THE RESULTS OF EARLY OPERATION IN TALIPES EQUINO-VARUS

A PRELIMINARY REPORT

BRIAN J. MAIN, R. J. CRIDER, M. POLK and G. C. LLOYD-ROBERTS, LONDON, ENGLAND, and MALCOLM SWANN and B. A. KAMDAT, ASCOT, BERKSHIRE, ENGLAND

From the Hospital for Sick Children, Great Ormond Street, London, and Heatherwood Hospital, Ascot

The results of operation performed within the first six months of life upon seventy-seven resistant club feet are presented. The indications for and the rationale of early operation are discussed. Particular attention has been paid to the relationship between the age at operation and the outcome more than four years later; the results were greatly superior when operation was undertaken early. Two surgical techniques are compared, the postero-medial release proving better than a simple posterior release. The relationship between clinical and radiological assessment is discussed, and also the influence of the results reported upon future practice.

In recent years surgical release of the hindfoot in infancy has become increasingly favoured as an incident in the continuing management of those club feet which do not rapidly respond to whatever primary non-operative method the surgeon elects to use (Attenborough 1966). We have therefore reviewed the indications for, and the results of, such operations performed during the first six months of life at the Hospital for Sick Children and at Heatherwood Hospital, with special reference to the relationship between the age at operation, the technique employed and the outcome.

**Rationale of early operation**

Although it is possible to apply direct pressure by manipulation and splinting upon the varus and supination deformity of the forefoot, such corrective forces cannot be so readily imposed upon the equinus, varus and inversion deformities of the hindfoot. Notwithstanding attempts to pull the calcaneus downwards we must rely largely on an indirect approach, using the long lever of the forefoot to receive and transmit the correcting pressure to the hindfoot. This may well succeed when hindfoot deformity is mild and rigidity moderate, but too often the correcting force fails to influence resistant equino-varus of the ankle and talocalcaneal joints and expends its energy elsewhere in the foot, so that spurious correction is common.

Dorsiflexion of the foot as a whole is a composite movement involving dorsiflexion of the ankle and evasion of the talo-calcaneal joint. If both or either movement is restricted by unyielding ligaments or tendons true dorsiflexion will be prevented, and if the correcting force continues some less rigid structure will yield to pressure.

In this connection Denham (1967) has rightly observed that the bones are the soft and vulnerable elements of a baby’s foot, whereas the ligaments are resistant. It is not surprising that continuing attempts at correction may cause compression of the dome of the talus, a coronal breech in the midtarsal area (rocker-bottom foot) or a sagittal breech at the ankle (bean-shaped foot) (Swann, Lloyd-Roberts and Catterall 1969). In either event the calcaneus remains in equinus and the talo-calcaneal joint inverted.

The purpose of early posterior release is therefore to enable an eversion and dorsiflexion force applied to the forefoot to influence the joints of the hindfoot in their normal planes of movement, so that the tarsal bones and joints are neither compressed abnormally nor dislocated. Should this occur, adaptive bony deformity will develop during further growth, adding to the difficulty of correction later.

**ROUTINE MANAGEMENT AND INDICATIONS FOR OPERATION**

We have favoured a modification of the Robert Jones strapping method (Lloyd-Roberts 1971) as the method of primary treatment. At the Hospital for Sick Children the feet were carefully assessed both clinically and radiologically at eight weeks of age. If we judged that correction was proceeding satisfactorily we continued with the method, monitored by regular assessment, until full correction was achieved. Denis Browne’s bootee splints with a crossbar were then applied.
Unsatisfactory evolution at eight weeks is recognised clinically either by failure to obtain dorsiflexion of the foot to a right angle or, if this is possible, by observing the inclination of the calcaneus. If this remains in equinus the heel is prominent, its contour contrasting with the normal (Fig. 1). The lateral radiograph will confirm the clinical suspicion (Fig. 2). It is essential when taking the radiograph that the foot be positioned at a right angle to the leg, or approaches this position as nearly as possible, by applying gentle pressure to the forefoot. In addition to the inclination of the calcaneus we look carefully for evidence of midtarsal angulation (coronal rocker-bottom breech) and posterior displacement of the fibula (sagittal bean-shaped breech). It is important not to use undue pressure when positioning the foot for the lateral radiograph because excessive dorsiflexion may cause posterior fibular displacement even in a normal foot. If one or more of these signs are present at either the first or subsequent assessments we regard the foot as being vulnerable to spurious correction and proceed to soft-tissue release of the hindfoot.

The same principles of primary treatment and assessment were used at Heatherwood Hospital but the decision for or against operation was taken earlier. In some children with severe deformity operation was performed between the third and the sixth week of life.

TECHNIQUES OF OPERATION
We have used two methods at the Hospital for Sick Children. We at first performed a posterior release (Attenborough 1966) but later extended the operation postero-medially. At Heatherwood Hospital the postero-medial operation was used throughout.

Posterior release—This involves lengthening of the calcaneal tendon, division of tibialis posterior within its sheath and incision or excision of the posterior capsules of the ankle and talo-calcaneal joints. We were at this time primarily concerned with the prevention of a rocker-bottom foot.

