TROCHANTER RE-ATTACHMENT IN REVISION HIP ARTHROPLASTY

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We present a new method of trochanter stabilisation designed for use in difficult revision hip arthroplasties. A fixator is secured to the metaphysis of the femur, and its two malleable prongs encompass the trochanter fragment and stabilise it using the tension band principle. The fixator is versatile, simple to apply and has better mechanical properties than any technique using wires.

We reviewed 49 revisions after a mean follow-up of 40 months. Patients had been mobilised early, but there were no detachments or displacements from the initial postoperative position. Although 31% of patients were osteoporotic and 16% had poor trochanter fragments, there was bony union in 46 of the 49 hips, the remaining three developing stable fibrous union.

In revision hip arthroplasty, exposure by a transtrochanteric osteotomy is widely accepted, even by surgeons who do not routinely divide the trochanter. However, this has a significant incidence of complications after a variety of techniques of wire fixation (Amstutz et al 1982; Pellicci et al 1982, 1985; Kavanagh, Ilstrup and Fitzgerald 1985; Goodman and Schatzker 1987; Schutzer and Harris 1988). Factors predisposing to failure of trochanter fixation are a shortened and scarred abductor mechanism, a small and/or poor quality trochanter fragment, a previously un-united trochanter, poor or absent bone in the trochanter bed, corticosteroid and cytotoxic drug treatment, obesity and any other condition which increases stress on the operated hip.

We reviewed 287 hip arthroplasties involving transtrochanteric osteotomy, and found significant complications in 12.4% (unpublished data, 1980). This prompted the development of a new type of trochanteric fixation which would offer improved stability. We now present this technique and our results.

Table 1. Original diagnosis in 49 revision arthroplasties

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number</th>
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<tbody>
<tr>
<td>Primary osteoarthritis</td>
<td>20</td>
</tr>
<tr>
<td>Hip dysplasia</td>
<td>10</td>
</tr>
<tr>
<td>Acetabular fracture</td>
<td>10</td>
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<tr>
<td>Femoral neck fracture</td>
<td>4</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>4</td>
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<tr>
<td>Slipped femoral capital epiphysis</td>
<td>1</td>
</tr>
</tbody>
</table>

PATIENTS AND METHODS

From 1981 to 1988, 49 revision arthroplasties by a transtrochanteric approach were carried out in 48 patients. The trochanter was re-attached with the new fixator. There were 20 men and 28 women; their average age was 55 years (26 to 72) and 10 were under 45. Their average weight was 73.5 kg (range 54 to 95). Follow-up was from six months to seven years (mean 40 months).

All patients had previous hip operations, of which at least one was an arthroplasty. One patient had had three revision arthroplasties and another had had eight previous operations, including one previous revision. The original diagnosis is shown in Table 1.

All but one of the revisions were carried out on cemented arthroplasties, the only exception being the revision of a non-cemented polyethylene screw-in cup, where the femoral component did not require revision. The revision procedure was to a cemented arthroplasty in 33 hips and to a non-cemented arthroplasty in 16.
Technique. The trochanter fixator is a short plate which is secured to the proximal femoral metaphysis. It has two elongated malleable prongs which embrace the trochanteric fragment (Figs 1 and 2). At operation, the trochanteric fragment is steadied with a holder, the prongs of the fixator are pushed through the abductors immediately above the bone and bent over the upper trochanter with a bender, so that the trochanter is firmly gripped and can be pulled distally. This is facilitated by abduction of the hip and downward pressure on the fixator between its prongs. The fixator allows the trochanter to be secured in an anterior or posterior position as needed to correct any undesirable rotation of the limb.

The plate is then held against the proximal femur with a bone clamp, and fixed with two or three AO screws, directed so as to bypass the prosthesis. This stabilises the trochanter by the tension band principle.

Postoperatively the patients were allowed to walk with the aid of crutches on the third to fifth day, but active abductor exercises against gravity were not started for six weeks. Patients with poorly rated trochanters did not start abduction for three months.

The original fixator was used from 1981 to 1986, after which the current, simplified design (Mark 2) was introduced. The Mark 2 design has increased versatility for different trochanter sizes and ease of application. Both models are of stainless steel.

Assessment. Patients were evaluated radiographically pre-operatively, immediately postoperatively, at six weeks, three months, six months and thereafter annually. On the original radiographs, bone mass was qualitatively assessed, using a modified Singh index (Engh, Bobyn and Mathews 1984). The bone response to the underlying disease was recorded as atrophic, normatrophic or hypertrophic (Jakim, Barlin and Sweet 1988), and trochanteric bone stock was graded as shown in Table II.

Postoperatively bone union was defined as trabecular bridging between the trochanter and the adjacent bed and was usually seen within three months. Bony union occurring between three and six months was defined as delayed union. Non-union was the absence of bone bridging at six months.

Fibrous stabilisation was recorded where there was no displacement of the trochanteric fragment from its immediate postoperative position despite the absence of bone union. Upward displacement was evaluated by serial measurements of the distance between the most distal point on the trochanteric bed to the inferior edge of the plate.

Figure 2a – Hip radiograph of a 65-year-old man with rheumatoid arthritis, osteoporosis and a grade 3 trochanter, seven years after primary arthroplasty. He had recent onset of recurrent dislocation. Figure 2b – Five years after revision arthroplasty, using the Mark 1 fixator, showing union of the trochanter in the anatomical position.
of the trochanteric fragment. The lever arm length of the abductors was measured as the distance from the anterior superior iliac spine to the highest point of the greater trochanter.

