Update on Metatarsus Adductus and Jones Fracture: Trephine Autograft Procedure

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JONES FRACTURE

Jones fracture is a common fracture that we encounter in our profession. Its presentation, classification, and different management protocol have been well studied, yet much of its etiology remains unknown. Historically, Jones fracture has been associated with high-energy indirect abduction force with the foot plantarflexed, and also with a sudden increase in high-impact training or activity (athletes, marathon runners, or military personnel). Underlying anatomic predisposing factors have also been discussed as a risk, such as hindfoot varus, cavus foot, or genu varum. One of the anatomic factors that has been revisited and has recently appeared in the literature is the presence of metatarsus adductus.

Sir Robert Jones first described the Jones Fracture in 1902 and his original article demonstrated the anatomic and radiographic significance of the fracture (1). It was this article that suggested the mechanism of injury of Jones Fracture to be transmission of excessive body weight through a foot fixed in an equinovarus position, rather than a direct blow to the metatarsals. In 1927 Carp reported 21 fractures of the fifth metatarsal and discussed clinical and radiographic non-union (2), and Stewart developed the classification system of fifth metatarsal base fractures in 1960 (3). Since then, much of the evolution on fifth metatarsal base fractures has been on concepts and management of poor healing and different treatment protocols.

Russell et al discussed proximal fifth metatarsal fractures and their association with metatarsus adductus foot type in 2004 (4). The article reviewed 108 patients with proximal fifth metatarsal fractures, and classified the fractures into 2 categories. All fractures lying distal to the distal aspect of the fourth and fifth metatarsal base articulation were placed into Group 1, which was similar to the Stewart classification of Jones fracture, and all fractures proximal to this articular junction were categorized as Group 2. Of the 90 patients who remained in the study, 9 sustained a Group 1 type fracture, and 81 sustained a Group 2 type fracture. The demonstrated metatarsus adductus angle for Group 1 was mean ± SD 24.66 ± -2.47 and Group 2 was 11.78 ± -0.54 degrees. This suggested a very high correlation with fractures in the proximal metaphyseal-diaphyseal region and the metatarsus adductus foot type and that this foot type may predispose an individual to fracture in this anatomic region.

In 2012, Yoho et al conducted a retrospective study to determine the relationship between transverse plane forefoot relationship and Jones fracture (5). In this study, radiographs of 30 acute Jones fractures were compared with 30 asymptomatic control subjects. Metatarsus adductus angle measurements were analyzed for the 2 groups with a digital software program, and it revealed the mean ± SD metatarsus adducts angle for the Jones fracture group to be 20.22 ± -6.79 degrees compared with a mean ± SD of 14.27 ± -4.60 degrees. This suggests a positive correlation between the increased metatarsus adductus angle and the Jones fracture. It was concluded that this positive correlation should be considered a risk factor for Jones Fractures and that it should be taken into consideration with respect to bone healing, treatment and prevention.

In a recent study, Fleischer et al revisited the relationship between metatarsus adductus and the Jones fracture (6). The study retrospectively evaluated forefoot and hindfoot alignment on Jones fractures using the metatarsus adductus angle and the fourth/fifth intermetatarsal angle on 50 patients and 200 controls. The mean ± SD metatarsus adductus angle among the patients with Jones fracture was 18.8 ± -8.2, and the mean ± SD in the controls was 14.7 ± -5.1. The analysis found that patients with greater metatarsus adductus angle are associated with a 2.4 times greater risk of a Jones fracture when compared to controls, and that a greater metatarsus adductus angle and a smaller fourth/fifth intermetatarsal angle were associated with increasingly greater odds of presenting with a Jones fracture.

Seidenstricker et al published a a report on plate fixation with the use of an autogenous calcaneal graft for proximal fourth and fifth metatarsal fractures as an alternate operative technique for managing non-union of Jones fractures (7). The case series was small, with just 4 patients; however, all 4 showed promising results. The technique involved 3 central principles, evacuation of sclerotic bone, placement of a richly vascularized autogenous bone graft plug, and plate fixation of the fracture.

