Management of High-Risk Ankle Fractures

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KEYWORDS

• Ankle trauma • Osteopenia • Osteoporosis • Geriatric • Elderly • Diabetes

KEY POINTS

- Ankle fractures in diabetic and elderly patients should not be managed in the same manner as their healthy counterparts.
- Careful attention to an often-unforgiving soft tissue envelope is crucial to avoid potentially catastrophic complications in these patients.
- Altered bone properties may adversely influence healing and fracture stability. Fixation constructs must be adapted accordingly.
- Transsyndesmotic screw fixation should be routinely used to stabilize ankle fractures in these patients, who frequently cannot abide by restricted weight bearing protocols.
- Early protected weight bearing in the osteopenic patient—and some diabetic patients—is safe and helps reduce injury morbidity.

BACKGROUND

Ankle fractures among the aging baby boomers and the increasing number of patients with diabetes mellitus have evolved into a colossal health care burden. The rate of such injuries is expected to escalate.[1–4] Each patient population presents unique risks for ankle fracture management. Fractures in this population can be unpredictable and deceiving. The timing of surgery, methods of osteosynthesis to facilitate primary or secondary bone healing, and time to load bearing after surgery all play a critical role for a successful patient recovery.

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The core problem in elderly patients with fragility, osteoporotic, or age-related fractures is compromised bone. Bone in this population is characterized by diminished trabecular density and remodeling that shifts toward resorption in much of the cortices of long bones. There is no definable underlying collagen or mineral abnormality, yet there can be upwards of 50% bone loss in the fractured extremity. This manifests as soft, malleable, and/or brittle bone, frequently resulting in comminuted fractures and additional bone loss, even in low energy injuries. The physician faces limited options in fracture treatment. It can be very difficult to maintain acceptable alignment with nonoperative care. Yet satisfactory fracture stability can be difficult to achieve with standard fixation techniques.[5–7]

Diabetic patients present a similar, but oftentimes more expansive management conundrum, which can be difficult to control. These patients typically carry a host of comorbidities resulting from a hyperglycemic state, including obesity, end-stage organ damage of the peripheral nervous and cardiovascular system, as well as advanced renal disease. Hyperglycemia compromises intra- and extracellular function due to advanced glycosylation, ultimately impairing bone healing due to an imbalance of cell-to-cell communication and osteoblastic and osteoclastic instability.[8,9] Hyperglycemia decreases bone tensile strength, stiffness, and callus size. Optimizing perioperative blood glucose levels is critical to mitigate complications. Lowering HgA1c levels by just 1% has been shown to reduce surgical complication rates by 25%.[10]

Compared with patients with uncomplicated diabetes, those with complicated diabetes—uncontrolled hyperglycemia with end-stage organ dysfunction or failure—show much poorer outcomes in the surgical treatment of ankle fractures. This fragile population has an infection rate of 17% to 50%, an amputation incidence of 4% to 7%, and revision surgery is 5 times more likely.[10] In addition, traumatic events—original injury or iatrogenic insult—may produce deranged bone remodeling associated with Charcot neuroarthropathy, leading to implant failure: implant failure, subsequent deformity, wound complications, revision surgery, or amputation.[11,12]

Aside from healing potential, these 2 patient cohorts frequently present difficult social constraints as restricted weight bearing recommendations are often unreasonable. Expecting elderly individuals and/or obese diabetic patients to remain non-weight bearing is not feasible and frankly unreasonable. In the event these patients adhere to such care instructions, they may decompensate, including cardiopulmonary compromise, increasing morbidity and mortality. A number of studies have demonstrated the burden these patients, much like geriatric hip fractures, place on our health care system in ensuring safe and appropriate disposition while balancing the needs of fracture healing.[1,5,13–15] Mitigating this burden demands reconstructing the ankle joint according to sound principles in fracture mechanics and fixation, safely mobilizing the patient with close attention to healing progress, and meeting their overall rehabilitation needs.[1,3,4]

Although patients with complicated typically diabetes require a protracted period of ankle immobilization and a longer course of non-weight bearing for successful treatment, most high-risk patients with unstable ankle fractures can safely ambulate with proper ankle protection following open reduction internal fixation (ORIF). Allowance for early protected load is rooted in ankle fracture pathomechanics. Most ankle fractures result from low-energy rotational injuries due to excessive external rotation under axial load, producing a distal fibular fracture, often with neighboring fractures or ligament disruption. Following restoration of the ankle mortise, a short leg cast or CAM boot orthosis is effective to offload the malleoli by restraining morbid rotation

Fig. 1. Elderly patients often have tenuous soft tissues, increasing the risk for wound complications in unstable ankle fractures.

of the talus within the mortise. The cast or boot establishes vertical load, transferring force from the foot directly through the talus and plafond, thereby protecting reduction and fixation of the malleoli.[16] There is ample literature to support safe early weight bearing and range of motion following surgical treatment of unstable ankle fractures.[16–20]

Careful attention to the soft tissue envelope is paramount for the surgical treatment of ankle fractures in these patient populations. In the elderly patient, the skin is often very thin, easily bruised, and prone to tearing (**Fig 1**). Significant atrophy of the subcutaneous tissue is common. The fragile soft tissue envelope demands close attention relative to timing of surgery, tissue handling, and postoperative care.[5–7] Peripheral vascular disease and neuropathy may be present in some elderly patients, disorders that may have a devastating impact on soft tissue healing. Ankle fractures in patients with diabetes often present with both peripheral arterial disease and neuropathy. The astute surgeon takes a careful history and physical examination. Atrophic skin changes may be seen in the diabetic patient, but the more common concern is incision healing complications due to glycosylation and peripheral arterial disease.

Principles of ankle ORIF of these 2 high-risk patient populations are identical to the tenants of the Association for the Study of Internal Fixation (ASIF) in patients of lower risk: restore a congruent and stable ankle joint mortise with as little insult to soft tissue as possible and provide for early and safe mobilization. However, fixation methods to achieve these endpoints can be different. Over the last several decades there have been many advancements in ankle fracture fixation techniques, implant development, and changing perspectives on joint sparing and destructive procedures. Conventional fixation applied in a rationale and mechanically sound fashion has shown to produce equal—and at times superior—results to newer devices or techniques, even in the osteoporotic ankle.[7,19–22] These techniques rely on biomechanical principles of implant application to maximize stability. The operative techniques and treatment philosophy presented highlight methods to achieve reliable outcomes in these patient populations.

