PELVIC OBLIQUITY AND THE UNSTABLE HIP AFTER POLIOMYELITIS

CHARLES F. EBERLE

From King Faisal Specialist Hospital and Research Centre, Riyadh

Of 400 patients with disabilities resulting from poliomyelitis, seen at the King Faisal Specialist Hospital and Research Centre between June 1976 and April 1978, 32 required surgical correction of abduction contracture on one side associated with severe pelvic obliquity of infrapelvic origin causing the opposite “high” hip to be unstable. Rather than directing treatment toward the unstable hip initially, the more appropriate management was to release the abduction contracture completely. The obliquity was thereby corrected and, often, the previously unstable hip became functionally stable and required no further operative treatment.

The aetiology of paralytic dislocation of the hip after poliomyelitis is generally attributed to muscle imbalance about the unstable hip. The usual pattern of imbalance has been defined as weakness or total paralysis of the abductors and extensors with normal or near normal flexor and adductor muscles, leading to progressive valgus of the upper femur and lateral and superior subluxation of the femoral head. The treatment recommended generally includes restoring the muscle balance, by converting flexion to abduction power, and osteotomy of the femur to correct valgus.

Deformity resulting from poliomyelitis is a major medical problem in Saudi Arabia. In most of the patients with this deformity treated at the King Faisal Specialist Hospital and Research Centre there is no muscle imbalance in the unstable hip, which is frequently flail. As the instability seemed to be related to significant pelvic obliquity (Mayer 1936) secondary to contracture of the abductors on the contralateral side, a prospective study was designed to evaluate the treatment for these deformities.

MATERIAL AND METHODS

Each patient referred with a clinical diagnosis of poliomyelitis is seen by members of the orthopaedic staff who define the objects of treatment, by a physiotherapist who measures the contractures, and by the audiovisual staff who record the gait pattern; radiographs are taken. The patients and their families are then taught remedial exercises to stretch contractures and to strengthen all functional muscles that can be identified.

Between June 1976 and April 1978, 400 patients with disabilities resulting from poliomyelitis were seen but 20 per cent failed to keep follow-up appointments before surgical treatment was initiated. Of the 328 patients remaining, 87 per cent had major involvement of the lower limb. Contractures about the hips were sufficiently severe in 140 patients for surgical release to be indicated. Thirty-two of these patients had significant pelvic obliquity due to unilateral abduction or abduction-flexion contracture; the opposite, “high”, hip was often unstable. This group constitutes the patient population which is the subject of this report (Table I).

<table>
<thead>
<tr>
<th>Flail</th>
<th>Subluxated “high” hip</th>
<th>Dislocated “high” hip</th>
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<tr>
<td></td>
<td>14</td>
<td>7</td>
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<tr>
<td>Flexion contracture or active flexor and absent abductor</td>
<td>5</td>
<td>6</td>
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In 11 of the 32 patients, there was either a flexion contracture which required release or a strong flexor with absent abduction on the unstable side. In the rest, the “high” hip was flail. In each group some hips were dislocated or dislocatable and some subluxated (Table I). Only one patient in the first 400 had an unstable hip without pelvic obliquity; this was attributed to muscle imbalance about the unstable hip.

ILLUSTRATIVE CASE REPORT

Case 1. This two-year-old girl was first seen in December 1970 with an abduction contracture, marked pelvic obliquity, and dislocation of the hip on the “high” side (Fig. 1). There was a good flexor muscle on the dislocated side without contracture. She underwent open reduction...
with a Salter osteotomy of the pelvis and derotational osteotomy of the femur (Fig. 2). Nothing was done to the abduction contracture on the opposite side. Within three months her hip had redislocated. A varus osteotomy and ilopsoas transfer to the trochanter was then done (Fig. 3). Again, within several months the same hip was again dislocated (Fig. 4). Finally, recognising the significance of the obliquity and contralateral abduction contracture, the latter was released and she has since remained stable (Fig. 5).