The bone graft is harvested from the calcaneal wall with a small incision directly over the site, and the nonunion site is prepared for the hole by utilizing a reamer with the appropriate guide. Then the dowel graft is deployed into the site and secured in its position using a 4-hole plate with

2 locking screws on either side of the graft. All 4 active patients achieved radiographic consolidation at a mean of 4.75 weeks postoperatively. This time is shorter than published data for utilizing intermetatarsal screws, and all patients returned to full activity by 3 months.

AUTHORS' PROTOCOL

Open fracture reduction with trephine calcaneal autograft can be used in both acute and non-union cases. The benefits of faster return to activity and a lower complication rate versus intramedullary fixation were recently discussed in the small patient study published by Seidenstricker et al (7). This technique is the primary author's preferred procedure for both acute and non-union cases.

The patient is placed in a supine position on the operating table with a sand bag bump to the ipsilateral hip for aid in positioning. A lateral position may also be used at the surgeon's discretion. A thigh tourniquet may be used; however, the author's preference is to utilize epinephrine in the preoperative incisional block.

An incision is placed along the dorsal lateral aspect of the fifth ray from the fifth metatarsal cuboid articulation proximally to the distal one-third of the metatarsal shaft distally (Figure 1). This incision is deepened through the dermal layer. The subcutaneous layer should be dissected through bluntly, avoiding and retracting the lateral dorsal cutaneous nerve once it is identified (Figure 2). The deep fascia and periosteum can now be incised along the dorsal lateral aspect of the base of the fifth metatarsal. Proximally, the insertion of the peroneus brevis should be avoided. The periosteal incision can be carried from this point distally along the dorsal lateral aspect of the metatarsal shaft for the length of the incision (Figure 3). Length of this incision, as well as careful dissection of the periosteum will allow for closure coverage over the fixation (Figure 4).

Next the fracture site is identified and curettage of the fracture is avoided. If the medial cortex is intact, it is this

Figure 1. Incision placement.

Figure 2. Subcutaneous dissection.

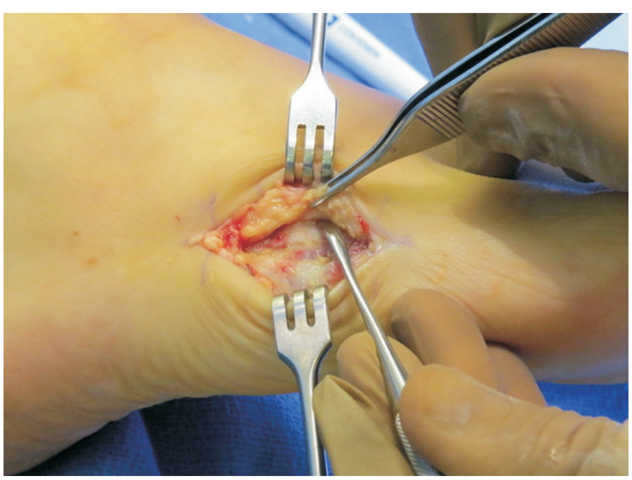

Figure 3. Periosteal incision.

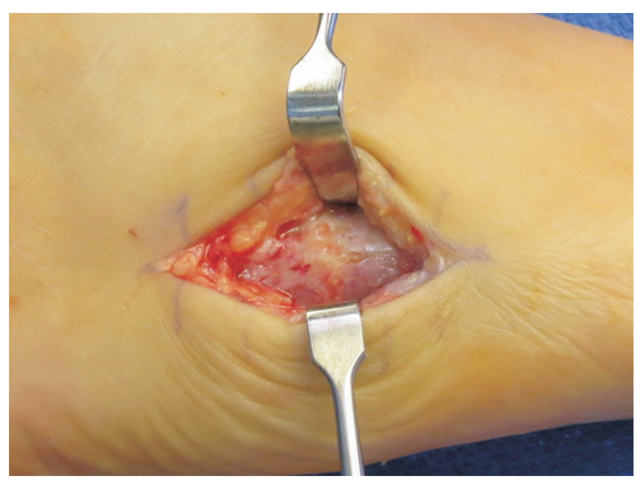

Figure 4. Dissection of the periosteum.

author's preference to fixate over the lateral aspect of the metatarsal shaft using a 2-hole locking plate with eccentric compression capabilities if possible. Doing so allows for a more stable construct for the trephine resection of the fracture site (Figure 5).

