Eccentric Reaming is Biomechanically Superior to Posterior Augment for Posterior Glenoid Wear

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Introduction: Increased glenoid loosening in Total Shoulder Arthroplasty (TSA) may be seen in uncorrected retroversion in patients with posterior glenoid bone loss. Posterior-augmented glenoid components have been introduced to address posterior wear. Few biomechanical studies have compared the performance of these new components.

Methods: Two groups consisting of six composite scapulae each were used and a 12-degree posterior glenoid defect was created in all specimens. In the posterior augment (PA) group, the glenoid face was corrected to eight degrees of posterior wear and an eight-degree angle-backed pegged polyethylene glenoid component was cemented in place. In the other group, eccentric anterior reaming (EAR) to neutral version was performed and a standard pegged polyethylene glenoid was cemented. Cyclic loading to 90% of the subluxation distance in the superior-inferior direction was performed under 750 Newton axial load to 100,000 cycles according to the American Society for Testing and Materials (ASTM) standard F2028-08. Failure was defined as more than four mm of implant subsidence (motion perpendicular to the glenoid face) prior to reaching 100,000 cycles. Superior and inferior edge displacements were measured using digital image processing of motion using fixed makers placed on the superior and inferior glenoid neck and on the glenoid component at predetermined cycles. Welch t-tests were utilized with an alpha value of 0.05 set as significant. Pilot testing indicated that a sample size of five specimens in each group would give a power of 0.80.

Results: Three of six specimens (50%) in the PA group and five of six (83%) specimens in the EAR group achieved the final endpoint of 100,000 cycles without catastrophic failure. Surviving specimens in the PA group demonstrated significantly increased displacement of the superior (1.01±0.02 vs. 0.83±0.10 mm; p = 0.014) and inferior markers (1.36±0.05 vs. 1.20±0.0 mm; p = 0.020) during glenoid component superior edge loading (Figure 1a). Similarly, the PA group exhibited significantly greater displacement of the superior marker during inferior loading (1.44±0.06 vs. 1.16±0.11 p = 0.005) while no significant difference was seen with the inferior marker (0.93±0.15 vs. 0.78±0.06; p = 0.209) (Figure 1b). There was no statistically significant difference in implant subsidence in the PA when compared to the EAR group (3.3±3.3 mm vs. 1.1±1.6 mm; p = 0.179).

Discussion: Significantly increased edge displacement and increased failure rates were noted in the PA group, with half of specimens failing prior to completion of cyclical testing. With a twelve degree posterior wear pattern, eccentric reaming to neutral provided increased biomechanical stability when compared to use of an eight degree PA component. Use of an angle-backed posterior augment glenoid components may introduce shear stress during glenoid loading which may compromise stability.
Significance: Eccentric anterior reaming provides increased biomechanical stability to cyclic loading when compared to angle-backed posterior-augmented glenoid components for posterior glenoid wear in Total Shoulder Arthroplasty.

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