SCIENTIFIC ARTICLE

The Dorsal Tangential X-Ray View to Determine Dorsal Screw Penetration During Volar Plating of Distal Radius Fractures

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Purpose To evaluate whether the dorsal tangential view (DTV) allows for reliable and valid *in vivo* measurement of the distance between screw tips and the dorsal radial cortex (STCD) during volar plating of distal radius fractures.

Methods Subjects included 22 patients with displaced distal radius fractures who had volar plate osteosynthesis. We performed standardized DTV images intraoperatively. After surgery, we performed computed tomography (CT) scans with reconstructions parallel to the distal screws. Three independent observers blinded to the study protocol measured the STCD on the basis of the DTV images and CT reconstructions. We calculated inter- and intraobserver reliability and the correlation between STCD values measured with DTV images and CT scans.

Results Eleven screws were changed intraoperatively. We observed no cases of postoperative screw perforations. Inter- and intraobserver reliability of STCD measurement was good when measured with DTV images and excellent when measured on the basis of CT reconstructions. Statistical analysis showed a good correlation between mean STCD values measured with DTV and CT.

Conclusions The DTV allowed *in vivo* evaluation of the dorsal radial cortex and enabled reliable assessment of the distance between the screw tip and the dorsal cortex. It may allow detection of dorsal screw perforation during volar plating of distal radial fractures. *(J Hand Surg Am. 2015;40(1):27–33. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Diagnostic II.

Key words DTV, screw perforation, volar plating, distal radius, extensor tendon injury.

With increasing use of volar locking plates for distal radius fracture fixation, the incidence of extensor tendon injuries caused by screw perforation through the dorsal cortex of the distal radius is as high as 6%.[1–6] In apex-dorsal fractures in which the dorsal radial cortex is comminuted, measurement for appropriate screw length may be especially difficult.

Several authors have pointed out the limitations of standard anteroposterior and lateral fluoroscopic images in detecting dorsal screw penetration.[7–11] Therefore, the dorsal tangential view (DTV) has been proposed to

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visualize screw tips in relation to the dorsal radial cortex to detect screw perforation, especially at the area of the third extensor tendon compartment.[7–10] This technique may be used to locate screw perforations intraoperatively. In addition, it may represent a valuable postoperative alternative to computed tomography (CT) scanning with less radiation exposure in patients in whom standard postoperative x-rays show a concern for screw penetration.

Some studies have validated the DTV on the basis of human cadavers and found high sensitivity for detecting dorsal screw perforation with this technique.[7,10] Those cadaver studies used non-fractured human radiuses for evaluation.[7,10]

In clinical practice, fractures with an intact dorsal cortex are at lower risk for dorsal penetration compared with fractures with comminuted dorsal cortex.

If DTV images allow for clear visualization of screw tips and the dorsal radial cortex, the screw tip cortex distance (STCD) can be measured and may expedite replacement with a shorter screw when necessary.

Measurement of the STCD in the DTV has not been validated *in vivo* and information regarding the reliability of this method remains sparse. Both are important basic requirements for routine use of a diagnostic method.

The purposes of this study were to evaluate the inter- and intraobserver reliability of this technique and to validate this method *in vivo* on the basis of CT scans with multiplanar reconstructions.

We hypothesized that the DTV may enable reliable intraoperative measurement of the STCD during volar plating and that the measured STCD values would show a good correlation with the STCD measured by CT scanning.

MATERIALS AND METHODS

Our institution's human subject review board approved this study, which was in accordance with the Declaration of Helsinki. Between January and December 2012, we studied 22 consecutive patients (4 men and 18 women; mean age, 58 y; range, 25–79 y) with 9 right and 13 left dorsally displaced distal radius fractures. According to the AO/Orthopaedic Trauma Association classification,[12,13] 2 fractures were type A3, 3 were type B3, and 17 were type C (C1: n = 5; C2: n = 4; and C3: n = 8).

Inclusion criteria were distal radius fractures that had been scheduled for open reduction internal fixation by volar plating and patients' consent to participate in the study. Exclusion criteria were prior injuries or surgeries that could have affected the anatomy of the distal radius, mental comorbidities that could affect informed consent, fractures that needed intraoperative augmentation, and Smith-type fractures.[14]

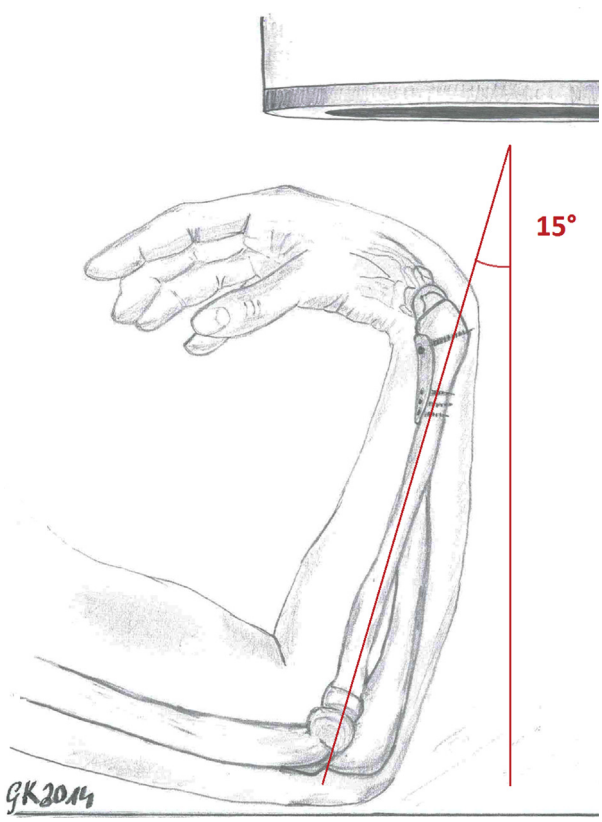

FIGURE 1: The DTV was performed with the wrist held in maximum flexion. The dorsal radial cortex was positioned with 15° inclination to the vertical x-ray beam of the fluoroscope.

All fractures were surgically treated by senior consultants for orthopedic and trauma surgery. In 17 cases we used variable angle locking compression plates (VA-LCPs) (Synthes, Oberdorf, Switzerland) with 4 distal holes and in 5 cases VA-LCP with 5 distal holes. Before surgery we instructed surgeons regarding standardized intraoperative performance of the DTV.

Surgeons obtained the DTV images with the upper arm placed on a horizontal arm table. The proximal forearm was held with 75° of inclination to the horizontal arm table. The wrist was held in maximum flexion. As a result and according to the recommendation of Haug et al,[7] the dorsal cortex of the distal radius was positioned with 15° inclination to the vertical x-ray beam of the fluoroscope (Fig. 1). The surgeons used a sterile goniometer for precise adjustment of forearm inclination.

The tube voltage of the fluoroscope was 84 kV and we used a circular x-ray cover to reduce scattered radiation.