SCIENTIFIC ARTICLE

Volar Plate Position and Flexor Tendon Rupture Following Distal Radius Fracture Fixation

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Purpose To determine whether there were differences between plate position in patients who had postoperative flexor tendon ruptures following volar plate fixation of distal radius fractures and those who did not.

Methods Three blinded reviewers measured the volar plate prominence and position on the lateral radiographs of 8 patients treated for flexor tendon ruptures and 17 matched control patients without ruptures following distal radius fracture fixation. We graded plate prominence using the Soong grading system, and we measured the distances between the plate and both the volar critical line and the volar rim of the distal radius.

Results A higher Soong grade was associated with flexor tendon rupture. Patients with ruptures had plates that were more prominent volarly and more distal than matched controls without ruptures. Plate prominence projecting greater than 2.0 mm volar to the critical line had a sensitivity of 0.88, a specificity of 0.82, and positive and negative predictive values of 0.70 and 0.93, respectively, for tendon ruptures. Plate position distal to 3.0 mm from the volar rim had a sensitivity of 0.88, a specificity of 0.94, and positive and negative predictive values of 0.88 and 0.94, respectively, for tendon ruptures.

Conclusions We identified plate positions associated with attritional flexor tendon rupture following distal radius fracture fixation with volar plates. To decrease rupture risk, we recommend considering elective hardware removal after union in symptomatic patients with plate prominence greater than 2.0 mm volar to the critical line or plate position within 3.0 mm of the volar rim. *(J Hand Surg 2013;38A:1091–1096. Copyright © 2013 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic III.

Key words Distal radius fracture, flexor tendon rupture, plate position, volar plate.

Flexor tendon rupture is a rare but serious complication following open reduction internal fixation of distal radius fractures with volar plates.[1,2] In several recent reports of flexor pollicis longus and flexor digitorum profundus ruptures after volar plating, authors suggest that plate prominence and/or distal plate position are the cause of the tendon ruptures.[1,3–7]

Although prominent and distal plate positions are accepted as known risk factors for postoperative tendon rupture,[3,4] the association between plate position and flexor tendon rupture is not known. Surgeons generally try to keep plate position proximal to the watershed line, but there are no current recommendations as to what distance is too prominent or too distal with respect to tendon rupture risk.

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TABLE 1. Demographics of Patients With Ruptures and Controls

	Age (y)*	Sex	Time From Surgery (y)*
Ruptures (n = 8)	Mean, 66 (range, 48–76)	F 5, M 3	Mean, 3.8 (range, 1.2–6.3)
Controls (n = 17)	Mean, 66 (range, 57–72)	F 14, M 3	Mean, 4.3 (range, 2.3–5.7)

Time from surgery indicates the time elapsed between the index distal radius fracture fixation and the time of rupture or the time of latest follow-up evaluation (for the control group).
*P values > .05 between groups.

Soong and colleagues[7] recently described a grading system for classifying volar plate prominence following distal radius fracture fixation. In their paper, they also attempted to associate Soong grade with tendon rupture risk, but their conclusions were limited by having only 3 cases of flexor tendon ruptures in their paper.

We analyzed a larger cohort of patients with flexor tendon attrition following volar plating to identify plate positions associated with flexor tendon injury. We hypothesized that a higher Soong grade would be associated with flexor tendon rupture. We also hypothesized that volar plate position in patients with confirmed flexor tendon ruptures would be farther distal and more prominent than volar plate position in a matched cohort of patients without ruptures.

MATERIALS AND METHODS

After approval from our institutional review board, we identified 8 patients who were treated at our tertiary care center for flexor tendon ruptures a mean of 3.8 years (± 1.8 SD) following volar plating of distal radius fractures (Table 1). Four patients had flexor pollicis longus ruptures and 4 had 1 or more flexor digitorum profundus ruptures. We collected demographic data on these 8 patients, and we randomly selected an age- and sex-matched cohort of 17 control patients from our distal radius database who did not sustain tendon ruptures after a mean of 4.1 years (± 1.2 SD) since surgery (Table 1).

For analysis, we selected the postoperative standard lateral wrist plain radiograph with the thinnest profile of the volar plate for each patient according to the methods described by Soong and colleagues.[7] In all of the chosen lateral radiographs, the pisiform was noted to project over the distal portion of the scaphoid, signifying a proper lateral view. Three blinded orthopedic surgery resident reviewers graded the lateral radiographs for plate prominence relative to the volar critical line using the Soong grading system.[7] Using a picture archiving communication system (PACS), we drew a line along the volar cortex of the radial shaft. We then drew the "critical line"[7]: a line parallel to the volar radial cortex touching the most volar tip of the distal radius (Figure 1A). We graded plates dorsal to this volar critical line as grade 0, plates that either touched the critical line or protruded volar to the line as grade 1 (if they were also proximal to the volar rim), and plates on or distal to the volar rim as grade 2 (Fig. 1B).

The blinded reviewers also quantified plate prominence by measuring the distance in millimeters between the plate and the volar critical line–the plate–to–critical line (PCL) distance. We quantified distal plate position by measuring the distance between the distalmost extent of the plate and the most distal portion of the volar rim–the plate–to–volar rim (PVR) distance (Figure 1A). To account for potential magnification errors, plate length was measured on the lateral view and compared with manufacture-reported plate lengths. The PVR and PCL measurements were all normalized based on these measurements, and the correction was negligible (mean normalization factor, 1.01; SD, 0.04). Plate position on posteroanterior radiographs was also analyzed to determine whether the plates were well centered on the distal radius or ulnarly or radially deviated. To assess for a potential plate/patient size mismatch, the width of the plate was measured at the level of its greatest width and compared with the width of the radius at the same level. The ratio of plate width to radius width was compared between patients in all 3 groups. All radiographs were also assessed for potential loss of fracture reduction and prominent hardware.

We calculated interobserver reliability between readers using intraclass correlation coefficients for PCL and PVR measurements and kappa statistics for Soong grade. We used chi-square analysis to determine the association between Soong grade and flexor tendon rupture. We used 1-way analysis of variance tests with Bonferonni adjustments to compare the mean PCL and PVR distances between our 2 patient groups. A post-hoc power analysis showed that group sample sizes of 17 controls and 8 ruptures had greater than 90% power to detect the normalized PCL and PVR differences in