CHAPTER **55**

THE "JONES FRACTURE" REVISITED: A New Surgical Approach for Consideration

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Fractures of the fifth metatarsal are common injuries treated by podiatric physicians. While most are considered straight forward with regard to their mechanism of injury and treatment, some are considerably more difficult. Among these are the so-called typical "Jones fractures" of the proximal aspect of the fifth metatarsal. There is little controversy over the classification, if any, of spiral oblique fractures of the distal diaphysis or avulsion fractures of the base and styloid process of the fifth metatarsal. Likewise, bone healing complications of these two fracture types are uncommon if appropriate conservative or surgical care has been provided in accordance with current recommendations. Delayed unions and nonunions, however, are more commonly associated with fractures occurring in the proximal diaphyseal-metaphyseal area even when seemingly appropriate care has been rendered.

It is the authors intent to provide a brief background and discussion of fractures occurring in the proximal metaphyseal-diaphyseal area of the fifth metatarsal and to review current treatment recommendations. The authors also wish to introduce a new surgical technique, not previously described in the literature, for management of some of these fractures. Although the technique has only been employed in one case, it is based upon sound scientific principles. It is hoped that this technique will receive greater consideration by podiatric physicians treating such fractures, and that results of such treatment will provide a more effective surgical technique for the management of such fractures.

FRACTURE CLASSIFICATION

Several classification systems have been proposed for fractures of the fifth metatarsal. Two deserve consideration as they impact the treatment of such fractures. In a series of articles, Torg proposed a classification system based primarily on the radiographic appearance of the fracture with some consideration of the clinical history of the injury. His classification scheme was based upon a review of forty-six fractures occurring at the proximal diaphyseal-metaphyseal junction. The mean age of all patients was 18.6 years, and all patients were involved in some sort of athletic activity at the time of injury. Almost 50% of his cases (21 of 46 fractures) had a prior history of injury or fracture.

Patients were classified in one of three different categories: acute fracture, delayed union, and nonunion. The acute fracture category included patients with no prior history or previous fracture; a fracture line with sharp margins and no widening or radiolucency; no intramedullary sclerosis; and minimal cortical hypertrophy or evidence of chronic stress. The delayed union category included patients with a history of previous injury or fracture; a widened fracture line that involved both cortices with radiolucency due to bone resorption and periosteal new bone formation; and intramedullary sclerosis. The nonunion category included patients with a history of repetitive trauma and recurrent symptoms; a wide fracture line with radiolucency and periosteal new bone formation; and complete obliteration of the medullary canal at the fracture site by sclerotic bone.

DeLee proposed a classification scheme based on the clinical and radiographic findings which directs treatment and was also somewhat prognostic. A sub-classification scheme is proposed which further defines the type of fracture and helps guide treatment. Type A fractures respond favorably to conservative (non-operative) treatment, while Type B fractures commonly fail with conservative treatment and should be considered for operative intervention depending on the clinical situation.

Type 1 - Acute fracture at the metaphyseal-diaphyseal junction (JONES FRACTURE)

A. Nondisplaced

B. Displaced and/or comminuted

Type II - Fracture at the metaphyseal-diaphyseal junction with clinical and/or radiographic evidence of previous injury (STRESS FRACTURE)

A. Absence of intramedullary sclerosis

B. Presence of intramedullary sclerosis

Type III - Fracture of the styloid process

A. Without articular involvement; less than 2 mm displacement

B. With articular involvement; greater than 2 mm displacement and/or large fracture fragments

The authors feel the classification described by DeLee incorporates the ideas and findings of Torg and is more useful in the decision making process of how to manage fractures of the proximal metaphyseal-diaphyseal area. The acuteness of the fracture, combined with an accurate history and radiographic interpretation, should enable the physician to select and recommend the most appropriate treatment and help predict which patients are likely to heal uneventfully and which are more prone to a bone healing complication.

TREATMENT CONSIDERATIONS AND GUIDELINES

Type IA & IIA Fractures

The treatment of acute Jones fractures and so called stress fractures of the proximal metaphyseal-diaphyseal region of the fifth metatarsal are very similar. Both can be expected to respond well to conservative treatment consisting of cast immobilization of about 6 weeks duration. Non-weight bearing for the first 3 to 4 weeks, followed by partial weight-bearing with progressive increase to full weight-bearing over 3 to 4 weeks is recommended by the authors. A surgical shoe or protective walker may be necessary for an additional 2 to 3 weeks (Figs. 1, 2).

