Surgical Management of Ankle Fractures in Patients with Diabetes

Dealing with complications can present challenges.

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Ankle fractures are seemingly straightforward injuries; however, in the patient with diabetes, this injury can have disastrous outcomes. Given the rise in diabetes (and increased incidence of complications due to diabetes), it is important to be aware of its impact when treating ankle fractures. Patients with diabetes have a higher risk of complications after sustaining an ankle fracture. Multiple studies have reviewed the outcomes of ankle fractures in patients with diabetes and increased rates of complications have been reported with both conservative and surgical management.[1] A retrospective review comparing surgically treated ankle fractures in patients with diabetes to those without, demonstrated significantly more complications in the patients with diabetes.[2] Reported complications following open reduction and internal fixation (ORIF) of ankle fractures in patients with diabetes include wound infection, nonunion, Charcot neuroarthropathy, loss of fixation, increased rates of revision surgery, and amputation.[3,4] Limb salvage after failed ORIF can be very challenging and often requires multiple operative procedures.[5]

In a large population-based study, SooHoo and colleagues identified 57,183 operatively managed ankle fractures, whereas 1,219 were complicated diabetic ankle fractures (defined as those with end-organ damage).[3] The authors found a significant increase in complication rates (wound infection, revision operation, and BKA) in the complicated diabetic group. Similarly, Wukich, et al. reported on their outcomes of ankle fractures in patients with diabetes and found that patients with complicated diabetes had the highest rates of complications.[4] The authors concluded that it is the complications of diabetes that increase the risk of further complications following ORIF of ankle fractures.

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Fracture Management

Fracture management in this patient population requires an understanding of the impact of the disease process and its inherent challenges. Accordingly, it is important to follow the basic tenets of fracture management and be familiar with fixation techniques and constructs that are advantageous for the management of high-risk ankle fractures. This article will present principles of ankle fracture management, including fixation techniques and constructs that may facilitate improved outcomes in treating diabetic ankle fractures.

Is Conservative Care an Option?

One must determine whether a non-operative or surgical approach is ideal for optimal outcome and to minimize complications.[6] In a retrospective review comparing complication rates in non-operative versus operative treatment of displaced diabetic ankle fracture, Lovy, et al. found that non-operative treatment was associated with a 21-fold increased odds of complication compared with operative treatment.[7] The authors concluded that non-operative treatment of displaced diabetic ankle fractures was associated with unacceptable high complications when compared to ORIF. Therefore, conservative therapy should only be considered for non-displaced, stable ankle fractures, ideally isolated lateral malleolar fractures. Schon, et al. reported a series of 16 neuropathic diabetic patients with non-displaced ankle fractures treated non-operatively with a cast or brace and all patients went on to fracture healing.[8]

However, conservative treatment is not without risk. Flynn and colleagues[3] reported their outcomes on 25

Continued on page 106

Ankle Fractures *(from page 105)*

patients with diabetic ankle fractures who were treated by either surgical or non-surgical methods. Of the six treated non-operatively, four developed infections from skin ulcerations. The risk of infection appeared to correlate with a duration of diabetes of >10 years, poor medical compliance, peripheral vascular disease, peripheral neuropathy, and bimalleolar and trimalleolar ankle fracture patterns.

Patients treated non-operatively must be followed closely and require more frequent follow-up visits and cast changes. The surgeon should inspect both the affected and unaffected limb and have a heightened index of suspicion for the development of complications, such as skin breakdown, infection, and Charcot neuroarthropathy. The Charcot syndrome is a rapidly progressive and debilitating complication and may lead to severe deformity, ulceration, and amputation. Early recognition of the development of Charcot and rapid intervention is most important and is associated with significant lower incidence of complications, in contrast to a delay in diagnosis and intervention.

Patients may require an extended period of immobilization and prolonged non-weight-bearing until sufficient fracture healing is noted. Patients must be counseled on the risks of non-operative care as they may require unintended ORIF for persistent non-union or mal-union when treated non-operatively.[7]

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Key Pointers on Surgical Management

Displaced, unstable ankle fractures treated non-operatively are associated with an unacceptably high complication rate when compared to ORIF and should only be reserved when the risk of surgery outweighs the risk of complications. The primary goal of ORIF is to achieve anatomic healing of the ankle mortise to improve function and decrease complications. In a series by Schon and colleagues, poor outcome after ORIF of ankle fractures in patients with diabetes and neuropathy was attributed to inadequate reduction, suboptimal fixation, and an inadequate period of non-weight bearing.[9]

Being mindful of the soft tissue envelope is an important management priority for ankle fractures. Ideally, operative management should be delayed until edema is controlled, fracture blisters have resolved, and skin lines have returned.[10] Any marked deformities or dislocations may be reduced and if unstable, a spanning external fixator may be applied (Figure 1). Otherwise, patients are placed in a splint for compression and immobilized until soft tissue is normalized and ready for surgery.

Figure 1: A spanning external fixator provides skeletal stabilization, allows normalization of soft tissue, and is left in place until definite ORIF is performed.

