Radiosteriometric Analysis (RSA) of Tapered Femoral Stem in Cementless Total Hip Replacement in Young Patients

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ABSTRACT INTRODUCTION:
Early implant stability is essential to long-term success in total hip arthroplasty (THA). Subsidence greater than 1.2mm within 2 years of surgery carries a higher risk of early-mid-term failure among cemented femoral components. Proximal porous-coating appears to enhance fixation of press-fit stems, however, the subsidence threshold predictive of clinical failure among cementless stems has not been demonstrated. Radiostereometric analysis (RSA) provides accurate and precise measurement of implant micromotion. This study employs RSA to characterize early three-dimensional micromotion of a tapered, proximally-coated, titanium alloy femoral stem (Zimmer M/L Taper) in young, active recipients of primary THA.

METHODS:
Patients diagnosed with hip osteoarthritis, AVN, or osteonecrosis who were offered THA were recruited if they were less than 65 years old, able to provide informed consent, and in stable health. Patients were excluded if they were skeletally immature, pregnant, had failed ipsilateral endoprosthesis or THA, unavailable for follow-up, or required an acetabular shell with outside diameter less than 48mm or a high-offset femoral component (due to the limited availability of RSA-compatible implants). After informed consent was obtained, 46 patients were enrolled in this IRB-approved, prospective study. All patients underwent primary THA performed by a single surgeon (DCA) and received a cementless, proximally porous-coated, titanium alloy, double-tapered M/L Taper stem (Trilogy, Zimmer) that was manufactured with 3 tantalum markers. All implants were standard offset, and had a 28mm femoral head. At the time of surgery, 1.0mm tantalum RSA markers were implanted in the greater trochanter and lesser trochanter to serve as fixed reference markers. All patients had a Dorr A or B femoral canal, and final femoral broaches were stable to rotational and longitudinal stresses. Patients remained partial weight bearing on the operated lower extremity for 4 weeks followed by gradual advancement to full weight-bearing.

RESULTS SECTION:
Forty-six patients were enrolled; 42 had hip osteoarthritis, and 4 had AVN. The average age at enrollment was 58, and 36 were female. At baseline, the randomized groups demonstrated similar age (58±7 years), preoperative activity (UCLA score, 4.8±2.1), and BMI (30±4).

Excluding the 14 day post operative UCLA and SF-12 scores, median stem subsidence was 0.05mm at 2 years and 0.04mm at 4 years (Figure 3). Rate of subsidence was highest at 6 months (0.09mm/year) and subsequently declined. No significant difference existed between time points. Median stem rotation defined as y-rotation ((+) retroversion and (-) anteversion, Figure 1B) was 0.13deg at 1 year, -0.05deg at 2 years, and -0.12 at 4 years. No significant difference existed between time points.

DISCUSSION:
All patients, including the two outliers, have enjoyed equally outstanding clinical outcomes with significant improvements in function and pain relief. Neither outlier has experienced osteolysis or implant failure at 4 years. These young, active patients undergoing primary THA with a cementless, proximally porous-coated titanium double-tapered stem (Zimmer M/L Taper) demonstrate excellent component fixation with less than 0.1mm of subsidence over 4 years. These results are superior to other RSA cementless stem subsidence studies (Figure 4).

This study is limited by the minimal micromotion approaching the accuracy of RSA (0.05mm). Continued follow-up is necessary to evaluate the long-term performance of the M/L Taper stem, and to monitor for implant failure.

SIGNIFICANCE:
This study shows the excellent stability of a cementless, double-tapered stem in a young active THA population. The median subsidence of these stems is at the threshold of RSA detection, primarily limited to first 6 months, and less than previously published studies.