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## TENDON TRANSPLANTATION FOR CLAWING OF THE GREAT TOE

BY M. F. FORRESTER-BROWN, M.S., M.D. (LOND.), BATH, ENGLAND

In orthopaedics, as in other branches of surgery, the so-called "minor" disabilities are often the most crippling to the patient and, therefore, "major" to him. One of these, which is common in the late stages of poliomyelitis, as well as in other paralytic conditions, and which has not received from surgeons the attention it deserves, is clawing of the great toe.

The condition is one of plantar flexion of the terminal interphalangeal joint and dorsiflexion of the metatarsophalangeal joint, and each of these joints may reach a stage of irreducible subluxation. This attitude may develop very slowly and insidiously in a foot that appeared normal for a year or more after the acute onset of poliomyelitis, and it is due to minor degrees of faulty balance among the muscles,—that is, weakness of the tibialis anterior associated with overaction of the extensor hallucis longus and flexor hallucis longus, together with weakness of the intrinsic muscles of the foot, especially those acting on the great toe. If the sole muscles are strong, there is usually a cavus deformity of the whole tarsus. The deformity is most liable to occur in the good limb, upon which most of the body weight is borne, due to weakness of the other hip or knee. It is also frequently latent while the patient is at school and is seated a large part of the day, but it develops steadily after he begins work with much standing or walking. Hence its seriousness. What the patient actually complains of is not the deformed appearance, but the corns which occur under the head of the first metatarsal and on the dorsum of the terminal joint. These are likely to be very hard and painful and to resist all the efforts of the chiropodist. When muscle balance is restored by the simple operation to be described, they yield to the simplest measures, such as scrubbing with soda or an application of a salicylic preparation, and they do not recur.

The operation which the author wishes to describe is based on the principle suggested by Sir Harold Stiles<sup>1</sup> during the Great War for the treatment of lumbrical paralysis of the hand,—namely, the creation of an artificial lumbricalis by transferring part of the flexor tendon (flexor digitorum sublimis in the hand) to the extensor tendon opposite the first phalanx, the course normally taken by the lumbricalis, so that it may flex the knuckle and extend the interphalangeal joints.

In the case of the great toe, the present writer began by transferring half of the flexor hallucis longus to a new insertion in the extensor hallucis longus. Later it was found that, if the terminal joint of the toe was subluxated, it was best corrected and fixed by arthrodesis in a straight line. Then it was safe to transfer the whole flexor hallucis longus to the new insertion.

## TECHNIQUE

*Incision*

The incision should be curved like a long-drawn-out S, so as to reduce tension when suturing, and it should run from the internal cuneiform, along the upper border of the abductor hallucis to the side of the great toe opposite the interphalangeal joint,—along the anterior two-thirds of the inner border of the foot, as one must have good exposure to reach both flexor and extensor tendons and to induce them to run a smoothly converging course at the end of the operation. No transplant works well in which the united muscles meet at a wide angle.

Skin flaps are dissected up in both directions, as much as possible in the plane immediately over the tendon sheaths, so as to avoid the large plexus of veins. Some of these must be divided and ligatured, but a tourniquet is not necessary and, since in these cases the circulation is poor, it seems to the writer that the use of a tourniquet jeopardizes the vitality of the thin skin flaps.

*Freeing of the Tendons*

The flexor tendon is found in its sheath, lying close to the plantar aspect of the proximal phalanx. The sheath is opened, and the tendon is pulled out with a blunt hook and traced up as far as the middle of the metatarsal. The toe is then bent sharply, and the tendon is divided as near its insertion as can be reached without making a skin scar under the phalanx, which might become painful on weight-bearing. The tendon must not be freed too far up the foot, for, if it should slip onto the dorsum of the metatarsal head, it would cease to have its plantar-flexing action.

The extensor tendon is lifted out of its sheath for several inches. If it becomes like a bow-string when the claw attitude is corrected, it must be lengthened by splitting it Z-fashion for several inches. Unless the split is a long one, there will be more separation than one expects and no overlap will remain for suturing of the ends.

