

# Primary Stability Of Metallic Baseplates In Reverse Shoulder Arthroplasty: Are Two Peripheral Screws Enough?

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**INTRODUCTION:** The stability and longevity of the glenoid component in reverse total shoulder arthroplasty (rTSA) are largely influenced by the fixation strategy employed. Traditional recommendations advocate for four peripheral screws, but this may increase surgical time, bone removal, and risk of neurovascular injury. Finite element modeling (FEM) provides a framework for evaluating the biomechanical performance of various screw configurations under physiologic loading conditions. This FEM study aimed to compare the biomechanical performance of a two screws (superior and inferior) fixation configuration compared to the four screws construct in symmetric metallic augmented glenoid implants using an additional central fixation screw.

**METHODS:** This study was approved by the Institutional Review Board, and informed consent was obtained. We collected computed tomography (CT) scans from 13 patients (8 females, 62-88 years) scheduled for rTSA. Preoperative planning was performed with the two implants and the four peripheral screws. 6 patients had osteoarthritis (OA) with posterior wear (Walch B2) and 7 had advanced cuff tear arthropathy (CTA) with superior wear (Favard E2/3 glenoids). A surface mesh of the scapula with identified anatomical landmarks was generated from CT scans using a deep learning model. The implant and screws, provided by the manufacturer (Stryker Perform glenoid), were positioned in the glenoid based on preoperative planning (Stryker Blueprint). Bone material properties, specifically Young's modulus, were derived from a calibrated CT scan. A glenohumeral force corresponding to 60 degrees of abduction was applied. The absolute maximum principal strain of the bone within 10 mm of the bone-implant interface was calculated with the finite element solver Abaqus. We then considered a physiological strain of 1000  $\mu$ -strain, and the bone volume exceeding this value within this interface region, and more specifically for the inferior screw, superior screw, central screw, baseplate, and overall implant. For each of these 4 regions, we reported the average (paired) difference between 4 screws and 2 screws, 95% confidence interval, minimum, maximum, and p-value of the paired t-test.

**RESULTS SECTION:** The differences of bone volume above physiological value were very small (< 190 cmm) and not statistically significant (Table 1). There were cases with less strain or more strain with 2 screws vs 4 screws (Figure 1). The highest strain was around the superior screw.

**DISCUSSION:** This finite element analysis demonstrated that baseplate fixation with only superior and inferior screws, combined with a central screw, provides biomechanical stability comparable to the traditional four-screw construct. We assume that the observed differences are within the global uncertainty of the predictions. The findings suggest that the anterior and posterior screws contribute minimally to primary stability under physiologic loading. The main limitation is the small sample size, but the paired comparison provided by the finite element analysis enhances the validity of the study.

**SIGNIFICANCE/CLINICAL RELEVANCE:** Since this study did not reveal a significant mechanical difference between the two and four screws configurations in symmetric metallic augmented implants, it suggests that it is safe and time-efficient to only use the superior and inferior screws to secure the baseplate in rTSA.

## REFERENCES:

Eghbali P et al, Glenohumeral joint force prediction with deep learning, J Biomech. 2024  
Satir OB et al, Automatic quantification of scapular and glenoid morphology from CT scans using deep learning, Eur J Radiol. 2024

Table 1. Mean difference of bone volume above 1000  $\mu$ -strain between 4 and 2 screws. Positive value corresponds to more strain with 4 screws.

|               | Volume difference (cmm) | 95% CI       | Min (cmm) | Max (cmm) | p-value |
|---------------|-------------------------|--------------|-----------|-----------|---------|
| Inf. screw    | 11.8                    | (-2.4, 26.0) | -14.5     | 63.6      | 0.130   |
| Sup. screw    | 14.5                    | (-0.6, 29.6) | -9.1      | 91.0      | 0.084   |
| Central screw | 25.2                    | (-0.9, 51.2) | -14.7     | 134.1     | 0.083   |
| Baseplate     | 30.2                    | (0.3, 60.2)  | -3.6      | 172.8     | 0.076   |
| Overall       | 32.2                    | (-1.6, 66.1) | -6.7      | 188.4     | 0.086   |

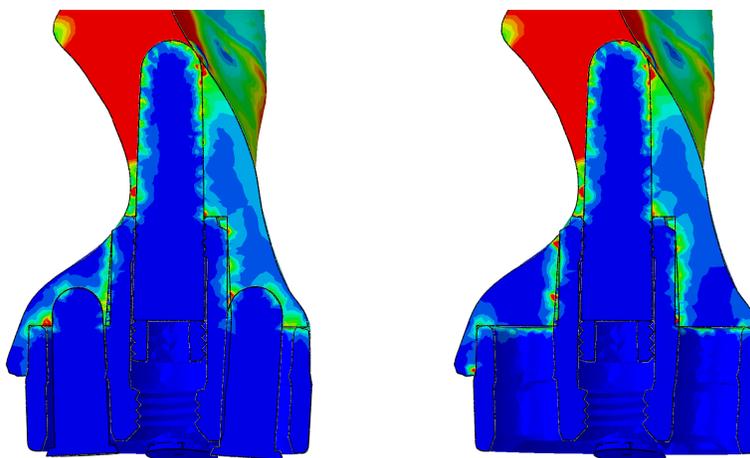


Figure 1. Case with the highest difference in bone strain between 4 screws (left) and 2 screws (right), on a cut view through a plane containing the anterior and posterior screws. The colors represent the calculated strain (red corresponds to 1000  $\mu$ strain).