

Arthrodesis as a salvage procedure for failed open reduction internal fixation of ankle fractures

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1 - Submitted during Post-Graduate Year 3, Corewell Health Wayne MI, Podiatric Foot and Ankle Surgical Residency

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Ankle arthrodesis is a commonly performed procedure for the treatment of end stage ankle arthritis however, it can also be valuable in lower extremity trauma. Limited literature has been reported on patients who have undergone an ankle arthrodesis as a salvage procedure because of non-compliance following multiple surgical attempts to repair a Weber C ankle fracture. The purpose of this case report was to examine how non-compliance has detrimental effects on the outcomes of surgical repair of ankle fractures. We also demonstrate the stability and reliability of ankle arthrodesis as an end stage treatment option for ankle fractures. We present a case of a 21-year-old male who reported to the Emergency Department for evaluation and treatment of his left ankle injury. Radiographs revealed a comminuted displaced Weber C ankle fracture. The patient initially underwent surgical intervention consisting of an open reduction internal fixation. Secondary to non-compliance consisting of early and excessive weight bearing, the patient required additional surgeries. Considering his age, multiple attempts were made to preserve the patient's ankle range of motion. Due to failure to comply with postoperative instructions, the patient developed significant valgus mal-alignment of his ankle, diastasis of the syndesmosis in addition to a comminuted displaced distal fibular diaphyseal fracture. In attempts to salvage his limb, an ankle arthrodesis was performed utilizing an intramedullary nail with the addition of a circular multiplanar external ring fixator. The external fixator was removed once consolidation was noted across the ankle arthrodesis site which was approximately 5 months following application. At his 12-month follow up, the patient was able to ambulate without assistance and was pain free.

Keywords: open reduction internal fixation, range of motion, non-weight bearing, below knee amputation, limb salvage, ankle arthrodesis

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Ankle fractures account for 10% of all fractures in the human body and are the second most common lower extremity fractures encountered in the Emergency Department [1]. Ankle fractures are typically seen in the younger male population with the mean age being 37 years old [1]. Ankle fractures have an inherent risk of complications. Management of ankle fractures consist of either conservative or surgical intervention. Conservative treatment options are typically reserved for non-displaced ankle fractures or patients that are unable to undergo surgery secondary to comorbidities. Surgical intervention is recommended for displaced or unstable ankle fractures. However one must appreciate the potential risk factors. The goal of ankle fracture surgery is to restore anatomic alignment of the ankle mortise and provide stability of the ankle. Open reduction internal

fixation (ORIF) is the most utilized procedure for a displaced or unstable ankle fracture [2]. Typical postoperative instructions include strict non-weight bearing to the surgical limb utilizing a below the knee cast or a protective boot until radiographic osseous healing is achieved. A study performed by Friedman, et al., demonstrated that the average radiographic osseous time to healing following surgical intervention of an ankle fracture was 82.2 days (± 33.5 days) [3]. We present a case where multiple surgical procedures were necessary because of non-compliance of postoperative instructions and subsequent displacement and mal-alignment. The patient failed multiple attempts of joint preservative surgery which ultimately led to an ankle arthrodesis for definitive treatment in attempts to salvage his limb.

Case Report

A 21-year-old male presented to the Emergency Department complaining of severe pain to the left ankle after sustaining a fall. His medical history was significant for class III obesity (BMI of 48.2), bipolar disorder and substance abuse. His surgical history was unremarkable. He had no known drug allergies and was not taking any medication. He admitted to smoking 1 pack per day for 6 years, daily heavy marijuana use and 5 alcoholic beverages per week.

Initial radiographic imaging obtained in the Emergency Department revealed a severely comminuted displaced Weber C bimalleolar equivalent ankle fracture. There was widening of the medial clear space and decrease in the tibia-fibula overlap indicating a syndesmotic ligament tear (Figure 1A).

The patient was examined by a foot and ankle surgeon at an outside facility who determined that his ankle fracture required surgical intervention secondary to displacement and instability. Surgery consisted of ORIF of his left ankle. The fracture was reduced and stabilized using two 3.5mm interfragmentary screws. The comminuted fibular fracture was then bridged with one 10 hole 1/3 tubular plate and five 3.5mm locking bone screws. Additionally, two olive wires were left in place. The syndesmosis was reduced and stabilized with flexible fixation (Figure 1B).

