



THE UNIVERSITY OF TOLEDO MEDICAL CENTER

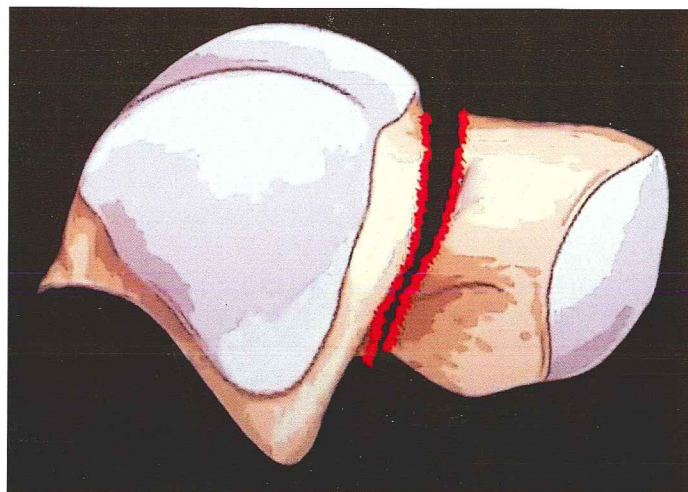
ORTHOPAEDIC MONTHLY

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Talus Fractures

There is cartilage at the top of the talus and on the bottom of the talus. 70% of the talus is covered by cartilage. This is why fracture of the talus (body or neck) will injure the cartilage and result in arthritis. Subtalar arthritis is the most common complication after talus fractures. The talus is composed of a head, neck, body, lateral process, and a posterior process. The artery of the tarsal canal supplies the lateral 2/3 of the talar body. The deltoid branch of the posterior tibial artery may be the only remaining blood supply remaining with Type III talar neck fractures. Avascular necrosis depends on the extent of the initial fracture displacement. The incidence of AVN correlates with the degree of displacement and the severity of the fracture. The incidence of AVN goes from 10% in Type I (nondisplaced), to 100% AVN in Type IV (displaced in three joints). The talus becomes fractured by forced dorsiflexion and axial loading. Fracture usually occurs to the talar neck, but it may occur in the talar body in about 15-20% of cases. The patient may have a lateral process fracture, and the patient may complain of lateral ankle pain. This fracture could be missed, thinking that the injury is just an ankle sprain. Another name for this injury of the lateral process is "snowboarder's fracture". CT scan is very helpful for this fracture. Posterior process fracture is a very rare entity. It is difficult to see, difficult to diagnose, and the surgery is usually difficult. Talus fractures are classified by the Hawkins' Classification for Talar Neck Fractures. Type I is non-displaced and has 10% incidence of AVN. Type II is a fracture of the talar neck with subtalar dislocation or subluxation and has 50% incidence of AVN. Type III is a fracture of the talar neck with subtalar and tibiotalar subluxation or dislocation and has a high-90% incidence of AVN. Type IV is a fracture with subtalar and tibiotalar dislocation in addition to talonavicular subluxation or dislocation and has 90-100% incidence of AVN. It can be missed as an ankle sprain, and if it is displaced, then you will need to do surgery. If it is a small displaced fragment, you can excise the fragment. If the fragment is nondisplaced, do short leg cast, nonweight-bearing for 6 weeks. There are three types of lateral process fractures: type I avulsion, type II involves the subtalar joint (needs surgery), and type III comminuted fracture (usually treated initially with a cast- may need to excise). Excision of 1cm of the lateral process fracture will affect the lateral talocalcaneal ligament, but it does not affect the ankle or subtalar joint stability. The posterior process has a medial and lateral tubercle separated by a



groove for the flexor hallucis longus tendon. The posterior process fracture is a rare injury that is usually missed on the initial x-rays, and it can be misdiagnosed as an ankle sprain. The Hawkins' sign is a subchondral lucency seen in the dome of the talus at six weeks on the mortise view x-rays. Subchondral radiolucent band is more commonly seen on the medial side on the mortise view. Hawkins' sign means that there is vascularity, there is resorption and no AVN. Absence of radiolucency should not be a reliable sign for the development of avascular necrosis. If you do not have the Hawkins' sign, then it means that there may be interruption of the blood supply and the vascularity of the talus. The Hawkins' sign is usually seen between six to eight weeks after the injury. With Hawkins' sign, you will have disuse osteopenia, and it is caused by resorption of the subchondral bone. Hawkins' sign is a good indicator of talus vascularity following talar fractures. It is unlikely that AVN will develop at a later stage after the injury if the patient's x-rays show the Hawkins' sign. Hawkins' sign is 100% sensitive and 58% specific. If it is present, then it indicates that the talus is alive, and there is a good prognosis. Absence of the Hawkins' sign does not rule out an intact vascularity. Once the fracture heals, begin weight-bearing. Restricting weight-bearing beyond that which is needed for healing of the fracture does not decrease the risk of avascular necrosis. At 3-6 months post-operatively, AVN can be seen on the x-rays as sclerosis.

