Hip resurfacings revised for inflammatory pseudotumour have a poor outcome


From the Nuffield Orthopaedic Centre, University of Oxford, Oxford, England

Inflammatory pseudotumours occasionally occur after metal-on-metal hip resurfacing and often lead to revision. Our aim was to determine the severity of this complication by assessing the outcome of revision in these circumstances and by comparing this with the outcome of other metal-on-metal hip resurfacing revisions as well as that of matched primary total hip replacements.

We identified 53 hips which had undergone metal-on-metal hip resurfacing and required revision at a mean of 1.59 years (0.01 to 6.69) after operation. Of these, 16 were revised for pseudotumours, 21 for fracture and 16 for other reasons. These were matched by age, gender and diagnosis with 103 patients undergoing primary total hip replacement with the Exeter implant.

At a mean follow-up of three years (0.8 to 7.2) the outcome of metal-on-metal hip resurfacing revision for pseudotumour was poor with a mean Oxford hip score of 20.9 (SD 9.3) and was significantly worse (p < 0.001) than the outcome for fracture with a mean Oxford hip score of 40.2 (SD 9.2) or that for other causes with a mean Oxford hip score of 37.8 (SD 9.4). The clinical outcome of revision for pseudotumour was also significantly worse (p < 0.001) than the outcome of matched primary total hip replacements. By contrast, the outcome for fracture and other causes was not significantly different from that of matched primary total hip replacements (p = 0.065). After revision for pseudotumour there were three cases of recurrent dislocation, three of palsy of the femoral nerve, one of stenosis of the femoral artery and two of loosening of the component. Five hips required further revision. In three of these there was evidence of recurrent pseudotumour, and one is currently awaiting further revision. The incidence of major complications after revision for pseudotumour (50%) was significantly higher (p = 0.018) than that after revision for other causes (14%).

The outcome of revision for pseudotumour is poor and consideration should be given to early revision to limit the extent of the soft-tissue destruction. The outcome of resurfacing revision for other causes is good.

Metal-on-metal hip resurfacing (MMHR) has recently been advocated for the younger, more active patient because of its perceived advantages and the limitations associated with conventional total hip replacement (THR). Those advantages are said to include bone conservation, physiological femoral loading, restoration of normal joint mechanics, reduced stress-shielding and superior wear properties. In addition, it has been proposed that conversion to a THR should be a relatively, straight-forward option when MMHR fails. A recent study of conversion of MMHR to THR for failure of the femoral component gave results which were comparable with those of primary THR in terms of the surgical effort, safety and early clinical outcomes.

Known complications of MMHR include fracture of the femoral neck, avascular necrosis and/or collapse of the femoral head and neck, aseptic loosening of a component, femoral impingement and infection. Recently, concern has been expressed about soft-tissue reactions to the metal wear debris which have collectively been called inflammatory pseudotumours. These masses (hence tumours) may be cystic or solid (hence ‘pseudo’) and have an inflammatory component. They have been described by other terms such as bursae, cysts or inflammatory masses. Their histology has some of the features of aseptic-lymphocytic-vasculitis-associated lesions although there is more marked necrosis. They cause a range of problems from an asymptomatic abnormality detected on a scan to a destructive lesion lead-
ing to revision of the MMHR.\textsuperscript{15} The incidence of revisions for pseudotumour in one series at eight years has been reported to be 0.5\% in men, 5\% in women over 40 years of age and 25\% in women under 40 years of age.\textsuperscript{20} However, other long-term series have not reported high rates.\textsuperscript{21}

Our aim was to determine the extent of the problem posed by pseudotumours by assessing the outcome of MMHR revised for conventional THR because of the formation of pseudotumours. The outcome was compared with that of MMHR revised for other reasons and with that of a matched group of primary THRs. The data allowed us to address our secondary aim which was to determine if the revision of MMHR was straightforward and achieved good results as has been suggested previously.\textsuperscript{7}

**Patients and Methods**

**Study groups.** Between December 1999 and November 2006 a total of 1375 MMHRs was performed in our centre using four different implants Birmingham Hip resurfacing (Smith and Nephew, Birmingham, United Kingdom), Cormet (Corin, Cirencester, United Kingdom), Conserve Plus (Wright Medical Technology, Memphis, Tennessee) and Re Cap (Biomet, Swindon, United Kingdom). In all, 49 (3.6\%) hip resurfacings in 47 patients required revision and were converted to conventional THR. Two patients had conversion of bilateral hip resurfacings to bilateral THRs. We also revised four MMHRs which had been performed at other centres. These 53 revised resurfacings formed our study group.

