A Randomized Controlled Trial of a Cemented vs. Cementless Femoral Component for Metal-on-Metal Hip Resurfacing: A Bone Mineral Density Study

The etiology of femoral neck narrowing is most likely multi-factorial and involves choice of surgical approach, type of fixation, as well as implant design [1,2]. In the current literature, the highest incidence of neck narrowing was reported with a cementless femoral component [3]. Although the long term implications of femoral neck narrowing on survivorship of the femoral component in hip resurfacing are unknown, it is well established that increasing osteopenia of the femoral neck puts the hip at risk of fracture [4]. Because neck fracture [5,6], combined with femoral component loosening, is one of the main failure mechanisms of hip resurfacing, the presence of osteopenia and subsequent femoral neck narrowing after hip resurfacing could negatively impact outcomes.

The potential effects of femoral component design (cemented vs. uncemented) on bone mineral density (BMD) have yet to be examined in a randomized controlled trial (RCT). Therefore, this prospective RCT quantified and compared a) BMD on the femoral side, and b) total BMD of the contralateral femur, between two groups of patients undergoing hip resurfacing: one receiving a cemented femoral component (Conserve Plus; Wright Medical Technology Inc., Arlington, TN), and one receiving an uncemented femoral component (Cormet; Corin Inc., Cirencester UK). The primary goal of the present study was to compare BMD in the operative and contralateral hips at one-year post-surgery. Secondary, subjective outcomes, as measured by self-report questionnaires, and revisions/reoperations were compared between the study groups.

METHODS

One-hundred twenty patients (60 per group) were randomized to receive hip resurfacing with either the cemented or uncemented femoral component. There were 105 males (53 cemented, 52 uncemented) and 15 females (7 cemented, 8 uncemented), with a mean overall age of 49.4±7.3 years (range 20.5-67.7). The mean BMI of patients was 28.9±4.2 (range 20.3-42.1). There were no differences in these demographics between study groups. A clinical examination, standard radiographs as well as bilateral BMD were performed at baseline (2 weeks post-surgery), 6 months, and one year following surgery. BMD was measured in six femoral neck zones [7,8] (Figure 1) on the operative side and five zones on the contralateral side using a Lunar Prodigy Advance Bone Densiometry System (GE Healthcare; Mississauga, ON). For analyses of femoral BMD, the total contralateral BMD value was used as a covariate. All BMD values are reported as g/cm². Patients also completed three subjective quality of life questionnaires; the Harris Hip Score (HHS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the University of California at Los Angeles (UCLA) Physical Activity Index. Postoperative complications and reoperations were documented. Approval was obtained from our institutional review board and the investigations were done conforming to ethical principles of research.

RESULTS

At baseline, both groups exhibited similar femoral BMD in all 6 zones. Comparing cemented versus uncemented femoral components, the uncemented group had greater BMD in zones 1 (p<0.03) and 4 (p<0.001) at 6 months post-surgery, and in zones 1 (p=0.03), 2 (p=0.03), and 4 (p=0.001) at 1 year. From a within-group perspective, compared to baseline, the cemented group exhibited greater BMD in zone 1 at the 1-year interval (p=0.01). Compared to baseline, the uncemented group exhibited greater BMD in zone 1 at the 6-month interval (p=0.04), and in zones 1 (p=0.01) and 4 (p=0.004) at the 1-year interval. Compared to baseline, the cemented group had reduced BMD in zone 3 at 6-months (p=0.03).

Table 1: Between-Group BMD Results (ANCOVA)

<table>
<thead>
<tr>
<th>Zone</th>
<th>Uncemented</th>
<th>Cemented</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1</td>
<td>1.01 (0.23)</td>
<td>0.88 (0.17)</td>
<td>0.03</td>
</tr>
<tr>
<td>Zone 2</td>
<td>0.96 (0.22)</td>
<td>0.86 (0.18)</td>
<td>0.11</td>
</tr>
<tr>
<td>Zone 3</td>
<td>1.05 (0.22)</td>
<td>0.93 (0.21)</td>
<td>0.10</td>
</tr>
<tr>
<td>Zone 4</td>
<td>1.50 (0.22)</td>
<td>1.25 (0.27)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Zone 5</td>
<td>1.37 (0.27)</td>
<td>1.23 (0.32)</td>
<td>0.14</td>
</tr>
<tr>
<td>Zone 6</td>
<td>1.30 (0.26)</td>
<td>1.20 (0.32)</td>
<td>0.61</td>
</tr>
</tbody>
</table>

No between-group differences in outcome scores were present at baseline, or at the 6-month and 1-year follow-ups. Within-group analyses revealed that all patient outcomes significantly improved in both groups from baseline to the one-year interval. There was one revision in the cemented group (due to adverse tissue reaction) and none in the cementless group. There were 2 complications in the cemented group (1 peroneal nerve palsy and one acute cup spin out) and 2 in the cementless group (1 hematoma, 1 posterior column fracture).

DISCUSSION

Compared with a cemented femoral component, patients receiving an uncemented femoral component had significantly higher BMD levels at baseline, 6 months and 1-year. Both groups experienced increased BMD over the follow-up period, particularly in zones 1, 3, and 4. Despite differences in BMD, both study groups significantly improved during follow-up, as shown by their subjective outcome scores. Further long-term evaluation is necessary in order to determine the potential association between BMD and implant survivorship between cemented and uncemented component designs.

SIGNIFICANCE

When compared with patients receiving a cemented femoral hip resurfacing component, patients receiving an uncemented component had greater periprosthetic BMD at baseline, 6 months and 1 year post-operatively. Both groups, however experienced gains in BMD.

REFERENCES