ANTERIOR LAXITY OF THE ANKLE
A Cause of Recurrent Paralytic Drop Foot Deformity

MICHAEL H. FLINT, LONDON, ENGLAND, and IAN G. MACKENZIE, ABERDEEN, SCOTLAND

From The Institute of Orthopaedics and The Royal National Orthopaedic Hospital, London and Stanmore

Many operations have been devised to correct paralytic drop foot but none has proved reliable. The two most commonly used today are Lambrinudi's (1927) arthrodesis and the posterior bone block devised by Campbell (1923). Neither is altogether successful because the foot drop recurs in at least one in four patients (Patterson, Parrish and Hathaway 1950; Ingram and Hundley 1951; Mackenzie 1959). In discussing the reasons for failure of these operations these authors noted that recurrence of the deformity seems often to be due to opening out of the front of the ankle joint. This is seen in lateral radiographs taken when the foot is held in full equinus (Fig. 1). We have called this phenomenon "anterior laxity of the ankle" because it appears to be due to stretching of the tenuous anterior capsule and of the anterior fibres of the strong collateral ligaments.

This has generally been accepted as a complication arising after operation in consequence of the additional strain on the ankle, but since the success of most of the operations for foot drop depends upon the integrity of the supporting structures around the ankle (Burrows 1955) it seemed important to determine whether anterior laxity was a sequel to the operation, or whether it had, in fact, been present before. In order to obtain information on this point, patients who had not received surgical treatment for paralytic drop foot were studied.

MATERIAL AND METHODS OF EXAMINATION

Fifty-four patients with sixty paralytic drop feet were interviewed and examined. The age at which the paralysis occurred and the interval between the onset and the fitting of a toe-raising apparatus were noted, and the residual muscle power in the leg was estimated and recorded. Lateral radiographs of the ankle were taken with the foot held in forced plantar-flexion to demonstrate the stability of the front of the joint.

Opening out of the front of the ankle joint was easily identified in adults, because forced plantar-flexion produced a wide gap between the articular surfaces of the tibia and talus. Prolonged stretching of the front of the joint sometimes gives rise to osteophytic changes at either the talar or the tibial attachment of the anterior joint capsule (Fig. 2), and fragments may become detached to form loose bodies at the front of the joint. These changes are like those described in "footballer's ankle" by McMurray (1950) and which are known to occur in acrobats and other athletes from repeated stretching of the front of the ankle (McDougall 1955). The radiographic appearances are less obvious in children, but the gap at the front of the joint and the incongruity of the joint surfaces (Fig. 3) do not occur when the normal child's foot is plantar-flexed (Fig. 4).

Those ankles which showed a significant tilt of the talus with opening out of the front of the joint on forced plantar-flexion were described as lax, and those showing no significant tilt were considered stable.

Having assessed the muscle power, we graded the drop feet into one of three groups:

Flail—When there was no muscle acting below the knee. Balanced—When the power of plantar-flexion was equal to the power of dorsiflexion, or only one grade stronger. Since we were dealing with drop feet where the power of dorsiflexion was at best 2 (Medical Research Council grading), this group included those patients with plantar-flexion power of 1 to 3. Unbalanced—When there was strong power in the plantar flexors graded 4 or 5.
FIG. 1

FIGS. 1 AND 2
Figure 1—Stretching of the anterior capsule of the ankle leads to recurrence of drop foot after Lambrinudi's arthrodesis. Figure 2—Opening out of the front of the ankle in an adult with untreated drop foot; degenerative changes are present at the tibial and talar attachments of the capsule.

FIG. 3

FIG. 4

Figure 3—Stretching of the anterior capsule of the ankle in a child with untreated drop foot. Figure 4—Lateral radiograph of a normal ankle of a child taken in forced equinus.
ANTERIOR LAXITY OF THE ANKLE

RESULTS

No less than 43 per cent of the ankles which had been supported by a toe-raising appliance showed significant anterior laxity demonstrable on forced plantar-flexion.

Effect of muscle power—Of the sixty drop feet examined 47 per cent were found to be flail, 28 per cent unbalanced, and 25 per cent balanced. Anterior laxity was not evenly distributed between the three groups: about half of the unbalanced and flail drop-feet showed laxity, but only one in five of the balanced ankles showed a similar weakness (Fig. 5). There were approximately equal numbers of balanced and unbalanced drop feet, but anterior joint laxity was more than twice as common in the latter.