Power or hand trephine can be utilized for both the harvest of the graft or resection of the fracture site. Using a power trephine set makes for a cleaner resection as long as low speeds and plentiful hydration are used during trephining. Use a 1 to 1.5 millimeter smaller size for the resection of the fracture site than the harvest site. The author's preference is to resect through the sclerotic fracture site from a dorsal-dorsal lateral to plantar medial direction (Figure 6). Once resected, a depth gauge is utilized for planning of the harvest site graft (Figure 7).

The calcaneal graft harvest site is made from the lateral posterior superior portion of the ipsilateral calcaneus (Figure 8). The dissection plane is made just posterior to the course of the sural nerve or in the posterior one-third of the distance between the anterior lateral margin of the Achilles tendon and the posterior aspect of the peroneal tendons. An inverted Y incision is made and reflected off the periosteum (Figure 9). Again, a size larger than the resection site is utilized for the harvest graft trephine. The graft is trephined to a depth predetermined from the depth of the resected site. A total of 2 mm extra is added to this measurement to allow for any loss of depth after removing the graft. The graft is removed and detached from its medial attachment using concentric motions along the circumference of the harvest aperture, laterally (Figure 10). The calcaneus harvest site can be backfilled with cancellous chips. Closure of the periosteal layer is now accomplished after copious irrigation.

Once harvested, the graft is placed and packed in to the fracture site using a bone tamp (Figure 11). The reflected periosteal layer is now closed over the hardware and fracture site. The patient is kept non-weightbearing in a posterior splint for a period of 4 weeks. The patient is then transitioned to a Cam walking boot for the next 2 weeks, after which transition to a running shoe and a gradual return to activity is allowed as tolerated.

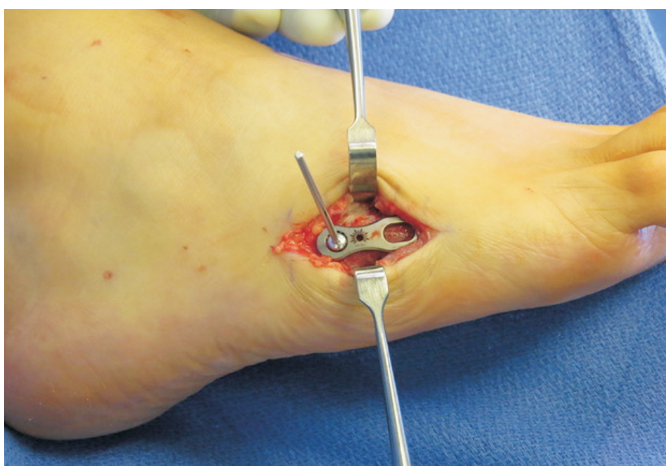

Figure 5. Fixation with a 2-hole locking plate.

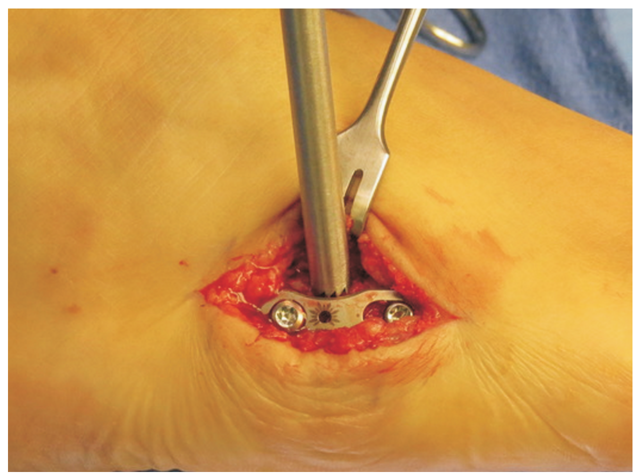

Figure 6. Harvesting the graph.

