Early Micromotion of a Tapered Femoral Stem in Cementless Total Hip Replacement

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INTRODUCTION
Early implant stability is essential to long-term success in total hip replacement surgery. Subsidence greater than 1mm within 2 years of surgery carries a higher risk of early-/mid-term failure among cemented femoral components (3). 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 (3). Radiostereometric analysis (RSA) provides precise and reproducible measurement of implant micromotion. This study incorporates RSA in order to characterize early three-dimensional micromotion of a tapered, proximally-coated, titanium alloy femoral stem (Zimmer ML Taper) in young, active recipients of primary total hip replacements.

METHODS
After informed consent was obtained, 45 patients enrolled in this IRB-approved, prospective, randomized study. Candidates for THR were recruited if they were suffering from severe hip pain secondary to osteoarthritis or AVN, less than 65 years old, able to provide informed consent, and in stable health. Due to the limited availability of RSA-compatible implants, patients were excluded if they required an acetabular shell with an outside diameter less than 48mm or a high-offset femoral component. All patients underwent primary THR performed by a single surgeon (DA) and received a cementless, proximally porous-coated, titanium double-tapered M/L Taper stem (Trilogy, Zimmer) that was manufactured with 3 tantalum markers. All implants were standard offset, and employed a 28mm femoral head. At the time of surgery, 1.0mm tantalum RSA markers were implanted around the liner periphery and 12 markers were implanted into the patient’s femur and periacetabular bone (inset). All subjects completed preoperative screening, demographic, and physical exam evaluations. Outcome measures include the SF-12, Harris Hip, WOMAC, and UCLA scores completed at baseline and at 10 days, 6 months, and yearly postoperatively. Patients wore a Step Activity Monitor (SAM) for a 3 day objective quantification of their activity level at 6 months and 1 year. Standing digitized RSA film pairs were obtained at the above postoperative time points, and were analyzed using the UmRSA software package. Descriptive statistics and univariate analyses were completed. Comparisons between groups were analyzed using a two-tailed t-test with a significance level of 0.05.

RESULTS
To date, a total of 45 patients have been included in the study; 41 have hip osteoarthritis, and 4 have avascular necrosis. The average age at enrollment is 58, and 36 (80%) are female. Median stem subsidence was -0.067mm (SE 0.10, range -1.59 to -0.13mm) for the 17 patients at 2 years (Fig. 1). Rate of subsidence was highest at 6 months (0.091mm/yr) and subsequently declined through 1 and 2 years (0.059mm/yr and 0.032mm/yr, respectively). Varus/valgus tilt and stem rotation were minimal. Greater subsidence at 6 months, 1 year, and 2 years was significantly associated with increased WOMAC Pain score at 2-year follow-up. Overall, mean UCLA, WOMAC, Harris Hip, and SF-12 PCS and MCS scores were improved compared to preoperative scores at all time points. Most of this improvement (89.5% for total WOMAC) occurred within the first 6 months. Patients with BMI >30 exhibited greater mean subsidence at all time points with significance detected at 2 years (0.0165mm vs. 0.0657mm, <0.05) as well as fewer average steps at 1 year (<0.01).

Figure 1. Median Subsidence of a Press-fit, Tapered Femoral component

DISCUSSION
Subsidence of cemented stems greater than 1mm within 2 years of surgery has been associated with a higher rate of clinical failure, but the effect of press-fit stem micromotion is incompletely understood (3). Young, active patients undergoing primary THA using a cementless, proximally porous-coated titanium double-tapered stem demonstrate excellent component fixation. The subsidence of this M/L taper press-fit stem is comparable to or less than that observed for stable cemented stems with clinically successful long-term follow-up (3, 6). Among uncemented stems, the M/L taper stem had a lower rate of subsidence than most other RSA-studied, press-fit femoral stems (1,4,5).

Similar to previous reports, we observed the greatest stem subsidence to occur within the first 6 postoperative months (5). After peaking at this time point, the rate of subsidence decreased through 2 years. A BMI greater than 30 was significantly associated with greater stem subsidence. Stem migration was not related to increased activity as measured by step activity, UCLA, and PCS scores.

REFERENCES