THE SHELF OPERATION FOR HIP DYSPLASIA IN ADOLESCENCE

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Failure of normal acetabular development is inevitable in congenital dislocation of the hip when it is unrecognised until late infancy or early childhood. Numerous stabilising procedures have been described, one of the first being the shelf operation or acetabuloplasty. This procedure fell into disrepute because the shelf was often located too high or was too small to prevent upward migration of the femoral head. The technique described emphasises the importance of resecting the thickened capsule and exposing the lateral margin of the acetabulum to allow a substantial portion of the outer cortex of the ilium to be turned down both laterally and anteriorly over the femoral head.

Twenty cases of acetabuloplasty have been followed up for an average period of nine years. The results have been assessed from the point of view of function, relief of pain, and degree of support of the femoral head as demonstrated radiologically. The shelf operation is a simple and safe procedure, and provided it gives adequate support to the subluxated femoral head it will ensure a stable, mobile joint capable of standing up to reasonable use for many years. If deterioration should occur in later life, total hip replacement may be undertaken more easily than if the joint had been allowed to undergo progressive subluxation.

The organisation for detecting laxity of the hip joints in new-born babies varies from one centre to another, but even where it works efficiently there will always be some cases that escape the net, and others in which the dysplasia does not manifest itself until the child is older; and certainly the present generation of orthopaedic surgeons will, from time to time, be faced with the problem of progressive dysplasia of the hip in adolescence, which, if untreated, may be the cause of crippling disability in early adult life.

Not infrequently the hip appears clinically normal, and the radiographs show only minor degrees of incongruity until the age of ten or thereabouts, after which the femoral head continues to grow and the acetabulum fails to contain it, leaving a considerable portion of the head uncovered.

ILLUSTRATIVE CASE REPORT

Case 1—A girl first attended at the age of three years with congenital dislocation of both hips. She was treated by traction and later by closed manipulation and immobilisation in a series of frog-leg plasters. A radiograph taken at the age of six years showed obvious dysplasia, but she failed to attend for further treatment and was lost to follow-up (Fig. 1). She re-attended twenty-seven years later with pain and a marked limp, and radiographs showed complete dislocation of both hips (Fig. 2).

Up to the age of seven or eight, a variety of stabilising procedures are available: innominate osteotomy (Salter 1966); capsular arthroplasty (Colonna 1965); pelvic osteotomy (Chiari 1970); and peri-capsular osteotomy (Pemberton 1965).

Although the exponents of these operations do from time to time extend the age limit, there is no doubt that in older children and adolescents all these operations

become more difficult and the results less predictable. In treating subluxation of the hip in older children and adolescents, we have to recognise our limitations. Once the femoral head can no longer be contained and the

FIG. 1

FIG. 2

Case 1. Figure 1—Radiograph at the age of 6 years. Figure 2—Twenty-seven years later both femoral heads are dislocated. On each side there is almost complete disappearance of the acetabular roof.

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acetabulum remains deficient, a normal joint is no longer possible, and in striving to improve function and prevent deterioration we must be careful not to make matters worse.

THE SHELF OPERATION

The term "shelf operation" includes a number of procedures in which part of the cortical bone of the ilium adjacent to the hip is reflected distally over the subluxated

FIG. 3

Diagram of author's shelf operation.

femoral head, or in which a free iliac graft is used to extend the acetabular roof laterally and antero-posteriorly. It is one of the oldest of the stabilising operations, and many distinguished names in orthopaedic surgery have been associated with it (Dickson 1935; Heyman 1963; Eyre-Brook 1966).

The operation fell into disrepute some years ago, largely because the supporting shelf was absorbed when it was too small or too high. Deprived of the stimulus of weight-bearing, in these circumstances the shelf would fail to develop.

Enough of the outer table of the ilium must be reflected downwards and forwards to cover the exposed capsule over the femoral head (Fig. 3). The operation will succeed only if the femoral head is well covered by a contiguous and strong bony shelf.

