We implanted 51 Metal-Cancellous Cementless Lübeck (MCCL) prostheses into 45 patients with dysplastic hips and followed 49 hips (96.1%) for five to nine years. One had needed revision for stem fracture and one for infection; the clinical outcome of the other 47 hips was assessed using the Merle d’Aubigné and Postel hip score.

All hips were either excellent (63%) or good (37%). Three patients (6%) had mild thigh pain at six months, but this had settled within two years. Serial radiographs showed stable fixation with bone ingrowth in all hips, with increased density of the cancellous bone in contact with the implant and some trabecular ingrowth. There was early varus shift of the stem in one hip, but this stabilised in three months. Osteolysis of the femoral cortex was seen in one hip at seven years after surgery, and mild bone resorption due to stress shielding in 31 (63%). Acetabular bone grafting with autogenous bone from the femoral head gave successful support to the socket in 13 hips.

The MCCL prosthesis gave satisfactory mid-term results in patients with osteoarthritis secondary to hip dysplasia.

Patients and Methods

In the MCCL system, the stem and metal socket of the implant are of cobalt-chrome-molybdenum alloy, and the entire surface which is in contact with bone has a structure like cancellous bone (Fig. 1). This metal-cancellous surface is produced as an integral part of the implant; it has an intercommunicating porous structure with a pore size ranging from 800 to 1500 μm and 60% porosity. Bone ingrowth into the metal-cancellous structure has been demonstrated in animal experiments and in studies of specimens retrieved from patients.

Initial stability of the metal socket is achieved by two spikes wedged into the anterior and posterior parts of the acetabular rim, and a peg embedded into the ischium. The polyethylene liner is inserted during the operation, and has a 10° wedge-shaped overhang to increase superolateral coverage. Four sizes are available with outer diameters of 44, 48, 52 and 56 mm. We use modular alumina ceramic heads (Biolox; Feldmühle Aktiengesellschaft, Plochingen, Germany) which are 28 mm in diameter and could be used with three possible neck lengths. The curved collared stem is anatomically matched to the medullary canal of the proximal femur and is relatively short, ranging from 9 to 13 cm in length in 1 cm intervals.

Between May 1987 and December 1991, 51 MCCL hips were implanted in 45 patients with dysplastic hips. Two were lost to follow-up at less than five years after operation, but both had excellent clinical results when last
reviewed. Both clinical and radiological data were available for the 43 remaining patients (49 hips). There were 42 women and one man with a mean age of 50 years (29 to 66), a mean height of 153 cm (144 to 168) and a mean weight of 54 kg (43 to 69). All had osteoarthritis secondary to acetabular dysplasia or congenital dislocation of the hip (CDH). Both hips were involved in 20 patients and six had bilateral THAs. The mean follow-up was 6.3 years (5 to 9). Previous treatment for CDH in childhood had consisted of closed reduction in 11 hips and open reduction without a shelf procedure in one. Two patients had had reconstructive surgery: one had a dome osteotomy of the pelvis and the other an intertrochanteric valgus osteotomy.

Operative technique. Antibiotic cover and thromboembolic prophylaxis are used in all patients. The operations are performed under general anaesthesia through a posterolateral approach. As a rule, the metal socket is placed in the anatomical position in the acetabulum with 45° of abduction and 10° of anteversion. When there is a defect in the acetabulum of more than 1 cm, the roof is augmented with a graft taken from the resected femoral head and fixed with AO screws inserted at 45° from the horizontal. This was done in 12 hips. After thorough rasping of the medullary cavity, the largest possible stem is press-fitted into the proximal femur in 20 to 60° of anteversion, depending on its shape. The size and number of the prostheses used are shown in Table I. Partial weight-bearing is started at six weeks and full weight-bearing allowed after 12 weeks. Recently, most patients have been allowed to start partial weight-bearing at one week, followed by the use of a cane in the opposite hand three weeks after operation.

