We treated 31 hips in 30 patients with advanced osteoarthritis of the hip secondary to acetabular dysplasia, by valgus-extension femoral osteotomy. The mean follow-up was 12.7 years (10 to 17). Acetabuloplasty was added in ten severely dysplastic hips.

In 28 hips, radiological widening of the joint space was seen three years after operation, but in 12 had narrowed again by ten years. Survivorship analysis showed that the rate of survival was 82% using the pain score as the index of failure, and 72% based on radiological findings at ten years. Better long-term results were obtained in hips which had an acetabular head index greater than 70% or a roof osteophyte more than 5 mm in length three years after operation. Acetabuloplasty should be added for the hip which is severely dysplastic and with a poorly developed roof osteophyte.

The management of advanced osteoarthritis (OA) of the hip in young patients is controversial. Total hip arthroplasty (THA) in such patients is associated with a high rate of early loosening. Recently, THA using hydroxyapatite-coated components or a ceramic head has been used in these patients with good results. Aseptic loosening requires revision arthroplasty which has many technical problems.

When OA of the hip is secondary to acetabular dysplasia, pelvic osteotomy or acetabuloplasty may be carried out. These procedures are rarely effective in advanced cases.

Valgus-extension femoral osteotomy may be used in these patients. Bombelli suggested that joint congruity could be improved and recommended an osteotomy with a large angle. Some reports have shown good long-term results, but the radiological changes at follow-up have not been analysed in detail. We describe the clinical and radiological changes after femoral osteotomy, as performed by Bombelli, with a follow-up of more than ten years. We review the factors which influence the preservation of the hip and the clinical outcome.

Patients and Methods

Between 1982 and 1988, we carried out valgus-extension femoral osteotomy on 33 hips in 32 patients with advanced OA secondary to a dysplastic acetabulum with gross narrowing of the joint space. The preoperative radiographs showed that the capital drop osteophyte was well formed and it seemed to contact with the osteophyte in the acetabular fossa in maximum adduction of the hip.

Two patients were lost to follow-up and the remaining 30 (31 hips) were reviewed for more than ten years. There were 28 women and two men, with a mean age of 45 years (24 to 57). The mean period of follow-up was 12.7 years (10 to 17). One patient had bilateral osteotomies and 18 had bilateral OA of the hip.

All operations were carried out by the senior author (SK) with the patients in the supine position. The valgus angle was 20° to 35°, which was about 10° greater than the angle of maximum abduction. Extension osteotomy was added, at an angle of about 10° to 20°, which removed the flexion contracture. All patients had a range of hip flexion of 50° or more. Internal fixation was initially carried out using a compression hip screw and plate. Although there were no cases of nonunion, we changed to an AO angled blade plate which provided better fixation. The iliopsoas tendon was released at its insertion into the lesser trochanter. A shelf procedure was added in ten hips with severe acetabular dysplasia.

Mobilisation with touch weight-bearing and active exercises began three days after operation. The patients who also had a shelf operation started mobilisation after 14
days. Passive exercises began after three weeks, and all patients could adduct their leg 5° or more within two months of the operation, in spite of the large angle of the osteotomy. Walking with a single crutch began three months after operation. The long-term use of a walking stick in the contralateral hand was recommended to all patients.

We examined the patients clinically and radiologically before the operation, and then yearly during the follow-up period. The clinical results were evaluated using the Harris hip score. The narrowest width of the joint space in the weight-bearing area was measured on AP radiographs with a loupe with a magnification of ten. Other radiological measurements were recorded as shown in Figure 1. A shelf or roof osteophyte was included in the acetabulum when the acetabular head index (AHI) of Heyman and Herndon was measured.

Kaplan-Meyer survivorship analysis was undertaken with the endpoint defined as a pain score of 20 or less, or reduction of the joint space on radiographs at follow-up. We determined whether there was a statistical difference between the results of radiological evaluation and measured variables using Student’s *t*-test or Fisher’s exact test.

**Results**

Clinical evaluation using the Harris hip score showed that the total scores improved and were maintained for eight years after operation, but began to deteriorate gradually at nine years (Fig. 2). Pain scores were 10 in nine hips and 20 in 22 hips before the operation. These increased to 30 or more at three years, except for two hips, and improved scores were maintained in 22 hips at ten years. The mean pain score improved from 17 before operation to 38 at eight years and 33 at 12 years. Gait scores were increased in 14 patients, but the scores for range of movement (ROM) were not improved in most patients at three years. The mean gait score improved from 16 before operation to 19 at eight years and 17 at 12 years but the mean score for ROM decreased from 3.9 before the operation to 3.7 at ten years.

The mean width of the narrowest part of the joint space on radiographs increased from 0.0 to 1.8 mm three years after operation and this was maintained for five years. It started to decrease eight years after operation. A widened joint space had narrowed again in 12 hips by ten years. Three hips did not improve after operation, and two patients, who had continuous pain on walking, had a THA within ten years. They were both included in the evaluation of the clinical score and in the survivorship analysis until they had a THA.

There were no postoperative infections or other serious complications and no cases of delayed union.

**Statistical analysis.** Survivorship analysis used a clinical pain score of 20 or less or reduction of the joint space on radiographs as the endpoint. Clinically, the rate of survival was 82% at ten years and 60% at 14 years. Based on radiological findings (Fig. 3) it was 72% at ten years and
We divided the patients into two groups based on the radiological findings at ten years, excluding three joints which did not improve. The patients in group A maintained the widened joint space for more than ten years, but in group B this had narrowed or disappeared. The AHI was almost equal in the two groups before operation, but was slightly larger in group A at three years (Table I). The proportion of hips with an AHI greater than 70% in group A was larger than that in group B and the difference was statistically significant (Table I). The patients in group A showed a large capital drop osteophyte before operation, but there was no statistically significant difference between the two groups. With respect to age and OA of the opposite hip, no differences were observed between the two groups (Table I).