I have employed this technique for many years and found it the best way to stabilise the subluxating hip in the older child and adolescent.

TECHNIQUE OF OPERATION

Through a Smith-Petersen approach the lateral cortex and the anterior edge of the ilium are exposed subperiosteally and the capsule of the joint is cleared. The capsule, often very thick in these cases, is thinned by cutting away the surface layers.

The lateral margin of the acetabulum is next defined, and the bone required for the shelf is outlined with a drill. The flap is then gradually turned down from the outer table of the ilium by means of a thin, curved osteotome. It is essential to bring the bone down far enough to lie in close contact with the thin capsular covering of the exposed femoral head both superiorly and anteriorly (Fig. 4).

FIG. 4

Photograph of operation. Note the large flap of bone that has been raised from the outer table of the right ilium and which is to be turned down to cover the head superiorly and anteriorly. The capsular fibres have been thinned.

The iliac crest is next exposed and two or three wedge-shaped grafts are cut from the outer table of the ilium. The grafts are packed into the cleft behind the bone flap, which is anchored in position with catgut sutures passed through drill holes made in the bone. The gluteal muscles are then firmly sutured over the graft to the iliac crest.

Post-operative management—At the conclusion of the operation a tibial traction pin is inserted and the leg is supported in balanced suspension traction in a position of 30 degrees of abduction, slight flexion and slight medial rotation. After four weeks a plaster spica is applied and is worn for six weeks, after which mobilising exercises with skin traction for two or three weeks are instituted, with special emphasis on re-education of the gluteal muscles. Before full weight-bearing is permitted there should be radiological evidence of consolidation of the graft.

CASE REPORTS

Case 2—A girl was first seen at the age of two years with congenital dislocation of both hips (Fig. 5). She was treated conservatively by traction, followed by manipulation and

FIG. 5

FIG. 8

FIG. 6

FIG. 9

FIG. 7

Case 2. Figure 5—Bilateral dislocation in a girl aged 2 years. Figure 6—Radiograph at 6 years. Progressive subluxation on each side. Figure 7—The right hip twelve years after a shelf operation. The left hip is dysplastic.

FIG. 10

Case 3. Figure 8—Sixteen years after closed reduction of the right hip. Figure 9—Four years after a shelf operation. Note remodeling of the bone. Figure 10—A tracing of the radiographs to illustrate the pressure distribution. By estimating the area of contact on each radiograph and assuming that the pressure distribution over that area is of a paraboloid form, the maximum pressure intensity has been calculated. This has been reduced to about one-third of the original magnitude as a result of the support given by the shelf.

plaster fixation for one year. Four years later there was evidence of progressive subluxation, with flattening of the femoral head and acetabular dysplasia (Fig. 6). A shelf operation was performed on the right side. Twelve years later the joint was stable and painless (Fig. 7). The dysplasia of the left hip had increased and was causing pain (Figs. 5 to 7).

Case 3—A girl was treated conservatively for congenital dislocation of the right hip at the age of two years. Satisfactory reduction was achieved. The hip remained stable and she was discharged at the age of twelve years. She attended

again at the age of eighteen years with intermittent pain and a limp, and radiographs showed subluxation of the hip (Fig. 8). A shelf operation was performed. Radiographs four years later showed the femoral head adequately supported (Figs. 9 and 10). She was free from symptoms except for an occasional ache after exercise.

Case 4—A girl was first seen at the age of two and a half years with congenital dislocation of the right hip. She was treated conservatively and the reduction appeared to be complete. Subsequent radiographs showed progressive subluxation

FIG. 11

FIG. 12

FIG. 13

Case 4. Figure 11—Right hip at age of 10 years. Figure 12—Two months after shelf operation performed at the age of 11. Figure 13—Six years later. Note the remarkable remodelling and solid incorporation of the graft.

