THE UNIVERSITY OF TOLEDO MEDICAL CENTER

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Lisfranc Injury

The Lisfranc injury diagnosis is missed in about 20-30% of cases, especially in patients with multiple traumas. A high index of suspicion is needed to prevent the progression of foot deformities, chronic pain, and dysfunction. If a Lisfranc injury is not diagnosed properly, it can lead to an altered gait, midfoot arthritis, and long-term disability. Lisfranc injuries will indicate a disruption between the base of the 2nd metatarsal and the medial cuneiform. Lisfranc injuries are a spectrum of injuries of the tarsometatarsal joints and can be purely ligamentous or they can be associated with fractures. Arthrodesis is the best treatment for ligamentous injuries, while fractures may require an open reduction and internal fixation. Generally, ligamentous injuries have a worse outcome than fractures.

The lisfranc ligament is a large oblique ligament that extends from the plantar aspect of the medial cuneiform to the base of the second metatarsal. The Lisfranc ligament stabilizes the 2nd metatarsal and maintains the midfoot arch. Osseous stability is provided by the Roman arch of the metatarsals and the recessed keystone of the 2nd metatarsal base. The tarsometatarsal joint complex is divided into three units:

•Medial—1st tarsometatarsal joint 6° mobility

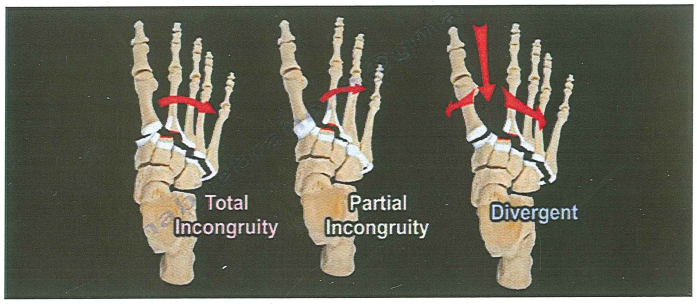
•Middle—2nd and 3rd tarsometatarsal joints-rigid

•Lateral—4th and 5th tarsometatarsal joints-mobile

The dorsalis pedis artery and the deep peroneal nerve both run between the 1st and 2nd metatarsal bases.

Plantar displacement is more common in direct injuries, however, indirect injuries are more common. Indirect injuries result from axial loading or twisting on a plantar flexed midfoot. Dorsal displacement of the 2nd metatarsal is the most common. The physician will want to check the alignment of the dorsum of the 2nd metatarsal with the middle cuneiform.

Tarsal fractures, especially of the cuboid, result from a twisting injury causing a forceful abduction of the forefoot. This fracture is also known as a "Nutcracker" fracture and occurs at the base of the 2nd metatarsal with a compression fracture of the cuboid.



Lisfranc classifications are not useful in deciding the treatment or the prognosis of the injury. Severe injuries are obvious, easily diagnosed, and may develop compartment syndrome of the foot. Injuries with minimal displacement could be missed and they will need surgery regardless of the classification. Arthritis may develop even with minimal displacement.

In general, there are three patterns of injury: total incongruity, partial incongruity, and divergent. In total incongruity, all five metatarsals are displaced in the same direction. Total incongruity can occur laterally or medially, with laterally being more common. In partial incongruity, one or two metatarsals are displaced. Divergent injuries have lateral displacement of the lesser metatarsals with medial displacement of the 1st metatarsal. All of these injuries share the disruption of the tarsometatarsal joint complex.

When making a diagnosis, the patient will have severe pain in the midfoot and will be unable to bear weight. There may be some swelling in the midfoot, dorsally. Plantar bruising may be present, especially medially, and there will be tenderness over the tarsometatarsal joint. The physician will want to check the skin condition, rule out compartment syndrome, and assess the neurovascular status of the foot.

Weight-bearing standing x-rays with comparison views of the other side should be ordered if the initial x-rays appear to be normal and the physician clinically suspects a Lisfranc injury. Another alternative is to have a physician assisted midfoot stress radiograph.

