PARALYTIC HIP INSTABILITY IN POLIOMYELITIS

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A retrospective study was made of the results of surgical treatment of subluxation or dislocation of the hip in patients who had suffered from poliomyelitis. Good results were achieved in 46% and satisfactory results in 24%. The key factors for success are muscle balance, the femoral neck–shaft and anteversion angles, and the acetabular geometry. Iliopsoas transfer can augment the hip abductor power by an average of one MRC grade. Varus derotation femoral osteotomy is important to re-establish a normal neck–shaft angle and anteversion. The results of pelvic osteotomy are variable and the importance of a posterior acetabular defect is emphasised.

In 1932, Elzinga and Key gave a good description of the clinical features and radiographic findings in poliomyelitis patients with dislocated hips, emphasising the importance of the prevention of deformities. They advocated a shelf operation for cases beyond conservative treatment. Hallock (1942) concluded that well-constructed and properly placed shelves could provide structural stability but could not improve gait. In his second paper (1950) he recommended arthrodesis for patients with painful dislocation or severe limp. Jones (1954, 1962) emphasised the correction of coxa valga by varus femoral osteotomy.

Weissman and co-authors (1959, 1961, 1969) reported the results of capsular arthroplasty in paralytic dislocation of the hip. Complications including spontaneous fusion, stiffness and recurrent subluxation were encountered. In 1968, Parsons and Seddon reported on 16 hips treated with a variety of bony realignment operations, but had to describe the results as “a catalogue of failure”. Steel (1977) mentioned in his paper on triple innominate osteotomy that 18 of the 121 hips were treated for poliomyelitis with apparently satisfactory results. Mustard described the iliopsoas transfer in 1952 and, in the latest major review of this technique, Cabaud, Westin and Connelly (1979) reported favourable results.

Our paper presents the results of a retrospective study of the surgical treatment of subluxation or dislocation of the paralytic hip in post-poliomyelitic patients in the Duchess of Kent Children’s Hospital, Hong Kong between 1961 and 1981.

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MATERIALS AND METHODS

Thirty-nine patients (16 male and 23 female) with a paralytic hip due to poliomyelitis, who had received surgical treatment for subluxation or dislocation, were studied.

Table I. Operations performed on 39 patients

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle transfer</td>
<td>15</td>
</tr>
<tr>
<td>Mustard</td>
<td></td>
</tr>
<tr>
<td>Sharrard</td>
<td>1</td>
</tr>
<tr>
<td>Femoral osteotomy</td>
<td></td>
</tr>
<tr>
<td>Varus derotation</td>
<td>11</td>
</tr>
<tr>
<td>Supracondylar derotation</td>
<td>4</td>
</tr>
<tr>
<td>Schanz</td>
<td>1</td>
</tr>
<tr>
<td>Pelvic osteotomy</td>
<td></td>
</tr>
<tr>
<td>Salter</td>
<td>19</td>
</tr>
<tr>
<td>Chiari</td>
<td>4</td>
</tr>
<tr>
<td>Steel</td>
<td>4</td>
</tr>
<tr>
<td>Shelf</td>
<td>1</td>
</tr>
<tr>
<td>Posterior acetabuloplasty</td>
<td>1</td>
</tr>
<tr>
<td>Pelvic lengthening</td>
<td>1</td>
</tr>
<tr>
<td>Open reduction</td>
<td>1</td>
</tr>
<tr>
<td>Hip arthrodesis</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
</tr>
</tbody>
</table>

Twenty-three patients (59%) had contracted poliomyelitis in the first two years of life, 92% in their first four years. The average age at operation was 13.4 years (range 6 to 38 years). The average follow-up was 9.3 years (range 2 to 22 years). In two patients (one with an arthrodesis and one after a Schanz osteotomy) the x-ray films were unsuitable for radiological assessment but both were assessed clinically.

A wide range of operations was performed and these were broadly classified into three main groups: muscle transfer, femoral osteotomy, and pelvic osteotomy (Table I). Twenty-one patients (54%) had more than one operation (Figs 1 to 3).