Serial x-rays every 4 to 6 weeks are recommended until solid radiographic and clinical evidence of union is achieved. A return to high level activity should be done with caution and only after total resolution of symptoms. When these

Figure 1. An acute Type 1A Jones fracture with no displacement. The fracture would be expected to heal uneventfully with cast immobilization.

Figure 2. An acute Type IIA stress fracture with no displacement, medullary sclerosis or obliteration, or callus formation. Fracture would be expected to heal uneventfully with cast immobilization.

acute fractures are recognized early, conservative treatment can be expected to provide consistent healing without complication.

Torg reviewed 25 Type IIA fractures in which 10 were treated with immobilization and weight bearing, and 15 were treated with a short leg non-weight bearing cast. None of the ten fractures managed with weight bearing healed uneventfully. Four of the fractures were asymptomatic delayed unions which required an average of 11.5 months to heal. The remaining six (two asymptomatic delayed unions and four symptomatic nonunions) required surgical intervention. The fifteen fractures treated by non-weight bearing immobilization healed with excellent results. Fourteen of the fifteen healed at an average of 7.4 weeks; the remaining one fracture developed into a symptomatic nonunion which underwent surgical treatment and subsequently healed without further complication.

Zogby and Baker followed ten patients with proximal fifth metatarsal fractures. Seven of these patients sustained stress fractures and were treated with a short-leg non-weight bearing cast. Nine of the ten patients healed clinically within nine weeks and returned to their preinjury activity level by 12 weeks. Intramedullary sclerosis was considered a poor sign.

The literature reports favorable outcomes in most reviews. Seitz, et. al, reported an average of 9.8 weeks until cessation of symptoms with full weight-bearing instituted at 2 to 4 weeks. Only two of his 36 cases resulted in a delayed union; both of which went on to heal at 44 and 64 weeks respectively. Other papers have reported similar results.

A prolonged time to osseous union and resolution of clinical symptoms has also been reported by some authors. Arangio reviewed 100 cases of acute Type IA fractures and reported an incidence of delayed unions in 38%, with 19% progressing onto a complete nonunion. Even DeLee indicated that 8 to 12 weeks of conservative treatment is often needed to produce clinical evidence of union. Seitz's report of an average of 9.8 weeks is certainly longer than most fractures of a similar nature in other metatarsals.

Type IB and IIB Fractures

Displaced and/or comminuted Jones fractures (Type IB) and stress fractures with intramedullary sclerosis (Type IIB) may require more aggressive treatment including primary or early surgical intervention. This is particularly true of athletic or young patients as well as any individual with significant risk factors which might contribute to a delayed or nonunion (i.e. chronic nicotine consumption, diabetes, underlying neuromuscular disease, or prior history of complicated healing with the same injury on the same or other foot) (Fig. 3).

Figure 3. A chronic Type IIB stress fracture 3.5 months after initial diagnosis. Note the presence of medullary sclerosis of a moderate nature, as was well as obliteration of the medullary canal. The patient had prolonged symptomatology in spite of immobilization and noninvasive electrical bone stimulation and eventually required surgical intervention.

Several approaches have been described. Some authors have advocated use of an intramedullary screw technique (large cancellous screw) for the repair of delayed unions or nonunions of Type IA fractures. Because of the poor distinction in the literature between Type I and Type II fractures, Type II fractures presumably fall into this category as well. The authors feel this technique should be used with caution. Although relatively simple in technique, it does not take into consideration the bone healing potential of the fracture site and the possible need for bone grafting of the area, especially in cases of a more chronic nature. It is unlikely that significant compression of the fracture interfaces is created. Significant destruction of the intramedullary canal and its contents, as well as the arterial blood supply probably occurs, although the clinical significance of this can only be hypothesized. Technical complications, the risk of refracture after screw extraction, and painful prominent fixation devices postoperatively have also been reported.

Plate fixation has also been a popular method of fixation of these fractures. In many instances, it is performed in conjunction with partial or complete resection of the fracture site with bone grafting of the area. Depending on the technique and amount of bone resected, the bone graft may be cancellous or corticocancellous in nature. Autogenous bone is clearly preferred over allogeneic bone because of its osteoinductive and osteoconductive properties and osteogenic potential. The calcaneus has served as an excellent graft choice when bone grafting is a necessary part of the surgical repair. Demineralized bone grafts would be an acceptable choice and superior to non-demineralized allogeneic grafts, but inferior to an autogenous graft.

