Managing Foot Fractures in Urgent Care

Second in a Two-part Series

Urgent message: Acute injuries to the midfoot and hind foot require immediate treatment or emergent referral. Close attention to the location and mechanism of injury at the urgent care site may facilitate efficient care and prevent long-term disability.

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Introduction

In keeping with the tone of part 1 of this two-part series (*JUCM*, December 2008), this article will discuss the urgent care clinician's approach to foot fractures by emphasizing the following (but shifting our focus toward the cuboid, cuneiforms, navicular, talus, Chopart joint, and calcaneus, as well as compartment syndrome):

1. Proper management of and follow-up for simple nondisplaced fractures in the foot.
2. The role of the urgent care clinician in patients with other significant fractures, the vast majority of which will need to be referred to orthopedics for definitive care. The important pitfall to avoid is under-diagnosing the seriousness of a midfoot or hind foot injury, and not protecting the patient with proper splinting and crutches.

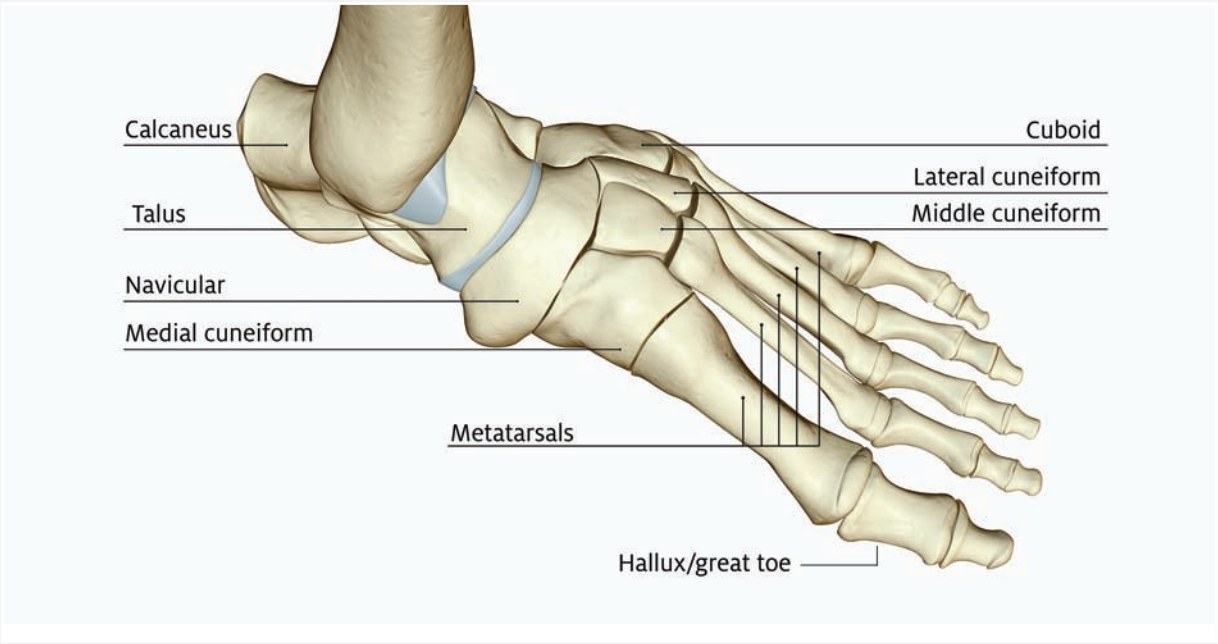
Cuboid and Cuneiform Fractures

Taken together, the cuboid, cuneiforms, navicular, talus, and calcaneus make up the tarsal bones of the foot. See **Figure 1**.

The joint between the tibia and talus is referred to as the talar joint, while the joint between the talus and the calcaneus underneath is the sub-talar joint. The talar joint allows normal motion in plantarflexion and dorsiflexion of the ankle, while the subtalar joint allows inversion and eversion of the ankle.

The cuboid and cuneiforms combine to form an important part of the arch of the foot. This area of the midfoot is quite rigid. The bones are shaped in a trapezoidal fashion to form the arch, with the second

Figure 1. Relevant key anatomy of the foot.



cuneiform forming the "keystone" of the arch.

