THE UNIVERSITY OF TOLEDO MEDICAL CENTER

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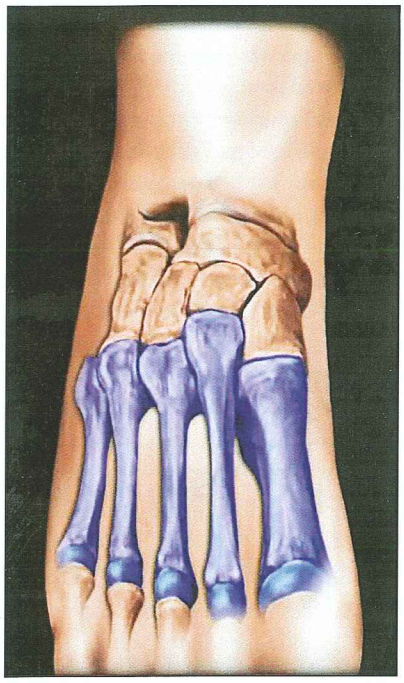
Stress Fractures of the Metatarsal Bones

Bone is a living tissue, it responds to stress by making new bone. When the bone fails to respond adequately to stress, a fatigue fracture may occur. The fracture can present itself early as a minor injury with minimal symptoms. If the fracture is not treated adequately it can become very disabling. A high index of suspicion is necessary for the diagnosis of stress fractures of the metatarsal bones. In athletes, there may be localized pain that worsens with progressive activity such as increased training, increased running mileage, a change in running surface, or changing shoes. Early on in the injury, the x-ray may be negative in the majority of patients. A bone scan or MRI can be used to detect early activity in the bone. The patient will have vague symptoms; they may seek different opinions, and diagnoses such as neuroma or metatarsalgia may be given. Female athletes with stress fractures should have a complete dietary and menstrual history taken. There is a correlation between eating disorders, amenorrhoea, and osteoporosis in female athletes. In runners, the fracture usually occurs in the metatarsal neck. In dancers, the fracture occurs at the base of the 2nd metatarsal. This type of fracture may result in a delayed union. Restrict weight bearing for 6 weeks. Look for anatomic causes of fracture in the 2nd and 3rd metatarsal neck such as heel cord tenderness, a short 1st metatarsal, or a long 2nd metatarsal. Check for metabolic bone disease such as osteoporosis, or osteomalacia. Upon physical examination, the patient may have tenderness, induration, mass, or cavus foot. An MRI or bone scan can be helpful. Fractures can occur due to the stress of weight bearing or prolonged walking. It is sometimes called a "march" fracture because it occurs in military recruits and runners who increase activity levels. It usually occurs in the 2nd metatarsal followed by the 3rd metatarsal in frequency. The fracture is diaphyseal in location, and there will be localized tenderness at the fracture site. The 2nd metatarsal is the longest and most rigid of the metatarsal bones, and it is usually exposed to greater repetitive stresses. Fracture of the proximal 5th metatarsal occurs in a watershed area of the blood supply that is susceptible to stress fracture nonunion. The blood supply in this area is tenuous. Healing is difficult with a high incidence of delayed and nonunion

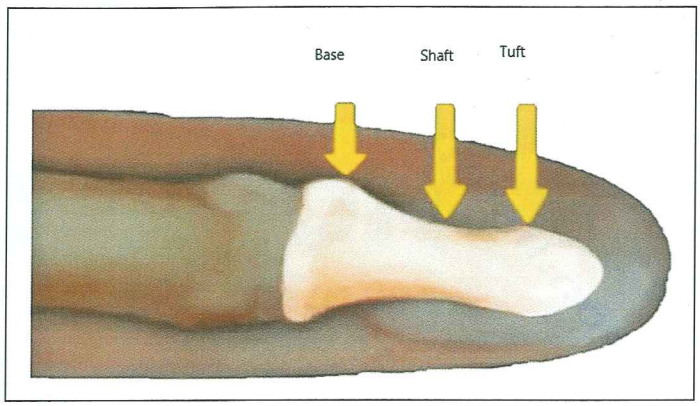


Common Areas For Metatarsal Stress Fractures

of the fracture. The stress fracture occurs distal to the 4th and 5th intermetatarsal joint. The Jones fracture is an acute fracture, and a stress fracture is a chronic condition that will require surgery. There are three types of fractures at the proximal fifth metatarsal: zone I, zone II, and zone III. Zone I is a tuberosity avulsion fracture. Zone II is a Jones fracture. Zone III is a stress fracture. The stress fracture occurs distal to the ligament that connects the 4th and 5th metatarsal together. The stress fracture can occur in cavus foot due to increased ground reaction force over the 5th metatarsal. It will be overloaded on the lateral border of the foot. X-rays will show the fracture and its location. The x-ray will show varying degrees of sclerosis and widening of the fracture line. Treatment is a lag screw fixation with or without bone graft.

