The modified Spitzy shelf operation for patients with dysplasia of the hip

A 24-YEAR FOLLOW-UP STUDY
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We evaluated the long-term results of a modified Spitzy shelf operation for secondary osteoarthritis in 119 hips with a mean follow-up of 23.8 years. The mean age of the patients at the time of surgery was 25 years. Preoperative osteoarthritic change, the age at operation and shelf height were important factors in determining the outcome. Of the 61 hips in the pre-stage (three) and the initial stage (58) of osteoarthritis, 53 (87%) had good results, compared with only 30 (51%) of 58 hips with advanced osteoarthritis. Of the latter, 72% of those aged less than 25 years had good results compared with only 40% of patients aged over 25 years. The shelf height in the group with good results was significantly lower than in those with poor results. This operation is a safe procedure and indicated for acetabular dysplasia or subluxation of the hip with early osteoarthritic change in patients aged less than 25 years.

Received 9 August 2001; Accepted after revision 6 December 2001

Patients and Methods

Between 1960 and 1982 we treated 167 patients (179 hips) with acetabular dysplasia, subluxation or dislocation of the hip by a modified Spitzy shelf operation. Of these, 108 (119 hips) were followed up for more than 15 years. Sixty hips were excluded because adequate information was not available. Eighty hips (67%) were evaluated by interview and examination (group 1) and 39 (33%) by questionnaire (group 2). The mean follow-up was 23.8 years (15 to 41). There were three males and 105 females with a mean age of 25 years (1 to 56). Twenty operations were undertaken on the immature pelvis, i.e., in patients aged less than 15 years.

Stage of osteoarthritis. All hips were classified into one of four stages according to the radiological evaluation described by the Japanese Orthopaedic Association (JOA) for osteoarthritis as follows: pre-stage, no narrowing of the joint space; initial stage, poor congruity of the joint and partial narrowing of the joint space, with some sclerotic change and formation of osteophytes; advanced stage, more pronounced narrowing of the joint space, with a bone cyst in the femoral head or acetabulum; and terminal stage, elimination of the joint space, with a large cyst or osteophyte and some destruction of the acetabulum.

Operative technique. The details of this operation have been previously reported. A Smith-Petersen approach is used, and the outer cortex of the ilium exposed subperiosteally down to the joint capsule. A broad osteotome is introduced along the joint capsule into the rim of the acetabulum at the origin of the reflected head of rectus femoris. A slot for the new shelf and an inlet are made with the osteotome. A free bone graft obtained from the ilium is inserted into the slot. Cancellous bone chips are packed into the space between the new shelf and vertical flap.

Combined operation. The shelf operation was combined with a varus (20 hips) or valgus (five hips) intertrochanteric osteotomy with advancement of the greater trochanter in two hips.

Clinical evaluation. This was done using the assessment of hip function proposed by the JOA which is based on pain...
The effects of the preoperative stage of osteoarthritis and age at operation on the results at the last follow-up.

(40%), range of movement (20%), ability to walk (20%) and activities of daily living (ADL) (20%). The total score was 100 for a normal hip in group 1, but 80 for a normal hip in group 2, since no score was available for range of movement. Patients with a good result achieved a score of 70 or more in group 1 and 56 or more in group 2.

**Radiological evaluation.** This included measurement of the Sharp angle, the centre-edge angle (CE angle), the acetabular head index (AHI), the angle of the roof and the height of the shelf which is the vertical distance between the undersurface of the grafted bone and the outer edge of the acetabulum. These evaluations were performed on 119 hips in group 1 and all in group 2.

The progression of osteoarthritis was determined using the score table as shown in Table I, and the radiological score before operation on an anteroposterior radiograph was compared with that at the last follow-up in the pre-initial and advanced stages separately. A normal hip had a score of 100. A hip showing progression of osteoarthritis was given a minus score, and that with improvement as a plus score. The evaluation was performed on all 80 hips in group 1 but a radiograph before operation or at the last follow-up was not suitable for evaluation in 27 hips so that only 53 were assessed.

**Statistical analysis.** The Kaplan-Meier product-limit method was used to estimate the cumulative probabilities of poor results. The survivorship curves for the two groups were compared by the log-rank test. For statistical analysis
of pre- and postsurgical radiological data, Student’s t-test was used.

Results

Preoperative stages of osteoarthritis. There were 61 hips in the pre- or initial stages and 58 in the advanced stage. Of the patients who were aged less than 25 years, 51 hips were in the pre- or initial stages and 22 in the advanced stage. In those who were over 25 years of age, ten hips were in the pre- or initial stages and 36 in the advanced stage. No hip was classified as being in the terminal stage preoperatively.