One week following his surgery, the patient disregarded postoperative instructions and prematurely bore full weight to the surgical limb. He sustained another fall which unfortunately caused displacement and failure of hardware in the ankle.

The patient was then referred to our clinic for further management. New radiographs were obtained which demonstrated comminution with significant loss of bone across the fracture site at the distal fibular diaphysis with increased medial gutter clear space. There was also a decrease in the tibia-fibula overlap signifying failure of the flexible syndesmotic fixation (Figure 2A). On the lateral radiograph you can also appreciate the significant comminution noted to the distal fibular diaphysis (Figure 2B).

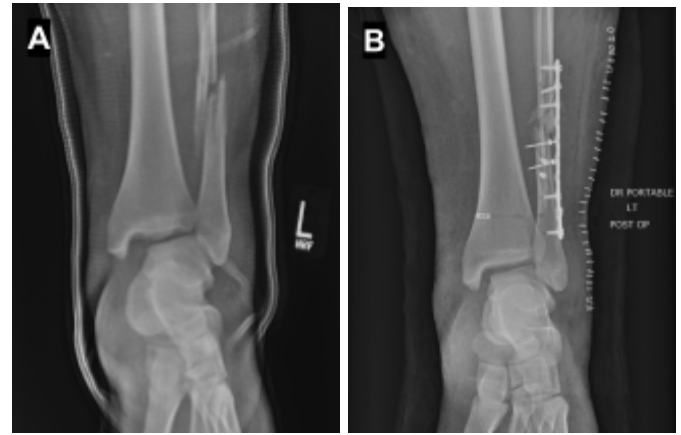


Figure 1 A: Radiographs of the initial injury demonstrating a comminuted displaced Weber C bimalleolar equivalent ankle fracture with diastasis of the syndesmosis. B: Radiographs of the left ankle immediately post ORIF of the left ankle at an outside facility. Demonstration of malreduction of fibula secondary to shortened fibula with lateral talar shift, mild widening of the medial clear space. The fibula was not brought back to length. The syndesmosis was inadequately reduced and stabilized with flexible fixation.

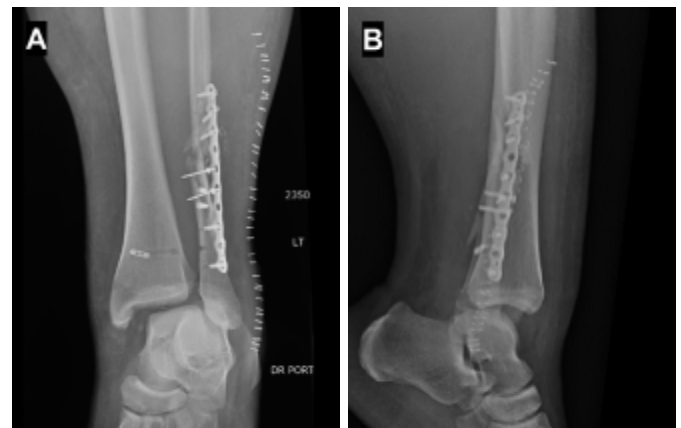


Figure 2 One week since initial injury, one week following ORIF. Patient sustained a fall. A: Anteroposterior ankle view demonstrating comminution of the Weber C ankle fracture, increase in the medial clear space with complete tear of the syndesmosis. B: Lateral view of the ankle demonstrating comminution at the distal fibular diaphysis and subluxation of the ankle.

Secondary to instability a revisional ORIF of his left ankle with removal of retained failed hardware was planned. The goal of revisional surgery was to restore anatomical alignment and preserve his ankle joint motion. The comminuted fibular diaphyseal fracture was reduced ensuring the fibular length was restored and was stabilized using one 10 hole 1/3 tubular lateral plate, one 8 hole 1/3 tubular anterior plate and filled with fourteen 3.5mm bicortical bone screws.

