VALGUS-EXTENSION OSTEOTOMY FOR ADVANCED OSTEOARTHRITIS IN DYSPLASTIC HIP

RESULTS AT 12 TO 18 YEARS

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We treated 31 consecutive patients of mean age 43 years (22 to 59) with severe osteoarthritis of the hip secondary to dysplasia by valgus-extension osteotomy. The clinical results were analysed for factors which may have affected the outcome. The procedure was carried out only on one side and was combined with a Chiari pelvic osteotomy in four patients. The angle of valgus was between 30 and 40° with 10 to 20° of extension. The mean follow-up was 15 years (12 to 18).

Clinical evaluation using Charnley's modification of the system of Merle d'Aubigné and Postel showed that the mean score for pain had improved from 2.3 before operation to 4.2 at 15 years, and function from 2.3 to 4.2. Range of movement had decreased from 4.2 to 3.5. Fifteen patients (48.4%) had a pain score of 5 or 6 and were evaluated as satisfactory. Kaplan-Meier survivorship analysis showed a survival rate of 51% at 15 years after operation. Two preoperative factors had a significant positive correlation with the radiological results, namely the thickness of the capital drop osteophyte and the length of the roof osteophyte.

We suggest that this procedure is effective for advanced osteoarthritis in the dysplastic hip in young and active patients if these factors are satisfactory on the preoperative radiographs.

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The management of severe osteoarthritis of the hip in younger and more physically active patients is controversial. Although total hip arthroplasty is an excellent treatment for older patients, the long-term results may be poor in younger age groups.¹⁻⁴ Reconstructive osteotomy may still be an important procedure.

Since 1976 we have performed valgus-extension osteotomy of the femur on young adults with osteoarthritis of a dysplastic hip. We have followed 31 patients for more than 12 years after operation, reviewed the clinical and radiological results and analysed factors which may have affected the postoperative outcome.

PATIENTS AND METHODS

From 1976 to 1983, we performed 32 consecutive valgus-extension osteotomies for advanced osteoarthritis of a dysplastic hip. One patient could not be reviewed completely, leaving 31 who were followed up fully after operation. There were 15 patients with unilateral osteoarthritis and 16 in whom the condition was bilateral, all secondary to congenital dysplasia or dislocation of the hip. They were all younger than 60 years and had a minimum of 30° of flexion and 15° of adduction. Preoperative radiographs with the hip passively adducted showed a capital drop osteophyte, widening of the lateral joint space and changes representing grade 3 of the Tönnis classification,⁵ characterised by the presence of large cysts in the femoral head or the acetabulum with moderate or complete loss of the apparent joint space.

The mean age of the patients at operation was 43 years (22 to 59) and they were followed up for a mean of 15 years (12 to 18). All had had an osteotomy on one side only, and four, with acetabular dysplasia and a Sharp angle of more than 52°, had had a Chiari pelvic osteotomy at the same time.

All the procedures were performed by the senior author (MA) with the patient supine on a standard operating table. A straight lateral incision was made in the proximal thigh. The valgus angle of the osteotomy was determined by the angle formed by the axis of femoral shaft in the neutral position and in the adducted position which ensured contact between the capital drop and the medial acetabular osteophytes. The degree of extension used was calculated by assessing the amount of flexion required to position the

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Fig. 1

Diagram showing features in assessing the pre-operative radiographs.

Table I. The radiological measurements made before operation

1	The acetabular angle
2	The degree of lateralisation of the femoral head
3	The thickness of the capital drop osteophyte
4	The length of the roof osteophyte
5	The degree of disappearance of the cartilage of the femoral head in anteroposterior arthrography
6	The degree of disappearance of the cartilage in lateral arthrography
7	The width of the lateral joint space in the adducted position

capital drop osteophyte in contact with the posterior part of the acetabulum as judged on a lateral radiograph before operation. The angle of valgus used was 30 to 40° with 10 to 20° of extension. An AO blade angle plate was used for internal fixation. The iliopsoas tendon was released at its insertion into the lesser trochanter and the distal femur was displaced laterally by between one-third and one-half of the width of the shaft. Active movement began after three weeks and partial weight-bearing with crutches six weeks after the operation.

At follow-up we assessed the clinical results using the Charnley⁶ modification of the Merle d'Aubigné and Postel scoring system. A pain score of 5 or 6 was judged as good, and the cases which were converted to total hip arthroplasty during the period of follow-up were judged as poor.

