ACETABULAR RECONSTRUCTION WITH A
BIPOLAR PROSTHESIS

FIVE YEAR RESULTS OF THE DAUTRY TECHNIQUE

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We report the results of acetabular reconstruction using a bipolar prosthesis bearing on cancellous bone graft in 37 patients after a minimum of five years. There was a satisfactory clinical outcome in 58% when assessed by pain, range of movement and stability, with greater improvement in the pain score than of the other parameters. Radiological migration of the prosthesis was a frequent finding although this did not always correlate with symptoms. Better results were obtained in cases of primary or secondary protrusio acetabuli than after the revision of previous total arthroplasties.

The increasing incidence of acetabular failure after total hip replacement has led to many descriptions of techniques to improve the fixation of an implant at revision and to compensate for the loss of bone stock. Most methods involve the use of methylmethacrylate cement, either alone (Lee and Ling 1984), or with bone grafting (Heywood 1980) or with osteosynthesis with metallic implants in addition to bone grafts (Müller 1983). When there has been severe acetabular destruction these techniques may give poor long-term results (Hunter et al. 1979; Callaghan et al. 1985) and a high incidence of complications such as dislocation, infection and subsequent component loosening (Kavanagh, Illstrup and Fitzgerald 1985; Pellicci et al. 1985).

To avoid some of the problems of revision surgery, Dautry, Koechlin and Faivre (1979) used bipolar prostheses bearing directly on a bed of the bony graft which had been used to fill the acetabular defect. This method aims to restore deficient bone stock while avoiding the use of either methylmethacrylate cement or supplementary osteosynthesis, and has been used for reconstruction in primary protrusio and secondary protrusio after fracture or hemiarthroplasty, as well as for revision of cemented or uncemented acetabular cups.

The short-term results were encouraging, but were accompanied by a warning that the long-term results were still uncertain (Sommelet and Dautry 1981). Other surgeons are now using this method (Oakeshott et al. 1987; Wilson 1987) and it now seems appropriate to report our longer-term results in 37 patients.

METHODS AND PATIENTS

Operative technique. The hip may be exposed by the anterior, lateral or posterior approach. We prefer the posterior approach retaining the greater trochanter intact in primary and, if possible, in revision cases. The decision on removing a well-fixed femoral component depends on the ease of access to the acetabulum and the availability of a compatible bipolar shell. In primary cases, the femoral head is used for the graft; in revision cases this is obtained from the posterior iliac crest. Bank bone mixed with autogenous iliac crest bone was used in only one patient in our series.

Acetabular preparation involves meticulous removal of all soft-tissue remnants and any cement. Final preparation is by gentle reaming and perforation of the cortical bony plate with multiple drill holes to expose bleeding bone (Fig. 1a). Copious irrigation is used to remove debris. The defect is then built up gradually with cancellous bone chips, first filling any major defects in the acetabular floor with cortico-cancellous strips. As the cavity is filled, the graft is compressed and shaped, using
Table 1. Indications for operations in 38 hips

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prosthetic loosening</td>
<td>23</td>
</tr>
<tr>
<td>Protrusio acetabuli</td>
<td>10</td>
</tr>
<tr>
<td>Post-traumatic arthritis</td>
<td>2</td>
</tr>
<tr>
<td>Paget's disease</td>
<td>2</td>
</tr>
<tr>
<td>Cystic osteoarthritis</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. 1a

The acetabulum is cleared of all debris, packed with small chips of bone graft and shaped with punches and the trial femoral head.

Fig. 2a

Figure 2a - Left hip before operation, showing a loose prosthesis with dislocation. The Merle d'Aubigné score was 0 out of 18. Figure 2b - After operation the bipolar prosthesis rests on a bed of bone graft. Figure 2c - At five years there has been some migration but the medial wall defect has healed. Walking was limited by vertigo. The score was 5 out of 6 for pain and 13 out of 18 overall.

Table 1: Indications for operations in 38 hips.

- Prosthetic loosening: 23 patients
- Protrusio acetabuli: 10 patients
- Post-traumatic arthritis: 2 patients
- Paget's disease: 2 patients
- Cystic osteoarthritis: 1 patient

Figure 2b

Patients. Between October 1979 and July 1981, we performed 38 acetabular reconstructions in 37 patients using the Dautry technique, for the indications summarised in Table 1. There were 25 women and 12 men. Their mean age was 69.9 years (range 29 to 83). The average follow-up was 5.7 years (range five to seven). One patient died early after operation from chest infection; this patient also had the only wound infection in the series.

Two other patients died of unrelated causes at two years six months and three years two months after operation. Of the 34 patients available for review, eight were reviewed by postal questionnaire because of the distances involved, and the remainder were seen by DF or EL. The full series of radiographs was available for only 22 patients.

