CONGENITAL DISLOCATION OF THE HIP

REVIEW AT MATURITY OF 147 HIPS TREATED BY EXCISION OF THE LIMBUS AND DEROTATION OSTEOTOMY

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In 1957 Somerville and Scott presented their principles of management for the older child with congenital hip dislocation. They advocated preliminary traction followed, in those hips which remained dislocated, by excision of the limbus and subsequent derotation varus osteotomy of the femur. As alternative regimes are advocated it becomes increasingly important to subject each method to detailed long-term review.

One hundred and forty-seven hips in 121 patients aged between 12 months and three years and treated by the standard Somerville and Scott regime have been reviewed. The age at review ranged from 16 to 31 years. The recall rate was 91 per cent. Each patient was seen regularly in a special clinic where detailed notes, radiographs and records were available. The results have been assessed clinically and radiographically by modifications of Severin’s criteria to enable comparisons to be made with other published series. Attention has been focused on the good and the bad prognostic factors and on the long-term complications. The most worrying feature has been the premature onset of degenerative arthritis even in hips which seemed to have been satisfactorily reduced.

Despite screening programmes for the detection of congenital dislocation of the hip in the newborn, children with dislocated hips continue to present late (Wilkinson and Carter 1960). Treatment in the newborn gives reliably good long-term results; treatment in the older child does not (Schwartz 1965; Frank and Michael 1967; Salter 1961). In childhood, the clinical results of treatment are invariably better than the radiological results; a poor anatomical configuration of the hip may cause few symptoms until late adolescence or early adult life. Short-term clinical reviews, therefore, have little relevance to the long-term outlook. Similarly, most authors find progressive deterioration of the radiological appearances with time (Muller and Seddon 1953; Smith et al. 1968). It is doubly important therefore that any method of treatment should be subject to long-term review. The 147 hips in this series have been followed at least to skeletal maturity. All hips in this series have been treated by the “direct approach” to the problem of hip dislocation advocated by Somerville and Scott (1957).

METHODS AND MATERIAL

The Somerville and Scott treatment programme. In early childhood subluxation and dislocation of the hip are spectra of the same disease process. For the child aged more than 10 or 11 months, treatment began with preliminary skin traction on the Wingfield frame (Scott 1953). Progressive longitudinal traction was combined with progressive abduction and serial radiographs were taken to plot the descent of the femoral head. After three to six weeks of traction the child’s hip was examined under anaesthesia and an arthrogram performed. If the arthrogram demonstrated no block to complete reduction (Fig. 1) the child was placed in a hip spica with the affected hip extended, abducted and in full medial rotation. Six weeks later a femoral derotation osteotomy was performed, usually of 70 degrees (Fig. 2), at the subtrochanteric level and a spica cast applied. This was retained for six weeks, after which the child was mobilised (Fig. 3). Such hips were designated subluxated. During the period under review 35 hips fell into this category.

If, however, the hip arthrogram demonstrated central pooling of the dye, with inversion of the limbus (Fig. 4), then the limbus was excised under the same anaesthetic. Through a small anterior oblique incision a capsulotomy parallel to the acetabular margin was performed and the turned limbus excised. No other intra-articular procedure was performed. The psoas and adductors were not divided. No capsular repair was carried out. After operation the hip was held in

Figure 1—An arthrogram of the hip showing no inverted limbus and slight central pooling of the dye. Figure 2—A radiograph showing the appearance after reduction and derotation osteotomy. Figure 3—Appearance at five years.

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a hip spica in extension, abduction and full medial rotation. Four to eight weeks later a subtrochanteric derotation osteotomy of 60 to 90 degrees (70 degrees in most cases) was performed. Six weeks later the plaster cast was removed and the child mobilised (Figs 5 and 6). Such hips were designated dislocated.

The follow-up regime was strict. Each child was seen three or four times in the first year, twice in the second year and annually thereafter. 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.

**Patients.** The criteria for inclusion in this present study have been strict. Each patient was between 12 and 36 months of age at the time of the initial operation. Each patient was treated by preliminary traction, excision of the limbus and subsequent derotation osteotomy. (The group of patients with subluxated hips in whom open reduction was not performed, is therefore not included.) Each patient in this study has been followed at least to the age of 16 years. The age at review ranged from 16 to 31 years with a mean of 21.5 years. Patients in whom there was a significant neuromuscular disorder, including spina bifida, spasticity or arthrogryposis, have been excluded.

One hundred and forty-seven hips, in 121 patients, remained for study. There were a further 15 patients, but their records were inadequate and they have therefore been excluded. The total recall rate was therefore 91 per cent.

The 147 hips comprised 95 patients with unilateral dislocation and 26 patients with bilateral dislocations. Some of these patients have been included in a previous survey (Somerville 1978).

