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Patterns of Changes in Femoral Bone Mineral Density Up To Five Years After Hip Resurfacing

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ABSTRACT

This is a prospective study of 26 patients (29 hips) on the patterns of change in the Bone Mineral Density (BMD) in various zones of the femoral neck and proximal femur five years after hip resurfacing. We have found that BMD continues to positively change up to five years after hip resurfacing. This was observed primarily in the trochanteric and superior neck regions. In both these regions BMD had decreased by up to 10% at six-weeks and three-months after surgery and then had recovered to preoperative level by one year. A regression analysis to assess the influence of age, gender, BMI, preoperative BMD, component size and orientation revealed that the best predictor of change in BMD at five years in the trochanteric area was acetabular component inclination.

It has been proposed that potentially adverse effects on the load-bearing bone due to decreased degree of mineralization may affect the durability of hip resurfacing in terms of femoral fracture or late femoral collapse [1]. Previous studies have demonstrated a decrease in femoral bone mineral density at six weeks and three months following hip resurfacing procedure in the superior neck region [2–4]. However, this increases to the preoperative level at one year [3,4] and is maintained at two years [2]. In a previous pilot study we have employed a zonal reporting technique [2,5]. This technique has been shown to be reliable and reproducible [5] with an intraclass correlation (i.e. the correlation between any two assessments of one region of interest) was 0.997, with an overall coefficient of variation of 5%. The acetabular bone mineral density (BMD) has been shown to remain unchanged at short term after hip resurfacing arthroplasty [6]. Retrospective comparative studies have shown no difference in BMD at three to five years comparing two different designs of hip resurfacing [7]. Kishida et al. [8] reported a preservation of proximal femoral bone stock after hip resurfacing as compared with hip replacement, and believed that this followed the principles of Wolf's law, although femoral neck bone could not be studied. Similarly Smolders et al., in a randomized controlled trial comparing the BMD of calcar region of the proximal femur, reported an increase after hip resurfacing compared with a significant decrease after total hip replacement [4].

The need for long-term longitudinal study to assess changes in BMD in the femoral neck has been identified [9], as this has potential implications on prosthetic survival. Femoral component has been shown to be the predominant mode of failure after hip resurfacing [10]. The factors influencing post-operative BMD over time have not been studied in details and it is not clear if the previously reported changes in BMD are sustained further than two years. The aim of this study was to prospectively study the patterns of change in the BMD in various zones of the femoral neck and proximal femur over five years following hip resurfacing and assess the influence of age, gender, BMI, component size and orientation.

Patients and Methods

We have performed a prospective study of change in BMD after hip resurfacing. 31 consecutive patients undergoing Birmingham Hip Resurfacing (BHR) (Midland Medical Technologies, Birmingham, UK) consented to participate in the study over a nine-month period. Complete five-year follow-up was available for 26 patients (29 hips); 25 of these had osteoarthritis and one patient had rheumatoid arthritis. Four patients were unable to attend the five-year scan appointment, although were doing well functionally, and were excluded from the analysis. One patient withdrew from the study.

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2012.09.012.

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The study received ethical approval from Newcastle and North Tyneside Local Research Ethics Committee (ref 2002/234) and patients were included after giving their consent.

A single surgeon (JH) performed all of the procedures, which were done using a posterior approach. A standard operative technique was used in all cases using the method described by McMinn et al. [11] although without the use of a femoral vent. The purpose of femoral vent, as described in the original technique, was to reduce the risk of cerebral emboli, but the benefit has been questioned with actually a potential to increase blood loss [12]. Components were cast cobalt chromium alloy. Fixation on the acetabular side was cementless (hydroxyapatite coated) and on the femoral side was cemented using a low-viscosity cement (Simplex, Stryker Howmedica, Allendale, Jersey). A standard post-operative regimen was used. All patients were mobilized on day one with protected full weight bearing on crutches for between four and six weeks.

The bone mineral density (BMD) was measured using dual energy x-ray absorptiometry (DEXA) using techniques previously described [2,5]. Pre-operative DEXA scans were performed in the routine pre-assessment clinic two weeks before surgery and then at periods of six weeks, three months, one year, two years and five years after surgery.