The most common indication for MMHR in the group was primary osteoarthritis (40 hips, 75.5\%) followed by osteoarthritis secondary to developmental dysplasia, slipped upper femoral epiphysis and avascular necrosis (AVN) (13 hips, 24.5\%). One hip with developmental dysplasia had undergone a proximal femoral valgus osteotomy before the resurfacing. None of the other hips had previous surgery. There were 34 hips in female patients (64\%) and 19 in male patients (36\%, Table I). The mean age at the time of MMHR was 53.7 years (20 to 71) and the operation was on the right side in 26 hips and on the left in 27. The extended posterior approach was used in all but one of the operations. The primary procedures were performed by 18 different surgeons.

The indication for revision surgery was inflammatory pseudotumour in 16 hips (pseudotumour group), fracture of the femoral neck in 21 (fracture group) and other causes including loosening, infection, AVN/collapse and recurrent dislocations in the remaining 16 hips (other group). In all cases in the pseudotumour group, both components were revised and a conventional THR (cemented Exeter stem (Stryker, Newbury, United Kingdom) with Trident (Stryker) uncemented acetabular component) was implanted using ceramic-on-ceramic (8), ceramic-on-polyethylene (6) and metal-on-polyethylene (2) bearings. In 13 of the fracture group, the femoral component was revised to a conventional stem (cemented CPI stem (Zimmer, Warsaw, Indiana) with a large femoral head which matched the inner diameter of the retained acetabular component. In the remaining cases, both components were revised and ceramic-on-polyethylene (3) or metal-on-polyethylene (5) bearings were used. In the other group, the acetabular components were retained in seven cases and in the remainder conventional THR (cemented Exeter stem (Stryker) with Trident (Stryker) or Trilogy (Zimmer) uncemented acetabular component) was used with ceramic-on-ceramic (4), metal-on-polyethylene (4) and ceramic-on-polyethylene (1) bearings. The revisions were performed by 13 different surgeons. The posterior approach was used in most of the revision cases (42, 80\%). Eight were performed through the anterolateral approach and three through the Smith-Petersen approach. The mean time between the initial MMHR and revision surgery was 1.59 years (0.01 to 6.69). The mean follow-up was three years (0.8 to 7.2).

**Control groups.** For each of the subgroups (pseudotumour, fracture and other) a control group was established by matching each study case with two primary THR cases. We aimed for a ratio of 2:1 in order to increase the statistical power. The control groups were matched for gender, age at primary surgery, the pre-operative diagnosis and the length of follow-up. The control cases were obtained from the Exeter Primary Outcome Study (EPOS).\textsuperscript{22} This is a multicentre, prospective study which recruited more than 1400 patients undergoing primary THR between January 1999 and July 2007 with all patients prospectively followed at yearly intervals by independent observers. We were able to match 41 control THR patients for the fracture group, 32 for the pseudotumour group and 30 for the other group (Table I).