Postero-medial release—We later became aware of the sagittal breech (bean-shaped foot) and extended the operation to release the medial tethers which restrict eversion. The incision was extended vertically to the sole, exposing the medial and inferior aspects of the calcaneus. The abductor hallucis, medial ligament of the ankle and plantar fascia with underlying muscle were stripped forwards from their attachments. If on dorsiflexion of the foot flexor hallucis or flexor digitorum longus seemed tight these were also divided.

In most cases strapping was applied immediately, and on discharge the following day this was changed or reinforced as necessary by the physiotherapist. In a few cases plaster of Paris was used for about five days, followed by strapping as before.

CLINICAL MATERIAL
Seventy-seven feet in fifty-four patients were submitted either to posterior or to postero-medial release within the first six months of life. Thirty patients had unilateral and twenty-four bilateral deformities, in one of whom only one side was operated upon. The type of operation used, the age at which it was performed and the interval between operation and assessment are shown in Table I.

METHOD OF ASSESSMENT OF RESULTS
All patients were seen at a special clinic and assessed clinically and radiologically. The interval between
The results of early operation in talipes equino-varus

TABLE I
Clinical Material

<table>
<thead>
<tr>
<th>Type of operation</th>
<th>Number</th>
<th>Age in weeks at operation</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0–6</td>
<td>7–12</td>
</tr>
<tr>
<td>Posterior release</td>
<td>38</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Postero-medial release</td>
<td>39</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>6</td>
<td>23</td>
</tr>
</tbody>
</table>

TABLE II
Results of First Assessment

<table>
<thead>
<tr>
<th>Results</th>
<th>Age in weeks at operation</th>
<th>Total</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–6</td>
<td>7–12</td>
<td>13–18</td>
</tr>
<tr>
<td>Satisfactory (excellent or good)</td>
<td>5</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Unsatisfactory (poor)</td>
<td>1</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

operation and assessment was at least four years (average 7.3 years).

Clinical assessment—The results of treatment were graded excellent, good or poor on the strict criteria given below. Results less than good were considered to be failures. The criteria of assessment were as follows. Excellent—Normal function and appearance. Good—Normal function with a plantigrade foot, no fixed deformity and the ability to dorsiflex and evert the foot to the neutral position. Poor—Activity limited in any way; residual fixed deformity, such as hindfoot equinus, heel inversion, forefoot varus, cavus (plantaris) or excessive plano-valgus; inability to dorsiflex and evert the foot to the neutral position; the need for secondary operations. Stiffness was not assessed separately but was considered in relation to its effect on function.

Radiological assessment—Lateral radiographs were taken with the foot in the neutral position, and antero-posterior (supero-inferior) films were exposed with the ankle in about 10 degrees of equinus.

Radiographs in 30 degrees of equinus (Beatson and Pearson 1966) were not used. We believe that with the foot in or as near as possible to the position of function we obtain a closer representation of the anatomical relationship of the bones in the standing position. The angles between the long axes of the talus and calcaneus were measured in the two projections and added together to give a talo-calcaneal index.

RESULTS
The results will at first be presented without distinguishing between those submitted to the posterior or postero-medial operation but their relative merit will be discussed later. We will analyse the outcome after one operation (first assessment) and after subsequent operations (second assessment) on the basis of clinical appraisal. We will further relate the outcome to the age at which the first operation was performed and briefly mention the radiological features.

First assessment—The excellent and good results are combined as satisfactory and the poor are regarded as unsatisfactory. On the strict criteria employed the overall results are somewhat disappointing for no more than half achieved a satisfactory result which was maintained without the need for further treatment (Table II).

Second assessment—Fifteen feet were promoted following further surgical treatment so that fifty-four (70 per cent) were now regarded as satisfactory (Table III).

The operations employed on those fifteen feet involved soft tissues alone in eight and a combination of soft tissues and bone in seven. The soft-tissue corrections were either a revision of an earlier posterior or postero-medial release or tendon transplantation. The bony operations were either calcaneal osteotomy (Dwyer 1959) or medial release with calcaneo-cuboid arthrodesis (Evans 1961) (Table IV).

Results related to age at first operation
The final outcome is related to the age at the first operation in Table III. It is evident that the proportion of satisfactory results decreases as the age at which the first operation is performed increases. This is graphically shown in Figure 3. Only 54 per cent of those
TABLE III
RESULTS OF SECOND ASSESSMENT

<table>
<thead>
<tr>
<th>Results</th>
<th>Age in weeks at operation</th>
<th>Total</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–6</td>
<td>7–12</td>
<td>13–18</td>
</tr>
<tr>
<td>Satisfactory (excellent or good)</td>
<td>5</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Unsatisfactory (poor)</td>
<td>1</td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>

TABLE IV
SECONDARY OPERATIONS USED TO OBTAIN A SATISFACTORY RESULT

<table>
<thead>
<tr>
<th>Age in weeks at first operation</th>
<th>Number</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Soft tissue only</td>
</tr>
<tr>
<td>7–12</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>13–18</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>19–24</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>8</td>
</tr>
</tbody>
</table>

operated upon between nineteen and twenty-four weeks achieved a satisfactory grading, whereas 82 per cent were so assessed after operations carried out between seven and twelve weeks. A satisfactory outcome was similar in the one- to six-week age group (83 per cent). Only six feet were available in this category but it should be noted that no secondary operations were needed to maintain correction.