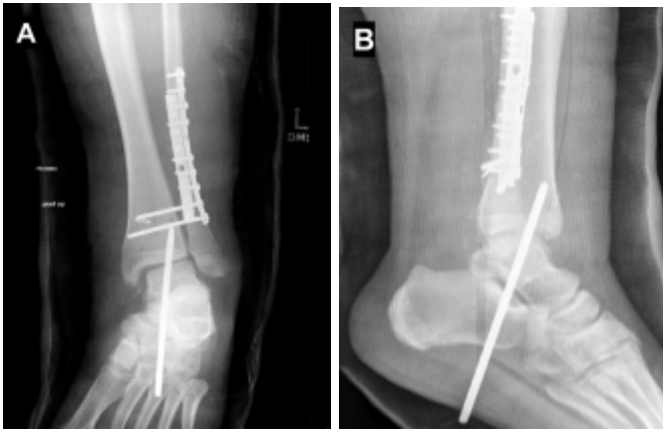


Figure 3 Second surgery, revisional ORIF of the left ankle. A: Ankle mortise view obtained immediately postoperative demonstrating lateral and anterior fibular plates, 2 syndesmotomies 3.5 mm screws and one temporary trans-articular Steinman rod. B: Lateral ankle view obtained immediately postoperative after revisional ORIF of the ankle. The previous severe displacement has been reduced and stabilized postoperatively.

Additionally, since there was significant bone loss at the fibular fracture, allogenic bone graft was used to fill the void. The tibiofibular syndesmosis was reduced and was fixated using two 3.5mm quadricortical syndesmotomies proximal to the ankle joint. Additionally, a temporary trans-articular Steinman rod [4] was not only utilized as a joystick to obtain appropriate reduction (Figure 3A) but was also left in place as an attempt to discourage early weight bearing (Figure 3B). The Steinman rod was removed at his 8 weeks follow up clinic visit.

Approximately 4 months following the revisional ankle surgery, the patient was intoxicated and fell once again. This resulted in valgus displacement of the ankle mortise with an increase in the medial clear space (Figure 4). Due to repeated injuries to his ankle we recommended a fusion of the ankle joint in an attempt to salvage his limb. The patient was adamant and refused a fusion as he wanted to preserve motion of his ankle. Following a lengthy discussion, patient education and review of patient expectations, a second revisional ORIF of the left ankle was performed approximately 4 months following his last surgery.

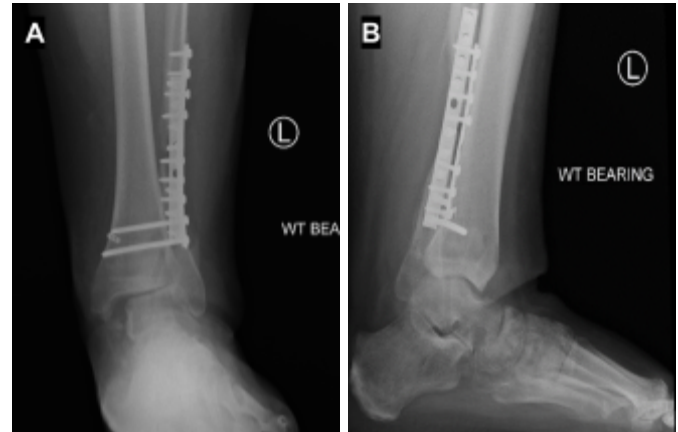


Figure 4 Four months since initial surgery. Ankle displacement following revisional ORIF. A: Antero-Posterior and B: Lateral view of the ankle demonstrating mal-alignment, widening of the medial clear space with valgus tilt of the talus. The lateral malleolus has shifted laterally. Of importance, there was compression of the distal anterior lateral aspect of the tibia.

The second revision of the ankle was reinforced with an additional one 8 hole locking compression plate. Three 3.5mm bone screws were removed from the distal aspect of the 10 hole 1/3 tubular plate to allow placement of a locking compression plate. This plate was placed over a portion of the 10 hole lateral 1/3 tubular plate. To compensate for significant bone loss supplemental allogenic bone graft was utilized. Additionally, there was significant bone loss at the fracture site of the fibula which was filled with allogenic bone graft. The syndesmosis was then reduced and stabilized using four 3.5mm syndesmotomies bone screws. The remaining distal holes of the locking compression plate were stabilized with five 2.7mm locking screws (Figure 5A). Two large Steinman rods were used for temporary trans-articular fixation to aid in stability of the ankle mortise (Figure 5B). The Steinman rods were removed during his 8 week postoperative clinic visit.

Following removal of the two Steinman rods, the patient was lost to follow-up. Two years later he presented to our clinic with a complaint of severe pain to his left ankle which he graded as a 10 out of 10. The patient stated that one month prior to this clinic visit he was again intoxicated and fell. Because of his severe pain, the patient had difficulty bearing weight and used a cane for ambulation.