On follow-up, the passive range of movement and pain were recorded using Grades 1 to 6 of Merle.
d'Aubigné and Postel (1954). The walking grade in this system was not used because walking ability is a reflection of the function of both lower limbs and many of our patients had multiple lower-limb deformities. The hips were tested for any lateral or posterior subluxation; telescoping and Trendelenburg gait were noted.

The muscle charts were analysed and muscle imbalance was recorded when the sum of the muscle power of the hip flexors and adductors was three or more MRC grades greater than the sum of the hip extensors and abductors. The basis for this method of calculation is that the flexors and adductors are believed to be the deforming muscles leading to dislocation of the hips (Watson-Jones 1926).

In the radiological assessment, particular attention was paid to bony development of the femur and acetabulum. It was found impossible to measure femoral anteversion accurately in retrospect, so grades of nil, moderate and severe were used. The femoral neck–shaft angle was measured on standing anteroposterior radiographs of the pelvis. However, it must be admitted that since this view had not been standardised (a problem in most retrospective studies), there was room for error. The angle was compared with the normal value given by Lang and Wachsmuth (1972). The pre-operative and postoperative centre-edge (CE) angle and percentage coverage (Fig. 4) were also measured on standing anteroposterior radiographs. The presence of pelvic obliquity on standing or sitting radiographs was recorded as valgus (−), zero (0) and varus (+) according to Elzinga and Key (1932). Any osteoarthritic changes in the hip were noted.

The results of reduction were classified as good, satisfactory or unsatisfactory. The result was good when clinically the hip was stable and free of pain (Grade 6), the passive range of movement was good (Grade 6), the coverage was 75% or more and the CE angle was normal (Severin 1941). The result was satisfactory when clinically the hip was stable and pain-free (Grades 5 and 6) with good passive range of movement (Grades 5 and 6), the coverage was less than 75% and the CE angle was reduced. Unsatisfactory hips were unstable and painful (less than Grade 5), or the passive range of movement was restricted (less than Grade 5), or the coverage was less than 60% and the CE angle decreased.

The results of reduction were correlated with the muscle grade, the neck–shaft angle and femoral anteversion.

RESULTS

The result of reduction was good in 46%, satisfactory in 24% and unsatisfactory in 30%; muscle imbalance was found in 17.5% of good cases, 22% of satisfactory cases and 45.5% of unsatisfactory cases. An increase of femoral neck–shaft angle of 20% was found in 73% of unsatisfactory results, in 11% of satisfactory results and
in none of the good results. Severe anteversion was found in 36% of unsatisfactory results but not in the other two groups.

Cover. After pelvic osteotomy, there was an average increase of coverage of 27% (ranging from no improvement to 71%) and the CE angle improved by an average of 18.5° (ranging from no improvement to 73°). There was poor correlation between the type of osteotomy and the final result.

Pain and movement. Six patients had painful hips, recorded as Grade 5 or less: two were Grade 3 and four Grade 4. Only one patient had passive range of movement of Grade 5, all the others were in Grade 6. The patient with arthrosis is not included.

Obliquity. Five patients were found to have pelvic obliquity contributing to subluxation of the hip: in four it was due to paralytic scoliosis and one had severe abduction contracture of the opposite hip. Two of the four scoliosis patients had complete paralysis of the subluxated or dislocated hips; two underwent spinal operations which lessened the obliquity, but a good reduction was not achieved and subsequent hip operations were required. In retrospect, it was impossible to calculate the improvement in percentage coverage and CE angle obtained by correction of the pelvic tilt. The patient with severe abduction contracture of the opposite hip was treated by an extensive hip release and pelvic lengthening osteotomy. The coverage and CE angle of the subluxating hip improved by 15% and 16° respectively, and no operation was then required on this hip.