A biologically-friendly approach for fracture reduction should be used to create an environment that is favorable for healing. Advances in plating designs and the introduction of fibula nails have allowed surgeons the opportunity to consider using a percutaneous or a mini-open approach. However, often a completely percutaneous approach is not possible and meticulous surgical technique is essential to reduce disruption of the soft tissue envelope, and every attempt is made to minimize rough handling and overzealous dissection.

Restoring anatomic length, rotation, and obliquity to the fibula is essential. Nwoko and colleagues recently reported difficulty reducing fibular fractures in diabetic ankle fractures due to glycation of the peroneal tendons and performed peroneal tendon lengthening as an adjunct procedure to aid in the reduction of the lateral malleolus.[11]

Poor Bone Quality in Diabetics

Poor bone quality is often noted in patients with diabetes and neuropathy; as a result, it may be unrealistic to expect traditional fixation constructs to maintain stability. Consequently, fixation failure and loss of correction may occur. Choosing the appropriate fixation construct is critical for success. Recent advances in fixation design, such as locking plate technology, intramedullary nails, external fixation, and techniques such as supplemental fixation have effectively enhanced outcomes in this high-risk population.

Locking Plates

Locking plates provide a fixed angle construct with increased pull out strength. The locking mechanism between the plate and screw head prevents toggle and pullout, thereby having the advantage of providing improved fixation for fracture care in osteoporotic bone. One must recognize the absolute stability

Continued on page 108

Ankle Fractures *(from page 106)*

achieved with the locking plate, and locking screws should only be added after compression is obtained; otherwise, if not applied correctly, locked plates may impede bone healing. At times, comminuted fractures may not be amenable to interfragmental compression and, in this situation, one should bridge across the comminuted fracture zone. Bridge plating with locking plates overcome several of the disadvantages of conventional plate fixation and provide a construct sufficiently stable to allow for fracture healing (Figure 2).[12] Longer plates increase the rigidity of the construct.

Figure 2: Bridge plating technique used for a comminuted fibula fracture. A locking plate spans the fracture zone, and the construct was enhanced by using multiple syndesmotic screws.

Supplemental Fixation

Supplemental fixation is commonly used to manage osteoporotic or neuropathic diabetic ankle fractures.[13] Supplemental fixation may be achieved in numerous ways for ankle fractures: 1) syndesmotic screws with tetra-cortical purchase,[14] multiple or stacked plates, intramedullary fixation, external fixation,[13,15] and transarticular fixation.[16]

The bone strength of the fibula may not be sufficient to hold screws well and the use of multiple transsyndesmotic screws increases the rigidity of the entire fixation construct. Syndesmotic screw fixation should be considered for all unstable diabetic ankle fractures, especially those with poor bone stock to enhance fixation (Figure 3).[9,12,14]

If the soft tissue permits, multiple or stacked plates may be used for severely comminuted distal tibia or pilon fractures. Multiple plates offer increased stability and help neutralize deforming forces that may occur over the time it takes for the bone to heal. This added stability is beneficial and helps prevent late collapse and/or mal-union.

Figure 3: Multiple syndesmotic screws used to increase the rigidity of the fixation construct for a comminuted distal fibula fracture in a patient with poor bone quality.

External Fixation

External fixation may be useful to supplement an internal fixation construct or may also be considered in patients with a compromised soft tissue envelope and/or history of infection.[15] This technique is also useful in managing ankle fractures that are associated with severe joint dislocations, allowing the necessary stabilization of the previously dislocated joints.[12]

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Intramedullary Nail Fixation

Intramedullary nail fixation with percutaneous reduction of the fracture has the advantage of a biologically friendly approach by limiting soft tissue disruption and preserving the soft tissue envelope around the fracture site. Ashman and colleagues retrospectively reviewed the results of fluoroscopy-guided reduction and percutaneous fibular nail fixation for unstable ankle fractures in 24 adult patients with diabetes. They found that this technique was associated with a low incidence of wound and overall complications and provided effective surgical fixation.[17]

Transarticular Fixation

Transarticular fixation may be considered to prevent late joint subluxation and to supplement the fixation construct.[16] The disadvantage of transarticular fixation is the iatrogenic injury created across the articular surfaces. Often, this is not a major concern particularly in patients with neuropathy.

Post-operatively, patients are placed in a compressive splint for immobilization and are non-weight-bearing. Initially, they are seen weekly and then biweekly to monitor the incision

Continued on page 110

Ankle Fractures *(from page 108)*

and surrounding skin as well as the fracture position radiographically. Both the affected and unaffected extremity should be evaluated throughout the post-operative period with a heightened index of suspicion for the possible development of Charcot neuroarthropathy. These patients often require extended periods of non-weight-bearing of up to 12 weeks.

Figure 4: Unstable ankle fracture with significant bone loss in a patient with diabetes, neuropathy and poor bone quality.

Figure 5: Primary ankle fusion used to treat an unstable ankle fracture in a patient with diabetes, neuropathy, and poor bone quality.

Is Primary Fusion an Option?

