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Case Report

Salter Harris Type I Fracture of the Proximal Tibial Epiphysis

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INTRODUCTION

Injuries of the proximal tibial epiphysis are rare. They predominantly occur in adolescent males following, signfficant trauma. They usually involve a Salter Harris Type II, III or IV injury, and are associated with a high level of growth disturbance. We present the case of a twelve year old boy, who suffered a Type I proximal tibial epiphyseal injury. The mechanism of injury has not been previously described.

CLINICAL COURSE

A twelve year old boy presented to the accident and emergency department having sustained a twisting injury to his right knee whilst racing on a scrambler bike. He described that his right foot became lodged into the ground, with his knee in the extended position, as the motorcycle turned sharply to the right. Clinically he had a swollen and bruised right knee. There was an obvious internal rotation deformity, with the foot internally rotated with respect to the knee and thigh. Knee motion was grossly restricted and the patient could not straight leg raise. There was localised tenderness over the proximal tibia. It was not possible to accurately assess the status of the collateral and cruiciate ligaments. There was no evidence of neurological or vascular compromise, although the calf was very swollen.

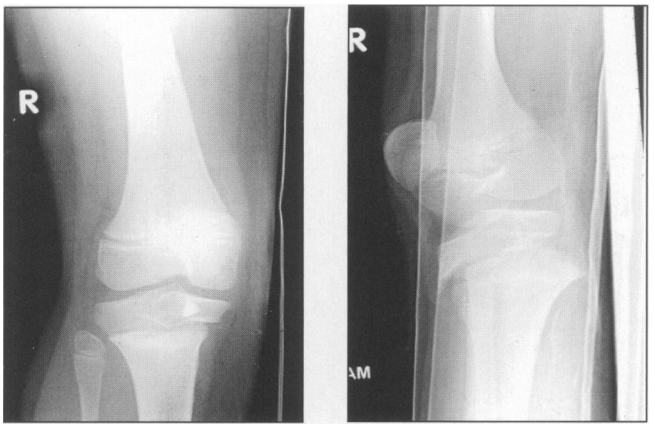

Fig 1: Salter Harris Type I fracture of proximal right tibial epiphysis with associated non-displaced fracture of proximal fibula.

Radiographs demonstrated a Salter Harris Type I injury of the proximal right tibial epiphysis (Figure 1). It was treated by closed reduction and K-wiring, with plaster immobilisation (Figure 2). Post-operatively the tight lower limb remained neurovascularly intact and radiographs were satisfactory. He remained in cast for six weeks and the pinswere removed in the fracture clinic. He was reviewed after six months, and found to have healed in anatomical position with a full range of knee movements and ligamentous

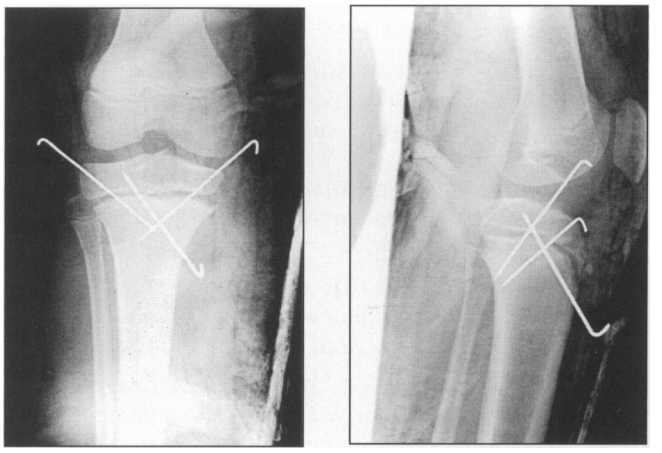

Fig 2: Fracture following closed reduction and K-wiring.

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stability. There was no evidence of premature physeal arrest as the Harris growth lines remained parallel to the growth plate.

REVIEW OF THE LITERATURE

Epiphyseal injuries of the upper tibia are rare. It has been estimated that fractures of the upper tibial epiphysis account for 0.5 % to 3. 1 % of all epiphyseal injuries [1, 2].

