

Two Versus 3 Lag Screws for Fixation of Long Oblique Proximal Phalanx Fractures of the Fingers: A Cadaver Study

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Purpose To compare 2- versus 3-screw fixation for oblique fractures of the proximal phalanx in a cadaver model that simulates active finger motion.

Methods We experimentally cut the proximal phalanges of the index, middle, and ring fingers of 9 cadaveric hands. Five fingers were assigned to a control group with no fixation, and 22 were fixed with either 2 or 3 lag screws. One digit was excluded because of iatrogenic fracture during preparation. The fingers were fitted with a differential variable reluctance transducer that measured maximum interfragment displacement while the fingers were subjected to 2,000 full flexion and extension cycles to simulate a 6-week active motion protocol.

Results Analysis of variance revealed a significant difference between the control group and both the 2- and the 3-screw group. The 2- and 3-screw group average displacements were not significantly different. Both of these groups were equivalent with a power of 90%.

Conclusions Biomechanical stability during simulated active motion protocol did not differ in simulated proximal phalanx fractures treated with 2 lag screws or 3.

Clinical relevance Fracture fixation using 2 screws may be more cost and time effective and, therefore, more attractive to the surgeon, even when 3 screws can be placed. Furthermore, surgeons may consider using 2 screws rather than resorting to plate fixation when 3-screw fixation is not possible for these types of fractures. (*J Hand Surg Am.* 2015;40(6):1124–1129. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Fracture, lag screw, proximal phalanx, stability.

THERE IS CONSENSUS THAT unstable displaced spiral and long oblique proximal phalanx fractures warrant operative intervention,¹ but the superior method of fixation remains undetermined. The AO Foundation recommends using 2 or more screws for managing long oblique fractures (Fig. 1).²

The first lag screw is used for reduction and the second screw controls rotation. Although it may not be necessary, many surgeons use 3 screws, regardless of fracture length, as a matter of routine, and when surgeons cannot obtain fixation with 3 screws, they may resort to plate-and-screw fixation.

Plate fixation with a lag screw is the most rigid method of fracture fixation.³ This allows for early motion protocols,^{4,5} but authors have reported high complication rates.^{6,7} K-wire fixation, the least rigid method, can be done quickly and without extensive dissection but cannot achieve interfragment compression.^{8,9} Complications include infection,¹⁰ nonunion and loosening,¹¹ and stiffness.¹² Lag screw fixation, an intermediate between plate and K-wire fixation, is recommended by the Association for the Study of

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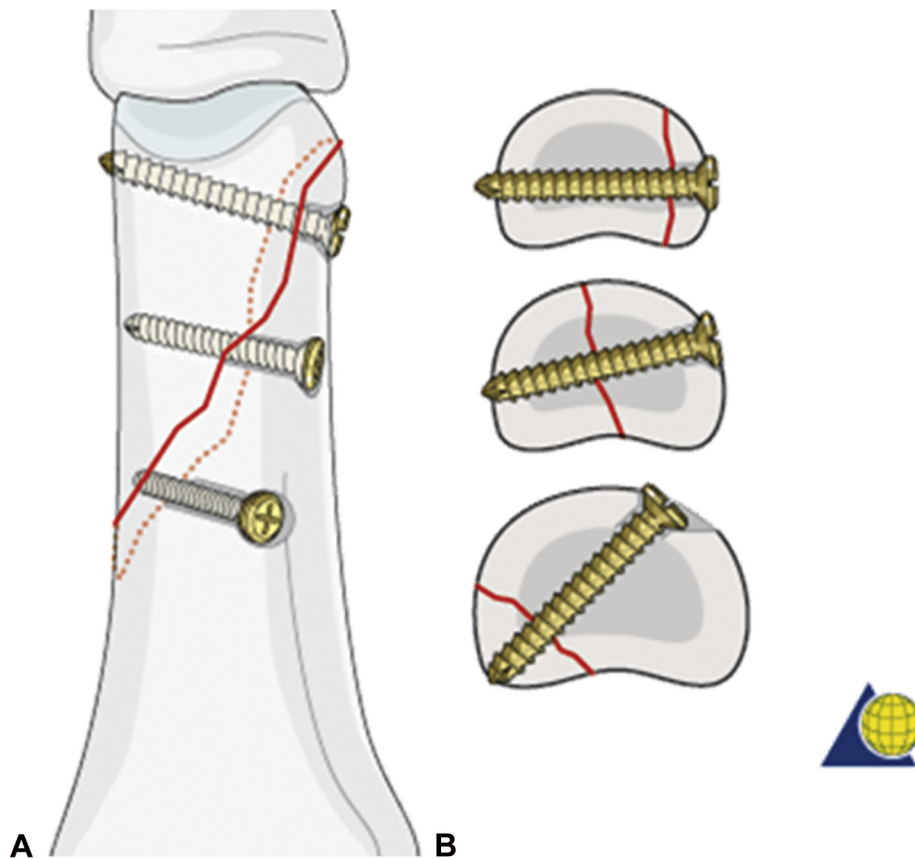


FIGURE 1: Anteroposterior view of AO recommendation for lag screw fixation of oblique proximal phalanx fractures **A** and transverse view of AO recommendation for lag screw fixation indicating orthogonal positioning of the screws relative to the fracture line and the use of countersinking **B**. (Reprinted with permission from Nuñez F, Fricker R, Kastelec M. Proximal phalanx: long oblique fractures. Available at: <https://www2.aofoundation.org/wps/portal/surgery/2008>. Copyright © by AO Foundation, Switzerland.)

Internal Fixation.¹³ One prospective, randomized study that compared K-wire fixation to 2 lag screws demonstrated no difference in pain and functional recovery at 40 months.¹⁰ In another study, the authors found that lag screws conferred more rigidity than dorsal plating alone and crossed K-wires.³

We hypothesized that the bony constructs using 2 or 3 1.5-mm lag screws for treatment of oblique proximal phalanx fractures would confer equivalent stability in the setting of simulated early resistance-free active motion hand therapy. Evidence that 2-screw constructs perform similarly to 3-screw constructs in a simulated standard rehabilitation protocol should encourage routine placement of 2 screws with the assurance that the repair will withstand early active motion. This would also support the concept of using 2 lag screws rather than resorting to plate-and-screw fixation when 3-screw fixation is not possible.

MATERIALS AND METHODS

We tested 26 fresh-frozen human cadaveric fingers on 9 hands in 2 phases. Specimen mean age was 67

years (range, 59–75 y) and there were 7 females and 2 males. We thawed the specimens for 24 hours at room temperature before preparation and testing. Specimens had appropriate mobility of the joints and were free of deformity. The limbs were disarticulated at the radiocarpal joint, but the flexor digitorum superficialis, flexor digitorum profundus, and extensor digitorum communis tendons were divided more proximally at the muscle-tendon junction. A carpal tunnel release was performed, and the flexor digitorum superficialis and flexor digitorum profundus tendons were separated distally to facilitate individual tendon excursion. Locking 3-0 Ethibond (Ethicon, Somerville, NJ) sutures were placed in the long extensors and flexors of the index, middle, and ring fingers. The sutures of the flexors and extensors were carefully tensioned so composite simulated active flexion and extension was full and equal among digits.

We used a central dorsal approach over the proximal phalanges of the index, middle, and ring fingers. A partial tenotomy of the radial lateral band allowed for ulnar retraction of the extensor mechanism and full

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