**Clinical assessment.** For ease of comparison we have adopted the classification used most frequently in assessing the results of treatment of congenital dislocation of the hip (Severin 1941), but we have amalgamated some of his seven groups so that ours correspond to excellent, good, fair and poor (Table I). The grading has been strict. Any patient with a specific symptom was placed in the lowest appropriate group. Thus, a patient with a severe limp was placed in Group 4 even if he had no pain and no great restriction of endurance.

**Radiological assessment.** The radiological assessment was similarly based on Severin's classification (Table II) and is shown in Figures 7 to 12.

**Methods of review.** Each patient was assessed together with his notes and radiographs. A record was made of the age of diagnosis, the initial treatment and the timing of subsequent management and operations.
In assessing patients, certain fixed points were used for the comparative review. These included the clinical and radiological appearance at presentation; and the clinical and radiological appearance one year after operation, five years after operation and at final review.

**RESULTS**

**Clinical results.** As one might expect, clinical results were a great deal better than radiological results. One hundred and nine hips (74 per cent) were clinically Group I or excellent. Only four hips (2.7 per cent) were classified as Group 2. Twenty-two hips (15 per cent) fell into Group 3 and 12 (eight per cent) were in Group 4. It should be stressed that the age of final review ranged from 16 to 31 years and there was no doubt that the clinical results deteriorated with age.

By one year after operation 75 per cent of children had regained full flexion at the hip and by five years this had risen to 91 per cent; at final review the figure had fallen again to 75 per cent. Seventy-two per cent of children had regained full abduction by one year after operation and this figure rose to 86 per cent by the fifth year; at final review only 68 per cent had full abduction. As noted earlier, the majority of children had a derotation osteotomy of 70 degrees. At one year after operation 60 per cent of the children had an arc of rotation with a preponderance of lateral rotation but by final review in only 30 per cent of the adults was such a preponderance noticeable.

**Radiological grading.** It is not possible to apply Severin’s radiological grading to children at the age of two or three years. At the one year review 85 per cent of the hips looked well reduced with no sign of the capital epiphysis “standing away” from the acetabulum and with Shenton’s line not significantly breached. At five years 67 per cent of the hips fell into the Severin Grades I and II but by final review only 47 per cent of the hips could be so classified (Table III). It is interesting to note that the reason for down grading at final review was progression into Grade III (uncovered head) of Severin. There was little change in groups with severe subluxation or dislocation.

**Results according to methods of treatment.** All hips were treated initially by the standard regime of preliminary traction, arthrogram, open reduction, excision of limbus and derotation osteotomy. Further treatment was required for many hips, however, and these have been classified according to the methods of subsequent operation.

**Table IV.** Final results according to method of treatment (as percentage of hips treated)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard method (68 hips)</td>
<td>32</td>
<td>36</td>
<td>17</td>
<td>13</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Standard method + varus osteotomy (25 hips)</td>
<td>12</td>
<td>42</td>
<td>39</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard method + late varus osteotomy (41 hips)</td>
<td>—</td>
<td>22</td>
<td>34</td>
<td>41.5</td>
<td>2.5</td>
<td>—</td>
</tr>
<tr>
<td>Late pelvic osteotomy (13 hips)</td>
<td>—</td>
<td>23</td>
<td>23</td>
<td>46</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

**Table V.** Final results of those treated by later varus osteotomy

<table>
<thead>
<tr>
<th>Age at operation</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 5 years</td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5–9 years</td>
<td>—</td>
<td>5</td>
<td>9</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 10 years</td>
<td>—</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total*</td>
<td>—</td>
<td>9</td>
<td>16</td>
<td>19</td>
<td>1</td>
<td>—</td>
</tr>
</tbody>
</table>

* Four patients had two varus osteotomies (in addition to the original derotation osteotomy)

**Group A.** Sixty-eight hips were treated by only the standard method just described. Sixty-eight per cent of these hips were graded radiologically Grade I or II at final review. A further 17 per cent fell into Grade III which showed evidence of dysplasia but not subluxation (Table IV).

**Group B.** Twenty-five hips were treated by the standard regime but in these 15 degrees of varus was built into the original osteotomy in combination with the derotation. Fifty-four per cent of these hips were radiologically assessed as Grade I or II at final review. While a smaller proportion fell into the subluxated category at final review there was no statistically significant difference between the results of simple derotation and derotation plus varus. Varus osteotomy became a standard part of the treatment in the later part of the series.