OSTEOPENIC AND ELDERLY ANKLE FRACTURE FIXATION TECHNIQUES

Tissue handling and bone healing concepts

Ankle soft tissues are often at high risk for wounds owing to fracture instability and skin tenting. It is imperative to reduce unstable ankle fractures immediately and apply a well-molded splint without excessive padding, which helps maintain the reduction. This will help minimize soft tissue compromise and avoid long delays prior to surgery. Maintaining satisfactory ankle fracture alignment in a splint over time can be difficult. During the operation, creation of multiple soft tissue planes, undermining, or significant tension on the skin should be avoided. Full thickness flaps should be raised with atraumatic soft tissue handling through an incision of appropriate length. Skin edge necrosis may be unavoidable in some instances (Fig 2). Close monitoring of these patients in the acute postoperative period should be considered.

Bone stability and blood supply—the 2 elements essential for bone healing—should be carefully considered during ankle ORIF in this population. Callus formation in secondary bone healing may be desirable, particularly in comminuted fractures that demand respect for the injury zone and periosteal blood supply. It is critical to avoid soft tissue stripping in the zone of injury when approaching these fractures. Stability is often adequate with bridge plating methods. The risk of devascularization with substantial dissection is often not worth primary fracture healing and should be avoided.

Poor soft tissues in the very elderly may preclude open approaches to fracture repair (Figs. 3 and 4). Closed reduction with percutaneous pinning may be sufficient

Fig. 2. Incision skin margin necrosis may occur in elderly patients after ankle fracture repair.

Fig. 3. Open approaches to ankle fracture repair may not be possible owing to poor soft tissues in some elderly patients. (*Courtesy of* Brian Elliot, DPM.)

Fig. 4. Same patient, anterior ankle view depicting open fracture laceration repair.

for stability in some cases. This 85 year old woman with a history of peripheral arterial disease and atrial fibrillation with long-standing coumadin anticoagulation sustained an open bimalleolar ankle fracture dislocation. Following fracture reduction and early intravenous antibiotics, the wounds were irrigated and primarily closed. Percutaneous fixation was accomplished with an array of Steinman pins spanning the fractures (see Figs. 3 and 4; Fig. 5). Large transarticular pins were driven across the tibiotalar joint to help maintain stability during fracture healing. When using this technique, the pins should be introduced into the posterior tibiotalar joint to minimize articular insult and to engage the tibial cortex in the denser, diaphyseal bone (see Fig 5). The talus may also be plantarflexed to minimize damage to its articular surface.

Figs. 6 and 7 depict both primary and secondary bone healing of the fibula in an osteopenic comminuted ankle fracture suffered by a 44 year old woman with B-cell lymphoma and a contralateral nonoperative ankle fracture. An interfragmentary screw was placed across the primary fibular fracture without periosteal stripping and the larger zone of comminution was not opened, with supraperiosteal plating

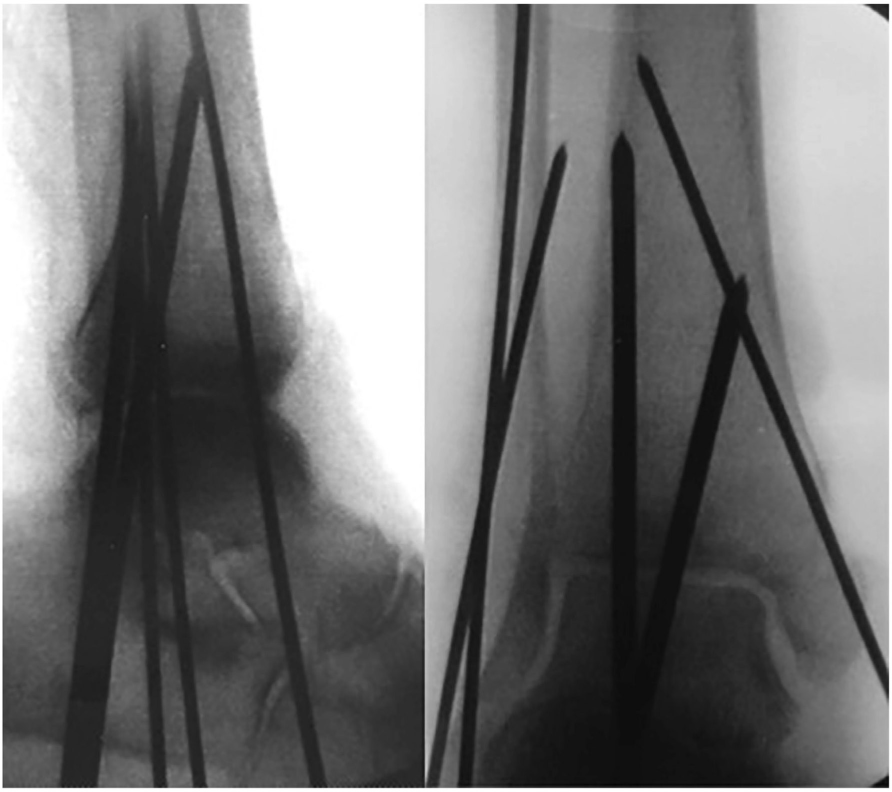

Fig. 5. Fluoroscopic images depicting transarticular pin stabilization. Note pins cross posterior tibiotalar joint to minimize articular insult.

to help preserve blood supply. A syndesmosis screw was placed to lend further support to the fibula (see below). This patient was casted on the operating room table, walked on her ankle immediately, and recovered relatively quickly. Intact mortise and fibula fracture callus formation is seen in the 2 month follow-up films (see **Fig 7**).

