Talus Fractures in Children Associated with Ipsilateral Bone Injuries

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Abstract: Fractures of the talus are very rare in children. The most common talar fracture involves the neck. A history of a fall with axial loading of the ankle, followed by pain and swelling in the area of the ankle, should conduct the clinical examination towards a talus fracture. With high-energy trauma, such as falls from height, crushing and lawnmower injuries, clinical deformity, displacement as well as a large degree of soft tissue damage may be evident. In addition, ipsilateral fractures in the foot or tibia, the so called ‘floating ankle’, may also be encountered. It should be emphasized that it is only the careful clinical examination that will alert the trauma surgeon whenever an area of tenderness is revealed in a neighboring area where a secondary traumatic bone lesion may exist. Treatment of talar fractures in younger children is more often conservative with generally good results, whereas talar fractures in older children are best addressed like fractures in adults. Avascular necrosis is the main cause of disability following fractures of the talus in children and may be followed by early degenerative changes. The incidence of avascular necrosis following talar fractures in children is considerably higher in high-energy injuries, especially in those associated with concomitant fractures, as well as in initially missed, and therefore non-treated, fractures.

Keywords: Talus, children, ipsilateral, concomitant, tibia, foot, fractures

EDITORIAL

The talus is divided anatomically into the body, the neck, and the head. The head of the talus articulates with the navicular bone and is mostly cartilaginous. Little cartilage is present on the neck, which is largely an area of vascular perforation. There are no direct muscular attachments on the talus. Because much of the talar surface is made up of articular cartilage, it has limited vascular connections and a precarious blood supply that can be directly affected by fracture. The four main sources of extraosseous blood supply are branches of the posterior tibial, anterior tibial, and peroneal arteries. The sinus tarsi is the entry for most of the blood supply of both the talus and the calcaneus.

The rare incidence of pediatric fractures of the foot has precluded large epidemiologic series referring to outcomes and rates of complications. However, the incidence is becoming higher due to the increasing participation of children in high-impact sports and in recreational activities of greater intensity and physical contact than ever before, and even in competing extreme sports (motocross, all terrain vehicles, motorized dirt bike or snowmobile racing, rock-climbing, etc).

The usual mechanisms of talus fractures are forceful dorsiflexion of the foot in a fall from a height or twisting trauma combining a component of supination with the forced dorsiflexion and axial loading. Crushing injuries to the foot (as by an automobile or motorbike tire) and lawnmower injuries may result in severe leg injuries.

The skeletally immature bones of a very young child's developing foot is much more flexible and resilient to traumatic forces and may lead to patterns of injuries different from those seen in adults.

Talar fractures in children may be classified in type I-IV fracture patterns correlating with the severity of injury and the risk of avascular necrosis using the Hawkins classification, modified by Canale and Kelly that is used in adults. Fractures of the body of the talus were initially classified in 1977 into transchondral...
dome fractures, lateral process or posterior tubercle fractures and shear or crush fractures. A classification, including two groups of patients, depending on the age of the injured child has also been proposed. In children younger than 6 years the diagnosis may be easily missed because the fracture may not be clearly delineated on radiographs. In children older than 6 years osteochondral fractures, complete fractures and avascular necrosis are more commonly encountered.

History and clinical examination in children with fractures of the talus may be challenging. The child is usually unable to bear weight on the affected extremity. Physical examination reveals a painful effusion of the anterior aspect of the ankle joint. In undisplaced injuries, the presentation may be subtle and the injury may be easily missed. With high-energy trauma, such as falls from height and traffic road accidents, a large degree of soft tissue damage and clinical deformity is often evident, while concomitant fractures elsewhere in the foot or about the ankle may also be encountered (Fig. 1, 2). The injured foot must be examined for vascular viability and for any sensory deficits, as well as for signs and symptoms of foot compartment syndrome. It has been shown that compartment syndrome of the foot in children may occur with soft tissue damage alone, without an obvious fracture.

**Figure 1:** A 6-Year-Old Boy was Injured when a Motorbike Ran over his Foot. He Could not Put Weight and Had a Diffuse Painful Swelling.

