The Effect of Flexural Rigidity, Taper Angle, and Contact Length on Fretting and Corrosion at the Head-neck Junction

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Introduction: Although modularity at the head-neck junction in total hip arthroplasty (THA) allows for intraoperative adjustment of head size, neck length, and bearing surface, the presence of a modular junction creates a possible source of metal debris. Therefore, we sought to determine how (1) flexural rigidity, (2) taper angle, and (3) contact length affect fretting and corrosion at the head-neck junction.

Methods: 77 retrieved MoP THA components from 75 patients were obtained over a 10 year period at a single institution. The female taper of the heads and male trunnion of the stems were examined by two independent graders using an optical stereomicroscope and scored for fretting and corrosion (Goldberg et al. 2002). Trunnions were scanned using a noncontact 3D digitizer and dimensioned using Geomagic Qualify 12. Differences in continuous variables among tapers were assessed with Kruskal Wallis tests. When significant, post-hoc pairwise comparisons were performed with Mann- Whitney U tests with Bonferroni correction for multiple comparisons. Multivariable linear regression was used to assess the combined ability of contact length, rigidity, and taper angle to predict average stem fretting.

Results: Average stem fretting was inversely related to rigidity ($p = 0.002$) and taper angle ($p = 0.011$), while positively correlated to contact length ($p=0.008$). In multivariate models, contact length and rigidity predicted 21.5% of the variation in average stem fretting. Head taper fretting and corrosion and femoral stem trunnion corrosion were not associated with rigidity, taper angle, or contact length.

Conclusion: At the head-neck junction in THA, flexural rigidity of the femoral stem only affects the fretting visible on the stem trunnion. More rigid trunnions experienced less fretting, which suggests that fretting is predominantly a mechanically driven process.