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Arthroscopic assisted reduction and fixation of a juvenile Tillaux fracture

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Abstract We report a case of Tillaux fracture of the distal tibia in a 14-year-old patient. Reduction and fixation of the fracture was achieved arthroscopically through the anterolateral portal. The patient was able to participate in competitive athletic activities 3.5 months after surgery with an AOFAS score of 100. Arthroscopy is an expedient tool in the management of intra-articular fractures of the ankle providing anatomical reduction under direct visualization with minimum intervention.

Keywords Tillaux fracture · Ankle arthroscopy · Ankle fracture

Introduction

Ankle fractures account for up to 38% of physeal injuries reported in children. The skeletally immature athlete is particularly susceptible; more than half of ankle fractures in children occur during sports activities and physeal ankle fractures account for 40% of sports-related injuries reported in children [4]. The physis of the distal tibia accounts for 18% of the overall limb length and 32% of the overall growth of the tibia. The distal tibial physis closes at about 15 years of age in girls and 17 in boys. Closure begins centrally, extends medially, and then laterally over an 18 month period. This asymmetric closure sequence leads to the characteristic adolescent transitional fractures of the ankle, i.e. the tri-plane and Tillaux types [5, 12].

Paul Jules Tillaux [16] partially described the fracture in 1892; he performed experiments on cadavers and found that stress to the anterior inferior tibiofibular ligament (AITFL) could lead to this type of avulsion fracture. A similar injury to the posterolateral tibia was later described by Chaput whereas, in 1964, following their extensive work on distal tibial fractures, Kleiger and Mankin described an isolated fracture of the lateral portion of the distal tibial physis in adolescents, which represents a relatively uncommon Salter Harris type III fracture and today is termed the Tillaux or Kleiger fracture [11]. These fractures can occur in adolescents in the 18-month period during which the distal tibial epiphysis is closing. These injuries occur either by lateral rotation of the foot or by medial rotation of the leg on the fixed foot [2]. The fracture is of great importance because it involves a major weight-bearing articular surface. A residual deformity of the joint surface can lead to premature degenerative arthritis [1]. Arthroscopic assisted reduction and fixation of Tillaux fractures has been previously described in the literature [8, 9]. We present a case in a juvenile athlete, which was carried out exclusively arthroscopically and led to an excellent outcome 3 months postoperatively.

Case report

A 14-year-old football player sustained a right ankle injury on November 2005 after being tackled. The

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mechanism of injury was consistent with an external rotation injury of the ankle. He presented with swelling, lateral bruising, and anterolateral pain. Range of motion was reduced and weight bearing painful.

Plain radiographs revealed a Tillaux fracture with 9.0-mm displacement in the classic position (Fig. 1). A CT-scan of the right ankle was not considered necessary as the patient's age, the location of the fracture and the mechanism of injury were each consistent with the diagnosis of a typical Tillaux fracture.

Arthroscopy was carried out through standard anteromedial and anterolateral portals. The fragment with its articular incongruity was readily visualized from the anteromedial portal and was reduced from the anterolateral portal using a drill sleeve (Fig. 2a,b). Anatomic reduction and temporary fixation with a 2.0 K-wire inserted through the sleeve was achieved under direct vision (Fig. 2c). Subsequent fluoroscopy was used to confirm adequacy of the reduction. A 4.0-mm partially threaded cannulated screw was inserted over the K-wire to fix the fracture. Adequacy of reduction was again confirmed both arthroscopically and fluoroscopically (Fig. 2d). Postoperatively, the patient was placed in a below knee soft-cast splint for 3 weeks exchanged to a removable boot [XP Walker^{TM}, Aircast LLC Summit, New Jersey) for another 3 weeks. He was instructed not to bear weight for 6 weeks but was allowed for full range of motion after the 3rd postoperative week. Check X-ray at 12 weeks after the surgery showed complete healing of the fracture and full range of motion in the ankle joint (Fig. 3). He has returned to competitive sport activities 14 weeks after the injury having an AOFAS score of 100.

Discussion

The juvenile Tillaux fracture comprises less than 3% of distal tibial injuries and occurs in children and adolescents 13–15 years of age. It is a Salter-Harris III injury of the distal tibia caused by an external rotation force applied to the foot which tensions the AITFL and avulses the anterolateral distal tibial epiphysis [2, 5, 11]. Fractures displaced less than 2 mm can be treated

Fig. 1 Anteroposterior and lateral view of the Tillaux fracture (*arrows*)

