

Robust Design for Acetabular Cup Stability Accounting for Patient

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The stability of cementless acetabular cups depends on a close fit between the components and reamed acetabular cavities to promote bone ingrowth. Cup performance and stability are affected by both design and environmental (patient-dependent and surgical) factors. This study used a statistically based metamodel to determine the relative influences of design and environmental factors on acetabular cup stability by incorporating a comprehensive set of patient-dependent and surgical variables. Cup designs with 2 mm or 3 mm intended equatorial bone-implant interferences appeared to perform the best, improving implant stability with smaller mean and variability in cup relative motions and greater mean and smaller variability in ingrowth areas. Cup eccentricity was found to have no effect on implant performance. Design variables did not contribute as much to the variation in performance measures compared to the environmental variables, except for potential ingrowth areas.