Merle d'Aubigné's scoring system (1954) was used for clinical assessment; cup migration was measured from the radiographs using the migration index described by Collet et al. (1985). A standard anteroposterior pelvic radiograph is made with the patient standing, the lower limb in 15° internal rotation and the beam centred two finger-breadths above the symphysis pubis at a focal length of 150 cm. The images of the coccyx and the midline of the sacrum are then
The Collet migration index

\[ M = G \sqrt{(a_5 - a_0)^2 \times (p_5 - p_0)^2} \]

Where M, migration index
- G, magnification factor (to allow for differences between radiographs)
- \( a_0 \), height on first standing film
- \( a_5 \), height at five years
- \( p_0 \), medial position at first standing film
- \( p_5 \), medial position at five years

Fig. 3

Comparision of the scores for pain, range of movement and stability before and after surgery

Fig. 4

Comparison of the migration index and the total Merle d'Aubigné score

Fig. 5

Comparison of migration index and pain score

Fig. 6
compared with the position of the symphysis to check rotation and that the beam is in a true sagittal plane. The radiological “tear-drop” is then the base line for measurement (Fig. 3). This migration index (M) combines both medial and proximal migration in a single figure, and remains accurate provided that the angle of the beam is not more than $\pm 7^\circ$ from truly sagittal.

RESULTS

Hip scores. Before operation the average hip score was 7.5 out of a possible total of 18 (6 points each for pain, range of movement and stability/walking). Four patients scored zero before operation because of dislocation in one, femoral shaft fracture around the prosthesis in another and a broken femoral component in two.

After operation the average total score was 12 points, but the pain score showed most improvement (Fig. 4). Stability and walking ability were often affected by intercurrent problems associated with ageing, such as cerebrovascular accident, vertigo and rheumatoid disease. Three patients had scores of zero. This was due to migration and intraprosthetic dislocation in one, femoral stem fracture in one and painful migration requiring early revision in the third. In this last case our operation was the fourth attempt at arthroplasty on the same hip. In all, 19 of our 34 patients (58%) had excellent (17+), good (15+) or fair scores (12+) after five years.

Acetabular migration. The index of migration was calculated for 23 patients, and varied from 0 to 37 (average 10). This was compared with the total hip score (Fig. 5) and with the pain score (Fig. 6). Only two patients had no migration; one had ectopic bone formation and an ankylosed hip; and the other had been pain-free at five-year review but at six years had increasing pain, which appeared to be due to late infection, secondary to urinary tract infection. Although there was a trend for a high migration rate to be associated with a poor clinical result and pain, the association was not invariably. The figures given for migration are averages: in some cases the position stabilised after two years, but in two patients, no migration occurred until the fifth year of follow-up.

Complications. One patient died after revision of a loose cemented prosthesis, and there was one case of non-fatal pulmonary embolus. One hip dislocated early after a revision operation and later showed the most severe migration of the series, intraprosthetic dislocation and massive ectopic bone formation.

DISCUSSION

The use of bipolar prostheses in primary hip replacement for osteoarthritis has been reported to give satisfactory results (Devas and Hinves 1983; Lecestre et al. 1985), and one of Charnley’s (1972) early designs was effectively a bipolar arthroplasty. He reported that this gave comparable results to a cemented cup provided that the shell did not tilt into varus. Our technique is an extension of this concept. The prosthesis (SeM Intermediaire) is of the self-centring variety to avoid tilting. In revision operations, our aim was to restore lost bone stock. The method may give a definitive result or it may be part of a staged operation, using the bipolar prosthesis as a spacer and inserting a conventional cup when the grafted bone has consolidated.

Measurement of migration was frequently difficult, because of the altered anatomy and obliteration of the tear-drop after the failure of previous arthroplasties, but as yet no better method of assessment has been described. Some of the early migration may be due to remodelling of the graft on walking. Some hips appeared to stabilise, but it is not yet certain whether migration is progressive in most cases. In some patients who required further revision, the grafted acetabular floor appeared to be solid on gross inspection.

The clinical hip scores after operation are lower than would be acceptable for primary hip replacement, but our 58% of satisfactory results compares favourably with the results reported by others after revision surgery (Hunter et al. 1979; Kavanagh et al. 1985; Pellicci et al. 1985). Although stability was little improved by operation, our patients often required only a single walking stick to improve their gait. Several of our patients had already had multiple operations on the affected hip and their scores should be compared with those for alternative procedures such as a Girdlestone excision arthroplasty.

The use of this technique for primary protrusio and for protrusio secondary to acetabular fracture or hemiarthroplasty, where there is an intact floor and a relatively normal-shaped acetabulum, gives results similar to those for primary osteoarthritis (Sommellet and Coudane 1986). The results of major reconstruction after failure of a previous total hip replacement are less encouraging, partly because large grafts necessitate a prolonged period of bed rest on traction. In the predominately elderly population involved, a conventional revision arthroplasty would allow earlier mobilisation. Our experience suggests that this technique should not be used in patients with an inflammatory arthropathy or osteoporosis.

Conclusion. The Dautry technique of acetabular reconstruction has given encouraging results in terms of pain relief, with remarkably few major complications. Although the long-term outcome may be much the same as that of other methods of arthroplasty for such difficult cases, the avoidance of the use of either methylmethacrylate cement and any form of metallic osteosynthesis may encourage graft incorporation and make any subsequent operation easier to perform.

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