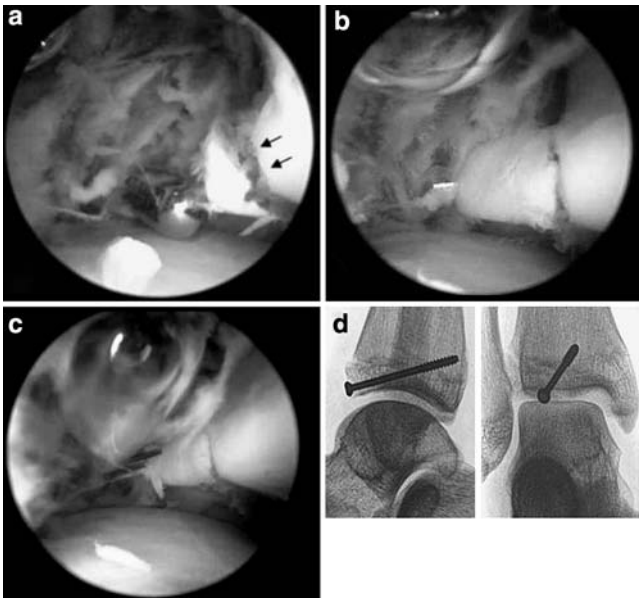

Fig. 2 **a** Arthroscopic documentation of the fracture from the anteromedial portal (*arrows*), **b** arthroscopically-assisted reduction with a sleeve through the anterolateral portal, **c** temporary fixation with a 2.0 K-wire and **d** excellent reduction of the fracture with a 4.0-mm partially threaded cannulated screw that was inserted over the K-wire

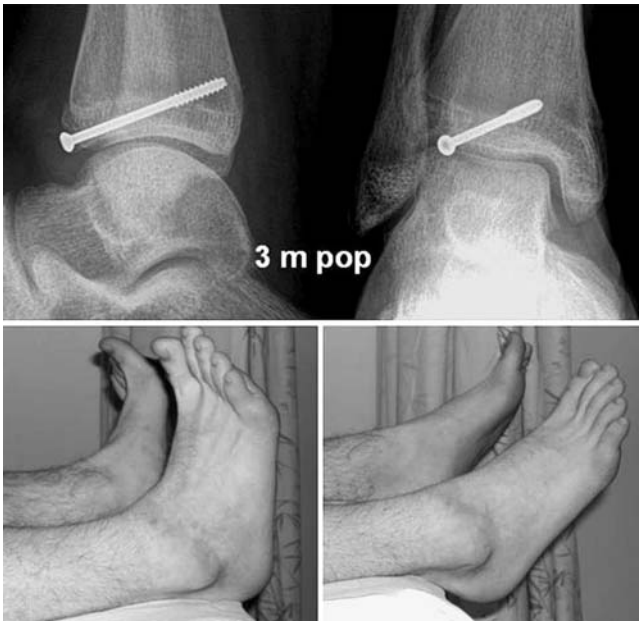

Fig. 3 Solid union of the fracture 3 months postoperatively with full active range of motion in the ankle joint (AOFAS score = 100)

with cast immobilization; a non-weight-bearing long-leg cast is applied with the foot positioned in internal rotation for 4 weeks exchanged to a walking cast for another 3 weeks. Displaced fractures of more than 2 mm require reduction under anesthesia; the pronated foot is internally rotated in plantar-flexion, with direct pressure applied to the anterolateral epiphysis. Failure of reduction necessitates surgical intervention. The fracture is usually exposed via the anterolateral approach between the peroneal muscles and extensors tendons and is fixed with smooth K-wires, pins or screws [13]. Transepiphyseal fixation of the fracture is not usually required as this increases the damage to the growth plate, but it has been reported in cases of very unstable fractures or when reduction cannot be maintained satisfactorily [8]. A technique of percutaneous manipulation using smooth K-wires has also been described for the reduction and fixation of the fracture under fluoroscopic guidance. Reduction can be then secured using an additional smooth wire or canulated screw placed pecutaneously [14]. This technique utilizes a stamp incision and abstains the risks of arthroscopy, but achievement of anatomic reduction is difficult and multiple efforts of manipulation are usually required that can further damage the articular cartilage. Arthroscopy provides 100% visualization of the fracture line and anatomic reduction can be achieved easily from the anterolateral portal.

Arthroscopic assisted reduction and fixation of intra-articular fractures in the ankle region has been successfully used in the management of tibial Pilon [7], maleolar [10], Tillaux [8, 9], triplane [6], talar [15] and calcaneus [3] fractures. The advantages of arthroscopic treatment are the direct visualization of the fragments, the interpretation of associated chondral injuries and the minimal invasive mode of reduction and internal fixation avoiding thus, extensile approaches and wide capsulotomies.

Leetun et al. [8] reported an arthroscopically assisted management of a juvenile Tillaux fracture but the epiphyseal fragment was not amenable for arthroscopically assisted reduction and a mini-anterolateral arthrotomy was used for fixation. Similarly, Miller [9] has reported an equivalent of a Tillaux fracture in a 58-year-old woman but he facilitated reduction and internal fixation extending the anterolateral arthroscopic portal. In our case, both reduction and fixation of the epiphyseal fragment were achieved arthroscopically using the anterolateral portal; a small osteochondral fragment was also removed from the ankle joint This allows patients and especially athletes to return to their sport activities with decreased risk of stiffness and the lowest possible risk of later osteoarthritic changes secondary to the reduction achieved under arthroscopic visualization. Arthroscopy provides an excellent view of the articular surface of the distal tibia with minimal soft tissue disruption and is a valuable adjunct in the treatment of juvenile Tillaux fractures.

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