There are a number of anatomical factors which may account for this relatively low incidence. The proximal tibial epiphysis does not receive attachments from the medial or lateral collateral ligaments. Hence varus and valgus forces are transmitted not directly to the epiphysis, but to the metaphysis. This is in contrast to the lower femoral epiphysis which does receive attachments of these ligaments, and which has a higher incidence of injury[1]. Laterally, the proximal tibial epiphysis is buttressed by J the upper end of the fibula, and anteriorly the tubercle projects inferiorly to overhang the metaphysis. The epiphyseal attachment to the shaft is irregular, hence any fracture at this level will shear across different levels within the physeal plate. This fact may, explain the high association of proximal tibial physeal fractures and growth disturbance. Additionally, the insertion of the semi-membranosus tendon extends into the metaphysis and the patellar tendon inserts into a separate centre of ossification, protecting the epiphysis from avulsion strains[3].

The peak incidence of injuty is twelve to fourteen years of age being more common in males. This probably reflects a greater exposure to trauma and the relative skeletal maturity found in females, rather than to any intrinsic physeal difference. Analysis of five series of these types of injuries, published by Burkhart and Peterson[2], Poulsen *et al.* [4], Rhenirev *et al.*[5], Wozasek *et al.*[6] and Gautier *et al.*[7], gives a total of eighty-four patients of whom sixty-three were males and twenty-one were females.

There were fifteen Salter Harris Type I injuries, nineteen Type II injuries, twenty-four Type III injuries, twenty-two V injuries (one case was bilateral Type IV fractures[2]), four Type V injuries and one fracture described as "recurvatum and valgus"[6].

Most of these injuries are sustained in either sports-related activity or road traffic accidents[2,4,5]. The various types of trauma have been described as shearing, avulsing, splitting, or crushing. In the case presented, the mechanism of injury was twisting with the foot fixed and the twisting force applied to the leg. The knee capsule and cruciate ligaments withstood the force and the physeal plate failed first. This would correspond to the adult dislocated knee where the ligaments fail before the bone.

Clinical features include the inability to lift the leg because of pain and because of hamstring spasm. There may be a haemarthrosis present with soft tissue swelling of the leg and tenderness ness at the level of the growth plate 1 to 1. 5 cm. distal to the joint line. Wozasek *et al.*[6] in a series of 30 patients found a 40 % incidence of ipsilateral lower limb injuries.

Radiographs may be difficult to interpret, and when an epiphyseal injury is suspected, stress views and -views of the unaffected leg may be required[5,8]. Hyper extension of the knee should be avoided because of the possibility of popliteal artery injury.

Anatomical reduction may be achieved by closed reduction and cast immobilisation, K-wiring, or open reduction with screw fixation[4,5].

Associated problems include ligamentous injuries[4], vascular complications[6] including compartment syndrome, knee instability, and growth disturbance[4,7]. Growth disturbance, as defined by deformities of more than 25 mm in length, or more than 5° of angulation, has been reported to occur in more than 25% of cases of proximal tibial injuries in children, when a meta-analysis of published series was performed[7]. Gautier *et al,* in a study of six children with proximal tibial injuries reports that the most consistent clinical deformity was recurvatum, with a resultant effect on the range of motion of the knee[7].

CONCLUSION

The mechanism of injury in this case has not been previously described. Given the forces involved i.e. the momentum due to the combined mass of the patient and the scrambler effectively pivoting at high velocity on the long axis of his lower linib, this should be regarded as a high energy injury. This high energy rotational force has resulted in a fracture through the growth plate, as opposed to ligamentous injury. This may be because with the patient's body weight acting through the extended knee, the proximal tibial epiphysis becomes the

focus through which the rotational force acts. In the adult population the resulting injury would probably have been knee dislocation. Clinically there was an internal rotation deformity evident, and this is in contrast to the expected appearance of the knee when the mechanism of injury has been the more cornmonly described shearing, avulsing splitting, or crushing.

The treatment consisted of accurate closed reduction and stabilisation with heavy K wires and cast. The physeal plate appeared widened probably because of periosteal interposition, but given the nature of the injury open reduction was felt not to offer any benefit. Had the fracture extended into the joint surface (Salter Harris Types III or IV), open reduction to gain articular congruity would have been carried out.

This case illustrates that Salter Harris Type I and II injuries of the proximal tibial physis can be managed adequately with accurate closed reduction and stabilisation. The patient has regained full knee motion with no evidence of growth disturbance at six months from fracture. Careful initial assessment and documentation of the vascular status of the limb is required because of the association with compartment syndrome and popliteal artery injury.

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