CONGENITAL SUBLUXATION OF THE HIP

A LONG-TERM REVIEW

D. A. SHERLOCK, P. H. GIBSON, M. K. D. BENSON

From the Nuffield Orthopaedic Centre, Oxford

In 1957 Somerville and Scott described their "direct approach" to the management of established congenital dislocation of the hip; arthrography after a period of traction served to distinguish the dislocated from the subluxated hip. We review the long-term outcome of hips which, using their criteria, were subluxated; 72 hips have been reviewed at periods ranging from 15 to 37 years after treatment by traction, closed reduction and femoral osteotomy. The results have been classified clinically and radiologically according to Severin's criteria.

There was progressive deterioration with age in both clinical function and radiographic appearance: 48.5% of hips showed evidence of dysplasia or subluxation at review. The results are similar to those found in a series treated by open reduction and limbectomy, differing only in the much lower incidence of degenerative changes after closed reduction.

In describing their approach to the management of congenital dislocation of the hip in children over 12 months of age, Somerville and Scott (1957) differentiated between two groups, which they designated respectively as "dislocated" and "subluxated". Although their definitions of these words differ from those used by some authors, we, in this paper, have followed Somerville and Scott's usage throughout. They based their definitions upon the arthrographic findings after a period of preliminary traction. One group, comprising those hips whose arthrograms showed inversion of the limbus and central pooling of dye, was designated *dislocated*: these were treated by preliminary limbectomy and a later derotation femoral osteotomy. We have previously reviewed 147 hips treated in this way and subsequently followed to skeletal maturity (Gibson and Benson 1982).

A second group of hips in which the arthrogram showed no block to concentric reduction was treated by closed reduction and subsequent derotation femoral osteotomy: these hips were designated as *subluxated* by Somerville and Scott. Seventy-two hips falling into this category have been followed to skeletal maturity, and the results of this method of treatment are reviewed in this paper.

All patients have been followed at least to skeletal maturity. Previous surveys have regularly shown that function is often much better than the radiographic appearances would suggest. Both function and appear-

ance, however, deteriorate with increasing maturity (Muller and Seddon 1953; Smith *et al.* 1968; Trevor, Johns and Fixsen 1975). Table I summarises the results of other authors.

The Scott-Somerville programme (Fig. 1) was instituted for all children aged 12 months or over with congenital dislocation or subluxation of the hip. Treatment began with preliminary skin traction on the Wingfield

Fig. 1

Diagram of the Somerville and Scott programme of treatment for dislocated hips.

D. A. Sherlock, FRCS, DPh, Orthopaedic Registrar
P. H. Gibson, FRCS, Senior Orthopaedic Registrar
M. K. D. Benson, FRCS, Consultant Orthopaedic Surgeon
Nuffield Orthopaedic Centre, Headington, Oxford OX3 7LD, England.
Requests for reprints should be sent to Mr M. K. D. Benson.

©1985 British Editorial Society of Bone and Joint Surgery
0301-620X/85/3086 \$2.00

Table I. Review of other studies

Authors	Age at operation (years)	Number of hips	Method of treatment	Follow-up (years)	Avascular necrosis (%)	Good result (%)
Severin, 1941	1 to 3	315	Manipulative reduction	14	(35)	(15)
Massie and Howorth, 1951	2 to 8	58	Open reduction	18 (average)	(41)	(17)
Ponseti and Frigerio, 1959	1 to 4	67	Traction, adductor tenotomy, manipulation	8 to 16	(12)	(67)
Salter and Dubos, 1974	1½ to 4	110	Traction, open reduction, pelvic osteotomy	1½ to 11	(5.7)	(93.6)
Gibson and Benson, 1982	1 to 3	147	Traction, limbectomy, femoral osteotomy	16 to 31	(5)	(47)

frame (Scott 1953). Longitudinal traction was combined with progressive abduction. Occasionally "cross-pull" was applied by means of a canvas sling around the upper thigh when, as a result of progressive abduction, the longitudinal traction vector was so diminished that the femoral head again began to ride up. Serial radiographs were taken over a period of 3 to 6 weeks to plot the descent of the femoral head to the level of the acetabular introitus. The child's hip was then examined under anaesthesia and an arthrogram performed.

