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Biomechanics and innovations in Reverse shoulder arthroplasty

Background: Modern implant design for reverse shoulder arthroplasty has emphasized a larger radius of curvature of the glenoid component and movement of the center of shoulder rotation inferiorly and medially. This creates a more stable and efficient fulcrum and decreases shear forces at the glenoid-bone interface. The purpose of this study was to evaluate the impact of glenosphere size (center of rotation offset) on clinical and functional outcomes.

Methods: Thirty-two patients treated with a primary RSA for rotator cuff arthropathy were followed clinically and radiographically for a minimum of 24 months. Patients were grouped by glenosphere size and had comparable group mean differences for scapular neck angle, length of follow up and component design. Group 1 contained a 36mm glenosphere while Group 2 had a 42 mm glenosphere. The effect of glenosphere size on outcomes was evaluated in terms of surgical technique, scapular morphology, occurrence of complications, active forward flexion, passive external rotation, and presence of lag sign using Mann-Whitney U test. Regression analysis was used to explore the relationship of surgical technique, component design and postoperative outcomes.

Results: There was no significant difference in average prosthetic scapular neck angle (PSNA) ($p=0.86$) for Group 1 (135±10.9°) compared to Group 2 (136±11.8°). The average peg glenoid rim distance (PGRD) for Group 1 was 14 mm compared to the average for Group 2 of 19 mm ($p=0.0001$). Obtained results demonstrated a trend toward increased range of motion, forward flexion (FF) and external rotation (ER) for the larger glenosphere size (42 mm). The average postoperative FF was 119° and ER 17° for Group 2 compared to average postoperative FF was 103° and 8° for Group 1($p=0.055$, 0.09, respectively). There was also increased strength with larger glenosphere based on an improved average lag sign for Group 2 compared to Group 1 ($p=0.02$). Although the occurrence of notching was not significantly different, notching occurred 15 times in Group 1 with an average notching grade of 1.56 compared to 12 notching occurrences in Group 2 with an average notching grade of 1.25. There was no significant difference in complications between Group 1 and Group 2 ($p>0.05$).

Discussion: Biomechanical evidence suggests that a lateralized center of rotation offset with a larger glenosphere improves range of motion and can lead to better functional outcomes. Although theoretical evidence suggests significant improvements with a larger glenosphere size, our results suggest more modest increases in ROM and strength without increased complications. Larger glenosphere size also reduced the average notching grade and occurrence of notching in our cohort. More long-term studies are needed to evaluate the effect of glenosphere size and functional outcomes over time.

Biography

Vani Sabesan is an Assistant professor with the Department of Orthopedics at the Western Michigan University School of Medicine. She completed her M.D. at Indiana University and residency in Orthopaedic Surgery at Duke University. She is a fellowship trained, ABOS board certified shoulder and elbow specialist. She currently serves as a co-chair of the US Bone and Joint Initiative program and is committed to the improvement of musculoskeletal education in medical schools. Sabesan's contributions to improving outcomes in shoulder arthroplasty are seen in her commitment to innovative clinical and biomechanical research, as well as in her publications in peer reviewed literature.

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