The Journal of Arthroplasty xxx (2016) 1–6

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Original Article

Proximal Femur Bone Density Decreases up to 5 Years After Total Hip Arthroplasty in Young, Active Patients

Denis Nam, MD, MSc *, Robert L. Barrack, MD, John C. Clohisy, MD, Ryan M. Nunley, MD

Department of Orthopedic Surgery, Washington University School of Medicine/Barnes-Jewish Hospital, St. Louis, Missouri

ARTICLE INFO

Article history:
Received 4 March 2016
Received in revised form
3 May 2016
Accepted 25 May 2016
Available online xxx

Keywords:
hip arthroplasty
bone density
surface replacement arthroplasty
total hip arthroplasty
activity level

ABSTRACT

Background: The number of young, active patients undergoing hip arthroplasty continues to increase. The purpose of this study was to evaluate femoral bone density over a 5-year period after hip arthroplasty in young, active patients.

Methods: A total of 96 patients (103 hips) with a presymptomatic University of California at Los Angeles (UCLA) score ≥6 who had a total hip arthroplasty (THA; 45 hips) or surface replacement arthroplasty (SRA; 58 hips) were prospectively enrolled. UCLA and Harris Hip Scores were collected preoperatively and postoperatively, and dual energy X-ray absorptiometry scans were performed at 6 weeks, 6 months, 1 year, 2 years, and 5 years postoperatively. Bone density was analyzed for 7 traditional Gruen zones in both groups and 6 femoral neck zones in the SRA group. Bone density ratios were calculated for change in bone density compared with baseline.

Results: No differences were present in the preoperative or postoperative UCLA or Harris Hip Scores between the SRA and THA cohorts ($P = .07$-$.7$). In the THA group, bone density never returned to baseline during the 5-year period in Gruen zones 1 (91.2% of baseline), 2 (94.8%), 6 (97.3%), and 7 (89.2%). There were no decreases in bone mineral density ratio for the femoral Gruen zones in the SRA group at any interval. Femoral neck bone density after SRA increased on the lateral, tension side up to 5 years postoperatively ($P < .0001$).

Conclusion: Young, active patients undergoing THA with cementless femoral fixation demonstrate reductions in bone density in the proximal femur in Gruen zones 1, 2, and 7 over time.

Total hip arthroplasty (THA) in the management of degenerative joint disease is associated with excellent clinical outcomes and survivorship [1]; thus, its utilization continues to rapidly increase [2]. The fastest growing subset of patients undergoing THA is aged younger than 65 years [2]. Therefore, patients seeking hip arthroplasty are now younger, more active, and likely place increased functional demands on their prostheses. Despite the "success" associated with THA, persistent pain and residual symptoms remain a significant concern [3-6]. Recently, an investigation focusing on young, active patients after THA found 32% to report groin pain, 25% anterior thigh pain, and 20% lateral thigh pain based on a patient-reported pain-drawing questionnaire [4]. Thus, with an evolving patient population, persistent pain leading to patient dissatisfaction may continue to increase.

In the appropriately selected patient, surface replacement arthroplasty (SRA) remains a viable alternative to THA and has numerous proposed advantages including increased bone preservation, improved stability, decreased leg length inequality, and the potential to return to higher activity levels [7,8]. However, SRA is a more technically demanding procedure and carries increased risks including metallosis, early aseptic loosening, and higher rate of revision compared with THA [9,10]. An additional unique risk associated with SRA is femoral neck fracture, which can occur in up to 4.7% of patients who undergo SRA [11-13]. Although numerous surgical and patient-related factors contribute to the risk of femoral neck fracture [13-15], loss of bone density in the proximal femur may increase the risk of this complication, along with aseptic loosening of the femoral component. Thus, the long-term effect of SRA on the bone mineral density (BMD) of the femoral neck and proximal femur requires further investigation.

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.05.059.

* Reprint requests: Denis Nam, MD, MSc, Washington University Orthopedics, Barnes Jewish Hospital, 660 S. Euclid Avenue, Campus Box 8233, St. Louis, MO 63110.

