LEG LENGTHENING BY THE TRANSILIAC METHOD

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The transiliac method of leg lengthening uses a modification of Salter’s innominate osteotomy. The bone graft increases the length of the hemipelvis distal to the sacro-iliac joint.

Leg-length inequality in 23 patients was treated by this method with an average gain in length of 2.8 cm (2.0 to 3.5). Apart from one residual femoral nerve palsy there were no notable complications. The facility to redirect the acetabulum allowed by the technique, may be useful in cases of potential hip instability or acetabular dysplasia.

The technique of gradual distraction used for the correction of leg-length inequality draws heavily on the resources of the patient and the attending medical team. Without a considerable investment in equipment and expertise, consistently successful results are not attained.

In a review of current methods of leg lengthening, Paley (1988) excluded one-stage procedures from discussion as “not practical for most discrepancies or indications”.

Most patients with leg-length inequality have discrepancies of less than 6 cm. Shapiro (1982), studying 803 such patients, found less than 10% with an inequality of more than 6 cm. An effective one-stage lengthening method which can give 3 cm of lengthening of the short leg, reducing the discrepancy to an acceptable degree, is a desirable alternative. If such a technique were simple and safe, did not require intensive support services, and allowed early active mobilisation with a minimum of late complications, it would have added merit.

In 1979 Millis and Hall described a modified innominate osteotomy for the treatment of postural imbalance. They lengthened the hemipelvis in 20 patients aged between five and 20 years with problems such as acetabular dysplasia with ipsilateral femoral shortening, simple leg-length inequality, primary intrapelvic asymmetry, and decompensated scoliosis. Lengthening of up to 3 cm with the option of a variable amount of acetabular redirection was possible. This latter facility may offer the benefits of lengthening to certain patients who might otherwise be excluded from conventional lengthening techniques because of fears for a potentially unstable hip.

In Salter’s innominate osteotomy minimal leg lengthening may occur as a secondary effect. This is minimised by preservation of the posterior periosteum, thereby keeping the osteotomy closed posteriorly while allowing it to open anteriorly to achieve redirection of the acetabulum. In the modification used in transiliac lengthening complete periosteal release allows distraction at the osteotomy (Fig. 1). Limiting factors are the risks of necrosis of cartilage, osteonecrosis of the femoral head, sacro-iliac subluxation, and neuropraxia.

PATIENTS AND METHODS

Between 1986 and 1988, 23 patients with leg-length discrepancy underwent transiliac lengthening. The various causes are shown in Table I.

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Before operation all skeletally immature patients had growth studies comprising serial radiographs and bone age determinations. The straight line graph method of Moseley (1978) was used to estimate predicted discrepancies.

There were 15 female and eight male patients. The age range at operation was between 5 years 10 months and 21 years 5 months (mean 14 years 1 month). The length of follow-up varied between 15 and 44 months (mean 30).

Operative technique. We use a modified Smith–Peterson approach as described by Salter (1972). After innominate osteotomy, distraction is achieved by the use of a lamina spreader between the bony fragments combined with traction on the leg and distally directed pressure on the iliac crest to protect the ipsilateral sacro-iliac joint.

An iliopsoas tenotomy is routinely performed to avoid the development of excessive pressure within the

<table>
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<th>Diagnosis</th>
<th>Number</th>
<th>Age range (yr:mth)</th>
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<tbody>
<tr>
<td>Congenital hip displacement with physeal injury</td>
<td>5</td>
<td>5:10 to 16:7</td>
</tr>
<tr>
<td>Spina bifida (diastematomyelia)</td>
<td>4</td>
<td>10:6 to 16:11</td>
</tr>
<tr>
<td>Septic arthritis of hip</td>
<td>3</td>
<td>10:7 to 19:4</td>
</tr>
<tr>
<td>Cerebral palsy (hemiparetic)</td>
<td>3</td>
<td>13:0 to 16:3</td>
</tr>
<tr>
<td>Fixed pelvic obliquity</td>
<td>2</td>
<td>17:2 to 21:5</td>
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<td>Malunion femoral fracture</td>
<td>1</td>
<td>19:9</td>
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<tr>
<td>Osteomyelitis femur</td>
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<td>19:10</td>
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<tr>
<td>Poliomyelitis</td>
<td>1</td>
<td>16:10</td>
</tr>
<tr>
<td>Klippel–Trenauney syndrome</td>
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<td>7:3</td>
</tr>
<tr>
<td>Trevor’s disease</td>
<td>1</td>
<td>12:6</td>
</tr>
</tbody>
</table>

Table 1. Details of 23 patients who had transiliac lengthening

Male, aged 13, with a history of neonatal septic arthritis, who presented with pain and impaired mobility. Predicted length discrepancy at maturity was 5.5 cm. Radiographs before (a) and after (b) transiliac lengthening, after transfer of the greater trochanter (c), and at review three years later (d). Leg-length discrepancy was reduced to 2.5 cm. The range of hip movement was not affected.
hip. An appropriately shaped bone graft is fashioned from the exposed anterior iliac crest (Fig. 1) and held in place with threaded pins passed posteriorly and medially to the hip (Fig. 2).

