SPINAL OSTEOTOMY FOR SEVERE KYPHOSIS IN CHILDREN WITH MYELOMENINGOCELE

H. B. ECKSTEIN and R. M. VORA, LONDON, ENGLAND

From the Hospital for Sick Children, Great Ormond Street, London, and
Queen Mary’s Hospital for Children, Carshalton, Surrey

Severe kyphosis or kyphoscoliosis is not infrequently associated with myelomeningocele. This complication may be caused by faulty development of the affected vertebral bodies, or it may arise from lateral displacement of the spinous processes and therefore of the erector spinae muscles. Such displacement may convert these extensor muscles into flexors, thus unbalancing the normal muscular control of the vertebral column (Hoppenfeld 1967). In most cases the kyphosis is in the lumbar spine and it is always progressive.

Several problems may be the consequence of severe kyphosis. Firstly, it may be impossible to achieve primary skin closure over the protuberant bone (Fig. 1). Secondly, even if skin

Fig. 1
Newborn baby with severe kyphosis making skin closure impractical.

Fig. 2
Chronic ulceration over a kyphos.
cover can be obtained by primary closure or secondary epithelialisation, recurrent ulceration over the kyphos may lead to chronic debility (Fig. 2). Thirdly, the child with severe kyphosis cannot be placed in an upright position even with the help of full-length calipers with waistband and thoracic band, and walking even with calipers and crutches becomes impossible (Fig. 3).

![Fig. 3](image)

**Fig. 3**
This child has had operation on the hips but gross kyphosis does not allow an erect posture to be attained.

![Fig. 4](image)

**Fig. 4**
The short anterior abdominal wall associated with the kyphosis makes urinary diversion impractical.

Fourthly, the kyphos reduces the area of the anterior abdominal wall to such an extent that a urinary diversion procedure becomes impossible; even if a diversion procedure has been done, it is impossible to fit a satisfactory appliance (Fig. 4). Fifthly, compression of the abdominal cavity leads to elevation of the diaphragm and embarrassment of respiration. Finally, the costal margin impinges on the pelvic crest, causing discomfort or pain.

It is for these reasons that correction of kyphosis has to be undertaken in some patients with myelomeningocele. Spinal osteotomy was done by Kilfoyle, Foley and Norton (1965) by excising vertebral bodies, and Sharrard (1968) reported the operation of spinal osteotomy in children with myelomeningocele.
CLINICAL MATERIAL

This paper reports sixteen patients with myelomeningocele in whom spinal osteotomy was performed. One of the patients was a newborn baby; the age distribution of the others is shown in Table I. The operations were performed in the five-year period 1966 to 1970, during which the senior author was involved in the care of some 700 patients with myelomeningocele.

In one patient the osteotomy was performed to enable primary skin closure to be made. In three patients it was done to allow urinary diversion to be undertaken. In the remaining twelve the indication for osteotomy was usually a combination of recurrent ulceration over the kyphos and inability to obtain an upright position with calipers.

Since spinal osteotomy in this group of children with an Arnold-Chiari malformation may interfere with the circulation of cerebro-spinal fluid, it is essential either to have a functioning ventriculo-atrial shunt in position or to make a prophylactic burr hole so that a ventricular tap may be performed as an emergency measure. Two of the patients who appeared to have a so-called “arrested” hydrocephalus developed obvious signs of raised intracranial pressure soon after spinal osteotomy.

The operation can be performed safely in the presence of trophic ulceration provided there is no severe infection, and in practice it was found impossible to promote healing of such trophic ulcers by conservative means. Spinal osteotomy should be performed only in those children who have total paralysis below the spinal lesion because the osteotomy would certainly cause further neurological deficit, either by injury to the spinal cord or nerve roots or by interference with its blood supply. In our experience, children with myelomeningocele associated with severe kyphosis always have total paralysis below the lesion.

Figure 5 shows the situation at operation. The operation consists essentially in removing one, two or three vertebral bodies with their transverse processes. The line of division is through a body and not through an intervertebral disc. The spinal cord can either be mobilised and retracted or divided above and below the kyphos, provided the proximal end of the theca is closed with a continuous suture to prevent a cerebro-spinal fluid leakage. A suitable instrument

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>under 1</td>
<td>3</td>
</tr>
<tr>
<td>1-2</td>
<td>1</td>
</tr>
<tr>
<td>2-3</td>
<td>3</td>
</tr>
<tr>
<td>3-4</td>
<td>2</td>
</tr>
<tr>
<td>4-5</td>
<td>—</td>
</tr>
<tr>
<td>5-6</td>
<td>2</td>
</tr>
<tr>
<td>6-7</td>
<td>—</td>
</tr>
<tr>
<td>7-8</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
</tr>
</tbody>
</table>
Appearances at operation on newborn infant with myelomeningocele and gross kyphosis. Figure 5—Skin closure impossible. Figure 6—A blunt instrument has been passed anterior to the vertebral body. Figure 7—After osteotomy skin closure now becomes possible. Figure 8—Radiographs before and after operation. Note distal end of ventriculo-atrial shunt in the second picture.
is passed anterior to the vertebral body, and provided this instrument remains close to the bone there is no danger of damaging the aorta or inferior vena cava (Fig. 6). Once the space anterior to the vertebral body has been developed, a Gigli saw can be introduced and the appropriate number of vertebral bodies can be resected by two cuts at an angle of approximately 45 degrees to each other. The size of the angle depends on the degree of kyphosis. In our experience bleeding has not been troublesome and can usually be controlled by pressure, but
hypotensive anaesthesia is helpful. Once the affected segment of bone has been removed, the lower part of the spine and pelvis are totally mobile on the upper spinal column and adequate correction can be obtained (Fig. 7). The removed vertebral bodies are cut to supply bone grafts. With the possible exception of staples, internal fixation has not, in our experience, been very successful. Kiel grafts and Kuntscher nails were used in one case each without success and we believe that external fixation with a plaster spica is preferable. Bony union occurs quickly and in infants under one year of age probably within three weeks of operation.

Our results are summarised in Table II. Five of the patients died. This mortality is high. The most important causes of death have been raised intracranial pressure or meningitis resulting from infection at the osteotomy site. In none of the fatal cases was there trophic ulceration before operation but in three fatal cases there was late sloughing after operation. It must, however, be stressed that this type of operation is only performed in exceptional circumstances and that one’s endeavour to keep a patient alive may be somewhat limited by sound judgment. There was a definite improvement in the angulation and especially in the stability of the skin scar in eight of the patients (Figs. 8 to 12). The clinical results are, on the whole, very much better than the radiological results would suggest.

<table>
<thead>
<tr>
<th>Result</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved</td>
<td>8</td>
</tr>
<tr>
<td>No change</td>
<td>3</td>
</tr>
<tr>
<td>Died</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
</tr>
</tbody>
</table>

DISCUSSION

Our experience confirms the view that spinal osteotomy is a justifiable and reasonable procedure in some patients with myelomeningocele and an associated severe kyphosis. The operation is technically not difficult but carries a fairly high mortality, but without it the child’s life is likely to be extremely miserable. The operation itself is easier in young infants than in older children and should, ideally, be performed in the neonatal period at the same time as the closure of the spinal defect.

SUMMARY

1. Kyphosis and kyphoscoliosis associated with myelomeningocele are discussed.
2. It is suggested that the condition be treated by osteotomy of the spine, with removal of one or more vertebral bodies.
3. Sixteen patients treated by this method of spinal osteotomy are presented.
4. Although almost a third of the patients died, a high operative and post-operative mortality in this condition is considered acceptable.

REFERENCES

