PIPJ Arthrodesis for repair of rigid hammertoe. Should we abandon the K-wire as primary fixation?

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Introduction

Lesser digital deformities can occur at the interphalangeal and metatarsophalangeal joints. To add to the complexity, they may be flexible or rigid, static or dynamic, and congenital or acquired and may occur as an isolated deformity or in conjunction with other pathology (2). They may be associated with painful hyperkeratotic lesions overlying, or adjacent to, any or all of the interphalangeal joints (IPJs) or on the distal most aspect of the affected digit. Adventitious bursa may develop between the lesion and the underlying bony prominence, which can complicate the deformity. When evaluating hammertoes, it is vital to determine the most likely cause.

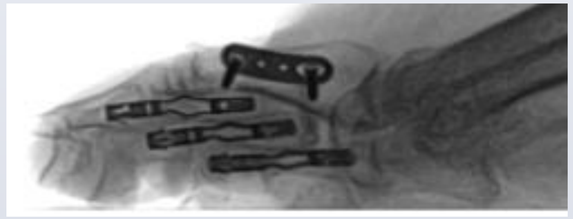
There are three major categories that can help explain the etiology of lesser digital deformities. Flexor stabilization is perhaps the most common cause of lesser digital deformities with the FDLs gaining advantage over the interossei during late stance. This is perhaps due to over-pronation causing the flexors to fire earlier and stay contracted longer (10). Flexor stabilization can also be seen in patients with peripheral neuropathy in which the interossei become weak. Flexor substitution is the least common cause of hammer digit syndrome and is usually seen when the flexors compensate for a weak triceps surae. Again, the flexors overpower the interossei in an attempt to plantarflex the ankle and supinate the foot. Extensor substitution can occur when the anterior muscle groups, specifically the EDLs, fire earlier and longer in an attempt to correct foot and/or ankle equinus.

Other causes of hammertoes include post-traumatic arthritis, hallux valgus, neuromuscular disorders, excessively long metatarsals, congenital deformities, and inflammatory arthropathies. Regardless of cause, there is similar pathology, which can often guide treatment options.

Hammertoe deformity is often treated by interphalangeal arthrodesis. In severe cases, surgical intervention is required to correct the deformity thereby relieving pain and discomfort through arthrodesis (i.e. fusion) of the interphalangeal joints. Traditionally, this procedure is performed through the use of stainless steel Kirschner wires (or K-wires) that run longitudinally through the toe. These K-wires are temporarily implanted and left for weeks protruding through the skin. Common complications include K-wire tract infection from bacteria migration and loss of fixation between the phalanges. These complications often lead to delayed unions or even failed arthrodesis altogether. Moreover, the patient's mobility is limited for weeks as a result of K-wires protruding from the toe(s). Studies have reported upward of 50% patient-related "dissatisfaction" or "reservation" after complex hammertoe repair and complication rates of almost 30%. New novel fixation techniques are changing the approach to digital arthrodesis. This paper presents results of a retrospective study on the use of a nitinol memory metal implant designed to enhance fusion and eliminate the potential complications of K-wire fixation. Both hammertoe implant devices and K-wire fixation have their advantages and disadvantages and with the proper knowledge, surgeons can make the best decision for their patients.