http://dx.doi.org/10.1016/j.arth.2016.05.059
0883-5403/

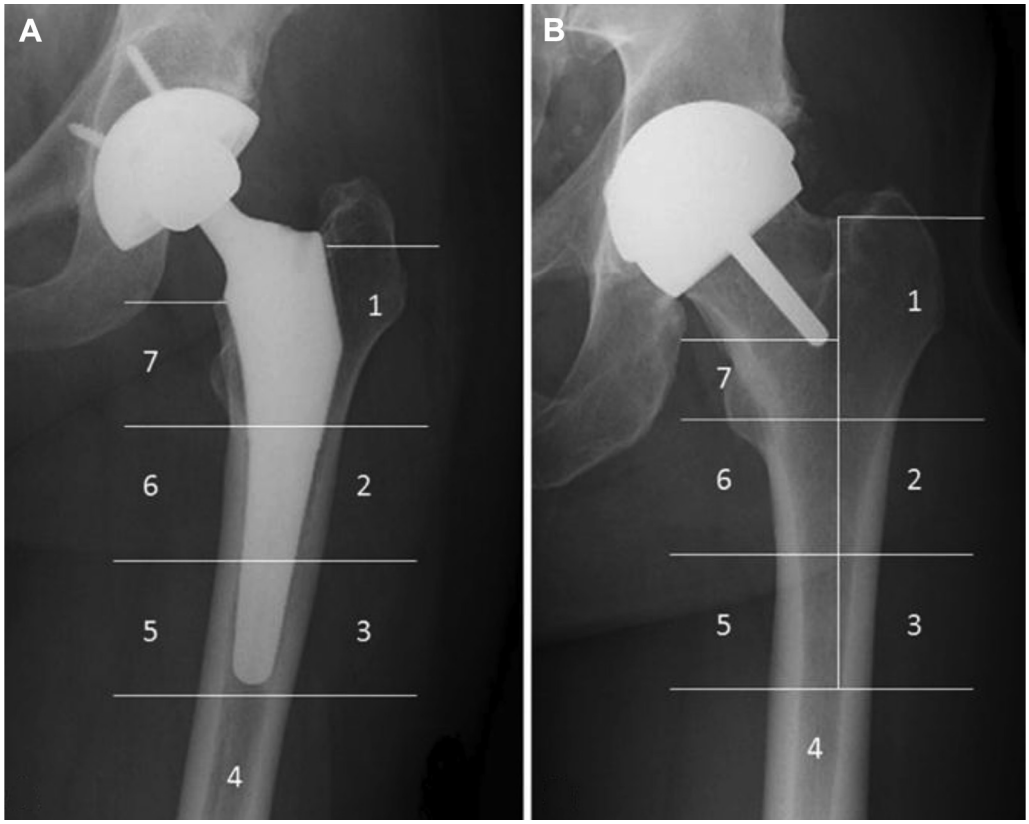

Fig. 1. Radiographs demonstrating (A) the 7 Gruen zones in patients undergoing total hip arthroplasty (THA) and (B) the Gruen zone template that was superimposed on the image from a patient undergoing SRA to allow comparison to the 7 Gruen zones in a THA.

Periprosthetic bone loss secondary to stress shielding of the proximal femur has been well documented in patients after THA [16] and can increase the risk of aseptic loosening, periprosthetic fracture, and potentially thigh pain [4,17]. Prior investigations have analyzed the impact of THA on proximal femur bone BMD but have been limited by their relatively short length of follow-up, small cohort sizes, and use of a fully porous-coated, cobalt–chrome femoral stem, which is less frequently used in the primary THA setting [18-20]. Furthermore, as patients seeking hip arthroplasty are younger and more active, it is important to prospectively evaluate the impact of both THA and SRA on proximal femur BMD. Understanding the impact of hip arthroplasty on proximal femur BMD could provide insight into etiologies of persistent pain and modifications in implant design that could lead to a more physiological stress transfer through the proximal femur and potentially improved bone preservation. Thus, the purpose of this investigation was to determine the effect of SRA and THA on the BMD of the proximal femur postoperatively in a cohort of young, active patients. Our hypothesis was that at 5 years postoperatively, there would be evidence of decreased BMD of the proximal femur in patients undergoing THA.

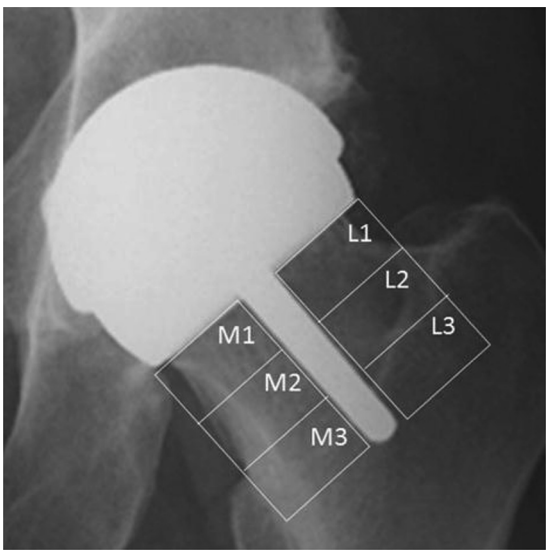

Fig. 2. Radiograph demonstrating the 6 regions of interest in the femoral neck; L1-L3 correspond to lateral, and M1-M3 correspond to medial to the femoral stem.

Materials and Methods

This study was a prospective, institutional review board–approved investigation performed at a single institution with extensive experience in performing both THA and SRA in young, active patients. Between November 2007 and October 2009, 3 surgeons performed all procedures after exceeding the learning curve period for SRA [14,21,22]; thus, we presume there would be fewer technical errors and more consistent surgery between patients. Patients were included if they were skeletally mature undergoing primary hip surgery for noninflammatory arthritis, had a body mass index (BMI) of 35 kg/m^2 or less, and had an increased activity level defined by a presymptomatic University of California at Los Angeles (UCLA) activity score of 6 (regularly participates in moderate activities) or greater [23]. Due to concerns related to increased age such as decreased BMD, medical comorbidities, overall functional activity level, and inferior results reported in the