FIG. 14

FIG. 15

FIG. 16

FIG. 17

FIG. 18

Case 5. Figure 14—Radiograph of a woman of 28 years showing subluxation of the left hip and early arthritic changes. Figure 15—One year after a shelf operation. Figures 16 and 17—Lateral radiographs before and after operation showing the degree of support to the head anteriorly. Figure 18—Seven years after the shelf operation.

(Fig. 11) despite the absence of pain. A shelf operation was performed at the age of eleven years (Fig. 12). Six years later the shelf was well incorporated with the pelvis and there was a remarkable degree of remodelling (Fig. 13). She had a full range of painless movement and walked without a limp.

Case 5—A girl was first seen at the age of five years with congenital dislocation of the left hip. After closed reduction she remained under observation for some years but was later lost to follow-up. She attended again at the age of twenty-eight years with increasing pain and a marked limp (Fig. 14).

Radiographs showed subluxation of the hip with marked acetabular dysplasia. A shelf operation was performed and a radiograph taken a year later showed that the graft was becoming well incorporated (Fig. 15). Comparable lateral radiographs showed the dysplastic femoral head well supported anteriorly (Figs. 16 and 17). Seven years later, at the age of thirty-five years, the femoral head was well contained and the shelf had hypertrophied in response to function (Fig. 18).

MATERIAL

The clinical records and radiographs of forty-six shelf operations or acetabuloplasties performed at the Orthopaedic Hospital, Stoke-on-Trent, during the past twenty-five years have been reviewed; in twenty the operation had been performed in later childhood, adolescence or early adult life. The follow-up period was from five to twenty years, with an average period of nine years (Table I).

TABLE I
CLINICAL MATERIAL

	Age at operation	Number of cases
Adolescents . . .	9-18 years	17
Adults . . .	20, 26 and 30 years	3

TABLE II
RESULTS IN SEVENTEEN ADOLESCENT PATIENTS, BASED ON
GAIT, RELIEF OF PAIN, AND RADIOLOGICAL APPEARANCE

Grade	Number of cases
Excellent . . .	13
Fair . . .	2
Poor . . .	2

RESULTS

The initial assessment was based primarily on the radiographic appearances. Serial radiographs revealed whether or not the shelf was supporting the head, and evidence that the shelf was functional was shown by

gradual hypertrophy of the roof and the establishment of two cortices separated by cancellous bone.

Patients were assessed to determine whether the operation had the desired effect of 1) preventing further displacement of the femoral head; and 2) relieving symptoms. An excellent result implied a barely perceptible limp, full relief of pain and radiological evidence of a strong bone shelf supporting the head.

Range of movement—The most consistent finding at review was the absence of any significant loss of movement at the hip. In ten cases out of the twenty there was a full range of movement. Six patients showed slight loss of full abduction and medial rotation. In only four cases was abduction limited by 30 degrees and flexion and rotation movements by 25 degrees. The results in the case of seventeen adolescents are shown in Table II.

The causes of failure as seen in the two patients with poor results were 1) improper location of the shelf, which was too high on the pelvic wall; and 2) an inadequate shelf, which was either too small originally or had partly absorbed later.

COMMENT

When properly performed the shelf operation will prevent further displacement, and by distributing the load will relieve pressure on the outer border of the acetabulum and reduce strain on the capsule. Because of the eccentric position of the head, some degree of Trendelenburg limp may persist, but in many cases this diminishes gradually as the gluteal muscles strengthen.

It is concluded that the long established operation of shelf acetabuloplasty is a simple, safe, conservative procedure—an important consideration when an elective operation is to be carried out in the growing child. The operation does not disturb the integrity of the pelvic ring, and as it is an extra-articular procedure it does not affect the viability of the head and there is no danger of progressive stiffness of the joint. It can be used to support a subluxating femoral head from any cause in adolescence, and it can provide a stable, mobile joint which will stand up to reasonable use for many years. If the joint deteriorates in later life, total hip replacement can be undertaken much more easily than if the hip had been allowed to undergo progressive subluxation.

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