Traumatic forces applied to one side of the midfoot are transmitted to the other side, so the clinician must look to both sides of the foot for damage. Midfoot fractures may result from forced eversion, inversion, plantar flexion or dorsiflexion, or crushing of the foot.

Injuries to the midfoot must be examined carefully for dislocations, ligamentous disruptions, and fractures. On exam, look for point tenderness of the midfoot and inability to bear weight on toe-walking. These injury patterns are characterized by the high amount of force required to disrupt the extremely stable midfoot complex. If the injuring force was high, have a low threshold for orthopedic referral.

Cuboid fractures are rare in isolation, and usually result from a direct blow or crush mechanism. They may present as impacted buckle fractures, where there is a small increase in the density appearance of the bone on x-ray, or as a small chip fracture. In cases where the mechanism is more of a torque on the midfoot, the clinician must look very carefully for additional fractures and ligamentous instability. In these circumstances, an MRI or CT of the foot may be indicated.

Fractures may also be associated with lateral subluxation or even dislocation of the tarsal-metatarsal joint (Lisfranc disruption; see *JUCM* December 2008).

Cuneiform fractures are unusual, especially in isolation. When they do occur, they usually involve the medial cuneiform and tend to be part of a more global midfoot injury pattern, such as a Lisfranc disruption. Therefore, the presence of a cuneiform fracture should signal the need to carefully evaluate and identify concomitant fractures or instability patterns. Failure to diagnose a Lisfranc disruption is an important pitfall in urgent care.

In the rare instances in which cuneiform fractures do occur in isolation, they are most likely to result from a crush injury or direct impact, as opposed to the high-energy mechanisms responsible for the more diffuse injury patterns.

Small isolated fractures of the cuboid or cuneiforms with intact ligamentous support may be treated conservatively. The foot should be immobilized in a high-top walking boot, or CAM walker, if the patient can tolerate weight bearing. If not, the patient should be splinted with crutches and converted to a walker after two to three weeks. Total immobilization should last a minimum of six weeks, though some patients require longer in a CAM walker or post-operative shoe for persistent symptoms.

The key to conservative treatment is that is that the

patient should not have any pain on ambulation or limping.

Operative repair is always indicated for severely displaced or impacted cuboid or cuneiform fractures. Also, patients with significant intra-articular involvement or articular displacement require surgery. If the medial or lateral columns of the midfoot are not aligned perfectly, long-term disability can result. The best outcomes in these circumstances are obtained with reestablishment of normal anatomy of the bony arch utilizing bone grafting, and stable open reduction and internal fixation (ORIF).

Navicular Fractures

The tarsal navicular bone is a sail-shaped bone of the midfoot that lies on the medial column between the talus and cuneiforms. A normal navicular and intact talonavicular joint are essential for normal gait.

The talonavicular joint is crucial for normal pronation (cushioning heel strike) and normal supination (strengthening push-off) of the foot. Fractures of this bone must be carefully sought and treated.

Like the scaphoid of the wrist, the navicular bone has a vascular watershed at its waist, making it susceptible to non-union and poor healing. The bone is easily palpated. The examiner can locate a bony prominence medially, 2 cm below the medial malleolus. Navicular fractures are divided into three types: acute traumatic, acute avulsion, and stress fractures.

Acute traumatic fractures

Acute traumatic fractures of the navicular are rare in the urgent care center. They require high-energy forces, such as those commonly associated with motor vehicle accidents, applied axially or by forced eversion of the foot. When suspected, they can be easily identified using standard three-view x-rays of the foot (anteroposterior [AP], lateral, and oblique). Occasionally, a CT will be necessary to assess the surrounding anatomy and rule out concomitant ligamentous injuries.

Most of these fractures will have an intra-articular component.

Acute fractures of the navicular should be splinted non-weight bearing and referred to orthopedics for ORIF. Unstable or displaced fractures should be referred to the emergency room for stabilization and emergent surgery.

Acute avulsion fractures

Acute avulsion fractures are more common in urgent care. They may occur as the result of forced eversion of the foot, resulting in a dorsal fragment being created from the strong deltoid ligament or tear of the joint capsule superiorly. One may also encounter an avulsion medially on the navicular, caused by the insertion of the posterior tibial tendon.

