Mixed-Reality Visualization in Revision Reverse Shoulder Arthroplasty: A Retrospective Comparative Study

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INTRODUCTION:
Accurate glenoid baseplate positioning is critical for implant stability and long-term success in reverse shoulder arthroplasty (RSA). Preoperative 3D-CT planning has improved surgeons' ability to evaluate patient-specific anatomy and develop more precise surgical strategies. Mixed-reality (MR) headsets represent a novel intraoperative adjunct that integrates preoperative planning with real-time execution. While early studies suggest potential benefits in primary RSA, evidence remains limited, and the role of MR in revision procedures is largely unexplored. Revision RSA presents unique challenges, as implant removal often leaves substantial glenoid bone loss and distorted anatomy, complicating fixation and positioning. This study aimed to evaluate whether intraoperative MR visualization improves outcomes in revision RSA.

METHODS:
Patients who underwent revision RSA by a single surgeon between 2017 and 2024 were retrospectively reviewed. Two groups were compared: those in whom intraoperative MR visualization was utilized (MR group) and those treated without MR assistance (standard group). Patients were excluded if the revision was to an anatomic arthroplasty or if the previous baseplate was retained. Baseline data including demographics, preoperative diagnosis, and glenoid morphology were collected. The primary outcome was one-year postoperative revision rate; secondary outcomes included one-year postoperative reoperation rate, one-year postoperative complication rate, and immediate postoperative glenoid baseplate RSA angle.

RESULTS:
A total of 67 patients met inclusion criteria (33 standard, 34 MR). The standard group was 55% female with a mean age of 67.4 ± 8.7 years, while the MR group was 29% female with a mean age of 71.0 ± 9.4 years. The most common indication for revision in both groups was prior failed arthroplasty. Revision surgery was required in 30% of standard patients and 24% of MR patients, with no significant association between revision rate and surgical technique (p=0.73). Complications were observed in 49% of standard patients compared with 29% of MR patients (p=0.18). Notably, instability occurred in 24% of standard patients but in none of the MR patients, representing a statistically significant difference (p=0.027). Rates of infection and implant failure did not differ significantly between groups. There was no significant difference in baseplate positioning when comparing mean RSA angle between groups (standard $-0.47° \pm 6.78$ vs MR $+0.67° \pm 9.36$, p=0.58).

DISCUSSION:
While MR visualization demonstrated numerically lower revision, reoperation, and overall complication rates compared with standard techniques in revision RSA, these differences were not statistically significant. Importantly, MR visualization was associated with the elimination of postoperative instability, a significant finding given its role as a common cause of failure in revision RSA. No differences were observed in baseplate positioning between groups. These findings suggest MR may offer potential advantages without introducing additional risk, though the study is limited by its retrospective design, single-surgeon cohort, and modest sample size, which may have underpowered detection of clinically meaningful effects. Larger, prospective studies with long-term follow-up are warranted to better define the role of MR in complex revision shoulder arthroplasty.

CLINICAL SIGNIFICANCE:
Accurate glenoid baseplate positioning in revision RSA is often compromised by bone loss and distorted anatomy. This study evaluated MR visualization as a novel intraoperative adjunct that may enhance surgical precision, reduce complications, and ultimately improve outcomes. While further validation is needed, MR has the potential to inform future standards of care in complex revision shoulder reconstruction.