After one other case of early recurrent dislocation following surgical treatment directed to the unstable hip, and after seeing other patients in the clinic with this complication, we altered our approach. Surgical correction of the infrapelvic obliquity became the primary goal of the initial surgical procedure. We found that in patients where the "high" subluxated unstable hip was flail, correcting the obliquity by release of the contralateral abduction contracture was often all that was necessary to convert the unstable hip to stability in the weight-bearing posture. After complete release on the abducted side, the patient can be braced and can walk, frequently without any operation on the flail, previously unstable side. The radiograph confirms the stability of the hip after this procedure (Figs 6 to 8).

**THE RELEASE PROCEDURE TO CORRECT OBLIQUITY**

If there is significant flexion contracture with abduction contracture, the longitudinal incision is preferred as skin closure is facilitated. If there is relatively little flexion deformity, the transverse incision at the anterior superior spine is preferred as it is cosmetically more acceptable.

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**Case 1.** Figure 1—Initial radiograph showing the abduction contracture on the right and dislocation of the left hip. Figure 2—After a Salter osteotomy of the pelvis and derotational osteotomy of the femur. Figure 3—Three months later, after the second femoral osteotomy performed to correct redislocation. Figure 4—A further dislocation three months after the second operation. Figure 5—Three years after closed reduction on the left and abduction release on the right.

**Case 2.** Figure 6—Initial radiograph showing abduction of the left hip and subluxation of the right hip with flexion contracture. Figure 7—After release of the abduction and the flexion contracture. Figure 8—One year after release the hip remains stable.
The lateral femoral cutaneous nerve is identified and preserved, for if it is divided at the crest a tender neuroma may well ensue.

Every tight fascial structure that by palpation prevents extension and adduction to neutral is divided. If muscle is found, the fascial bands are released leaving the muscle tissue intact. The anterolateral fascia, tensor fascia lata, the fascia covering the gluteus medius and minimus, and occasionally the superior capsule of the hip are released in pure abduction deformity. Usually, it is also necessary to release the anterolateral portion of the gluteus maximus fascia which blends into the iliotibial band. If flexion deformity is also present, the sartorius, rectus, and iliopsoas fascia and occasionally the tendon of the iliopsoas are divided to obtain correction. The release is considered complete when the hip can be extended and adducted to neutral. All structures that can be felt to restrict adduction to the neutral position are, by the end of the release procedure, divided. The dead space is then closed as much as possible by bringing subcutaneous tissues against the underlying soft tissues and wing of the ilium. Skin closure can be obtained without tension if the appropriate incision is made, determined by the presence or absence of flexion contractures. With release of the abduction of abduction-flexion deformity, the pelvic obliquity is corrected and the contralateral unstable hip appears stable. If on the side of the instability there is a flexion contracture, it is released. If the iliopsoas is active, it can be transferred to the trochanter as described by Mustard (1959) or Sharrard (1964) to provide greater stability and better gait. Intravenous cephalothin is used during the operation and for two days afterwards.

After closure, bilateral long leg casts are applied. The casts are then positioned to correct the pelvic obliquity. The previously abducted hip is held in neutral or in slight adduction. In this position, maintained by a pair of crossbars between the casts (Fig. 9), the previously subluxated hip is usually well centred in the acetabulum. The casts are left on for four weeks. The patient is nursed prone for at least four hours each day to stretch out any residual flexion deformity, and allowed to sit for part of the time.

When the casts are removed the child is fitted with braces and started immediately on gait training with parallel bars, a walker, and finally crutches. The parents are instructed to remove the braces regularly for exercises against increasing resistance to improve the range of movement and, most importantly, to stretch the limbs to prevent recurrence of the deformity.

Several points need emphasising. The surgical release of the abduction contracture has to be complete. In many of the cases, the most rigid structure maintaining abduction deformity is the anterolateral portion of the gluteus maximus. Only when this is released can the abducted hip be adducted to neutral. The anterosuperior capsule of a lesser number of patients also requires release to allow adduction and extension. Finally, nursing prone during the period of immobilisation and stretching exercises after removal of the casts are integral parts of the surgical treatment and vital to maintain a good result.

