The Use of Preoperative DEXA Scans to Evaluate Bone Quality in Hip Resurfacing

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SUMMARY
In this study the usefulness of a preoperative dual-energy X-ray absorptiometry (DEXA) scan to help in patient selection for hip resurfacing arthroplasty (HRA) is examined. The operating surgeon determined intraoperatively whether the patient had a HRA or a large head metal-on-metal total hip arthroplasty (MOM). The t-score was significantly lower in the MOM group compared to the HRA group. This indicated that DEXA scan is a reliable tool for the preoperative assessment of bone quality and can help in selecting appropriate candidates for HRA.

INTRODUCTION
There is renewed interest in hip resurfacing arthroplasty because of the theoretical advantages of femoral bone stock conservation, proposed suitability for younger and more active patients, as well as improvements in the technology and surgical technique compared with those available 25 years ago (Figure 1). It is generally agreed that maintenance of bone in the proximal aspect of the femur is desirable, and is of particular importance if the need for revision arises. Younger patients who are candidates for hip resurfacing are more likely to eventually need a revision, and preservation of femoral bone stock to support an implant during revision becomes especially important.

Figure 1: Anteroposterior radiograph of the pelvis of a patient with a MOM on the left hand side and a HRA on the right hand side.

Femoral neck fracture is a unique complication of resurfacing, with an incidence ranging from 0% to 4%. It is the most common short-term concern with this type of hip replacement. Most fractures occur spontaneously rather than as a result of trauma. The causes of femoral neck fractures are multifactorial. Femoral neck fractures have been related to component malposition and poor bone quality femoral neck.

Bone material quality affect the risk for short-term neck fracture [1,2] and should be assessed when screening patients for hip resurfacing. There is a strong correlation between absolute bone mineral density (BMD) and fracture load in biomechanical studies. [3,4,5] Although the exact threshold is currently unknown, femoral neck bone with femoral-neck BMD less than 0.8 g/cm² supported very low fracture loads (Figure 2). Patients with BMD values below this level are likely inappropriate candidates for resurfacing procedures.

Figure 2: Bar chart indicating an increased load to fracture in femurs with higher bone mineral density. This effect is more pronounced when the femoral component is placed in valgus.

In a study of structural trends in the aging femoral neck and proximal shaft, Beck et al [6] reported men lose 18% and women 25% of bone mineral density in the femoral neck from age 30 to age 70. There is a wide variety in bone quality in relatively elderly patients and BMD is a more important factor than age in selecting patients for HRA. Currently, bone quality is assessed intraoperatively by the surgeon who decides whether the patient is eligible for a HRA. The goal of this study was to determine whether a preoperative DEXA scan could be useful in patient selection for HRA. The null hypothesis of this study was that there was no difference in BMD comparing patients who received a MOM and a HRA.
METHODS
Elderly patients with primary osteoarthritis who were good candidates for a HRA had a preoperative DEXA scan of the hip region. Patients were consented that they were eligible for HRA, but that a MOM would be used if the bone quality of the femoral head and/or neck was found to be insufficient at time of the operation. All patients were operated in a lateral decubitus position using a standard posterolateral approach with transosseous capsular repair. The operating surgeon was blinded for the result of the DEXA scan and determined intraoperatively whether the patient had a HRA or a MOM. Postoperatively full weight bearing was allowed in all patients. They were advised to use crutches for 6 weeks and standard dislocation prevention instructions were given by a physiotherapist.

RESULTS AND DISCUSSION
Between January 2004 and December 2007, 40 elderly patients with primary osteoarthritis of the hip were eligible for HRA and had a preoperative DEXA scan. During surgery, 12 patients (10 women and 2 men) had a MOM because of poor bone quality and 28 patients (19 women and 9 men) a HRA. The t-score was significantly lower in the MOM group compared to the HRA group (p=0.021 and p=0.014 respectively). The mean age of the MOM group (56.13 SEM 2.30) and the HRA group (57.04 SEM 1.24) was similar (p=0.73). There were no neck fractures in the HRA group at a minimum follow-up of 2 years.

Most resurfacing procedures are performed in younger patients, with the mean ages of assessed patients ranging from 42-52y in published studies. There are concerns that, as a result of poor bone quality, older patients may be more susceptible to femoral neck fractures or aseptic loosening after resurfacing. Biomechanical studies have demonstrated a strong correlation between BMD and fracture load. Nevertheless, there is little clinical evidence to support or oppose the use of resurfacing in older patients. However, many older patients also engage in physical activities, and the lengthening life span of humans increases the likelihood that older patients may outlive the expected life span of a conventional total hip replacement. Because there is a wide variety in bone quality of the proximal femur, BMD is probably a more reliable criterion to select patients than age. Bone density is assessed only qualitatively and there is a subjective component in the assessment. The interobserver and intraobserver variability and reliability in bone density assessment have not been established.

Table 1: Comparison of age, gender, and BMD in the two study groups.

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<tr>
<th></th>
<th>MOM</th>
<th>HRA</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>age (years)</td>
<td>56.1</td>
<td>57.0</td>
<td>0.73</td>
</tr>
<tr>
<td>gender (F/M)</td>
<td>10/2</td>
<td>19/9</td>
<td>0.65</td>
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<tr>
<td>t-score (95% CI)</td>
<td>-1.53</td>
<td>-0.24</td>
<td>0.006</td>
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<td></td>
<td>(-1.81 to -1.25)</td>
<td>(-0.65 to 0.17)</td>
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Our study demonstrates that a preoperative DEXA scan can account for proximal femoral bone material quality. According to our data, HRA can be safely done in patients with a t-score > -1. In patients with a t-score < -1.5 a conventional total hip arthroplasty should be considered.

CONCLUSIONS
Because of femoral bone stock conservation, HRA is a good alternative for a standard hip arthroplasty in young and older patients who engage in physical activity. However, the procedure is technically more challenging and patient selection is crucial to reduce the risk of femoral neck fractures which is an important short term complication of this type of implant. A preoperative DEXA can help in selecting patients. We recommend a DEXA scan in patients eligible for HRA and older than 50y. HRA can be safely done in patients with a t-score > -1.

REFERENCES