Effect of Fin Length/Shape of Stemless Humeral Component of the Reverse Shoulder Implant

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Introduction: The recent reverse shoulder implant designs employ shorter humeral component stems or eliminate the stem completely. They display minimal frictional fixation between the implant component and the metaphysis of the bone, which provides several advantages: preserved bone, less stress shielding, ease of revision surgery, and freedom of humeral component location due to the minimal stem length and non-complex shape. Despite its advantages, this stemless design may cause failure of the implant due to the minimal bone-to-implant contact surface, especially during early stages following surgery before osseointegration occurs. In this study, using FEA, the effects of stem length and shape on the stability of the reverse shoulder stemless humeral component was investigated.

Materials and Methods: A 3D model of a humerus and a generic reverse shoulder implant system were developed and analyzed. To investigate the effect of fin length and shape, humeral components with a baseplate radius of 18mm and various fin shape/length were developed; these included a straight fin, fins with steps, and a semi sphere with fins. Each component consisted of 6 fins of 2mm thickness and had a total length of 10.8mm, 14.4mm, 18mm and 21.6mm respectively. A press fit condition was simulated between the bone and fins, and anatomical loading was applied.

Results and Discussion: The ratios of fin lengths over the radius of the baseplate were calculated. Values for stress and micromotion were normalized by the values at 0.6 fin-to-baseplate ratio, because it showed minimum stress and micromotion. For all fin shapes, as fin length increases, the stress and micromotion decreased although the straight fin showed that the stress at ratio 0.6 and 0.8 are similar to each other (Figure 1). The results from all shapes and lengths showed that micromotion is more sensitive than the stress at the bone to changes in stem length.

Translational Impact: From the data, it can be concluded that, for the case of stemless reverse shoulder humeral component, the length of the fin affects the stress at bone and micromotion. It is well known that a longer stem provides better clinical outcomes because it minimizes micromotion, and results from this study are in line with that conclusion. The results suggested that an even smaller ratio (fin length longer than 21.6mm) would be the best for stress and micromotion, but a long fin would not fit well in an anatomical humerus, and a long fin shape will eventually fall into a “short stem” category. Therefore, the results suggest that a 20-30% longer fin length than baseplate radius would be ideal for the stemless humeral component design. The various fin shapes did not have significant effects on the results and demonstrated the same trends as displayed in Figure 1.

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