RESULTS

Pre-operative evaluation. General bone mass was good in 20 patients, fair in 14 and poor in 15, while the biological response to the original disease was hypertrophic in 14, normotrophic in 20 and atrophic in 15 patients. Trochanteric bone stock was rated as grade 1 in five hips, grade 2 in 12, grade 3 in 24, and grade 4 in eight.

Of the 49 hips, 25 had had a previous transtrochanteric osteotomy. In 19 cases this had united, but seven of these had shortened abductor lever arms (by 10 to 65 mm). In the other six hips the osteotomy had failed to unite: the trochanter was displaced from 25 to 35 mm and in five was rated grade 4 (poor), and in one grade 3 (fair). Three of these six patients were osteoporotic and had an atrophic bone response.

Of the 24 patients who had not had previous trochanteric osteotomies, five had abductor lever arms shortened by 10 to 30 mm as compared to the normal side. In the whole series there were 18 trochanters with shortened lever arms. In 31 hips the trochanters were in the normal position, giving a normal abductor lever arm. Of these, 12 had had previous transtrochanteric osteotomies and 19 had not.

Follow-up. After revision, trochanteric union in the postoperative position was seen in 46 patients, 23 by six weeks and 23 by three months. The 18 trochanters with shortened lever arms had been lowered 5 to 65 mm (mean 24), and in five hips the trochanter was more distal than that on the normal side. In the other 31 hips, five trochanters had been moved distally and 26 had united in an anatomical position.

Early union had occurred in 17 patients with good bone mass, 12 of whom had a hypertrophic bone response; the others had fair or poor bone stock with a normotrophic pattern. Trochanteric bone stock in this group was grade 1 in five hips, grade 2 in nine, grade 3 in eight, and grade 4 in one.

Three patients had stable fibrous union, without displacement from the initial postoperative position (Fig. 3). These trochanters were all grade 4 pre-operatively, with no trochanter bed, and displacement ranging from 10 to 35 mm. At revision these three trochanters were lowered to a position 5 to 10 mm proximal to that of the normal trochanter. Clinical results were not significantly affected by the fibrous union.

Figure 3a – Hip radiograph of a 28-year-old woman with hip dysplasia, who had had eight previous operations including two arthroplasties. The cup is sited proximally and the trochanter is grade 4. Figure 3b – Eighteen months after revision, despite the absent trochanteric bed, stabilisation has been maintained.
No complications were associated with the use of the trochanter fixator, and there was no significant difference between the results with 26 Mark 1 and 23 Mark 2 models.

DISCUSSION
The many fixation techniques described, show that this is still a problem, particularly after revision arthroplasty in which complication rates range from 4.2% (Schutzer and Harris 1988) to 26.7% (Goodman and Schatzker 1987). Trochanter union and stabilisation are the major problems, and one serious associated complication is dislocation; the reported incidence of this varies from 12.5% (Callaghan et al 1985) to 67% (Pelicci et al 1982).

After revision arthroplasty, rates of trochanter non-union without migration have ranged from 3% (Schutzer and Harris 1988) to 13% (Kavanagh, Ilstrup and Fitzgerald 1985). Our rate was 6.1%; but all three had trochanter stability. Wroblewski and Shelley (1985) regard fibrous union as a failure of fixation, but, in the absence of displacement, this has little effect on hip function (Charnley 1972; Amstutz and Maki 1978; Nutton and Checketts 1984; Glassman, Engh and Bobyn 1987).

It is unrealistic to expect bony union in the multiply operated hip with severe trochanteric displacement and bone loss, but stabilisation in a good position allows unimpeded function. Our three patients with fibrous union showed no displacement at 18 to 50 months.

Our experience suggests that osteoporotic patients with poor biological response and grade 3 or 4 trochanteric bone stock will show poor trochanteric healing; we label these cases 'trochanter at risk', and most of our delayed unions were in this group. After cup revision in which the femoral component has not been disturbed, reattachment of the trochanter by wire is difficult (Kay 1985), but is readily dealt with by using the fixator. If repeat osteotomy is necessary after the use of a fixator it may be possible to use the same screw-holes.

Drilling through the cement mantle might, in theory, produce local stress raisers, but Müller also used such screws and no complications regarding the cement have been reported. Charnley (1979) expressed no objection to it. We have seen no complications at the cement interface.

Wire breakage after revision arthroplasty has been reported in up to 27% of cases (Schutzer and Harris 1988), though migration of wire fragments into the hip joint is a rare complication. Removal of previous trochanter wires is time-consuming, while removal of the trochanter fixator is quick and simple.

After difficult revision operations, where optimal trochanter stabilisation has not been obtained, some surgeons recommend a conservative postoperative rehabilitation regime with bed rest for three to six weeks (Wroblewski and Shelley 1985; Schutzer and Harris 1988), crutches for six months or more (Schutzer and Harris 1988) or an abduction brace (Amstutz et al 1982; Callaghan et al 1985). We believe that early mobilisation is advantageous; in our series this was possible without loss of trochanter stability.

The trochanter fixator is versatile, simple to apply and has better mechanical properties than any of the current wiring systems. It has given gratifying results in difficult revision cases.

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REFERENCES