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Get AP, lateral, and canale view x-rays. In the canale view x-ray, the foot is placed in 15 degrees of pronation with maximum plantar flexion. The x-ray beam is directed 75 degrees cephalad. CT scan is very helpful in talus fractures. MRI is sensitive for detecting

avascular necrosis because it shows decreased signal on T1. In MRI studies, the use of titanium implants for surgery allows for better visualization than stainless steel implants.

Calcaneal Fractures

Calcaneal fractures are a huge topic. There are two lines for the calcaneal fractures. The primary fracture line runs obliquely through the posterior facet. The primary fracture line divides the calcaneus into two parts, an anteromedial sustentacular fragment and posterolateral tuberosity fragment. The anteromedial fragment is a constant fragment or the sustentacular fragment. In the posterolateral fragment, the primary fracture line goes through the posterior facet. The anteromedial fragment is called the constant fragment because it stays in its position connected to the talus by the talocalcaneal ligaments and the interosseous ligaments. The secondary fracture line will produce either a tongue-type fracture or a joint depression fracture. If it is a tongue-type fracture, then you can do percutaneous fixation. Sander's classification is based on the number of articular fragments seen on coronal CT scans. Type I is nondisplaced. Type II has one fracture line, and the calcaneus is split into two fragments. Type III has two fracture lines creating three fracture fragments of the calcaneus. Type IV has three fracture lines or more; if it is comminuted, you get four fragments or more. Type IV has the most common complication of surgery (wound dehiscence). In general, if you have a two-part intra-articular fracture, you will do ORIF. If you have a Type IV fracture, you will do subtalar arthrodesis. You may want to delay the surgery until the soft tissue condition improves and until you have the wrinkle test. Avulsion fracture of the calcaneal tuberosity will have a very thin, overlapping soft tissue envelope. This can lead to full thickness skin necrosis if the fracture is not urgently reduced and fixed. Type I avulsion fracture is a "sleeve" type tuberosity fracture. Type II avulsion fracture is a "beak" type avulsion fracture. Type III is an infrabursal avulsion fracture; it is very rare. You probably will need to do immediate open reduction and internal fixation or closed reduction and percutaneous screw fixation. This could present skin necrosis. You will try to do closed reduction and hold the fracture with reduction clamps. You can use screws percutaneously perpendicular to the fracture, especially in the tongue type fracture. You may need to open the fracture and put some suture anchors in the calcaneus if the fracture piece is small. Post-operatively, you need to monitor the skin condition. Avulsion of the bifurcate ligament may give you an anterior calcaneal process fracture. If it is a Grade I or Grade II open fracture medially, then you can do surgical repair by a lateral approach because it is open medially. There will be no significant difference between infection rate for this fracture and for a similar one that is a closed fracture. Give the patient antibiotics for 2-3 days. Open reduction internal fixation is not recommended for Grade III medial wounds and for most lateral wounds. With open injuries, there is a high risk of wound complication including amputation. Calcaneal stress fracture is a clinical diagnosis. The patient will have heel pain increased by prolonged weight-bearing, and the patient will have difficulty in ambulation and in running.