Patients were assessed clinically before operation and then at intervals of six months using the Merle d’Aubigné and Postel hip score, which allocates six points for each category of pain, mobility and gait giving a total of 18 for a normal hip. An excellent result was indicated by a score of 17 or 18 points, a good result by 15 or 16, a fair result by 13 or 14, and a poor result by 12 points or less.

Radiological assessment. AP and lateral radiographs were taken at each follow-up by a standard technique. Every effort was made to place the patient in the same position. The diameter of the head of the prosthesis was used to correct for magnification for the acetabular side and the length of the stem for the femoral side. On the acetabular side, migration of the implant was determined by measuring the horizontal distance from the centre of the femoral head to the teardrop, the vertical distance from the inferior margin of the socket to the teardrop line, and the angle of opening of the acetabular component (Fig. 2). Changes of more than 2 mm in either direction or more than 5° in the angle of opening were considered to indicate migration. On the femoral side, the vertical distance from the superior margin of the greater trochanter to the collar of the stem and the vertical distance from the collar of the stem to the midpoint of the lesser trochanter were measured. More than 4 mm of subsidence was considered to indicate stem migration. In the femur the presence of osteolysis and of a radiolucent line and sclerosis at the bone-implant interface were estimated in each zone as described by Gruen, McNeice and Amstutz, and in the acetabulum according to DeLee and Charnley. Sclerosis was defined as an area of increased radiodensity in the cancellous bone adjacent to the implant and was considered to indicate good bone ingrowth. Resorptive remodelling of the bone in the

<table>
<thead>
<tr>
<th>Femoral stem</th>
<th>Acetabular component</th>
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<tr>
<td>Size (cm)</td>
<td>Number</td>
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<tr>
<td>9</td>
<td>16</td>
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<td>22</td>
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<td>11</td>
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The femur was assessed separately at each of 14 sites on the AP and lateral films, and was classified into four grades as described by Engh and Bobyn.\footnote{23} 

**Results**

**Postoperative complications.** There were no dislocations or nerve palsies. In two patients, intraoperative fracture of the femoral neck occurred and was successfully fixed by cerclage wires. Both fractures healed completely and no femoral subsidence developed. One deep infection occurred 3.8 years after operation. It was associated with acetabular migration and required a revision procedure.

One fracture of the mid-portion of the stem occurred without major trauma at 4.5 years after operation (Fig. 3). The height of this female patient was 146 cm and her weight was 56 kg. A 90 mm fully porous stem had been used, which was the smallest one available. At revision the proximal component was notably loose and the distal component very stable with bone ingrowth. The two patients who needed revision were excluded from the clinical and radiological evaluation.

**Clinical.** The mean Merle d'Aubigné and Postel hip score improved from 7.8 (pain 1.2, mobility 3.6, function 3.0) before operation to 16.2 (pain 5.7, mobility 5.6, function 4.9) at one year, to 16.9 (pain 5.8, mobility 5.6, function 5.5) at two years, and was 16.9 (pain 5.8, mobility 5.6, function 5.5) at the latest follow-up. All hips were excellent.

**Table II.** Incidence of radiolucent lines (%) in each zone at the final follow-up

<table>
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<tr>
<th>Stem zone</th>
<th>Socket zone</th>
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<th>4</th>
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<th>6</th>
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<td></td>
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**Fig. 2**

To evaluate implant migration, we measured the horizontal distance from the centre of the femoral head to the teardrop (A), the vertical distance from the inferior margin of the socket to the teardrop line (B), the opening angle of the acetabular component (C), the vertical distance from the superior margin of the greater trochanter to the collar of the stem (D), and the vertical distance from the collar of the stem to the midpoint of the lesser trochanter (E).

**Fig. 3a**

Figure 3a – Postoperative radiograph of a 50-year-old woman with a champagne-flute canal. **Fig. 3b** – At 4.5 years after operation there is a fracture of the stem. She had complained of thigh pain for two months.
Table III. Incidence of sclerosis (%) in each of 17 zones at two years after surgery

<table>
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<tr>
<th></th>
<th>Socket</th>
<th>Stem</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sclerosis</td>
<td>69</td>
<td>63</td>
<td>40</td>
</tr>
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</table>

(63%) or good (37%) at two years after operation. Pain was never severe enough to disturb daily activity, but three patients (6%) had mild thigh pain at six months after surgery, which settled within two years.

