The Journal of Foot & Ankle Surgery 49 (2010) 194–196

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Chevron Arthrodesis of the Interphalangeal Joint for Hammertoe Correction

J. Michael Miller, DPM, FACFAS [1], Douglas K. Blacklidge, DPM, FACFAS [2], Vafa Ferdowsian, DPM, FACFAS [3], David R. Collman, DPM, FACFAS [4]

[1] *Director, Fellowship in Reconstructive Foot & Ankle Surgery, American Health Network of Indiana, LLC, Private Practice, Avon and Carmel, IN*
[2] *Attending Staff, Fellowship in Reconstructive Foot & Ankle Surgery, American Health Network of Indiana, LLC, Private Practice, Kokomo and Lafayette, IN*
[3] *Private Practice, Conway, AR*
[4] *Attending Physician, Department of Orthopedics/Podiatry, Kaiser Foundation Hospital, Modesto, CA*

ARTICLE INFO

Keywords:
absorbable fixation
deformity
digit
fusion
Kirschner wire

ABSTRACT

Interphalangeal joint arthrodesis is a common procedure to correct fixed or semifixed lesser toe contracture. The authors present a simple modification to end-to-end interphalangeal joint arthrodesis that increases surface area and enhances construct stability. The technique is most commonly used for the proximal interphalangeal joint and may be combined with any number of fixation techniques.

Interphalangeal arthrodesis is a common procedure used to correct lesser toe contracture where joint adaptation has produced a fixed or semirigid deformity. The operation is indicated when intrinsic muscle function across the interphalangeal joint (IPJ) and metatarsophalangeal joint (MTPJ) becomes unbalanced, and the flexor tendons require a platform on which to function to restore stability (1). Toe arthrodesis was first described by Soule (2) in 1910 as an end-to-end procedure at the proximal IPJ, and a variety of modifications have been described since that time (3–11). The stability of flat cuts used in the traditional end-to-end arthrodesis may be improved by increasing both the surface area of bone contact and the configuration of joint resection (9, 11). Digital arthrodesis in the hand is often accomplished with a concave-convex construct, which is a useful variation of the end-to-end arthrodesis (12). The "V" (sagittal plane chevron) arthrodesis construct has also been used to correct lesser toe contractures with favorable results (9, 11), and, in this report, we describe a chevron method that we have found useful for proximal IPJ fusion.

Surgical Technique

The lesser toe is approached with a dorsal linear or 2 converging transverse semi-elliptical incisions centered over the proximal IPJ. The joint is entered in a standard fashion, releasing the extensor tendons and hood mechanism, collateral ligaments, and capsule. Vital neurovascular structures are protected. Complete exposure of the base of

Fig. 1. Bone to be removed from the proximal interphalangeal joint of the toe to accomplish chevron arthrodesis. Shaded portion indicates area of bone removal (sagittal view).

intermediate phalanx facilitates bone removal at this surface. A power saw or a rongeur is used to remove the cartilage and subchondral bone along the dorsal and plantar aspects of the head and base of the corresponding phalanges. Bone is removed from each surface at a 45° angle in the transverse or horizontal plane, thereby creating a sagittal plane "V" or chevron interface for arthrodesis (Figure 1). The cuts converge at the centers of the long axis of each phalanx, such that the convex apex of the proximal phalanx fits into the concave apex of the intermediate phalanx (Figure 2). Appropriate shortening or correction of angular deformity is best executed at the cuts on the head of the phalanx. Slight plantarflexion of the arthrodesis can be accomplished by either resecting more bone from the plantar aspect of the phalangeal head, or by making the angle of the plantar cuts more acute. The authors prefer to use buried or internal intramedullary pin fixation with either a threaded Kirschner wire or an absorbable fixation rod. The fixation is driven into the base of the proximal phalanx, cut at the appropriate length to fit the intermediate phalanx, and inserted into

Financial Disclosure: None reported.
Conflict of Interest: None reported.
Address correspondence to: J. Michael Miller, DPM, American Health Network of Indiana, LLC, 5250 East U.S. 36, #610, Avon, IN 46123.
E-mail address: jmm@jmichaelmiller.com (J.M. Miller).