The additional procedure of trochanteric transfer is indicated when there is relative overgrowth of the greater trochanter (Fig. 2c). Transfer enhances the power of the abductor muscles and may improve the range of abduction and minimise the incidence of late degenerative arthritis (Wedge and Salter 1974). The trochanter should be moved both distally and laterally (Fig. 2c).

Postoperatively, patients under 12 years of age are immobilised in a 'one-and-a-half' spica cast in which early mobilisation and discharge are allowed. The mean duration of hospital stay in such cases is one week. The child is readmitted at six weeks, the spica and transfixed pins are removed and mobilisation towards full weight-bearing commenced. Crutches are usually discarded two or three weeks later.

In older patients immobilisation in a spica cast is generally not required because they are better able to understand and comply with the physiotherapy programme. In the immediate two or three days after operation the leg is nursed in flexion with the knee on pillows. Subsequently, patients are allowed to mobilise with crutches bearing no weight and are discharged at two or three weeks.

At review the clinical measurement of leg length relied on the use of blocks under the short leg to balance the pelvis. The alteration to the external shape of the pelvis, resulting from the use of the anterior iliac crest as donor for the interpositional bone graft, destroys the usual landmarks of clinical measurement. Similarly, because of the intrapelvic lengthening and alteration in level of the ischial spines, the inferior margins of the sacro-iliac joints were used for radiological measurement of leg lengths.

**RESULTS**

In our series an average lengthening of 2.8 cm was achieved (2.0 to 3.5). At review 16 (70%) of the patients were judged to have had a successful lengthening, that is a final leg inequality of less than 2.5 cm and with no significant complication arising from the surgery. The procedure produced inadequate lengthening in six patients. One major complication attributable to the technique, a femoral nerve palsy, occurred in a patient whose inequality was secondary to a congenital scoliosis with a hemivertebra at L4 and pronounced pelvic tilt after lumbar fusion. The neurological deficit remains after three years.

There was successful lengthening in all five patients with inequalities due to physeal injury, sustained during closed treatment of congenital dislocation of the hip, and in two of the three patients with previous septic arthritis. In the third patient the innominate osteotomy was performed above an already stiff hip, contravening one of Salter's prerequisites for successful outcome (Salter 1972). The hip became more stiff.

Unsatisfactory results were seen in half of the group with miscellaneous conditions. This reflected the temptation to extend the application of this technique to length inequalities outside the limited scope of hemipelvic lengthening.

There were some minor complications which did not interfere with the final outcome. Postoperative superficial wound infections in two patients responded rapidly to appropriate antibiotics. Four patients from the groups with spina bifida and cerebral palsy were slow to mobilise independently, requiring crutch support for an extended period; this was probably the result of the underlying pathology rather than the surgical procedure. A case of transient postoperative deficit of the femoral nerve resolved spontaneously within one week. One of the fixation pins broke during the mobilisation period without associated symptoms. This has been left in situ.

Other complications typical of long-bone lengthening techniques were not encountered. There were no nonunions, displacements or late fractures. Loss of graft height occurred once, and was attributed to early weight-bearing in a 20-year-old patient.

The ranges of motion at the hip and knee were not affected, even in patients who would have been considered unsuitable for conventional lengthening owing to their already compromised joints. Injury to the ipsilateral sacro-iliac joint due to the intrapelvic distraction was not observed either clinically or radiologically.

Three patients with congenital dislocation of the hip and two with septic arthritis required distal transfer of the greater trochanter. These transfers improved the radiological appearances of the hip (Fig. 2d) and increased the abductor muscle function.

**DISCUSSION**

There are a number of advantages and disadvantages of this technique which distinguish it from previously reported methods. It requires no sophisticated equipment or attendant specialised care, and minimises the period of hospital treatment. There is inherent mechanical stability of the osteotomy by virtue of its location within the pelvis, avoiding the problems of the more distally based long-bone osteotomies. The osteotomy is carried out through cancellous bone with rapid healing and incorporation of bone graft. This allows early rehabilitation and obviates the need for continuing internal fixation.

Femoral lengthening in the presence of acetabular dysplasia may decrease further the cover of the femoral head and increase the risk of joint instability and secondary osteoarthritis. The benefits of acetabular redirection have already been emphasised. The cosmetic effect of limb inequality is also an important aspect. With
this technique the operation incision is easily covered by the minimum of clothing.

As this is a one-off procedure, involving a predicted leg inequality of limited proportion and with a specific corrective potential, the timing of surgery is not critical and can be scheduled to suit the patient. There may also be a place for its use as an interim procedure in young patients, with predictably large discrepancies, until the child has matured enough to embark on a distraction programme. The compensatory mechanisms of constant toe-walking on the short side or knee flexion on the long side, with the risk of developing secondary contractures, would be avoided.

One of the major disadvantages is the limited potential for correction with a procedure which many would consider technically demanding and hazardous. Innominate osteotomy is not for the occasional operator and its modification to achieve lengthening carries its own inherent problems. There is a risk of nerve traction injury as with other immediate distraction techniques. For anatomical reasons, it is not suitable for discrepancies secondary to tibial shortening since it would create an imbalance at knee level.

The temptation to extend the application beyond its limitations must be resisted. Prerequisites for a successful outcome are similar to those of Salter's osteotomy. With careful selection of patients it can reliably provide up to 3 cm of lengthening at the level of the pelvis with a low morbidity.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


