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A Simple Method of Intramedullary Fixation for Proximal Interphalangeal Arthrodesis

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ABSTRACT

Lesser digital arthrodesis has become one of the most widely used techniques in foot and ankle surgery. When performing digital arthrodesis, surgeons have an abundance of options for implantable devices. We provide information on a simple method of achieving successful arthrodesis. An intramedullary Kirschner wire is implanted into the proximal phalanx with the intermediate phalanx compressed over the wire for rigid internal fixation to avoid the use of an external device. We have had results similar to those from the published data of more expensive implants.

Lesser digital arthrodesis is one of the most used techniques in foot surgery for the treatment of a far-reaching spectrum of conditions ranging from post-traumatic arthrosis, hammertoes, toe shortening, and other lesser digital deformities. First described by Soule (1) in 1910, the technique for arthrodesis of lesser interphalangeal joints has continued to evolve. Fusing the interphalangeal joints without fixation developed with the peg and hole arthrodesis. Additionally, the use of Kirschner wire fixation was first described by Taylor (2) in 1940. It was believed that the use of Kirschner wires would decrease the motion at the site of fusion, and soon, digital implants for arthrodesis began to increase in popularity.

When performing digital arthrodesis, surgeons have a surplus of options for implantable fixation devices. The most commonly used device has been the Kirschner wire. The technique for Kirschner wire fixation for proximal interphalangeal joint arthrodesis can be performed by burying the Kirschner wire or leaving it external to the distal tip of the toe (3). Implants can be broadly stratified as absorbable and nonabsorbable devices. An extensive list of the devices available in the United States can be found in Table.

Nonabsorbable implants can be categorized as single-component or multicomponent devices and further catalogued into static and dynamic materials. There are single-component products that have metal memory, such as the Stryker® Smart Toe® (Stryker, Kalamazoo, MI) or BME® HammerLock™ (BioMedical Enterprises, San Antonio, TX). One component, nonmetal memory products include the Wright Medical™ Pro-Toe VO™ (Wright Medical Technology, Arlington, TN), Arrowhead® ARROW-LOK™ (Arrowhead Medical Device Technologies, Collierville, TN), or cannulated screws, which possess no temperature requirements and hence do not offer theoretical dynamic compression. The Tornier® StayFuse™ intramedullary fusion device (Tornier, Amsterdam, The Netherlands) is a 2-component system in which each component is placed into its respective phalanx and then fastened together to facilitate arthrodesis. The use of a portion of a threaded intramedullary pin has also been previously described (4).

Absorbable implants include the osseous Solana Surgical® TenFUSE™ PIP Allograft (Solana Surgical, Memphis, TN), which is placed into the intramedullary canal of the proximal and intermediate phalanges. Theoretically, the osseous peg will be absorbed over time and replaced by cancellous bone. Synthetic, absorbable rods have been developed to fuse the interphalangeal joint. The All-Inside® technique has evolved, with Arthrex® (Arthrex, Naples, FL) creating the Trim-It-Pin® composed of poly-L-lactide acid (5).

With the development of these newer internal implant devices, it is comprehensible why they have been chosen instead of externally protruding Kirschner wires. The present detailed technique provides surgeons with an alternative to the more expensive implants that avoids the use of external hardware.

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Table
List of 68 digital fusion devices (compiled February 1, 2014)

1. Acumed® Biotrak Pin	35. Metasurg® Ti6 DS-Series Screw™
2. Acumed® Acutrak 2 Micro™	36. Minifragmentary Plating
3. Acumed® Acutrak Fusion™	37. MTF™ ALLOFIX Cortical Pins
4. Acumed® AcuTwist Compression Screw™	38. Nextremity Solutions® Nextra® Hammertoe Correction System™
5. Acumed® Biotrak Mini Compression Screw™	39. OrthoHelix® Intraosseous Fixation
6. Acumed® Biotrak Pin™	40. Orthopediatrics® Scwire®
7. Acumed® Hamemrtoe Fusion Set™	41. OrthoPro® Cannulated Screw System
8. Arrowhead® ARROW-LOK Hybrid™	42. OrthoPro® PhaLynx System
9. Arrowhead® ARROW-LOK™	43. OrthoPro® Orthoflex Toe Implant
10. Arthrex® Trim-IT Drill Pin™	44. Osteomed® ExtremiFix™ Lesser Digit Arthrodesis
11. Arthrex® Trim-IT Spin Pin™	45. Osteomed® ExtremiFuse Hammertoe Fixation
12. Biomet® Sports Medicine ReUnite	46. Osteomed® InterPhlex™ Flexible Stabilization
13. Biomet® Sports Medicine Weil-Carver	47. Osteomed® Inion OTPS™ Biodegradable Pins
14. BioPro® Digital Compression Screw™	48. SBI® PercuFix™ Break-Away Pin
15. BioPro® Memory Staple™	49. SBI® StaFIX™ Staple
16. BME® Barbed OSStaple (BOSS)™	50. Smith & Nephew® Drill Wire Module
17. BME® HammerLock DIP™	51. Solana Surgical® TenFUSE™ PIP Allograft
18. BME® HammerLock™	52. Stryker® Smart Toe®
19. BME® OSStaple™	53. Stryker® Smart Toe® DIP
20. BME® Speed™ Continuous Active	54. Stryker® X-Fuse®
21. Conmed® Linvatec 1.5 Bone Fixation Kit™	55. Synchro Medical® Toegrip®
22. Conmed® Linvatec SmartPin®	56. Tornier® Futura™ Flexible Digital Implant
23. Depuy® Orthopaedics FRS® Basic Screw	57. Tornier® NexFix™ Compression Pin
24. Depuy® Orthopaedics FRS® S.O.C. Pin™	58. Tornier® StayFuse™ Intermedullary Fusion
25. Depuy® Orthopaedics Orthosorb Pin™	59. Tornier® The RFS™
26. Inion® OTPS Biodegradable Pins™	60. Traditional Screws (Osteomed®, Stryker®, Synthes®, Vilex®, etc)
27. Integra® Aeon Staple	61. Trilliant® Surgical Tiger Cannulated Screws™
28. Integra® Capture Digital Screw™	62. Trilliant® Surgical Two-Step Hammer Toe Implant
29. Integra® Tac Pin (threaded and compression)	63. Vilex® Digit Fusion Toe Implant
30. Integra® IPP-ON® PIP Fusion System	64. Vilex® Extra Long Fusion Screws
31. Konza Med® Memodyne Clips	65. Wright Medical™ CHARLOTTE® Quick
32. Merete® Medical MetaToe™ Endosorb™	66. Wright Medical™ Pro-Toe VO™
33. Metasurg® DigiFuse™	67. Wright Medical™ Weil Hammertoe Implant™
34. Metasurg® Ti6 Digital Fusion System	68. Wright Medical™ MiToe™