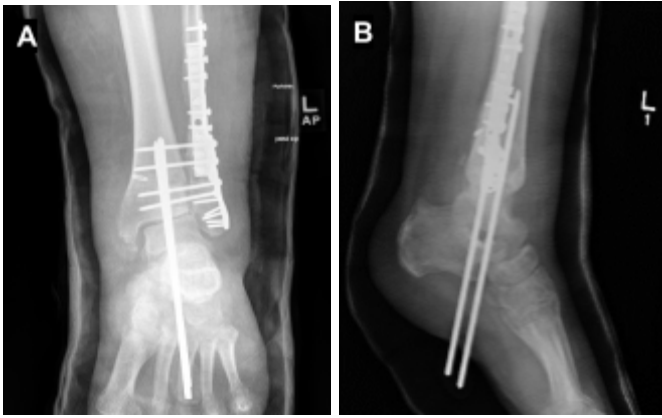


Figure 5 Third surgery – second revisional ORIF. A: Anteroposterior view of the ankle following an additional revisional ORIF of the left ankle consisting of three fibular plates, four 3.5 mm syndesmotic screws and two temporary trans-articular Steinman rods. B: Lateral view of the ankle demonstrates anatomic alignment of the ankle mortise.

Radiographic findings were significant for a valgus displacement of the ankle. There was significant widening of the tibia-fibula articulation indicating complete rupture of the syndesmotic ligaments. Of important note, there was compression osteonecrosis noted to the distal anterior lateral aspect of the tibia (Figure 6A). On the lateral radiographic view there was posterior translation of the foot (Figure 6B).

Arthrodesis of the ankle joint was recommended once again due to multiple traumatic events and repeated displacement of his ankle. In addition, the patient was given the option of pursuing a below the knee amputation (BKA) since previous attempts to salvage the limb had been unsuccessful secondary to his non-compliance. The patient refused the BKA and requested every attempt to save his limb and opted for the ankle fusion.

The patient underwent subsequent removal of retained orthopedic fixation that was obstructing the planned ankle arthrodesis. The fusion of the ankle joint was performed utilizing an intramedullary nail via a transmalleolar approach which has been described by Yasui Y, et al., [5]. A static ring external fixator device was used for additional stability (Figure 7A). His postoperative course was uneventful and at his 5 month postoperative visit there was complete consolidation through the ankle fusion site therefore we subsequently removed the external ring fixator. Twelve months following the ankle fusion the patient was pain free and expressed gratitude for saving his limb. Final ankle radiographs demonstrated complete consolidation of the fusion site (Figure 7B).

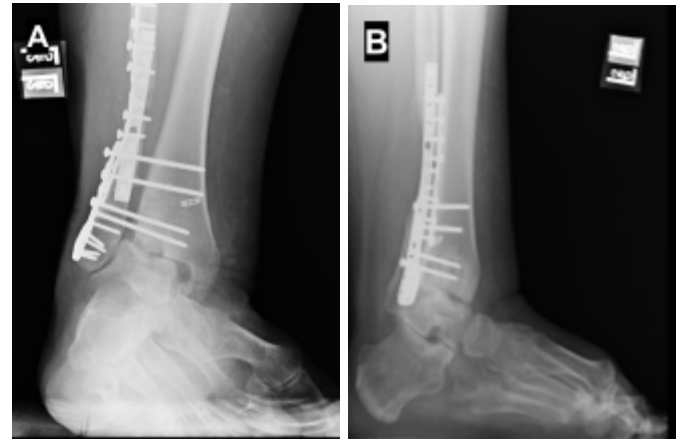


Figure 6 A: Valgus malalignment of the ankle. Radiographic evidence of diastasis of the syndesmosis indicating complete rupture of the syndesmotic ligaments, widening of the medial clear space and compression at the anterior distal lateral aspect of the tibia. B: On the lateral view, there is posterior translation of the foot.

