Effects of Different Humeral Stem Length on Stem Alignment and Proximal Stress Shielding in Reverse Total Shoulder Arthroplasty

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INTRODUCTION: Humeral stem malalignment and proximal humerus stress shielding are complications neither uncommon nor negligible after reverse total shoulder arthroplasty (RTSA). Furthermore, it is still unclear whether such an association exists between stem malalignment and stress shielding. This study was designed to investigate the effects of different humeral stem length on stem alignment and proximal stress shielding after RTSA.

METHODS: Retrospective review was performed on 326 patients who underwent primary RTSA from October 2010 to May 2020 with a minimum 2-year follow-up. The participants were classified into 3 groups according to the humeral stem length of different types of prosthesis used in surgery: Group A (short stem, n = 91), Group B (medium stem, n = 158), Group C (standard stem, n = 77). For radiologic assessment, immediate postoperative neck shaft angle (NSA) was measured to evaluate malalignment. Canal filling ratio (CFR) of humerus metaphysis, distal one-third and distal tip of the humeral stem were measured. Humerus canal diameter at the distal tip of the humeral stem and distal tip decentering of the humeral stem were also measured. At the final follow up, cortical bone thinning, bone resorption and humeral stem subsidence were reviewed to evaluate proximal humerus stress shielding. Functional outcomes were evaluated with range of motion, ASES forms, Simple Shoulder Test and Constant Score.

RESULTS: The proportion of humeral stem malalignment was significantly higher in Group A than Group B and C (20.9%, 11.6% and 9.1%, respectively, $P = 0.022$). The humerus canal diameter was wider at the distal tip of the humeral stem in Group A ($P < 0.001$), and the distal tip of the humeral stem was more decentered in Group A ($P = 0.02$). Meanwhile, in terms of stress shielding, there were more cases of bone resorption at medial and lateral metaphysis ($P = 0.015$ and 0.003, respectively) in Group C. For subgroup analysis in patients of stem malalignment, more stress shielding occurred at medial and lateral metaphysis ($P = 0.013$ and 0.010, respectively) in Group A. Furthermore, those patients' bone mineral density was lower and humerus canal diameter at the distal tip of the humeral stem was wider in Group A than Group B and C. There were no differences in functional outcomes among three groups.

DISCUSSION AND CONCLUSION: Humeral stem alignment and proximal stress shielding in RTSA had significantly affected by different humeral stem length. Although shorter stem could be beneficial for bone preservation, in patients with lower bone mineral density or larger humerus canal diameter, the short stem could lead to humeral stem malalignment resulting in increased proximal humerus stress shielding. Therefore, surgeons should be careful in selecting the length of humeral stem in RTSA.