**Group C.** These hips, after initial treatment by the standard regime (including derotation osteotomy), in later childhood showed signs of progressive subluxation. Forty-one of these were treated by a varus osteotomy at this late stage. The age at the time of this osteotomy ranged from 4 to 13 years. Four patients had a third femoral osteotomy. Only nine of this group of 41 patients (22 per cent) achieved a good final radiological result while 41.5 per cent showed late radiological evidence of persistent subluxation. Interestingly, the age at varus osteotomy did not appear to affect the outcome (Table V); three of the group who achieved good final
results were aged 10 or over when their osteotomies were performed. Group D. Late pelvic osteotomy was performed on 13 hips. In none of the series was primary pelvic osteotomy performed. Of the pelvic osteotomies undertaken, four were of the Salter type, two of the Pemberton type and there were seven Chiari osteotomies. The groups are too small for useful evaluation but only three were felt to be good at final radiological review.

In a small group of three patients, all in Group A, capsular plication was performed for recurrent subluxation. One of these was performed only six weeks after the initial open reduction; the second was performed six months after the initial reduction and the third five years after initial reduction. Only the first patient achieved a good final result.

PROGNOSIS
We have tried to analyse those factors which may have affected prognosis in this series of patients.

Bilateral dislocations. Of the 26 pairs of hips in this series only four pairs achieved symmetrically good results at final review. In all others the result differs on the two sides although both were treated by the same technique and usually at the same time. The overall results of the bilateral dislocations showed that 41 per cent achieved a good final result. Thirty-two per cent of the hips were dysplastic and the remaining 27 per cent were subluxated.

Age at diagnosis. In this series, as in most other reported series, the younger the age at diagnosis the better the eventual outcome. Of those children operated upon at the age of 12 months, 73 per cent achieved a good final radiological appearance (Grades I and II). In the group operated on at 13 to 24 months the proportion fell to 48 per cent and in those aged 25 to 36 months only 31 per cent achieved a good final radiological result (Table VI).

Table VI. Final radiological grading related to age at initial operation

<table>
<thead>
<tr>
<th>Age at diagnosis</th>
<th>Radiological grading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>12 months</td>
<td>7</td>
</tr>
<tr>
<td>13–24 months</td>
<td>17</td>
</tr>
<tr>
<td>25–36 months</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
</tr>
</tbody>
</table>

Height of original dislocation. The height of the original dislocation was judged by the relationship of the metaphysis to the outer edge of the acetabulum as seen in a radiograph made when the child was not bearing weight; this was compared with the final radiographic appearance. If the metaphysis was above the outer acetabular edge the dislocation was recorded as high; if the metaphysis was at the level of the outer acetabular lip it was classified as intermediate; and if below it was classified as low (Fig. 13). By this grading 29 hips were classified as low dislocations, 61 were intermediate and 57 were high dislocations. Fifty-nine per cent of the patients with low dislocation had a good final result; 47 per cent of the patients with high dislocations had a good final result; and 43 per cent of the patients with intermediate dislocation showed good final results (Table VII). The suggestion is that intermediate dislocations have a higher likelihood of damaging the outer lip of the acetabulum which may be prejudicial in achieving a good final result.

Table VII. Final radiological grading related to the height of the original dislocation

<table>
<thead>
<tr>
<th>Height of dislocation</th>
<th>Radiological grading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Low</td>
<td>6</td>
</tr>
<tr>
<td>Intermediate</td>
<td>12</td>
</tr>
<tr>
<td>High</td>
<td>11</td>
</tr>
</tbody>
</table>

Acetabular angle. The acetabular angle was the angle subtended by the slope of the acetabular bony roof and Hilgenreiner's line (the horizontal line between the triradiate cartilages). There were 54 hips with an initial acetabular angle between 30 and 40 degrees; 84 hips had an initial angle between 41 and 50 degrees; and in only nine hips was the initial angle greater than 50 degrees. A good final result was achieved by 56 per cent of hips with an acetabular angle between 30 and 40 degrees; by 44 per cent of hips with an initial angle between 40 and 50 degrees and by only 33 per cent of those with severely dysplastic acetabula (Figs 14 to 17; Table VIII).

The rate of improvement of the acetabular angle in the year following reduction significantly affected the outcome. If the angle failed to improve by at least 10 degrees in the first year the prognosis was poor: only 18
Radiographs showing an initial good acetabular angle developing into a normal hip.

Radiographs showing a poor initial acetabular angle developing into a poor hip.

Table VIII. Final radiological grading related to initial acetabular angle

<table>
<thead>
<tr>
<th>Acetabular angle (degrees)</th>
<th>Radiological grading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>30–40</td>
<td>12</td>
</tr>
<tr>
<td>40–50</td>
<td>13</td>
</tr>
<tr>
<td>&gt;50</td>
<td>—</td>
</tr>
</tbody>
</table>

per cent of such cases achieved a good final radiological result. If the acetabular angle failed to improve by 10 degrees after five years no hip developed a good final result.

