

ACTIVE TENODESIS, AN ATTEMPT TO
CORRECT PARALYTIC DROP-FOOT WHILE
PRESERVING THE MOBILITY

BY
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The treatment of paralytic drop-foot varies according to the extent of the paralysis.

1. *All muscles of the foot and lower leg are paralysed.*

Various stabilizing operations have been suggested: astraglectomy, tendon fixation (*Gallie*), panastragalar arthrodesis, posterior bone-block, and wedge subastragalar arthrodesis (*Lambrinudi*). Appliances may be used for children too young for arthrodesis, and for patients unwilling to have an operation.

2. *Three or two muscles have good power.*

When there are three strong muscles, one of them is transplanted to the calcaneus, and one to each side of the foot; this is often combined with subastragalar arthrodesis. When there are two good muscles, one of them is transplanted to the calcaneus and one to the middle of the dorsum pedis and subastragalar arthrodesis is necessary.

3. *Only one muscle is active, usually the triceps surae.*

Either an appliance or one of the operations used for total paralysis may be chosen. Panastragalar arthrodesis is not suitable. Good results may be obtained by a subastragalar arthrodesis combined with posterior arthrorisis, or by a Lam-

brinudi subastragalar arthrodesis, but these methods considerably reduce both active and passive flexion and, for instance, the use of an ordinary riding-boot is prevented. In order to preserve this valuable mobility, a method, which is termed active tenodesis, has been tried at the Orthopaedic Hospital of the Invalid Foundation at Helsingfors. It aims to preserve passive movement at the ankle joint and to enable the patient to keep the foot in a neutral position by the active contraction of the triceps surae.

Method: Through anterior and lateral incisions the tendons of the paralysed tibialis anterior and peroneus brevis are divided where they join the muscular tissue. Through a small incision at its distal insertion the peroneal tendon is pulled out and passed up via the lateral tendon sheath of the extensor digit. comm. to the anterior incision. If the tendon of peroneus brevis is too weak or too short, that of the peroneus longus can be used, attached by a silk suture to the distal insertion of the peroneus brevis. A hole is cut in the interosseous membrane, and both the tendons are passed through it to the lateral incision, where with the foot in maximum dorsiflexion, the tendons are passed through the tendo Achilles and attached to it with silk suture. The tendo Achilles should be lengthened, if it is contracted. In some cases the tendon fixation has been combined with ordinary subastragalar arthrodesis.

In 1902, *Vulpinus* described a method in which the active tendo Achilles was split into three parts. One lateral part was joined to the tendon of the tibialis anterior, and the other to the tendons of peroneus longus and brevis. *Vulpinus* expected the different parts to function separately, but this did not happen, and the procedure was ineffective.

Haglund, in 1913, described a method of tendon fixation in paralytic drop-foot, which he termed "activated tenodesis". He attached the tendons of the paralysed tibialis anterior and ext. dig. communis to the tibia. If there was some contractile muscle present, the tendons were divided above the suture, and the proximal and distal ends of the tendons were joined distal to the tenodesis. By this means he hoped to be able to utilize any existing muscle power. However, if a muscle retains part of its contractile power, it should be possible to utilize it in other

ways than by this kind of tenodesis, whose effect is small if there is severe paralysis.

The active tenodesis, which has been tried at the Invalid Foundation has not, I believe, been described before in the literature.

Failures must be expected, as the tendons may become attached to the interosseous membrane or to the bone; the tendons may stretch on one or both sides; or the tendon suture may break.

6 patients have been treated by this method and have been observed for from one to three years. In 3 the tendon fixation was combined with subastragalar arthrodesis. 5 had had infantile paralysis, and 1 a myelitis of unknown etiology which had caused paralysis of all the long muscles of the foot, excepting the triceps surae. The operation has also been done on 5 further patients, but the time of observation is less than one year.

Of the 3 cases treated by tenodesis alone, 1 showed a good result. At follow-up examination there was almost full passive dorsal and plantar flexion of the foot. Contraction of the triceps surae pulled the foot into slight plantar flexion, regardless of its initial position. In the other two patients the equinus position was increased, and there was a tendency to varus position due to stretching of the transplanted tendons. These relapses were corrected by shortening the tendons. A small incision was made on the dorsum of the foot under local anaesthesia. By shortening one tendon more than the other, any varus or valgus position of the foot can be corrected. Of the 3 cases in which tenodesis was combined with subastragalar arthrodesis, 2 showed a satisfactory shape and position of the foot at the follow-up examination. Passive dorsal flexion was full; there was active plantar flexion to about 120° ; and a little more passive plantar flexion. There was, however, no active dorsal flexion by the triceps surae. Probably the transplanted tendons had become adherent to the interosseous membrane. The third case had a less good result; it had relapsed due to stretching of the tendons.

