

## **Mixed reality with real-time navigation grants low deviations from planned inclination and version of the glenoid for reverse shoulder arthroplasty**

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### **INTRODUCTION:**

Correct glenoid version and inclination can limit scapular notching, instability and glenoid loosening in reverse shoulder arthroplasty (RSA). Traditionally, planned trajectories were displayed on a screen close to the operating table, and reproduced freehand intra-operatively. Mixed reality planification has emerged, using superimposition of the scapular hologram on the patient's glenoid, with intended trajectories and real-time navigation to provide more accurate guidance. The purpose was to assess the implant version and inclination in reverse shoulder arthroplasty using mixed reality with navigation.

### **METHODS:**

The authors retrospectively assessed a series of 36 shoulders that underwent RSA using mixed reality with navigation using a head mounted display (HMD) (Figures 1 and 2). Computed tomography scans were acquired for each shoulder, and processed using 3D imaging software to plan the RSA, and define the target inclination and version. The HMD was used to display an interactive hologram over the operative site to navigate the guidewire. Postoperative CT scans were performed at 6 months, and version and inclination of the implant were measured by an independent radiologist, blinded to the study protocol. Absolute deviations between planned and achieved postoperative (on 6-month CT scan) values, and between intraoperative (displayed on the HMD) and achieved postoperative (on 6-month CT scan) values were calculated. Additionally, intraoperative time required for mixed-reality navigation and any intra- or postoperative complications were recorded.

### **RESULTS:**

The final cohort comprised 35 shoulders, aged  $75.5 \pm 7.3$ . Additional operative time was  $10.1 \pm 2.5$  minutes. The absolute deviation between post-operative and planned version was  $2.8^\circ \pm 2.0$  ( $p < 0.001$ ), and the absolute deviation between post-operative and intra-operative version was  $2.9^\circ \pm 2.1$  ( $p = 0.003$ ) (Table). The absolute deviation between post-operative and planned inclination was  $4.6^\circ \pm 4.6$  ( $p = 0.154$ ), and the absolute deviation between post-operative and intra-operative inclination was  $4.3^\circ \pm 4.3$  ( $p = 0.074$ ) (Table). Intraoperatively, one patient sustained a coracoid fracture due to tracker pin placement. Postoperatively, another patient sustained coracoid and acromion fractures following a fall 3 days after surgery. Both coracoid fractures healed without further intervention, as confirmed on 6-month follow-up CT.

### **DISCUSSION AND CONCLUSION:**

RSA with mixed reality navigation enables accurate glenoid implant positioning, with minimal deviations from planning, within  $3^\circ$  for version and  $5^\circ$  for inclination. However, surgeons should be aware of the additional time required and the risk of coracoid fracture.