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Lisfranc Injury continued

The physician will want to obtain three views—AP, Oblique, and Lateral. The medial border of the 2nd metatarsal should line up with the medial border of the middle cuneiform on both the AP and the Oblique views. The physician should check for fractures, especially at the base of the 2nd metatarsal, the navicular, and cuboid. Additionally, it is important to check for widening between the first and second x-ray (more than 2mm is an indication for surgery). In the lateral view x-ray, the physician should check for dorsal displacement or subluxation of the metatarsal at the level of the corresponding cuneiform. The physician should look for the Fleck Sign, or bony fragment, which is an avulsion fragment of the lisfranc ligament from the base of the 2nd metatarsal. The medial side of the fourth metatarsal should line up with the medial side of the cuboid on the oblique view. CT scans can be useful and an MRI can confirm ligamentous injuries.

If the patient has a dorsal sprain with no instability, they can be treated with a non-weightbearing cast for 6 weeks and return to activity gradually. Surgery is only done in cases of instability. An open reduction and internal fixation is performed with cortical screws if there are bony fractures. When a physician performs an ORIF, they will need anatomic reduction. Hardware removal can be done after 5-6 months, however some surgeons leave the hardware in place indefinitely. If the injury is purely ligamentous, an arthrodesis will be performed. The healing of ligaments are less reliable than bony healing. Arthrodesis is also done in old injuries if there is a delay in treatment or if there is a failure of an ORIF. Midfoot arthrodesis is also used for chronic Lisfranc injuries that lead to severe midfoot arthritis with progressive arch collapse and midfoot abduction. The surgeon will perform a fusion of the medial and middle column, which includes the 1st, 2nd, and 3rd metatarsal joints. A fusion of the lateral column will not be done, as the lateral column is mobile. The lateral column should be reduced and stabilized by K-wire fixation.

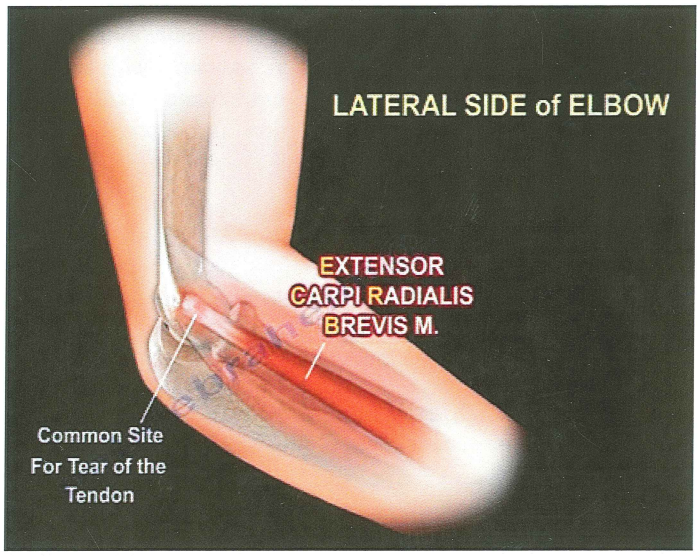
Post-traumatic arthritis occurs in up to 50% of patients. Patients may have an altered gait and long-term disability. Malalignment of the fractures usually lead to arthritis.

Tennis Elbow

The muscle involved in the condition known as, "Tennis Elbow", is the Extensor Carpi Radialis Brevis (ECRB) muscle. The name of this muscle suggests that it is small; however, it is an important muscle that is involved in multiple unique conditions. The ECRB muscle originates from the lateral epicondyle of the humerus (Common extensor tendon). The Extensor carpi radialis longus muscle is inserted into the base of the dorsal aspect of the 3rd metacarpal bone. The ECRB muscle gets its nerve supply from the radial nerve. The function of the ECRB is to extend and abduct the hand at the wrist joint. The ECRB is located in the 2nd dorsal compartment on the radial side of the lister's tubercle. Tennis Elbow, or Lateral Epicondylitis, is an overuse injury that causes inflammation, tendinosis and lateral elbow pain at the origin of the ECRB tendon.