Distal Phalanx Fractures

Fracture of the distal phalanx is the most common phalangeal fracture, and it can occur from a crushing injury that produces major soft tissue injury. It can involve the tuft, shaft, or the base of the distal phalanx. If it involves the tuft, it is usually a crush injury and may be associated with a nail bed injury. Usually it is associated with subungual hematoma. If the hematoma involves more than 25% of the nail, especially if there is a fracture, then remove the nail, as well as explore and suture the nail bed. Most of the time the fracture is comminuted and probably will need a splint. In some cases, the fracture may need k-wire fixation. The fracture may fail to unite. Fracture of the distal phalanx shaft is usually stable and can be treated conservatively by a splint or buddy taping, surgery is rarely needed. Distal phalanx nonunion, if symptomatic and painful, do reduction and internal fixation with bone graft. There are two types of distal phalanx base fractures- jersey finger and mallet finger. The jersey finer, or volar base fracture= unable to flex the DIP joint. The mallet finger, or dorsal base fracture= unable to extend the DIP joint. If the fracture is large, there may be a volar subluxation of the distal phalanx. Be aware of an avulsion fracture at the base of the distal phalanx. It must be evaluated thoroughly as it could be an avulsion of the insertion of the flexor, or the extensor tendon, and the fracture could appear small and benign. If the fragment is large or if there is volar subluxation of the joint, then this can be treated by different techniques. K-wire utilization is a very common technique. The goal is to keep the DIP extended until the bone or the tendon heals. Some orthopaedic surgeons will continue to treat this injury by closed means (splint), even if there is a volar subluxation of the joint. The rationale is that a stiff finger that is treated by closed means is better than a stiff finger that is treated by surgery. When the tendon is avulsed with a bony fragment, the tendon with a piece of bone

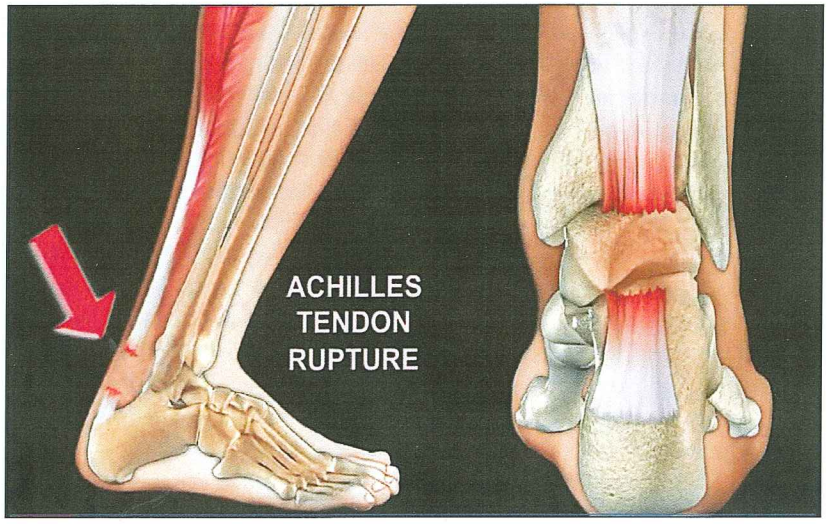


Distal Phalanx Fractures

could be retracted at different levels, and it can be seen in the x-ray. In general, if the tendon is retracted to the palm, then the blood supply could be affected and surgery should be done within 10 days. If the fragment is large, then usually the retraction is limited to the DIP. The finger lies in extension relative to the other fingers, and the patient will not be able to do active DIP flexion. Seymour fracture is an epiphyseal fracture of the distal phalanx. It is a flexion injury that leads to physeal separation between the extensor tendon dorsally and the flexor digitorum profundus volarly. This flexion injury causes an avulsion of the nail from the nail fold with disruption of the nail matrix. The patient's finger will appear flexed, which looks like a mallet finger, and the nail appears to be larger compared to the nail on the other side. This injury is really an open fracture and needs to be treated by antibiotics, removal of the nail, irrigation and debridement of the fracture, reduction and pinning of the fracture and nail bed repair.

