Tibial tuberosity avulsion fractures are critical injuries requiring prompt recognition due to the risk of vascular compromise and permanent deformity in the affected limb. These fractures are most commonly seen in adolescent athletes approaching skeletal maturity, with a male predisposition. Tibial tuberosity avulsion fractures are rare (<1% of physeal injuries and approximately 3% of proximal tibial fractures) and often require orthopedic surgical intervention. Unique fractures occur due to the timing of maturation of the two unique tubial ossification centers. The mechanism of injury is thought to be from quadriceps contraction during knee extension or passive flexion of the knee against the contracting quadriceps.

Case History

A 14-year-old adolescent male with past medical history of left tibial tubercle fracture one year prior, presented to our Children's ED by EMS directly from a basketball event with complaint of right lower extremity pain after performing a lay-up. He experienced a popping sensation upon landing and felt immediate pain in his knee with inability to bear weight. Patient's mother reports prior tubercle fracture was managed non-operatively with immobilization and serial radiographs. Physical examination: Vital signs: HR 82, BP 125/56, RR 20, O2 sats 100% on RA, Height 4’9”, Weight 54.4 kg. MSK: +2 PT and DP pulses in the affected right lower extremity. Sensation was normal. Vital signs were stable. Physical examination of the knee was normal with no instability or deformity. Pain was elicited with passive dorsiflexion and plantarflexion of the ankle or great toe dorsiflexion.

Injury concerning for acute right non-displaced tibial tubercle avulsion fracture, Ogden Type IA. X-ray of right tibia/fibula demonstrated apophyseal widening (Image A) with associated soft tissue swelling that was worse in imaging (Image B), obtained by recommendation of interpreting Radiologist to rule out anatomic variant.

Right leg was splinted in extension with knee immobilizer for stabilization of injury. Multimodal analgesics were provided for pain control. The on-call orthopedic trauma team was consulted for evaluation and further management of acute tibial tubercle avulsion fracture, Ogden Type IA. The patient and his parents requested a second opinion from the patient’s established Orthopedist, who managed his prior tibial tubercle fracture last year. The patient’s mother reports prior tubercle fracture was managed non-operatively with immobilization and serial radiographs. He was discharged in a knee immobilizer with limited weight-bearing and close interval follow up with Orthopedic clinic for casting and serial radiographs.

Management of Tibial Tubercle Fracture in an Adolescent Athlete

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INTRODUCTION

Tibial tuberosity avulsion fractures are uncommon, yet critical injuries to diagnose. These unique growth plate fractures involve the apophysis of the tibial tubercle and comprise less than 1% of physeal injuries and less than 3% of proximal tibial fractures. If not recognized and appropriately treated, these fractures may result in vascular compromise and permanent deformities including genu recurvatum and leg length discrepancies. The pathology of tibial tubercle fractures is intricately linked to the ossification of the tibia. There are two ossification centers of the proximal tibia, a primary site on the tibial physist and a secondary site at the apophysis, or tibial tubercle. With respect to the knee, the proximal tibial growth plates close in a posterior to anterior and proximal to distal orientation, causing the tibial tubercle the last area to mature. During this critical physiologic period, the fibrocartilage connecting the tibial tubercle to the metaphysis is being replaced with columnar cartilage. The new cartilage has yet to mature which makes this location more susceptible to injury.

Early recognition and treatment for tibial tubercle avulsion fractures are critical. Immediate complications and concomitant injuries include patellar tendon rupture in 2% and compartment syndrome in 4% of cases. The latter is due to soft tissue edema leading to vascular compromise of the recurrent anterior tibial artery. If the fracture is left untreated, further complications can include genu recurvatum in 4% and limb length discrepancies in 5% of untreated patients under 11 years of age. Compartment syndrome is also a concern in post-operative period and is reported in 0-20% of cases.

DISCUSSION

Tibial tuberosity avulsion fractures are uncommon, yet critical injuries to diagnose. These unique growth plate fractures involve the apophysis of the tibial tubercle and comprise less than 1% of physeal injuries and less than 3% of proximal tibial fractures. If not recognized and appropriately treated, these fractures may result in vascular compromise and permanent deformities including genu recurvatum and leg length discrepancies. The pathology of tibial tubercle fractures is intricately linked to the ossification of the tibia. There are two ossification centers of the proximal tibia, a primary site on the tibial physist and a secondary site at the apophysis, or tibial tubercle. With respect to the knee, the proximal tibial growth plates close in a posterior to anterior and proximal to distal orientation, causing the tibial tubercle the last area to mature. During this critical physiologic period, the fibrocartilage connecting the tibial tubercle to the metaphysis is being replaced with columnar cartilage. The new cartilage has yet to mature which makes this location more susceptible to injury.

Early recognition and treatment for tibial tubercle avulsion fractures are critical. Immediate complications and concomitant injuries include patellar tendon rupture in 2% and compartment syndrome in 4% of cases. The latter is due to soft tissue edema leading to vascular compromise of the recurrent anterior tibial artery. If the fracture is left untreated, further complications can include genu recurvatum in 4% and limb length discrepancies in 5% of untreated patients under 11 years of age. Compartment syndrome is also a concern in post-operative period and is reported in 0-20% of cases.

REFERENCES