Subluxated hips. If the arthrogram showed no block to complete reduction (Fig. 2), the child was placed in a hip spica with the affected leg extended, abducted and in full medial rotation. Six weeks later a femoral derotation osteotomy was performed, usually of 70°, at the subtrochanteric level (Fig. 3) and a spica cast applied. This was retained for six further weeks, after which the child

was mobilised. These hips are the subject of the present study.

Dislocated hips. If the hip demonstrated central dye pooling with inversion of the limbus (Fig. 4), then the limbus was excised under the same anaesthetic. Following this the hip was held in extension, abduction and full medial rotation in a hip spica. Four to six weeks later a subtrochanteric derotation femoral osteotomy was performed. After a further six weeks in a hip spica the child was allowed to mobilise freely. These dislocated hips are excluded from the present study.

PATIENTS AND METHODS

The study comprised 72 hips in 64 patients. The records of a further six patients were inadequate and were excluded. The total recall rate was therefore 91.4%.

Fig. 2

Fig. 3

Figure 2—Arthrogram showing no block to reduction. Figure 3—Radiograph after derotation osteotomy at the subtrochanteric level.

Fig. 4

Arthrogram showing inversion of the limbus with central pooling of the dye.

The 64 patients were between 12 and 36 months of age at the time of operation. Children diagnosed after the age of three months were observed until the age of 12 months and then followed the standard treatment programme. In most cases the primary treatment was preliminary traction, although three patients had previously been treated with progressive abduction and medial rotation plasters; a further three patients had been treated unsuccessfully by splintage. The criteria for inclusion in this study were strict and we excluded any child with a significant neuromuscular disorder such as spina bifida, spasticity or arthrogryposis.

The follow-up regimen also was strict. Each child was seen three or four times in the first year, twice in the second year and thereafter annually. Radiographs were taken at each visit and each radiograph was photographed and mounted on an instant display sheet. Where further procedures were performed, each was fully documented.

Each patient was followed up at least until his proximal femoral epiphysial plate had closed. The age at review ranged from 15 years to 37 years (mean 21.8 years). There were 56 female patients and 8 male.

Forty-one patients had unilateral subluxations (34 left, 7 right); eight had bilateral subluxations. In the remaining 15 patients the unilateral subluxation was associated with a dislocation of the contralateral hip which required open reduction (5 of these dislocations were associated with a left subluxation and 10 with a right subluxation).

Derotation osteotomy of the femur through 70° was performed in 57 hips, derotation through 50° to 60° in 12

Table II. Clinical assessment groups derived from Severin (1941)

	Symptoms	Severin's groups
Group 1 (Excellent)	No pain, no limp, unlimited endurance	A + B
Group 2 (Good)	No pain, slight limp, endurance slightly restricted	C + D
Group 3 (Fair)	Occasional pain, noticeable limp, endurance moderately restricted	E
Group 4 (Poor)	Regular pain, marked limp, endurance severely restricted	F + G

and derotation through 80° to 90° in the remaining 3. In 6 hips (8%) the primary derotation was combined with a varus displacement of 5° to 20° .

Assessment. We have adopted Severin's (1941) method of clinical assessment but have amalgamated some of his seven groups to produce four gradings which we have labelled excellent, good, fair and poor (Table II). The criteria have been applied strictly and any patient with a specific symptom has been placed in the lowest appropriate group. Radiographic assessment also has been based on Severin's classification (Table III).

Methods of review. Each patient was assessed together with his notes and radiographs. A flow chart was drawn up detailing the age at diagnosis, the initial treatment and the timing of subsequent management and operation. The clinical and radiographic findings were charted for the time of presentation, one year after the initial operation, five years after operation and at final review.