---

**Table I. Details of the patients in all the groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>M/F ratio</th>
<th>Age at primary surgery (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudotumour</td>
<td>16</td>
<td>0/16</td>
<td>51.3 (12.0)</td>
</tr>
<tr>
<td>Pseudotumour control</td>
<td>32</td>
<td>0/32</td>
<td>51.8 (12.0)</td>
</tr>
<tr>
<td>Fracture</td>
<td>21</td>
<td>13/8</td>
<td>57.9 (8.5)</td>
</tr>
<tr>
<td>Fracture control</td>
<td>41</td>
<td>26/15</td>
<td>58.6 (7.4)</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>6/10</td>
<td>50.5 (13.2)</td>
</tr>
<tr>
<td>Other control</td>
<td>30</td>
<td>13/17</td>
<td>52.8 (13.4)</td>
</tr>
</tbody>
</table>
Table II. Summary of the complications for each group by number and percentage

<table>
<thead>
<tr>
<th></th>
<th>Fracture group (n = 21)</th>
<th>Fracture group control (n = 41)</th>
<th>Pseudotumour group (n = 16)</th>
<th>Pseudotumour group control (n = 32)</th>
<th>Other group (n = 16)</th>
<th>Other group control (n = 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood transfusion</td>
<td>7 (33)</td>
<td>4 (10)</td>
<td>12 (75)</td>
<td>2 (6)</td>
<td>7 (44)</td>
<td>3 (10)</td>
</tr>
<tr>
<td>Dislocation</td>
<td>-</td>
<td>4 (10)</td>
<td>3 (19) (2 recurrent)</td>
<td>2 (6)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nerve palsy</td>
<td>-</td>
<td>-</td>
<td>3 (19) (1 partially resolved)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Component loosening</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Infection</td>
<td>3 (14)</td>
<td>-</td>
<td>2 (13)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Periprosthetic fracture</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Re-revision</td>
<td>3 (14)</td>
<td>-</td>
<td>5 (38) (+1 awaiting)</td>
<td>1 (3)</td>
<td>2 (13)</td>
<td>-</td>
</tr>
</tbody>
</table>

Outcome variables. Functional outcome was measured by the Oxford Hip Score (OHS). This was used in the recently recommended manner with a maximum of 48 points (best outcome) and a minimum of 0 points (worst outcome). Unfortunately, the OHS measured before the primary MMHR was not available for many of the patients in the study group. Complications were also assessed. Other variables measured included the operating time, blood loss by transfusion amount given and level of activity. The University of California Los Angeles (UCLA) activity score was recorded for the study group. This has a maximum of 10 points (undertaking regular impact sports) and a minimum of 1 point (wholly inactive). No activity scores for the control THR groups were available.

Statistical analysis. This was undertaken in two parts. First, the differences between the different groups of resurfacing revisions were analysed and then the differences between the revision groups and their respective matched primary THRs were examined. The Mann-Whitney U test was used to analyse the operating time and the OHS. We used the chi-squared test to compare rates of complications. The Kruskal-Wallis test was used for the UCLA activity score. Differences were considered to be significant when a p-value ≤ 0.05 was obtained. All the statistical analyses were performed using SPSS version 15 software (SPSS Inc., Chicago, Illinois).

Results

Clinical summary of the various groups. Revision surgery in the pseudotumour group tended to be more complex because of the associated massive soft-tissue destruction. In three cases the participation of a plastic surgeon was required, in two for the exploration of vessels and nerves and in one for a transverse rectus abdominis pedicle flap to cover a large defect anterior to the capsule after resection of a pseudotumour. In these three cases the Smith-Petersen approach was used. In one case, because of the uncertainty of the diagnosis, the revision was carried out in two stages. In 12 cases a blood transfusion was required post-operatively. In three cases dislocation of the revision THR components occurred, in two of which this was recurrent. All three required further femoral and acetabular component revision because of extensive soft-tissue loss as part of inflammatory process and previous surgery. Palsy of the femoral nerve was observed in three hips, which in one patient was associated with symptoms of intermittent claudication secondary to stenosis or fibrosis of the femoral artery which required an angioplasty. In one case, because of the uncertainty of the diagnosis secondary to stenosis or fibrosis of the femoral artery which required an angioplasty. To date, only one of the palsies has partially recovered. Two hips had early loosening of the acetabular component within two years, one of which has been revised and the other is awaiting revision. In three out of five cases that had re-revision there was evidence of recurrent pseudotumour.