**Radiological.** We saw no evidence of acetabular migration or circumferential radiolucent lines around the acetabular component except in the patient with infection. Segmental radiolucent lines of less than 1 mm in width were seen in zone 3 of the acetabulum in two hips (Table II). At two years after the operation all hips showed sclerosis in some areas adjacent to the socket, usually zones 1 and/or 2, without intervening radiolucency (Table III). There was no osteolysis around any acetabular component. The large acetabular bone grafts were united by two years, as assessed by the presence of connecting trabeculae and there was no change at five years (Fig. 4). In 15 hips in which acetabular coverage was deficient by less than 1 cm, bone grafts were not used. In most of these, new bone formation had improved containment of the acetabular component by one year.

No stem showed subsidence of more than 2 mm. Early varus shift of the stem was found in one hip but this had stabilised by three months and was satisfactory at eight years (Fig. 5). Radiolucent lines were seen around 18 stems but most were less than 1 mm in width. Zone 1 on the AP view was most commonly affected (Table II). There was some sclerosis adjacent to the implant in all hips within two years (Table III), with many trabeculae running into these areas, often around the proximal part of the stem (Fig. 6). Femoral osteolysis was found only in one hip at seven years after surgery, but produced no symptoms. The osteolysis had advanced at the latest review at eight years, being present in six zones on the AP and lateral views (Fig. 7). Resorption of femoral bone probably due to stress shielding, was seen in 31 hips (63%); all showed first-degree resorption. Stress shielding showed no progression after two years.

**Discussion**

Biological fixation of the implants by bone ingrowth is thought to be essential for the long-term success of a cementless THA. Stems which are porous-coated only in their proximal part have been popular because the more proximal stress transfer should help to prevent stress shielding, with less corrosion and release of metal ions, and easier removal of the implant if needed.23 There have been problems, however, with thigh pain and the early failure of the femoral component.10,18,20 Even after there has been bone ingrowth into a limited part of the porous surface, partial...
Figure 5a – Varus shift of the stem three months after operation in a 66-year-old woman with a stove-pipe canal. Figure 5b – Eight years after operation, the stem has stabilised and she had an excellent clinical score.

Figure 6a – Postoperative radiograph of the left hip of a 55-year-old woman. Figure 6b – At nine years the implant is stable but there is sclerosis of the cancellous bone adjacent to the stem in zones 2 and 6.
porous coating may not provide sufficient stability,24 since rotational and bending stress may still cause micromovement of the tip of the smooth stem and produce thigh pain.25 We have therefore chosen to use a fully porous-coated stem to obtain secure fixation both proximally and distally.

Our experience with the MCCL prosthesis has shown a low incidence of thigh pain and satisfactory clinical scores. Serial radiographs have demonstrated no progressive migration of the implant and a consistent sclerotic reaction adjacent to the porous surface, suggesting that a stable interface had been achieved by bony ingrowth.23 Stress shielding was less than expected, perhaps because of the short stem length and the metal-cancellous structure, which both contribute to reduce the effect of the stiffness of the stem. The coating, however, may weaken the stem: one stem fracture in our series was in a patient with a champagne-flute canal26 which was wide proximally and narrow distally (Fig. 3). Ingrowth of bone occurred mainly into the distal portion of the stem and the middle part was subject to severe stress.

Femoral osteolysis will cause loosening and may be due to particles of polyethylene which have been shown to cause bone resorption.27 We saw significant lysis about the stem in only one patient,6,28 probably because of the lower wear induced by an alumina ceramic head.29 It is known that the incidence of femoral osteolysis after cementless hip arthroplasty increases with time and may progress rapidly.28 It is therefore important to continue our careful follow-up.

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