On the radiographs the width of the joint space of the weight-bearing zone was calculated and its area measured by a digitiser (Graphtec Co, Yokohama, Japan). Anteroposterior radiographs of both hips were taken with the patient supine. The heels were separated and the limbs were rotated internally as far as possible. The X-ray beam was directed to the centre of the triangle made by both anterosuperior iliac spines and the pubic symphysis. The

weight-bearing zone was defined as the portion of the sclerotic area of the superior part of the acetabulum which was in contact with the femoral head and limited by two lines drawn from its edges to the centre of the head (Fig. 1). The measurements were made ten times on each radiograph by two examiners; the standard deviation (SD) of the measured value in the same patient was within 3% of the average value. We made similar measurements on radiographs of 190 normal adult hips and found the average value to be $135.6 \pm 23.6 \text{ mm}^2$.

Radiological measurements were also made before operation on 24 patients who had a valgus-extension osteotomy, as described in Table I and Figure 1. We determined the correlation between the area of weight-bearing and each of the measured parameters using Student's *t*-test. A *p* value of less than 0.05 was considered significant. Kaplan-Meier survivorship analysis⁷ was undertaken with the endpoint defined as a pain score of 4 or less at follow-up or conversion to total hip arthroplasty.

RESULTS

As measured by the Charnley scoring system, the pain score in 15 of our patients (48.4%) had increased from 0 before operation to 5 or 6. In 14 patients a functional score of 5 or 6 was found at review compared with scores of 0 before operation, but the number with a good range of movement had decreased from 7 to 2.

The mean pain score improved from 2.3 ± 0.80 before operation to 4.2 ± 1.4 at 15 years after and the mean function score improved from 2.9 ± 0.83 to 4.2 ± 0.90 , but the range of movement decreased from 4.0 ± 0.76 to 3.5 ± 0.93 . Four patients required conversion to total hip arthroplasty and another six are being considered for this proced-

Fig. 2a

Fig. 2b

Fig. 2c

Graphs showing the average Charnley score for pain (a), function (b) and range of movement (c).

ure. The mean pain, function and range of movement scores changed from 5.0, 4.7 and 4.1 at five years after operation to 4.5, 4.3 and 4.0 at ten years respectively, showing a gradually decreasing trend (Fig. 2). Radiological evaluation showed that the area of the weight-bearing zone increased significantly from $24.6 \pm 24.5 \text{ mm}^2$ (18% of a normal adult hip) before operation to $71.5 \pm 58.5 \text{ mm}^2$ (52% of normal) at ten years after operation ($p < 0.02$), and to $49.8 \pm 46.8 \text{ mm}^2$ (37% of normal) at 15 years after operation ($p < 0.02$). The average area of the joint space in patients with a pain score of 5 or 6 at 15 years after operation was $88.1 \pm 34.6 \text{ mm}^2$ (65% of normal) and that of patients with grade 4 or less $17.8 \pm 27.5 \text{ mm}^2$ (13% of normal). Radiographs of three successful cases are shown in Figures 3 to 5.

We investigated the features seen on the preoperative radiographs which may have influenced the result in 24 patients who received only valgus-extension osteotomy. There were two factors which showed a significant correla-

tion with the area of the joint space of the weight-bearing zone on the latest radiograph (Table II). One was the width of the capital drop osteophyte of the femoral head (Fig. 6a) and the other was the length of the roof osteophyte at the lateral edge of the acetabulum (Fig. 6b). Of the patients with a capital drop osteophyte thicker than 3 mm and a roof osteophyte longer than 5 mm, 75% showed good pain relief at 15 years. Kaplan-Meier survivorship analysis indicated a survival rate of 51% (95% confidence interval 33% to 69%) at 15 years after operation (Fig. 7). Twenty-one patients (67.7%) did not need a further operation after 15 years.

DISCUSSION

There are several options in the management of a young adult with severe degenerative disease of the hip including total hip arthroplasty, arthrodesis and reconstructive osteotomy. The long-term results of total hip arthroplasty in young, active patients show a rate of failure of 32% to 67%

Fig. 3a

Fig. 3b

Preoperative (a) and 14-year follow-up radiographs (b) of a 46-year-old man. Scores for pain, function, and range of movement improved from 2, 2 and 4 to 5, 4 and 4, respectively. The weight-bearing area improved from 0 mm² before operation to 77 mm².

Fig. 4a

Fig. 4b

Preoperative (a) and 16-year follow-up radiographs (b) of a 52-year-old woman. Scores for pain, function and range of movement improved from 3, 4 and 4 to 6, 5 and 4, respectively. The weight-bearing area improved from 29 mm² before operation to 84 mm².

Fig. 5a

Fig. 5b

Preoperative (a) and 17-year follow-up radiographs (b) of a 38-year-old woman. Scores for pain, function and range of movement had improved from 3, 4 and 3 to 6, 5 and 4, respectively. The weight-bearing area improved from 39 mm² before operation to 104 mm².

