Comparison of Screw Trajectory on Stability of Oblique Scaphoid Fractures: A Mechanical Study

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Purpose To determine whether a screw placed perpendicular to the fracture line in an oblique scaphoid fracture will provide fixation strength that is comparable with that of a centrally placed screw.

Methods Oblique osteotomies were made along the dorsal sulcus of 8 matched pairs of cadaveric scaphoids. One scaphoid from each pair was randomized to receive a screw placed centrally down the long axis. In the other scaphoid, a screw was placed perpendicular to the osteotomy. Each scaphoid underwent cyclic loading from 80 N to 120 N at 1 Hz. Cyclic loading was carried out until 2 mm of fracture displacement occurred or 4,000 cycles was reached. The specimens that reached the 4,000-cycle limit were then loaded to failure. Screw length, number of cycles, and load to failure were compared between the groups.

Results We found no difference in number of cycles or load to failure between the 2 groups. Screws placed perpendicular to the fracture line were significantly shorter than screws placed down the central axis.

Conclusions A perpendicularly placed screw provides equivalent strength to one placed along the central axis.

Clinical relevance Compared with a screw placed centrally in an oblique scaphoid fracture, a screw placed perpendicular to the fracture line allows the use of a shorter screw without sacrificing strength of fixation. *(J Hand Surg Am. 2014;39(3):430–435. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Biomechanics, internal fixation, scaphoid fracture, wrist.

Herbert and Fisher[1] classified acute scaphoid waist fractures into 2 main groups: simple transverse waist fractures (type B2) and distal oblique fractures (type B1). Oblique scaphoid fractures are difficult to treat owing to the shear forces generated by a more vertical pattern in the fracture line and the high tendency toward development of a humpback deformity.[2] Although initially thought to be rare, recent data suggest that the oblique scaphoid fracture pattern may be underappreciated.[3] Furthermore, the dorsal sulcus fracture pattern appears to be the more common variant of the oblique scaphoid fracture (Fig. 1).[3]

A current recommendation for stabilizing all scaphoid fractures, irrespective of the fracture pattern, involves placing a screw down the central axis of the scaphoid.[4,5] This recommendation was based on the improved biomechanical strength of a centrally placed screw compared with an eccentric screw when treating transverse waist fractures.[4] Recent studies suggest that it may be more appropriate to fix oblique fractures by means of a screw that is directed

