Adult tibial intercondylar eminence fracture: evaluation with MR imaging

Abstract Tibial intercondylar eminence (TIE) fractures are well described in the pediatric orthopedic literature. Adult TIEs are much less common, and limited literature exists on the subject. Adult knee hyperextension injuries commonly result in anterior cruciate ligament (ACL) injury; however, with significant trauma, a TIE enters the differential diagnosis. Identification and classification of TIE fractures typically has been provided by radiography. The incidence of concomitant injuries with magnetic resonance (MR) imaging in patients with adult TIE fractures has not been determined. We present a case of an adult type III TIE fracture seen on radiography that only with further MR imaging revealed a concomitant lateral tibial plateau fracture. Utilization of MR imaging altered the surgeon’s course of treatment and postoperative care. Radiographic and MR images and a review of the literature are provided.

Keywords Knee injury · Tibial intercondylar eminence fracture · Adult · Classification · Tibial plateau fracture · Magnetic resonance imaging

Case report A 32-year-old man without a significant past-medical or surgical history presented to our clinic after falling from a 2 m high (6 foot) fence injuring his left lower extremity. The patient reported that he sustained a hyperextension injury to his left knee after his foot fell into a hole. Initially seen in the emergency room, the patient presented with pain, swelling, and decreased range of motion of the left knee. Examination revealed a marked effusion, limited range of motion, and a grade II Lachman with a soft end-point.

Radiographs demonstrated a TIE fracture, which was displaced anteriorly and proximally (Fig. 1A, B). No other osseous abnormalities were noted on radiography. Three days later, MR imaging of the left knee (Fig. 1C–E) demonstrated a displaced but nonrotated (Meyers and McKeever type III) TIE fracture. Additionally, there

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Introduction Tibial intercondylar eminence (TIE) fractures are usually seen in children ages 8–14 years and represent a minority of childhood fractures [1, 2]. The anterior cruciate ligament (ACL) pulls on the immature tibial eminence causing an avulsion injury. They are analogous to an adult ACL injury, occurring during knee hyperextension, e.g., when falling off a bicycle [3, 4]. Adult reports of this entity are much less common, with the largest reported series from 1970 involving 22 adult cases [2]. The difference in prevalence between childhood and adult TIE fractures is due to skeletal maturity at the ACL insertion [4, 5, 6]. Adult TIE fractures usually involve greater degrees of trauma and more associated injuries [1, 2, 5, 7].

Traditionally, radiographs have been relied upon to identify and classify injuries to the TIE. To our knowledge, the incidence of concomitant injuries seen with magnetic resonance (MR) imaging in patients with adult TIE fractures has not been determined. It is our hypothesis that radiography underestimates the significance of TIE fractures seen in adults and that MR imaging should be utilized in order to better predict occult injuries and to assist surgical pre- and postoperative planning.
was a fracture of the posterior aspect of the lateral tibial plateau and a joint effusion. The menisci, cruciate and collateral ligaments were noted to be intact.

The patient was subsequently taken to surgery where the fractures were repaired under arthroscopic assistance. Postoperatively, the patient was placed in a articulated knee brace locked in full extension. Weight-bearing on the affected extremity was delayed by 6 weeks secondary to the presence of the lateral tibial plateau fracture. After 6 weeks, the patient began physical therapy and was able to return to work. He had a mildly (less than 7°) decreased range of motion and moderate quadriceps atrophy, both of which improved with physical therapy. Stability of the knee was considered excellent at his 3-month follow-up physical examination.

**Discussion**

Childhood TIE fractures most frequently occur after falling from a bicycle onto a hyperextended and rotated leg [1, 2, 4, 8]. Other less common scenarios include automobile accidents and athletic injuries. The mechanism of injury is felt to be due to forceful hyperextension, tugging the ACL from its relatively weak and immature chondroepiphyseal insertion on the proximal tibia [3, 5, 6]. This is analogous to an adult ACL injury; however, children are more likely to avulse the immature eminence than to tear the relatively stronger ACL [3, 4, 5]. By comparison, adult TIE fractures most commonly occur during automobile accidents (e.g., a car dashboard slamming into the outstretched leg of a seated passenger). While the adult mechanism is also due to hyperextension, there is usually a higher degree of impact energy necessary to cause the avulsion [3]. Subsequently, adult patients tend to have concomitant injuries such as a medial collateral ligament (MCL) tear [1, 2, 5], an ACL tear [7], or additional fractures about the knee [1, 2, 3, 5], as was found in our case. With this injury, both children and adults present with pain and decreased range of motion, which may be due to hemarthrosis, a displaced fracture fragment, or muscle guarding.

Radiographs are the frontline of diagnosis in TIE fractures. The later-