RESULTS

The clinical results for the subluxated hips were much better than the radiographic results although progressive deterioration of function with time was noted. At final review 51 hips (70.8%) were classified clinically as excellent or Group 1. Ten hips (13.9%) were placed in each of

Table III. Severin's grades of radiographic assessment

Grades	Assessment
I	Normal hips C/E angle: adults $> 25^\circ$ children $> 15^\circ$
II	Mild deformity of hip head and neck with concentric reduction C/E angle the same as in Grade I
III	Dysplastic hips without subluxation C/E angle: adults $< 20^\circ$ children $< 15^\circ$
IV	Subluxation
V	Head articulating with a secondary acetabulum in the upper part of the original acetabulum
VI	Redislocation

C/E, centre edge (from Wiberg 1939); children, 6–14 years

Table IV. Length of follow-up and clinical grading

Years of follow-up	Clinical grading: number (%)			
	Group 1 (Excellent)	Group 2 (Good)	Group 3 (Fair)	Group 4 (Poor)
5	60 (84.7)	8 (9.7)	4 (5.6)	—
15 to 37	51 (70.8)	10 (13.9)	10 (13.9)	1 (1.4)

Table V. Length of follow-up and radiographic grading

Years of follow-up	Grading: number (%)				
	I	II	III	IV	V
5	23 (32)	27 (37.5)	12 (16.7)	9 (12.5)	1 (1.3)
15 to 37	22 (30.5)	15 (20.8)	18 (25)	12 (16.7)	5 (7.0)

Table VI. Method of treatment and radiographic grading

Treatment	Grading: number (%)				
	I	II	III	IV	V
Standard (66 hips)	21 (31.8)	13 (19.7)	15 (22.7)	12 (18.2)	5 (7.6)
Standard + varus (6 hips)	1 (16.7)	1 (16.7)	4 (66.6)	—	—

Groups 2 and 3 with only one hip (1.4%) in Group 4 (Table IV).

Five years after operation only five hips (7%) had a reduced range of movement, although there was a preponderance of lateral rotation in a further 14 hips (19.4%) and increased medial rotation in three (4.2%). At final review the number of hips with a reduced range of movement had increased to eight (11%), including one hip which was arthrodesed. One hip was hypermobile. The number of hips with an increased range of lateral rotation fell to four (5.6%) with two hips (2.7%) showing increased medial rotation at maturity.

Severin's radiographic grading cannot be applied to children under five years of age but, at the review performed one year after initial reduction, 69 (96%) hips looked well reduced, as judged by the integrity of Shenton's line and an ossific nucleus well centred below the acetabular roof. At five years 50 hips (69.5%) fell into Severin's radiological Grades I and II (Table V) with a further 12 hips in Grade III. By final review the number of hips in Grades I and II had fallen to 37 (51.3%) with an accompanying increase in the numbers falling into Groups III, IV and V. In the subsequent text we have taken both Grades I and II as indicating good results; Grade III hips are described as dysplastic, while Grades IV and V are again combined and labelled as subluxated. **Results according to treatment.** *Rotation osteotomy without varus.* Sixty-six hips had no varus combined with their primary rotation osteotomy; 51.5% of these hips had a good outcome (Table VI); 22.7% developed eventual dysplasia.

Rotation osteotomy with varus. Six hips were treated this way. While only one needed subsequent operation by a further varus osteotomy, the results were not significantly better than those without varus (Table VI).

Additional operations. Fifteen hips required further procedures for progressive subluxation: 10 hips had one further operation, four hips needed two and one hip had three further operations in addition to the standard derotation osteotomy (Table VII). Late varus femoral osteotomy led to a successful outcome in only two of the 10 patients so treated. No patient treated by a late pelvic osteotomy had a happy outcome.

Table VII. Additional operations

Number	Hips	Type of operation
1	8	Late varus osteotomy with/without derotation
	2	Pelvic osteotomy
2	1	Pemberton osteotomy; Chiari osteotomy
	1	Open reduction; arthrodesis
	1	Late varus osteotomy; further derotation osteotomy
	1	Open reduction with derotation osteotomy; late varus osteotomy
3	1	Late varus osteotomy; Pemberton osteotomy; "exploration" of hip

Fig. 5

Fig. 6

Figure 5—A high dislocation of the right hip. Figure 6—An intermediate dislocation of the right hip.

Prognostic factors. Those factors which may predispose to a good or poor result have been examined in relation to a number of features.

Unilateral and bilateral displacements. There were 41 unilateral displacements. In comparing right with left subluxations, the data suggest that right hips fare worse than left, but this fails to reach statistical significance ($X^2 = 1.83$; $P > 0.1$). There were 23 bilaterally displaced hips. Of these, however, only 8 were bilateral subluxations while the remaining 15 were treated by open reduction for dislocation on one side and by closed reduction for the subluxation on the other.

