Axial Length and Overstuffing Affects Radiocapitellar Pressures in Radial Head Arthroplasty, A Cadaveric Study

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Introduction:
Successful results following radial head arthroplasty are dependent upon proper component position and size. Insertion of an implant that is incorrectly sized significantly alters stability, elbow kinematics and load transfer leading to unfavorable results and poor clinical outcomes. We examine the effects of alteration of axial length of the radial head prosthesis and force conveyed at the radiocapitellar joint.

Methods:
Seven paired, fresh-frozen sided cadaveric arms were utilized. Radial heads were resected and a unipolar, rigid, metal radial head prosthesis was implanted. Adjustments of radial head length were made in 2 mm increments using radiolucent washers to create an understuffed (-2), neutral (0), and overstuffed (+2, +4) effect. Forearms were cyclically loaded from 13 N distraction to 130 N compression with the forearm in neutral, in sixty degrees of pronation, and in sixty degrees of supination. Radiocapitellar forces were measured using Tekscan (Tekscan, Inc., Boston, MA) pressure sensors with radial head length set at -2 mm, 0, +2 mm and +4 mm and comparisons were made with the neutral (0) radial head. Multivariant ANOVA with Tukey's HSD post hoc test was used for statistical analysis.

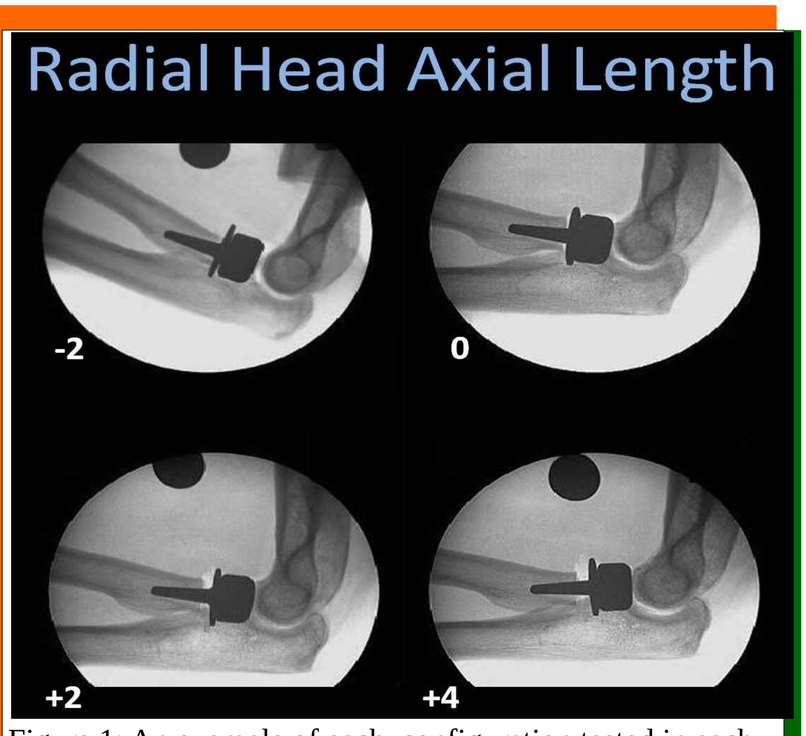

Figure 1: An example of each configuration tested in each forearm.

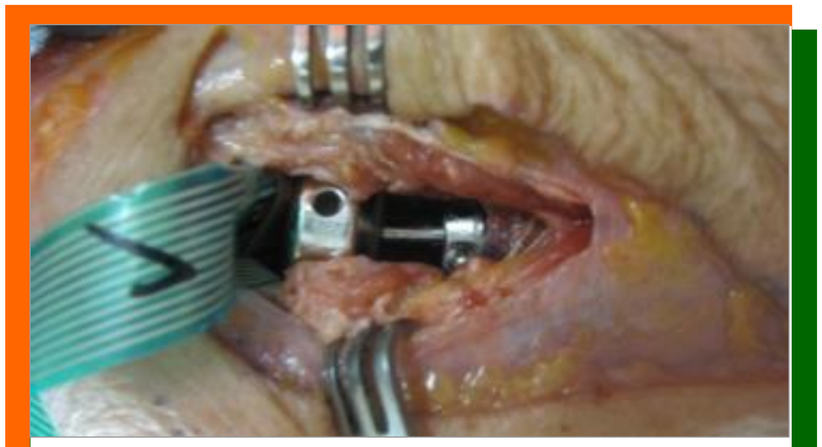
Figure 2: The radial head implant placed against the capitellum with the Tekscan transducer in between to measure the contact pressure.

