

# Management of Ankle Fractures

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## ABSTRACT

Ankle fractures are a common injury across all age groups. Management may be operative or nonoperative, depending on the severity of the injury and the patient's overall health and functional status. Although imaging defines the nature of the fracture, a careful history and physical also helps determine the patient's plan of care. Initial management is focused on adequate alignment and safe immobilization of the injury. Definitive management must provide anatomic alignment of the joint as well as consideration of the surrounding soft tissues. Rehabilitation after either operative or nonoperative treatment aims at restoring range of motion, strength, proprioception, and function.

**KEYWORDS:** Ankle, fracture, rehabilitation, treatment

## INTRODUCTION

Ankle fractures have increased in incidence over the last 30 years, affecting one in every 800 people each year, typically young active males and geriatric osteoporotic females, and accounting for 9% of all fractures.<sup>1,2</sup> Management of the fracture itself ranges from nonoperative treatment with immediate weight bearing to surgery and 12 weeks of non-weight

bearing. Care of the patient includes greater considerations such as medical optimization, rehabilitation, and safe return to work and activity.

## ANATOMY AND MECHANISM

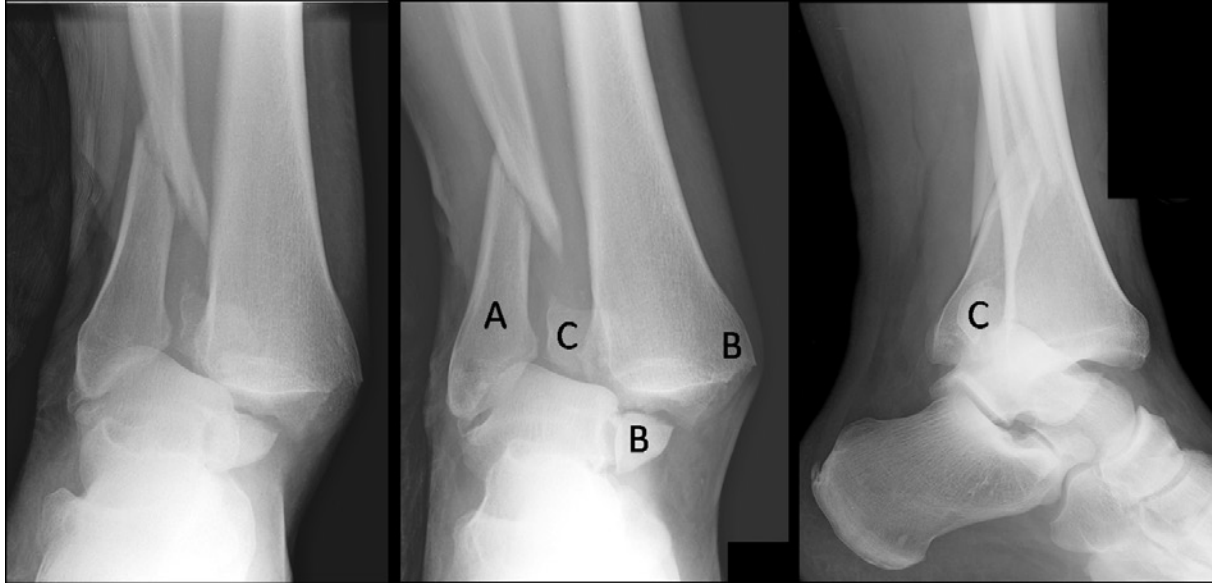
The ankle is a hinge joint with the tibia and fibula proximally and the talus distally (Figure 1). Ankle fractures classically refer to malleolar injuries: the distal fibula or lateral malleolus, the distal medial tibia or medial malleolus, and the posterior distal tibia or posterior malleolus. Fractures that involve multiple sides are referred to as bimalleolar or trimalleolar. The injury may also involve the deltoid ligament medially or the syndesmotic ligaments laterally. Over 60% of ankle fractures involve only the lateral malleolus.<sup>1</sup> Fractures of the lateral malleolus proximal to the joint line correspond to syndesmotic injuries. The commonly used Weber classification relies solely on the level of the lateral malleolar fracture relative to the ankle joint line.<sup>3</sup>

The mechanism of injury generally involves a twisting or bending across the joint, whether low-energy as from twisting off a curb or high-energy as from a motor vehicle accident. The most commonly used Lauge-Hansen classification scheme is based on the position of the foot at the time of injury (supination or pronation) and the direction of the deforming force, external rotation, adduction, or abduction.<sup>4</sup>



**Figure 1.**

Ankle x-ray anatomy: (A) lateral malleolus, (B) medial malleolus, (C) posterior malleolus, and (D) tibial plafond.



