Fixation of the Proximal Interphalangeal Arthrodesis with the Use of an Intraosseous Loop of Stainless-Steel Wire Suture

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A wide range of options is available to surgeons for fixation of the proximal interphalangeal joint when arthrodesis is undertaken for repair of the hammertoe deformity. In this technical report, we describe the use of an intraosseous loop of stainless-steel wire for permanent stabilization of the interface between the proximal and middle phalanges during fusion of the interphalangeal joint. (The Journal of Foot & Ankle Surgery 48(3):411–414, 2009)

Key Words: arthrodesis, fusion, hammertoe, osteosynthesis, stabilization

Hammertoes are a very common complaint encountered by the foot surgeon. Such toes can be problematic primarily because of their sagittal and transverse plane deformation, which typically localizes to the proximal interphalangeal joint (PIPJ). The deformity (Fig 1) may be associated with cutaneous compromise in the form of hyperkeratosis or, in the neuropathic or vasculopathic individual, wound formation. Moreover, the sagittal plane contracture is often associated with retrograde plantar buckling of the corresponding metatarsophalangeal joint (MTPJ), which can lead to plantar metatarsalgia. When conservative therapies fail to achieve a satisfactory outcome, hammertoes are often treated by means of PIPJ arthroplasty or arthrosdesis, depending on the degree of interphalangeal and metatarsophalangeal contracture. When fusion is undertaken, a wide range of fixation methods is available for stabilization of the interphalangeal fusion interface. These range from peg-in-hole arthrodesis without adjunct fixation to end-to-end or peg-in-hole constructs that use Kirschner wires (K-wires), sutures, bioabsorbable pins, small interfragmental compression screws, staples, and other intramedullary and extramedullary devices. Each of these methods conveys a variety of advantages and disadvantages, as well as potential risks and complications. Perhaps the most traditional form of PIPJ arthrodesis fixation is the K-wire that transfixes the fusion site while exiting the toe distally for easy removal. Although this form of fixation is indeed useful, particularly when transfixation of the MTPJ is also deemed necessary, it is not without complication. The prevalence of pin tract infection is a known potential problem with any pin that exits through the skin (1), and the postoperative course is clinically significantly altered whenever a pin requires protection and care. Moreover, removal of such pins can be a cause of patient anxiety and pain, as well as a time-consuming postoperative chore for surgeons. In this report, the authors describe an alternative method for achieving stable fixation of the proximal interphalangeal arthrodesis that uses an intraosseous loop of stainless-steel wire suture.

Surgical Technique

With the patient in the supine position, and after administration of an intravenous sedative, a digital block is achieved with the surgeon's choice of local anesthetic. If contracture of the MTPJ is present to the degree that soft tissue release of the deformity is warranted, then more proximal blockade is required. After appropriate operative preparation, anatomical dissection and resection of the interphalangeal joint, the fusion interface between the proximal aspect of the middle phalanx and the distal aspect of the proximal phalanx is prepared for arthrodesis, with particular attention being paid to the alignment of the toe and the MTPJ. After determining that there is no need for transfixation of the MTPJ, and assuring proper alignment of the end-to-end fusion interface (or peg-in-hole, if desired), the proximal phalanx is manually stabilized and a 0.045-in K-wire is used to create an intraosseous channel from medial to lateral (or lateral to medial), at a point approximately 5-10 mm proximal to the distal stump of the proximal phalanx (Fig 2). This channel is positioned midway between the dorsal and plantar cortices of the phalanx. Then, a similar transverse intraosseous channel is created approximately 5-10 mm distal to the

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Financial Disclosure: None reported.

Conflict of Interest: None reported.

1067-2516/09/4803-0024$36.00/0
doi:10.1053/j.jfas.2009.01.012

FIGURE 1 Preoperative clinical and radiographic views of hammertoe deformity. **A.** Clinical appearance. **B.** Anteroposterior radiographic view. **C**. Lateral radiographic view.

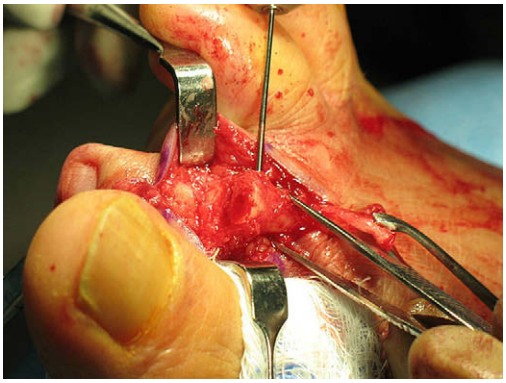

FIGURE 2 Intraoperative photograph depicting creation of the intraosseous channel, from lateral to medial, in the proximal phalanx (different patient from that depicted in Fig 1).

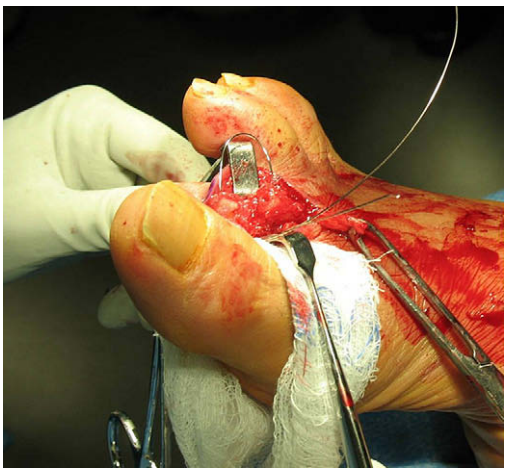

FIGURE 3 Creation of the box loop of stainless-steel wire suture (22 gauge, in this case) for interfragmental compression (same patient as that depicted in Fig 2).

