THE IMPORTANCE OF GASTROCNEMIUS RECESSIOIN IN THE CORRECTION OF EQUINUS DEFORMITY IN CEREBRAL PALSY

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Spasm or contracture of the gastrocnemius muscle is predominantly responsible for the equinus deformity of the foot in cerebral palsy. Its release is therefore logical in the treatment of all cases which do not respond to conservative measures. The authors have demonstrated, by the use of metal markers and radiographic control at operation, that adequate release cannot be achieved by severance of the calcaneal tendon alone, and that in order to ensure relaxation of the gastrocnemius muscle, the operation of choice is gastrocnemius recession by the method of Strayer, coupled with lengthening of the calcaneal tendon to deal with such degree of the deformity as may be attributable to shortening of the soleus. A survey of 100 limbs treated by this method revealed a recurrence rate of equinus of 9 per cent and a degree of calcaneus deformity resulting in inadequate push-off in 3 per cent of cases after an average follow-up period of six years.

Probably the most common deformity among the cerebral palsied is equinus of the foot. In our experience, this is usually due to contracture of the gastrocnemius muscle, shortening of the soleus muscle being responsible for only a small measure of the deformity. Contracture of the gastrocnemius is confirmed by performing the knee flexion test: if the equinus is due mainly to gastrocnemius contracture it can be readily overcome by flexing the knee and relaxing the gastrocnemius. If this is not the case, the deformity is due to contracture of the soleus, long toe flexors, tibialis posterior or peroneal muscles, to contracture of the posterior capsule of the ankle joint or, in the older child, to enlargement of the body of the talus as a result of its being in a position of equinus for a number of years.

Treatment of the equinus deformity is based on established principles which are applicable to the cerebral palsied patient as a whole. The approach is, in the first instance, essentially conservative and takes the form of free and resisted active dorsiflexion, prolonged passive stretching in functional positions, bracing and the use of the Forest Town boot to place the forefoot in hyperextension (Fig. 1).

The indications for operation are persistence of the equinus deformity after a conscientious trial of conservative measures, and the development of secondary or compensatory deformities such as genu recurvatum or rocker sole.

Surgical correction consists in gastrocnemius recession, accompanied by lengthening of the calcaneal tendon to release any degree of deformity contributed by spasm or contracture of the soleus. If the knee flexion test is negative the equinus can be assumed to be due mainly to spasm or contracture of the soleus, and lengthening of the calcaneal tendon alone will suffice.

Denervation of the Stoffel type is not indicated because it converts an elastic spastic muscle into an inelastic fibrous structure.

Proximal release of the gastrocnemius origin (Silfverskiöld 1923) has not been practised because it is considered wise to retain the gastrocnemius as a knee flexor should a hamstring release become necessary subsequently.

It is our belief that simple lengthening of the calcaneal tendon does not to any significant extent relax a spastic

![Fig. 1](image)

The Forest Town boot, which holds the forefoot in hyperextension or contracted gastrocnemius. The flat tendon and muscle belly of the gastrocnemius are invariably adherent to the underlying soleus and can therefore at best retract only as far as the muscle belly of the soleus retracts, and since the origin of the soleus extends half way down the tibia and fibula this muscle cannot retract further proximally than the midpoint of the leg. Proximal to this point the spastic gastrocnemius still exerts its pull on the underlying structures.

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Being convinced of this argument on clinical grounds for a number of years, we have recently attempted to demonstrate its validity. At operation a metal marker was attached to the tendon of the gastrocnemius proximal to the soleus aponeurosis. The foot was then passively forced into maximal dorsiflexion with the knee extended and the radiograph was taken (Fig. 2). Thereafter, the calcaneal tendon was lengthened, the foot was again forced into dorsiflexion with the knee extended and a further radiograph was obtained (Fig. 3); this showed that the marker had not moved significantly proximally as a result of the tendon lengthening. The third step was to perform a gastrocnemius recession by the method of Strayer (1950); only then did the marker move proximally to any marked degree on passive dorsiflexion of the foot (Fig. 4). This seems to confirm the impression that if it is intended to relax a contracture or reduce spasm of the gastrocnemius, it is essential to perform a gastrocnemius recession, as lengthening of the calcaneal tendon by itself does not achieve this aim satisfactorily. The reduction of spasm of the gastrocnemius is particularly indicated in cases when to some extent the equinus deformity is due to persistence of the positive support reflex or stretch reflex.

CLINICAL MATERIAL

Between 1958 and 1973, 338 operations for the correction of equinus deformity were performed at the Transvaal Memorial Hospital for Children on pupils attending the Forest Town School for the Cerebral Palsied (Table I). A survey of 100 operations (fifty-nine patients) has been carried out (Table II); these were the first 100 cases of combined gastrocnemius recession and calcaneal tendon lengthening with a minimal follow-up period of three years.

The time lapse from operation varied from three to twelve years with an average of more than six years. Each patient was examined for recurrence of the equinus deformity or the development of other deformities (such as calcaneus) which could be attributed to the operation.

The operations were performed by a single surgeon (J. J. C.) and the post-operative assessment was carried out by an independent observer (J. v. V.) who had not participated in the operations.
OPERATIVE TECHNIQUE
AND AFTER-CARE

Access to the musculo-tendinous junction of the gastrocnemius is achieved through an incision 7.5 centimetres long in the midline of the calf. The tendon of the gastrocnemius muscle is identified just proximal to its junction with the soleus aponeurosis. By blunt dissection with the finger the belly of the gastrocnemius muscle is completely separated proximally from the soleus muscle as far as the popliteal space. Thereafter the tendon of the gastrocnemius muscle is divided and the foot forced into about 40 degrees of dorsiflexion with the knee extended.