**Figure 2.** Trimalleolar fracture-dislocation with medial skin tenting by the medial malleolus: (A) lateral malleolus, (B) medial malleolus, and (C) posterior malleolus.

Pilon fractures, caused by an axial load, involve the plafond, the weight-bearing portion of the distal tibia. The management and prognosis of pilon fractures is completely different and will not be covered in the scope of this article.

## HISTORY

The general goals of fracture management are anatomic reduction of the fracture and protection of the soft tissue envelope. Stable fractures, where the alignment of the ankle joint is preserved, rarely need surgery. Unstable fractures typically require closed reduction or open reduction and internal fixation, depending on the patient's co-morbidities and pre-injury functional status. There is an increasing trend toward operative management of unstable ankle fractures, but historically good long-term outcomes have been well documented with non-operative management.<sup>5</sup>

Underlying diabetes, nicotine use, peripheral neuropathy, and peripheral vascular disease are all risk factors for poor fracture healing and wound complications.<sup>6,7</sup> Even without co-morbidities, foot and ankle surgery is notoriously prone to wound dehiscence, deep infection, and nonunion. These complications may lead to repeated operations, prolonged hospitalizations, and intravenous antibiotics. Although non-operative management carries an increased risk of malunion and pressure ulcers from prolonged immobilization, in select populations it is the more prudent approach. Patients whose general health precludes surgery are also candidates for closed reduction and casting as their definitive treatment. However, these same patients may be at increased risk of complications from prolonged limb immobilization and decreased mobility.

Medications that may compromise healing potential such as steroids, chemotherapy, and immune modulators should be noted. Similarly, medications that may cause increased

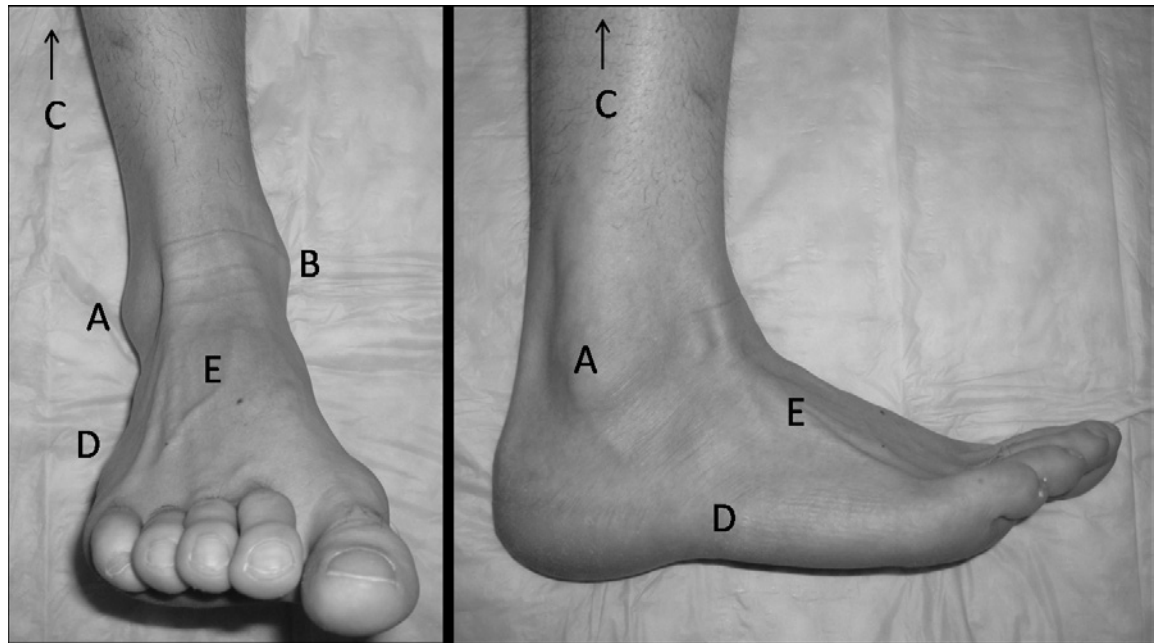
bleeding such as aspirin, warfarin, clopidogrel, and non-steroidal anti-inflammatories should be documented and possibly held preoperatively.

