THE MANAGEMENT OF METATARSUS ADDUCTUS ET SUPINATUS

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Forty-three patients with 69 feet affected by isolated metatarsus adductus et supinatus were reviewed. Of these, 20 patients (with 31 involved feet) had been treated expectantly and spontaneous resolution had occurred with time. The remaining 23 patients (with 38 feet) had required anteromedial release; the operative technique is described. Excellent results were uniformly achieved in both groups, with neither recurrence nor complications in the operatively treated feet. There was a consistent correlation between good clinical results and a naviculo-metatarsal angle of less than 100°. The timing of soft-tissue release did not influence the final outcome.

Metatarsus adductus et supinatus describes a deformity of infants and young children in which the forefoot is held in an adducted and supinated position. Both elements of the deformity must be present for the diagnosis to be accepted (Fig. 1). Adduction of the forefoot is more obvious on weight-bearing, but supination becomes noticeable on step-off. On clinical examination supination is most noticeable when the heel is held centralised. The hindfoot is normal even in severe and resistant cases until later in childhood when secondary bony deformity occurs; it is this feature which distinguishes severe examples from congenital talipes equinovarus. In some feet the deformity is evident at birth, but in most, unlike club foot, it is not obvious for weeks or months after birth.

Kite (1967) suggested that the deformity is caused by muscle imbalance; we have found no evidence, however, to suggest weakness or overaction of any muscle group in the lower leg. We maintain that the deformity is caused by a combination of: (a) preponderance of the insertion of the tibialis anterior muscle into the plantar aspect of the medial cuneiform, with consequent prominence of its supinator action; and (b) contracture of the capsular ligaments of the first metatarsocuneiform and naviculocuneiform joints. Once the mechanism for producing the combination of adduction and supination has been initiated, the continued action of the tibialis anterior muscle, whose site of insertion gives it a mechanical advantage, eventually produces a cavus deformity as well (Figs 2 and 3). This cavus deformity has been observed by other authors (Kite 1950, 1967) but its pathogenesis and significance have not been made clear.

The adduction mostly occurs between the first metatarsal and the medial cuneiform bone, but often there is additional angulation at the naviculocuneiform joint. There is no involvement of the midtarsal or subtalar joints in metatarsus adductus et supinatus.

Mild examples of the deformity resolve spontaneously without treatment, but severe deformities may be confused with club feet; this confusion is a source of anxiety to the parents. Severe examples are distinguished from congenital talipes equinovarus, which at first sight they may resemble, by the absence of any hindfoot deformity on clinical examination and an open hindfoot "scissors" on radiographic examination (Ghali et al. 1983).

Failure of spontaneous correction is usually apparent between the age of 12 and 18 months and operation is then necessary. The presence of a persistent skin-crease at the tarsometatarsal level or of a palpable subluxation is a poor prognostic sign indicating failure of spontaneous resolution. Children who do not require operative treatment are observed for at least three years.

The abnormality may also present as a component of severe club foot (Heyman, Herndon and Strong 1958; Fripp and Shaw 1967; Kendrick et al. 1970; Lowe and Hannon 1973) and may persist after an otherwise successful hindfoot and midtarsal reduction. For this reason, for the past 18 years, we have performed an anteromedial release at the same time as the pantalar reduction, which we described for the treatment of congenital talipes equinovarus deformities (Ghali et al. 1983).
OPERATIVE TREATMENT

There are two indications for the operation: (1) persistent adduction of the forefoot which is not passively correctible into axial alignment with the heel (incompetence of the medial ray); and (2) supination of the forefoot which cannot be avoided when walking. Both elements of the deformity must be present. The aims of the operation are: (1) realignment of the metatarsus at the level of the tarsometatarsal joint; and (2) control of the supinating action of the tibialis anterior muscle. These are achieved by anteromedial release.