1067-2516/$ – see front matter
doi:10.1053/j.jfas.2009.09.002

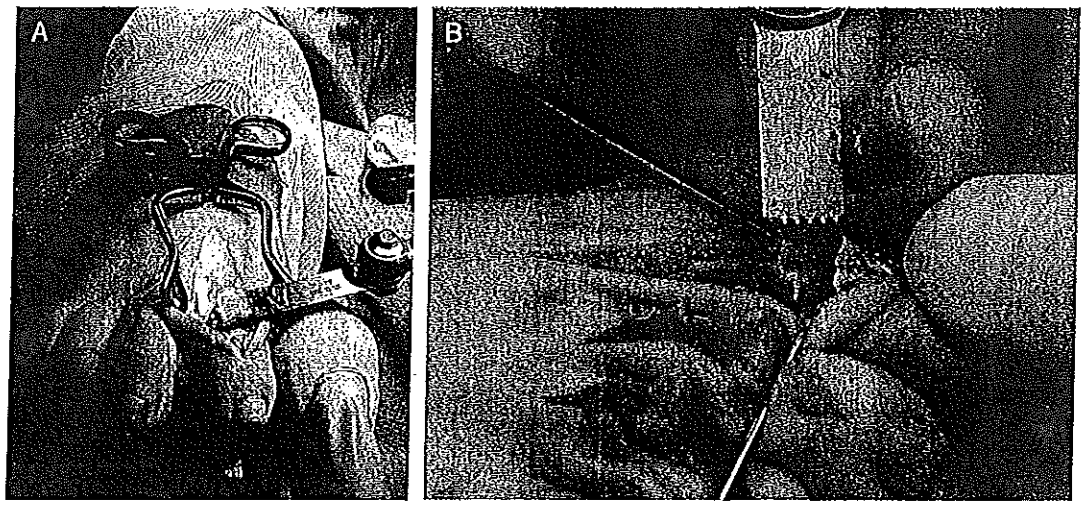

Fig. 2. Intraoperative removal of bone from the proximal phalanx head. Note the oblique orientation of the saw blade to achieve convex cuts with a central apex. (A) Frontal view, dorsal cut. (B) Sagittal view; both the plantar and dorsal cuts are complete.

a predrilled hole in the bone. Neighboring joints are not crossed (Figure 3), unless deemed necessary to correct additional deformity, which may require transfixation of the distal IPJ or the MTPJ with the use of a Kirschner wire or other device. Adjunct procedures are performed as needed, and the wound is closed in layers.

Discussion

Advantages inherent to the chevron cut include increased cancellous bone surface area to promote union and stability in 3 planes. Its application for correction of lesser toe contractures is particularly useful, where there is little bone volume at the fusion interface and toe misalignment or an unstable nonunion may occur after a traditional end-to-end arthrodesis. Because the primary deformity is typically in the sagittal plane, making orthogonal cuts may enhance construct stability. The authors are not aware of any studies evaluating the transverse chevron arthrodesis in the lesser toes. A different configuration of the chevron construct, the "V" arthrodesis, has shown excellent stability, early union, and good outcomes for correction of lesser toe contractures (9). The peg-in-hole technique has been shown to be superior to the both the end-to-end and "V" construct with good outcomes, but this approach is technically more demanding and carries with it the risk of fracture of the dorsal cortex of the proximal phalanx (5–8, 10, 11). Disadvantages of the described technique

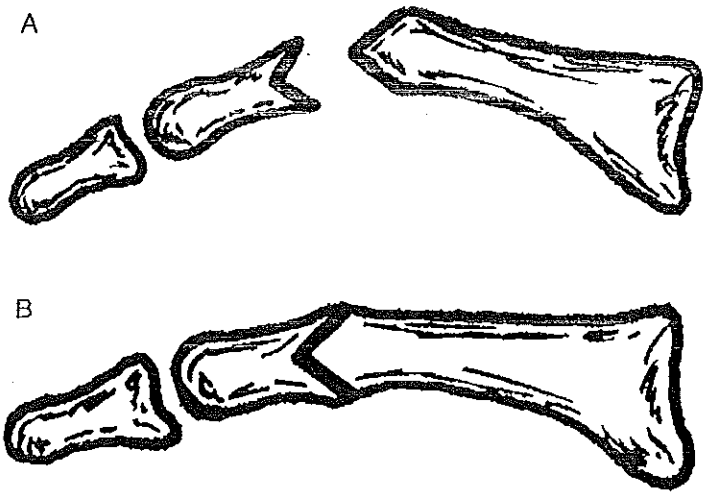

Fig. 3. Bone removed from the proximal interphalangeal joint of the toe (sagittal view). (A) Note orientation of the chevron cuts with the central apices. (B) Convex-concave bone apposition with proper fit.