This problem is a common area for foot pain. It is really exercise induced foot and heel pain that occurs more in females. The patient will have diffuse swelling and tenderness. With a positive squeeze test, when squeezing the calcaneus from side to side, the patient will complain of pain. The x-ray may show a sclerotic line that may be present in about 15% of the patients, which usually takes about 2-3 weeks to appear (in the posterior part of the bone). MRI will help you in the early diagnosis if the x-ray is negative. There will be a dark line in T1, and the line will be oriented obliquely or vertically. There will be an increased signal on T2. Treatment of a calcaneal stress fracture is rest, avoid or restrict weight-bearing, and physical therapy. A normal Bohler angle is between 20-40 degrees measured on lateral x-rays. Bohler angle is an angle between two lines: a line connecting the anterior process of the calcaneus to the highest point on the posterior articular surface and the second line connecting the highest point on the posterior articular surface and the calcaneus to the superior tuberosity. Collapse of the posterior facet will decrease or flatten the Bohler angle. In this case, subtalar distraction arthrodesis is preferred to treat the subtalar arthritis to restore the height of the calcaneus and to improve dorsiflexion of the ankle. A history of a fall from a height and calcaneal fracture may be associated with about 10% incidence of a spine fracture. Always examine the spine and always examine the neurological status of the patient. When compartment syndrome occurs, especially when it is missed, there will be contractures of the intrinsic flexor muscles of the foot, and that will create clawing of the lesser toes. This will create problems with wearing shoes. The plantar fascia will limit the space that is available for hematoma and swelling. That will cause damage to the intrinsic flexor muscles of the foot. There are 10 compartments in the hand and 9 compartments in the foot.

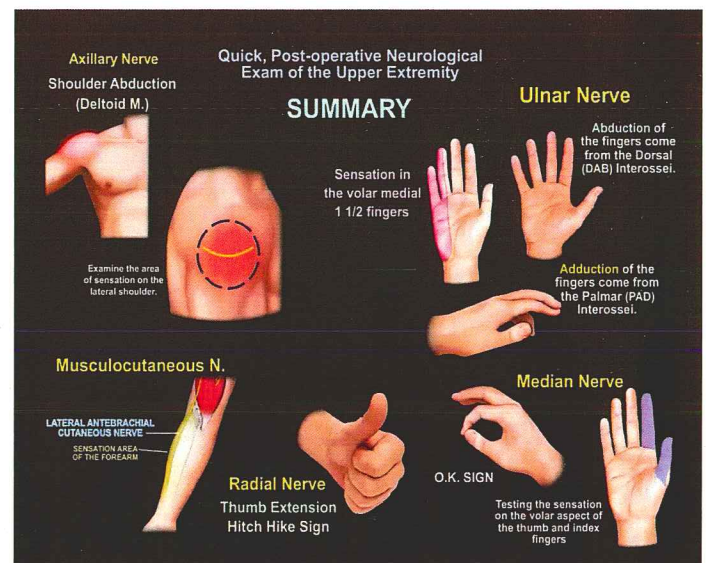
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Isolated flexed great toe can occur due to screws in the sustentaculum fragment that are too long. The tendon of the flexor hallucis longus muscle lies underneath the sustentaculum tali (constant fragment). When the screw is too long, the tendon of the FHL is tethered over the screw. You drill from lateral to medial and place the screw during fixation of intra-articular fracture of the calcaneus. This complication can also happen from fracture of the sustentaculum tali. The fracture of this bone can cause fibrosis and

stenosis around the FHL tendon. The patient will complain of pain and catching sensation in the medial foot, especially when the patient tries to do active flexion of the great toe. The major blood supply to the heel pad is the medial calcaneal branch of the posterior tibial artery. In the extensile lateral approach, the flap is supplied by the lateral calcaneal branch of the peroneal artery. The sinus tarsi approach and extensile lateral approach can both risk injury to a nerve.

Exam of Upper Extremity Nerves Post Operatively

Post-operative neurological examination of the patient is usually needed to check the result of the surgery and the status of the patient before you give the patient immediate post-operative pain block. Examine the area of sensation on the lateral shoulder. If the patient can tolerate shoulder abduction, then you can test the deltoid muscle for contraction and strength. For the musculocutaneous nerve, it is probably better to test the sensation on the upper lateral aspect of the forearm. Elbow flexion alone is not a good test for the musculocutaneous nerve. Elbow flexion can come from the biceps muscle (innervated by musculocutaneous nerve) and can also come from the brachialis muscle (innervated by radial nerve and musculocutaneous nerve). Remember that the patient just had surgery, and it is very difficult for the patient to freely move the extremity. For the radial nerve, it is better to use a component that tests both the radial nerve and the posterior interosseous nerve at the same time. If you are operating at the humeral shaft area, the radial nerve can be affected, and this can cause wrist drop and loss of extension of the thumb and fingers because this will affect both the radial nerve and the posterior interosseous nerve. If you are operating near the elbow, near the radial head area, the posterior interosseous nerve can be affected. In this case, the extension of the wrist will be mainly O.K., but extension of the fingers and the thumb will be affected. The best test for the radial nerve is the thumb "hitch hike" sign. It doesn't matter if it is the radial nerve or the posterior interosseous nerve, the thumb hitch hike will be the one that is affected, and it is easily tested. Testing extension of the fingers can be misleading because extension of the fingers can occur by the intrinsic muscles, so this is complicated. For proper testing of extension of the fingers, you must dorsiflex the wrist first and then ask the patient to extend the fingers. Therefore, the hitch hike test is better. Testing sensation on the dorsal radial aspect of the hand can be helpful in evaluating radial nerve injury, but it is not very reliable. In regards to the ulnar nerve, the ulnar nerve has multiple tests. The problem with the ulnar nerve is that the findings are variable depending on the location of the injury. To have a pure, generic test that can be used for any location, it has to be to test the sensation in the volar medial 1 1/2 fingers, as well as testing the hand intrinsic (interossei) muscles like crossing of the fingers or testing abduction of the fingers. Abduction of the fingers come from the dorsal (DAB) interossei. Adduction of the fingers come from the palmar (PAD) interossei. All of these findings will come from the terminal nerve entering the