When viewing x-rays of the navicular, careful attention must be paid to avoid confusing an avulsion with one of the accessory bones of the navicular. Contralateral films may help clarify the situation.

Small avulsion fractures can be treated with a CAM walker, while larger or displaced fragments should undergo operative repair.

Stress fractures

Stress fractures of the navicular are a common entity seen in urgent care. They comprise 35% of all stress fractures in some series and usually occur in running and jumping athletes. An athlete may complain of midfoot pain that worsens with activity and after activity.

Such fractures are notoriously difficult to diagnose, with a mean of seven months lapsing from the onset of symptoms to diagnosis. They are also frequently confused with anterior tibial tendonitis, as both present with pain on the dorsal/medial aspect of the midfoot.

Suspect a stress fracture if the athlete has progressed training too rapidly, or has a rigid or abnormal foot. The navicular may be tender and pain may be elicited with vibration from a low- pitch tuning fork. The patient will have pain with hopping on the affected foot. The fracture is difficult to visualize because it always runs vertically in the plane of the AP film. Look for sclerosis in the waist of the navicular or periosteal reaction. CT scanning may be helpful and can delineate partial from complete stress fractures.

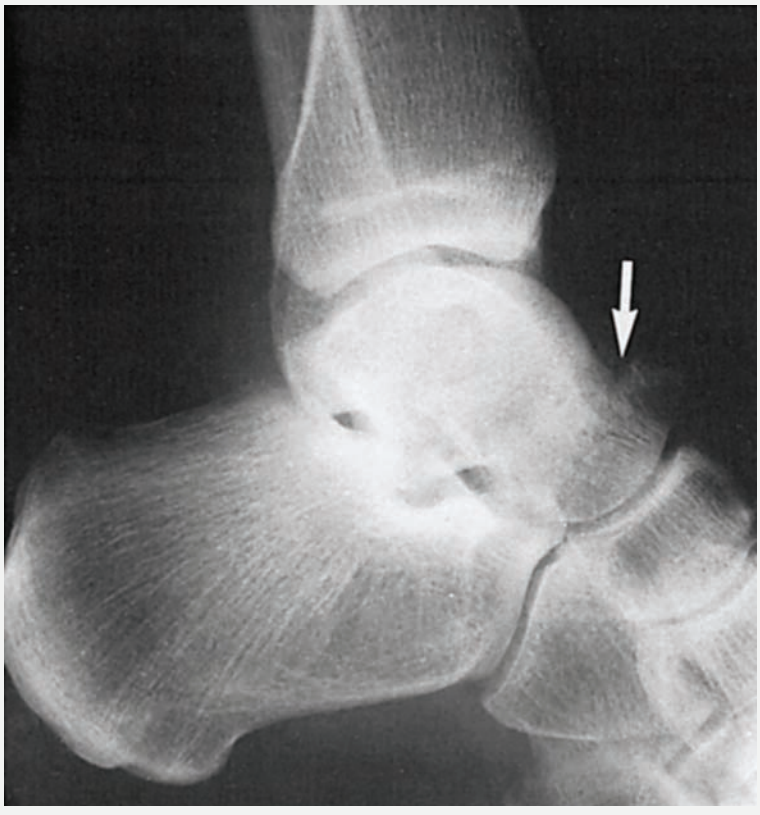
Treatment of stress fractures of the navicular must always include a period of non-weight bearing, typically at least four weeks in a cast for an incomplete stress fracture. This is in distinction to other stress fractures of the foot, which may heal with protected weight bearing. Failure to make the patient non-weight bearing initially is another common pitfall in urgent care.

Complete stress fractures or those with displacement will require operative repair. All athletes have a prolonged recovery and delayed return to sports. If the fracture is not identified early enough, the injury could be career-ending.

Talus Fractures

The talus bone plays the crucial role of transferring

Figure 2. Fracture of the talar neck.



Source: Rosen P, Doris PE, Barkin RM, et al. *Diagnostic Radiology in Emergency Medicine*. St. Louis: Mosby, 1990.

weight and energy from the leg onto the foot. Precise anatomy is essential for normal painless gait in humans. Seventy-five percent of the surface is covered with articular cartilage, as it articulates with several bones.

The word *talus* comes from the Latin root for "dice," so named because Roman soldiers used horse tali as dice in games. It is a hard and dense bone with a tenuous blood supply that is easily disrupted in fractures or dislocations. The talus has no tendon or muscle attachments, but numerous ligaments are attached.

The talus is divided into four zones for the purposes of our discussion:

- The head of the talus is anterior and articulates with the navicular and calcaneus bones; 10% of fractures occur here.
- The body of the talus is wider and forms the posterior portion of the bone. It articulates with the calcaneus; 20% of fractures occur here.
- The dome of the talus is the superior part of the body and forms the ankle mortise, along with the tibia and fibula; 20% of fractures occur here.
- The neck of the talus lies between the head and body. It does not articulate with other bones, but it possesses the crucial blood supply and accounts for 50% of talar fractures. Fractures in this area have the highest incidence of non-union and avascular necrosis.

Talar fractures can be classified as avulsion type, osteochondral, and acute traumatic. They are best evaluated radiographically by both foot and ankle films, with the best single view being the true lateral of the ankle. In particular, look carefully at the neck of the talus for fracture lines (**Figure 2**).

Avulsion type fractures

Avulsion type fractures of the talus are seen commonly in urgent care, as they result from severe inversion and eversion ankle sprains or torsion of the foot. The required energy forces are lower than those required in acute fractures, and the strong ligaments pull fragments of bone free. Fracture fragments noted on x-ray should instigate further search for other soft tissue injuries to the joints or ligaments. When found in isolation, avulsion fractures can be treated with conservative therapy of RICE (rest, ice, compression, and elevation) and weight bearing when tolerated in a CAM walker.

Osteochondral fractures

Osteochondral fractures occur from a severe axial load to the ankle, in severe ankle sprains, and in syndesmotic injuries of the ankle. They are located on the dome of the talus. The clinician should examine the mortise view of the ankle carefully, looking for a small defect on the talar dome. If the plain films are negative and a high index of suspicion exists, CT scanning will identify the defect. A clue to a possible osteochondral fracture is the presence of an ankle effusion. All patients with acute ankle effusion should receive a CT if the plain films are negative. One should also consider

an osteochondral fracture in patients who have persistent pain four weeks after an ankle sprain. The fracture fragment may need to be excised arthroscopically. When diagnosed acutely, patients should be splinted non-weight bearing and referred to orthopedics as an outpatient.

Acute traumatic fractures

Acute traumatic fractures of the talus occur as the result of high-energy forces, such as motor vehicle accidents, falls from a height, and severe football collisions. Even with proper treatment, these injuries commonly lead to post-traumatic complications such as avascular necrosis, arthritis, tarsal coalition, and chronic pain.

As a rule of thumb, all acute traumatic fractures of the talus should be referred to orthopedics. If there is no displacement or dislocation, the referral can be made as an outpatient as long as the ankle is protected and non-weight bearing. Fractures with displacement need urgent referral and the orthopedist should be contacted to give advice on disposition. These patients will probably need to go the ED. These injuries require early ORIF to prevent non-union and early return to weight bearing. Most orthopedists will request a CT scan to clarify the injury and for pre-operative planning.