Materials and Methods

In this retrospective study we sought to determine fusion rate, time to fusion, complication rate using an nitinol intramedullary fixation scaffold implant in treatment of rigid PIPJ contracture. We also wanted to determine if use of a concomitant k-wire through the implant across the PIPJ would affect the primary outcomes. Thirty nine patients with 52 implants were retrospectively reviewed. All charts were reviewed for age, sex, significant past medical history, concomitant procedures, and complications intra operatively and postoperatively. Radiographs were also reviewed, preoperatively and postoperatively. Radiographs were evaluated for fusion at the PIPJ, broken implants, and broken k-wires. All patients presented with at least 1 rigid hammer toe contracture at the PIPJ. Patients were treated with a one-piece cannulated, NiTinol, tubular fenestrated intramedullary bone fixation implant and ingrowth scaffold. (IFS implant). The IFS implant is elongated at -76^{0}C, and kept sterilely at room temperature. Upon implantation the constrained NiTinol material expands entering the Martensite phase once it is deployed in the body. This expansion causes increased compression and resists rotation at the bone healing interface. This implant is cannulated and allows a k-wire to pass through it across the PIPJ and MPJ if desired. The technique used for all patients is as follows. A dorsal incision is created on the toe, followed by a extensor tenotomy and traditional resection of the head of the proximal phalanx and base of the middle phalanx. A drill bit is hand turned into the medullary canal of the proximal and middle phalanges to a laser line. The scaffold is then inserted into the proximal phalanx with the lock plate hook pointing dorsally. A pin in the inserter is then pulled, and knob turned clockwise and removed. This leaves the implant in the proximal phalanx. The toe is then distracted and the distal aspect of the implant is inserted into the medullary canal of the middle phalanx and compressed. The lock plate hook is then removed. The tendon is then repaired with 4-0 Vicryl, and skin closed utilizing 5-0 nylon in horizontal mattress type suture fashion.



Results

There were 39 patients with 52 IFS hammer toe implants. The left foot was treated in 20 patients, right foot in 18 patients, and 1 patient had implants bilaterally. The 2nd toe was the most common toe operated on with 38/52 implants, third toe in 9/52, and 4th toe in 5/52. Nine patients had multiple implants. Concomitant procedures included: Austin bunionectomy, Lapidus bunionectomy, akin, tailor's bunionectomy, sesamoidectomy, MPJ arthrodesis, neurectomy, weil, plantar plate repair, gastroc recession, hallux IPJ fusion, cheilectomy, digital arthroplasty. No statistically significant difference in age, sex, laterality, past medical history, or concomitant procedures. Overall union rate was 76% (40/52). The average time to union was 10 weeks. A concomitant temporary k-wire was implanted in 24/52 (41%) of toes. Of these there was a 16.7% non union rate with kwire, compared to 28.5% non union without k-wire. Overall complication rate was 13.5% (7/52). These complications included 2 broken implants, 1 bent implant, 3 broken k-wires, and 1 surgical site infection. Of these 3 (5.7%) required surgical intervention. Broken k-wires were removed in 2 metatarsals and 1 implant removal with revision occurred.

Discussion

Our results determined that the IFS hammer toe implant has comparable results in fusion rate and complications with other implants on the market. There was a higher union rate with a concomitant k-wire compared to implants alone. With new technologies and techniques, there has been a movement to use hammertoe implants to solve some of the problems associated with k-wires. The implants goal being no pin site infections, improved alignment, less chance of traumatic breaks. Along with the use of new hammertoe implants are several articles citing good to excellent post-operative results while examining various implants on the market(1, 4, 8, 18, 20-22). Jay, R., M., et.al. Dual-component intramedullary implant versus Kirshner wire for proximal interphalangeal joint fusion: A randomized clinical trial concluded that the dual-component stainless steel implant resulted in statistically and clinically significant less radiographic gapping and more bone-to-bone union and greater incidence of union from the 6 weeks to 6-month observation periods. The digits with k-wire fixation revealed 84% fibrous pseudarthrosis at 6 months follow-up. Regarding fixation with the two-piece implant, approximately 42% revealed fibrous pseudarthrosis at 6 weeks and 16% had persistent fibrous pseudarthrosis at 6 months follow-up.

In 2015, Kramer reported on a large series of hammertoe correction with K-wire fixation. 2698 toes with a 20.8-month follow-up demonstrated the following complications: 3.5% pin migration, 0.3% pin tract infection, 0.1% pin breakage, 5.6% recurrent deformity, 3.5% revision surgery, 2.1% malalignment, 0.6% vascular compromise, and 0.4% digital amputation.

Radiologic fusion of intramedullary implants has been noted to be 60.5%-100%(9). Even with these promising results, differentiating between the various types of implants and choosing the best implant to fix the deformity can be challenging. Each implant has its advantages and disadvantages making the decision even more daunting. More studies are needed to determine the most efficacious implant on the market.

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