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BACKGROUND

Volar plate fixation is the preferred surgical treatment of distal radius fractures1. Fixation with a volar plate can lead to extensor tendon complications, commonly due to screw protrusion dorsally2. Intra-operative fluoroscopy and depth gauges are used to try to prevent extensor tendon injuries; however, screw protrusion often goes undetected. A number of fluoroscopic views have been described to increase the ability to detect dorsal cortex screw penetration3,4. The skyline and carpal shoot-through views have been developed to increase the visibility of the dorsal cortex5, 6.

OBJECTIVES

To determine the accuracy of using depth gauge independently to measure the appropriate screw length.

To determine the sensitivity and specificity of skyline and carpal shoot-through views of determining screw protrusion.

To determine the utility of the skyline and carpal shoot-through views to augment standard intraoperative views as a means to detect screw protrusion during volar plate fixation for distal radius fractures.

MATERIALS AND METHODS

Seven fresh frozen human cadaver specimens from 6 different donors without gross evidence of wrist or forearm abnormalities were used.

Surgical Technique:
The Acu-Loc 2 Volar Distal Radius plating system was used per manufacturer-recommended guidelines to measure screw lengths with the depth gauge. Then the plates were placed in the appropriate location on the specimens and screws were inserted into the distal screw holes on the plate to fix it to the bone. Dorsal dissection was performed to determine if screws were protruding (Figure 3). Screws that were not protruding were deemed to be baseline length. Screws in hole positions 3 and 4 (Figure 4) were sequentially lengthened by 2mm and 4mm above baseline.

Radiographic Assessment

Fluoroscopic views were taken at baseline, 2mm, and 4mm screw lengths utilizing a radiolucent support base to ensure accuracy of arm placement.

Survey Analysis

Fluoroscopic images were formatted into an untimed survey asking participants to determine screw protrusion. The survey included a short orientation about the fluoroscopic views (Figure 5). The survey was presented to a group of orthopedic residents, orthopedics surgeons, and hand specialists and emailed to orthopedic surgeons and hand specialists.

Statistical Analysis

The survey results were used to calculate the sensitivity and specificity of the skyline and carpal shoot through views.

RESULTS

Out of the 7 specimens used, 4 were right arms and 3 were left. Five were fitted with standard plates and 2 were fitted with wide plates. A total of 44 screws were placed in holes 3 and 4. Four screws were found to be protruding upon dorsal dissection and were replaced with screws 2mm shorter to qualify as baseline.

Sensitivity and Specificity of Skyline and Carpal Shoot views

Of the total 64 survey participants, 26.5% were residents or fellows, 35.9% were general orthopedic surgeons, and 37.5% were fellowship trained hand surgeons.

In our study, the sensitivity of the carpal shoot through was significantly greater than that of the skyline view at both 2mm and 4mm of protrusion. The specificities were not significantly different between the skyline view and the carpal shoot through view.

Table: Sensitivity and Specificity of Skyline and Carpal Shoot Through views

<table>
<thead>
<tr>
<th></th>
<th>Skyline</th>
<th>Carpal Shoot Through</th>
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<tbody>
<tr>
<td>Sensitivity 2mm</td>
<td>75% (95% CI, 0.70-0.80)</td>
<td>86% (95% CI, 0.82-0.90)</td>
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<tr>
<td>Sensitivity 4mm</td>
<td>76% (95% CI, 0.71-0.81)</td>
<td>89% (95% CI, 0.85-0.92)</td>
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<tr>
<td>Specificity P =</td>
<td>85% (95% CI, 0.80-0.88)</td>
<td>84% (95% CI, 0.80-0.88)</td>
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CONCLUSIONS

Our findings further support the need for better visualization of the dorsal cortex to confirm that the screws are in a safe position. At the conclusion of this study, we were able to determine the sensitivity and specificity for the carpal shoot-through view which, to our knowledge, has not been reported in the literature. We believe that the carpal shoot through view can be used an adjunct to standard views to detect screw penetration. This may decrease the incidence of EPL tendon injuries. The skyline view has potential for overexposure of the image. This is thought to be attributed to the palmar flexion on the wrist. The carpal shoot-through view attempts to eliminate this and was found to be more sensitive compared to the skyline view.

REFERENCES

3. Lee SK, Bae KW, Choy WS. Use of the radial groove view intra-operatively to prevent damage to the extensor pollicis longus tendon by protruding screws during volar plating of a distal radius fracture. Bone Joint J. 2013;95-B(10):1372-1376