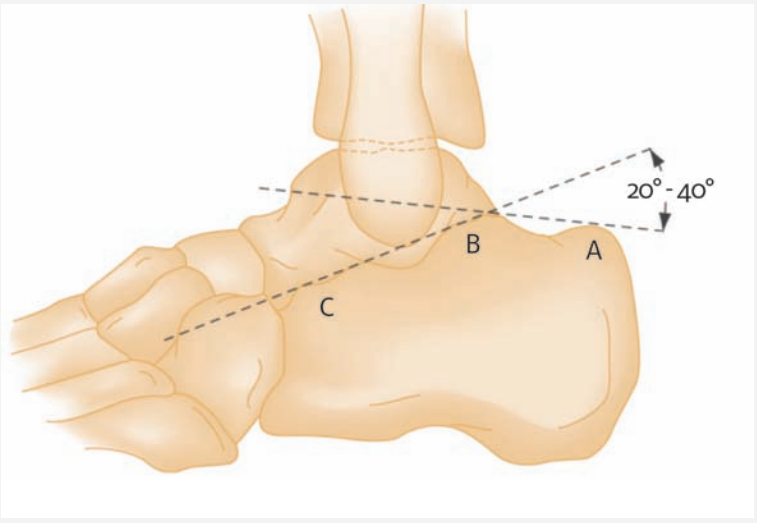
The Hawkins classification developed in 1970 is still used today for talar neck fractures. As one progresses into more complex fractures and displacement in the scheme, the risk of avascular necrosis and non-union rises to a level of 90%. Fractures that are visible on plain films are probably displaced to some degree. The presence of a fracture also suggests a high impact force that could cause other concomitant injuries to the ankle and deltoid ligament. Therefore, orthopedic referral and ORIF are advised when found.

Fractures of the lateral process of the talus may occur from severe inversion injuries to the ankle. These fractures are often diagnosed initially as ankle sprains, and the patient fails to improve with RICE and early weight bearing. Hence, one should suspect this injury whenever ankle sprains fail to remit after two weeks of conservative therapy.

Such injuries result from an axial load with the ankle in dorsiflexion and are often referred to as "snowboarder's fracture." The lateral process has strong ligamentous attachments from the anterior talofibular ligament and the lateral talocalcaneal ligament. On exam, the patient will have tenderness over the lateral tubercle—the bony prominence located just inferior to the tip of the lateral malleolus. Most of these fractures can be seen with a true mortise view of the ankle, especially with the foot held in plantar flexion. Small fragments may be treated with cast immobilization; larger fragments will require ORIF. For ideal results, surgery must take place before week 4. For later diagnoses, the fracture fragment may need to be excised.

On the posterior talus, fractures may occur from extreme forced plantar flexion of the ankle. The patients will be tender anterior to

Figure 3.



Boehler's angle is obtained by drawing two lines—one extending from the posterior tuberosity (A) to the apex of the posterior facet (B), and the other between the apex of the posterior facet (B) and the apex of the anterior process (C). A value of <20 degrees suggests a calcaneal compression fracture.

Source: Rosen P, Doris PE, Barkin RM, et al. *Diagnostic Radiology in Emergency Medicine*. St. Louis: Mosby, 1990.

the Achilles tendon. On x-ray, one must distinguish between an acute fracture and the accessory bone, *os trigonum*. The *os trigonum* is located on the posterior talus and is present in 50% of individuals, often bilaterally. Contralateral films may help. One should note that acute fractures have an irregular contour compared with the accessory bone. Fractures are treated the same way as those of the lateral process, as explained previously.

Chopart Joint Injury

Chopart's joint consists of the talonavicular and the calcaneocuboid joints. Injury to this joint is less common than injuries to Lisfranc's joint. Disruption of the ligaments can occur with significant forced dorsiflexion of the ankle, and should be considered in any patient with a fracture of the tarsal bones. The patient will experience pain, swelling, and inability to bear weight. There may be tenderness over Chopart's joint.

The disruption is difficult to diagnose in the urgent care center, but must be sought on the plain films. If a high index of suspicion is present, or significant force was involved, a CT will be helpful in assessing the joint. One should also entertain the diagnosis if an ankle sprain fails to heal properly in two to four weeks. Most of these injuries will require operative fixation and may lead to chronic disability.

Calcaneus

The calcaneus is the largest bone of the foot and the most frequently fractured tarsal bone. It articulates with the talus superiorly and with the cuboid on its anterior aspect. Fractures to the calcaneus usually result from the impact of a fall.

A significant force is necessary to fracture this dense bone. Therefore, one must look for concomitant injuries. Seven percent of the injuries are bilateral; approximately one quarter of patients have other foot or ankle injuries, and one in 10 have spinal injuries (usually, compression fractures). On exam, one may note a loss of height in the heel when viewed from behind, bruising on the plantar surface of the foot. There will be exquisite tenderness of the heel and the patient will be unable to bear weight on the heels.

All suspected calcaneal injuries should be evaluated initially with plain radiographs of the foot in standard AP, lateral, and oblique projections.

