

STATEMENT OF PURPOSE

The purpose of this study was to assess cost, time to return to full activities, and complications of various implants as compared to traditional K-wire fixation technique.

LITERATURE REVIEW

Hammertoe deformities are one of the most common deformities of the foot impacting over 30% of the adult population¹. Kirschner wire (K-wire) fixation has traditionally been used as the means of fixation in the surgical correction of hammertoe deformities of the proximal interphalangeal joint (PIPJ)^{3,5,8}. The use of the K-wire remains a mainstay of fixation due to its reliability, ease of use, sagittal plane correction, and cost effectiveness^{2,5,8}. However, new implants have been developed with the intent of improving correction, shortening healing time, reducing risk of infections, and increasing patient satisfaction^{2,3,5,6,7}.

Touted advantages of implants potentially include maintaining the integrity of the distal interphalangeal joint, distal tuft of the phalanx, sagittal plane digital correction with the choice of 0 or 10-degree plantar flexion at the PIPJ, and the ability to maintain control frontal plane deformity^[2]. Disadvantages of implants have been raised including breakage, implant migration, loss of correction, fracture of phalanx during insertion or healing, potential need for removal, as well as increased requirement of time and surgical skills needed for proper placement⁶.

Technological developments have made the use of internal fixation with commercial implants increasingly popular. These new advancements aim to have better anatomic outcomes, healing potential, limit complications, and decrease the time to return to full activities. Multiple comparative studies of commercial implants suggest the procedure yields overall successful results and patient satisfaction but notably raises concern with higher implant cost^{4,9,10,11}. There are limited studies, however, addressing whether these improvements truly outweigh the increased cost. This decision is relevant in our progressively cost conscious hospital environment.

METHODOLOGY AND PROCEDURE

200 patients with total of 356 digits corrected digits were included for arthrodesis of 2nd, 3rd, and/or 4th PIPJ over a two-year period. Inclusion criteria consisted of arthrodesis of the PIPJ of any lesser digits 2, 3, or 4, with or without concomitant procedures. Also considered in the evaluation were additional procedures, date of birth, sex, implant used, rate of return to activity, and complications. Exclusion criteria included patients that had failed arthrodesis with fixation, K-wires and implants on the same foot, and patients lost to follow up.

A total 10 different implant products were used by 20 surgeons. The "listed price" for each product, reported by individual official representatives, was compared rather than personal contracted prices.

RESULTS

Type of Implant	# of surgeons	# of patients	Complication rate(%)	Infection	Hardware failure	Dehiscence	Loss of correction	Other	Full healing time(wks)
K-wire	14	76	7.9%	4	0	0	2	0	13.83
Crossroads Crosstie	6	78	14%	1	2	5	0	2	12.52
Stryker smart Toe	7	24	8.3%	-	-	-	-	-	9.71
Trilliant	2	2	0%	-	-	-	-	-	14
Extremity Medical	2	3	33.3%	-	-	-	1	-	5
Stryker Toe-Tac	2	2	50%	-	1	-	-	-	14
Arthrex Retro Fusion	2	2	0%	-	-	-	-	-	8.5
Arthrex Trim Pin	1	2	0%	-	-	-	-	-	6
Arthrex Dark Peek	3	4	0%	-	-	-	-	-	24
Wright-Pro Toe	2	4	0%	-	-	-	-	-	22
Wright-Cannulink	3	3	33.3%	-	-	-	-	1	8.5

Type of Implant	Cost	Total patients	Total implants used
Extremity Medical Cannulated Implant	\$2,776.00	3	4
Wright Medical Cannulink True View	\$2,047.00	3	6
Stryker Toe tac	\$1,990.00	2	4
Crossroads Crosstie	\$1,895.00	78	140
Trilliant Hammertoe implant	\$1,495.00	2	2
Stryker Smart Toe	\$1,568.00	24	37
Wright Medical Pro Toe	\$949.00	4	6
Arthrex Retrofusion Screw	\$895.00	2	3
Arthrex Dart Peek	\$595.00	4	6
Arthrex Trim Pin	\$350.00	2	4
K-wire 0.045 in.	\$2.50	76	144
Totals		200	356