FIGURE 4 Twisting the stainless-steel wire suture places the wire under tension, which results in the development of interfragmental compression (same patient as that depicted in Fig 1).

proximal stump of the middle phalanx, once again, localized approximately midway between the dorsal and plantar cortices. The orientation of the intraosseous channel should be perpendicular to the long axis of the bone. Once the channels have been prepared, an appropriately sized stainless-steel wire suture is passed through both phalanges in a ''box'' loop fashion (Fig 3). In the experience of the authors, 20- or 22-gauge wire works best for this purpose.

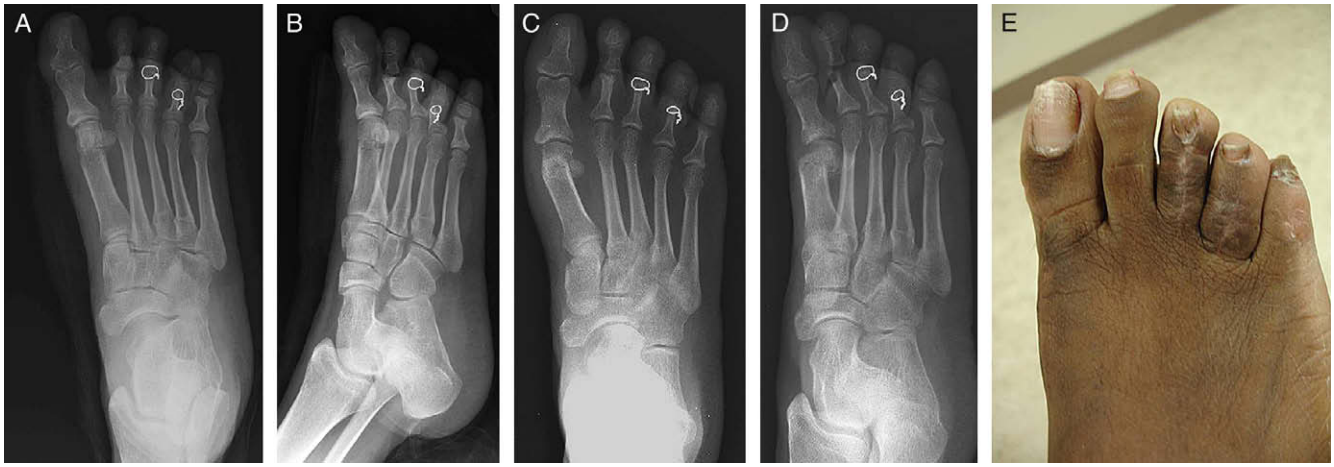

FIGURE 5 Postoperative radiographs of intraosseous box wire–loop arthrodesis (same patient as that depicted in Fig 1). **A.** Immediate postoperative anteroposterior radiographic view. **B.** Immediate postoperative oblique radiographic view. **C.** Eight-week postoperative anteroposterior radiograph showing solid interphalangeal fusions. **D.** Eight-week postoperative oblique radiograph showing solid fusions. **E.** Eight-week postoperative clinical appearance.

FIGURE 6 Alternative intraosseous box wire–loop arthrodesis with adjunct intramedullary axial K-wire. **A.** Anteroposterior radiographic view. **B.** Lateral radiographic view.

To ensure toe purchase after arthrodesis, the distal segment of the fused phalanges can be manually held in a slightly plantarflexed position when the wire loop is placed under tension, after first assuring that the orientation of the arthrodesis is suitable. After confirming satisfactory alignment of the fusion, the intraosseous loop of wire is placed under tension and gradually twisted with pliers until satisfactory interfragmental compression is achieved (Fig 4). Once adequate compression has been achieved, the excess wire is cut and bent flush with the adjacent phalanx (Fig 5). It is important to assure adequate soft tissue coverage of the fusion mass and wire loop. An alternative method of box wire–loop fixation of the interphalangeal fusion entails the addition of an intramedullary wire or pin, either stainless steel or absorbable polymer, positioned within the phalanges and coaxial with the long axis of the fusion mass (Fig 6). After completion of the fixation maneuver, the wound is closed in anatomical layers and dressed, and postoperative management is undertaken in a fashion that is determined by the individual surgeon.

Discussion

Hammertoe deformity is a common pathology treated by most foot surgeons. PIPJ arthrodesis is known to be a reliable and effective method for the treatment of painful and rigid toe deformities that are not amenable to arthroplasty. When arthrodesis is undertaken and fixation of the fusion mass is used, we have found the intraosseous box wire loop

described in this report to be a convenient method of fixation that avoids percutaneous hardware placement and obviates the need for subsequent hardware removal. Although this form of osteosynthesis is relatively simple and requires minimal instrumentation, it is known to be particularly resistant to displacement (2) and has been shown to be useful for repair of hand and arm fractures (3–5). Use of the intraosseous loop of wire for stabilization of the proximal interphalangeal arthrodesis, however, requires that the surgeon consider the alignment of the corresponding MTPJ, which, in some cases, may require temporary pin transfixation. In such cases, a single K-wire can accomplish both tasks, whereas use of the box wire loop would require the additional percutaneous placement of a K-wire across the MTPJ.

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