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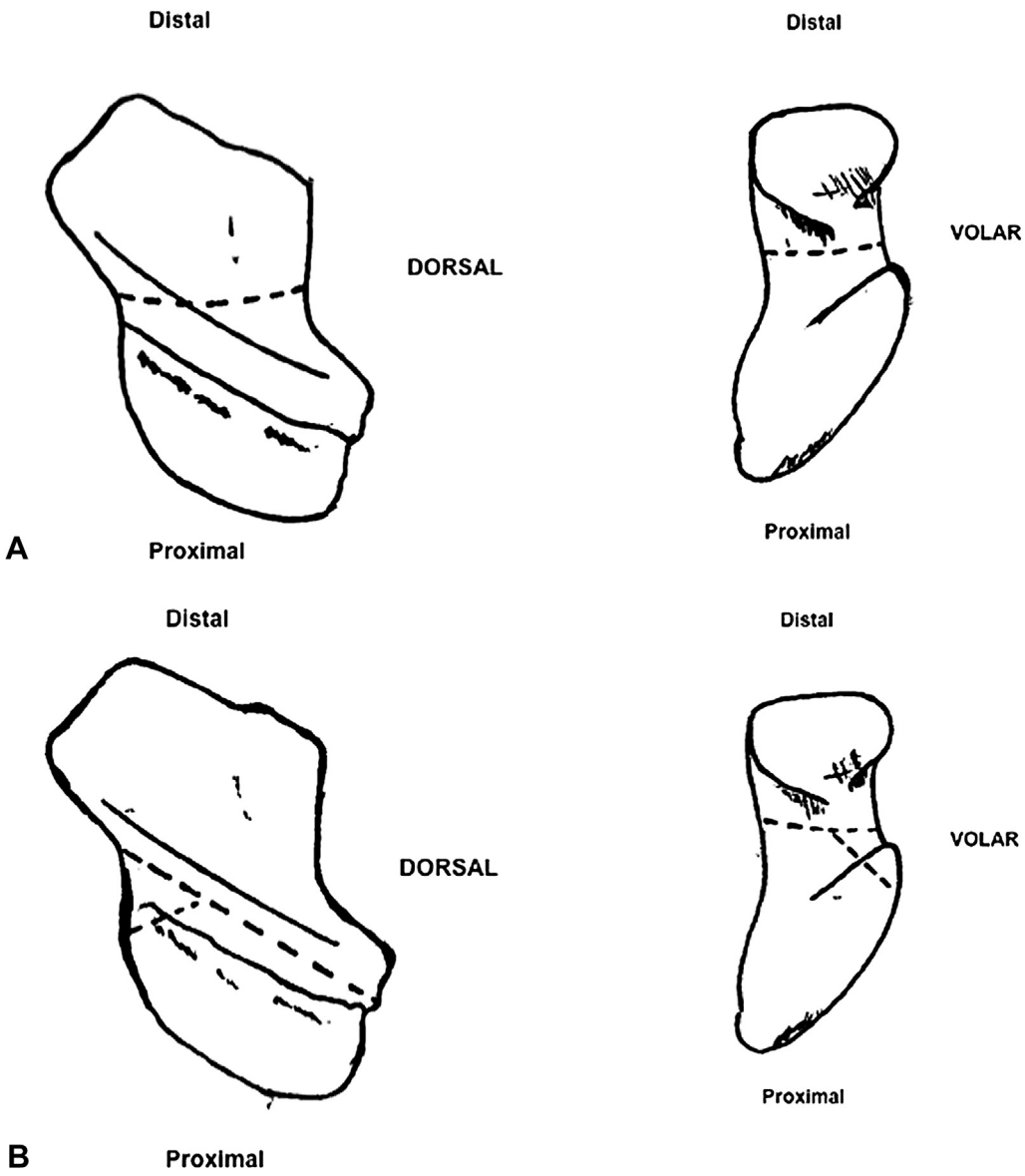

FIGURE 1: A Transverse waist scaphoid fracture (dotted line) on dorsal and volar views. **B** Dorsal sulcus pattern of scaphoid fracture (dotted line) on dorsal and volar views. [Reproduced with permission and copyright © of the British Editorial Society of Bone and Joint Surgery from Compson JP. The anatomy of acute scaphoid fractures: a three-dimensional analysis of patterns. *J Bone Joint Surg Br*. 1998;80(2):218–224.[3]]

perpendicular to the fracture line.[6–10] One study used a cadaveric biomechanical model to compare fixation between perpendicular and central trajectories for the oblique fracture.[7] This study did not, however, apply cyclic loading, nor did it simulate the more common dorsal sulcus fracture pattern.[3]

The primary aim in this cadaveric study was to determine whether a screw placed perpendicular to the fracture line in an oblique scaphoid fracture could achieve fixation comparable with that achieved by a screw placed down the central axis. We surmised that this perpendicular trajectory would also allow for a shorter screw to be placed, thus providing the surgeon with an alternative to placing the longest screw possible. A cadaveric biomechanical study was designed to compare the effect of screw trajectory on fixation strength for the oblique fracture pattern following cyclic loading and load to failure. Second, we sought to compare the average screw length and mechanism of failure between the 2 groups.

MATERIALS AND METHODS

Cadaveric specimens

Eight pairs of scaphoids from the left and right wrists of 8 fresh frozen cadavers were harvested. The sample size was calculated assuming equal numbers of specimens in both study samples, with $\alpha = 0.05$,