ANALYSIS & DISCUSSION

The most commonly used implants in this study included Crossroads Crosstie and Stryker Smart Toe with the cost of \$1,895.00 and \$1,568.00 respectively compared to \$2.50 for the traditional K-wire. In comparison with this study's most commonly used implants, Crossroads Crosstie implant had the highest complication rate and a K-wire had the lowest. Stryker Smart Toe had the quickest healing time with an average of 9.71 weeks compared to K-wire with an average of 13.83 weeks with no statistically significant difference in complications. Our findings are consistent with Albright et al. who evaluated the cost effectiveness of implants compared to K-wires determining that commercial implants were insignificantly more effective than K-wires at a significantly higher cost; Scholl et al that compared Smart Toe Implants to the buried K-wire technique concluding K-wires are as effective and reliable and not inferior to implants⁶.

Limitations to this study included the small sample sizes of majority of other implants. Although 10 implants were included in our study, the low number of cases for 7 implants yielded insignificant results for statistical comparison.

The objective of this study was to determine if the benefits of implants warrant use despite the increased cost. Stryker Smart Toe in our study was comparable to k-wires in terms of patient satisfaction, healing time, and complication rates, however at nearly 900X the cost. The marginal increase in successful outcomes with specific commercial implants compared to K-wire were not statistically significant. Our findings imply the benefits do not warrant the increased costs. Ultimately, tried and true K-wire fixation for a hammertoe deformity is significantly more cost-effective and produces outcomes consistent with commercial implants.

REFERENCES

- Albright R, Waverly B, Klein E, Weil L, Weil LS, and Fleischer A. Percutaneous Kirschner Wire Versus Commercial Implant for Hammertoe Repair: A Cost-effectiveness Analysis. *Journal of Foot and Ankle Surgery, The*, 2018-03-01, Volume 57, Issue 2, Pages 332-338.
- Angirasa A, Barrett M, Silvester D. SmartToe Implant Compared with Kirschner Wire Fixation for Hammer Digit Corrective Sugery: A Review of 28 Patients. *Journal of Foot and Ankle Surgery, The*, 2012-11-01, Volume 51, Issue 6, Pages 711-713.
- Doty J, Fogleman J. Treatment of Rigid Hammer-toe Deformity. *Foot and Ankle Clinics*, 2018-03-01, Volume 23, Issue 1, Pages 91-101.
- Jay R, Malay D, Landsman A, Jennato N, Huish J, and Younger M. Dual-Component Intramedullary Implant Versus Kirschner Wire for Proximal Interphalangeal Joint Fusion: A Randomized Controlled Clinical Trial. *Journal of foot and Ankle Surgery, The*, 2018-07001, Volume 55, Issue 4, pages 697-708.
- Kramer W, Parman M, and Marks R. Hammertoe Correction with K-wire fixation. *Foot and Ankle Int*, 2015, Volume 36, Issue 5, pages 494-502
- Scholl A, McCarty, Scholl D, and Mar A. Smart Toe Implant Versus Buried Kirschner Wire for Proximal Interphalangeal Joint Arthrodesis: A Comparative study.
- Southerland J, Downey M, Nakra A, and Rabjohn L. McGlamry's Comprehensive Textbook of Foot and Ankle Surgery 4th edition. Lippincott, Williams, and Wilkins. Philadelphia.
- McGlamry, ED, Jimenez AL, Green DR. Lesser ray deformities: deformities of the intermediate digits and metatarsophalangeal joint. McGlamry's Comprehensive textbook of Foot and Ankle Surgery, edited by AS Banks, MS Downey, DE Martin, SJ Miller, McGlamry
- Ellington, JK. Hammertoes and clawtoes: Proximal interphalangeal joint correction. *Foot ankle clin* 16: 547-558, 2011.
- Obrador Caterina, Losa-Iglesias M, Vallejo RBB, Kabbash CA. Comparative Study of Intramedullary Hammertoe Fixation. *American Ortho Foot and Ankle*
- Guelfi M, pantalone A, Daniel JC, Vanni D, Guelfi MGB, Salini V. Arthrodesis of proximal inter-phalangeal joint or hammertoe: intramedullary device options. *J orthop Traumatol* 16: 269-273,2015.