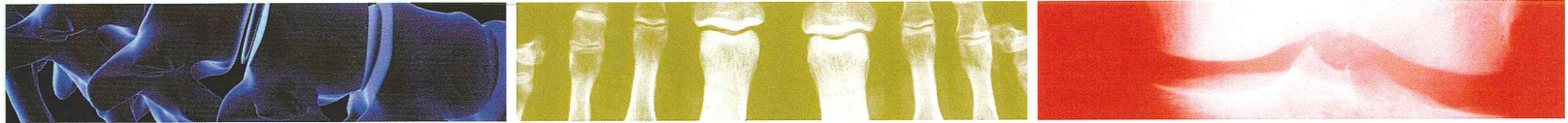


Guyon's canal. An ulnar nerve injury near the elbow will affect the sensation in the dorsal aspect of the medial 1 1/2 fingers, but an injury of the ulnar nerve near the wrist will not affect the same area. Testing the dorsal sensation of the medial 1 1/2 fingers may not be reliable for injury at every location. Ulnar nerve injury near the wrist will not affect the same area as ulnar nerve injury at the elbow. These are the things that are reliable: sensation in the volar medial 1 1/2 fingers, abduction of the fingers come from the dorsal (DAB) interossei, and adduction of the fingers come from the palmar (PAD) interossei. Testing the median nerve can also be variable. The O.K. sign is a good test for the median nerve on the arm and the forearm, but it is not a good test if you injure the nerve in the carpal tunnel or after the anterior interosseous nerve comes off. When you test the O.K., the patient has to make that circle because if the patient has an intact ulnar nerve they will be able to make adduction of the thumb, but it will not be a circle. The patient has to bend the DIP joints of the thumb and index finger to make the circle. Testing the sensation on the volar aspect of the thumb and index fingers will probably work. The median nerve innervates the skin on the palmar side of the thumb, the index finger, the middle finger, and half of the ring finger. For the median nerve, you will ask the patient to do the O.K. sign, and you will test the sensation at the volar aspect of the thumb and the index finger.



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Plantaris Muscles

The plantaris muscle arises from the lateral supracondylar ridge of the femur above the lateral head of the gastrocnemius. The plantaris muscle inserts into the medial side of the calcaneus. The plantaris muscle passes between the soleus and gastrocnemius muscles down to its insertion into the calcaneus. The plantaris is located within the superficial posterior compartment of the lower leg. The plantaris muscle plantar flexes the foot and flexes the knee. The plantaris muscle is innervated by the tibial nerve. The plantaris muscle contains a high density of proprioceptive receptor and organs. It provides proprioceptive feedback to the central nervous system regarding the position of the foot. It is mainly used by surgeons for tendon grafts, especially for Achilles tendon rupture to augment the repair. The plantaris muscle could be injured in association with an Achilles tendon rupture. If the plantaris tendon is ruptured with the Achilles tendon, then the test is usually positive. If the plantaris is intact with a ruptured Achilles tendon, then the test may appear negative. When you squeeze the calf muscles, there may be plantar flexion of the ankle due to the intact plantaris tendon. With rupture of the plantaris tendon, the patient may feel a sharp stabbing pain at the back of the calf. The patient may also feel a “pop” similar to being struck from behind. The calf muscle will become swollen with significant bruising. The condition is often referred to as “tennis leg”. Injury occurs due to eccentric loading on the ankle with the knee extended. Plantaris tendon rupture is treated with elevation, crutches, and pain control.

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