Reduction. Five patients had osteoarthritic changes in the hips. All of them had unsatisfactory reduction and four had significant pain: two were Grade 3 and two Grade 4. One patient had an open reduction with the hip immobilised in a spica for three months, but two months after removal of the cast the hip dislocated again.

Muscle power. Before operation, the average muscle power for the hip abductors and flexors was 1.5 and 4.1 respectively; after the transfer the average muscle power was 2.5 and 3.3 respectively. No patient had abolition of the Trendelenburg gait. The only patient with a Sharrard transfer had no improvement of abduction and extension power but the flexion power decreased by one MRC grade.

DISCUSSION

Although paralysis occurs early, subluxation of the hip may develop insidiously and is often unnoticed; by the time surgical intervention was needed, most patients were in their teens. It was common to find grossly subluxated or dislocated hips reducing easily on traction and abduction (Figs 5 to 8); this was because the muscles were flaccid, the capsule was lax and there was no intra-acetabular obstruction. The limbus remains everted because there is no oft-repeated active flexion and extension (Somerville 1959). Reduction and splintage is useless because the causes of dislocation are unchanged.

In patients with bilateral lower limb weakness it is our experience that the subluxated hip is usually in the stronger limb. Dislocation in a completely paralysed hip is uncommon but does occur and is associated with pelvic obliquity, which is usually a sequel to paralytic lumbar scoliosis.

There are two groups of patients with subluxation or dislocation in poliomyelitis. In the first group, the basic pathology is muscle imbalance, the hip flexors and adductors usually being stronger than the extensors and abductors. Unlike Elzinga and Key (1932) we found that the lateral rotators were slightly stronger than the medial rotators. As demonstrated by Brookes and Wardle (1962), the development of the femur is influenced by muscle pull. Coxa valga occurs in poliomyelitis because the iliopsoas muscle is stronger than the weak glutaeus medius and minimus; and with this increased coxa valga, the iliopsoas acts as a lateral rotator because of changes in the axis of rotation of the femur (Somerville 1959).

Fifty-nine per cent of our patients contracted the
disease in the first two years of life before they started to walk. The maturation of bony development of the hips depends on normal weight-bearing in early childhood and, in the absence of this stimulus, the acetabulum may remain shallow and underdeveloped, and the femur may retain the large neck-shaft angle and anteversion of infancy. The greater the coxa valga, the greater will be the tendency to subluxation (Somerville 1959). Despite all these factors, the femoral head usually remains located and reasonably contained for some years.

In the second group of patients, the subluxation or dislocation is provoked by pelvic obliquity leading to poor coverage of the higher hip. The resultant forces in the hip are directed towards the outer part of the acetabulum, thus favouring dislocation (Merchant 1965; Bjerkreim 1974). Pelvic obliquity can be due to a suprapelvic cause such as lumbar scoliosis or to an infrapelvic cause such as severe fixed abduction or adduction contracture of one hip (Mayr 1931).

Somerville (1959) found that pelvic obliquity due to spinal deformity was difficult to correct and maintain because the scoliosis was likely to progress. He therefore advocated no operation for a dislocated hip associated with pelvic obliquity caused by scoliosis. O'Brien, Dwyer and Hodgson (1975) described good correction of pelvic tilt by Dwyer instrumentation of the spine coupled with posterior spinal fusion. In two of our patients the hips were incompletely reduced after correction of scoliosis: one of them subsequently had a varus derotation femoral osteotomy and a Chiari osteotomy with a satisfactory result; the other had a Salter innominate osteotomy but the result was unsatisfactory. The other two scoliotic patients did not undergo spinal operation, but both had a varus derotation femoral osteotomy and a pelvic osteotomy with good results.

In the patient with a subluxating hip due to pelvic obliquity caused by abduction contracture of the opposite hip, the subluxated hip was better contained after the correction of the abduction contracture (Figs 9 and 10).