Some further aspects merit emphasis. First, the more severe the initial deformity the more likely we have operated earlier. Thus the better results include some of the worst deformities. Secondly, the response to a second operation was more favourable in those in whom the first operation had been performed early, and furthermore the second operation was less radical. Eight of eleven feet operated upon for the first time between seven and thirteen weeks with less than a satisfactory result were re-categorised as satisfactory after a further operation on the soft tissues only. In contrast bony operations were always necessary when the first operation was between thirteen and twenty-four weeks (Table IV). Lastly, seventeen of the fifty-four satisfactory feet were classed as excellent. Of these, eleven were operated upon for the first time at less than twelve weeks of age.

The relative merit of the posterior and postero-medial operations
Comparison was only possible in the patients treated at the Hospital for Sick Children. At the first assessment there was no difference between the results of either operation because 42 per cent of the posterior and 39 per cent of the postero-medial releases were satisfactory. At the second assessment the comparable proportions improved to 67 per cent and 74 per cent. Other differences emerged on detailed analysis. Further operations were performed more often after posterior release than after postero-medial release; the ratio of secondary operations per treated foot after posterior release and after postero-medial release was 1:05:0:65. Residual deformities such as equinus, varus of the heel, or inadequate active correction were separately noted and added together for each unsatisfactory foot; when posterior release was followed by an unsatisfactory result there were, on average 2:6 faults in each foot whereas the comparable figure for postero-medial release was 1. After posterior release seven feet became satisfactory with secondary operations, and eight after postero-medial release; however this regrading required bony operations in five of the seven feet after posterior release, compared with only one of the eight feet after postero-medial release.

The length of follow-up in the postero-medial operation group (five years) is shorter than in the posterior (ten years). Nonetheless, over the five-year period the results of the postero-medial operation show a consistent if slight advantage over the posterior. The postero-medial operation includes the steps of the posterior so it is unlikely that this relative difference will become reversed with time. It is possible however that further operations will be employed more often in the younger postero-medial group than in the older pos-

![Figure 3](image-url)
terior, so that ultimately the difference in the secondary operation rate between the two groups may be reduced.

These findings favour the posteromedial operation which we continue to use with increasing confidence.

Radiological assessment
Radiographs did not correlate well with the clinical assessment. The average combined talo-calcaneal angle using normal controls was 56 degrees with a range of 41 to 78 degrees. The mean combined angles for the good and excellent feet was 38 degrees and for the feet with poor results 36 degrees and in this respect there was no significant difference between the two operations.

DISCUSSION
The lack of control material concerns us, but we were unable to contrive a challenging model. Clearly, comparison with techniques employing non-surgical regimes predominantly or exclusively during the first six months will be unfairly prejudiced towards the controls because they will include feet which have responded to the method used whereas we are concerned only with those resisting such measures. Varying standards of grading of clinical results, coupled with variations in the age and technique of operation render earlier published reports useless for this purpose. Standards are steadily rising and it is only recently that we, in company with others, are accepting as good clinical results only those feet which are practically indistinguishable from normal.

Although we shall continue to use the posteromedial operation in resistant feet we must consider more closely the age at which it should be performed. Our results during the first twenty-four weeks of life reveal a direct relationship between the age at operation and the outcome. This is the more significant because earlier operations were performed on the worse feet. The longer a necessary operation is delayed the more time becomes available for secondary structural changes to occur in the bones and joints which will at some point become irreversible. A detailed analysis of these structural changes in relation to the age of soft-tissue release will be presented later by two of us (B. J. M. and R. J. C.) and will confirm a direct relationship between them.

It would seem logical therefore in the future to make the decision for or against operation and to carry it out within the first six weeks of life providing that non-operative treatment has been assiduously applied from birth. Selection may be based on the same criteria without undue difficulty and operation performed without significant hazard, due to contemporary standards of anaesthesia.

The validity of this proposition is supported by the outcome in a few patients within the Heatherwood series who were treated in this fashion. Nine feet were operated upon at an average of 6-2 weeks and reviewed after a mean interval of 5.4 years. Seven were graded excellent. There were no failures among those so treated at less than six weeks and no excellent results over twelve weeks.

Implementation of this policy requires that the surgeon has control of the management of the patient from birth. At the Hospital for Sick Children we are less fortunate in that most of our patients are first seen when it is evident that correction is failing. As a result we have usually operated later than we would have wished and this is reflected in our results. Analysis of the causes of failure however encourages us to consider extending the operation to the midtarsal area when operation is, perforce, delayed beyond the most favourable age.

REFERENCES