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Talus fractures in children

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Abstract: *Pediatric talus fractures are very rare in childhood. The talar neck is the most common fracture site, followed by the talar body. The mechanism of injury is usually an axial load on a dorsiflexed foot. They are classified in two age groups. In group I, involving children younger than 6 years, fractures are usually undisplaced and the diagnosis may be easily missed. In group II, involving children older than 6 years, fractures are usually due to high-energy injuries, the incidence of complications is higher and osteochondral fractures may also be encountered. The Hawkins classification may be used to describe the different types of fractures of the talar neck and to predict the risk of avascular necrosis. Undisplaced injuries may be managed non-operatively with cast immobilization. Displaced injuries may be treated with either closed or open reduction. Internal fixation is recommended for any instability following reduction. The most significant complications of talus fractures are avascular necrosis and post-traumatic malalignment, which may be followed by early osteoarthritic changes.*

EDITORIAL

The rare incidence of pediatric talus fractures in the literature has precluded large epidemiologic studies referring to outcomes and rates of complications. The most common fracture location in children is the talar neck. The skeletally immature bone, in younger children, is less brittle and provides higher elastic resistance to torsional forces than in older children and adults. The most common mechanism of injury in talus fractures is forceful dorsiflexion resulting in talar neck fracture as it impinges against the anterior tibia. Inversion injuries may result in osteochondral fractures of the superior talar dome, due to impingement of the talus against the medial malleolus, while plantar flexion forces may displace os trigonum segments or fracture the posterior talar dome.

Talus fractures encompass fractures of the neck, of the body, such as transchondral dome fractures, lateral process or posterior tubercle fractures, shear or crush fractures, and bone bruises.

History and clinical examination in children may be challenging. The clinical symptoms and signs usually include pain and swelling to the anterior aspect of the ankle associated with inability to bear weight on the affected extremity. 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.

Figure1. *A 5-year-old boy injured his ankle after a fall from height. The initial plain radiographs were reported as not indicative of a fracture. The leg was immobilized in a posterior splint. Sagittal images of CT, performed a week post-injury, indicated a Hawkins type I neck of talus fracture. He remained non-weight bearing in a below knee splint for 6 weeks. No complications were detected after a 5-year follow-up.*

Plain 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 (Fig.1).

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 an occult fracture. The Hawkins sign, appearing 6-8 weeks post-injury, as radiolucency in the subchondral area of the talar body indicates a good blood supply and that the talus is likely to remain viable.

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.

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 is 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.
It is important to note that talus fractures may also be associated with other concomitant fractures. Even in the setting of an obvious talus fracture, radiographs must be scrutinized to rule out additional injuries. Talar neck fractures have been described in association with compression injuries of the calcaneocuboid joint, as well as with fractures of the distal tibia.

The majority of pediatric talus fractures is undisplaced and is managed with non-weight bearing in a long leg cast for 6 to 8 weeks. In displaced fractures the principals of joint fractures 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 must be followed with serial radiographs. Nondisplaced fractures should be followed for at least 18 months and more severe fracture patterns should be followed well beyond this timeline.

Avascular necrosis of the talus may complicate fractures and dislocations. It usually develops between several weeks to 6 months after injury. Talar avascular necrosis may lead to significant disability and 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. Other complications associated with talus fractures include non-union, malunion, loose bodies, infection, neuropraxia and wound healing issues [1-43].

Transchondral, osteochondral, talar dome or flake fracture and osteochondritis/ osteochondrosis dissecans are all terms used to describe similar lesions of the talus (Fig.2, 3).

Figure2. *A 15-year-old boy sustained a supination injury of the foot and ankle. Anteroposterior radiographs at injury (left) and following one month of immobilization in a posterior splint (right). The lesion was clearly defined in the superomedial corner of the talar dome in the coronal and sagittal CT images.*

Figure3. *A symptomatic lesion in a 15-year-old girl. Radiographs at injury (left) and following a 2-month period of immobilization in a posterior splint (right) indicated a lesion of the super medial corner of the talar dome.*

Their cause is controversial, since some patients have unilateral or bilateral lesions with chronic ankle pain but no history of trauma, while others (the majority) are diagnosed following trauma. The two groups are often radiographically indistinguishable. Traumatic, ischemic or micro-traumatic necrosis, abnormal patterns of vasculature, congenital factors, and spontaneous necrosis have all been proposed as etiological theories. Conservative treatment remains the mainstay of treatment of traumatic osteochondral defect in children. Surgical treatment is mandatory in unstable cartilage fragments. The lesion may be complicated by secondary osteoarthritis [44-59].

Finally, children with significant residual clinical symptoms and signs 6 weeks after an ankle injury, with no radiographic findings, should undergo a limited MRI to detect bone contusions or flake fractures (Fig.4, 5, 6).

Figure4. *A 7-year-old girl was injured when a car ran over her foot. Initial radiographs indicated no fracture. She could not put weight and had a painful swelling, tenderness and bruising on the ankle and the sole of her foot one week post-injury. The clinical symptoms and signs indicated a missed or an occult bone lesion. MRI indicated multifocal bone bruising of the tarsal bones, including the talus.*

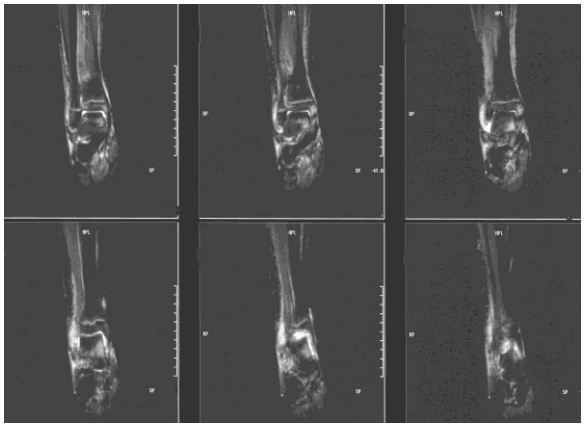

Figure5. *A 12-year-old girl stumbled and fell down the stairs injuring her right ankle. Due to the severity of the local symptoms and signs a MRI was performed 5 weeks post-injury. Short tau inversion recovery images showed bone bruising of the talus and medial malleolus as well as fluid signal more pronounced around the talus and in the lateral collateral ankle ligament.*

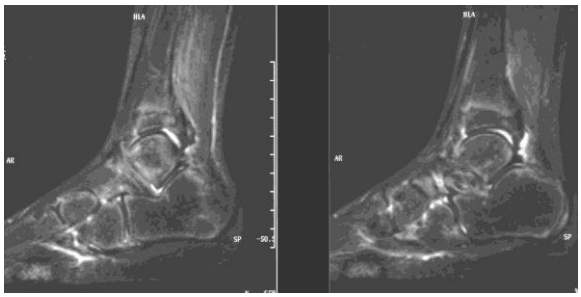

Figure6. *An 11-year-old boy sustained a sport injury of his right ankle while playing football. Due to the severity of the local symptoms and signs a MRI was performed 6 weeks post-injury. Short tau inversion recovery images showed bone bruising of the distal tibia and fibula, as well as of the talus, calcaneus and navicular. Fluid signal was also evident around the talus.*

In bone bruises, an elongated immobilisation and recovery period is required for the complete resolution of the clinical symptoms and signs. It has been shown that bone bruising represents a distinct clinical entity with 'benign' characteristics, since no long-term morbidity has been reported in any of the presented patients [60-64].

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