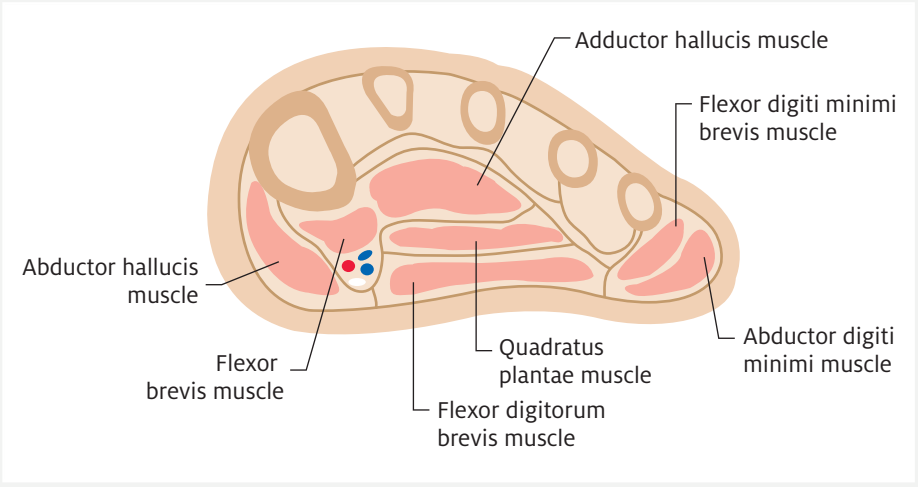
From an urgent care perspective, the clinician needs to determine if the sub-talar joint is involved, and if there is depression in the posterior facet of the calcaneus. On the lateral view of the foot, it is helpful to measure Boehler's angle to determine a compression fracture of the calcaneus (**Figure 3**).

In addition, a calcaneal or axial (Harris) view is critically important in all suspected calcaneus fractures. If a fracture is found, additional views of the ankle should be obtained to rule out talar disruption and concomitant injuries, such as those mentioned previously.

Standard films, though helpful, tend to underestimate the displacement in calcaneal fractures. Therefore, all patients with calcaneal fracture should undergo a CT scan soon after diagnosis.

The vast majority of calcaneal fractures reveal some displacement on CT scanning. Patients cannot tolerate a loss of height in the calcaneus or change in the tilt angle of the sub-talar joint. For this reason, most fractures are treated operatively with screw fixation. Occasionally, a fracture can be managed with closed reduction. In all such instances, it is advisable to refer these patients to orthopedics. Even with minor fractures, the patient will be cast immobilized for a minimum of six to eight weeks.

Figure 4.



The foot has nine individual muscle compartments, as described by Manoli. Medially, they can communicate with the deep posterior compartment of the leg, and thus swelling in one area can affect the other. Any physician treating traumatic foot injuries should be familiar with the deep compartmental anatomy of the foot in the event that a compartment syndrome requires release.

In the urgent care center, the patient should be placed in a well-cushioned posterior splint with the ankle in neutral position. Care should be taken during splinting to avoid exacerbating any soft tissue injury and to allow for swelling that will occur. Patients should be non-weight bearing until they are seen by the orthopedist.

If the x-ray reveals a displaced fracture or involvement of the sub-talar joint, the orthopedist should be consulted immediately for assistance in the disposition of the patient; they may want to evaluate the patient in the ED. Be alert for significant soft-tissue injury that may be present, and for concomitant injuries. The foot and ankle must be assessed critically for neurovascular compromise. Some patients will need to be admitted to the hospital for observation of neurovascular status, soft-tissue compartments, and pain control.

Younger patients

With regard to children, the calcaneus is largely cartilaginous. Fractures are less common than in adults, but may occur with falls. Children can also develop stress fractures of the calcaneus.

A condition unique to skeletally immature children is Sever's disease, a type of apophysitis of the heel in which the calcaneal apophysis develops a secondary ossification center at age 10 and eventually fuses with the calcaneus by age 15. During that interval, the strong pull of the Achilles tendon inserts on the apophysis and can lead to apophysitis. It is more common in boys who participate in jumping and running sports.

