CEMENTLESS TOTAL REPLACEMENT FOR SEVERELY DYSPLASTIC OR DISLOCIATED HIPS

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We report the short-term results of 100 cementless total hip replacements in 52 severely dysplastic and 48 totally dislocated hips, with some new technical solutions to the problems involved. In cases with a very narrow iliac bone, the acetabular screw ring is seated below the true cotyloid area. In hips with tight flexor and abductor muscles or with deformities of the proximal femur, various osteotomies were performed. Special attention was paid to careful pre-operative planning and precise operative technique.

In spite of a high complication rate the results were generally good and even patients who required re-operation were satisfied with the final result.

The total replacement of severely dysplastic or dislocated hips provides considerable technical problems; complications occur more frequently than in routine replacement surgery (Dunn and Hess 1976; Crowe, Mani and Ranawat 1979; Woolson and Harris 1983; Hartofilakidis, Stamos and Ioannidis 1988; Linde, Jensen and Pilgaard 1988). The operation is therefore performed only when the symptoms are sufficient to make the risk of complications acceptable. Some authors have considered complete dislocation as a contra-indication for hip replacement (Charnley and Feagin 1973; Eftekhar 1978).

To date, all the operative techniques reported for these hips have been based on cement fixation, and aseptic loosening has been a considerable problem, especially in young and middle-aged patients (Chandler et al 1981; Dorr, Takei and Conaty 1983; Halley and Wroblewski 1986; Jones and Hungerford 1987). To avoid this disadvantage of cement fixation, the use of Lord's madreporic cementless prosthesis (Lord, Hardy and Kummer 1979) for these cases was started in 1980 by the senior author (KAS).

The prosthesis was first used in younger patients with primary osteoarthritis, but we soon found it to be suitable for dysplastic hips. Corrective osteotomies of the proximal femur were also facilitated by the cementless technique. With increasing experience, we have modified our operative procedures and designed more appropriate prostheses.

We have now evaluated the short-term results with special attention to the fixation of the acetabular component, and to the new corrective osteotomies of the proximal femur.

PATIENTS AND METHODS

From 1982 to 1986, 100 severely dysplastic or totally dislocated hips were replaced by Lord's cementless prosthesis in the Orthopaedic Hospital of the Invalid Foundation, Helsinki. The indications for arthroplasty were severe hip pain, with considerable difficulty in walking and in performing normal daily activities. All cases remain under clinical and radiological review. We assessed hip pain, ability to walk and total range of hip movements, grading the pain on the scale of Merle d'Aubigné and Postel (1954). Radiographs were taken standing (Gofton and Trueman 1971; Turula et al 1985; Hoikka et al 1987) and in the Lauenstein position.

Prophylactic antibiotic therapy (fluclaxacillin or clindamycin) was given two hours before operation and continued for 48 hours. Prophylaxis against thromboembolism by subcutaneous heparin or coumadin was used for selected high-risk patients before 1985; since then Orstanorm-heparin (dihydroergotamine with heparin) has been given for one week to all patients having hip replacement. Early mobilisation, encouragement of active leg movement, and anti-embolic stockings were also used routinely.

Hip deformities were graded according to Eftekhar (1978); only severe dysplasia was included (Table I). The
hips were divided into two groups according to the need for femoral osteotomy:

**Group I.** This included 54 hips which were replaced without shortening or corrective osteotomy of the femur. Of the 46 patients, seven were men and 39 women; the mean age was 41 years (range 24 to 66). The mean follow-up was 3.2 years (range 1.0 to 5.9).

**Group II.** In 46 hips in 40 patients a shortening osteotomy of the femur was necessary. There were seven men and 33 women in this group, with a mean age of 50 years (range 22 to 78). The mean follow-up was 2.4 years (range 1.0 to 4.3).

In both groups the most common cause of the deformity was congenital dislocation of the hip (Table II) and in many cases multiple operations had been performed in childhood or later (Table III). The mean duration of our operation was 143 minutes (range 85 to 265) in group I and 216 minutes (range 115 to 330) in group II. Peroperative bleeding was on average 1300 ml (range 400 to 6500) in group I and 2200 ml (range 550 to 6500) in group II. The average postoperative hospital stay was 18 days in group I and 19 days in group II.

**Operative techniques.** Diagrams of the techniques used for the acetabulum and the femur are given in Figures 1 and 2. Either a posterolateral Moore exposure or an anterolateral approach (Hardinge 1982) is used, with the patient in a lateral position. We chose the posterolateral approach when distal advancement of the greater trochanter was considered necessary (Figs 2a, b and e); this approach leaves the gluteus medius intact. We preferred the anterolateral exposure when shortening of the proximal femur was planned (Figs 2c and d), since access is troublesome through the posterolateral exposure.

