Anatomic Radial Head Arthroplasty: The Importance of Implant Angle

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Purpose: Multifragmentary radial head and neck fractures not amenable to open reduction and internal fixation are usually treated with radial head arthroplasty (RHA). The optimal implant design is subject to debate. An anatomic radial head implant has the theoretical benefit of mimicking the native radial head and thus the physiologic radiocapitellar and radioulnar joint contact forces. The angle of the radial head stem with respect to the proximal radius shaft (radial stem angle [RSA]) will influence radiocapitellar contact pressures. We hypothesize that variances in the placement leading to increased RSA in an anatomic implants will contribute to failure. The aim of this study is to characterize the risk of RHA failure with respect to the stem angle placement of an anatomic RHA design.

Methods: A retrospective review of patients who underwent RHA for acute fractures between 2006 and 2019 at two academic centers was performed. Adult patients with anatomic implants and a minimum of 6 months of radiographic follow-up were included. Review of the patients' initial postoperative radiograph was conducted to measure the RSA on AP and lateral views. Radiolucency, stress shielding, and radiocapitellar arthritis were also evaluated. Patients were stratified according to whether their implant was intact or had failed at the time of last follow-up. Implant failure was defined as prosthesis removal or revision by the time of review. AP and lateral RSAs were compared using two-sample t tests. Radiolucency, stress shielding, and radiocapitellar arthritis were compared using Fisher exact tests. Binomial regression was used to predict failure—one for angles measured on AP radiograph and one for those measured on lateral radiograph.

Results: 40 patients were identified and included in the analysis. The mean age was 43 years. Of the 40 patients, 19 were female and 21 were male. In 34 elbows (85%), the RHAs were intact and 6 RHAs (15%) had failed. Implant failure was associated with larger lateral RSA when compared to intact implants ($P = 0.01$). Additionally, larger lateral RSA was associated with increased odds of failure (odds ratio [OR] 1.32, 95% confidence interval [CI] 1.11-1.71). There was no difference between the two groups in anterior RSA and no associated increase in the odds of failure with increasing anterior RSA (OR 1.02, 95% CI 0.89-1.17). There was no difference in radiolucency, stress shielding, or radiocapitellar arthritis between the groups.

Conclusion: The significance of stem positioning in RHA remains understudied. RSA in this anatomic design appears to play an important role in implant survival and may act as an independent factor that can lead to implant failure. Further research is warranted to better understand the mechanism of failure seen in anatomic designs with larger RSAs. A comparison study of failure in nonanatomic RHA should also be undertaken to better understand if this finding is consistent across all RHA implant types or limited specifically to anatomic components.