Technique. The incision is made along the medial aspect of the foot from the anterior border of the tip of the medial malleolus to the level of the first metatarsal neck. Flaps are developed exposing the first tarsometatarsal joint, as well as the medial metatarsocuneiform and the naviculocuneiform joints. The tibialis anterior tendon is identified as it divides into two bands over the medial aspect of the talus and navicular (Fig. 4). The superficial band passes forwards to be inserted onto the dorsal and medial aspects of the base of the first metatarsal. The deeper band, thicker than normal in this condition, dips downwards and backwards over the medial aspect of the medial cuneiform to gain attachment to its plantar and medial surfaces; this deeper band is divided and allowed to slide dorsally in order to release the medial cuneiform from a direct pull which lifts and rolls it into lateral rotation (Fig. 5). It is this combination of lifting and lateral rotation which is translated by the first metatarsal shaft into active supination of the forefoot.

The medial metatarsocuneiform and the naviculocuneiform joints are opened up by dividing their respective capsular ligaments on the medial, dorsal and plantar aspects (Fig. 6). Passive abduction applied to the forefoot will now open up the liberated joints and restore the axial alignment of the metatarsals in relation to the tarsus (Fig. 7).

After suture of the skin flaps the limb is supported in a padded L-shaped splint without tension for two weeks to ensure sound healing of the wound. No attempt is made at this stage to hold the foot in the corrected position. Thereafter an above-knee plaster cast is applied with the foot in the corrected position and this is maintained for three months.

CLINICAL MATERIAL

Forty-three patients with 69 feet affected by isolated metatarsus adductus et supinatus were reviewed; 22 were boys and 21 girls. Twenty-six patients had bilateral involvement while 17 patients had unilateral deformity with the right foot involved in 5 patients and the left in 12. There was no family history of the defect in any patient and there were no associated congenital anomalies.

Table I. Clinical details of patients

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of patients</th>
<th>Sex Male</th>
<th>Sex Female</th>
<th>Side Bilateral</th>
<th>Right</th>
<th>Left</th>
<th>Number of feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>2</td>
<td>7</td>
<td>31</td>
</tr>
<tr>
<td>Operative</td>
<td>23</td>
<td>12</td>
<td>11</td>
<td>15</td>
<td>3</td>
<td>5</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>22</td>
<td>21</td>
<td>26</td>
<td>5</td>
<td>12</td>
<td>69</td>
</tr>
</tbody>
</table>

Twenty-three patients (38 feet) were treated operatively and 20 children (31 feet) with only mild deformities were merely observed (Table I).

The high incidence of bilateral involvement is noteworthy, as is the almost equal sex distribution which differs from that of congenital talipes equinovarus.

The median age at the time of operation was 1 year 8 months, the youngest patient being 9 months and the oldest 5 years 6 months (25th percentile of 1 year 9 months and 75th percentile of 2 years 2 months).

The median duration of follow-up in those treated operatively was 4 years 4 months ranging between 1 year 2 months and more than 17 years (25th percentile of 2 years 6 months and 75th percentile of 10 years 9 months). The median duration of follow-up in those treated expectantly was 4 years 3 months ranging from 3 years to 22 years (25th percentile of 3 years 2 months and 75th percentile of 8 years 4 months).
ASSESSMENT

Clinical assessment. The patients were reviewed by two of us (NNG and MJA) at a special clinic. A record was made of function, type of work, sporting activities, symptoms, the presence or absence of forefoot or hindfoot deformities and pressure areas, and the range of movement of the subtalar and midtarsal joints. The criteria for evaluation of the end-result were based on those described by Kendrick et al. (1970).

Radiographic assessment. The method described by Lowe and Hannon (1973) was used to assess 44 feet in 30 patients between the age of 4 and 20 years. Standard anteroposterior radiographs of the foot were taken in the standing position. The base of the navicular is defined by a line joining the extremities of its proximal articular outline (Fig. 8). A central line is drawn through the long axis of the first metatarsal. The lateral angle produced by the junction of these two lines (the naviculo-metatarsal angle) is measured.

It was not possible to measure the naviculo-metatarsal angle in the remaining 13 children (25 feet) because they were less than 4 years of age; at this age the outline of the navicular is less well defined and its long diameter is not necessarily parallel with its proximal articular outline.

