High Initial Stability in Porous Titanium Acetabular Cup Designs: A Biomechanical Study
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Initial stability with limited micromotion in uncemented total hip arthroplasty acetabular components is essential for bone ingrowth and long-term biomechanical fixation. The purpose of this study was to assess porous titanium surface coatings in terms of interface stability and required seating force in comparison to clinically established plasma-sprayed designs. Hemispherical acetabular cup designs of porous titanium and plasma-sprayed surface designs were analyzed in this study. Components were inserted into manufactured test blocks reamed to a 1mm interference fit using a servohydraulic materials testing machine at 2.5 mm/s to a maximum force of 8kN and subsequently edge loaded at the peripheral rim in lever out testing. Seating force, insertion energy, removal force and interface stiffness data was analyzed using linear mixed regression. The porous titanium cup design exhibited significantly higher force to removal and interface stiffness than each of the three plasma-sprayed cup designs, including those cups with stabilizing circumferential flanges (p=0.006). The porous titanium cup required decreased seating force compared to the thin-walled metal-on-metal (MOM) cup design (p=0.021), and was statistically equivalent to the porous plasma-sprayed titanium and thick-walled MOM cups. Prior studies have reported excellent clinical stability in porous plasma-sprayed cementless components. The results of this study indicate increased interface stability in porous titanium designs without significantly increasing the necessary force and energy required for full seating.