If the gluteus medius muscle is too tight, the posterior third of its origin is released from the iliac bone by blunt dissection. If distal advancement of the greater trochanter is performed through an anterolateral approach there is some danger of compromising all its muscle attachments. The sciatic nerve is always identified; it often lies on the lateral side of the ischial bone near the site proposed for the new acetabulum.

**Acetabulum.** The hypoplastic cotyloid cavity is identified and carefully exposed to evaluate the bone stock available for the acetabular component. It is important to expose the proximal parts of the pubic and ischial bones, especially in hips with total dislocation, since this is always associated with a hypoplastic pelvic wall. When possible, the new acetabulum is placed close to the real acetabulum (Fig. 1a), but the superolateral rim is often defective and is then reinforced with a bone graft from the removed femoral head (Fig. 1b).

In cases with total dislocation the anterior wall of the hypoplastic acetabular area is defective and the iliac bone too narrow for even the smallest screw ring (42 mm). However, close to the junction of the pubic and iliac bones, there is an anterolateral bony prominence that offers a good anterosuperior support, while the proximal...
part of the ischial bone can give excellent posterosuperior support. In these cases the screw ring is seated below the anatomical acetabulum (Figs 1c and 1d).

If the pelvic bone is very thin, the medial wall of the remodelled acetabulum can be detached from the surrounding pelvic bone and pushed inwards while preserving its periosteal attachments. In this way a bony medial wall is preserved and can readily be reinforced with cancellous bone grafts (Hess and Umber 1978). Roof reinforcement with a bone graft is performed as described above (Fig. 1d).

**Femoral osteoplasty.** When the acetabular component has been seated at the level of the real acetabulum or distal to it, reduction is often impossible because of the tight abductor and flexor muscles, so that shortening of the femur is needed. This shortening is performed by an osteoplasty, which varies according to the shape of the proximal femur (Fig. 2).

When the proximal femur is straight and the femoral neck is lacking, a shortening osteotomy of the femur and transfer of the greater trochanter is performed. This method is also applied when the proximal part of the femur has to be advanced distally more than 2.5 cm. The femur is divided at the metaphysis, about 7 to 10 cm distal to the apex of the greater trochanter, and the medial half of the proximal part is removed (Fig. 2a). The greater trochanter with the intact attachments of the gluteus medius and vastus lateralis muscles is pulled anteriorly. This allows excellent access to the acetabulum. The femoral shaft is then reamed, and its length adjusted according to the tightness of the hip muscles. Rasping the medullary canal may produce a medial bone defect which requires bone grafting (Fig. 2a). After reduction of the prosthetic hip the greater trochanter with its muscular attachments is advanced distally far enough to tighten the abductor muscles and is fixed with two to four screws. The advancement and fixation of the greater trochanter is easier when the hip is in wide abduction.

In cases with an adequate calcar femorale and no requirement to advance the proximal femur by more than 2.5 cm, enough metaphyseal shortening is performed to allow reduction (Figs 2c and d); the amount is estimated in advance from radiographs and templates. Again a step method is used to stabilise the osteotomy against rotation. In these cases, both the proximal and distal parts of the femur have to be reamed carefully: the aim is accurate fitting of the prosthetic stem so that it functions as an intramedullary nail (Figs 2c, d and 3). This is the most demanding phase of the procedure, especially if a Schanz osteotomy has previously been performed; in these cases correction of angulation is combined with the shortening (Figs 2d and 5).

If the femoral shaft is too narrow for the stem, it is split both anteriorly and posteriorly for 8 to 10 cm, before the medullary canal is prepared (Figs 2e and 4). The longitudinal splits are filled with cancellous bone, the posterior one from within before the stem is inserted.
The splits are crossed by the screws used to secure the greater trochanter. This technique was used for seven femora in group II in which the smallest Lord's stem was too thick.

All osteotomies are performed with minimal periosteal stripping, to avoid devitalisation. Adductor tenotomy is used when the leg is to be lengthened more than 2 cm or there is an adduction or flexion contracture. Slackening of the vastus lateralis due to femoral shortening is corrected by advancing its posterior half and overlapping its anterior half.

