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Hammertoe Correction With K-Wire Fixation

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Abstract

Background: Kirschner wire (K-wire) fixation for correction of hammertoe deformity is a common, low-cost method for fixation of hammertoes after proximal interphalangeal (PIP) arthroplasty or fusion. Complications of this procedure include pin-tract infection, pin migration, pin bending or breakage, and recurrence of deformity. The investigators reviewed a large experience using K-wire stabilization for hammertoe correction.

Methods: All hammertoe corrections performed by a single surgeon from 1999 to 2013 were retrospectively reviewed. A resection arthroplasty of the PIP joint or PIP fusion was performed and fixed with a K-wire. Follow-up duration, preoperative diagnosis, pin duration, concomitant procedures, recurrence rates, and complications were reviewed and analyzed. A total of 1,115 operations were performed on 876 patients, with correction of 2,698 hammertoes. There were 709 female and 167 male patients, with an average age of 57.5 years (range, 14-88 years), followed for an average of 20.8 months (range, 27 days to 12.7 years).

Results: Complications included 94 pin migrations (3.5%), 9 pin-tract infections (0.3%), and 2 pin breakages (0.1%). There were 150 recurrent deformities (5.6%) and 94 toes (3.5%) required revision hammertoe surgery. Malalignment was noted in 55 toes (2.1%). Vascular compromise occurred in 16 toes (0.6%), with 10 (0.4%) requiring amputation. Ninety-four toes (3.5%) required revision surgery because of symptomatic recurrence of deformity. The expected rates and rate ratios (RRs) of patients requiring revision hammertoe correction, compared with the study population as a whole, were statistically significantly higher in patients who underwent an metatarsophalangeal joint capsulotomy (3.10 vs 0.97; RR, 3.20) and those who experienced K-wire-related complications (5.10 vs 1.80, RR, 2.84).

Conclusions: K-wire fixation for the treatment of hammertoe deformities led to good maintenance of correction with a relatively low complication rate, and we believe that it remains an effective, low-cost method of fixation for hammertoe correction.

Level of Evidence: Level IV, retrospective case series.

Keywords: hammertoe, claw toe, Kirschner wire, K-wire, PIP, lesser toes, complications, correction

Hammertoe deformities are commonly seen in clinical foot and ankle practices, affecting approximately one-third of the general population.[11] Etiologic factors leading to hammertoe deformities include hallux valgus, inflammatory arthritis, diabetes, neuromuscular abnormalities, older age, and trauma.[6] Hammertoes result from imbalance of the extrinsic and intrinsic musculature. The interossei become dorsally subluxated, resulting in progressive flexion of the proximal interphalangeal (PIP) joint, often with subsequent metatarsophalangeal (MTP) joint hyperextension.[25] Secondary deformities can develop, including medial or lateral deviation with creation of crossover deformity and subluxation or dislocation of the MTP joint in more severe cases because of secondary failure of the plantar plate.[25] This resultant deformity creates pain about the dorsal PIP joint, with secondary callus, corn, ulceration, and difficulties with shoe wear.[6] Secondary changes from muscular imbalance can result in relative distal migration of the fat pad, leading to metatarsalgia and painful ambulation.[25] Nonoperative measures include shoe-wear modifications, padding around bony prominences, corrective taping, orthotics for metatarsalgia, and activity modifications.[6]

When nonoperative measures fail, surgery is indicated. Correction of the deformity consists of a PIP arthroplasty or fusion for fixed deformity and is often combined with

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additional soft tissue and bony procedures, including MTP capsulotomy, extensor tendon lengthening and release, flexor tendon release, flexor tendon–to–extensor tendon transfer, plantar plate repair, and shortening metatarsal osteotomy.[9,28] Operative treatment has been shown to be effective in reducing pain and improving function.[1,6,9,12,16,29,34] Temporary or permanent fixation of the toe is commonly performed, as this reduces recurrence and misalignment rates compared with an external strap dressing.[18] A traditional method of fixation, used in this study, involves antegrade insertion of a Kirschner wire (K-wire) at the base of the middle phalanx distally out of the toe, followed by retrograde insertion across the PIP joint as well as across the MTP joint if necessary.[5,6,34]

Numerous recommendations exist regarding weight bearing, pin care, pin protection, and the length of time pins should remain in place.[1,2,5,12,18,20,29] Other authors have hypothesized that early removal leads to fewer complications, particularly with regard to infection and pin breakage.[6]

Many different fixation techniques have been described, and newer implants have become available for internal fixation of the lesser toes at the PIP joint.[3,4,8-10,13,14,17,21-23,26,27,32,33,35-37] Numerous studies have demonstrated equivalent efficacy of these newer implants compared with K-wires.[3,17,22,27,30,32,33] Authors have hypothesized that permanent internal fixation devices would lessen complication rates by avoiding the external wire. Permanent implants, however, may require removal, which can often be difficult.

The purpose of this study was to evaluate a large series of patients undergoing hammertoe correction using K-wire fixation. Through a retrospective review, we document patient demographics, comorbidities, concomitant procedures, risk factors, K-wire-related complication rates, and recurrence and revision rates.

Methods

This retrospective institutional review board–approved study involves 876 patients who underwent hammertoe correction with K-wire fixation by the senior author (R.M.M.) between July 1998 and July 2013. All patients were included. The 876 patients underwent a total of 1,115 operations, 166 of which were bilateral staged procedures involving the correction of 2,698 hammertoes.

The operative procedure was performed with the use of an ankle block and sedation unless general anesthetic was required for concomitant procedures. An Esmarch bandage was used to exsanguinate the foot and used as a tourniquet at the level of the ankle. The PIP joint was approached through a dorsal longitudinal incision, with resection of the extensor hood and release of the collateral ligaments at the PIP joint. The head and neck of the proximal phalanx was resected with a microsagittal saw in toes undergoing resection arthroplasty. In toes undergoing fusion of the PIP joint, the base of the middle phalanx was additionally resected.

Additional procedures were performed as needed to correct the patient's deformity, including MTP capsulotomy, extensor tendon lengthening and release, flexor tendon release, flexor tendon–to–extensor tendon transfer, and shortening metatarsal osteotomy. Fixation was achieved with a 0.062-, 0.054-, or 0.045-inch K-wire, as determined by the size of the intramedullary canal of the phalanx. This was performed by antegrade insertion of the wire from the middle phalanx out the tip of the toe, followed by retrograde insertion across the PIP joint. In the large majority of cases, the K-wire was driven into the metatarsal to stabilize the MTP joint as well. The portion of the K-wire external to the toe was bent and cut and a forefoot dressing was applied (Figure 1). No specific pin care or protection was used. Patients were allowed to bear weight on the heel in a postoperative shoe after surgery, and the pins were pulled at the clinic between 4 and 6 weeks. The use of further immobilization and weight-bearing status was dictated by other procedures performed.

Data were collected regarding age, sex, comorbidities, follow-up, duration of K-wire fixation, coexisting toe and foot deformities, concomitant procedures, and history of hammertoe surgery. Radiographs were obtained preoperatively and postoperatively at 10 days, 6 weeks, 3 months, and 6 months and on further follow-up as necessary. Chart and radiographic review was used to examine pin-related complications such as migration, bending, breakage, early or late removal, and infection (Figure 2). Additionally, overall observed percentages of malalignment, recurrence, revision, vascular compromise, and amputation were tabulated.

Two hundred sixty-six of the toes (9.9%) had undergone previous hammertoe surgery, and these represented revision procedures. There were 167 male and 709 female patients, with an average age of 57.5 years (range, 14-88 years). The average follow-up duration was 20.8 months (range, 27 days to 12.7 years). Hammertoe distribution included 1011 second toes, 650 third toes, 561 fourth toes, and 476 fifth toes. Additional deformities included 229 toes (8.5%) with preoperative dislocation at the MTP joint, 296 (11.0%) exhibiting MTP instability, and 264 (9.8%) with medial or lateral deviation (Table 1).

A large percentage of the toes required 1 or more concomitant soft tissue or metatarsal procedures to correct the patient's deformity (Table 2). Of the 1,115 procedures, 195 (17.5%) were performed in patients with rheumatoid arthritis, 45 (4.0%) in patients with diabetes, and 38 (3.4%) in patients with neuropathy. Additional foot and ankle procedures performed in conjunction with the hammertoe corrections were also documented. Concomitant procedures associated with the hallux included 393 hallux valgus

Figure 1. (a) Preoperative radiograph showing hammering of the lesser toes. (b) Postoperative image of hammertoe correction performed with Kirschner wires. Note the shortening metatarsal osteotomy performed for the dislocated second metatarsophalangeal joint.

corrections (35.2%), 213 first metatarsophalangeal fusions (19.1%), 89 Keller or crescentic oblique basilar resection arthroplasty procedures (8.0%), 45 hallux interphalangeal fusions (4.0%), and 22 cheilectomies (2.0%). Other foot procedures performed in association with hammertoe corrections were 67 bunionette corrections (6.0%), 31 flat foot reconstructions (2.8%), 31 cavovarus reconstructions (2.8%), 26 midfoot fusions (2.3%), and 21 triple arthrodeses (1.9%).

To perform statistical analyses of the recurrence or malalignment and revision rates of various predictor subgroups, the overall observed percentages were normalized for follow-up time. This was necessary because of the large variability in follow-up time and the lack of standardized data regarding the exact time elapsed prior to the onset of recurrent deformity or need for revision. To accomplish this, the total number of recurrences and malalignments or revisions in each subgroup was divided by the total follow-up time (in years) for that subgroup and multiplied by 100. The resulting number estimates how many recurrences or malalignments would be expected if 100 toes were followed during a given year. In addition to normalizing for various follow-up times, *P* values and confidence intervals were further adjusted for within-patient replicate measures using bootstrap standard error estimates.

Statistical analysis was performed using SAS version 9.3 (SAS Institute Inc, Cary, NC) with repeated calls to PROC GENMOD for bootstrapping. Statistical significance was set at $P < .05$.

Results

The K-wires were left in place an average of 39.2 days (range, 1-67 days). One hundred eighteen pins (4.4%) either migrated out or required early removal. Postoperative symptomatic recurrence of deformity occurred in 150 toes (5.6%), with 94 (3.5%) requiring revision procedures to correct the recurrent deformities. Additionally, asymptomatic or minimally symptomatic malalignment was noted in 55 toes (2.0%) at final follow-up. Toes with significant

Figure 2. Pin bending and migration.

recurrence had pins removed at an average of 37.6 days as opposed to 39.2 days in the study population as a whole, which was not statistically different. The observed percentages of recurrence or malalignment and need for revision in different subgroups were also calculated (Tables 1 and 3).

Subgroup analyses for possible predictors of recurrence or malalignment and revision are outlined in Table 4 and shown graphically in Figures 3 and 4, respectively. The rates reported for each subgroup in this table have all been adjusted for follow-up time and are not the overall observed percentages for the entire study. For example, 34 of the 264 toes (12.9%) that had medial or lateral deviation preoperatively went on to have recurrent deformities or asymptomatic malalignment during their respective follow-up periods. For toes without medial or lateral deviation, 171 of the 2,434 toes (7.0%) went on to have a recurrent deformities or malalignment. The adjusted rate of recurrence or malalignment for toes with medial or lateral deviation was 8.59, whereas the rate for toes without medial or lateral deviation was 3.82. These adjusted rates represent the number of toes, of 100, that would be expected to develop recurrent deformities or malalignment during a given year. Therefore, we would expect to see a 2.25-fold (95% confidence interval, 1.45-3.48) increase in recurrence or malalignment in patients with medial or lateral deviation preoperatively compared with those without deviation ($P = .0003$).

There were 9 pin-tract infections (0.3%) in 8 patients. A pin-tract infection was defined as purulence or erythema at the pin site or toe erythema or drainage requiring early removal of the pin. Included was a patient with diabetes who had 2 toes that required early pin removal, and 1 patient

Table 1. Associated Diagnoses and Observed Recurrence and Revision.

Diagnosis	No. (% of Total)	Observed Recurrence/ Malalignment, No. (%)	Observed Revisions, No. (%)
Total no. of toes	2698	205 (7.6)	94 (3.5)
Gross metatarsophalangeal instability	296 (11.0)	13 (4.4)	4 (1.4)
Previous hammertoe surgery	266 (9.9)	40 (15.0)	18 (6.8)
Medial or lateral deviation	264 (9.8)	34 (12.9)	14 (5.3)
Metatarsophalangeal dislocation	229 (8.5)	11 (4.8)	3 (1.3)
Crossover toe deformity	107 (4.0)	12 (11.2)	5 (4.7)

Table 2. Additional Lesser Toe Procedures.

Procedure	No. (% of Total)
Total no. of toes	2698
Metatarsophalangeal capsulotomy	1198 (44.4)
Metatarsal head excision	645 (23.9)
Extensor tenotomy	602 (22.3)
Shortening metatarsal osteotomy	131 (4.9)
Flexor tenotomy	49 (1.8)

Table 3. Associated Procedures and Complications and Observed Recurrence and Revision.

Procedure or Complication	No. (% of Total)	Observed Recurrence/ Malalignment, No. (%)	Observed Revisions, No. (%)
Total no. of toes	2698	205 (7.6)	94 (3.5)
MTP capsulotomy	1198 (44.4)	133 (11.1)	68 (5.7)
Metatarsal head excision for RA	537 (19.9)	11 (2.0)	8 (1.5)
Revision procedures	266 (9.9)	40 (15.0)	18 (6.8)
Pin in <3 wk	44 (1.6)	8 (18.2)	7 (15.9)
Postoperative pin complication	105 (3.9)	15 (14.3)	10 (9.5)

Abbreviations: MTP, metatarsophalangeal; RA, rheumatoid arthritis.

Table 4. Adjusted Rates of Recurrent Deformity and Need for Revision.

Subgroup	+/–	No. of Toes	Recurrence Rate[a]	Fold Change (95% CI)	*P*	Revision Rate[a]	Fold Change (95% CI)	*P*
Total study population		2698	4.21			1.93		
Pin in <3 wk	+	44	11.2			9.76		
	–	2654	4.10	2.72 (0.87-8.47)	.0843	1.81	5.39 (1.28-22.7)	.0215
Revision procedures	+	266	7.77			3.50		
	–	2432	3.79	2.05 (1.27-3.30)	.0031	1.74	2.00 (0.84-4.76)	.1152
Postoperative pin complication	+	105	7.65			5.10		
	–	2593	4.06	1.88 (0.99-3.59)	.1225	1.80	2.84 (1.26-6.39)	.0116
Preoperative medial or lateral deviation	+	264	8.59			3.54		
	–	2434	3.82	2.25 (1.45-3.48)	.0003	1.79	1.98 (1.45-3.48)	.1065
MTP capsulotomy	+	1198	6.07			3.10		
	–	1500	2.68	2.26 (1.55-3.29)	<.0001	0.97	3.2 (1.86-5.52)	<.0001
Metatarsal head excision for RA	+	537	0.95			0.69		
	–	2161	5.22	0.18 (0.09-0.35)	<.0001	2.32	0.30 (0.13-0.70)	.0055

Abbreviations: CI, confidence interval; MTP, metatarsophalangeal; RA, rheumatoid arthritis.
[a]Rates are adjusted to compensate for wide variability in follow-up time. They reflect the number of toes, of 100, that would be expected to have recurrent deformities or require revision in a given year. They are not the overall recurrence and revision percentages of the study as a whole.

required an amputation of the fifth toe for osteomyelitis associated with a pin-tract infection.

Postoperative antibiotics were prescribed at a follow-up visit in 124 of the 1115 cases (11.1%). This was most commonly due to slight drainage from incisions for other procedures, web-space incisions, or erythema of the dorsum of the foot. In addition to the 9 toes with pin-tract infections, only 24 toes required antibiotics because of erythema or drainage over the PIP joint. None of these cases required pin removal, and all resolved with oral antibiotics. Two patients required irrigation and debridement of web-space incisions, and 4 required intravenous antibiotics for pin-tract or web-space infections.

Vascular compromise occurred in 16 toes (0.6%), and of these, 10 (0.4%) required amputation as a result of vascular compromise. Eight additional amputations were performed for reasons other than vascular compromise. Five had recurrent deformities, and 3 had late recurrent intractable ulcers, 1 of which had developed osteomyelitis associated with a pin-tract infection.

Pin breakage was observed in only 2 of the pins (0.1%). In both cases, the patients prematurely bore full weight on the forefoot, and the retained fragment was left in the metatarsal shaft. Neither patient was symptomatic or required further intervention.

Pin migration occurred in 94 toes (3.5%), in 59 (2.9%) of which the pin had completely migrated out of the toe or was so severely extruded that early removal was required. The others were either bent or had moved only slightly. These were still salvageable and were removed as scheduled.

During the study, 3 of the 876 patients (0.3%) had postoperative deep venous thrombosis with 1 nonfatal pulmonary embolus. One patient had a stroke during the postoperative period, with eventual good recovery.

Discussion

K-wire fixation is commonly used for the stabilization of hammertoe corrections. Arguments against the use of K-wires

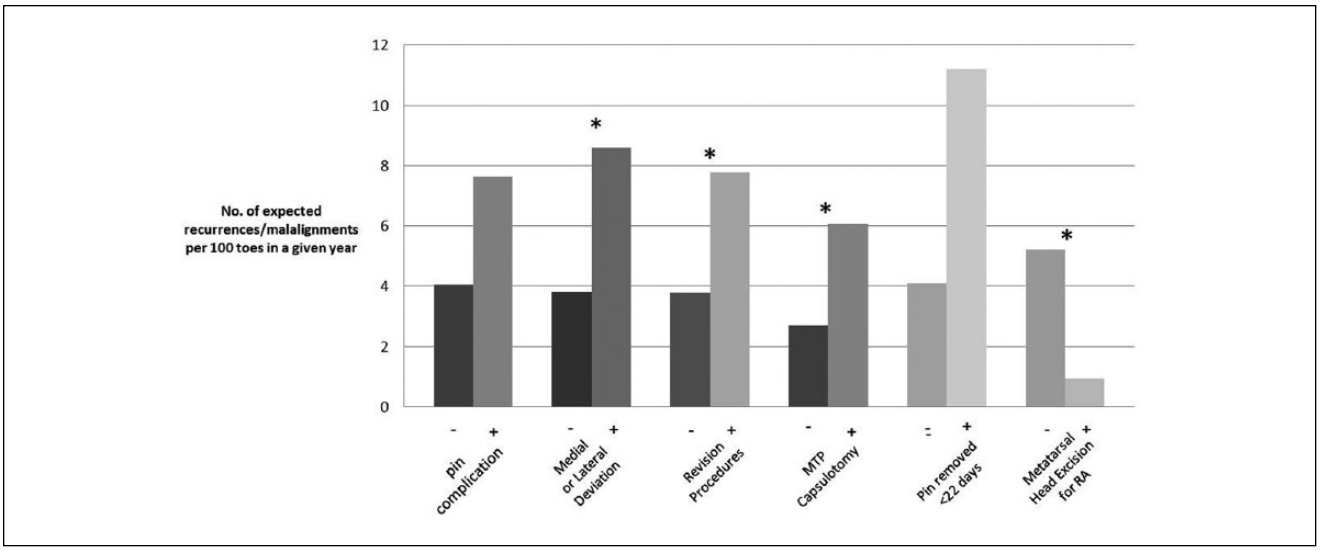

Figure 3. Number of toes, of 100, expected to have recurrences or malalignment in a given year for each subgroup. *P* values less than .05 were considered statistically significant and are marked with asterisks.

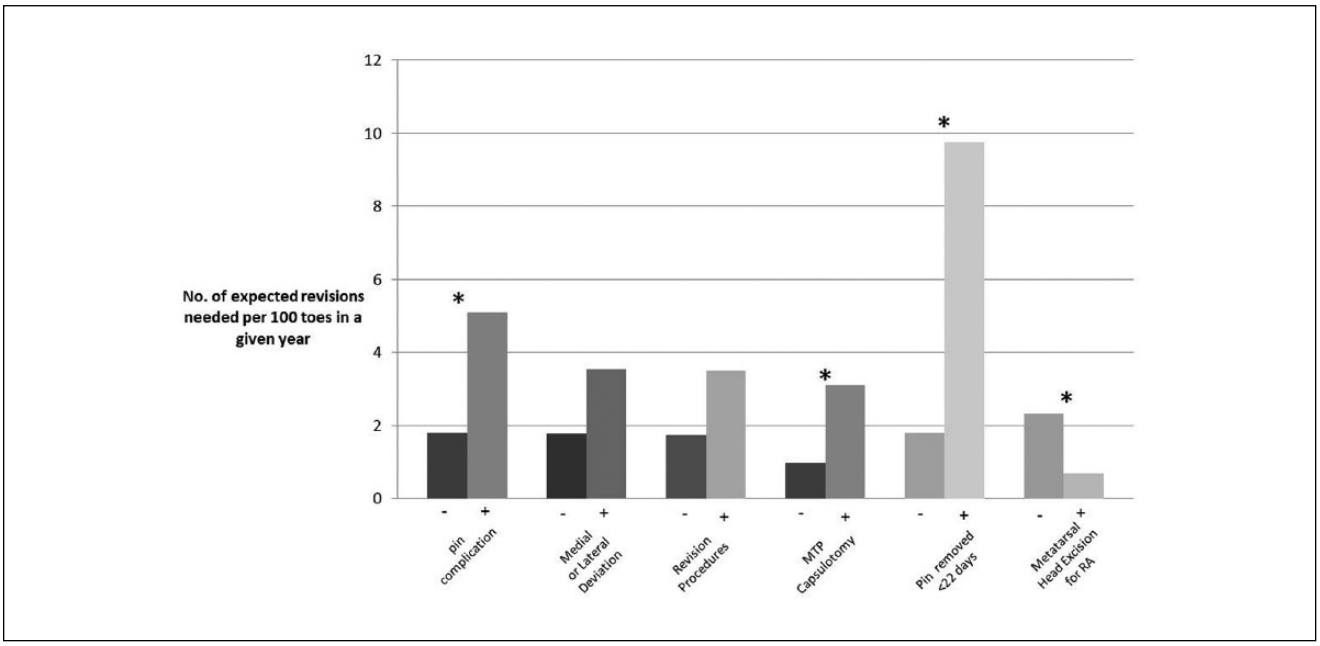

Figure 4. Number of toes, of 100, expected to need revision procedures in a given year for each subgroup. *P* values less than .05 were considered statistically significant and are marked with asterisks.

typically center on complications associated with the pins, with pin-tract infection a commonly cited reason against the use of K-wires.[13,31,36] Reece et al[31] reported an 18% pin-tract infection rate; however, other studies have reported lower rates, ranging from 0% to 3.5%.[7,15,24] We were unable to find any study that demonstrated statistically significant higher rates of clinical pin-tract infections with longer pin duration. For the purposes of this study, a pin-tract infection was defined as purulence or erythema at the tip of the toe or toe erythema, drainage, or purulence necessitating early removal of the pin. It has been the clinical observation of the senior author that pin infections in his practice are rare. There were only 9 pin-tract infections among 2,698 toes, a rate of 0.3%. This is lower than what has often been quoted in the literature. Only 2 patients of 876 (0.2%) required a return to the operating room for irrigation and debridement.

Oral antibiotics were prescribed in the postoperative period for any erythema, drainage, or slight wound dehiscence. In this series, oral antibiotics were prescribed in 124 of 1115 cases (11.1%), including for other operative incisions. When isolated to toe involvement, only 32 of 124 (26%) cases required antibiotics, for an overall rate of 2.9% (32 of 1115) of the total number of hammertoe operations. This included all cases of documented pin-tract infection.

Wire breakage has been another commonly cited complication of K-wire use. Zingas et al,[38] in a large case series of 1002 toes, demonstrated a K-wire failure rate of 3.2%. They showed longer pin duration, small K-wire size (0.045 inches vs larger), metatarsal head resection, crossing the MTP joint, and K-wire fixation in the second and third toes to be risk factors for K-wire breakage.[38] This was not seen in this study, in which only 2 K-wire failures (0.1%) occurred. In both cases, the fragment was retained in the metatarsal and did not cause any further problems. Several factors may have contributed to our small number of K-wire failures. The operative protocol included sizing the K-wire on the basis of the intramedullary canal of the phalanx, and the postoperative protocol consisted of no weight bearing on the forefoot while pins were in place. A much more commonly observed complication related to the pins was migration out of the toe or bending of the pin. This occurred in 94 toes (3.5%). Of those 94, 13 (13.8%) developed recurrent deformities or malalignment.

In our study, K-wire-related complications (migration, breakage, or infection) resulted in a higher rate of postoperative deformity. The expected rate, adjusting for varying follow-up length, of recurrent deformity in the group with wire-related complications compared with those not experiencing wire-related complications was 7.65 versus 4.06 (P = .0540), respectively. Toes with wire-related complications were also significantly more likely to require revision hammertoe correction, 5.10 versus 1.80 (P = .0116) compared with those without wire-related complications. Therefore, it appears that the risk for postoperative toe deformity is related to the maintenance of the correction by the K-wire during the first 6 weeks after surgery. This is consistent with the findings of Holinka et al,[18] who, in a series of 62 hammertoe corrections, found a lower recurrence rate (7% vs 12%) in patients treated with K-wire fixation than those with strap dressing.

The average duration of pin fixation in this study was 39.2 days. We found that the average duration of pin placement in toes that went on to require revision was 37.5 days. This difference was not statistically significant. However, there does appear to be a possible association with increased risk for recurrent deformity (P = .0843) and a statistically significant increased risk for revision (P = .0215) if the pins were left in place for less than 22 days. It appears that longer duration of pin placement is associated with lower recurrence of deformity. This is consistent with the findings of Klammer et al[20] demonstrating less postoperative deformity and a more stable fibrous union in patients in whom K-wires were left in place for 6 weeks as opposed to 3 weeks.

As part of the study, 266 hammertoe corrections (9.8%) were performed on toes that had undergone previous hammertoe surgery, most often by other surgeons (171 of 266). We were therefore able to examine this group of revision procedures to see if previous hammertoe surgery was a risk factor for postoperative complications. The expected rate of recurrent deformity in the group with previous surgery compared with those done as primary procedures was 7.77 versus 3.79 (P = .0031), respectively. The rate of further revision surgery in the group with previous surgery compared with the primary procedure group was 3.50 versus 1.74 (P = .1152), respectively. Thus, hammertoe deformities undergoing revision procedures were much more likely to have postoperative deformities. It is possible that the lack of statistical significance for the difference in revision rates is a result of the patients' reticence to undergo a second revision procedure considering that the first revision was unsuccessful in correcting their deformities.

This study contained a subset of 195 patients with rheumatoid arthritis. The majority of these patients underwent rheumatoid forefoot reconstruction involving hammertoe corrections performed in conjunction with metatarsal head excisions. We were able to demonstrate recurrence or malalignment rates, adjusted for follow-up, of 0.95 and 5.22 (P < .0001) and revision rates of 0.69 and 2.32 (P = .0055) compared with the rest of the study population. We believe the significantly lower recurrence and revision rates observed further demonstrate the effectiveness of metatarsal head excisions in persons with inflammatory arthritis. Additionally, we did not find any significant correlation between any of the complications and diabetes or neuropathy.