Tennis elbow affects about 50% of all tennis players. It is the most common cause of elbow symptoms in patients that complain of elbow pain. The pathology of the ECRB tendon in tennis elbow shows disorganized collagen, vascular hyperplasia, and fibroblast hypertrophy. This condition usually starts by micro-tears of the origin of the ECRB which is precipitated and aggravated by repetitive wrist extension and forearm pronation. About 5% of patients may have associated radial tunnel syndrome. In tennis elbow, the patient will complain of point tenderness around the lateral epicondyle. In radial tunnel syndrome, the point of tenderness will be about 3-4 cm distal and anterior to the lateral epicondyle. This should be in the differential diagnosis of tennis elbow. Treatment usually consists of activity modification, anti-inflammatory medications, physical therapy—especially eccentric exercises, and injections—steroidal and platelet-rich plasma, may be helpful. A release and debridement surgery of the ECRB origin is the last resort.

Another condition associated with the extensor carpi radialis brevis muscle is Intersection Syndrome. This condition is characterized by the inflammation at the crossing of the first dorsal compartment and the second dorsal compartment that contains the ECRB. This injury occurs due to repetitive wrist extension. The tenderness is found on the dorsoradial aspect of the forearm approximately 5cm proximal to the wrist joint. This is the area of inflammation of the ECRL/ECRB as they intersect with the APL and the EPB. Treatment for Intersection Syndrome is usually rest, splinting, and steroid injections. Surgery is done rarely.



The ECRB muscle is important in the dorsal approach to the radius. The Thomas dorsal approach to the proximal radius may be used for exposure of the posterior aspect of the radial shaft. The incision is made in between the ECRB and the Extensor Digitorum muscles.

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Tennis Elbow continued

In Tennis Elbow surgery, excessive release of the ECRB tendon (origin) during tennis elbow surgery can cause injury to the ulnar humeral ligament and posterolateral elbow instability. The ligament is close to the tendon and can be injured due to excessive release.

In high radial nerve palsy, injury to the radial nerve results in wrist drop due to paralysis of the wrist extensors. The pronator teres tendon transfer to the ECRB is a very popular tendon transfer in high radial nerve palsy and is used to restore wrist extension.

Crush Syndrome

Crush syndrome occurs due to crushing accidents such as those seen in war zones, industrial accidents, and natural disasters, and is due to a drug overdose or positioning during a long surgery. When the muscle is crushed, this results in muscle necrosis. This injury causes the muscle to breakdown, causing the toxic muscle cell components and electrolytes to be released into the blood stream causing third spacing and acute renal failure. Crushing of the limbs or the trunk can create a very harmful systemic affect. Crush injuries occur more often in the lower extremities than in the upper extremities. Crush injuries to the trunk most commonly occur due to earthquakes.

Some patients with crush injuries will have acute renal failure, require dialysis, and/or fasciotomies.

The three main conditions associated with crush syndrome are local muscle damage, organ dysfunction, and metabolic abnormalities. If the patient is not treated properly, they could die within days.

Crushing injuries and limb compression will lead to a soft tissue injury, causing ischemia which can induce Compartment Syndrome or muscle necrosis. Muscle necrosis occurs due to prolonged pressure and muscle ischemia. Muscle ischemia can lead to Rhabdomylosis creating Myoglobinura (and/or myoglobinemia) or Third Space Fluid Loss which can cause hypovolemic shock. Both Myoglobinura and hypovolemic shock can result in acute renal failure. Muscle necrosis can induce metabolic abnormalities envoking ventricular fibrillation. Metabolic acidosis and hyperkalemia can lead to a

cardiac arrhythmia. Disseminated intravascular coagulation can occur from muscle necrosis leading to a coagulation deficiency. With muscle necrosis, microcirculation is affected and the muscles swell creating irreversible damage to the muscles and nerves.

A multidisciplinary approach involving the medical and surgical team is necessary in treating crush syndrome. Non-surgical treatments will include fluid replacement—ideal fluid is normal saline— ventilator support, correction of metabolic acidosis, and possibly dialysis. A surgical team may be required to perform an emergency fasciotomy because compartment syndrome can occur even if a patient is trapped less than an hour. Compartment syndrome can also happen without a fracture and when good pulses are felt. Surgical teams may also be necessary to debride necrotic muscle and to assist in delaying VAC application and skin grafting.

Mortality can occur early from hypovolemia and hyperkalemia or, it can occur late from multiple organ failure and sepsis.