Last follow-up. The mean JOA score was 80.3/100 (80.3%) in group 1 and 68.2/80 (85.3%) in group 2. The preoperative JOA score was not available. Of the 61 hips in the pre- or initial stages 53 (87%) were considered to have a good result and eight (13%) a poor result. In the advanced stage, the outcome in 30 hips (51%) was good and in 28 (49%) poor. In total, the outcome was good in 83 hips (70%) and poor in 36 (30%). In the patients aged less than 25 years, 72% had a good result even in the advanced stage, but of those aged over 25 years only 40% had a good result (Fig. 1).

Radiological evaluation. There were equivalent improvements in the Sharp angle, the CE angle, the angle of the roof and the AH1 after surgery in all the patients. However, the height of the shelf was significantly lower in those with a good outcome than in those with a poor result (p < 0.05) (Table II).

Radiological progression of osteoarthritis was seen in 17/28 (60.7%) of those in the pre- and initial stages and 21/25 (84%) of those in the advanced stages of osteoarthritis at the final follow-up (Fig. 2).

Age at surgery and survival curve. The mean age of all the patients at the time of surgery was 25 years and of the good and poor outcome groups 23.3 and 27.5 years, respectively. We therefore divided them into two groups, those aged less than 25 years and those over 25 years of age. Kaplan-Meier survivorship analysis, with a poor result as the endpoint (<69 points in group 1 or <55 points in group 2), predicted a rate of survival for the shelf operation of 93% at ten years and 80% at 15 years in those less than 25 years of age, and 68% at ten years and 60% at 15 years in those over 25 years of age. The difference between the two groups was statistically significant (Fig. 3).

Additional surgery after the shelf operation. Nine total
hip arthroplasties, one cup and one bipolar arthroplasty were performed subsequently at a mean of 18.2 years (9.9 to 31.5) after the shelf operation (Table III). Figure 4 shows an illustrative case.

Discussion

There have been several reports of the long-term results of the shelf operation. There have been several reports of the long-term results of the shelf operation.6-15 Love et al11 evaluated 45 hips in adolescents at a mean of 11 years after a shelf operation and found that 80% were relatively free from symptoms. Bickel and Breivis14 reported that 75% of patients aged between 1 and 32 years with a mean follow-up of 12.8 years had a satisfactory result, but White and Sherman found that only 45% of patients who had undergone a shelf operation had good or excellent results 25 years later. They recommended consideration of other procedures for the dysplastic acetabulum.

In our study there were statistical differences in the survivorship and outcomes between patients aged less than 25 years and those over 25 years of age. In the younger group, 72% had good results despite having advanced osteoarthritis, but in the older group only 40% of such patients had a good result. The age of the patient with advanced osteoarthritis at the time of surgery is thus very significant. The younger a patient is at the time of surgery, the longer a good result is maintained. However, when the shelf operation is performed in early childhood at between one and six years of age, the long-term results are unsatisfactory because of absorption of the grafted bone and disturbance of the growth of the acetabulum, as reported by Yamamuro, Oka and Ratanasiri.16 Thus the shelf operation should not be recommended for patients aged less than six years.

The preoperative stage of OA was an important factor in determining the long-term outcome. At the last follow-up, 87% of patients who were in the pre- or initial stages preoperatively had maintained a good result, compared with only 51% of those in the advanced stage. Migaud et al,17 who reported the results of the shelf operation at a minimum of 15 years, stated that the main factor associated with a poor result was advanced osteoarthritis before surgery.

The classification of osteoarthritis in our study was based only on anteroposterior radiographs of the hip. However, Conrozier et al17 found that a combination of the anteroposterior and false-profile views gave more information in

![Fig. 3](image-url)

Kaplan-Meier survivorship analysis with a poor result as the endpoint. The thick and thin lines indicate the survival rates of patients who underwent surgery at less than 25 years and over 25 years of age, respectively. The difference between the two groups was statistically significant.
A 35-year-old woman had a shelf operation on the left hip. Figure 4a – Radiograph showing that the CE angle (R12°, L0°) and AHI (R71%, L58%) of the left hip were inferior to those of the right before surgery. Figure 4b – Radiograph one month after operation. Figure 4c – At 57 years of age she complained of severe pain in the right hip and hoped to have a THA, but had no symptoms from the left hip.
the evaluation of narrowing of the joint space in about one-third of their patients.

A correct technical procedure is essential. A graft placed too high is resorbed due to lack of loading, but one placed too low produces impingement on the femoral head and accelerates the degenerative changes. Our study has shown that the height of the shelf in the group with a good outcome was significantly lower than that in the group with a poor outcome. However, the relatively uncomplicated nature of the operation gives it an advantage over the Chiari osteotomy, especially as the latter may cause a more pronounced limp. Matsui et al reported early deterioration in the dysplastic hip after a modified rotational acetabular osteotomy and concluded that periacetabular osteotomy is an uncertain procedure since the development of early osteoarthritis may be accelerated by loss of articular cartilage.

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References