Results:
Radiocapitellar forces with the forearm in neutral in arms that were understuffed (-2), neutral (0), overstuffed (+2, +4) were 24.07 +/- 9.65 N, 30.21 +/- 9.63 N, 37.45 +/- 13.09 N, 46.47 +/- 9.25 N. There was a noticeable stepwise increase in force transmitted with progressive radial head lengthening. Radiocapitellar forces were essentially 1.5 times greater with radial head overstuffing (+4) compared to neutral (0). Radiocapitellar forces were significantly elevated in forearms that were pronated in comparison to forearms in neutral and in supination for each adjusted radial head length. Strain measurements of the central band of the interosseous membrane correlated with forearm position; enhanced in forearms that were supinated and diminished in arms that were pronated.

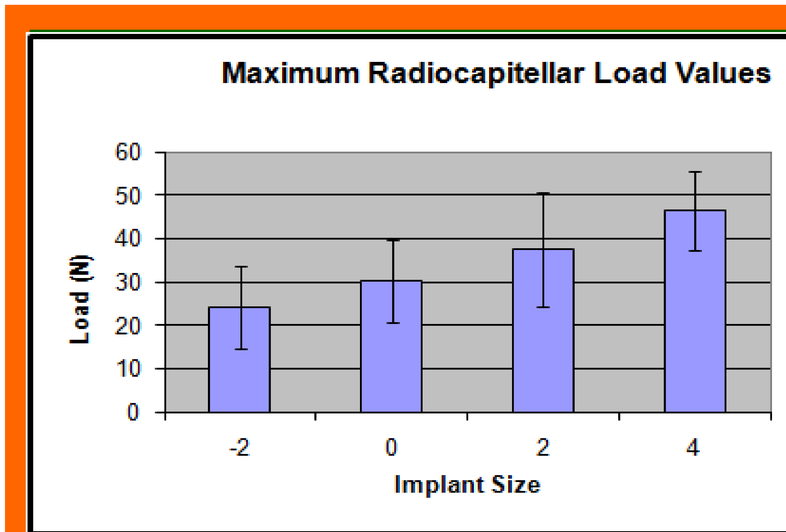

Figure 3: Load at the RC joint in forearm neutral rotation

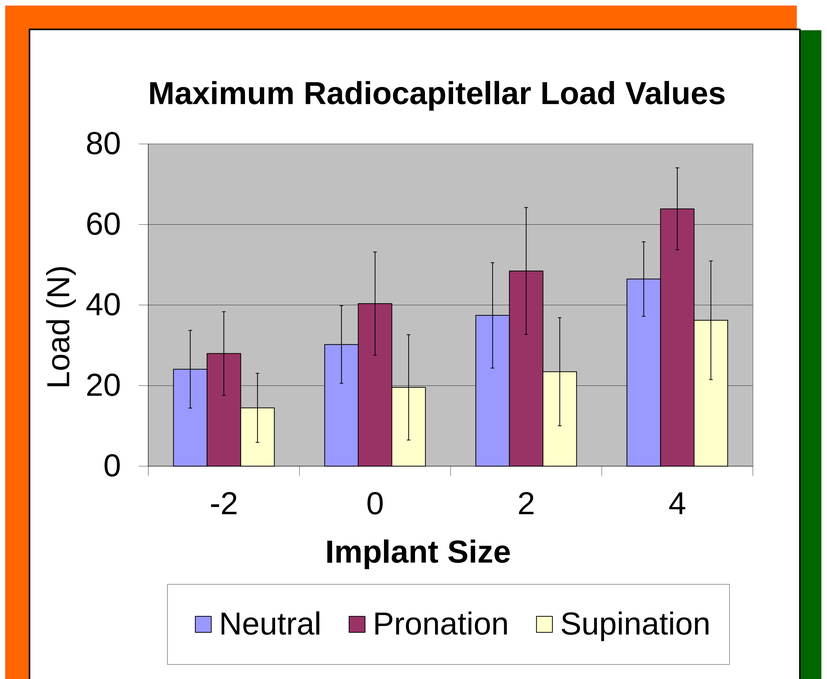

Figure 4: Load at the RC joint for all positions of forearm rotation .

Acknowledgements:
This work was supported in part by the Max Biedermann Institute for Biomechanics at Mount Sinai Medical Center, Miami Beach, FL and The Hand Place, North Miami Beach, FL

Significance:
Restoring the native axial length may prevent accelerated kinematics, loss of motion and wear at the radiocapitellar joint after radial head arthroplasty.