**Tenderness and Bruising of the Left Foot. Foot Radiographs (Top) were Initially Ordered in the Emergency Department. Fractures of the Metatarsals were Diagnosed. During the Follow-Up, Radiographs of the Ankle (Bottom) Indicated the Missed Talar Neck Fracture as well as the Undisplaced Fracture of the Distal Tibial Metaphysis.**

Routine radiographic survey of talar fractures includes anteroposterior (AP), lateral, and oblique views centered over the hindfoot. Canale and Kelly have described an x-ray technique that optimizes viewing of the position of talar neck fractures in the AP plane. The view is obtained with the ankle plantar flexed, in 15 degrees of internal rotation, and with the x-ray beam directed 75 degrees cephalad from the table. Radiographs may not necessarily demonstrate a fracture or an osteochondral defect. Advanced imaging is often necessary to better characterize the fracture pattern or extent of injury. When no fracture is visualized on plain films and suspicion is high, based on the clinical examination, computed tomography (CT) or magnetic resonance imaging (MRI) is useful to identify an undisplaced or minimally displaced fracture. In the case of a comminuted fracture, CT may better delineate the fracture fragments, the degree of displacement and assist in determining the need for operative intervention. The edema pattern seen on MRI may also be helpful to delineate the occult injury of bone bruising.

**Figure 2:** Radiographs of the Right Tibia and Ankle of a 9-Year-Old Boy after a Twisting Football Injury. Fracture of the Tibia was the Initial Diagnosis. The Talus Fracture was Missed in the Emergency Department.
It is important to note that talus fractures may also be associated with other ipsilateral fractures. Even in the setting of an obvious talus fracture, radiographs must be scrutinized to rule out additional injuries. The ‘floating ankle’ is an underappreciated pattern of injury that has been reported following violent trauma and/or blast injuries usually in military personnel. It is characterized by an intact ankle mortise with a distal tibia fracture and an ipsilateral foot fracture, creating instability around the ankle. Talar neck fractures have also been described in children in association with compression injuries of the calcaneocuboid joint, as well as with fractures of the cuboid, with a combined transtalar/transcuboidal Chopart fracture dislocation and fractures of the distal tibia.

Treatment of talar fractures in children largely depends on the age of the child and the amount of fracture displacement. Children with undisplaced or minimally displaced fractures are treated conservatively, with cast immobilization. In displaced fractures the principals of joint displacement should be followed to achieve an early anatomical reconstruction. Following reduction, whenever stability is questionable fixation is indicated. The approach is based on the fracture pattern and the need for both open reduction and fixation versus closed reduction and fixation. Reduction of talar neck fractures may be performed through a dorsomedial approach and fixation placed through a posterior approach. Tourniquet application may be a further negative factor for blood supply and may contribute to subsequent osteonecrosis. Due to the concern for the development of avascular necrosis, patients should be followed with serial radiographs. Nondisplaced fractures should be followed for at least 18 months and more severe fracture patterns followed well beyond this timeline. Considering the remodeling potential of the child’s talus, less harm may be done by accepting minor displacement with a closed reduction than by potentially attenuating the blood supply through repeated manipulation or extensive open reduction.

Ischemic post-traumatic damage is the most serious complication after a talar fracture and is directly related to the extent of chondro-osseous transformation that has occurred at the time of injury. The less ossified structures are more resistant to permanent damage and have a better chance of remodeling. Osteonecrosis is the primary reason for any long-term disability after a fracture or dislocation of the talus. It usually develops between several weeks to 6 months after injury. Talar avascular necrosis may lead to post-traumatic arthritis. The incidence of avascular necrosis in children with undisplaced talus fractures may be up to 16%, which is considerably higher than the reported in adults. However, this reported incidence could be due to initially missed and therefore non-treated fractures. Though it has not been proved, when avascular necrosis has been diagnosed and fracture healing has occurred, restriction of bearing weight is recommended in an effort to prevent collapse. The Hawkins sign, appearing 6–8 weeks post-injury, as radiolucency in the subchondral area of the talar body indicates a good blood supply or sufficient revascularization of the talus. Absence of the Hawkins sign is not considered an entirely reliable indicator that avascular necrosis will develop. Other complications associated with talus fractures include non-union, malunion, loose bodies, infection, neuropraxia and wound healing issues.

**REFERENCES**


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