Listing of the manufacturers of the devices in order of appearance: Acumed, Hillsboro, OR; Arrowhead Medical Device Technologies, Collierville, TN; Arthrex, Naples, FL; Biomet, Warsaw, IN; BioPro, Port Huron, MI; BioPro, Port Huron, MI; BioMedical Enterprises, San Antonio, TX; ConMed, Utica, NY; DePuy International, Leeds, UK; Integra LifeSciences, Plainsboro, NJ; Integra LifeSciences, Plainsboro, NJ; Konza Medical, Wichita, KS; Merete Medical, New Windsor, NY; MTF, Edison, NJ; Nextremity Solutions, Warsaw, IN; Nextremity Solutions, Warsaw, IN; Orthohelix, Surgical Designs, Medina, OH; OrthoPediatrics, Warsaw, IN; OrthoPro, Salt Lake City, UT; OsteMed, Addison, TX; Small Bone Innovations, Morrisville, PA; Smith & Nephew, Largo, FL; Solana Surgical, Memphis, TN; Stryker, Kalamazoo, MI; Synchro Medical, Wettolsheim les Erlen, France; Tornier, Amsterdam, The Netherlands; Trilliant Surgical, Houston, TX; Vilex, McMinnville, TN; Wright Medical Technology, Arlington, TN.

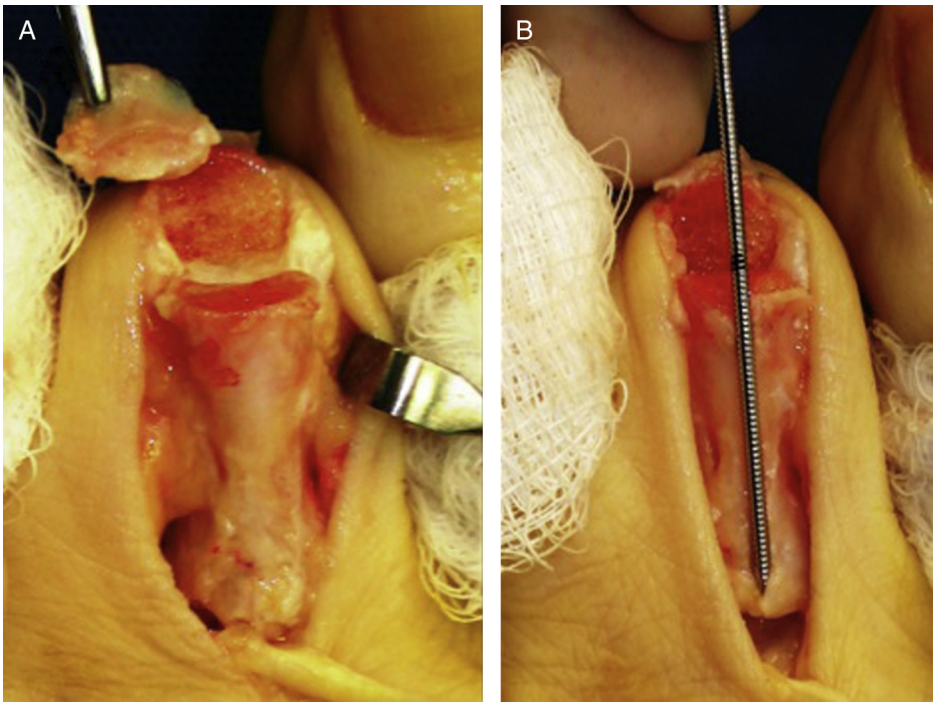

Fig. 1. (*A*) Preparation of reciprocal joint surfaces with an exposed cancellous interface devoid of intervening tissue. (*B*) Estimation of the required Kirschner wire length can be accomplished with the aid of a skin scribe.