Antiglide plating

Antiglide plating in osteoporotic ankle fractures has its primary application in the spiral oblique distal fibular fracture and tibial fractures that tend to fail under axial loading with shearing forces. There are clear mechanical advantages to antiglide plating with conventional implants for fixation of distal fibular fractures compared with neutralization plating and locking plates.[23–26] Posterolateral plating of the distal fibula is the workhorse of osteopenic fractures, effectively preventing superior, posterior, and lateral migration of the distal fibula fragment. Soft tissue coverage is also superior compared with lateral plating methods. This technique produces good results in soft bone.[23–27]

Fig. 8 depicts a 70 year old man with a trimalleolar ankle fracture equivalent (deltoid lesion). Following posterolateral plating of the fibula, the talus was effectively incarcerated in the mortise. In some instances, diaphyseal bone strength is sufficient

Fig. 6. Osteopenic bimalleolar ankle fracture. The comminuted fibular fracture zone was spanned to avoid compromising periosteal blood supply. Syndesmosis screw helps support fibula.

to maintain construct stability. This patient required only minimum screw fixation because his bone was relatively strong. This patient was managed non-weight bearing in a splint for 10 days, transitioned to a walking cast for 3.5 weeks, followed by a fracture boot for 2 weeks, before progressing into regular shoes roughly 6 weeks after surgery as radiographs demonstrated fracture healing and an intact mortise (**Fig. 9**).

Posterolateral plating of the distal fibula also permits bicortical purchase of all screws that secure the plate to bone, increasing construct stability compared with unicortical distal metaphyseal screw placement in lateral plating methods. The metaphysis can be drilled with a 2.0 mm Steinman pin to improve screw thread purchase. **Fig. 10** depicts bicortical purchase of the distal metaphyseal bone of the fibula in an 82 year old woman. This screw frequently measures between 24 and 28 mm in length as the distal fibula widens. Finally, the technique does not preclude placement of transsyndesmotic fixation, as shown below.

Antiglide plating is also useful for larger posterior malleolar fractures often seen in low-energy injuries in this population. **Fig. 11** depicts a 74 year old woman with controlled diabetes who sustained a comminuted trimalleolar ankle fracture with a posteromedial malleolar fracture involving roughly 25% of the plafond (see **Fig 11**). Antiglide plates were applied to both the fibula and the tibia with the addition of a syndesmosis screw, stabilizing the talus against posterior escape (**Fig. 12**). Small screws were used to stabilize the small comminuted medial malleolar fracture. This patient

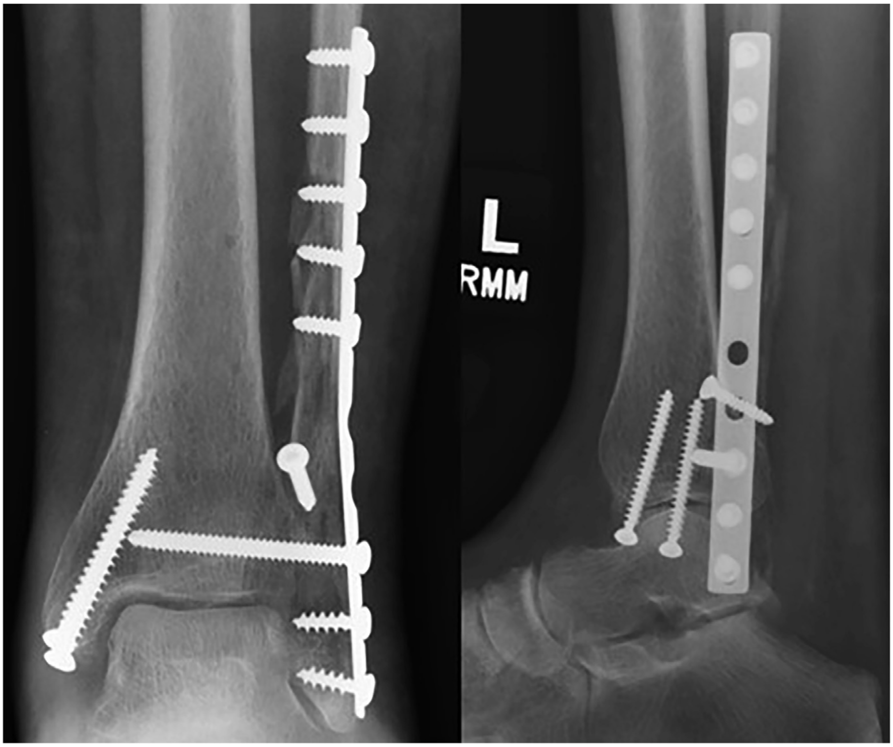

Fig. 7. Postoperative radiographs of the same patient 2 months later. The patient walked in a short leg cast immediately after surgery. The mortise remained intact. Note fibula callus formation.

was permitted to walk in a short leg cast within 10 days of surgery and went on to uneventful healing. In some cases, screw fixation is adequate to stabilize larger posterior malleolar fractures in the elderly population and should be placed close to the joint to capture more bone (see **Fig 10**). Early load is permitted in most posterior malleolar fractures because neutral ankle alignment afforded by the cast or boot puts the talar contact pressure at the center of the plafond, so the posterior malleolar fragment does not load.[28]

Syndesmotic fixation/fibula pro-tibia screw stabilization

Placement of syndesmosis screws in this population is common because it enhances construct stability, regardless of syndesmosis injury. In cases of appreciable osteopenia and fracture comminution, multiple syndesmotic screws should be placed through a plate and purchase 4 cortices. When combined with a stiff plate, or stacked traditional plates, this technique significantly increases the stiffness of the construct as the fibula buttresses the talus under the tibia.[28,29] This technique provides excellent control of the fibular segment.

Fig. 13 depicts a 74 year old man with cardiac disease, idiopathic neuropathy, and osteopenia who presented with a highly comminuted distal fibular fracture and deltoid ligament compromise. Stability was attained with interfragmentary screws of the

Fig. 8. Trimalleolar ankle fracture equivalent (deltoid lesion) in an elderly man.