Good results were seen in 51.2% of unilaterally subluxated hips and in 56.2% of the bilateral subluxations. Of the 15 hips with dislocation on one side and subluxation on the other, 46.7% achieved a good result on the subluxated side (Table VIII). Only five of the eight pairs of subluxated hips attained symmetrical results with three of these pairs achieving Severin's Grades I or II. Five of the 15 hips with dislocation on one side and subluxation on the other were symmetrical at final review; all were graded good. In seven cases the final result was better on the subluxated side; in the remaining three cases, the dislocated side showed the better result.

It can be seen from these results that the presence of a bilateral subluxation did not significantly worsen the outcome, despite the common prejudice that children with bilateral hip displacement carry a worse prognosis (Muller and Seddon 1953). Similarly, if the subluxation occurred opposite a dislocation, the final result was no worse than for a unilateral subluxation.

Age at diagnosis. As would be expected, better results were seen in those subluxated hips which were diagnosed early (Table IX). Nine of the 11 hips (81.8%) operated on at 12 months achieved a good result. Only 17 of the 30 hips (56.7%) operated on between the ages of 13 and 24 months attained a good result. Of the 31 hips operated on after 25 months, only 11 (35.5%) were rated good. Surprisingly, the apparent fall-off in results with increas-

ing age of operation did not reach statistical significance ($X^2 = 8.32$; $P > 0.05$).

Level of original dislocation. The level of the original dislocation was classified as in our previous paper (Gibson and Benson 1982). The relationship of the proximal femoral metaphysis to the outer edge of the acetabulum was assessed on the initial radiograph of the non-weight-bearing child. Where the metaphysis lay above the outer acetabular edge, the dislocation was recorded as high (Fig. 5); where it lay at the level of the outer lip of the acetabulum it was labelled intermediate (Fig. 6). Where the metaphysis lay below the outer acetabular edge, the category was sub-divided into low dislocations (Fig. 7) and subluxations (Fig. 8): if the femoral head stood widely away from the acetabulum so that the entire ossi-

Fig. 7

Fig. 8

Figure 7—A low dislocation. Figure 8—A subluxation.

fic nucleus lay outside the cover of the bony acetabular roof, the hip was classified as a low dislocation; if the ossific nucleus was covered in any part by the bony acetabular roof, the hip was designated as subluxated. This sub-classification was necessary to allow our results to be compared with those of other authors who used the terms dislocation and subluxation to apply to the initial

radiographic examination. As has been stated above, the Somerville and Scott definitions of subluxated and dislocated hips apply to the arthrographic findings after a period of preliminary traction on an abduction frame. Interestingly, subluxations and low dislocations fared identically: a successful outcome was seen in 54% of both groups (Table X).

Table VIII. Type and number of hips and radiographic grading

Description		Grading: number (%)				
		I	II	III	IV	V
Unilateral subluxation	34 L	12 (35.3)	7 (20.6)	7 (20.6)	6 (17.6)	2 (5.9)
	7 R	—	2 (28.6)	2 (28.6)	1 (14.2)	2 (28.6)
Bilateral subluxation	8 L	3 (37.5)	1 (12.5)	2 (25)	2 (25)	—
	8 R	2 (25)	3 (37.5)	2 (25)	1 (12.5)	—
Bilateral displacements:						
1 dislocated	5 L	3 (60)	—	1 (20)	1 (20)	—
1 subluxated	10 R	2 (20)	2 (20)	4 (40)	1 (10)	1 (10)

Table IX. Age at operation and radiographic grading

Age in months at operation	Grading: number (%)				
	I	II	III	IV	V
12 (11 hips)	6 (54.5)	3 (27.3)	2 (18.2)	—	—
13 to 24 (30 hips)	8 (26.7)	9 (30)	6 (20)	6 (20)	1 (3.3)
25 to 36 (31 hips)	8 (25.8)	3 (9.7)	10 (32.3)	6 (19.4)	4 (12.8)