The type of plate used depends on several factors including the nature and configuration of the fracture, the amount of compression desired, and past experiences of the surgeon. The authors recommend a one-third or one-quarter tubular plate, or in some cases a limited contact or standard dynamic compression plate (DCP or LCDCP) for increased compression at the fracture interface. Plates should be applied to the lateral or preferably, plantar lateral aspect of the fifth metatarsal. The authors have found this technique to be very efficacious when performing autogenous bone grafting of the area. Providing proper AO/ASIF technique is employed, significant compression can be achieved at the fracture site. Because of the alteration of bone physiology, these plates should be removed at some time in the future. This, unfortunately, necessitates a second surgery similar to the use of the intramedullary screw technique described earlier. Removal and insertion of a plate is a more invasive procedure than that of intramedullary screw fixation.

The use of an isolated sliding inlay bone graft has also been promoted. In 1975 Dameron recommended this approach for professional athletes. Zelko also favored the concept of bone grafting, and recommended a tibial corticocancellous bone graft after thorough curettage of the sclerotic bone at the fracture site. He believed this to be the most effective method of treatment of a delayed or nonunion.

The authors believe that a sliding bone graft technique may have some limited application in cases where autogenous bone is desired and where the use of internal fixation such as a plate is undesirable. The procedure utilizes corticocancellous bone from the same fifth metatarsal as the fracture. A long rectangular section of the fifth metatarsal is prepared from the bone, distal to the area of the disturbed union and includes a small area proximal to the fracture site. The proximal portion of the rectangular longitudinal section of bone also incorporates the area of the disturbed union. The entire longitudinal section of bone is flipped around 360 degrees in the sagittal plane which results in the distal diaphyseal portion of the bone now overlying the site of the delayed or nonunion. The graft is fixated to the remaining recipient bed which is represented by the remaining portion of the fifth metatarsal with a series of small cortical screws inserted from lateral to medial. If desired, a tubular plate, which exceeds the length of the sliding graft, can be applied and fixated with additional small cortical screws to provide additional protection of the graft and the compromised bone healing site.

While this approach is physiologic in nature, it requires extensive surgical exposure of the fifth metatarsal. The procedure is technically demanding and requires precise technique. If the procedure is done without the use of a plate, it may not be necessary to remove the small internal fixation screws. If a plate is applied, then its removal is recommended.

A variety of other techniques have also been described. They include the use of tension band wiring technique, and percutaneous or open Kirschner wire fixation. The authors do not advocate such techniques because they intuitively provide less than optimal fixation of such potentially difficult fractures. At best they provide stability to the fracture site.

There are a number of important considerations when choosing a surgical approach for a complicated fracture of the fifth metatarsal. Some Type IB and IIB fractures will be relatively straightforward while others will be more difficult.

The authors believe that the inherent bone healing capacity is a major consideration. It can be assessed by a conventional limited extremity bone

EXTERNAL MINIFIXATION

When direct open exposure of the fracture site is not necessary, why open the site at all? Many fractures of the small bones of the hands and feet can be fixated percutaneously, however, such an approach has not been described, recommended, or advocated in either the orthopaedic or podiatric literature. The authors suggest that complicated fractures of the proximal fifth metatarsal as described previously should *not* be opened and directly visualized unless necessary. Certainly direct visualization is necessary when bone grafting will be an integral part of the surgical repair. Significant malalignment, displacement, or comminution may also be indications for an open approach. In other cases, the primary goal should be stabilization of the fracture site with compression. Direct visualization of the fracture site is not necessary.

The authors suggest that a miniature fixation system might best accomplish the goal of stabilization with significant controlled compression. The technique is performed percutaneously without the need for direct visualization of the fracture site. If the surgeon is not sure of the location of the fracture (delayed or nonunion) site, then intraoperative fluoroscopic image magnification can be employed. Depending on the type of fixator used, adjustments in the alignment of the distal portion of the fifth metatarsal on the proximal portion can be made at the time of surgery or subsequently.

There are several different minifixator systems available for the application. Because the authors have applied this type of fixation in only one case, they do not have a specific brand recommendation. There are, however, several important considerations in the selection of a device. It is important that the size (diameter) of the fixator pins are compatible with the metatarsal bone. Several pins will be required to stabilize the fracture fragments. One or preferably two pins should be inserted proximal to the fracture or disturbed union site. Both pins can be inserted into the proximal portion of the fifth metatarsal or, if necessary, one pin inserted into the proximal aspect of the metatarsal and the other in the cuboid. Two additional pins should be inserted into the diaphyseal portion of the metatarsal, distal to the fracture or disturbed union site. Insertion of the pins should be done with caution to avoid damage to the lateral dorsal cutaneous nerve.