## PHYSICAL EXAMINATION

Chronic skin changes related to vascular insufficiency, steroid use, or nicotine use should be documented. Ecchymosis may increase the suspicion of fracture but is usually not present. The degree of swelling, including whether or not skin wrinkles are present, should be noted. In general, swelling may take 24-48 hours to fully develop and 5-7 days to resolve, creating a window when surgery should be avoided. Severe swelling may progress to significant blistering. Any fracture blisters, skin tears, or abrasions over the medial and lateral malleoli should be documented before the ankle is covered and immobilized. Operative fixation, if any, may have to wait until overlying skin heals. In the setting of a fracture-dislocation, the talus most often dislocates laterally and the medial malleolus will tent and even blanch the skin medially, requiring an emergent reduction (Figure 2). Any violation of the dermis or constant bleeding regardless of size should raise concern of an open fracture.

If a fracture is diagnosed by imaging or gross deformity, provocative testing of the ankle should be deferred. Otherwise, when a fracture is suspected, the ankle should be examined using the Ottawa Ankle Rules, which have near 100% sensitivity.<sup>8</sup> Ankle x-rays for a suspected ankle fracture are only necessary if either one of the following is true: (1) bony tenderness over the posterior edge or tip of the distal 6 cm of the medial or lateral malleoli or (2) inability to bear weight both immediately after injury and at time of examination. These rules should only be applied to the neurologically intact and cooperative patient with no distracting injuries and whose ankle swelling does not prevent palpation of the

**Figure 3.** Ankle exam surface anatomy: (A) lateral malleolus, (B) medial malleolus, (C) fibula, (D) base of fifth metatarsal, and (E) dorsal midfoot.



bony landmarks. Of note, the ability to ambulate does not exclude an ankle fracture. One of the most common fracture patterns, an isolated fracture of the lateral malleolus with intact medial and syndesmotic ligaments, is a stable injury pattern that allows many patients to ambulate.

The examination should rule out other injuries that may occur with a twisting mechanism. Tenderness just distal to the malleoli or at the base of the fifth metatarsal raises suspicion of a talar avulsion fracture or base of the fifth metatarsal fracture (Figure 3). Swelling and tenderness in the dorsal midfoot may be a sign of a navicular fracture, Lisfranc injury, or other tarsal-metatarsal injury. The entire length of the fibula should be palpated to rule out an associated proximal fracture (Maisonneuve injury). Neurovascular injury is rare but possible: distal sensation to light touch and posterior tibial and deep peroneal pulses should be assessed. Pulses may be difficult to palpate with swelling or underlying vascular disease and should be compared with the contralateral limb or assessed by Doppler. The ability to actively and passively move the toes with minimal pain should be documented. Compartment syndrome of the leg is a rare complication but should be suspected with a high-energy mechanism, significant swelling, inability to actively or passively move the toes, or pain out of proportion to the injury.<sup>9,10</sup>

## IMAGING

To characterize the initial fracture pattern and subsequent maintenance of adequate reduction, imaging should always include anterior-posterior, lateral, and mortise views. While the radiographic thresholds that define an unstable ankle fracture are beyond the scope of this article, for emergent treatment, the talus should be located directly underneath

the plafond of the tibia on all views. With high-energy mechanisms or an unreliable exam, initial studies should include three views of the foot (anterior-posterior, lateral, and lateral oblique), and two views of the tibia/fibula (anterior-posterior and lateral). Computed tomography may identify or better characterize injuries to the plafond and talus. Magnetic resonance imaging is rarely indicated in the acute setting.