In order to deal with any residual equinus due to spasm or contracture of the soleus, lengthening of the calcaneal tendon is performed by transverse division of half the tendon at different levels on opposite sides followed by forcible passive dorsiflexion of the foot.

At the conclusion of the operation the lower extremity is immobilised in a full-length plaster with the knee fully extended and the foot and toes in about 40 degrees of dorsiflexion for three weeks. Thereafter the skin sutures are removed and a walking plaster is applied with the foot once again in 40 degrees of dorsiflexion and in a neutral position as to varus and valgus. Whether this second plaster is above-knee or below-knee depends on the power of the quadriceps muscle. This walking plaster is retained for a further three weeks and then replaced by a boot with a lateral below-knee iron and back stop and medial T-strap. Once the child is capable of strong active dorsiflexion of the foot the appliance is discarded.

In most of the published works on this subject it is suggested that after operation the foot should be immobilised at a right angle to the long axis of the leg. The normal individual has a range of 15 to 20 degrees of dorsiflexion above a right angle. It is difficult to understand, therefore, how a patient with spastic equinus can do otherwise than relapse into equinus if the foot is immobilised at a right angle after operation. In our experience it requires intensive physiotherapy throughout the remainder of the growth period to ensure that the patient retains the capacity to dorsiflex at least to a right angle, even when the foot has initially been immobilised at 40 degrees above a right angle.

Intensive physiotherapy is commenced as soon as the walking plaster has been applied, at first in the form of quadriceps exercises and supervision in walking. Once the plaster has been removed, active free and resisted foot dorsiflexion exercises are added to the programme.

RESULTS

Recurrence of equinus deformity—The criterion for recurrence was inability actively to dorsiflex the foot above a right angle with the knee in the extended position.

In the age group one to five years at the time of operation, eight cases (11 per cent) had recurred at the time of the survey. In the six- to ten-year age group at operation there was one recurrence (4.3 per cent). There was no recurrence in patients aged from eleven to fifteen years at the time of operation (Table II).

The total number of recurrences in the 100 limbs subjected to operation for the treatment of equinus deformity was nine, representing a recurrence rate of 9 per cent after an average follow-up period of just over six years.

TABLE I

<table>
<thead>
<tr>
<th>Operation</th>
<th>Number of Operations</th>
<th>Average time of follow-up (years)</th>
<th>Recurrence (number of feet)</th>
<th>Percentage recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrocnemius recession only</td>
<td>35</td>
<td>6</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Gastrocnemius recession plus tendo-calcanee lengthening</td>
<td>276</td>
<td>6</td>
<td>1</td>
<td>4.3</td>
</tr>
<tr>
<td>Tendo calcanee lengthening only</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>338</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE II

INcidence OF RECURRENT EQUINUS DEFORMITY AFTER Operation

<table>
<thead>
<tr>
<th>Age at operation (years)</th>
<th>Average age at operation (years)</th>
<th>Number of operations</th>
<th>Average time of follow-up (years)</th>
<th>Recurrence (number of feet)</th>
<th>Percentage recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>4</td>
<td>75</td>
<td>6</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>6-10</td>
<td>8</td>
<td>23</td>
<td>6</td>
<td>1</td>
<td>4.3</td>
</tr>
<tr>
<td>11-15</td>
<td>14</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

TABLE III

COMPLICATING ANKLE AND FOOT DEFORMITIES AFTER TRICEPS SURAE LENGTHENING (100 OPERATIONS)

<table>
<thead>
<tr>
<th>Age at operation (years)</th>
<th>Average age at operation (years)</th>
<th>Average time of follow-up (years)</th>
<th>Post-operative deformities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calcaneus</td>
</tr>
<tr>
<td>1-5</td>
<td>4</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>6-10</td>
<td>8</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>11-15</td>
<td>14</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

With regard to physiotherapy, we consider that post-operative management by a therapist with a thorough knowledge of neurodevelopmental treatment techniques and the ability to select and combine various methods to meet the needs of each individual child is absolutely essential to the success of surgery for cerebral palsy. We believe the low recurrence rate of 9 per cent to be in large measure attributable to such therapy.

Complications (Table III)—Calcaneus may be a temporary post-operative complication if, for any reason, it is not possible to get the child to bear weight immediately. This may be due to the presence of a strong withdrawal reflex which was masked before operation by the action of the positive supporting reflex, or to the increased flexor reflex...
tone in children with predominantly flexor patterns of movement.

Persistent calcaneus occurred in only one and calcaneo-cavus in two of the 100 extremities. This resulted in inadequate push-off during walking.

**DISCUSSION**

Reference to Table I indicates that of the 338 operations carried out for equinus deformity, thirty-five took the form of gastrocnemius recession alone and in twenty-seven tendo calcaneus lengthening only was performed. These operations were done in the early years of our experience and the patients are no longer available for follow-up in sufficient numbers to make comparison of the results statistically significant. The change-over to the combined operation of gastrocnemius recession and lengthening of the tendo calcaneus was, however, dictated by the relatively high recurrence rate of equinus after either of these operations alone.

Comparison with the results of other authors who have treated equinus deformity by one or other of the operations alone indicates a higher recurrence rate following that line of action. Banks and Green (1958) reported a 29·6 per cent recurrence rate of equinus after lengthening of the heel cord, while Sharrard and Bernstein (1972) showed a 23 per cent recurrence rate after tendo calcaneus elongation and 15 per cent after gastrocnemius recession. A recurrence rate of 9 per cent in the 100 feet assessed on average six years after the combined operation of gastrocnemius recession and tendo calcaneus lengthening seems to commend this procedure.

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**REFERENCES**