Delay before fitting a toe-raising apparatus—Fitting a toe-raising apparatus within a year of the onset of the drop foot did not apparently prevent the development of anterior joint laxity in unbalanced or flail ankles (Fig. 6). This is perhaps not so surprising when one considers that most people spend about a third of their lives in bed. During this time the foot is unsupported and the dropping may often be worsened by the weight of the bedclothes. It is possible that the development of the foot drop could be delayed by the regular use of a well fitting night splint, but the satisfactory application of night splints is difficult.

In balanced feet, however, stretching occurred only after fifteen or more years without a toe-raising apparatus.

Age of onset and length of follow-up—We have not seen this deformity when the paralysis occurred after the age of twenty, but only eleven of our patients were adults at the time of onset. The fact that the paralysis occurred in most of the patients before the age of five allowed a long follow-up, ranging up to seventy years (Fig. 7).

Stretching can occur within one year of the onset of the paralysis, but its incidence did not increase with the passage of time. This is perhaps misleading because patients with severe anterior joint laxity might well have undergone operation on account of it and are thereby excluded from this series.

DISCUSSION

The fact that many operations are employed in the treatment of drop foot is an indication that none is universally satisfactory. When it is applicable, transfer of the tendon of tibialis posterior to the dorsum of the foot gives reliable results (Watkins, Jones, Ryder and Brown 1954). Clawson and Seddon (1960) considered this to be the treatment of choice for foot drop due to lateral popliteal nerve palsy. However, the tibialis posterior is likely to be involved in a severe case of poliomyelitis (Sharrard 1955) or an extensive sciatic nerve lesion, and the number of patients with drop foot who can be treated by this method is therefore limited.

Campbell's bone block operation produced excellent early results, and in 1930 he was able to record a series of 225 cases with only fourteen failures. But Ingram and Hundley, reviewing the late results of this operation at the same centre in 1951, found that there was a recurrence of drop foot in 25 per cent of cases. Carrell (1951) also found 21 per cent of failures or recurrences after the posterior bone block and after Lambrinudi's arthrodesis, and Mackenzie (1959) found that there were only thirty-seven good results in a series of 100 Lambrinudi operations. They all noted that recurrence was most likely if the plantar-flexors were working strongly, and that it was much less frequent in balanced ankles. Patterson, Parrish and Hathaway (1950) observed that in the only successful Lambrinudi stabilisations, and in many of the successful triple arthrodeses, the peroneal tendons had been transposed anteriorly, thereby giving a more stable ankle. They concluded that perilalar (pantarsal)
arthrodensis was the only sure way of correcting an unbalanced drop foot when a tendon transfer was not practicable. Steindler (1923), King (1940), Hunt and Thompson (1954) and Robins (1959) also recommended pantarsal fusion for the flail or unbalanced drop foot.

On the other hand, Barr and Record (1953) obtained 90 per cent of good results in the treatment of drop foot by arthrodesis of the ankle alone, incidentally an operation which was first devised by Albert (1882) to correct paralytic equinus deformity.

In his review of the results of his bone block operation Campbell (1930) noted that failure was associated with “relaxation of the tissues around the ankle”; Patterson, Parrish and Hathaway (1950), Mackenzie (1959) and Clawson and Seddon (1960) have all drawn attention to similar laxity of the joint after Lambrinudi’s operation.

