Lesser Digital Fusion with Cannulated Screw Technique

Abstract
Many variants on the fusion of the proximal interphalangeal joint of lesser digits have been described, some with advantages over others. This article describes a new approach for fusion of the proximal interphalangeal joint utilizing a small cannulated screw. This technique provides truly compressive, fully internalized fixation that is easily removed, and can be combined with temporary pin stabilization of the metatarsophalangeal joint, if necessary. The particular advantages of this technique make it an excellent option to consider for lesser digital arthrodesis.

Introduction
Lesser digital Arthrodesis is a common procedure for hammertoe correction. Many techniques of bone resection (1-7) as well as fixation (8-12) have been used with variable success. I have developed a technique using cannulated screws that has proven simple, reliable, and effective with several key advantages over those previously reported.

Surgical Technique
Following standard surgical prep, a dorsal linear longitudinal approach is used to access the proximal interphalangeal joint (PIPJ). A transverse tenotomy/capsulotomy to enter the PIPJ is next employed. A planar resection of the opposing PIPJ joint surfaces is performed. Additional tendinous or capsular releases of the MTPJ are performed as indicated. A linear longitudinal midline plantar incision is made, approximately 1 cm in length, from the distal digital flexure crease distally onto the plantar pulp under the distal phalanx of the digit. The flexor digitorum longus tendon is identified at the distal interphalangeal joint (DIPJ) level and a transverse plantar tenotomy/capsulotomy is performed to enter the DIPJ. The collateral ligaments are detached from the head of the middle phalanx, to allow the DIPJ to be easily dorsiflexed to expose the head of the middle phalanx plantarly. A Freer elevator is often helpful to free up the soft tissue attachments to complete this maneuver. The dual threaded headless screw cannulated guide-wire is driven from proximal to distal through the dorsal wound from the base of the middle phalanx through the middle phalanx head(retrograde) out the plantar wound site. The wire is then driven from distal to proximal across the PIPJ fusion site which is held in approximation, through the proximal phalanx, into the base of the proximal phalanx subchondral bone(an abrupt stop of otherwise easy advancement of the guidewire is “felt” when this point is reached).

Intraoperative mini c-arm is used to confirm wire position and a measurement is taken. A screw is selected that is approximately 1 cm shorter than the measurement to assure that the threaded portion of the screw is seated in the isthmus of the shaft of the proximal phalanx and the head of the screw is seated just below the cartilaginous surface of the middle phalanx. The cannulated screw is driven from the head of the middle phalanx across the fusion site into the shaft of the proximal phalanx via standard technique. As the screw is driven, compression is visualized across the fusion site and “two-finger tightness” of the screw is achieved. The guide-wire is then removed. Once seated, the screw-head surface should sit flush with or just below
the articular surface of the head of the middle phalanx. Depending on the girth of the digital bones, a 2.0mm to 3.0 mm diameter screw is used. If the screw does not give sufficient compression, a larger diameter screw of the same length may be tried or a longer screw that measures 2mm shorter than the actual guide wire measurement to the subchondral bone at the base of the proximal phalanx can be used to gain purchase more proximally while avoiding violation of the metatarsophalangeal joint. The FDL tendon is left detached to prevent mallet toe contracture, and simple interrupted skin closure is performed plantarly after removal of the guidewire. The patient may be full weight-bearing in a surgical shoe immediately post operatively, with a half-inch piano felt liner from heel to sulcus if a k-wire is crossing the MTPJ(see below). I maintain the protective shoe for approximately six weeks.

In cases where temporary post-operative stabilization of the MTPJ is required such as in flexor digitorum longus tendon transfers or flexor plate repairs, a cannulated screw which accommodates a 1.1 mm guide wire is used. Once fixation is achieved as described above, the guide-wire is advanced through the screw across the MPJ. The wire is pulled from the MPJ level proximally until the distal tip of the wire is proximal to the DIPJ. The DIPJ is then reduced to desired alignment and the wire driven in retrograde manner through the distal phalanx out the distal pulp of the digit. The MPJ is then reduced to the desired position and the wire driven across the MPJ. The distal end of the wire is cut and covered. The wire can later be removed at the time of surgeon preference, allowing the screw to continue to maintain full compression and apposition of the fusion site.

Discussion
Advantages of this technique include very low chance of mal/non-union due to extremely stable truly compressive fixation (primary bone healing, less swelling), quicker potential return to activity, completely internalized hardware (reducing risk of damaged/displaced percutaneous wires or pin-tract infections), ease of hardware removal, if necessary, with minimal morbidity, and the capability to temporarily stabilize the MTPJ with K-wire fixation while adjunctive MTPJ procedures are healing. Potential post-operative complications unique to this procedure include symptomatic damage to the DIPJ, which is significantly violated, however, I have yet to encounter this problem.

Potential intraoperative complications include stripping of the screw and fracture of the cortical wall of either phalanx. With careful attention to technique, these are avoided. In the case of poor screw purchase, larger screw size, or k-wire fixation may be required. In the case of cortical wall fracture, k-wire and/or circlage wire may be required. The procedure should be avoided in patients with poor bone stock or peripheral neuropathy. I have not needed to revert to alternative fixation on any of the more than 100 of these procedures that I have performed to date over the past nine years.
References: