Augmented Reality Guided Percutaneous Cannulated Screw Placement for Pelvic Trauma

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INTRODUCTION: Fixation of pelvic fractures with conventional techniques has known difficulties of complexity, time, accuracy, and extensive radiation exposure. For example, placement of a percutaneous sacroiliac (SI) fusion screw requires a long trajectory, with significant distance from the entrance of the skin to the bone, and the need to navigate across bony structures while avoiding adjacent critical anatomy. Similarly, the placement of anterior or posterior columns demands precise navigation along a narrow trajectory. Presented here is promising data from a clinical trial for navigating percutaneous cannulated screws of anterior and posterior column fractures and sacroiliac fusion procedures of the pelvis.

METHODS:

CT imaging was acquired with image visible alignment codes adhered to the skin of the patient after signing the consent form (Figure 1). Preoperative planning of trajectory, length, distance, and diameter were obtained on a surgical planning trail program. Data was wirelessly transferred to the augmented reality guidance system from an encrypted optical code retrieval system. Voice command workflow streamlined registration of the data from the CT scan to the patient. It was aligned with a 2.8mm wire guide. The navigation guide was affixed with an optical tracker for precise wire guidance. Navigation consisted of following 3-dimensional holographic virtual guides (Figure 1) as well as tool tracking in multiplanar space from coronal, axial, and sagittal views. Four SI joint fusion, 3 anterior column (Figure 2), and 1 posterior column screws were placed. Fluoroscopy was used during guide wire placement to assure the correct position.

Postoperative CT scans were made to confirm screw position and reduction.

RESULTS:

Up to this point 8 patients were recruited to this study. Five with lateral compression fracture treated with sacroiliac screw (S1) and three with transverse acetabular fracture treated with anterior column screw (one posterior column screw was planned but eventually wasn't used).

All screws were found to be in correct position according to preoperative planning on CT scan.

DISCUSSION AND CONCLUSION:

Overall, the system has proven that successful virtual navigation of long cannulated screws could be performed in a challenging anatomic environment with significant success. Modest improvements in the technique will allow the surgeon to perform fixation faster and with greater accuracy.