Due to the increase in rates of complications and poor functional outcomes when treated conservatively and surgically, some surgeons have advocated primary fusion for unstable ankle fracture in patients with diabetes. Primary fusion has been suggested as an alternative to ORIF when acceptable reduction and mechanical stabilization cannot be obtained (Figures 4 and 5). Ebaugh and colleagues proposed a minimally invasive tibiotalocalcaneal fusion (using an intramedullary nail without formal joint preparation) as a primary treatment for ankle fractures in patients with complicated diabetes.

The authors reported on 27 patients with complicated diabetes who underwent this procedure and reported a limb salvage rate of 96%, fracture union rate of 88%, and surgical complication rate of 18.5%. The authors concluded that a minimally invasive tibiotalocalcaneal fusion as primary treatment of ankle fracture was an appropriate approach to increase overall survivability of threatened limbs and lives in this patient population.[18]

Conclusion

Diabetic patients with ankle fractures are at greater risk of having a complication during treatment compared with patients without diabetes. It is important to understand the impact of the disease process and its inherent challenges. Many studies highlight the importance of employing sufficiently stable fixation constructs to achieve anatomic fracture healing. Continued advances in fixation design and techniques have facilitated improved outcomes in this high-risk population. However, despite these advances, there is still a need for further evolution and improvement to address these difficult injuries. **PM**

Bibliography

[1] McCormack, R.G. and J.M. Leith, Ankle fractures in diabetics. Complications of surgical management. J Bone Joint Surg Br, 1998. 80(4): p. 689-92.

[2] Blotter, R.H., et al., Acute complications in the operative treatment of isolated ankle fractures in patients with diabetes mellitus. Foot Ankle Int, 1999. 20(11): p. 687-94.

[3] SooHoo, N.F., et al., Complication rates following open reduction and internal fixation of ankle fractures. J Bone Joint Surg Am, 2009. 91(5): p. 1042-9.

[4] Wukich, D.K., et al., Outcomes of ankle fractures in patients with uncomplicated versus complicated diabetes. Foot Ankle Int, 2011. 32(2): p. 120-30.

[5] Vaudreuil, N.J., M.S. Fourman, and D.K. Wukich, Limb Salvage After Failed Initial Operative Management of Bimalleolar Ankle Fractures in Diabetic Neuropathy. Foot Ankle Int, 2017. 38(3): p. 248-254.

[6] Bibbo, C., et al., Complications of ankle fractures in diabetic patients. Orthop Clin North Am, 2001. 32(1): p. 113-33.

[7] Lovy, A.J., et al., Nonoperative Versus Operative Treatment of Displaced Ankle Fractures in Diabetics. Foot Ankle Int, 2017. 38(3): p. 255-260.

[8] Schon, L.C., M.E. Easley, and S.B. Weinfeld, Charcot neuroarthropathy of the foot and ankle. Clin Orthop Relat Res, 1998(349): p. 116-31.

[9] Schon, L.C. and R.M. Marks, The management of neuroarthropathic fracture-dislocations in the diabetic patient. Orthop Clin North Am, 1995. 26(2): p. 375-92.

[10] Mandracchia, D.M., V.J. Mandracchia, and D.E. Buddecke, Jr., Malleolar fractures of the ankle. A comprehensive review. Clin Podiatr Med Surg, 1999. 16(4): p. 679-723.

[11] Nwoko, N.C., E. Rodriguez-Collazo, and M.L. Goldflies, Peroneal Tendon Lengthening as an Adjunct Procedure to Aid in the Reduction of the Lateral Malleolus in Diabetic Ankle Fractures: 2 Case Reports. J Foot Ankle Surg, 2019.

[12] Bevilacqua, N.J. and J.J. Stapleton, Advanced foot and ankle fixation techniques in patients with diabetes. Clin Podiatr Med Surg, 2011. 28(4): p. 661-71.

[13] Wukich, D.K. and A.J. Kline, The management of ankle fractures in patients with diabetes. J Bone Joint Surg Am, 2008. 90(7): p. 1570-8.

[14] Perry, M.D., et al., Salvage of failed neuropathic ankle fractures: use of large-fragment fibular plating and multiple syndesmotic screws. J Surg Orthop Adv, 2005. 14(2): p. 85-91.

[15] Marin, L.E., D.K. Wukich, and T. Zgonis, The surgical management of high- and low-energy tibial plafond fractures: A combination of internal and external fixation devices. Clin Podiatr Med Surg, 2006. 23(2): p. 423-44, vii.

[16] Jani, M.M., et al., A protocol for treatment of unstable ankle fractures using transarticular fixation in patients with diabetes mellitus and loss of protective sensibility. Foot Ankle Int, 2003. 24(11): p. 838-44.

[17] Ashman, B.D., et al., Fluoroscopy-guided reduction and fibular nail fixation to manage unstable ankle fractures in patients with diabetes: a retrospective cohort study. Bone Joint J, 2016. 98-B(9): p. 1197-201.

[18] Ebaugh, M.P., et al., Outcomes of Primary Tibiotalocalcaneal Nailing for Complicated Diabetic Ankle Fractures. Foot Ankle Int, 2019: p. 1071100719869639.

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