Choice of treatment. In treating paralytic dislocation of the hip associated with fixed pelvic obliquity, improvement of pelvic tilt should be considered. It can be achieved by correcting scoliosis or by femoral osteotomy (Somerville 1959; Weissman et al. 1961). Excessive anteversion can also be corrected during femoral osteotomy. Any other abnormality such as acetabular deformity or muscle imbalance should also be corrected whenever possible. Our good results were obtained in those patients where the muscle imbalance was corrected and satisfactory femoral neck-shaft angle and anteversion was achieved.

As muscle imbalance is the main aetiological factor for hip subluxation or dislocation, it is rational to achieve a better balance by tendon transfer. The anterolateral transfer of iliopsoas by the Mustard procedure is useful in well-selected patients (Mustard 1952, 1959). In our study, it augmented the abduction power by one MRC grade and diminished the flexor power. This is important as it weakens the deforming force. In all our patients, the abduction lurch persisted, but Mustard (1959) and Parsons and Seddon (1968) reported that a dipping gait might be abolished. We agree with Mustard that absence of abductor power is an indication for operation at an early age as this can prevent subsequent bony changes. Even in patients who require femoral osteotomy for correction of coxa valga, muscle transfer is still useful because it helps to prevent recurrence of coxa valga and progressive subluxation, especially in patients with much growth potential. Parsons and Seddon also found relapse of coxa valga after femoral osteotomy. One of our patients required a second varus osteotomy to correct recurrence of coxa valga. Our experience with the Sharrard operation is too limited for comment.

A normal femoral neck-shaft angle is another key factor for good results. Subtrochanteric femoral osteotomy can correct both coxa valga and excessive anteversion and thus improve the containment of the femoral head. Varus osteotomy also improves the balance of existing muscles (Jones 1962). However, as shown in the arthrographic study by Weissman (1959), even after subtrochanteric osteotomy the femoral head will not be able to reach the bottom of the acetabulum when the hip is in

Figure 9 – Radiograph of a 15-year-old boy with a subluxating right hip due to pelvic obliquity caused by a fixed abduction contracture of the left hip. Figure 10 – Three years after hip release and a pelvic lengthening operation on the left hip, the coverage of the right hip is improved.
extension and medial rotation and the reduction will be incomplete. Changes in the acetabulum were common; often it was shallow with increased inclination and sometimes the posterior wall was defective.

Various types of pelvic osteotomy have been extensively discussed in the literature (Salter 1961, 1966; Chapchal 1974; Chiari 1974; Hoffman, Simmons and Barrington 1974; Mitchell 1974; Salvati and Wilson 1974; Utterback and MacEwen 1974; Steel 1977; Handelman 1980). Many of the discussions have centred on their use in congenital dislocation of the hip, but it is important to realise that in poliomyelitis the femoral head dislocates posteriorly (Elzinga and Key 1932; the lateral coverage of the femoral head. A CT scan would be better.

Although pelvic osteotomy has a definite role in improving the coverage of the femoral head, the results are variable. There is also a poor correlation between the types of pelvic osteotomy and the final results. It seems that the experience of the surgeon is a more important factor. In one patient posterior dislocation of the hip was associated with fixed flexion-adduction contracture. The hip was not reducible and was causing considerable pain on sitting and in bed. A Schanz osteotomy gave relief of pain and improvement in gait.

Hip arthrodesis was reported by Hallock (1950) and Sharp et al. (1964) as a useful procedure to improve gait, increase endurance and eliminate the need for external support. Good abdominal muscles, a good contralateral gluteus medius, satisfactory hip flexor power, a stable knee and no significant deformity of the foot and ankle are the prerequisites. Our only patient with hip fusion, however, complained of difficulty in sitting. This is important as many poliomyelitis patients are engaged in sedentary jobs.

In conclusion, poliomyelitis patients with hip subluxation or dislocation should be treated by re-establishing the muscle balance, and restoring a normal femoral neck–shaft angle, normal anteversion and normal acetabular geometry. Repair of any posterior acetabular wall defect should be considered, but arthrodesis should be reserved as a salvage procedure.

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REFERENCES