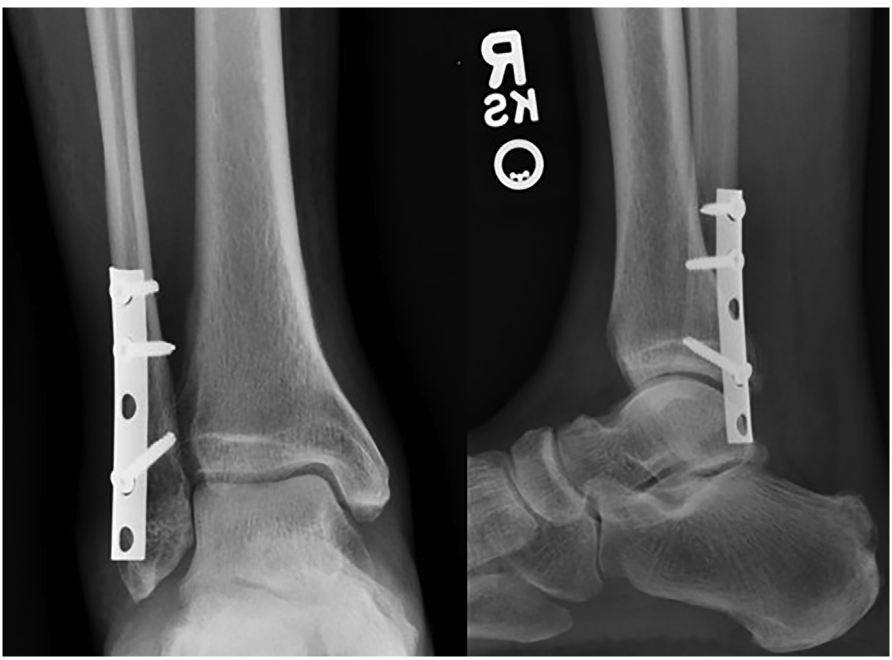

Fig. 9. Posterolateral plating of the fibula is the workhorse of osteopenic fractures. Healed fracture and intact mortise 6 weeks after surgery, early weight bearing in short cast.

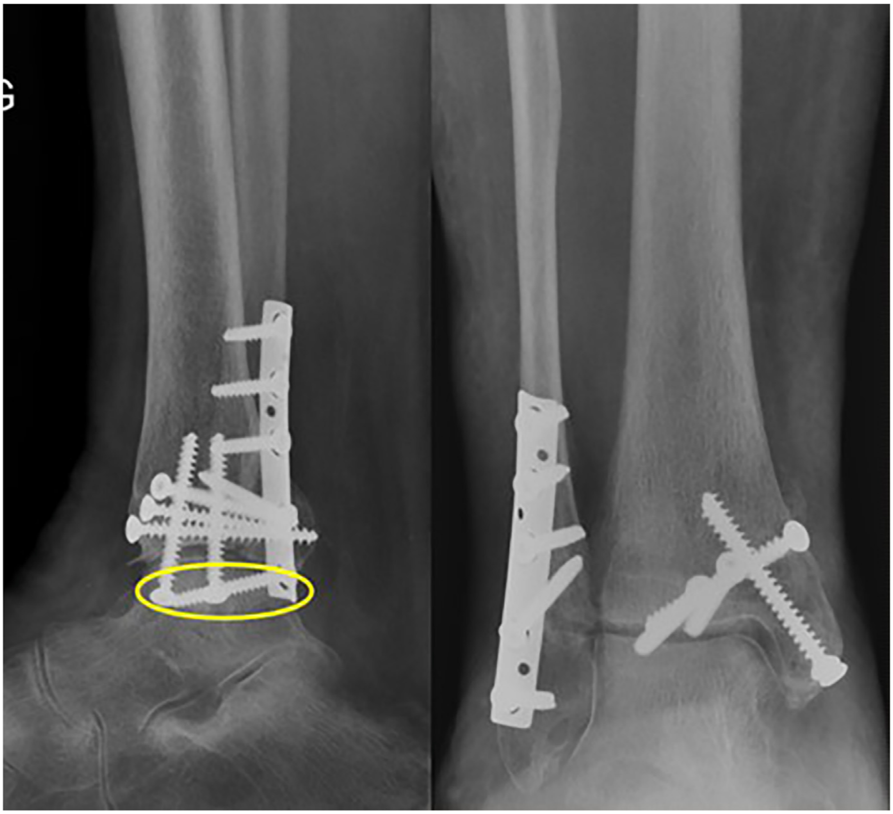

Fig. 10. Posterolateral plating of the fibula allows for distal bicortical screw purchase, producing a more stable fixation construct in osteopenic fractures.

Fig. 11. Osteopenic trimalleolar comminuted ankle fracture dislocation with a large posteromedial fragment in an elderly woman.

Fig. 12. Postoperative radiographs in the same patient, stabilized with antiglide plating of the tibia/fibula and a syndesmosis screw to prevent posterior escape of the talus.

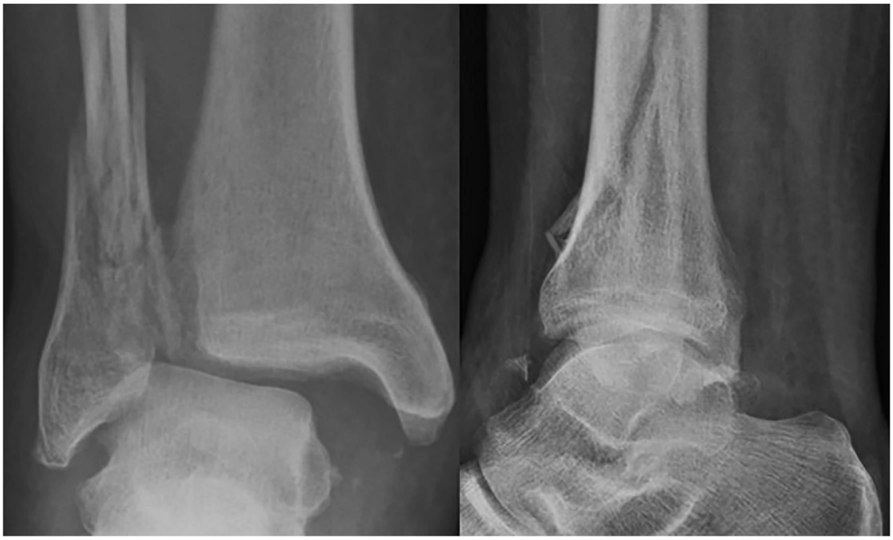

Fig. 13. Osteopenic comminuted distal fibular ankle fracture with deltoid compromise in an elderly man with neuropathy.

Fig. 14. Ankle radiographs at 5 months in the same patient. Large 4.5 mm syndesmosis screws significantly increase construct stiffness and are routinely used in this patient population, even when the syndesmosis is not compromised.

primary fracture, conventional neutralization plating, and stout 4.5 mm quadracortical syndesmotic screws. Radiographs at 5 months demonstrate a healed fibula and talus maintained in the mortise (Fig 14). This technique is routinely used in our institutions for both osteopenic and neuropathic ankle fractures alike, particularly when postoperative recommendations for non-weight bearing are assumed to be unmet in the latter population.

