Long-Term Bone Remodeling Around Uncemented Proximally Porous Coated Femoral Stems: Comparison to Un-implanted Contralateral Side

Paleskar, G., Jones, L.C., Bae, J-W., Hungerford, M.W., Hungerford, D.S., Khanuja, H.S.
Johns Hopkins University, Dept. of Orthopaedic Surgery, Baltimore, MD

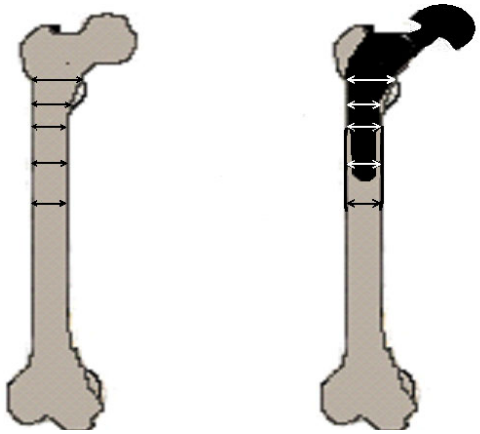
Statement of Purpose: Previous studies have analyzed bony remodeling associated with hip replacement[3,4]. Reports in the literature have documented that there are age-related changes in the femur including decreased cortical thickness, and increasing canal widths[1,2]. This study evaluated cross-sectional measurements over a ten year period in femurs implanted with an uncemented, proximally coated total hip prosthesis and compared these to the non-operated contralateral side to access how this type of implant affects bony remodeling over time.

Methods: Using an IRB-approved database of total arthroplasty patients, patients who had undergone total hip replacement with a Porous Coated Anatomic (PCA, Howmedica, Rutherford, NJ) prosthesis with a minimum of 10 year follow-up were identified. Inclusion criteria were limited to: uncemented fixation, patients with unilateral total hip replacement, and well-fixed components with no radiolucencies or evidence of loosening. In addition, only patients with adequate AP and lateral radiographs that permitted measurements were included. Preoperative and 10-year postoperative radiographs were analyzed for each patient. This study included 23 patients: 10 females and 13 males with a mean age of 54.7 years (range, 25-79 years).

Based on the findings of Yeung et al.[5], five major locations along the femur were identified: 2 proximal, 1 midstem, 1 distal stem, and one distal to the tip (comparable sites were identified on the unoperated leg). Measurements were made of the outer cortex width, the inner canal diameter, and implant width. Calculations included cortical thicknesses and fit& fill. Measurements were made using NIH ImageJ software. Differences in x-ray magnification between x-rays were corrected.

The matched pairs Student's t test was used to compare the preoperative vs postoperative data. Analysis was completed using the JMP statistical software (SAS, Cary, N.C.). Using a 2-tailed test, a $p<.05$ was considered significant. Data is shown in the text as mean and standard deviation.

Results: Comparing patient-matched x-rays, no statistically significant differences were detected for the non-operated side between the preoperative and 10 years postoperative visits. On the operated side, only two sites were statistically significantly different: proximal canal diameter (preop: 36.9 +/- 3.7 mm; 10 yr postop: 39.7 +/- 6.2 mm; $p=0.0131$) and outer cortex of the distal tip (preop: 27.9 +/- 3.0 mm; 10 yr postop: 29.1+/- 3.0 mm; $p=0.0249$). The cortical thickness below the distal tip was also significantly larger ($p=0.003$).



Conclusions: No significant changes were seen over the 10 years period on the unoperated femurs. This is in contrast to the findings of Kaptoge et al.[2] of longitudinal changes in bone arrow density, subperiosteal width, endocortical width, section modulus, cortical thickness, and buckling ratio. Following THR, the medullary canal surrounding the proximal femur enlarged. The cortical thickness below the distal tip increased. Cortical hypertrophy was observed by Saito et al. for metaphyseal stems and to a lesser extent for diaphyseal stems[3]. In summary, the changes observed appear to be independent of the physiologic changes. Future studies are planned to evaluate gender and age-specific differences in bone remodeling in this patient population.

References:

1. Bohr H.H., Schaadt, O.P. Structural Changes of the Femoral Shaft with Age Measured by Dual Photon Absorptiometry. Bone and Mineral 1990: 357-62.
2. Kaptoge, S., Dalzell, N., Loveridge, N., Beck, T.J., Khaw, K-T., Reeve, J. Effects of gender, anthropometric variables, and aging on the evolution of hip strength in mena and women aged over 65. Bone 2003; 32: 561-570.
3. Saito, J., Aslam, N., Tokunaga, K., Schemitsch, E.H., Waddell, J.P. Bone Remodeling is Different in Metaphyseal and Diaphyseal-fit Uncemented Hip Stems. Clinical Orthopaedics and Related Research 2006; 451: 128-133.
4. Torchia, M.E., Ruff, C.B. A Quantitative Assessment of Cross-sectional Cortical Bone Remodeling in the Femoral Diaphysis Following Hip Arthroplasty in Elderly Patients. Journal of Orthopaedic Research 1990; 8: 883-891.
5. Yeung, Y., Chiu, K.Y., Yau, W.P., Tang, W.M., Cheung, W.Y., Ng, T.P. Assessment of the Proximal Femoral Morphology Using Plain Radiograph – Can it Predict the Bone Quality? Journal of Arthroplasty 2006; 21: 508-513.