Dual plating technique for comminuted second metatarsal fracture in the diabetic obese patient: A case report.

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Purpose

Metatarsal fractures are not uncommon, accounting for 35% of all fractures within the foot and 5% of total skeletal fractures annually. As with most fractures, minimally displaced fractures of the central metatarsals are best treated with non operative care. Significantly displaced metatarsal fractures are generally treated with closed reduction and percutaneous pin fixation or ORIF with pin or single plate fixation. This case report presents a comminuted metatarsal shaft fracture with a unique fracture pattern that required a dual plating technique for proper reduction of the fracture.

Literature Review

Metatarsal fractures occur in multiple locations and are generally classified by location. Fracture locations are divided into proximal metaphyseal, diaphyseal/shaft, and head/neck fractures. Diaphyseal fractures are generally oblique in nature, but can present in various fracture patterns. These fractures are less stable and should be evaluated for shortening and displacement.(1-5) The diaphyseal region is the most common site for stress fractures of metatarsals, especially the central metatarsals. Stress fractures, if untreated, can progress to complete transverse or oblique fractures.(1) As with most fractures, minimally displaced fractures of the central metatarsals usually heal with non operative treatment including protected immobilization and RICE therapy. In general, physicians may be accepting of subtle displacement of central metatarsal fractures accepting up to 10 degrees of displacement and 3mm of translation in any direction.(6-9) The goal of surgical management of significantly displaced central metatarsal fractures is to achieve anatomic alignment of the metatarsal with stable fixation. In addition to percutaneous pinning, open reduction internal fixation (ORIF) is also an option for treatment of metatarsal fractures, especially if the fracture is significantly displaced or comminution is present. Biomechanical studies have shown that biplane fixation has increased stiffness, as well as a decreased chance of hardware failure, resulting in a more stable construct. However, dual plating has some disadvantages including increased soft tissue dissection, periosteal stripping, theoretical increased operating room time, increased chance of hardware irritation, and increased cost ..(11) There have been studies that reference orthogonal/dual plating throughout the body for fracture reduction and stabilization.(11-23) However; there have been no studies for dual plating of acute fractures of the central metatarsals.

Case Study

A 52-year-old male presented with acute tenderness to the 2nd metatarsal of the right foot of approximately 1 week duration. He denied any history of trauma. He had a history of acute gouty arthropathy and attributed his symptoms to a gouty flare up. His primary care physician prescribed a Medrol Dosepak which provided no relief. The patient was then evaluated in the emergency department where radiographs were obtained . A displaced mid-diaphyseal fracture of the second metatarsal, right foot was identified (Figure 1 A-B). The patient also stated that he had recently noticed lateral deviation of his second digit which was progressive. This was confirmed via physical exam as a flexible deformity secondary to displacement of the metatarsal fracture site. Physical exam revealed focal swelling and warmth about 2nd metatarsal region of the forefoot. Ecchymosis was absent. There was point tenderness to the second metatarsal with reducible lateral deviation of the second digit at the level of the second metatarsophalangeal joint (MTPJ). ORIF was recommended because of the displacement and the patient's complex medical history including diabetes, obesity and gout. In addition to ORIF, we recommended capsulotomy and extensor tendon lengthening to the second digit all right foot. The patient was placed in a Jones compression dressing and CAM walking boot until surgery was performed

One week after initial presentation, the patient underwent ORIF of the second metatarsal with capsulotomy and extensor tendon lengthening of the second MTPJ of the right foot. The incision was place along thedorsal aspect of the second metatarsal beginning at level of the proximal third of the metatarsal extending distally beyond the second MTPJ. Dissection was carried down to the level of the extensor tendons in which a z-tenotomy of the extensor digitorum longus tendon, as well as, a complete tenotomy of the extensor digitorum brevis tendon was performed. Attention was then focused on the fracture site. Upon inspection of the fracture site, the fracture was shown to be comminuted and split into three fracture fragments. Using standard surgical technique, bone callus was debrided and the fracture was then mobilized and reduced by joystick technique utilizing a 0.062 k-wire in the capital fragment. This facilitated reduction of the fracture and restoration of length.

Figure 1 A-B: Pre-operative radiographs AP, Lateral.

Figure 2 A-C: Intra-operative Radiographs AP, Oblique, Lateral.

Figure 3 A-E: Post-op clinical pictures and radiographs AP, Oblique and Lateral..

Case Study

The fracture sites were provisionally fixated with 0.045 k-wires. The fracture was then fixated with two 6-hole mini frag locking plates oriented obliquely into the bone and staggered for proper locking screw placement (Figure 2 A-C). Both medial and lateral dorsal fragments were fixated to the constant plantar fragment achieving stable fixation with the two- plate construct.

There was a dramatic reduction in the transverse plane deformity of the 2nd toe following fracture reduction and fixation.

The remaining deformity was addressed by performing a lateral capsulotomy at the level of the MTPJ and lengthening the extensor digitorum longus tendon.

Postoperative management included non-weight bearing in a CAM walking boot for 4 weeks. The patient began to progressively bear weight on his right foot in a CAM boot at 4 weeks and then transitioned into a tennis shoe at about 6 weeks status post surgery. Radiographs obtained at this time demonstrated adequate consolidation of the fracture site with satisfactory reduction and position (Figure 3 A-E). The patient was able to return to work in his normal capacity at 8 weeks following surgery with no restrictions.

Conclusion

Comminuted fractures of any long bone can be challenging to treat surgically. Though there are many techniques which have been shown to be viable options for such fracture types, dual plating has been shown to provide adequate stability and maintain correction of complex fractures of long bones.

Dayton et al. were able to show that a dual locking plate technique with single cortices locking screws, when compared to single locking plate with interfragmentary screw fixation, showed superior or equivalent stability in multiplanar orientations of force application in both static and fatigue testing. Though this study was used primarily to show stability at fusion sites such as the first tarsometatarsal joint, the results are very applicable to complex fractures of long bones.(11)

Dual plating has also been documented as a viable option for fracture fixation within the literature.

Conclusion

There have been studies demonstrating the successful use of dual plating techniques for ORIF of fractures. .(18-23). There is also literature describing the the use of dual plating for complex ankle fractures.(12-17). However, there are few studies or reports evaluating double plating within the foot.

Kwaadu et al. evaluated the use of a dual plate technique for the repair of complex fibular fractures in 25 patients. All patients had an uneventful post-operative course. Eight patients experienced complications all of which were wound complications. No additional operations were performed as a result of this technique. There were no complaints of hardware irritation, and no hardware removal was required. The average time to radiological healing confirmed via radiograph was 7.5 weeks.(12)

Our case report demonstrated successful use of dual plating technique for ORIF of a comminuted metatarsal fracture. This technique provided added support which was needed secondary to the fracture pattern. Dual plating should be considered in cases when traditional fixation techniques (i.e. k-wire fixation, screw, single plate) will not allow for appropriate reduction or stabilization of the fracture fragments. While this case study was not the first to incorporate dual plating in fracture cases, it is the first to document dual plate technique for lesser metatarsal fractures.

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