Growth of the roof osteophyte was analysed in 18 hips in which a shelf operation had not been carried out (Fig. 4). In four of six hips in which a roof osteophyte had not been present before operation, no osteophytic growth was seen after the procedure. Only three of 11 hips with a roof osteophyte less than 5 mm in length or no roof osteophyte before operation developed an osteophyte more than 5 mm in length three years later. Those patients with a roof osteophyte more than 5 mm in length at three years showed a better outcome and the difference was statistically significant (Table I).

Figures 5 and 6 show the importance of acetabular coverage for good long-term results.

**Discussion**

Good long-term results have been reported after the Chiari osteotomy and periacetabular osteotomy in patients with dysplastic hips. These procedures, however, were used mainly for early OA of the hip or dysplasia. In cases of advanced OA, satisfactory long-term results have not been obtained with these procedures. Reasonable long-term results have been described, however, after valgus-extension osteotomy in advanced OA. Maistrelli et al. reported 67% of hips with a good or excellent outcome at 11 to 15 years of follow-up. Gotoh et al. reported a rate of survival of 51% at 15 years as determined by Kaplan-Meier survivorship analysis. Our results are similar.

The results after valgus-extension osteotomy are not better than those after THA. The patients who have further hip pain after osteotomy may undergo THA later, as occurred in five hips in our series. All were carried out without technical problems relating to the deformity at the site of the osteotomy. Gotoh et al. reported similar results. Valgus-extension osteotomy is valuable as a ‘holding procedure’.

Femoral osteotomy causes widening of the weight-bearing joint space. Pauwels advocated valgus osteotomy for patients with good joint congruity in adduction. In cases of advanced OA it is difficult to improve joint congruity immediately by performing femoral osteotomy. Bombelli reported that valgus osteotomy at an angle of 30° or more made the capital drop a fulcrum, leading to abnormal movement of the hip with a decreased compression force at the lateral margin of the joint.
We carried out valgus-extension osteotomy in patients whose capital drop osteophyte was expected to contact with a central osteophyte of the acetabulum after operation. We did not always know whether contact of the osteophytes would occur immediately after the procedure, as the osteotomy angle was larger than the maximum angle of hip adduction and the likely postoperative position of the hip could not be assessed from the preoperative radiograph. We could not judge whether osteophytic contact occurred because the capital drop is on the posteromedial aspect of the femoral head and contact may occur posteromedially.

An AP radiograph does not allow evaluation of the contact between osteophytes on the posterior aspect of the joint. To clarify this issue, analysis with three-dimensional CT is required.

Harrison, Schajowicz and Trueta demonstrated a healing potential within the osteoarthritic femoral head. The postoperative formation of fibrocartilage within the femoral head is required for symptomatic improvement after valgus-extension osteotomy. We performed some postoperative arthrograms (Fig. 7) which showed radiolucent areas on both the femoral head and the acetabulum and speculate that

**Table I.** The relationships between the AHI, OA in the contralateral hip, length of roof osteophyte, capital drop and age and radiological evaluation of the joint space ten years after the operation in the two groups. Values are given as mean ± SD where appropriate.

<table>
<thead>
<tr>
<th></th>
<th>Group A*</th>
<th>Group B*</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>47 ± 9</td>
<td>44 ± 10</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Preoperative width of capital drop (mm)</td>
<td>7.1 ± 2.6</td>
<td>5.6 ± 4.5</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>OA in contralateral hip</td>
<td>8</td>
<td>9</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>No OA in contralateral hip</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>AHI (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before operation</td>
<td>62.3 ± 17</td>
<td>62.4 ± 12</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Three years after</td>
<td>77.2 ± 13</td>
<td>71.8 ± 14</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>≥ 70% at three years</td>
<td>13</td>
<td>5</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>&lt; 70% at three years</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Roof osteophytes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 5 mm at three years</td>
<td>9</td>
<td>2</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>&lt; 5 mm at three years</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

* Group A, 16 patients who maintained a widened joint space for more than ten years; group B, 12 patients whose joint space had narrowed or disappeared by ten years.

Radiographs of a 53-year-old woman with bilateral OA. Figure 5a – Before operation showing a large roof osteophyte. Figure 5b – At three years after operation the AHI was 74% and the roof osteophyte had become larger. Figure 5c – The repaired joint space was still preserved ten years after the operation.
these may represent formation of fibrocartilage.

For a good long-term outcome widening of the joint space is required. Our results show that for the improvement to be maintained for ten years or more, acetabular cover with an AHI greater than 70% is required. Most hips with an AHI in the range of 60% to 70% showed loss or narrowing of the joint space on radiographs within ten years. There are two ways of increasing the AHI; one is to depend on formation and enlargement of the roof osteophyte after operation, and the other is to carry out an acetabuloplasty. We recommend that a shelf procedure should be added for patients whose roof osteophyte is less than 5 mm in length before operation.

Our results show that although relief of pain can be
achieved by valgus extension osteotomy, improvement in ROM as has previously been described\textsuperscript{14,15} cannot be achieved. Patients whose range of movement is so restricted as to impair daily activities are recommended for THA rather than femoral osteotomy.

Maistrelli et al\textsuperscript{15} reported that patients who had a normal hip on the opposite side showed better results, but we were not able to confirm this finding, possibly because a high proportion of our patients had bilateral OA (61%).

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


