship that could bias their work related to this submission. There are no conflicts of interest.

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