**MANAGEMENT OF THE DISLOCATED HIP**

If the dislocated hip is flail, closed reduction is usually all that is necessary, after the correction of pelvic obliquity, for the hip to be stable in the weight-bearing posture. If the radiographs before operation demonstrate acetabular slope such that even with correction of the obliquity there may well be residual instability, an innominate osteotomy may be done to enhance stability (Figs 10 and 11). When flexion deformity or muscle imbalance with absent abduction and good flexion is present on the unstable side, open reduction may be necessary. Fibrotic flexion contractures are released and the normal or near normal iliopsoas is transferred to the trochanter. It is sometimes helpful to supplement the open reduction and transfer with innominate osteotomy. The Chiari osteotomy combined with femoral shortening has been reserved for older patients with incongruity.

**Postoperative management** of the patients treated by release of the contractures with either open reduction, iliopsoas transfer or osteotomy is the same as for those treated by release alone except that the long leg casts are left on for eight weeks instead of four. Then the same programme of bracing, gait training and exercises is carried out. Any plates or screws are always removed within a year.
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Table II. Surgical treatment on the unstable flail hip (after release of the contralateral hip)

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<tr>
<th>Procedure</th>
<th>Subluxed</th>
<th>Dislocated</th>
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<tbody>
<tr>
<td>Closed reduction</td>
<td>14</td>
<td>3</td>
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<tr>
<td>Closed reduction with innominate osteotomy</td>
<td>3</td>
<td></td>
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<tr>
<td>Open reduction with Chiari osteotomy and femoral shortening</td>
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Table III. Surgical treatment on the unstable hip with flexion contracture or good to excellent iliopsoas function (after release of the contralateral hip)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Subluxed</th>
<th>Dislocated</th>
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</thead>
<tbody>
<tr>
<td>Release and closed reduction</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Transfer and closed reduction</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Release and open reduction</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Transfer and open reduction</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Release and open reduction with innominate osteotomy</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Transfer with Chiari osteotomy, open reduction and femoral shortening</td>
<td>1</td>
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</tbody>
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RESULTS

Of the 32 patients (Tables II and III) treated surgically between December 1976 and April 1978 for significant pelvic obliquity of infrapelvic origin and associated instability of the “high” hip, two have been lost to follow-up. In the remaining 30 patients followed two to four years, there has been no dislocation or subluxation apparent in the follow-up radiographs, films of the pelvis being taken standing and supine to evaluate the stability and maintenance of correction. Of the patients treated by release only, all but two are walking with aids. In the other two children the weakness in the spine and arms was so severe that all attempts to walk were so exhausting that finally each had to revert to a wheelchair. Their operations, however, facilitated nursing care and ease of transfer and seemed justified on this basis alone.

In several cases mild contractures recurred, but on careful questioning it became apparent that stretching exercises had not been continued. After resumption of stretching, the recurrent contractures resolved except in one person where the obliquity was part of a scoliosis with contracture of spinal muscles. In this case, the hip remained stable in the weight-bearing posture. In a few postoperative films, there were changes on the femoral epiphysis of the dislocated hips suggesting avascular necrosis. In no case did these changes persist in follow-up films. There was no infection in this series of patients.

It is important to emphasize that in all patients correction of the deformity and resumption of an upright posture placed many muscles previously graded as poor into a more appropriate position. Thus, in several patients, these muscles improved as much as two grades in the muscle test. On the basis of this experience, we have tended to be aggressive in releasing deformity as we cannot predict the real potential for walking in a child with severe contractures. We have been surprised by the extent of rehabilitation in many as soon as the lower limbs can resume the normal weight-bearing relationship to the pelvis.

DISCUSSION

In his monograph Professor Clark (1969) described, in patients who had had poliomyelitis, fibrotic contracture in certain muscles where normal elastin was replaced by collagen that histochemically resembled collagen in tendons. The resultant tissue was rigid rather than elastic. This type of fibrotic contracture is to be distinguished from adaptive muscle shortening resulting from malposition. It is not clear why some muscles become fibrotic and contracted while others become weakened. In the group of patients treated at the King Faisal Specialist Hospital and Research Centre, it was characteristically the tensor, gluteus medius, anterolateral portion of the gluteus maximus and less often the iliopsoas which developed fibrotic contracture as the result of the illness, while the adductors were just weak. Both Clark (1969) and Tachdjian (1972) indicated that the fibrotic contractures do not respond to stretching and this has certainly been our experience. Conversely, adaptive shortening, as is commonly seen with the iliopsoas, does respond to stretching. Sometimes it is difficult to make this differentiation early in the management of these children so stretching is our initial approach to all contractures. All abduction contractures causing pelvic obliquity eventually required surgical release.