In the fracture group blood transfusion after surgery was required in seven cases. Three hips developed deep infection after the revision surgery and required further two-stage revisions. No infections recurred. There were no other complications.

In the other group blood transfusion was required in seven hips. One hip had a periprosthetic fracture at 20 months requiring a further revision with a change of the femoral component. One developed a deep infection and a later periprosthetic fracture at four years after index surgery requiring a two-stage procedure after infection and a further single-stage procedure after the periprosthetic fracture.

Differences between the various groups of revised MMHR. The operating times for the different groups were significantly different (p < 0.002, Mann-Whitney U test) with revisions for pseudotumours being the most protracted at a mean of 161.6 minutes (120 to 200) followed by revisions for other causes at a mean of 129.4 minutes (75 to 190). Revisions for fracture were the quickest at a mean of 99.6 minutes (46 to 145). Major complications occurred in eight (50%) of the pseudotumour revisions, in three (14%) of the fracture revisions and in two (13%) of the other revisions. The incidence of major complications was significantly different in the three groups (chi-squared test, p = 0.02) with most complications occurring in the pseudotumour group (Table II).
not return their OHS forms (Fig. 1). The pseudotumour group had significantly (p < 0.001, Kruskal-Wallis test) lower activity levels with a mean UCLA of 3.8 (2 to 7) compared with the fracture group with a mean of 7.0 (3.0 to 10.0) and the other group with a mean of 6.7 (3.0 to 10.0). Both the last two groups had similar levels of activity (Fig. 2, Table III). Two fracture group and three other group patients did not return their UCLA score forms.

Differences between revised MMHR and primary THR. The operating time for the pseudotumour group revisions was significantly longer than that for their matched THR controls (p < 0.001, Mann-Whitney U test, Table II). The pseudotumour group had a significantly higher rate of major complications at 50% than their control group at 6.2% (p < 0.01, chi-squared test). This group also had a significantly worse outcome than their matched THR control group (p < 0.001, Mann-Whitney U test, Fig. 1, Table II). The mean OHS of the pseudotumour group after revision was 20.9 (4 to 41) which was within the range of scores for their THR control group before they had their primary THR, the pre-operative mean OHS was 13.5 (4 to 28) for the THR control group.

There was no significant difference in the mean operating time between fracture group revisions and their matched THR group (Table III) (p = 0.6, Mann-Whitney U test, p = 0.6). Neither was there any significant difference in the mean OHS score between the fracture group and their THR group (p = 0.12, Mann-Whitney U test) (Fig. 1, Table III). Although there was no significant difference (p = 0.594, chi-squared test) between the major complication rate in the two groups, this may have been a function of the small numbers of patients.

There was no significant difference in the mean operating time between the other group revisions and their matched control group (p = 0.07, Mann-Whitney U test, Table II) or in the mean OHS between the other group and its control

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean (sd)</th>
<th>Mean (sd)</th>
<th>Mean (sd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudotumour</td>
<td>20.9 (9.3)</td>
<td>161.6 (24.5)</td>
<td>3.8 (1.9)</td>
</tr>
<tr>
<td>Pseudotumour control</td>
<td>39.1 (9.2)</td>
<td>113.1 (51.7)</td>
<td>N/A³ (N/A)</td>
</tr>
<tr>
<td>Fracture</td>
<td>40.2 (9.2)</td>
<td>99.6 (30.4)</td>
<td>7.0 (2.0)</td>
</tr>
<tr>
<td>Fracture control</td>
<td>42.7 (7.5)</td>
<td>95.9 (31.8)</td>
<td>N/A (N/A)</td>
</tr>
<tr>
<td>Other</td>
<td>37.8 (9.4)</td>
<td>129.4 (36.7)</td>
<td>6.7 (2.1)</td>
</tr>
<tr>
<td>Other control</td>
<td>39.7 (10.1)</td>
<td>104.4 (39.2)</td>
<td>N/A (N/A)</td>
</tr>
</tbody>
</table>

* OHS, Oxford hip score
† UCLA, University of California Los Angeles
‡ N/A, not available

Table III. Summary of the results for each group

Fig. 1
Box-and-whisker plots showing the differences in the Oxford hip score in the three metal-on-metal hip resurfacing revision and their control groups. The box represents the middle 50% of the data values lying between the 25th and 75th percentiles, with the median given by the transverse line, the whiskers represents the extreme non-outlier values. Values greater than 1.5 times the interquartile range (IQR) from the ends of the box are considered outliers (O) and those greater than 3 times the IQR from the ends of the box are considered extreme outliers (*).