It was previously thought that such stretching of the front of the ankle was a secondary phenomenon due to increased strain on the ankle joint as a result of stiffening the midtarsal and subtalar joints. We thought that it might have occurred before operation, and the results of our investigation confirm this, for 43 per cent of patients with drop foot treated only by a toe-raising apparatus showed this laxity.
The ankle joint is potentially weak anteriorly, and if the dorsiflexors which are the main support are paralysed, the only check to excessive plantar-flexion is that provided by the anterior fibres of the lateral ligament, known as the anterior talo-fibular ligament (Fig. 8) (Leonard 1949, Anderson and LeCocq 1952, 1954). The ligament lies parallel to the long axis of the talus and becomes taut when the foot is held in plantar-flexion. No other ligament about the ankle has a comparable function, and if this ligament is divided the talus is able to drop out of the ankle mortise on plantar-flexion. If the restraining effect of both the dorsiflexors and the anterior talo-fibular ligament is lost, anterior joint laxity is possible (Figs. 9 and 10). Our results confirm that this is more likely to occur if the effect of gravity is aggravated by a strong calf muscle, as in an unbalanced drop foot, and less likely to occur in a balanced foot drop or when the anterior talo-fibular ligament is protected by a peroneal tendon transplant (Patterson, Parrish and Hathaway 1950; Cholmeley 1960) (Figs. 11 and 12).

As the effectiveness of all operations for drop foot, other than ankle arthrodesis, depends on the integrity of the anterior and lateral supporting structures of the ankle, we believe that previously established anterior joint laxity must be a potent cause of failure in the operations commonly used for drop foot. Our findings show that over 40 per cent of all patients with drop foot are liable to develop anterior joint laxity, and we conclude that this substantially contributes to the constant 25 to 30 per cent recurrence rate after all types of drop foot operation.

Lambrinudi's operation was originally designed for use when there was an active calf muscle. Our investigation and previous studies on recurrence after operation show that the anterior laxity, and therefore the poor results of the operation, are most likely to occur when there is a strong calf muscle, and least likely to occur when the dorsiflexors and plantar-flexors are approximately balanced. It therefore seems that the original indication for Lambrinudi's operation is the one most likely to invite failure.

Many of the operations for drop foot are probably initially successful because the ankle has been immobilised in plaster for several months, but as the joint loosens up the foot drop tends to recur if there is still inadequate support anteriorly.

Before any stabilisation of the foot is undertaken it is important, especially in unbalanced ankles with a good calf, to determine whether there is anterior laxity of the ankle by taking a lateral radiograph of the foot in forced plantar-flexion. Stress films in inversion and eversion should also be taken, because the mechanism that allows anterior laxity also permits lateral talar tilting, especially in plantar-flexion.

By this simple examination it may prove possible to predict and avoid failure in a number of the patients seeking correction of foot drop. If laxity is present the standard operations for drop foot are unlikely to succeed unless the anterior check ligaments are reinforced by tendon transfer. Otherwise arthrodesis of the ankle is necessary, either alone or as part of a tarsal fusion.
Figure 9—Normally excessive plantar-flexion is prevented by the anterior tali-fibular ligament, by the anterior dorsiflexor muscles, and by impingement of the posterior tubercle of the talus against the tibia. Figure 10—If the anterior tali-fibular ligament stretches further plantar-flexion can occur, and the posterior tubercle no longer acts as a stop. Standard drop foot operations tend to fail.

Figure 11—In balanced deformity the ligaments remain intact and anterior laxity occurs less frequently. The foot drop operations are more likely to succeed. Figure 12—Dynamic deformity with a strong calf aiding gravity results in stretch of the anterior tali-fibular ligament and anterior laxity develops. Foot drop operations are less likely to succeed.
ANTERIOR LAXITY OF THE ANKLE

383

If these more extensive procedures seem unjustified it is probably best to continue to treat the patient with a toe-raising apparatus rather than to embark on a less extensive operation that is unlikely to correct the deformity permanently.

SUMMARY

1. Recurrence of deformity after operations for drop foot is often associated with opening of the front of the ankle joint: this has previously been regarded as a complication of the operation.
2. This study of sixty paralytic drop feet treated conservatively reveals that this laxity was in fact present in no less than 43 per cent.
3. The laxity is most commonly found when the calf muscle is strong and it can occur within a year of the onset of the paralysis. It is not always prevented by wearing a toe-raising spring.
4. Such anterior laxity may well be a common cause of failure of many of the standard operations for drop foot.
5. Before operation for drop foot is undertaken a lateral radiograph of the ankle should be taken in forced plantar-flexion. If this demonstrates anterior laxity any standard operation is unlikely to succeed unless the anterior fibres of the collateral ligaments are protected from strain by simultaneous tendon transplantation or unless the ankle is included in the arthrodesis.

REFERENCES