The severity of preoperative deformity does appear to increase the risk for postoperative deformity. We found medial or lateral deviation of the toe, including crossover toes, to be a risk factor for postoperative deformity. The operative protocol consisted of MTP capsulotomy with collateral ligament reefing or release as necessary. This was typically performed in conjunction with extensor tendon lengthening and release as indicated. After correction of the deformity, the tourniquet was released prior to pinning of the toe across the MTP joint to assess soft tissue balancing. Of the toes with medial or lateral deviation, including crossover deformity, the adjusted rate of recurrent deformity was 8.59, while the adjusted rate for those without medial or lateral deviation was 3.82 (P = .0003). The rates of revision surgery were 3.54 and 1.79 (P = .1065) and were not statistically significant.

MTP dislocation was present in 230 toes (8.5%) preoperatively. The operative protocol consisted of MTP

capsulotomy, extensor tendon release, collateral ligament release and reefing, and shortening metatarsal osteotomies as necessary. A flexor-to-extensor transfer was rarely used, and no plantar plate repairs were performed. Soft tissue balancing was performed with the Esmarch released prior to K-wire stabilization. We found that the adjusted rate of postoperative deformity in patients with preoperative MTP dislocations was 1.31 versus 3.51 (P = .1865) for the remainder of the study population. The revision rate in patients with preoperative MTP dislocation was 0.72, compared with 2.04 (P = .1351) for the remainder of the study population. Therefore, the toes in which the MTP joint was dislocated preoperatively actually had a lower incidence of postoperative recurrence and revision, though these differences were not statistically significant. When patients with inflammatory arthritis were excluded, the rates of recurrence and revision were not different in toes with preoperatively dislocated MTP joints compared with the overall study population. The low recurrence rates in patients with preoperatively dislocated MTP joints is likely due to meticulous soft tissue release and balancing, and the low rates of recurrence seen in patients with inflammatory arthritis undergoing and metatarsal head excision.

Interestingly, although no attempt was made to formally repair the plantar plate, this did not appear to negatively affect the maintenance of correction. In those toes with dislocation of the MTP preoperatively, 6 weeks of joint immobilization with K-wires appears to allow sufficient scarring and stabilization of the soft tissues, with a low incidence of recurrence and revision. It is difficult to compare overall complication rates between K-wires and other implants. The cost of newer permanent toe implants can range from $500 to $1500 per implant.[19] A K-wire typically costs between $10 and $40.[19] Given the low cost and low complication rate associated with K-wires, particularly with regard to pin-tract infection and complications, they appear to be an effective, low-cost option for hammertoe fixation.

The strength of this study is the large number of hammertoe procedures performed. This allowed us to better define the rates of complications, such as recurrent deformity, pin complications, vascular compromise, pin-tract infection, toe amputation, and deep venous thrombosis.

The drawbacks of this study are the lack of randomization regarding pin duration, as well as the lack of patient satisfaction outcomes data. Additionally, it possible that some patients sought care elsewhere for recurrent deformities and therefore were not captured in the study data.

Conclusions

K-wire fixation for the treatment of hammertoe deformities led to good maintenance of correction, with a relatively low complication rate. Infection due to the K-wires themselves was rare in this large series and is probably not justification for avoiding K-wires as fixation devices. The incidence of hammertoe recurrence and revision was associated with patients who experienced a K-wire-related complications, most commonly pin migration. Additional risks for recurrence include patients who had undergone prior hammertoe surgery and those with preoperative medial or lateral deviation. In contrast, toes with preoperative MTP dislocation had a very low incidence of recurrence. We believe that this is due to operative correction and tissue balancing as well as internal stabilization across the MTP joint, allowing postoperative scarring and stability. Overall, K-wire fixation remains an effective, low-cost method of stabilization for hammertoe correction.

Declaration of Conflicting Interests

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