The literature suggests that, after releases, recurrence of the deformity is common, and also that releases cannot be expected to correct severe deformity (Ober 1927; Irwin 1949; Barr 1950; Tachdjian 1972; Ingram 1980). We have seen, however, that if the release is radical enough, even the most severe deformity can be completely corrected. If stretching exercises are carried out regularly after releases, recurrence of the deformity can be prevented even in a growing child. Stretching has also been effective in treating mild contractures which have developed as a result of neglect in the early postoperative period.

The dislocation or subluxation on the “high” side has been attributed to ipsilateral contractures of the iliopsoas and adductors with resultant adaptive bony changes of valgus and acetabular deficiency. In this series we saw no adduction contractures. In the majority of patients the unstable hip was flail. This suggests that the obliquity secondary to abduction contracture may in itself precipitate instability of the contralateral hip without any contribution of muscle imbalance on the unstable side.

Several patients have been seen in whom the pelvic obliquity was part of a rigid scoliosis and not associated
with the contractures about either hip. In this condition, the obliquity persists with the patient sitting and is associated with contracture of abdominal and spinal musculature. In all these patients the hip muscles, particularly the abductors, retained a normal range of movement and power on the "high" side and no instability was present. Treatment has been directed to management of the spinal problem as outlined by O'Brien, Dwyer and Hodgson (1975). In none of these patients did an abduction contracture develop secondary to the scoliosis if the muscles about the hip were normal in range of movement and power when the patient was first seen.

Some patients after correction of the pelvic obliquity due to abduction contracture have residual scoliosis in the lumbar area either with or without contracture of spinal and abdominal musculature. When the pelvis is level in the weight-bearing position, the scoliosis and attendant abnormal relationship of the spine to the pelvis has not in itself caused any functional instability of the hip. Appropriate shoe lifts with or without braces are necessary to keep the pelvis level in the weight-bearing posture and thereby maintain functional stability of the previously unstable hip. It may be that some of the abduction contractures we have treated were secondary to pelvic obliquity caused by the scoliosis, but the release of the abduction deformity of the hip (whether it was primary or secondary) to produce a level pelvis in the weight-bearing posture resulted in stability. The abduction deformity is always released first and the scoliosis treated after the pelvis is level in the weight-bearing position. Often, the scoliosis is compensatory and corrects with levelling of the pelvis.

Frank dislocation occurs more frequently if flexion contracture or active flexion is present on the potentially unstable "high" side. Other authors (Ober 1927; Irwin 1949; Barr 1950; Weissman, Torok and Khermosh 1961; Tachdjian 1972; Ingram 1980) state that valgus is generally present as part of the picture. In our experience, once the obliquity due to abduction contracture has been corrected and the correction maintained, the valgus itself has not been an impediment to functional stability of the previously unstable hip; this is a somewhat different pattern from that reported by Somerville (1959).

I have had no experience with soft-tissue reconstruction to reinforce active abduction or extension of the hip using spinal or abdominal muscles (Irwin 1947; Mustard 1959). No femoral osteotomies or capsular arthroplasties have been done to correct obliquity or stabilise a hip (Irwin 1947; Weissman 1959; Weissman et al. 1961). Iliopsoas transfer, as described by Mustard (1959) or Sharrard (1964) can be done when the muscle is functional. More recently, when adductors have been found to be near normal on the unstable side, the adductor longus and gracilis have been transferred to the ischium primarily to enhance the stability and reduce deforming forces (London and Nichols 1975). Insufficient time has elapsed to determine whether this is of any significant benefit. We have continued to use the approach outlined in the paper with no other modification and have yet to see recurrence of instability when weight-bearing in our patients.

In summary, pelvic obliquity secondary to abduction contracture of the stable side must be corrected before one can anticipate successful management of the unstable "high" hip in a patient with residual effects of poliomyelitis and this correction must be maintained by exercises. In many patients, this is often all that is necessary to convert an unstable hip to one which is stable in the weight-bearing posture.

I would like to express my appreciation to Dr Loren Larsen for his constructive suggestions in the preparation of this report.

REFERENCES