The pins should be inserted from lateral to medial or from dorsal to plantar (Fig. 6). The pins should be inserted cautiously through two cortices with minimal protrusion beyond the second cortex. All of the pins are inserted in a parallel relationship to ensure proper and easy coupling to the fixator. The authors found it helpful to predrill the holes utilizing a 0.062" Kirschner wire prior to insertion of the actual pins. Once proper placement has been confirmed by intraoperative x-ray or fluoroscopic image magnification, the final pins are inserted and the device attached (Figs. 7A, 7B).

Following attachment of the fixator to the pins, all the clamps are tightened and secured. The fracture site can then be compressed or, if desired, distracted. While most fractures benefit from compression, some disturbed unions are likely to benefit from a period of distraction to stimulate

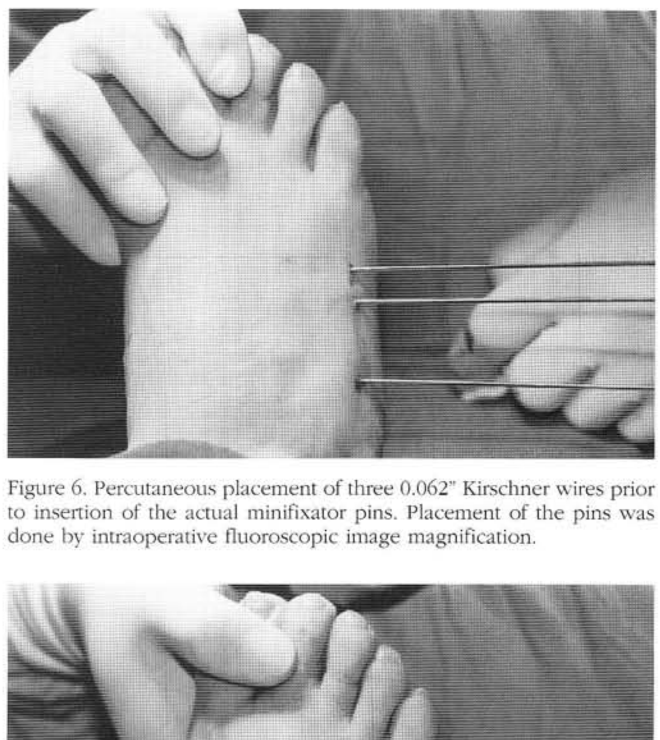

Figure 6. Percutaneous placement of three 0.062" Kirschner wires prior to insertion of the actual minifixator pins. Placement of the pins was done by intraoperative fluoroscopic image magnification.

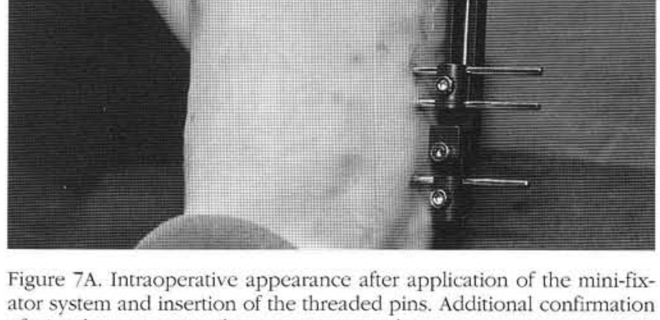

Figure 7A. Intraoperative appearance after application of the mini-fixator system and insertion of the threaded pins. Additional confirmation of pin placement was done intraoperatively.

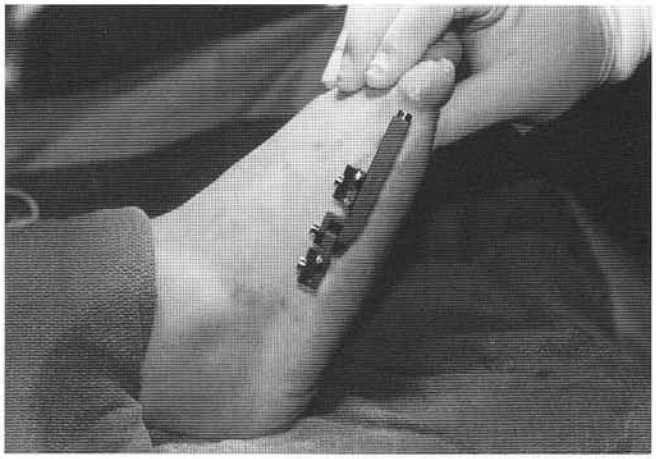

Figure 7B. Intraoperative appearance.

callus formation prior to compression. This is one major advantage of a minifixator over the techniques described earlier.