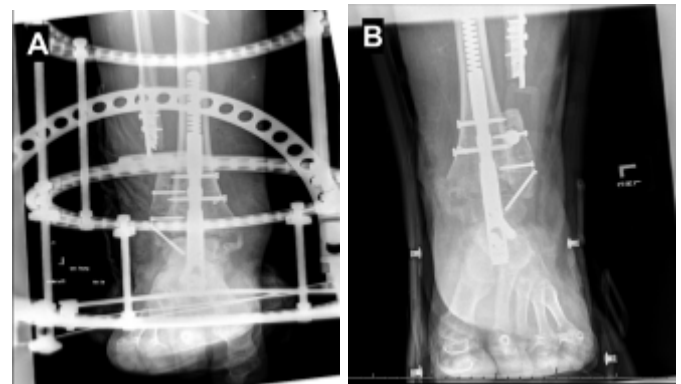


Figure 7 Fourth Surgery – ankle arthrodesis. A: Anteroposterior radiograph following ankle arthrodesis using an intramedullary nail with application of a circular multiplanar external ring fixator. B: External fixator was removed 5 months following its application. Radiographs demonstrate consolidation across the ankle joint.

Discussion

Compliance of patients following surgical intervention continues to remain a difficult task to overcome by many foot and ankle surgeons. Adherence to postoperative weight bearing status is extremely important and lack of compliance can lead to serious complications including failure of hardware, wound breakdown and infections. Despite extensive discussion consisting of patient education along with direct postoperative instructions, many patients either do not understand or blatantly ignore these specific instructions.

A study performed by Gershkovich, et al., demonstrated that 88% of their patients who underwent foot and ankle surgery were not compliant with their weight-bearing status despite education and instructions [6]. Unfortunately this was the case for our patient who did not remain NWB and fell multiple times. Despite lengthy discussions and best efforts we were unable to preserve his ankle motion secondary to noncompliance. His continued disregard for post-operative instructions led to limb salvage via ankle fusion at the age of 23 years old.

There has been a strong link between smoking and delayed bone healing. Tobacco use reduces blood flow which can increase complications and increase risk of delayed bone healing during fracture care. Not only has tobacco been shown to negatively impact bone healing but it also has an overall negative impact on patient's health and smokers are more likely to develop chronic illnesses including chronic obstructive pulmonary disease, lung cancer and heart disease. Given our patient's significant social history consisting of heavy daily marijuana use, this could have contributed to the poor bone healing and subsequent displacements of his ankle. A study by O'Connor, et al., demonstrated that cannabis use in patients who underwent recent orthopedic surgery following traumatic injuries had inhibited bone metabolism and repair [7]. An additional study by Sophocleous, et al., demonstrated that heavy cannabis use is associated with a high bone turnover and an increased risk of fracture [8].

The ankle joint is important during the gait cycle as it adapts to surfaces when we walk. When the ankle joint is fused it increases energy consumption of the knee and hip joints during walking. Long term restrictions of motion can lead to fatigue and damage to the lower limb muscles. Preservation of ankle joint motion following ankle injuries is important to reduce arthritis of other joints. Ankle arthrodesis is typically reserved for osteoarthritis or post-traumatic arthritis of the ankle joint. As demonstrated by Patel, et al., there are high rates of complications following arthrodesis of the ankle joint [9]. Ankle arthrodesis has complications with non-union ranking the most common complication seen following these procedures [10]. Early premature weight bearing was associated with increased risk of hypertrophic non-union of the ankle joint following arthrodesis [11]. Therefore, arthrodesis is typically reserved for a last stage option.

Utilizing an Ilizarov ring fixator device with the use of internal fixation, produces a high union rate and leads to general improvement in clinical and surgical outcomes following ankle arthrodesis [12]. The use of internal fixation with the addition of an external fixator device has been shown to provide the greatest stability with the highest rate of osseous union in patients who have undergone arthrodesis of the ankle joint [12].

In conclusion, ankle fractures can be challenging to treat surgically and have higher rates of complications. Surgical treatment for ankle fractures depends on the patient's bone quality, comorbidities and age. Adherence to postoperative care is of utmost importance following surgical repair of an unstable ankle fracture and non-compliance can add a layer of complexity to the outcomes. Unfortunately, foot and ankle surgeons cannot predict noncompliance. However, this may be worth consideration when selecting a fixation construct intra-operatively. Ankle fracture management can restore ankle motion. However, in situations such as presented in this case, recurring fractures and displacement of the ankle mortise secondary to non-compliance can lead to significant damage to the ankle joint. This extensive damage can lead to loss of motion with arthrodesis of the ankle joint as the only treatment option.

Financial disclosure: None

Conflict of interest declaration: None

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