Intramedullary pins

This technique is well documented in the literature and is particularly useful in severe osteopenic ankle fractures where screws will purchase. Osteopenic bone has a predictably lower volume of trabecular bone with weakened cortices. Intramedullary pins add to the intracortical mass, incarcerating the fibular fragment (Fig. 15). The screw-pin interference augments bending and torsional stability.[28–30] The pins should be driven past the fracture, well into the diaphysis, and are typically placed after fracture reduction. A plate is then secured with screws to complete the construct. In some cases, passing the drill and screws along the pins may engage them, advancing the pins up the fibular diaphysis. This problem can be avoided by bending the end of the pins or clamping them at the entrance of the fibula. Alternatively, the pins can be driven after plate/screw application, though this can be more technically challenging. Such constructs permit early load in a short leg cast or boot.

Fig. 15. Intramedullary pins improve construct stability in bending and torsion for osteopenic fibular fractures.

Tension band wiring

Tension band wiring has a storied history in fracture management. It is particularly useful in short, transverse fractures of the distal fibula and the medial malleolus, especially small collicular fragments. The added benefits of this technique in the osteoporotic fracture include adjustable tensioning, multiple points of fixation through multiple cortices, and direct buttressing of any focal comminution at the major fracture line. A transverse 3.5 mm bicortical hang screw for the wire is stronger than a bone tunnel in the osteopenic fracture (Fig. 16).[31] A bone tunnel risks failure in soft bone if the wire is overtightened.

Hook plate

Manufactured plates designed for a single function tend to be expensive, nonconforming, and can be oversized on the medial malleolus. They are stiff and resist tension failure but are often too bulky to use in fragile skin envelopes. When called for, a

Fig. 16. Tension band wiring with transverse hang screw is a good choice for small bone fragments in the osteopenic ankle fracture. The screw is stronger than a bone tunnel for wire tightening. The pins should be driven into far cortex for optimal stability.

standard 1/3 semi-tubular plate may be fashioned into a hook plate with a robust wire cutter and bent into shape with pilers. The sharp end of the plate is tamped into the distal fibula or medial malleolus with the option to add an axial screw, as depicted in Fig. 17.

DIABETIC ANKLE FRACTURE FIXATION TECHNIQUES

Many of the techniques described for osteopenic ankle fractures are also used in diabetic ankle fractures because they achieve the most stable constructs for the respective fracture patterns. Aside from deranged bone turnover and the untoward effects of hyperglycemia in the diabetic patient population, special attention must be given to inevitable challenges with non-weight bearing in cases of obesity and neuropathy.

Super constructs in foot and ankle surgery are often associated with Charcot reconstruction but are also well suited to many diabetic ankle fractures. In 1995, Schon recommended multiple tetracortical syndesmosis screws along with a prolonged period of ankle immobilization and non-weight bearing.[32] Wukich and colleagues[33] evaluated more robust fixation methods for ankle fractures in complicated diabetic patients and found that “ORIF Plus” techniques with multiple large trans-syndesmotic screws—and in some cases, large transarticular Steinman

Fig. 17. Custom semi-tubular hook plates conform to bone well and are often a better choice over manufactured hook plates in the elderly patient with a tension-failure fibula fracture and thin skin envelope.

pins—resulted in fewer complications. Although the fracture patterns seen in this patient population are often no different than those seen in their nondiabetic counterparts, catastrophic failure may result when simple methods of additional fixation to establish a robust construct are ignored. The absence of syndesmosis screws can quickly produce early failure in this high-risk population, even in uncomplicated fracture patterns (Figs. 18 and 19). Standard 1/3 semi-tubular plating with numerous 4.5 mm quadracortical transsyndesmotic screws and a longer period of ankle immobilization are often adequate to maintain ankle stability in diabetic patients who are morbidly obese, neuropathic, or ignore postoperative non-weight bearing restrictions. Dynamic compression plates may also be used instead of of semi-tubular plates.

Fig. 20 demonstrates the super construct principle in a typical Weber B bimalleolar equivalent fracture. This patient was a 57 year old severely obese male with congestive heart failure and long-standing type 2 diabetes with peripheral neuropathy. He was treated with a multiple 4.5 mm syndesmotic screw “ladder” through a 1/3 semi-tubular plate with maintenance of the mortise at 9 month follow-up. Note the heterotopic ossification at the medial/distal tibial metaphysis and throughout the syndesmosis, highlighting the alteration of bone remodeling in these patients.

Fig. 18. Trimalleolar ankle fracture in severely obese patient with insulin-dependent poorly controlled diabetes and dense neuropathy.

Figs. 21–23 depict the same principle and illustrate the importance of prompt closed reduction and splinting to minimize soft tissue insult in this population. This densely neuropathic, severely obese 64 year old man with alcoholic cirrhosis and controlled type 2 diabetes sustained a trimalleolar ankle fracture equivalent (see Fig. 21). It took a week for his soft tissues to quiesce in skilled care as a robust well-molded splint maintained the reduction (see Fig. 22). ORIF was achieved with a 4.5 mm screw syndesmotic ladder through a 1/3 semi-tubular plate. He was asked to remain non-weight bearing in a short leg cast thereafter. Six weeks after surgery his cast showed signs of wear, but the ankle mortise was intact (see Fig. 23). Six months later, he was deceased.

Fig. 24 depicts a comminuted trimalleolar fracture dislocation in a 64 year old severely obese man with congestive heart failure, neuropathy, and poorly controlled diabetes (HgA1c 9%). The posterior malleolar fracture was reduced with the fibula but not fixed because the syndesmosis screws provided adequate stability. The zone of injury in the fibula was not disrupted during the approach and spanned with stacked 1/3 semi-tubular plates to increase construct rigidity (Fig. 25). This patient managed to stay off his ankle in a cast for 2.5 months as advised. The patient required a year for full recovery and did well.

