The Effect of Central Post and Screw Constructs on RTSA Baseplate Stability

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INTRODUCTION:

The number of reverse total shoulder arthroplasty (RTSA) procedures performed annually is growing rapidly. The use of lateralized glenoid components is increasing in an attempt to avoid scapular notching and improve strength and impingement-free range of motion. Maximizing glenoid lateralization increases stress at the bone-baseplate interface and may contribute to baseplate loosening. The ideal type and length of central fixation remains uncertain. The purpose of this study was to evaluate differences in baseplate micromotion and load to failure in a biomechanical model with various central fixation methods of the baseplate. The primary hypothesis was that bicortical post or screw placement would improve baseplate stability/fixation compared to contained post placement. Secondary hypotheses were that larger amounts of construct lateralization will increase micromotion and decrease baseplate stability.

METHODS:

Thirty-six shoulder scapulae (12 pcf Sawbones, Pacific Research Laboratories) were separated into 6 test groups (Figure 1) and implanted with a baseplate, glenosphere, and four peripheral locking screws as well as either a central screw or post. The post groups were either contained within the glenoid or penetrated the vault (bicortical). Lateralization was tested at either 4 mm or 8 mm in each of the above scenarios. All implants from the same manufacturer (Arthrex, Naples, Florida) were placed using the Virtual Implant Positioning (VIP) patient specific guide to ensure optimal and consistent positioning of the central guide pin. X-Ray and CT analysis were also performed on each specimen following implantation to confirm proper positioning. Specimens were loaded into the Instron system and cyclic testing was performed using the LVDT system, and the load was increased until baseplate micromotion exceeded 150 mm. Load to failure testing was performed with failure defined as baseplate displacement of 1000 mm or scapula fracture. Fracture analysis was performed on each specimen. ANOVA testing was performed to evaluate for statistical significance between groups ($p<.05$).

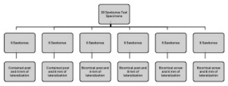
RESULTS:

Micromotion testing to 150 mm across all six test groups did not result in any significant difference ($p=0.3908$). Table 1 shows the individual results for all groups, and Tables 2 and 3 show the micromotion and load to failure results, respectively. Lateralization at 4 mm or 8 mm did not significantly affect micromotion testing for all six groups. Test groups with 4 mm of lateralization and a central post contained within the vault (Group 1, $p=0.01$) and 4 mm of lateralization with a central bicortical screw (Group 5, $p=0.005$) both had statistically significantly greater load to failure compared to the other groups.

DISCUSSION AND CONCLUSION:

Micromotion testing revealed that baseplate stability to prevent micromotion greater than 150 mm can be obtained with all constructs. Central posts within the vault, central posts exiting the vault, and bicortical screw fixation were equivocal in biomechanical testing and can provide sufficient strength for increased lateralization. Although not statistically different, bicortical screw fixation resulted in the highest stability with micromotion testing and may be advised in poor bone quality. Central post contained within the glenoid vault and bicortical screw contructs had the highest statistically significant load to failure of all test groups.

Figure 1 Flow chart representation of the six study groups



Test groups 1-4 with post constructs contained both peripheral 4.5 mm non-locking and 5.5 mm locking screws (compression screws as per technique with post constructs). Test groups 5 and 6 with screw constructs contained only peripheral 5.5 mm locking screws to secure the baseplate to the glenoid face.

Table 1: Average implant loads experienced at 50, 100, and 150 µm of baseplate movement, and average loads experienced at implant failure for each study group.

Baseplate Micromotion	Group 1 Load (N)	Group 2 Load (N)	Group 3 Load (N)	Group 4 Load (N)	Group 5 Load (N)	Group 6 Load (N)
50 µm	199.85	253.97	190.72	184.90	210.62	217.51
100 µm	355.82	427.14	343.03	323.76	425.11	389.26
150 µm	511.82	587.22	495.34	462.63	639.59	561.01
Failure	1267.13	880.24	941.72	994.95	1301.08	896.05

Table 2: Anova results for loads at 150 µm of baseplate micromotion. Based on the level scoring, no groups were statistically different from each other, as there were no differences in levels. Groups are arranged by the highest average load value.

Level		Least Square Mean (N)
G5	B	639.59
G2	B	587.22
G6	B	561.01
G1	B	511.82
G3	B	495.34
G4	B	462.63

Table 3: Anova results for implant failure loads. Based on the level scoring, group 5 and group 1 were statistically different from the other groups. Groups are arranged by the highest average load value.

Level		Least Square Mean (N)
G5	**A**	**1301.08**
G1	**A**	**1267.13**
G4	B	994.95
G3	B	941.72
G6	B	896.05
G2	B	880.24