Thus, this method may give satisfactory results, but it is not reliable. Tenodesis alone does not prevent other operations being performed later, and this is one of the advantages of the method. When it is combined with subastragalar arthrodesis, stability of the subtalar joint is obtained. However, arthrodesis requires a long period of immobility and there is a great risk that the transplanted tendons will become adherent to the interosseous membrane or to the bone with loss of the active

function. For children, whose splints have to be renewed frequently and in whom the active muscle should be used to prevent atrophy, the method is suitable until they are old enough for arthrodesis. Should tenodesis prove unsatisfactory, another stabilizing operation may be done later. A Lambrinudi arthrodesis, or posterior arthrorisis may be performed first, and, if the result is unsatisfactory, panastragalar arthrodesis later. Several surgeons have obtained good results with arthrorisis (*Campbell, Wagner, Gill*). It is, however, difficult to perform and uncertain in its results and it may cause pain through irritation of the talocrural joint. *Lambrinudi's* operation is simpler, and, according to *Fitzgerald* and *Seddon*, the results are good, but are not always satisfactory, as instability of the talocrural joint develops later in some cases. The two methods mentioned above do not prevent recurrences due to stretching of the ligaments of the anterior joints of the foot (Lisfranc' joint and the cuneonavicular joint) and consequent recurrence of the equinus position of the anterior part of the foot. Active tenodesis prevents these recurrences as the tendon of the tibialis anterior is inserted into the first cuneiform and base of the first metatarsal, and that of the peroneus brevis into the base of the fifth metatarsal.

S U M M A R Y

The author describes a method, which he calls active tenodesis, for treating paralytic drop-foot. The operation aims to prevent the drop-foot while preserving the movement at the talocrural joint. The tendons of the paralysed tibialis anterior and of one of the paralysed peronei are utilized. They are divided where they join the muscular tissue: the peroneus tendon is pulled out near its insertion and passed through to the anterior side of the ankle. Both tendons are now passed through an opening in the interosseous membrane and sutured to the active tendo Achilles. The method may give satisfactory results but it is not reliable. The various treatments of paralytic drop-foot are discussed.

R É S U M É

L'auteur décrit une méthode qu'il appelle ténodèse active pour le traitement du "drop-foot" paralytique. L'opération tend à empêcher le "drop-foot" en maintenant la mobilité de l'articulation talocrurale. Les tendons du tibial antérieur et de l'un des péroniers sont utilisés. Ils sont divisés à l'endroit où ils rejoignent le tissu musculaire: le tendon du péronier est sorti à proximité de son insertion et passé à travers sur le côté antérieur de la cheville. Les deux tendons sont passés à travers une ouverture dans la membrane interosseuse et suturés au tendon d'Achille actif. Cette méthode donne des résultats satisfaisants mais n'est pas absolument sûre. Les divers traitements du "drop-foot" paralytique sont discutés.

Z U S A M M E N F A S S U N G

Der Verfasser beschreibt eine Methode, die er als aktive Tenodese bezeichnet, und in der Behandlung des Lähmungsspitzfusses verwendet. Die Operation hat zur Aufgabe den Spitzfuß einerseits zu verhindern, andererseits aber die Beweglichkeit im Talocruralgelenk zu bewahren. Zur Verwendung gelangen die Sehnen des gelähmten tibialis anterior und eine der Peronäussehnen. Diese werden am Übergange zum Muskelfleische durchtrennt. Die Peronäussehne wird nahe ihrer Insertion herausgezogen und zur Vorderseite des Knöchels tunneliert. Beide Sehnen werden dann durch eine Öffnung in der interosseus Membran gezogen und an die aktive Achillessehne genäht. Die Methode kann zufriedenstellende Resultate geben, aber sie ist nicht sicher. Die verschiedenen Behandlungsmethoden des paralytischen Spitzfusses werden besprochen.

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