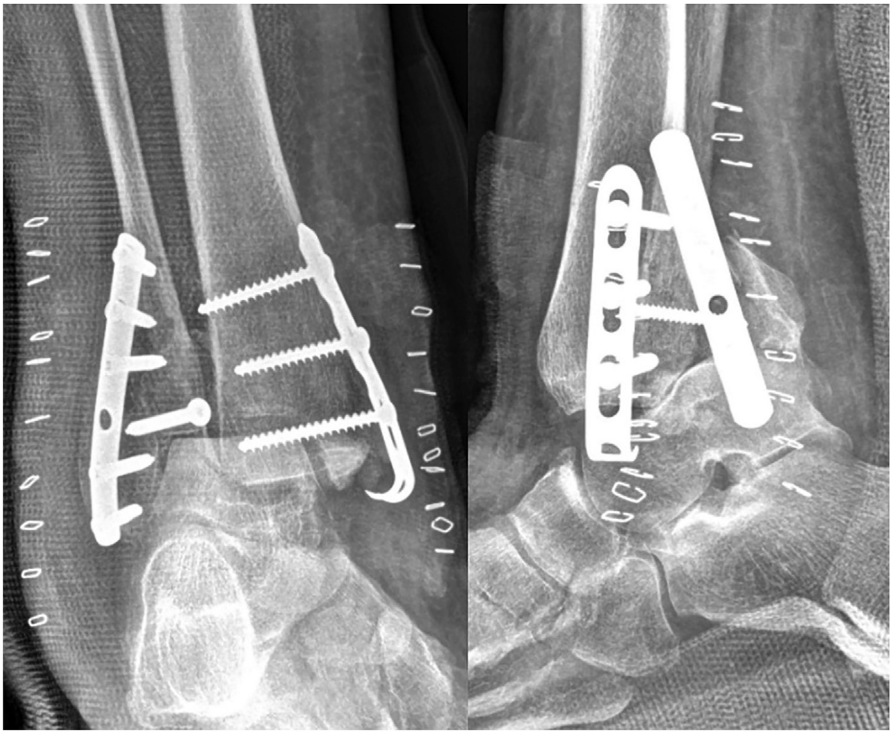

Fig. 19. Postoperative radiographs of same patient depict early failure within 2 weeks of surgery at another medical center. Note the absence of syndesmosis screws, which may have prevented re-dislocation. The patient developed a large anterior distal tibial wound and eventually required below-knee amputation.

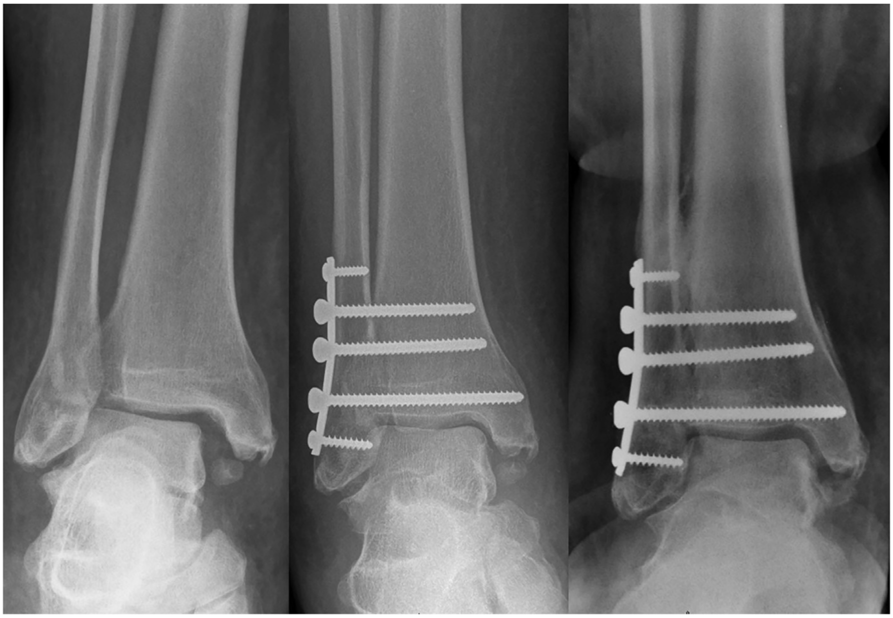

Fig. 20. The syndesmosis screw ladder superconstruct effectively stabilizes common ankle fracture patterns and produces favorable outcomes in patients with diabetic peripheral neuropathy.

Fig. 21. Trimalleolar ankle fracture in a severely obese diabetic man with dense neuropathy.

Closed reduction and percutaneous delivery of implants may be indicated for unstable ankle fractures in very high-risk patients who have numerous comorbidities and need to ambulate early to avoid cardiopulmonary decompensation. Figs. 26–28 illustrate this approach in an elderly patient with poorly controlled diabetes, end-stage renal disease on hemodialysis, extensive cardiac disease, chronic respiratory failure, and prior ipsilateral toe amputation. Little more than stab incisions were necessary to insert the plate and screws. The patient walked in a short leg cast within 2 weeks of surgery.

Charcot neuroarthropathy can produce significant morbidity in the ankle. A 77 year old female with early dementia and long-standing type 2 diabetes presented with a red, warm, and swollen ankle that was grossly unstable (Fig. 29). Elements of her history were unclear, but she may have had pedal osteomyelitis a few years prior. She had palpable pedal pulses and dense neuropathy to the leg. Work-up for infection was unremarkable and she was placed in a short leg cast for 6 weeks with close monitoring until the acute Charcot event subsided. She underwent primary tibiotalar arthrodesis with morselized fibular autogenous graft, stabilized with ring fixator over 3 months (Fig. 30). The fusion mass was stable when the fixator was removed,