Fig. 2
Box-and-whisker plots showing the differences in University of California Los Angeles (UCLA) activity scores between the three revision groups.
group (p = 0.26, Mann-Whitney U test; Fig. 1, Table III). Again, although there was no significant difference in the major complication rate between the two groups (p > 0.05, chi-squared test), there may have been a real difference which was masked by the small numbers.

Discussion

Our study has shown that inflammatory pseudotumours are potentially a catastrophic complication of MMHR. We have found that at least 70% of MMHR patients presenting with an inflammatory pseudotumour will have a revision.15 The most prominent operative and histological findings are of soft-tissue destruction and necrosis. The pseudotumours tend to pass through tissue planes. Revision surgery is often difficult, particularly if there is massive soft-tissue destruction or if nerves are involved. Revisions for inflammatory pseudotumour tend to take longer than revision of MMHR undertaken for other causes because of the soft-tissue destruction. It is still not certain why pseudotumours occur; but it is likely that they are a response to an abnormally large amount of cobalt-chrome particulate wear debris.26 Presumably, the reason why pseudotumours recur after revision is that a substantial amount of wear debris still remains after the first revision. A thorough debridement is therefore necessary. The metal wear debris may have a direct toxic effect on cells and/or may generate an idiosyncratic allergic response.15 The increased wear responsible for pseudotumours is probably a result of edge loading or impingement interfering with lubrication or destroying the congruity of the articulation. It is becoming evident that considerable care is needed in the positioning of these devices.27-29 The patient and surgical risk factors associated with pseudotumour must be identified so that these catastrophic complications can be avoided.

Metal-on-metal hip resurfacing is now commonly performed in high-demand young patients. One of the main reasons for this is that there is a perception that MMHRs are simple to revise and that patients who have had revisions of MMHR function as well as those with primary THR. This was not the case for the patients with revision for inflammatory pseudotumour in our series. However, our study provided evidence that the perception was correct for revision performed for other reasons, although significant complications did occur. The most common cause of failure of MMHR is a fracture of the neck of the femur.14 The operating time for revisions for fracture and the OHS after revision for fracture are similar to those for primary THR. This is not surprising since most of these cases require only a conventional femoral component with a large metal head, and confirms the findings of a single-surgeon series.17 In our series, most MMHRs revised for ‘other’ causes required revision of both components. Although the operating time was slightly longer and the OHS was slightly worse than for a matched THR control group, they were not significantly worse (p = 0.07 and p = 0.26, respectively, Mann-Whitney U test).

The combined incidence of major complications after MMHR revision for fracture and other causes was significantly higher than that after primary THR (p = 0.004, chi-squared test). This is to be expected for the other group since it included complex problems such as infection. However, it is surprising for the fracture group since these revisions tended to be straightforward. The fracture group experienced a high rate of infection with 15% becoming infected and requiring further two-stage revisions. This may have been related to the soft-tissue damage and haematoma resulting from the fracture which increased the risk of infection.

We conclude that the outcome after revision of MMHR is dependent upon the indications for revision. After revision for reasons other than inflammatory pseudotumour the outcome was generally good and similar to that after primary THR. However, there was a high incidence of infection after revision for fracture. By contrast, the outcome after revision for inflammatory pseudotumour was poor with major complications occurring in half of the patients. One-third required a further revision and the overall pain and function status was as poor as it was before the primary surgery. Therefore, if a patient presents with a symptomatic pseudotumour following MMHR consideration should be given to an early revision to limit soft-tissue destruction.