

Acute scaphoid fracture fixation – planned versus actual reduction and fixation - 3D computer analysis.

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INTRODUCTION

Scaphoid fractures are commonly treated with a single headless cannulated screw. There are different recommendations regarding the optimal location of this screw (Trumble 1996, McCallister 2003, Hart 2013). The purpose of this study was to compare the location of screws placed for the treatment of acute scaphoid fractures with theoretical and virtual possible screw locations.

MATERIALS AND METHODS

All patients with CT scans of acute scaphoid fractures treated surgically and with available pre- and postoperative CT scans performed during the study period were included in the study. The scans were analysed using a 3D software model (Amira Dev 5.3, Mercury Computer Systems, Chelmsford, MA). On the preoperative CTs the displaced fractures were virtually reduced. The actual screw location was compared with possible screw locations including a screw along the central third of the proximal fragment (central base screw), the scaphoid longitudinal axis calculated mathematically (PCA screw) and a screw placed 90 degrees to the fracture plane (90 degree screw). The angle between the axes and fracture planes were measured. The angle and distance between the different screw locations were measured as well.

RESULTS

The imaging studies of 10 patients were evaluated. The angles between the actual and virtual screws to the fracture plane were between a mean of 67 to 69 degrees (other than the 90 degree screw). The angle between the axes was greatest between the 90 degree screws to the PCA screws and actual screws (mean 23 degrees both; $p=0.034$) and smallest between the central base screws and PCA screws to the actual screws (mean of 12.1 and 12.5 degrees, respectively; $p=0.034$). The difference between the entrance and exit points between the axes was between 3.1 to 4.8 mm other than the 90 degree screws which were 5.3 to 7.1 mm to the other axes ($p=0.002$). The PCA screws (mean 28.3 mm) were found to be longer than the actual screws (mean 25.4) or the 90 degree screws (mean 23.5) ($p=0.034$ and $p=0.008$ respectively). The 90 degree screws were shorter than the PCA or central base screws ($p=0.008$, $p=0.034$ respectively), but not the actual screws.

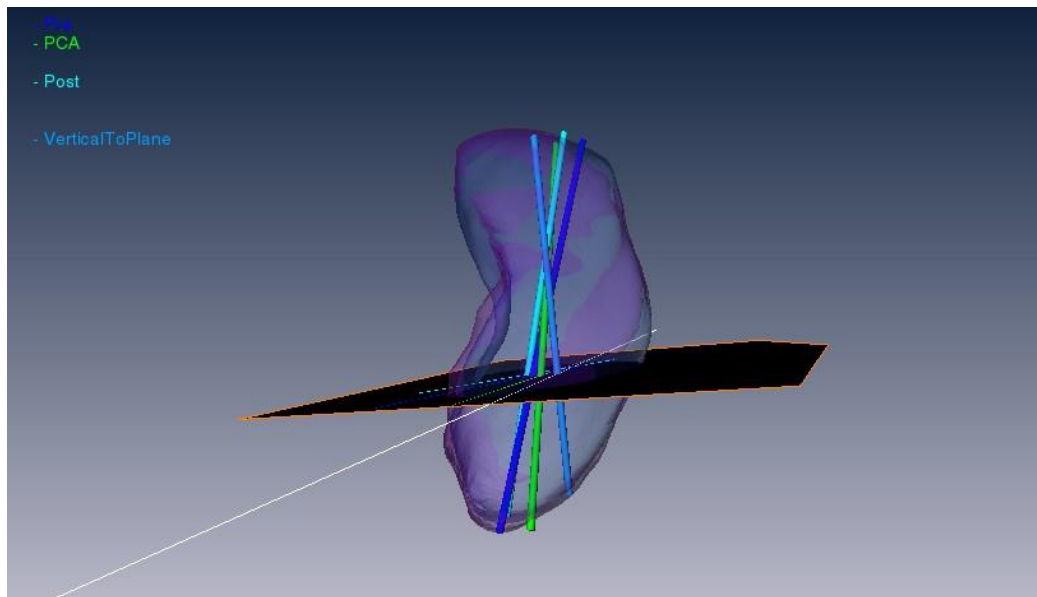


Figure 1: Possible screw locations. The black surface represents the fracture plane. Each line represents possible screw locations.

DISCUSSION

There were no significant differences in the angles between actual and virtual optimal screws other than the 90 degree screws. The PCA was found to be the longest screw and at a similar angle to the fractures as the other virtual screw options, other than the shorter 90 degree screw. Virtual reduction and preplanning of the screw location, using standard software, may enable the surgeon to place the longest screw along the PCA longitudinal axis without chondral penetration (Tumilty 1996). If placing a 90 degree screw is considered (Luria 2010), this may be technically difficult at times, or may necessitate a trans-trapezial approach.

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