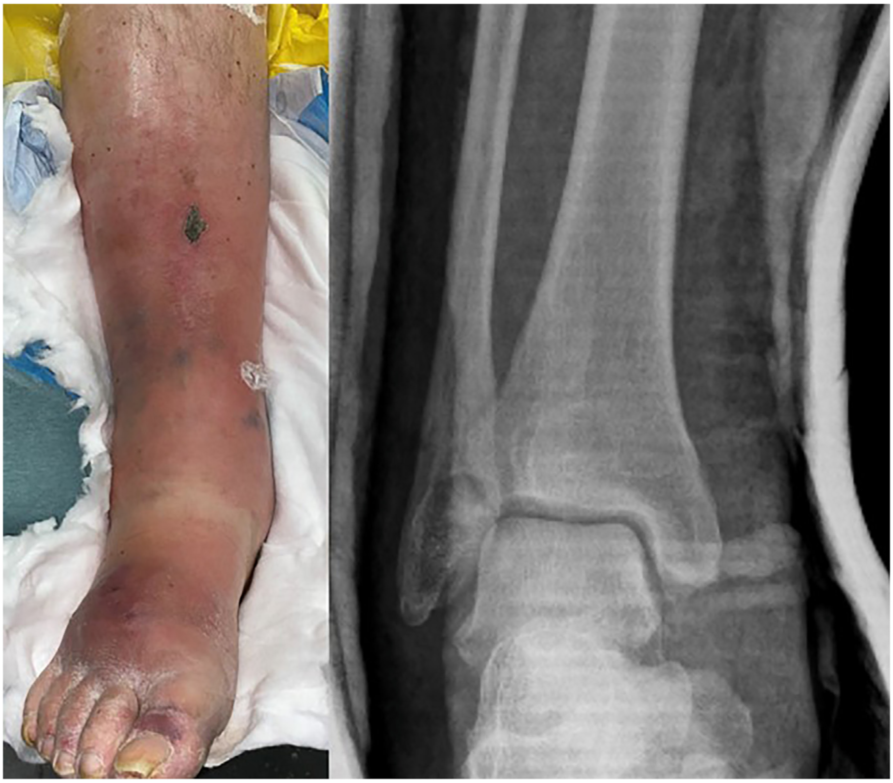

Fig. 22. Significant soft tissue inflammation in the same patient. Fracture reduction was maintained in a robust, well-molded splint.

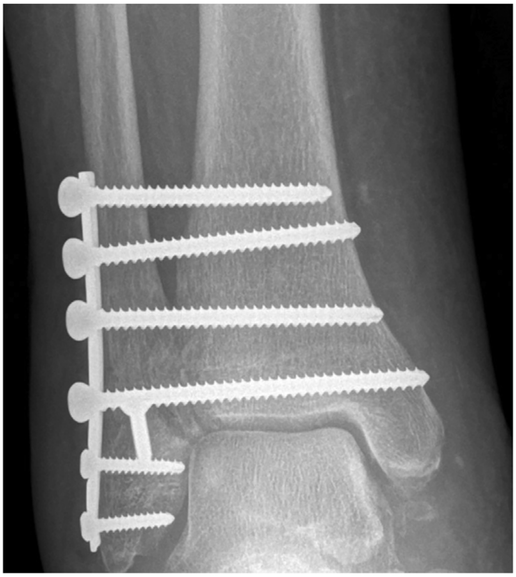

Fig. 23. Six-week postoperative radiographs in the same patient. The syndesmosis screw ladder helped to maintain an intact mortise despite the patient walking in the cast.

Fig. 24. Comminuted trimalleolar fracture dislocation in severely obese man with poorly controlled diabetes and peripheral neuropathy.

demonstrated on stress fluoroscopy (Fig. 31). Her 9-month postoperative films showed a solid fusion mass (Fig. 32). She walked without a brace, requiring only a cane.

OUTCOMES AND DISCUSSION

The core principles of ankle fracture management in both osteopenic and diabetic patients are initial soft tissue and medical management, early time to ORIF with adequate fixation, and protected weight bearing as soon as it is reasonable to prevent decompensation and morbidity.

The safe surgical treatment of elderly patients with unstable ankle fractures has been established.[34] Although prolonged immobilization in this population is recommended, the safety of early protected weight bearing has not been widely evaluated. One study from our institution over a decade ago retrospectively evaluated 216 patients over the age of 60 years with surgical ankle fractures requiring ORIF, with at least 6 months of follow-up.[19] Of these patients, 45 underwent ORIF with conventional plating methods and were allowed to weight bear with cast protection within 2 weeks; only a single patient experienced hardware failure. Overall complication rates peaked at 18.18% in patients with co-morbidities compared with 10.87% in those without. The most common complication was wound dehiscence.

More recently, techniques of both fibular intramedullary nailing and tibiotalocalcaneal (TTC) nailing with early weight bearing in elderly ankle fractures have been introduced.[35,36] Fibular nailing should be reserved for cases of significant soft tissue

Fig. 25. Final radiographs at 1 year in the same patient illustrating the techniques of stacked fibular plating for improved stability, a syndesmosis screw ladder, and spanning the zone of fibular fracture comminution.

impairment. We have not found TTC nailing necessary because of good outcomes with joint-preservation surgery. In fact, a recent randomized controlled trial demonstrated a higher complication rate and need for second surgery in TTC nailing compared with standard ORIF techniques.[37] However, TTC nailing may be necessary for limb salvage in some complex diabetic ankle fractures or those complicated by Charcot.[38,39]

The successful treatment of operative diabetic ankle fractures requires adherence to established principles of internal fixation and prolonged immobilization. A systematic review evaluated the outcomes of standard ankle fracture fixation in diabetic patients versus alternative fixation modalities—percutaneous and minimally invasive techniques (MIS)—in 11 studies.[15] There were 420 total diabetic ankle fractures: 326 standard ORIF, 80 percutaneous/MIS, and 14 combined. The predicted odds of hardware failure or migration in MIS techniques were compared with standard fixation, concluding that improved salvage rates correlate with the practice of standard internal fixation principles along with judicious glycemic control and prolonged immobilization. Literature in our institution demonstrates similar findings but

Fig. 26. Minimally displaced trimalleolar ankle fracture in very high-risk elderly patient with complicated diabetes and peripheral arterial disease.

advocates for early protected weight bearing in select diabetic patients with fewer comorbidities: 73 patients with diabetes underwent ORIF of their ankle fracture with standard internal fixation methods and were kept non-weight bearing for an average of 2 weeks, followed by weight bearing in a short leg cast or boot for 4 to 6 weeks. The most common complication was wound dehiscence or surgical site infection, but only 4.2% of patients had deep infections and no patient experienced limb amputation or death within 6 months of surgery.[40] However, in patients with complicated diabetes or those with dense neuropathy, an initial period of non-weight bearing in cast or brace and an extensive period of protected weight bearing may be necessary.[10,32]

Lastly, the medical management of osteopenia in the elderly patient cannot be overlooked. Bone health must be carefully evaluated in each patient: query for prior fragility fracture, reference existing bone mineral density scan, and inquire about medications for osteoporosis.[41] Laboratory studies should include 25-hydroxyvitamin D, serum calcium, alkaline phosphatase, parathyroid hormone,

Fig. 27. Intraoperative photographs demonstrate the minimally invasive fracture approach in the same patient. A key elevator established a subcutaneous tunnel for the fibular plate.