12 to 20 years after operation,¹⁻⁴ and revision arthroplasty is more difficult and often has unsatisfactory results.^{8,9} Arthrodesis is indicated only for male patients with unilateral involvement and has many disadvantages, including loss of movement and increased stress on the ipsilateral knee and the low back.¹⁰ Most patients who have dysplastic hips, however, are female and both hips may be affected. Consequently, there are few patients in whom arthrodesis is indicated. Reconstructive osteotomies, such as the periacetabular and Chiari procedures, may be indicated in young

patients. In 1995 Trousdale et al¹¹ reported the clinical results of periacetabular osteotomy for advanced osteoarthritis but the average follow-up was only four years. Reynolds¹² found the clinical results of the Chiari pelvic osteotomy for advanced osteoarthritis to be unsatisfactory, and Lack et al¹³ showed that the procedure failed to halt or reverse the degenerative process as judged by radiographs of the dysplastic hip.

There are two reports describing the long-term results of Bombelli's valgus-extension osteotomy. Santore and Bom-

Fig. 6a

Fig. 6b

Scatter plot of the correlation between the area of the joint space at the latest follow-up and the width of the capital drop osteophyte (a) and the length of the roof osteophyte (b).

Fig. 7

Survivorship curve with 95% confidence limits, using a pain score of 4 or less or conversion to total hip arthroplasty as the endpoints.

Table II. Correlation coefficient between the preoperative radiological factors and the area of the joint space

	Correlation coefficient
Acetabular angle	-0.407
Degree of lateralisation of the femoral head	0.009
Thickness of the capital drop osteophyte	0.470*
Length of the roof osteophyte	0.508*
Degree of disappearance of the cartilage of the femoral head in the AP view	-0.099
Degree of disappearance of the cartilage of the femoral head in the lateral view	-0.142
Width of the lateral joint space in the adducted position	0.136

* $p < 0.05$ significant

belli¹⁴ showed good or excellent results in 77% of 35 patients at 11 years after operation and Maistrelli et al¹⁵ found 67% of 277 hips to have a good or excellent result 11

to 15 years after operation. In both of these studies the radiological stage of osteoarthritis before operation and the method of radiological evaluation after were unclear and the duration of follow-up was relatively short. Our results at 15 years are superior to those of other reconstructive osteotomies for severe osteoarthritis of the dysplastic hip. Although they are inferior to those of total hip arthroplasty for young, more physically active patients, the better results of total hip arthroplasty after failed valgus osteotomy¹⁶ compared with those of revision arthroplasty^{8,9} favour the more conservative procedure. More careful selection of the patients would also have produced better results.

The assessment of sclerotic changes in the weight-bearing zone, the formation of cysts and osteophytes and the width of the lateral joint space is difficult to evaluate quantitatively on radiographs after osteotomy. We have measured the area of the weight-bearing zones using a digitiser and found it to be increased significantly 15 years

Fig. 8a

Fig. 8b

Radiographs of a 52-year-old man showing the shape of the femur seven years after osteotomy (a). There was a good result eight years after conversion to total hip arthroplasty (b).

after operation. Clinically, patients showing this had relief of pain and regeneration of the articular cartilage was confirmed by arthrography in three patients. The area of the weight-bearing zone was the only factor which correlated significantly with the clinical score.

Bombelli¹⁷ considers that excessive valgus osteotomy of more than 30° makes a fulcrum of movement between the capital drop osteophyte of the femoral head and the floor osteophyte of the acetabulum allowing passive widening of lateral joint space of the weight-bearing zone. This medialised fulcrum acts as a new centre of rotation of the hip, and bone contact changes from the painful innervated femoral head to the denervated capital drop osteophyte. The lever arm of the abductor muscles becomes longer and that of the body-weight shorter affording a decrease in the resultant forces on the hip. The extension osteotomy allows wider coverage of the femoral head in the sagittal plane. These features improve the congruity of the joint and increase the weight-bearing surface. There may be additional long-term improvement with the formation of the roof osteophyte which further increases the weight-bearing zone. The osteophytes played an important part in the regeneration of articular cartilage and reconstruction of the hip. We have shown that the two factors which influence the radiological result at 15 years after operation are the width of the capital drop osteophyte of the femoral head and the length of the roof osteophyte at the lateral edge of acetabulum.

We have converted four hips to a total joint replacement and because the distal femur was displaced laterally at the osteotomy and the shape of the femur reconstructed at the

site of the osteotomy, neither corrective osteotomy nor special implants were needed and no major problem occurred at operation (Fig. 8).

Valgus-extension osteotomy is an effective treatment for advanced osteoarthritis in young and physically active patients if preoperative radiographs show hypertrophic changes. We recommend this operation for patients with dysplastic hips who are younger than 60 years of age and in whom preoperative radiography shows a thick capital drop and a long roof osteophyte.

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