Position of Hip Resurfacing Component Affects Outcome

Position of Hip Resurfacing Component Affects Strain and Resistance to Fracture in the Femoral Neck

Abstract:


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Background: Retrieval studies have suggested that the cause of femoral implant failure after metal-on-metal hip resurfacing is multifactorial. Both varus positioning of the femoral component and notching of the superior part of the femoral neck have been associated with femoral component failure. The hypotheses of this study were that placement of a femoral resurfacing component alters femoral neck loading and that the cortical strain pattern reflecting this loading is directly related to the spatial orientation of the resurfacing component. An additional hypothesis was that notching of the superior part of the neck during implantation results in a decreased resistance to neck fracture under axial loading.

Methods: Varus, anteverted, retroverted, and anatomic positions of the femoral component were tested in sixty-four cadaveric femora. Simulated stance-phase loading was applied, and the shear strain on the femoral neck cortex was quantified with use of a photoelastic method. Preimplantation and postimplantation strain levels were compared over the entire neck region with use of generalized estimating equations. The influence of anteversion and retroversion of the component and notching of the superior part of the neck on the neck strength were evaluated.

Results: Placement of the implant in 10° of varus alignment relative to anatomic positioning increased strain on the superior aspect of the neck by 19% to 23% compared with intact femora. Anteverted and retroverted placement of the implant produced elevated strain in the anterior-inferior and posterior-inferior aspects of the neck, respectively. Placement of the component stem in alignment with the anatomic neck axis decreased neck cortical strain 6% to 19% compared with intact femora. Notching of the superior aspect of the neck decreased neck strength by 21%.

Conclusions: Relatively small deviations from anatomic alignment of a resurfacing hip component result in marked localized increases in loading of the femoral neck under conditions approximating single-limb stance. Neutral positioning of the femoral component results in localized strain reduction. Notching of the superior aspect of the femoral neck significantly reduces the resistance to fracture (p = 0.008).

Clinical Relevance: The implantation-related changes observed in this analysis might be used to model the initial loading conditions in the femoral neck after resurfacing and may serve to validate finite element analysis predictions and clinical observations.

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