Reverse Shoulder Arthroplasty Glenoid Fixation: Is there a Benefit in Using 4 Instead of 2 Screws?

Methods: Six pairs of scapulas were dissected. A flat, 4 screw hole glenoid baseplate (Tornier, Aequalis Reversed) was fixed to each scapula using standard surgical technique. On one side of a pair (randomly selected), only the superior and inferior locking screws were used. On the contralateral side, all 4 screws were used. Here the anterior and posterior screws were non-locking screws while the superior and inferior were locking screws. Each scapula was secured in a pot with fiberglass resin epoxy, while maintaining the same height of scapula exposed above the epoxy. The glenosphere was then impacted onto the baseplate.

Two cyclic loading modes were sequentially applied to the glenosphere, each for 100 cycles. The first applied superior loading (max planned = 1000 N) simultaneously while a compressive force (max planned = 1300 N) was applied across the joint. The second applied cyclic anterior/posterior loading (max planned = 100 N anterior, max planned = 500 N posterior), again with a max planned = 1300 N compressive load across the joint. For the first 100 cycles in each direction, 10% of the planned peak forces were applied. Another set of 100 cycles in each direction were applied at 20%, then at 30% and at 60% of the max planned loads.

Micromotion of the glensphere was measured by 4 LVDTs located evenly spaced around the glensphere (anteriorly, inferiorly, posteriorly and superiorly; figure 1). Offset arms were glued onto the glensphere and the LVDTs located above balls that were mounted onto each arm. Micromotion was computed to correspond to the anterior, inferior, posterior and superior edges of the glensphere as well as the overall center motion.

Comparison of the average peak central displacements at the 30% loading level (table 1) shows that while there was no statistical difference in the average peak displacements between 2 and 4 screws (p=0.93), there was an increase in displacement with additional loading (p=0.006) and a difference in the loading direction (p=0.029).

As expected there was a statistical increase (p=0.014) in average peak central displacements with increasing load (table 1), as well as a different in the loading direction (p=0.007).

Comparison of the peak displacement at the 4 corners of the glensphere (interior, anterior, superior and posterior) (table 3) shows there was no statistical difference (p=0.71) in their peak displacements for the given loading cases.

Discussion: These results demonstrate that under these loading conditions there is no difference in the peak glensphere displacement with 2 or 4 screws. The lack of differences between 2 and 4 screws may be due to a) variations in reaming of the glenoid that occurred between the left and right scapula due to differences in bone erosion and initial drill location b) variations in impaction of the baseplate permitting a gap between the baseplate and bone or more likely c) that the anterior and posterior screws contribute little to the fixation of the baseplate. These results also show that even with a lower maximum peak anterior/posterior applied load, that the deformations are greater during AP loading than during superior loading. These results may support rehabilitation protocols that limit daily activities which cause increased anterior-posterior loading.