Achilles Tendon Rupture

The Achilles tendon is the strongest and thickest tendon in the body. The Achilles tendon allows for plantar flexion of the ankle. The Achilles tendon is prone to tears and rupture. Rupture of the Achilles tendon could be missed. Rupture of the Achilles tendon occurs due to limited blood supply in a watershed zone which is 2-6 cm above the calcaneus. This area is narrow and has limited blood supply. The rupture occurs due to eccentric loading, similar to pulling a rope. When the strain is less than 8%, the patient will have microscopic tears, like an overuse injury. When the strain is more than 8%, the Achilles tendon ruptures. Rupture of the Achilles tendon is often referred to as the "weekend warrior's" injury. The injury occurs from over performing or overdoing the activity. When the injury occurs, there will be a palpable gap. The patient will have weakness in plantar flexion and the Thompson test will be positive. The gold standard is the Thompson test. There will be no movement of the ankle when performing the Thompson test, and the tear is complete. MRI can clearly show the Achilles tendon tear. Some systemic conditions and some medications can predispose to the tear. Treatment

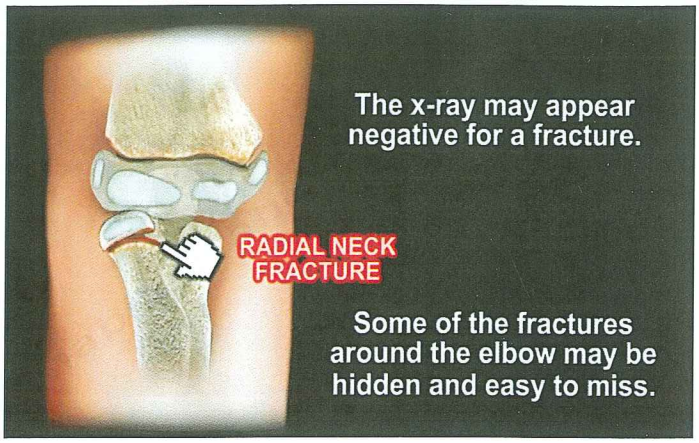


Achilles Tendon Rupture

nowadays is controversial. You can treat it surgically or conservatively (without surgery). Each treatment method has its own benefits and risks.

Avoid Missing Pediatric Elbow Fracture

A child may have an elbow pain after a fall. The x-ray may appear negative for a fracture. Some of the fractures around the elbow may be hidden and easy to miss. Doctors may not be familiar with reading or interpretation of elbow x-rays in a child. These doctors can be worried about missing a fracture with an injury that may cause an undesirable outcome to the patient. In this video, I am going to try to explain step by step the important points when you look at an x-ray of the elbow in a child. The first thing that you need to do is obtain a good quality, high definition x-ray that is properly aligned. See the figure 8 or hourglass in the lateral x-ray (as seen here). If you don't see the figure 8, then repeat taking the x-ray. The second thing that you need to do is to look at the ossification centers. Find the ossification centers around the elbow, both in the AP and lateral views. CRITOE is the ages when the ossification centers appear around the elbow. You need to know the age of the patient and the exact age and order of the development of the ossification centers. Look for a fracture or abnormality on the x-ray. Look for an ossification center that you expect to be there, but it is not on the x-ray. Look for the medial epicondyle ossification center. The medial epicondyle ossification center is in the joint. If you can't find the medial epicondyle ossification center where it should be, look for a medial epicondyle fracture that is trapped inside the elbow joint. The third thing is, look at the bone itself. Look at the surface of the bone. Look for cortical breaks. Look for subtle or unusual angulation of the bone. Look at the radial head, the olecranon, the supracondylar area, or the lateral condylar area. These are common areas that may have an elbow fracture in a child. The fourth thing is look at the fat pads. If there is no visible fracture, and the x-rays appear normal, then look at the fat pads for possible displacement of the fat pads. Anterior fat pad displacement is called the "sail sign". If you see the posterior fat pad, it means that there is an occult fracture that could not be found. There are two fat pads, anteriorly and posteriorly. The anterior fat pad is visible as a dark area, and it is attached to the anterior humerus. The posterior fat pad is not visible, it is deep (hidden). Effusion displaces the posterior fat pad and if you see it that means that there is a fracture. The fifth thing is look at the capitellum. God created the capitellum first, and everything around it later. The capitellum is the first ossification center to develop. The