Tarsal Tunnel Syndrome

The tarsal tunnel is a fibro-osseous tunnel posterior and inferior to the medial malleolus. The tunnel is covered by the flexor retinaculum, which protects the structures contained within the tunnel. The flexor retinaculum is a thick ligament that runs between the medial malleolus and the calcaneus. The structures which pass through the tunnel include the Tibialis posterior, the flexor digitorum longus, the posterior tibial artery, the tibial nerve, and the flexor Hallucis longus.

Tarsal tunnel syndrome is a neuropathy caused by the compression of the posterior tibial nerve within the tarsal tunnel. Tarsal tunnel syndrome is the most common compression neuropathy in the ankle and foot. Thickening of the flexor retinaculum may cause compression of the posterior tibial nerve. 80% of the cases are associated with a specific cause. The causes are many and include: space occupying lesions, varicose veins, trauma, tenosynovitis, and diabetes.

Symptoms of Tarsal Tunnel syndrome include: burning pain, numbness, tingling, and an electric shock sensation which will typically occur around the ankle or at the bottom (plantar aspect) of the foot. There may be swelling around the ankle and foot and symptoms will worsen with activity. Pain may be worse at night.

During the physical exam, the patient will have a positive compression test and a positive Tinel's sign. Tapping on the nerve posterior to the medial malleolus causes radiating pain into the medial side of the ankle and possibly the foot. Pressure within the tarsal tunnel increases with ankle dorsiflexion and foot eversion and may reproduce the symptoms. Pain associated with tarsal tunnel syndrome radiates proximally and distally. Tarsal tunnel syndrome may be present as part of the heel pain triad which occurs in adults. The heel pain triad include tarsal tunnel syndrome, plantar fasciitis, and acquired flat foot deformity. A flat foot deformity will increase tension on the nerve.

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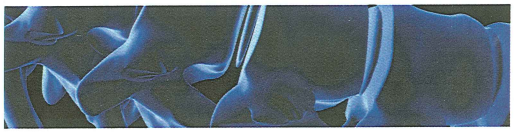
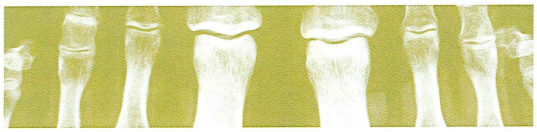


Tarsal Tunnel Syndrome continued

An EMG or other nerve studies may be conducted in order to find a diagnosis. The dorsiflexion-eversion test is described to be helpful in the diagnosis of tarsal tunnel. Sensory nerve conduction studies are more helpful than motor studies. Always rule out radiculopathy. Radiographs and CT scans may show osseous impingement or a posteromedial process fracture of the talus. MRIs may show a space occupying lesion such as a ganglion cyst or lipoma.

Differential diagnosis includes Peripheral Neuropathy, which involves all the nerves—not just the tibial nerve. You will see that the sural nerve and saphenous nerve are also involved and there will be an absent ankle jerk.

Treatment for tarsal tunnel syndrome include: Immobilization, anti-inflammatory medications, and steroid injections. The patient may benefit from an orthotic with medial posting if the patient has a valgus hindfoot. A surgical release of the tarsal tunnel will be performed if nonoperative treatment fails after a trial of 3-6 months. The fascia proximal to the flexor retinaculum and the tibial nerve proximal to the tunnel are released, followed by a decompression of the nerve and its three branches as well as the entire tunnel 5cm proximal to the flexor retinaculum and distally to the deep fascia of the abductor hallucis.

The best results will occur if symptoms have been present less than one year and/or the patient has a space occupying lesion with a positive physical examination and EMG findings. A successful outcome occurs in about 50-90% of cases. The suboptimal result can occur from inadequate release and traction neuritis. In these situations, the patient will not respond well to surgery (always rule out double crush syndrome). Revision surgery has a less successful outcome unless the patient has an inadequate release. The recurrence of tarsal tunnel syndrome is usually caused by an inadequate release and a repeat release is usually not advisable. In general, tarsal tunnel decompression may not produce good long-term outcomes.

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Dr. Ebraheim, Amanda Critton and Lauren Corba do not have any relationships with industry to disclose.

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