3D Virtual Pre-Operative Planning Lowers the Risk of Dorsal Screw Penetration in Volar Plating of Intra-Articular Distal Radius Fractures

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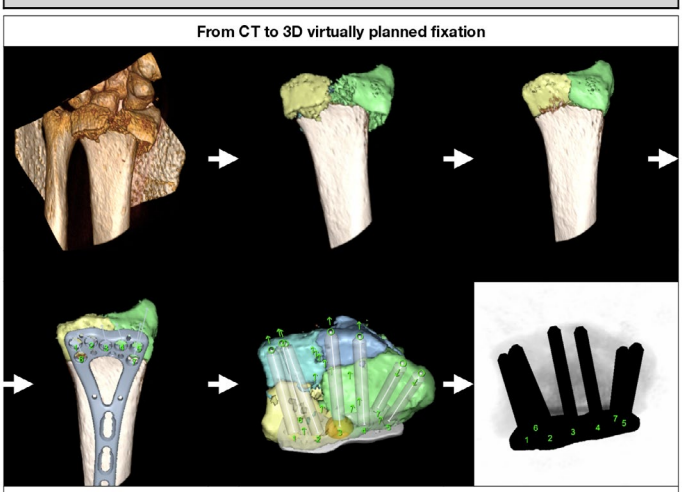
Purpose: The purpose of this study was to evaluate the effect of 3-dimensional virtual preoperative planning (3DVP) on the incidence of dorsal screw penetration after volar plating of distal radius fractures.

Methods: A cross-sectional diagnostic imaging study was performed. 20 out of 50 patients were randomly selected (computerized) from our index prospective cohort (IPC), a prior study to evaluate dorsal tangential views (DTVs) to reduce dorsal screw penetration in patients undergoing open reduction and internal fixation for an intra-articular distal radius fracture using postoperative CT scans to quantify screw protrusion. Preoperative CT scans from this cohort were now used for 3DVP by three experienced orthopaedic trauma surgeons. 3DVP was compared with the corresponding postoperative CT for assessing screw lengths, appropriate screw lengths (75% to 100% of radius diameter) and incidence of dorsal penetration. The Wilcoxon signed rank test was used to compare screw lengths and the Fisher's exact test for incidence of penetration.

Results: Three surgeons performed 3DVP for 20 distal radius fractures and virtually applied 60 volar plates and 273 screws. The median screw length was shorter in the 3DVP when compared to IPC: 18 mm (range, 12-22) versus 20 mm (range, 14-26) ($P<0.001$). The number of screws of appropriate length was similar between groups: 81% (222 of 273) for the 3DVP group versus 86% (78 of 91) for the IPC ($P = 0.472$). The number of penetrating screws was 5% (13 of 273 screws) in the 3DVP group compared to 11% (10 of 91 screws) in the IPC ($P = 0.047$). This corresponds to a reduction in incidence of at least one dorsally penetrating screw in 40% of patients in the IPC group, to 18% in the 3DVP group ($P = 0.069$).

Conclusion: 3DVP potentially reduces the incidence of dorsally penetrating screws in patients treated with volar plating for intra-articular distal radius fractures.

Figure III – Workflow Overview



First a 3D model is generated from a 2D CT scan, then removal of cast, surrounding bones and segmentation of individual fracture fragments is carried out. Next, reduction of fragments to their anatomical position, after which positioning of volar plate and positioning of screws is performed (bottom left, with screws 1-5 from ulnar to radial). Bottom middle is a view onto articular surface with screws 1-7 positioned. Bottom right presents the Dorsal Tangential view in Fluoroscopy mode

The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.