Pediatric Elbow Fracture

capitellum is a great landmark to help in the diagnosis of elbow trauma. Everything leads to the capitellum. The anterior humeral line should intersect the middle third of the capitellum. Make sure that you have the figure 8 in the x-ray so that the x-ray will be well aligned and accurate, otherwise repeat the x-ray before drawing that line. If the anterior humeral line does not intersect the middle third of the capitellum, then the patient will have a supracondylar fracture. The radiocapitellar line is a line from the radial neck that should bisect the capitellum in all views, regardless of the age of the patient. The radial neck line is better than the radial shaft line, which may bisect the capitellum, despite subtle subluxation of the radial head. This radiohumeral line is very important in the diagnosis of Monteggia fracture, with subtle proximal ulnar fracture and radial head subluxation. It is a key in the diagnosis or radial head position (normal or abnormal). Early diagnosis of Monteggia fracture by utilizing this line can avoid a major morbidity to the patient, which may require major reconstructive surgery to the elbow. The capitellum can also be a great landmark to diagnose transepiphyseal separation of the humerus. The olecranon moves posteriorly and medially. The elbow appears dislocated, but the radiocapitellar line remains the same (uninterrupted) both in an AP and lateral view.

Peroneal Tendon Subluxation- A Brief Overview

Two peroneal tendons run on the outside of the ankle just behind the fibula. The two peroneal tendons lie behind the fibula in a groove. The two peroneal tendons are the peroneus brevis tendon (closer to the fibula) and the peroneus longus tendon (posteriorly). The superior and inferior retinacula keep these two tendons in their positions. The superior retinacula is more important. Patients with peroneal tendon subluxation or dislocation usually describes the pain in the outer part of the ankle or just behind the fibula (lateral malleolus). Retromalleolar swelling with pain and giving way of the ankle and the feeling of "clicks" as the patient moves the ankle, should alert the clinician to the possibility of peroneal tendon subluxation. Testing for peroneal tendon subluxation is usually done with dorsiflexion/eversion of the foot against resistance. The ankle may feel as if it is unstable and sometimes the patient will be able to demonstrate the subluxation of the tendons. The peroneal tendons are held in their position behind the fibula predominantly by the superior peroneal retinaculum. Peroneal tendon subluxation usually occurs more in younger individuals. It is usually a sports related injury such as with soccer and skiing, and the injury can be missed. The condition can be acute, chronic, and recurrent.

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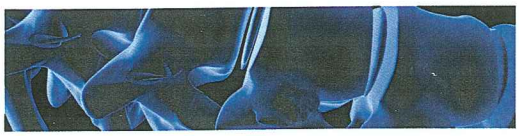

continued

It may be associated with a shallow fibular groove, a ruptured or a weak superior peroneal retinaculum, and the retinaculum can be peeled off of the piece of bone from the fibula due to the injury. X-ray may show an avulsion fracture of the fibula called a rim fracture. The "fleck sign" is an indication for peroneal tendon subluxation. MRI or ultrasound is very helpful in visualizing the condition of the peroneal tendons. They are helpful in assessing the position of the tendons, assessing the superior peroneal retinaculum and if the tendons are subluxed or if there are associated tears. The condition may be associated with a longitudinal tear of the peroneus brevis tendon. The tendon is near the fibula and as it goes outside of the groove; it may hit the fibula as it subluxes, causing a tear. For acute treatment cast or immobilization, results are average. Surgical repair of the superior peroneal retinaculum is necessary, especially if there is a rim fracture or if the condition is associated with other conditions such as calcaneal fractures. Repair of the retinaculum can be done in addition to the possibility of deepening the fibular groove. If the condition is chronic, recurrent and painful, a soft tissue procedure to reconstruct the superior peroneal retinaculum may me warranted. This includes the deepening of a shallow groove in addition to repair of the longitudinal tear of the peroneus brevis tendon (if it is present), by suturing the tendon side to side.

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