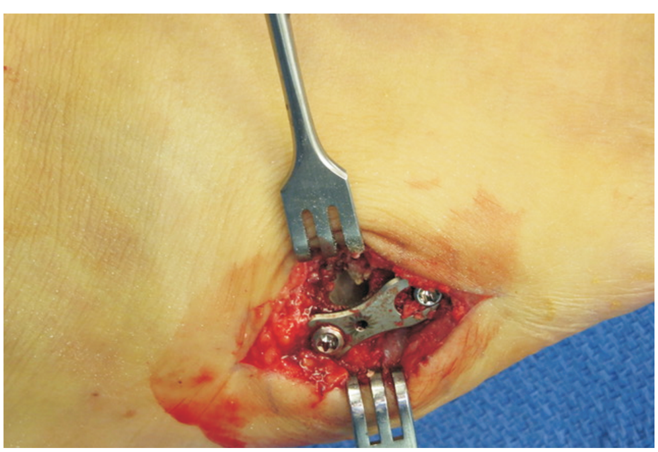

Figure 7. A depth gauge is used.

Figure 8. Calcaneal graft harvest site.

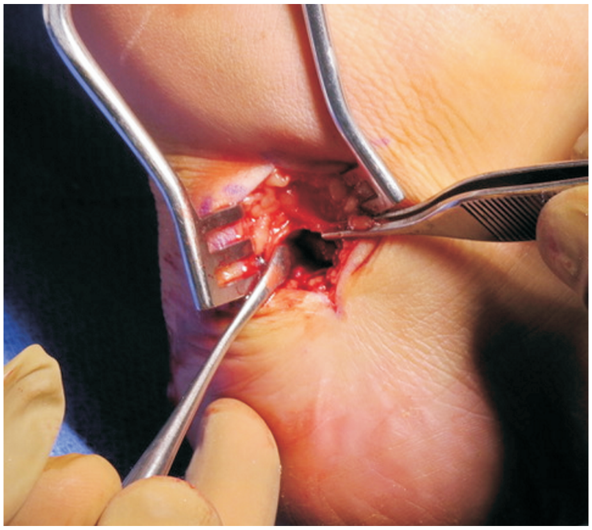

Figure 9. An inverted-Y incision is made.

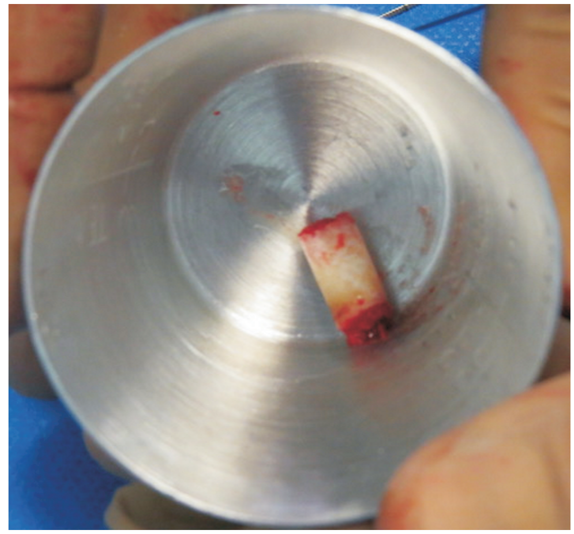

Figure 10. The graft after removal.

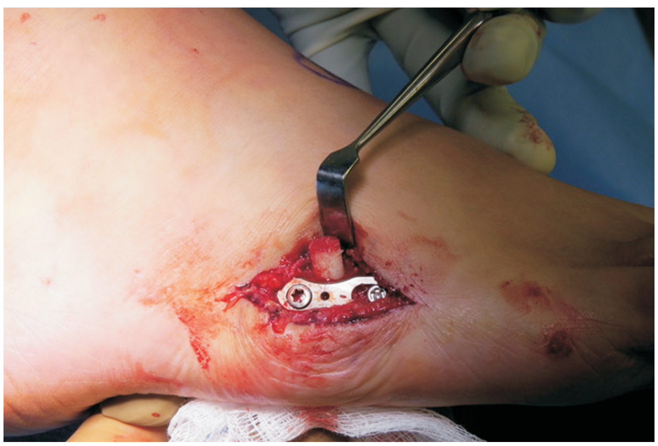

Figure 11. The graft is placed in the fracture site.

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