Table X. Level of initial dislocation and radiographic grading

Level of dislocation	Grading: number (%)				
	I	II	III	IV	V
True subluxation (11 hips)	3 (27.3)	3 (27.3)	3 (27.3)	2 (18.1)	—
Low (24 hips)	10 (41.7)	3 (12.5)	6 (25)	5 (20.8)	—
Intermediate (17 hips)	7 (41.2)	4 (23.5)	5 (29.4)	—	1 (5.9)
High (20 hips)	2 (10)	5 (25)	4 (20)	5 (25)	4 (20)

Table XI. Initial acetabular angle and radiographic grading

Angle	Grading: number (%)				
	I	II	III	IV	V
30° to 40° (63 hips)	20 (31.7)	12 (19.1)	16 (25.4)	11 (17.5)	4 (6.3)
41° to 50° (7 hips)	2 (28.6)	2 (28.6)	1 (14.3)	1 (14.3)	1 (14.3)

Table XII. Reversal of epiphysial angle and radiographic grading

Result	Grading: number (%)				
	I	II	III	IV	V
Positive (24 hips)	4 (16.6)	2 (8.3)	9 (37.5)	5 (21)	4 (16.6)
Negative (48 hips)	18 (37.5)	13 (27)	9 (18.8)	7 (14.6)	1 (2.1)

Sixty-four per cent of intermediate dislocations and only 35% of high dislocations could be similarly rated. The apparent differences between the results for high, intermediate and low dislocations were confirmed statistically ($X^2 = 10.15$; $P < 0.05$).

Acetabular angle. The acetabular angle was measured in all hips on presentation, and at one and five years after operation. The later measurements enabled the rate of decrease of the acetabular angle with time to be assessed. Although it is clear that the acetabular angle only reflects the bony configuration, it is a reproducible measurement.

The presenting acetabular angle did not significantly affect the final result (Table XI). Good results were attained in 50.8% of hips with an initial acetabular angle of 30° to 40° compared with 57.2% of hips presenting with an angle of 41° to 50°.

However, we have found that the rate of improvement of the acetabular angle was a reliable indicator of the final configuration of the hip. No hip which was eventually classified as good had failed to show a reduction of the acetabular angle by at least 10° in the first postoperative year. The correlation between failure of the acetabular angle to improve by more than 10° and an eventual poor result was highly significant ($X^2 = 53.1$; $P < 0.001$).

Epiphysal angle. The epiphysal angle is defined as the angle between the epiphysal line and the femoral shaft. Where the epiphysal plate was curved, the angle of the major portion was measured. It was noted that 24 out of 72 hips (33.3%) exhibited reversal of the epiphysal angle beyond the horizontal: that is to say, the epiphysal plate, instead of sloping downwards and medially, sloped downwards and laterally. Only 24.9% of hips (Table XII) demonstrating reversal of the epiphysal angle eventually achieved a good result. This compares with 64.5%

good results where there was no reversal of the epiphysal angle. There was thus a significant correlation between a poor final result and reversal of the epiphysal angle ($X^2 = 9.96$; $P < 0.01$).

Since avascular necrosis of the femoral head may be associated with premature closure of part or all of the capital femoral epiphysal plate (Bucholz and Ogden 1978; Kalamchi and MacEwen 1980; Kalamchi 1981), those hips complicated by avascular necrosis were examined with particular care to see whether partial closure of the plate could be responsible for epiphysal angle abnormalities. No localised osseous bridging was detected on any radiographs, although four of the seven hips with avascular necrosis developed a reversed epiphysal angle.

Complications. *Avascular necrosis.* Seven hips (9.8%) demonstrated the changes of avascular necrosis. The age of preliminary treatment ranged from 10 to 30 months. One child who developed bilateral avascular necrosis demonstrated early changes of epiphysitis prior to her entry into the treatment programme. Excluding these two hips, the rate of avascular necrosis falls to 7%. Subsequently, none of the seven hips had a good result, although two hips were graded as dysplastic and the remaining five as subluxated. The epiphysal plate of one hip closed prematurely.

Supracondylar fracture. The treatment of three hips (4%) was complicated by a supracondylar femoral fracture.

Redisplacement. Three hips showed partial displacement at one year, having initially been deeply and concentrically reduced; by five years, however, two of these had improved to radiological Grades I or II (Figs 9 to 11) without further treatment.

