Concomitant Tibia Shaft and Distal Triplane Fractures

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Concomitant tibia shaft fracture and triplane fracture of the distal tibia are very rare in the pediatric orthopaedic traumatology. The very limited number of cases in the world literature has all been documented in older children or adolescent patients. Appropriate diagnostic evaluation and treatment is required to minimize the incidence of delayed or missed diagnosis of the ankle injury, prevent complications and optimize outcomes of both fractures. A new case as well as an extensive review of the literature is presented in this editorial.

Key words: Concomitant; Ipsilateral; Tibia shaft; Triplane; Fracture

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fractures were diagnosed. There were also 4 triplane fractures and 7 Tillaux fractures. The pediatric triplane ankle fracture represents a unique spectrum of injury that does not fit neatly into the Salter-Harris classification of physeal injuries. This fracture is particular to the pediatric population and it is often termed a transitional injury. Transitional period refers to the time of epiphysodesis from adolescent to skeletally mature bone. It is the result of the characteristic asymmetric closure of the distal physeal plate of the tibia, over a period of approximately 18 months, in children aged 12 to 15 years. Classically, this fracture appears as a Salter-Harris type III injury in the anteroposterior x-ray and as a type II injury on the lateral view. The triplane ankle fracture is a multiplanar injury, since it may incorporate fracture lines in the sagittal, coronal, and axial anatomical planes (corresponding to Salter-Harris fracture types II, III, and IV, respectively). The incidence, classification, treatment and outcome of triplane fractures have been extensively studied in the English literature.

The application of external rotation and plantar flexion force on the foot in relation to the leg in adolescents forces the talus against the fibula and places the anterior inferior tibiofibular ligament under tension resulting in an avulsion fracture of the anterolateral epiphysis. This isolated Salter-Harris type III injury is referred as the biplane fracture of Tillaux. Further forcing of the foot may result in a triplane fracture of the distal tibia. Subsequently, the juvenile Tillaux and the triplane fractures were both included in the classification scheme developed by Diaz-Giegerich, which was based on created increasing forces, as stage I and stage II injuries, respectively. Stage III injuries were due to the transmission of still further external rotation forces and included a stage II injury associated with an ipsilateral spiral or oblique fracture of the fibula. Morgan and Jimenez considered that continued external rotation transmitted through the tibia may finally result in a stage II injury associated with an oblique fracture of the tibia shaft. They classified it as a new stage injury.

In adults, distal tibia fractures associated with ipsilateral tibia shaft fractures, specifically distal one-third spiral type, are more prevalent than previously reported. The recognition of a distal one-third spiral pattern tibia shaft fracture had 86.6% sensitivity and 63.9% specificity for the presence of an ankle injury. The recognition of the associated ankle injury has been considered sufficiently important for proper preoperative planning and appropriate postoperative physical therapy. Recently, there has been increasing recognition and interest in the association of tibia shaft fractures and ipsilateral ankle injuries, although clinical studies have not sufficiently examined the clinical significance of this entity in adults.

Unlike adults, the lesion is less reported in children and adolescents. Rapariz et al. found that 48% of triplane fractures were associated with a fractured fibula and 8.5% were associated with an ipsilateral tibia shaft fracture. Healy et al. reported a triplane fracture associated with a proximal fibula fracture and syndesmotic injury (Maisonnette equivalent). Failure to detect this injury may lead to chronic instability. Recently a limited number of new cases suffering from ipsilateral tibia shaft and distal triplane fracture have been presented. They were all recorded in adolescents.