**Postoperative management.** The day after operation the patient is allowed to stand and take a few steps. Next day he begins to walk, taking partial weight and using sticks. Progressive flexion, extension and abduction exercises are started, but abduction against gravity is allowed only after six to eight weeks. After this, progressive increase in weight-bearing is allowed according to the radiographic consolidation of the osteotomy. The ipsilateral stick is discarded eight to 10 weeks after the operation, but the contralateral one is used until the abductor muscles are strong enough to balance the pelvis and abolish any limp, usually four to six months postoperatively.

**RESULTS**

Pain was improved from a mean of 2.2 (range 2 to 4) to 5.6 (range 5 to 6) in group I and to 5.5 (range 4 to 6) in group II patients. All patients had limped before the arthroplasty, most of them severely, 69% of group I and 87% of group II having a typical Trendelenburg limp. Postoperatively the Trendelenburg sign was moderate in six (11%) and slight in three hips (6%) in group I, and moderate in three (7%) and slight in five hips (11%) in group II. The mean total range of hip movement improved in group I from 90° (range 10 to 240) to 200°.

**Table I. Pre-operative grading of deformity in 100 hips (Eftekhar 1978)**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>0</td>
<td>41</td>
<td>11</td>
<td>2</td>
<td>54</td>
</tr>
<tr>
<td>Group II</td>
<td>0</td>
<td>11</td>
<td>13</td>
<td>22</td>
<td>46</td>
</tr>
</tbody>
</table>

**Table II. Aetiology of the hip deformity in 100 cases**

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenital dislocation</td>
<td>51</td>
<td>33</td>
</tr>
<tr>
<td>Congenital coxa vara</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Tuberculous or septic arthritis in childhood</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Diastrophic dysplasia</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>46</td>
</tr>
</tbody>
</table>
Radiographs of a 45-year-old man with total dislocation of the right hip and a hypoplastic femoral shaft. It was necessary to split the narrow femur (see Fig. 2c).

Radiographs of a 62-year-old woman with total dislocation of the right hip treated by Schanz osteotomy 35 years previously. The new CDH prosthesis (Biomet) was used. Shortening and wedge correction at the metaphysis was needed (see Fig. 2d).

In group II from 130° (range 20 to 330) to 230° (range 140 to 310). After operation, personal foot care was possible in 93% of all the patients.

Complications. In group I, there were no infections or thrombo-embolic complications. Five patients (9%) had other complications: one femoral component perforated the proximal femur and needed revision at two days, and one peroperative fracture of the femoral shaft was fixed with a Parham band. Two immediate postoperative dislocations were managed by closed reduction, and one of these patients had a transient peroneal palsy. In the fifth patient, fracture and displacement of the greater trochanter noticed at two months resulted in a slight limp, but this did not need re-operation.

In group II, there were complications in 15 hips (33%). Two patients had deep vein thrombosis, one with a non-fatal pulmonary embolism. Five peroperative complications were treated successfully: one fractured greater trochanter was fixed with a plate and one with cerclage wire, but the latter had non-union which required refixation with a plate; in one case the tip of the femoral stem perforated the femoral cortex; a split in the proximal femur of another patient was fixed with a Parham band and plaster immobilisation was needed for two months; in the fifth patient, fracture of the shaft of the femur required a plate and screws with bone grafting.

In addition, eight postoperative or late complications required re-operations, which led to uneventful recovery in each case. One patient fell 10 days after operation, fracturing the posterior column of the acetabulum. A new, cemented acetabular component with a reinforcement ring was inserted. In another patient, medial migration and dislocation of the acetabular component at six months was treated with a new screw ring and bone grafting.

In one case non-union of the shortening osteotomy required revision arthroplasty (see Discussion). One case of aseptic loosening of the acetabular component two years after arthroplasty required replacement with a bigger one and bone grafting. In another patient, the prosthesis had dislocated at two months, needing operative reduction and immobilisation in plaster for six weeks. In one other case dislocation followed malalignment of the components and the revision procedure was complicated by deep infection. This was treated by debridement and antibiotics: the patient was free of symptoms after two years.

In one case, tuberculosis of the hip, which had been inactive for 45 years, flared up six months after the arthroplasty. The patient refused antituberculous medication after excision of the tuberculous fistula but has now remained symptom free for two years. In the eighth case, a transferred greater trochanter required refixation with a plate and screws.
DISCUSSION

The replacement of severely dysplastic and dislocated hips causes major problems, but all our patients were eventually satisfied with their result. Acetabular components placed high on the pelvic wall are likely to loosen (Linde et al., 1988), and the Trendelenburg limp remains (Eftekhar 1978; Fredin and Unander-Scharin 1980; Giunti et al., 1984; Linde et al., 1988). For these reasons, placing the new acetabulum close to the original location has been emphasised by many authors (Dunn and Hess 1976; Eftekhar 1978; Fredin and Unander-Scharin 1980; Harley and Wilkinson 1987; Hartofilakidis et al., 1988; Linde et al., 1988), and we also consider this to be important. Where the iliac bone was too narrow for the smallest screw ring at the level of the original acetabulum, we placed it more distally because the bone stock between the pubic and ischial rami is more substantial than in the hypoplastic iliac bone. Bone grafts are often necessary to reinforce the bone above the acetabular component (Harris, Crothers and Oh, 1977).