Degenerative changes. These were assessed using the following radiological criteria: joint space narrowing (less than 3 mm in the adult); increased sclerosis in the weight-

Fig. 9

Fig. 10

Fig. 11

Radiographs showing initial deep reduction, partial displacement at 1 year and improvement to Grade I or II at 5 years.

bearing segment of the femoral head or acetabulum; and osteophyte or subchondral cyst formation.

By these criteria 10 hips (14%) showed degenerative changes. In five hips these changes consisted of joint space narrowing alone and all were assessed Grades I and II. In the remaining hips the changes of degenerative arthritis were more advanced and were associated with dysplasia or subluxation. In only one hip was there evidence of predisposing avascular necrosis. Arthrodesis was performed in one girl of 19 with a residually subluxated and painful hip which showed little evidence of arthritis.

DISCUSSION

It is now 28 years since Somerville and Scott described their direct approach to the problem of hip dislocation in children aged 12 months to 5 years. Their first principle of treatment was to overcome the extra-articular obstacles to reduction. Recognising that forcible manipulation compromised the blood supply to the femoral head, they advocated slow reduction of the hip by longitudinal traction on the Wingfield frame followed by progressive abduction. Although traction invariably allowed the femoral head to descend to the level of the acetabular introitus, reduction was possible in only a third of their patients (72 out of 219).

Their second principle was to overcome the intra-articular block to reduction by excising the inverted limbus, which was felt to be the cause of failed reduction in two-thirds of the patients. We have previously reviewed 147 hips with blocked reduction treated by limbectomy (Gibson and Benson 1982). It has been argued that rigid frame traction converts a pliable, flexible and retractable limbus to a rigid block to reduction.

The next stage in their treatment was to correct excessive femoral anteversion since they believed that reduction could be stabilised by this manoeuvre. The belief that a rotation osteotomy conferred stability is based on the assumption that a deeply placed and correctly centred femoral head stimulates normal growth of the dysplastic acetabulum. Indeed, Harris, Lloyd-Roberts and Gallien (1975) suggested that, following congruent reduction, 95% of acetabula would develop normally in children up to four years old. In essence, our present long-term review tests that belief. The high proportion of hips that, at follow-up, proved to have dysplastic acetabula or to be subluxated once again must call into question this assumption. Pre-existing flattening of the posterior part of the femoral head, which articulates with the side wall of the pelvis, contributes to oval malformation of the head. With rotation and abduction, the thickened anterior cartilage is placed medially in the acetabulum, and it is not uncommon to see a second ossific nucleus appear in this area (Fig. 12). Furthermore, because of the femoral head asymmetry, rotation may not allow the instant centre to be placed centrally in the acetabulum. This failure to centralise the femoral head

Fig. 12

A second ossific centre is developing on the medial side of the femoral head following reduction.

predisposes to persistent and indeed progressive antero-lateral subluxation.

It is theoretically attractive to incorporate varus into the osteotomy as this decompresses the femoral head and minimises femoral overgrowth. In this series, however, the varus incorporated was too little and the numbers in whom it was performed too small for any conclusions to be drawn.

Somerville distinguished between subluxated and dislocated hips on the arthrographic findings after preliminary traction. It is on this basis that the 72 hips in this series have been classified as subluxated. These patients are extremely well-matched with the patients in the previous review of dislocated hips with regard to age, sex and length of follow-up.

It might have been expected that patients in whom no intra-articular block to reduction was found would fare better than those in whom open reduction and limbectomy proved necessary. In comparing this present series of subluxated with the previously published series of dislocated hips, no significant difference in the radiographic outcome is demonstrable; similar proportions of hips became dysplastic or subluxated. However, in reviewing the original radiographs of our present series, we think that most surgeons might have classified many of the hips in this series as dislocated. Indeed, by some definitions only 11 of the 72 hips would have been regarded as being truly subluxated at presentation. Surprisingly, even in this small sub-group of 11, the results of treatment by this method were not significantly better than in the group as a whole.