We were also able to identify, from the hospital database, a single case with this rare concomitant injury. The patient was a 13-year-old boy that was referred for a left tibia fracture associated with an ankle fracture. The left leg twisting injury had occurred after stepping into a hole while running. No open lesions were noted. Neurovascular assessment revealed no abnormal findings. Plain radiographs showed an oblique fracture of the tibia shaft associated with an ipsilateral undisplaced Tillaux fragment and a posterior malleolar shear fragment with an intact fibula (Figure 1A). The leg was immobilized in a long leg cast. A computed tomography (CT) scan was performed the next day. Both 2D-CT (Figure 1B) and 3D-CT (Figure 1C) scans were used in the imaging of the tibial and ankle fractures. There was no evidence of displacement bigger than 2 mm between the ankle fragments. The patient was then taken to theater and an above knee compression cast, with the tibia in valgus, was placed. The reduction of both the tibial and the triplane fracture was considered satisfactory. The patient was discharged on the seventh day post-injury after a satisfactory radiographic examination. He was then followed on an outpatient basis. Radiographs following a 2, 3 and 4 week-period post-injury showed satisfactory reduction of the tibial and ankle fractures. The plaster was removed 7 weeks post-injury, new radiographs were taken, and a below knee splint was applied for a further 2-week period. Radiographs at 3 months showed complete union of the fractured tibia. The triplane fracture was also well united with no disruption of the plafond of the tibia (Figure 1D).

The term triplane fracture has also been used to describe the ipsilateral triplane and diaphyseal shaft fracture in adolescents. This nomenclature is accurate, since it may be used to describe multiple fractures at several levels in a single bone. However, it may also be used to describe either an open/compound triplane fracture or a triplane fracture associated with comminution, cartilage injury, dislocation and bone lose. Therefore, the term concomitant or ipsilateral triplane tibia shaft fracture was preferred in this report.

A high index of suspicion is required for diagnosis. Pediatric orthopaedic surgeons should be aware that tibia shaft fractures, especially oblique or spiral-type fractures, may occasionally be associated with ankle injuries, such as triplane fractures. Minimum appropriate imaging for tibia fractures should always include ankle radiographs. Computed tomography may be required to reveal the full extent of the ankle injury and the degree of displacement. Various reports have showed that CT has a definite impact on the triplane fracture classification, displacement measurement, and treatment planning. The primary goal in treatment is reduction of the joint surface. Growth disturbance is not a common issue, since the fracture occurs just prior to the closure of the physis. Closed reduction is successful if there is no more than 2 millimeters of displacement. Positive results following closed reduction of displaced triplane fractures with internal rotation and casting have been reported throughout the literature. Displaced transitional fractures with a fracture gap of more than 2 millimeters in the weight-bearing portion of the epiphysis require closed or open reduction.

The ipsilateral presence of an oblique tibia shaft fracture may complicate the attempts at closed reduction of distal tibia triplane fractures in children and adolescents. Moreover, tibia shaft fractures with an intact fibula show a higher rate of delayed, non- and mal-union, in varus, than those with an associated fibular fracture. We usually offer patients with isolated fractures of the tibia a chance to Salter-Harris fracture types II, III, and IV, respectively). The concomitant tibia shaft and distal triplane fracture in our patient occurred with an intact fibula. Morgan and Himenez suggested the inclusion of the triplane ankle fracture associated with tibia fracture in the classification scheme suggested by Dias-Tachdjian and modified by Dias-Giegerich as a new last stage.
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Figure 1 A 13-year-old boy injured his leg and ankle after a fall. The initial anteroposterior and lateral radiographs of the leg and ankle indicated an oblique tibia shaft fracture and a distal tibia triplane fracture (A). A CT scan, in a two-dimensional (2D) form, showed 3-4 millimeters of shortening and a minimal recurvatum deformity of the tibia fracture as well as an undisplaced triplane ankle fracture (B). The three-dimensional (3D) CT reformation form provided better perception of the pattern of the fracture lines (C). Radiographs recorded uneventful healing of the tibia and ankle fractures, following conservative treatment, 3 months post-injury (D).

injury. However, it may be prudent to consider fractures of the fibula or tibia associated with a concomitant either Tillaux\cite{58-60} or triplane ankle fracture in adolescents as a subtype of the same last stage injury, which previously included only an ipsilateral distal tibia triplane and a fibula fracture.

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