THE EFFECT OF CEMENTLESS RADIAL HEAD IMPLANT STEM GEOMETRY ON INITIAL IMPLANT MICROMOTION IN-VITRO

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INTRODUCTION: Radial head fractures are the most common fracture of the elbow in adults.13 With the development of more anatomically shaped eccentric or offset radial head implants, stem fixation becomes a significant clinical concern. Tilting or rotation of a non-axisymmetric implant from its original position due to movement of the stem will alter joint kinematics and may cause elbow pain. Although a variety of stem configurations have been employed clinically, no studies report the initial stability offered by these designs. The objective of this in-vitro study was to determine the effect of radial head implant stem diameter, length and shape on the stability of metal uncemented radial head implants using an eccentric loading model.

METHODS: Eleven previously frozen proximal radii (mean age 70±17 years) were tested. Stainless steel radial head implants of varying stem diameter and shape were manufactured. Each specimen received a sequential series of five uncemented implants with differing stem geometries (Figure 1): short (21mm) and long (26mm) undersized straight stems; short and long optimally sized straight stems; and a tapered stem (21 mm, taper angle = 5.4°). Radiographs were templated to determine the optimal implant diameter, while the undersized stems were 2 millimeters smaller in diameter than the optimal size. After rasping, the smooth uncemented stems were impacted into the proximal radius.

RESULTS: The results are summarized in Figures 3 and 4.

Figure 1. Radiographs of a specimen showing implant stem geometry: (A) short undersized; (B) long undersized; (C) short optimal; (D) long optimal; and (E) tapered.

Compressive loads were applied successively to the anterior, posterior, medial and lateral edges of the implants using a materials testing machine. These four positions were established using the orientation of the radial tuberosity. At each position, the implant was preconditioned, and then loaded to 100 N five times. Images were taken, using a digital imaging system to measure micromotion, and loaded conditions. Maximum vertical “lift-off” was quantified by comparing the distance between bone and implant markers on loaded and unloaded images using image acquisition software (IMAQ vision and IMAQ Vision Builder, National Instruments, Austin, Texas) (Figure 2). Data was analyzed by employing a two-way repeated-measures ANOVA with α=0.05.

DISCUSSION & CONCLUSIONS: Significant differences in micromotion were found between the undersized (short = 240±333 µm, long = 165±247 µm) and both optimally sized implants (short =59±52 µm, long = 47±37 µm) and the tapered implant (45±33 µm)(p<0.05). There were no differences: (i) between the short and long undersized; and (ii) among the short and long optimal and tapered implants.


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