## INITIAL MANAGEMENT

Fractures with a subluxation of the talus relative to the tibia warrant closed reduction and a well-molded splint to hold the reduction. Intra-articular aspiration of fracture hematoma and injection of local anesthetic are helpful for this painful procedure.<sup>11</sup> Even when it is not the definitive treatment, near-anatomic reduction of the fracture decreases damage to the articular cartilage, swelling, soft tissue injury, and pain. Films prior to any manipulation are extremely useful to determine the severity of the injury. However, when the ankle is completely dislocated, the skin is threatened, or there are signs of ischemia, an emergent preliminary reduction without imaging is warranted. Applying axial traction with the knee bent at 90 degrees to relax the Achilles tendon is often sufficient. Restoring the rough alignment of the foot to the leg may save the threatened skin and restore blood flow to the foot. If pulses or Doppler signals do not return after reduction, emergency vascular surgery consultation is warranted.

Open fractures require urgent operative irrigation and debridement with definitive fixation or temporizing external fixation.<sup>12</sup> They should not be left subluxed or dislocated simply because operative intervention is planned. Intravenous first-generation cephalosporins should be started as soon as

the injury is identified.<sup>12</sup> Higher-grade open injuries may also require gentamicin and penicillin. A tetanus booster should be administered if the patient's vaccine is not up to date.

Fractures without subluxation of the talus relative to the tibia still require immobilization for stability, protection of soft tissues, and pain control. A well-padded short-leg posterior splint with side supports is typically used. Isolated, minimally displaced, lateral malleolus fractures may be placed in an Aircast boot for immediate weight bearing but non-weight bearing until follow-up will help reduce pain and swelling. Furthermore, isolated minimally displaced lateral malleolus fractures may have unidentified medial ligamentous injury, creating an unstable fracture. Follow-up x-rays of the ankle stressed in dorsiflexion and external rotation or after the patient has been bearing weight can determine stability. These are decisions that can be deferred until follow-up with the orthopaedic surgeon as there remains no consensus on how to manage these injuries.<sup>13</sup>

Temporary immobilization is not without complication. While immobilization decreases swelling, wrapping a splint too tightly can lead to compartment syndrome. Pressure ulcers of the posterior heel may develop in a matter of hours and are notoriously difficult to manage, so the heel should always be carefully padded. Patients should always be instructed to rest their leg on the calf and not the heel when sitting or lying down. The tendency to leave the ankle plantarflexed or in equinus causes a contracture that may require operative release. Unless not tolerated by the patient, all splints should immobilize the ankle at 90 degrees.

There are no clear guidelines for or against deep venous thrombosis prophylaxis after an ankle fracture. Prophylaxis

should be made on a case-by-case basis based on mobility and other risk factors.<sup>14</sup> Although nicotine use and diabetes are chronic issues that predispose the patient to wound complications, smoking cessation and improved glycemic control even starting at time of injury or surgery may be beneficial.<sup>6</sup>

Patients should follow up with an orthopaedic surgeon in 3–7 days. In the interim, patients should ice and elevate the extremity as much as possible to decrease swelling, which contributes tremendously to pain and can prevent timely surgical intervention. Prompt follow-up care is crucial to avoid turning an operative ankle fracture with a good expected outcome into a crippling injury. Patients should also be advised to seek emergency medical care for increased pain, which may be a sign of resubluxation or compartment syndrome.

### Hardware Removal

After the fracture has healed, removal of hardware is indicated only if patients are symptomatic. Some surgeons routinely remove syndesmotic fixation, as they have a tendency to break, loosen, or limit full ankle range of motion. The current literature, however, supports removal only to reduce pain or improve range of motion.<sup>15</sup>

### REHABILITATION

The goal of rehabilitation is to restore or maintain range of motion, strength, proprioception, and function. Earlier and more aggressive rehabilitation may prevent stiffness and lead to faster recovery as joint motion contributes to cartilage health and non-weight bearing diminishes bone density (Figure 4). Premature rehabilitation, however, may compromise