In cases with a high dislocation, the proximal femur has to be brought down to get the head of the prosthesis into the acetabular component. If reduction is impossible because of contractures, the flexor and adductor muscles can be released from the iliac bone, as suggested by Harley and Wilkinson (1987). We solved this problem either by shortening osteotomy of the metaphysis alone (Dunn and Hess, 1976), or combined with trochanter transfer.

In general our results were acceptable, with good pain relief; they were comparable with those obtained after cement fixation (Fredin and Unander-Scharin 1980; Lund and Termansen, 1985; Buchholz et al., 1985; Linde et al., 1988; Hartofilakidis et al., 1988).

In most cases the Trendelenburg limp disappeared; many of the nine early patients with residual limp in group I would have had distal advancement of the greater trochanter in the light of our present policies. In group II a residual Trendelenburg limp may be due to muscular denervation and atrophy from previous operations, but in this respect our results compare favourably with other comparable series.

The adjustment of leg length is a problem in these patients. Low back pain may appear if the leg length is changed a lot in patients with a fixed scoliosis. Correction of 2 to 5 cm is possible by means of the femoral osteotomies we used. Perhaps a combination of shortening osteotomy and the muscle release described by Harley and Wilkinson (1987) would provide even better correction of leg length inequality in severe cases.

Our total operative and postoperative complication rate was 9% in group I but rose to 33% in group II. These figures are similar to the average of other reported series (Dunn and Hess, 1976; Fredin and Unander-Scharin, 1980; Woolson and Harris, 1983; Buchholz et al., 1985; Harley and Wilkinson, 1987; Linde et al., 1988; Hartofilakidis et al., 1988). The high rate in group II is explained by the severe deformities of the femur and pelvis which we corrected: there were 16 cases in which a curved femur after a Schanz osteotomy needed correction. This procedure has, as far as we know, never been combined with replacement of the hip. Many of the complications in the early cases were due to technical errors which are now readily avoided.

When the lateral wall of the pelvis is markedly anteverted and the bone is too narrow for the acetabular component at the normal level there are certain difficulties. In these hips the ischial bone almost invariably protrudes laterally and limits external rotation of the joint. This variant is easily overlooked when the operation is performed with the patient on his side, and in one of our cases the screw ring was seated too low and medially. This resulted in restricted external rotation and in displacement and non-union of a metaphyseal osteotomy. At a revision operation a larger acetabular component was seated more laterally and higher, the protruding ischial bone was resected and the femoral component was replaced by a longer one, with plating, and bone grafting for the femoral non-union. This emphasises the importance of carefully exposing the whole junction of the pubic and ischial bones with the iliac bone to assess the best ring fixation. We saw loosening and medial migration of the acetabular component in only one hip in which the screw ring had been placed distal to the real acetabulum; this could probably have been avoided if the screw ring had been seated more laterally and vertically.

New prosthesis. To avoid some of the technical difficulties in using the femoral component, we have helped to design a straight femoral stem of titanium alloy (Biomet, Warsaw, Indiana, USA) (Fig. 5). The proximal part of the stem is oval in section, 12 mm thick, and is available from 13 to 19 mm in breadth, to match the size of the femur. The oval shape helps rotational stability and leaves room for screw fixation of the greater trochanter. We have used this stem in 42 operations during the past 12 months without complications. Splitting of the proximal femur and bone grafting of the medial upper part of the femur are now seldom needed.

Conclusions. The techniques we have described are

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**Table III. Previous operations**

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<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open reduction of the hip</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Colonna arthroplasty</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Chiari pelvic osteotomy</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Acetabuloplasty</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Schanz osteotomy</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Intertrochanteric osteotomy</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
<td><strong>29</strong></td>
</tr>
</tbody>
</table>

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suitable for use in the replacement of all varieties of dysplastic and dislocated hips. The procedure is demanding but highly rewarding; it should be reserved for surgeons with a special interest in this field and with the necessary technical expertise. Adequate equipment and a full range of prosthetic components suitable for dysplastic hips are essential.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