The urgent care clinician should be aware that there is an apophysis of the heel that is normally fragmented. This can be confused with a fracture on the lateral film. Sever's disease is considered to be an overuse injury, due to repetitive microtrauma. It heals with modification of activities and heel cushioning.

Compartment Syndrome

Urgent care clinicians also need to be aware of the possibility of a compartment syndrome in patients who have sustained trauma to the foot. Compartment syndrome occurs when the pressure within a confined fascial compartment exceeds the arterial pressure leading into it, and the blood flow and nerve function are compromised. There are several small compartments within the foot; see **Figure 4**.

The usual sequence of events is one of acute trauma to the foot, coupled with exaggerated elevation of the

leg at home. As with any injured extremity, RICE therapy is the hallmark of treatment. However, if the injured leg is held too high, the arterial inflow into a tight compartment may not be sufficient for adequate perfusion. Risk may be minimized with elevation limited 12 to 18 inches above the heart, and ensuring that any compression from a splint or elastic wrap is not too tight. Compartment syndrome in the foot is notoriously difficult to detect. Any severe injury, whether it is a fracture or severe sprain, may lead to a compartment syndrome.

Mechanism of injury may raise suspicion for certain fractures and dislocations.

The physician should be alert for tense swelling, exaggerated pain in the foot, or loss of two-point discrimination as the first signs of vascular compromise. Two-point discrimination is superior to light touch in assessing for neural compromise. Particular attention should be paid to pain out of proportion to the injury, elicited during passive extension of the toes. Compartment syndrome is a surgical emergency that should be referred to the ED immediately.

Conclusion

We have examined the common fractures and injury patterns of the foot, with a concentration on those that are most likely to present to an urgent care center.

As one progresses from the toes to the heel, more force is needed to fracture the larger and denser bones. Paying careful attention to the mechanism of injury raises suspicion for certain fractures and dislocations.

Other take-home points from this two-part series include:

- Of all the toes, the great toe is the most important for weight bearing and for treatment; displaced fractures of the great toe require operative treatment.
- The midfoot is commonly injured acutely and in stress fractures.
- The Lisfranc joint between the flexible forefoot and more rigid midfoot holds special significance for clinicians. One should suspect this injury if the force was an axial one with the forefoot in dorsiflexion. X-rays are imperative and must be examined for proper alignment on the medial aspect of each tarsal-metatarsal joint.
- Fractures of the midfoot require more force and are rarely isolated. Only small fractures or avulsions can be treated conservatively. The majority will have some displacement and will require operative intervention. If the injuring force to the midfoot was significant, and the patient has pain with toe-walking, the clinician would be wise to immobilize the patient and refer to orthopedics for follow-up.
- Fractures of the hind foot require even more force and usually result from a fall from a height or motor vehicle accident. One should look carefully for associated injuries and compartment syndrome or neurovascular compromise. These patients need to be splinted carefully and referred immediately.
- Tarsal fractures most common to the urgent care setting include:
  - avulsion fracture of the talus
  - stress fracture of the navicular.

In order to properly care for acute foot fractures in the urgent care center, the clinician must focus on several items:

- Take a careful history to determine the mechanism of injury and current symptoms, keeping in mind injuries likely to occur.
- Detailed and methodical exams of the foot for tenderness, deformity, neurovascular status, and ligament stability are needed. Before diagnosing a minor sprain, have all patients walk on their toes to rule-out a more significant injury.
- One must have immediate access to quality plain films of the foot and ankle. It is often helpful to examine these films with a hot light and magnification to see subtle fractures. Access to timely and high-quality CT scans is important for the equivocal cases. These can be ordered at an imaging center and further disposition made if necessary. Or, the clinician may decide to splint and refer to orthopedics in borderline cases.
- One must be able to place a patient in a temporary splint with crutches, as some patients should not bear any weight.
- For disposition, the clinician needs an excellent working relationship with a local orthopedist, preferably one with foot and ankle expertise.
- For severe fractures, significant displacement, or possible compartment syndrome, emergent therapy is warranted. Depending on the local situation, this would entail a call to the orthopedist for instructions or a direct referral to the ED.

For Resources and Suggested Reading associated with this article, log on to *www.jucm.com*. ■