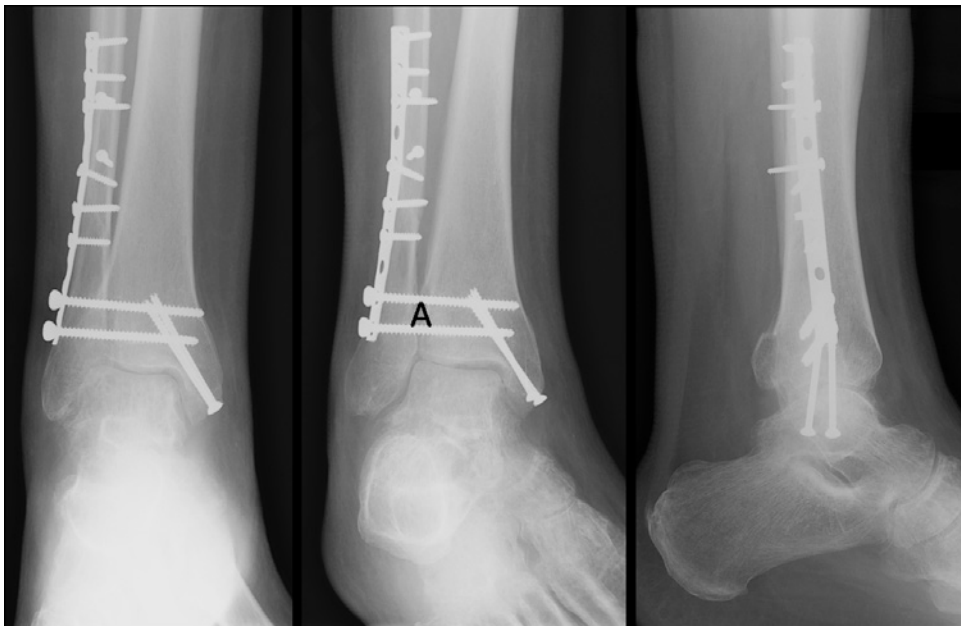
the anatomic alignment of the fracture. Unfortunately the available literature does not support any specific timing or protocol for rehabilitation.<sup>16</sup>

Patients with nonoperative stable ankle fractures are usually in some form of immobilization for approximately 6 weeks. Weight bearing may start immediately or after some initial pain improvement. Exercises for range of motion are started as soon as tolerated.

Patients with unstable ankle fractures that are being treated nonoperatively should expect to be splinted and then casted for 8–12 weeks with weight bearing beginning at approximately 6 weeks. These fractures require close weekly follow up and imaging for at least the first 4 weeks.<sup>5</sup>

Patients with operative ankle

**Figure 4.** Ankle from figure 2 after open reduction and internal fixation and three months of non-weight bearing to protect syndesmotic fixation (A). There is significant osteopenia demonstrated by increased radiolucency of bone especially on the lateral films as compared to injury films.





fractures are generally immobilized and kept non-weight bearing for 6 weeks. Once sutures are removed at 2 weeks, a removable form of immobilization may be used to allow active and active assisted range-of-motion exercises. If decreased point tenderness and callous formation is present on x-rays at 6 weeks, weight bearing and passive range of motion exercises are begun. In select patients, immediate post-operative weight bearing without immobilization may result in faster rehabilitation with only a slight increased risk of wound complications.<sup>17,18</sup> Regardless, if the syndesmosis required repair, then weight bearing is usually delayed until 8 or 12 weeks. Generally, patients with diabetes, neuropathy, or who use nicotine are delayed in their weight bearing for 8 to 12 weeks as well.

When weight bearing and range-of-motion exercises are initiated, most patients are stiff from their immobilization but usually do not require formal physical therapy. Patients should advance weight bearing as tolerated but limit activities such as heavy lifting and running.

### Patient Expectations

In order to have a successful outcome, patients should understand their injury and comply with their treatment plan. Regardless of how the fracture is managed, patients need to recognize that the ankle will never return to the pre-injury level of function. Even with an ideal fracture reduction, the concomitant damage to the soft tissue and cartilage causes some pain and loss of range of motion.

Patients may return to work as soon as they are able to comply with weight-bearing limitations and immobilization at work, are off narcotic pain medication, and are not a risk to themselves or others. The same rationale applies to driving. For right ankle fractures, braking response time has been shown to be delayed until approximately 9 weeks after surgery.<sup>19</sup>

### CONCLUSION

Treatment of an ankle fracture involves a careful examination, appropriate imaging, understanding of the fracture pattern, and technically sound fixation or immobilization. Just as important, the patient's treatment and subsequent rehabilitation must be tailored to his or her other medical conditions and pre-injury functional status.

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### Disclosures

The authors have no financial disclosures to report.

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