The DEXA scan was performed using a Hologic QDR 4500A scanner [2,5]. Each patient was placed supine on the table in conjunction with the Hologic prosthetic foot positioner. The foot positioner immobilizes the foot and ankle in 0 degrees of internal rotation that allows a reproducible DEXA scan of the hip. Each scan was analyzed using the Hologic prosthetic scan analysis software (operating system 9.80; v 8.26a:3). The superior aspect of the greater trochanter and the medial aspect of the lesser trochanter were identified and these two points

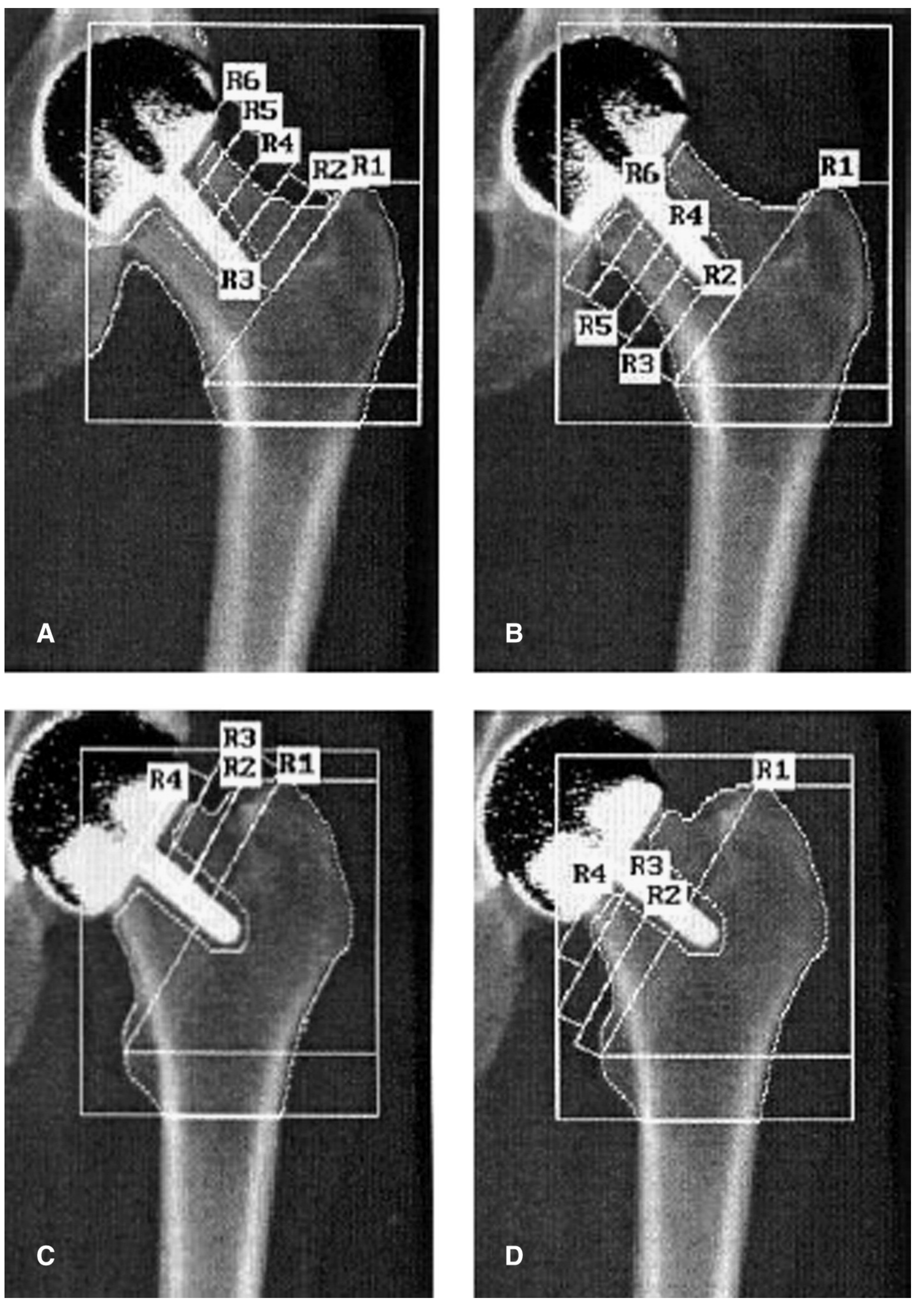

Fig. 1. Examples of DEXA scans with BHRs in situ. R1 is the trochanteric area. Figure 1A and 1B are in the same patient, with ten femoral neck ROI (region of interest). Figure 1A shows the superior zone (R2 to R5) and 1B shows the inferior zone of interest (R2 to R6). Figure 1C and 1D are from another patient with six ROI.