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Case Reports and Series

Plate Fixation With Autogenous Calcaneal Dowel Grafting Proximal Fourth and Fifth Metatarsal Fractures: Technique and Case Series

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A B S T R A C T

Metaphyseal and proximal diaphyseal fractures of the lateral column metatarsals can have problems with healing. In particular, those involving the fifth metatarsal have been associated with a high nonunion rate with nonoperative treatment. Although intramedullary screw fixation results in a high union rate, delayed healing and complications can occur. We describe an innovative technique to treat both acute and chronic injuries involving the metatarsal base from the metaphysis to the proximal diaphyseal bone of the fourth and fifth metatarsals. The surgical technique involves evacuation of sclerotic bone at the fracture site, packing the fracture site with compact cancellous bone, and plate fixation. In our preliminary results, 4 patients displayed 100% radiographic union at a mean of 4.75 (range 4 to 6) weeks with no incidence of refracture, at a mean follow-up point of 3.5 (range 1 to 5) years. The early results with our small series suggest that this technique is a useful treatment choice for metaphyseal and proximal diaphyseal fractures of the fourth and fifth metatarsals.

Fractures near the metaphyseal–diaphyseal junction of the fifth metatarsal are referred to as Jones fractures (1). The Jones fracture has been notoriously associated with delayed and nonunion with nonoperative treatment. A proximal diaphyseal stress fracture (PDSF) of the fifth metatarsal is treated similarly to the approach used for Jones fracture repair and might be more concerning than a Jones fracture owing to the diaphyseal location (2). Additionally, fractures of the fourth metatarsal base have a low healing potential similar to that of the fifth metatarsal base (3).

Recent data have suggested nonoperative methods for Jones fractures without a weightbearing restriction might have a role in treatment (4). However, the promising results from Torg et al (5) using nonoperative management and non-weightbearing cast immobilization for the acute Jones fracture have not been reproducible by others (6). Intramedullary (IM) fixation is the current reference standard; however, complications with the IM technique, including refracture, prominent hardware, and a slow time to fracture healing, have been reported (7–13). Tension band wiring and bone graft techniques are typically reserved for revision cases and have demonstrated some success (5,10,14,15). In the present report, we describe an innovative dowel grafting technique with plate fixation to treat the Jones fracture and PDSF along the lateral column metatarsals. Our initial use of this technique showed that it offers predictable results with rapid healing and a low incidence of complications.

Surgical Technique

The surgical technique used to treat the patients described in the present report has been previously described (16). Three primary tenets of the surgical procedure include evacuation of sclerotic bone, placement of a richly vascularized autogenous bone graft plug, and plate fixation of the fracture. This technique can be performed with the patient under local or general anesthesia, with or without an ankle or a thigh tourniquet.

Proximal Fifth Metatarsal Fractures

The patient is placed in a lateral decubitus position with the ipsilateral side facing superiorly. A dorsolateral incision is made, centered over the fifth metatarsal base fracture site. This incision allows direct visualization of the entire fifth metatarsal base, extending from the fifth metatarsal–cuboid joint to the mid-diaphyseal region of the fifth

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Fig. 1. Surgical exposure of a Jones fracture showing marker outlining the fifth metatarsal base.

Fig. 3. Drill placed over the guide pin preparing to make the dowel recipient hole. Note the orientation from slightly plantarly and laterally to dorsally and medially.

metatarsal. Careful subcutaneous dissection is performed to allow identification and protection of the lateral dorsal cutaneous nerve and its branches. Once identified, these nerves are protected with a vessel loop and protected. After completing subcutaneous dissection, the fracture site is explored, and the extent of the fracture line is appreciated (Fig. 1).

A guide pin is then placed for the reamer (Fig. 2), and an appropriate-size bone reamer is chosen (typically a 7- to 8-mm reamer is used) and placed over the guide pin (Fig. 3). The reamer is activated before bone contact, and a steady force is applied. The reamer head will “core through” the fracture and should extend to, but not through, the opposite cortex, thereby creating a well-formed “hole” (Figs. 4 and 5). Irrigation is typically used during reaming to avoid thermal osteonecrosis. Alternatively, a manually deployed trephine can be used to excavate the bone. The fracture site is inspected, and red medullary bone should be apparent on opposing sides of the fracture. If not apparent, careful curettage of the sclerotic medullary canal can be performed until red marrow is appreciated. If a tourniquet is used for hemostasis, it should be deflated at this time to more accurately assess the vascularity of the bone.

Next, a trephine is used to obtain a bone graft plug, which will be placed into the cored hole. To ensure a tight custom fit, the trephine diameter should be 1 mm greater than that of the reamer (or trephine) that was used initially for “hole” creation. We prefer to use a bone graft procured from the ipsilateral lateral calcaneal wall, obtained through a small oblique linear incision parallel and well below the course of the sural nerve (Fig. 6). Intraoperative C-arm image intensification fluoroscopy can be used to confirm trephine placement.

After removal of the bone plug (Fig. 7), whether to backfill the harvest site with allograft bone chips is determined by surgeon preference. The depth of the cored hole can be measured and an appropriate length of bone plug cut, leaving the cortical cap in place. The bone plug length should be slightly greater than that measured to ensure that an adequate amount of graft will be inserted into the hole in the fracture cleft. The dowel graft is then aligned and tamped into place (Fig. 8). A small plate is then applied to stabilize the fracture. We prefer a thin, low-profile plate that can easily be contoured and offers compression and locking features. Compression screws, using eccentric drilling, are placed first on either side of the graft.

Fig. 2. Intraoperative fluoroscopic view demonstrating guidewire placement through the fracture.

Fig. 4. Intraoperative fluoroscopic view demonstrating the recipient hole at the fracture site after drilling.