Scaphoid Fractures: Is a Single Screw Enough?

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INTRODUCTION:

The scaphoid is the most commonly fractured carpus. The tenuous blood supply of the scaphoid predisposes the carpus to nonunion and avascular necrosis (AVN). Therefore, certain fractures are managed surgically. Surgical treatment typically involves fixation with a headless compression screw (HCS) which allows for compression of the fracture site. However, despite operative fixation with HCS, there still remains a risk of nonunion postoperatively and a single longitudinally-directed HCS may still permit rotation among the fracture fragments. Alternatively, an additional HCS may control rotation and thus increase the stability of the construct. The purpose of this study was to assess *in vitro* the biomechanical stability of a single and two-HCS construct in the treatment of displaced scaphoid waist fractures. We hypothesized that two HCS would decrease rotational forces and thus improve stability of the fracture.

METHODS:

The scaphoids of 8 fresh frozen cadavers were included. A dorsal approach to the scaphoid was then used to expose the scaphoid. Two k-wires were placed perpendicular to the scaphoid (dorsal to volar) proximal and distal to the planned osteotomy site, respectively, and then cut flush to serve as markers for rotation (Figure 1). An osteotomy was created at the level of the scaphoid waist. The wrist was then taken through full range of motion (ROM) and radiographs taken at end ROM. The images were reviewed by two different observers, if the wires were not found to be parallel on radiographs, this was deemed to demonstrate rotation (Figure 2). A parallel guide was then placed over the k-wires to reduce the simulated fracture and an HCS was then advanced across the fracture site. The wrist was then taken through full ROM. For each radiograph, the specimen was rotated until one pin was orthogonal, the position of the second pin was then assessed and if the wires were not parallel this was deemed to demonstrate rotation once again. The HCS was then removed from the scaphoid and a cylinder with a magnet attached to the distal end was then advanced down the central axis of the scaphoid. The proximal end of the cylinder was affixed to the proximal scaphoid fracture fragment. A sensor was then affixed to the distal aspect of the scaphoid with the magnet and paired with a microcontroller board to measure rotation at the osteotomy site. The wrist was then taken through full ROM, including flexion-extension, pronosupination, and radial/ulnar deviation and rotation recorded.

RESULTS:

Six measurements were collected for each specimen in flexion, extension, pronation, supination, radial deviation, and ulnar deviation after the osteotomy and again after fixation with a single HCS. The radiographs after osteotomy demonstrated rotation at the osteotomy site in all specimens in flexion (8/8), extension (7/8), pronation (8/8), radial deviation (8/8), and ulnar deviation (8/8) with the exception of supination (4/8). The radiographs after fixation with an HCS demonstrated rotation in all ROM for all specimens with the exception of flexion for one specimen. Interfragmentary rotation was found to be 23-30° during flexion/extension, 18-24° during supination/pronation, and 28-35° during ulnar/radial deviation with single HCS fixation.

DISCUSSION AND CONCLUSION:

Fractures of the scaphoid are at risk for AVN and nonunion despite operative fixation. Typical surgical management includes fixation with a single HCS. However, a single HCS appears to allow for rotation at the fracture site despite fixation. Surgeons may consider the use of two HCS during operative fixation of scaphoids to increase stability at the fracture site and reduce the risk of AVN/nonunion.