Epiphysial angle. The angle between the femoral shaft and the epiphysial line was measured at presentation, at one year and at five years after operation. In 32 hips we noted that this epiphysial angle became progressively more horizontal after osteotomy or even reversed as development progressed (Figs 18, 19 and 20). Hips in which this occurred developed more valgus femoral necks, or evidence of subluxation, or both. In addition, the epiphysis frequently looked wedged, with a marked lateral bulge. Careful examination of the films has failed to show significant bony bridging across the superior portion of the epiphysial plate which would of course make such epiphysial tilting more likely to occur (Kalamchi, personal communication). No patient in this series showed a progressively more vertical epiphysial line or progressive varus of the femoral neck after osteotomy.

Radiographs to show progressive reversal of the epiphysial line in the right hip with lateral bulging of the epiphysial head and valgus femoral neck.

**COMPLICATIONS**

Avascular necrosis. Using the criteria of epiphysitis established by Salter, Kostuik and Dallas (1969) each hip was assessed sequentially for signs of avascular necrosis. This occurred in only eight hips (5.4 per cent). The age of preliminary treatment in these cases ranged from 12 to 22 months. Only one of the eight hips was finally assessed as radiologically good. Three of the hips developed premature fusion of the capital epiphysis.

Degenerative changes. The radiological signs assessed for degenerative changes were: loss of joint space; increased sclerosis of the femoral head or acetabulum at the weight-bearing segment; osteophyte formation; and cyst formation. By these criteria 65 hips (44 per cent) showed evidence of degenerative change. In the majority of these the changes were relatively minor. In 32 hips sclerosis was the only abnormality noted (Fig. 21). Eighteen hips, however, were noted to have major osteoarthritic changes (Fig. 22).
changes than one would expect at this age in the population at large (Table IX).

A comparison between the clinical result and radiological grading at final review shows that in the long term the quality of reduction does not necessarily parallel the quality of the clinical result. A subluxated hip at maturity does not necessarily cause significant symptoms and by contrast the well-reduced hip does not necessarily confer a symptom-free joint.

DISCUSSION

In 1941 Severin reviewed 315 patients treated between the age of one and three years and followed for a minimum of 14 years. They had been treated by manipulation under anaesthesia without preliminary traction. Only 15 per cent achieved a good final radiological result and the estimated incidence of avascular necrosis was 35 per cent. Massie and Howarth in 1951 reviewed 58 patients treated by open reduction between the ages of two and eight years: 70 per cent of these children were between the ages of two and four years at the time of the initial treatment. The average follow-up was 18 years and 21 per cent achieved a good final radiological result. There was a 41 per cent incidence of avascular necrosis. In 1959 Ponseti and Frigerio reviewed a series of 63 patients between the ages of one and four years, and followed for 8 to 16 years. Their treatment was also by manipulation under anaesthesia with variable use of preliminary traction and adductor tenotomy. They reported 65 per cent good long-term results with a 13 per cent incidence of avascular necrosis. In 1974 Salter and Dubos reviewed 110 patients treated between the ages of one and a half and four years by preliminary skeletal traction and subsequent open reduction and pelvic osteotomy. Their patients were followed for one and a half years to 11 years with an average follow-up of five and a half years. They reported 96 per cent good results with an avascular necrosis rate of five per cent.

Certain facts have become clear. Preliminary traction protects against avascular necrosis and those in whom traction was used routinely before open reduction show a consistently lower rate of avascular necrosis than those in whom traction was not used. As neither adductor tenotomy nor psoas tenotomy was performed in this series it would seem that their role in protecting the hip against avascular necrosis is smaller than that played by preliminary traction.

The relatively high proportion in this series with late subluxation is worrying. A clear relationship between the initial acetabular angle and subsequent progress lays stress upon the acetabular side of the problem. While accepting that the bony configuration of the acetabulum and the apparent acetabular angle are not reflections of the true cartilaginous state of the acetabulum, if the initial appearance is strikingly poor or if there is not significant improvement within one year of operation then reconstruction of the acetabular roof must seriously be considered. Late reconstruction fares less well than early reconstruction (Salter and Dubos 1974).

Derotation and varus osteotomy of the femur has two goals. It corrects the almost invariable valgus and anteversion seen with congenital dislocation of the hip, and it further tightens the capsule of the hip by a screw-home mechanism. As an elongated and abnormally shaped hip capsule is of prime aetiological importance in the development of established dislocation, it seems rational to shorten it by plication.

Much attention has been focused on the concentricity of hip reduction. This is not, of course, capable of accurate clinical interpretation. If at reduction the femoral head appears to enter deeply into the acetabulum, then reduction is frequently assumed to be concentric. This may well not be the case and indeed arthrography is a more reliable indicator of concentricity than the appearance at operation. Early lack of concentricity may well be partly responsible for the high rate of degenerative changes noted in the patients in this series.

References: See next page.
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REFERENCES