Fig. 28. Postoperative radiographs of the same patient depict minimal plate and screw osteosynthesis for sufficient fracture stability. The patient was permitted to walk in a short leg cast within 2 weeks of surgery and did well. (Courtesy of Lawrence Ford, DPM.)

Fig. 29. Acute ankle Charcot neuroarthropathy with marked collapse and bone resorption of the tibial plafond/talar body in this elderly woman.

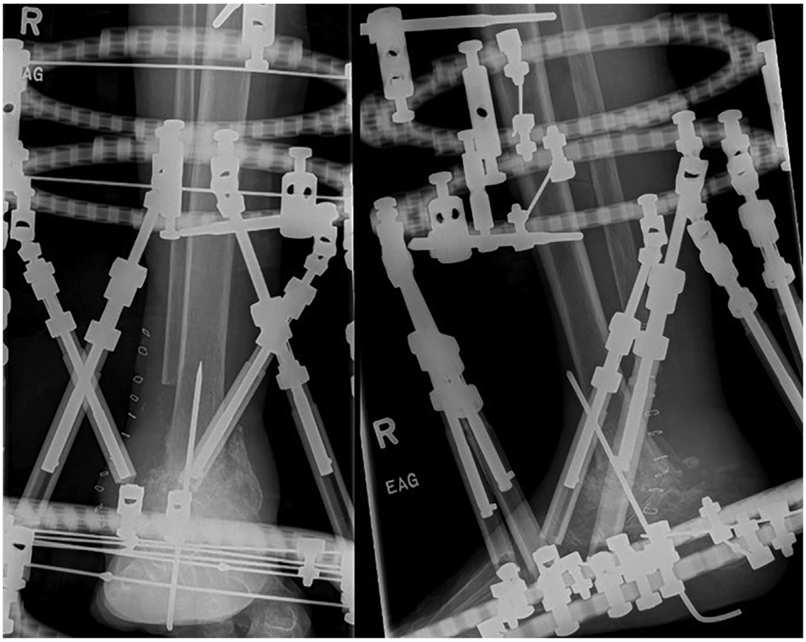

Fig. 30. The same patient underwent tibiotalar arthrodesis with morselized fibular autogenous graft and ring fixator stabilization once the acute Charcot event subsided. (In collaboration with Jack Schuberth, DPM.)

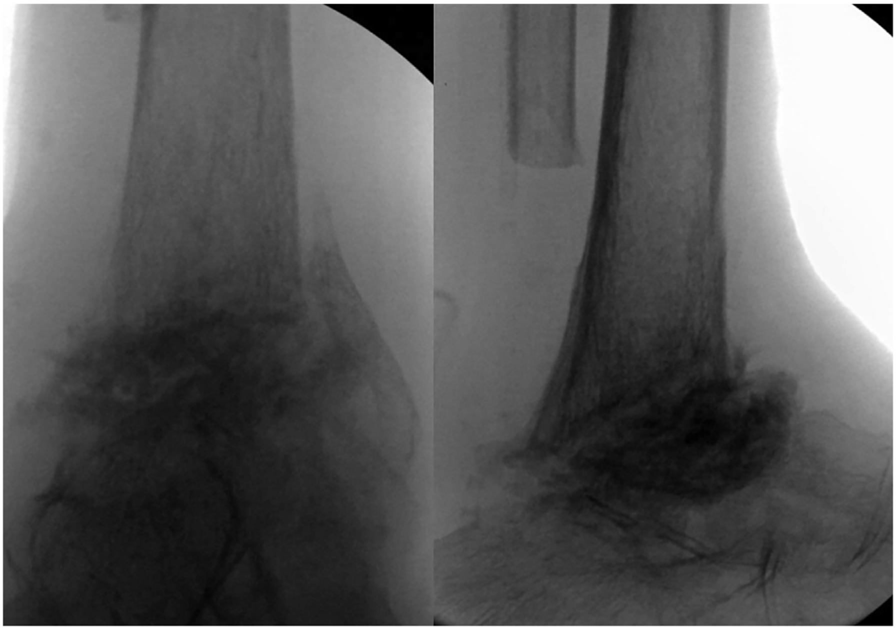

Fig. 31. Fluoroscopic stress imaging demonstrates stable fusion mass after fixator removal in the same patient.

Fig. 32. Nine month follow-up radiographs in the same patient. The fusion mass was solid and she was able to walk without a brace, cane-assisted.

and thyroid-stimulating hormone. Fall prevention and strengthening programs, reducing alcohol use, and stopping medications that may be responsible for bone loss are important. High-quality randomized controlled trials have demonstrated the efficacy of bisphosphonates for fracture prevention in osteoporotic patients.[42–44] The primary care physician and endocrinologist should collaborate on optimizing bone health to minimize the risk of additional fragility fractures. Finally, although vitamin D supplementation is often recommended in this population, our understanding about the efficacy of this treatment in fragility fracture management and prevention remains incomplete. A recent high-quality large randomized controlled trial demonstrated no significant effect in nonvertebral fractures in patients randomized to vitamin D supplementation compared with placebo counterparts.[45]

SUMMARY

Deficiencies in bone strength, fracture healing, soft tissue resilience, and host comorbidities in elderly and diabetic patients create significant challenges for the treatment of unstable ankle fractures. Patients in these high-risk groups should not be managed in the same manner as their healthy counterparts. Our experience with the treatment of these patients demonstrates satisfactory and predictable outcomes with the rational application of internal fixation principles and early cast or brace protected weight bearing in select patient groups.

CLINICS CARE POINTS

- Osteopenic and diabetic ankle fractures often present complex treatment challenges because of tenuous soft tissue, bone derangement, and host compromise.
- Prompt ankle fracture reduction and splint or cast stabilization, with careful attention to the soft tissue envelope, is the essential first step in treatment.
- Internal fixation constructs should be based on fracture mechanics and bone strength. Super constructs—most often transsyndemotic screws—are often necessary for adequate stability and prevention of failure in patients with ankle fractures.
- Expect complications, particularly in patients with complicated diabetes.
- Early protected weight bearing after ankle fracture repair is advisable for all patients except those with dense neuropathy or complicated diabetes.

DISCLOSURE

None.

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