INTRODUCTION

Tears of the medial head of gastrocnemius muscle at its myotendinous insertion is the most common injury in patients presenting with tennis leg [1]. Injuries to the medial head of the gastrocnemius tendon away from the musculotendinous junction are less commonly reported and include partial tears and tendinosis near its insertion on the femoral condyle [2-4]. Isolated avulsion fractures at the femoral insertion site of the medial head of the gastrocnemius muscle are even much less frequent with only two reported cases in the English medical literature [5,6]. Here we report an isolated avulsion fracture of the medial head of gastrocnemius muscle in a 13-year-old boy following a skiing injury, the youngest patient with this injury reported to date. Our goal is to review the literature focusing on the role of magnetic resonance imaging (MRI) in the diagnostic approach of such injuries often very difficult to recognize by simple radiographs.

Keywords: avulsion fracture; sport injury; gastrocnemius; occult fracture

CASE REPORT

A 13-year-old boy presented to our sports medicine clinic with left knee pain and swelling. He had injured his left knee one week prior while downhill skiing, when he had lost control and his left leg had slid forward and rotated externally. During the injury, he felt a ‘pop’ in his left knee with immediate pain and swelling. On physical exam, he had pain with palpation over the medial joint line and medial aspect of the distal femur, raising clinical concern for a medial meniscal tear or medial collateral ligament injury.

Radiographs of the left knee showed only a trace joint effusion (Fig. 1).

Figure 1. Lateral radiograph of the left knee shows only a trace joint effusion (→). The remainder of knee radiographs obtained at that time, not shown, were normal.


RÉSUMÉ • La fracture-avulsion isolée du muscle jumeau interne à son insertion fémorale est une entité rare. À notre connaissance, seuls deux cas ont été rapportés dans la littérature anglaise. Ce genre de fracture est très difficile à identifier par simple radiographie. Nous présentons un cas similaire suite à un accident de ski chez un garçon de 13 ans, le plus jeune patient à ce jour présentant ce type de fracture. La revue de la littérature qui l’accompagne a pour but d’insister sur l'importance de l’imagerie par résonance magnétique (IRM) dans le diagnostic de cette rare fracture difficile à diagnostiquer par radiographie simple.

Mots-clés : fracture-avulsion; blessure sportive; gastrocnémien; fracture occulte
Given the extent of symptoms and clinical concern for a medial meniscal tear and medial collateral ligament injury, the child was sent for an MRI of his left knee.

The MRI showed an avulsion fracture of the medial femoral condyle at the insertion site of the medial head of the gastrocnemius muscle with fluid signal intensity between the fracture fragment and the femoral condyle (Fig. 2).

There was only mild, less than 4 mm of displacement of the avulsed fragment.

The patient was treated conservatively with a knee brace and physical therapy. At follow-up, the patient had full range of motion and resolution of pain.

DISCUSSION

The knee joint has many tendinous, ligamentous and meniscal insertions making it especially susceptible to a wide variety of injuries (Fig. 3a). Avulsion fractures involve detachment of a bony fragment secondary to traumatic traction on the tendon or ligament away from their bony insertion. Despite the often-subtle findings on traditional radiography, such fractures can cause significant instability in the joint especially when proper treatment is delayed due to the unalarming clinical features at presentation [7]. These injuries should be sought out with advanced imaging when the mechanism of injury is suggestive.
Contrary to the more typical patterns of avulsion in the knee joint (which can involve the lateral capsular ligament, the medial collateral ligament, the anterior and/or posterior cruciate ligament, biceps femoris tendon, semimembranosus tendon, and the quadriceps tendon [7]), avulsion fractures involving the medial head of the gastrocnemius are very rare and are, typically, associated with other ligamentous or tendinous injuries.

The gastrocnemius muscle is the most superficial of the surae muscles in the posterior compartment of the leg that crosses both the knee and ankle joints (Fig. 3b). It is a bipennate muscle with two proximal heads, medial (inner) and lateral (outer), which originate via separate tendons from the respective medial and lateral femoral condyles. Distally, the medial and lateral heads converge and combine with the soleus muscle forming into a single common Achilles tendon, which inserts on the posterior aspect of the calcaneus (Fig. 4a) [8]. The main function of the gastrocnemius muscle is to plantar flex the foot and when the foot is planted flex the knee [8].

Common injuries to the gastrocnemius muscle include rupture at the myotendinous junction seen in tennis leg, which is a clinical condition typically seen in middle-aged patients who develop acute sport-related pain in the mid portion of the calf [1,9,10]. This condition is far less common in younger athletes who have more resilient and elastic muscles and tendons [11].

(a) The anatomy of the gastrocnemius muscle with its medial and lateral head.
(b) View of the posterior knee with the various ligamentous and meniscal structures.