In most cases, the surgeon will have the option of employing a simple uniplanar device or an articulated device. The simpler uniplanar devices can be employed when there is no angular deformity requiring correction. The articulated minifixators allow manipulation of the fracture ends to correct for malalignment in one or more planes. This is another advantage of the minifixator over the techniques described previously.

Another significant advantage is the avoidance of cast immobilization postoperatively. This is particularly beneficial in patients who are at significant risk for a thromboembolic phenomenon. The minifixator provides excellent rigid compression fixation while allowing the extremity to be exercised regularly to avoid the effects of cast immobilization.

One major disadvantage of the minifixator technique is the size and bulk of the device. Their protrusion beyond the foot makes ambulation and protection from the external environment awkward and cumbersome.

POSTOPERATIVE MANAGEMENT

In the immediate postoperative period, a sterile dressing is applied to protect the pin sites and the device itself. An antibiotic ointment may be applied at the pin skin interface if desired. The authors incorporated foam which was partially split, to pad and cushion around the device, as well as assist with decreasing edema in the foot. The foam padding was continued throughout the postoperative period and proved to be very beneficial to protecting the minifixator device. A modified surgical shoe can be worn to provide additional protection (Fig. 8).

The pin sites are inspected every two weeks to insure no pin tract infection or other wound complication develops. Serial x-rays are also obtained every 3 to 4 weeks to monitor bone healing at the fracture site. If necessary, adjustments in compression or distraction can be made (Figs. 9-11).

When satisfactory clinical and radiographic evidence of healing are observed, the device can be removed. Most devices require a special instrument to remove the threaded pins. The procedure can be performed with or without local anesthesia and analgesics as necessary or desired in an outpatient office or clinic type setting. Healing of the wire sites can be expected within 3 to 4 days in most cases.

In the authors' single case experience, the patient was maintained in a non-weight bearing status. More than likely, the device could withstand limited or partial weight-bearing without causing significant strain on the wires or the device. The value of weight bearing, if any, has yet to be determined. Seemingly, some limited weight bearing after several weeks might prove beneficial at stimulating the bone healing process. Excessive weight bearing is likely to be detrimental.

Whether additional compression or distraction should be employed during the postoperative period is not known. While compression of the fracture ends is more desirable than not, excessive compression is likely to be detrimental. Excessive compression might result in increased bone resorption rather than further stimulation of bone healing, even in the compromised situation of a delayed or nonunion.

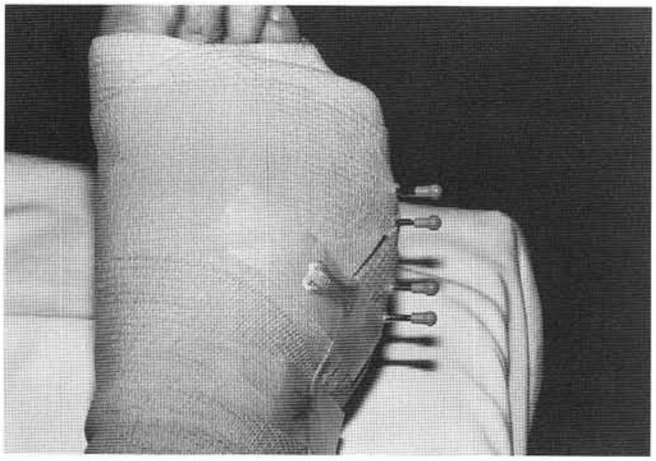

Figure 8. Appearance after application of the postoperative sterile surgical dressing and prior to application of the split foam to further protect the pins and device. Unfortunately, the pins could not be cut shorter, otherwise, removal would be very difficult.

Figure 9. Radiographic appearance 2.5 weeks postoperatively.

Figure 10. Radiographic appearance approximately 5 weeks postoperatively.

Figure 11A. AP and oblique view approximately 3 months postoperatively. Patient has remained clinically asymptomatic since surgery 7 months prior. No radiographic recurrence has been noted.

Figure 11B. Lateral view approximately 3 months postoperatively.

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