RESULTS

Of the 43 patients with 69 affected feet, 23 patients (38 feet) required anteromedial release and 20 children (31 feet) were treated expectantly. The outcome was uniformly excellent and comparable in both groups as assessed by clinical and radiographic methods. Figure 9 shows the end-result in a boy aged 9 years who had a severe bilateral deformity. Figures 10 and 11 show a unilateral deformity before and after anteromedial release. Table II shows that the range of naviculo-metatarsal angles and the median in both groups are comparable. There were no early or late complications in this series.
The results of correcting the supination and adduction component of severe congenital talipes equinovarus by "extended pantalar reduction" have already been published (Ghali et al. 1983).

DISCUSSION

The treatment of unresolving metatarsus adductus et supinatus presents problems that are not always appreciated. In children with persistent deformity, non-operative treatment fails to give acceptable correction (Berman and Gartland 1971). The condition must not be confused with allied but lesser deformities of the forefoot, such as the hooked forefoot (Rushforth 1978) in which supination is absent, the incidence of spontaneous resolution with age is higher and the development of secondary bony deformities of the hindfoot is unlikely even in resistant cases.

McCauley, Lusskin and Bromley (1964) treated the malalignment with serial plasters, and reported 46.5% of feet with residual deformity and 32% with recurrences (not counting multiple recurrences in the same foot). In addition, the supination element has led to attempts to correct the deformity by forceful pronation of the forefoot. This often has caused valgus deformity of the hindfoot and has resulted in severe flat foot with residual forefoot adduction (skew foot), a deformity worse than the original (McCauley et al. 1964; Kendrick 1970). Figure 12 shows a patient with bilateral skew feet.

Several operative procedures have been recommended in the past for the correction of resistant deformity. Peabody and Muro (1933) recommended excision of the base of the first metatarsal, mobilisation and reduction of the subluxated first metatarsocuneiform joint, and correction of the abnormal insertion of the tibialis anterior tendon. McCormick and Blount (1949) recommended arthrodesis of the first metatarsocuneiform joint with osteotomy of the middle three metatarsals in older children, or wedge-resection of the cuboid.

In 1950, Steindler stressed how difficult it was to correct this deformity in the older child and recommended...
wedge-resection. Osteotomy of all metatarsals was described by Steytler and Van der Walt (1966); this is a relatively extensive procedure and is not without complications (Berman and Garland 1971). Kendrick et al. (1970) described tarsometatarsal mobilisation and reported a lower rate of success and various complications. In our series osseous correction was not necessary at a later date.

Attenborough (1966) and Lloyd-Roberts (1971) suggested imbalance between the actively contracting adductor hallucis and the weak peronei as an aetiological factor in metatarsus varus, but the results reported by Thomson (1960) do not support this view. Resection of the adductor hallucis in 82 children was followed in 40 by recurrent metatarsus varus, and in 42 with club feet by residual adduction and supination of the forefoot.

Our findings support the observations of Heyman et al. (1958) and of Fripp and Shaw (1967) that the adduction and supination of the forefoot in congenital talipes equinovarus is present at birth and often persists. In a few patients with severe club feet treated earlier in our series, with an otherwise successful pantalar reduction (Ghali et al. 1983), forefoot adduction and supination persisted and anteromedial release had to be performed later. For this reason we have, for the past 18 years, included anteromedial release in the extended pantalar reduction of congenital talipes equinovarus.

Lowe and Hannon (1973) found that residual metatarsus varus was present in 74% of club feet treated by various methods when they were assessed by careful measurement; their series suggests that correction does not occur spontaneously with time. These findings are in marked contrast with those of Wynne-Davies (1964) who did not find any residual metatarsus varus in a series of 121 older patients reviewed after completion of treatment for congenital talipes equinovarus. This emphasises the importance of accurate radiographic assessment in the evaluation of the final results.

Our results of operative treatment in metatarsus adductus et supinatus, whether the condition is an isolated one or is a component of severe congenital talipes equinovarus, suggest that anteromedial release is a simple and effective method of treatment.

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REFERENCES