Figure 4. A sketch of the gastrocnemius muscle showing (a) the origin of the medial head (→); (b) the direction of the tensile force necessary to cause avulsion of the femur fragment at the attachment site of the medial head. A twisting motion at knee joint can cause myotendinous rupture or less commonly an avulsion of a femur fragment.
Partial tears of the tendon of the medial head of gastrocnemius near its femoral insertion have both been reported [2]. In a review of knee MRIs in adult patients Jawahar et al. found the incidence of gastrocnemius tendinosis to be approximately 50%, with most cases involving the medial head [2]. These authors attribute the increased incidence of medial head involvement to its more elongated proximal insertion and more distal extension into the Achilles tendon that allows the medial head to generate more force, likely leading to increased rates of injury [2]. Some authors believe that tendinosis and partial tears of the tendon of the medial head of the gastrocnemius are likely underreported causes of posterior medial knee pain [2,3].

Although caused by similar trauma to tendinous and myotendinous injuries of the medial gastrocnemius, avulsion fractures at its femoral insertion site are very rare; these injuries tend to occur at a younger age to myotendinous ruptures likely due to an underdeveloped epiphyseal bone. To our knowledge there are only two reported cases of isolated avulsion fractures at the insertion of the medial gastrocnemius in the English medical literature [5,6]. Avulsion of fractures of the medial head of the gastrocnemius muscle can be more frequently seen in combination with severe multi-ligamentous injury seen in the setting of knee dislocations [12].

The first case, reported by Maehara et al., involved a displaced avulsion fracture of posterior medial femoral condyle at the medial gastrocnemius insertion site in a 26-year-old man after a skiing accident [5]. In this patient, the avulsed fracture fragment, which was displaced into the popliteal fossa, could be seen on lateral radiographs [5]. CT and MRI confirmed the fragment was attached to the tendon of the medial head of the gastrocnemius and identified the femoral condylar donor site [5]. There was no associated muscle injury in this patient. Due to the degree of displacement of the avulsed fragment, this patient was treated with open reduction and internal fixation with good clinical results [5].

Patterson et al. reported a second case of an isolated avulsed fracture of the medial head of the gastrocnemius in a 14-year-old boy who sustained a rotational injury to his knee while participating in high school wrestling [6]. Like the case that we are presenting, the avulsed fracture fragment was only mildly displaced and therefore not definitively seen on initial radiographs [6]. Due to concern for medial meniscal injuries, the patient was later referred for MRI which showed the occult avulsion fracture [6]. This patient was treated conservatively and by the eighth week post injury, he was pain free and returned to competitive wrestling [6].

The mechanism of injury in the two other previously reported cases and the one we report here are similar. Our case and the one reported by Maehara both occurred during skiing injuries. Since the change in manufacture of ski boots from soft leather to hard plastic in the 1970’s, which led to a substantial decreased in ankle-related skiing injuries, there has been a corresponding increase in skiing-related knee injuries [13]. This is due to the foot and ankle being in a relatively “locked” position in a hard boot fixed to the ski binding. A sharp turn or fall can therefore result in a rotational injury at the knee with the foot in a fixed position. The case reported by Patterson et al. while occurring during a high school wrestling match had similar mechanism in that the patient reported an external rotational injury to his left knee as it was flexed with the left foot planted and “locked” on the mat.

Patterson and colleagues speculate that the distal femoral metaphyseal irregularity that is seen in some children may in some cases be related to a healing or minimally healed displaced occult avulsion fracture [6]. Distal femoral metaphyseal irregularity, also known as cortical desmoid and avulsive cortical irregularity, is most commonly seen between 10-15 years of age and is typically thought to be a chronic “tug-type” lesion from repetitive avulsion forces generated by the medial head of the gastrocnemius and adductor magnus tendons [12]. Many of these lesions are asymptomatic and are detected incidentally and are likely due to chronic “tug” by the medial gastrocnemius and adductor magnus tendons without an avulsion fracture. However, in this case and the one presented by Patterson et al., both children had isolated avulsion fractures in this location which were not seen on initial radiographs, which raises the possibility that some cases of distal femoral metaphyseal irregularity, particularly ones which are symptomatic and preceded by an acute injury, may be due to a healing avulsion fracture.

Our case and the two previously reported cases emphasize the role of MRI in evaluation of posterior knee pain following injury. Given the rarity of isolated avulsion fractures at the medial head of the gastrocnemius, these patients were not suspected as having these injuries prior to imaging. In our case and the other pediatric patient that has been reported, the fractures were only mildly displaced and occult on initial radiographs and only detected on subsequent MRIs. Both children were managed conservatively with good results.

CONCLUSION

The case we present here of a boy with an isolated avulsion fracture at the insertion of the tendon of the medial gastrocnemius is important for several reasons. First, to our knowledge this is the youngest patient reported with this injury. Also, it contributes to the very limited available literature with patients with this injury. Furthermore, it illustrates the need for MRI in the detection of mildly displaced avulsions in this area which may go undetected on knee radiographs.

Teaching Point

Isolated avulsion fractures of the medial head of the gastrocnemius are rare. They occur with external rotational strain on the knee in flexion. The avulsed fragment can be displaced enough to be seen on lateral radiographs or may be minimally displaced and therefore occult on plain radiographs necessitating a MRI study of the knee.
REFERENCES