In comparing the incidence of degenerative changes in the two groups, it appears that those patients who underwent limbectomy developed degenerative changes

earlier and more severely (Gibson and Benson 1982). Arthritic changes developed three times as commonly in the patients treated by limbectomy (44%) as in those treated by rotation osteotomy alone (14%). This is statistically highly significant ($X^2 = 10.75$; $P < 0.01$). Oddly, avascular necrosis was always complicated by arthritis at maturity in patients treated by limbectomy: only one of seven hips in the current series exhibited similar arthritis. It is tempting to speculate that excision of the limbus contributes to premature osteoarthritis.

Avascular necrosis did not occur significantly more frequently in those cases treated by closed reduction than in those cases undergoing open reduction and limbectomy.

The findings of this present study match those for the dislocated hips in showing that the regimen gives better results in younger children; in older children acetabular remodelling is less reliable. Indeed, if the acetabular angle does not improve swiftly after surgery, the outcome is likely to be poor. We suggest that, in view of the poor results of late pelvic osteotomy reported here, when failure to improve after the primary treatment is recognised, early pelvic osteotomy should be considered.

The authors are deeply grateful to Mr E. W. Somerville. His insight into the problems of hip dislocation and his dedication in applying his principles of treatment have greatly advanced our understanding of this still prevalent disease. Thanks also are due to Sandra Moore and Margaret Proudlock-Dunbar for their secretarial assistance.

REFERENCES

- Bucholz RW, Ogden JA.** Patterns of ischemic necrosis of the proximal femur in non-operatively treated congenital hip disease. In: *The hip: proceedings of the sixth open scientific meeting of The Hip Society*, 1978. St Louis: CV Mosby, 1978:43-63.
- Gibson PH, Benson MKD.** Congenital dislocation of the hip: review at maturity of 147 hips treated by excision of the limbus and derotation osteotomy. *J Bone Joint Surg [Br]* 1982;**64-B**:169-75.
- Harris NH, Lloyd-Roberts GC, Gallien R.** Acetabular development in congenital dislocation of the hip: with special reference to the indications for acetabuloplasty and pelvic or femoral realignment osteotomy. *J Bone Joint Surg [Br]* 1975;**57-B**:46-52.
- Kalamchi A, MacEwen GD.** Avascular necrosis following treatment of congenital dislocation of the hip. *J Bone Joint Surg [Am]* 1980;**62-A**:876-88.
- Kalamchi A.** Avascular necrosis of the femoral head in CDH. *Orthop Trans* 1981;**5**:182.
- Massie WK, Howorth MB.** Congenital dislocation of the hip. Part II: Results of open reduction as seen in early adult period. *J Bone Joint Surg [Am]* 1951;**33-A**:171-90.
- Muller GM, Seddon HJ.** Late results of treatment of congenital dislocation of the hip. *J Bone Joint Surg [Br]* 1953;**35-B**:342-62.
- Ponseti IV, Frigerio ER.** Results of treatment of congenital dislocation of the hip. *J Bone Joint Surg [Am]* 1959;**41-A**:823-46.
- Salter RB, Dubos JP.** The first fifteen years' personal experience with innominate osteotomy in the treatment of congenital dislocation and subluxation of the hip. *Clin Orthop* 1974;**98**:72-103.
- Scott JC.** Frame reduction in congenital dislocation of the hip. *J Bone Joint Surg [Br]* 1953;**35-B**:372-4.
- Severin E.** Contribution to knowledge of congenital dislocation of the hip joint: late results of closed reduction and arthrographic studies of recent cases. *Acta Chir Scand* 1941;**84** Suppl 63:1-142.
- Smith WS, Badgley CE, Orwig JB, Harper JM.** Correlation of post-reduction roentgenograms and thirty-one-year follow-up in congenital dislocation of the hip. *J Bone Joint Surg [Am]* 1968;**50-A**:1081-97.
- Somerville EW, Scott JC.** The direct approach to congenital dislocation of the hip. *J Bone Joint Surg [Br]* 1957;**39-B**:623-40.
- Trevor D, Johns DL, Fixsen JA.** Acetabuloplasty in the treatment of congenital dislocation of the hip. *J Bone Joint Surg [Br]* 1975;**57-B**:167-74.
- Wiberg G.** Studies on dysplastic acetabula and congenital subluxation of the hip joint: with special reference to the complication of osteoarthritis. *Acta Chir Scand* 1939;**83** Suppl 58.