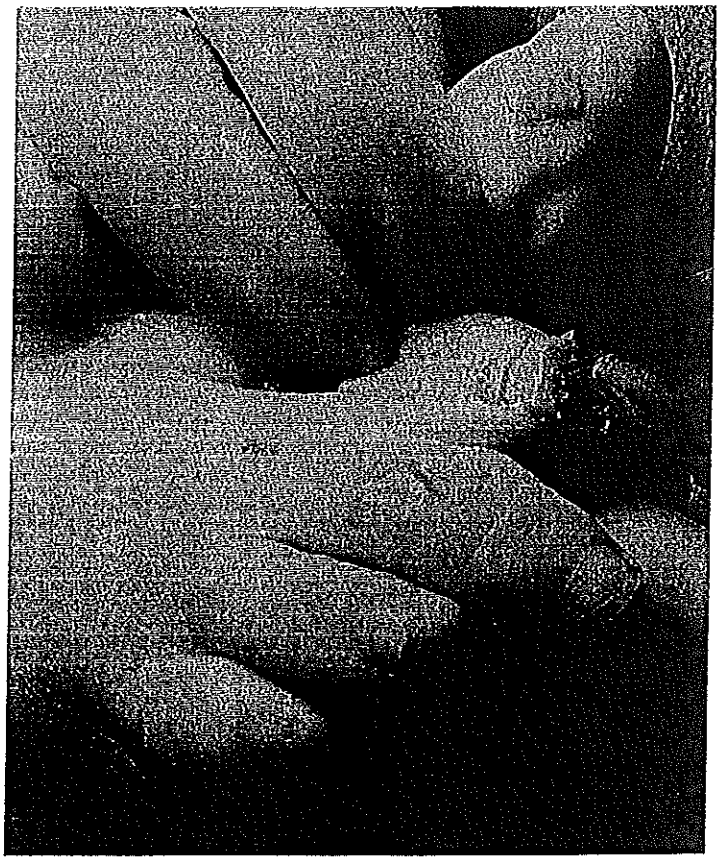

Fig. 4. Intraoperative placement of absorbable pin in proximal phalanx cut for insertion at the intermediate phalanx.

Fig. 5. Depiction of healed proximal interphalangeal joint arthrodesis of the toe with buried or internal intramedullary pin (sagittal view).

include additional bone resection in comparison with end-to-end arthrodesis, which further shortens the toe, and the need for more exposure at the base of the intermediate phalanx to make the cuts. Buried intramedullary pin fixation has been described previously with good outcomes using either metal or absorbable materials (13–15). This technique can be used to stabilize the chevron arthrodesis for the vast majority of toe deformities (Figure 4). Advantages are numerous, including avoidance of neighboring joint damage, no risk of pin tract infection or inadvertent pin removal, the use of a single pin for multiple toes, and improved patient acceptance (Figure 5). The senior authors (JMM and DKB) have been using the chevron arthrodesis technique to correct lesser hammertoe deformities for more than a decade and have found it to be reproducible with favorable outcomes, and recommend it for correction of fixed or semi-fixed lesser toe contractures.

References

1. Jimenez AL, Fishco WD. Lesser ray deformities. In *McGlamry's Comprehensive Textbook of Foot and Ankle Surgery*, pp 322–371, edited by AS Banks, MS Downey, DE Martin, SJ Miller, Lippincott Williams and Wilkins, Philadelphia, 2001.
2. Soule RE. Operation for the correction of hammer toe. NY Med J 91:649–650, 1910.
3. Higgs SL. Hammer-toe. Postgrad Med J 68:130–132, 1931.
4. Young CS. An operation for the correction of hammer-toe and claw-toe. J Bone Joint Surg 20:715–719, 1938.
5. Yu GV, Vincent AL, Wissam EK, Schinke TL. Techniques of digital arthrodesis: revisiting the old and discovering the new. Clin Podiatr Med Surg 21:17–50, 2004.
6. Edwards WH, Beischer AD. Interphalangeal joint arthrodesis of the lesser toes. Foot Ankle Clin 7:43–48, 2002.
7. Harmonson JK, Harkless LB. Operative procedures for the correction of hammertoe, claw toe, and mallet toe: a literature review. Clin Podiatr Med Surg 13:211–220, 1996.
8. Schelfman BS, Fenton CF 3rd, McGlamry ED. Peg in hole arthrodesis. J Am Podiatr Assoc 73:187–195, 1983.
9. Kimmel HM, Garrow S. A comparison of end-to-end versus "V" arthrodesis procedures for the correction of digital deformities. Clin Podiatr Med Surg 13: 239–250, 1996.
10. Lamm BM, Ribeiro CE, Vlahovic TC, Bauer GR, Hillstrom HJ. Peg-in-hole, end-to-end, and V arthrodesis: a comparison of digital stabilization in fresh cadaveric specimens. J Am Podiatr Med Assoc 91:63–67, 2001.
11. Pichney GA, Derner R, Lauf E. Digital "V" arthrodesis. J Foot Ankle Surg 32:473–479, 1993.
12. Watson HK, Shaffer SR. Concave-convex arthrodesis in joints of the hand. Plast Reconstr Surg 46:368–371, 1970.
13. Creighton RE, Blustein SM. Buried Kirschner wire fixation in digital fusion. J Foot Ankle Surg 34:567–570, 1995.
14. Konkel KF, Menger AG, Retzlaff SA. Hammer toe correction using an absorbable intramedullary pin. Foot Ankle Int 28:916–920, 2007.
15. Patton GW, Shaffer MW, Kostakos DP. Absorbable pin: a new method of fixation for digital arthrodesis. J Foot Surg 29:122–127, 1990.