*Joint Contractures*

If free plantar flexion has not been attained in the metatarsophalangeal joint, it may be necessary to divide the dorsal ligament, as no transplant can be expected to correct a deformity; its action is merely to prevent relapse. If the interphalangeal joint is subluxated, it is best to arthrodese it by removing a dorsal wedge, including both cartilages. The position is easily maintained by a single catgut stitch through the soft parts.

*Tendon Suture*

This can be done when both joints stay easily in the corrected position. The flexor tendon should be made to take a course along the side of the metatarsophalangeal joint, reaching the extensor on the dorsum of the proximal phalanx. Sometimes in severe cases it is hard to make the

tendon reach so far. It can be threaded through a slit in the extensor tendon, or, if the latter has been split and is very thin, as it commonly is in spite of its great activity, then the flexor tendon can be buttonholed and the distal end of the extensor tendon passed through it, the proximal end being sutured to the side of the junction. No. 120 linen thread makes the most convenient and least irritating form of suture. The skin is so thin over the line of union that any absorbable material like catgut is liable to irritate the skin and to work its way out. The linen becomes buried in scar tissue and is found with difficulty at any later exploration. No attempt should be made to suture the tendon sheaths, which are usually adherent and inelastic in these cases; a new sheath speedily forms and assists instead of hindering movement.

#### *Skin Suture*

Suture of the skin should be by interrupted stitches of silkworm gut, so as to allow free oozing, for, if a hematoma should form under tension, the skin would slough and jeopardize the vitality of the tendons beneath. After correction of the deformity, the skin is surprisingly tense in such cases, especially over the metatarsal head. In some cases a blister has occurred in this region, but exposure to the air under a wire cage for a few days (Böhler's technique) has dried it up without loss of skin or undue adherence. The skin stitches should be left in for from twelve to fourteen days.

#### *Splinting*

A firm bandage over plenty of wool is sufficient to fix the great toe in neutral position, but, in order to discourage movements of the tendons for ten days, a splint to hold the ankle at a right angle is useful.

#### *After-Treatment*

In order to give opportunity for the most favorable circulation, the patient should be kept in bed for three weeks with the limb raised on a cage. After this he can walk in a boot which is sufficiently long and wide to give room for the corrected great toe. Massage, to free light adhesions without bursting open the wound, is useful, but an intelligent patient can soon restore good movement by exercises in hot water.

### RESULTS

It is not claimed for this operation, any more than for any transplantation operation, that it will restore normal function, but in the writer's hands in every case it has relieved the pain and disability associated with corns and arthritis. There have been no relapses and improvement has been steady. The earliest case was operated upon about five years ago. All of the patients are working, and, before the operation, most of them seemed likely to have to give up work as the result of the deformity. Although the passive range of the great-toe joints may be normal after oper-

ation, provided that severe arthritis has not involved them before operation, yet the active range will be only about 20 degrees in each direction from neutral, the two phalanges moving as one rod about the metatarsal head. This is the amount required for walking and standing.

#### COMPLICATIONS

In a certain number of cases there is a similar claw attitude of all the toes. If the toes are not fixed and the corns are not painful, the deformity can be ignored. If the sole muscles seem fairly good and the extensor tendons alone are shortened, tenotomy may restore balance.

In more severe cases, it would be too tedious to do a similar transplantation operation on each toe, whereas excellent balance can be obtained by Hohmann's operation of looping the extensor digitorum longus tendons around the neck of the third or fourth metatarsal. A separate incision must be made for this,—a J-shaped incision along the fifth metatarsal is best. The tendons are cut at the root of the toes; the periosteum is raised around the neck of the metatarsal with an aneurysm needle; and, after the tendons have been secured with guide threads, these threads are used to pull the tendons in pairs around the bone from opposite sides. Two stitches then suffice to anchor the ends together, while the ankle is kept at a right angle. The extensor digitorum brevis tendons should be left intact to prevent dropping of the toes themselves. This is a simple operation of astonishing efficacy.

#### CONCLUSIONS

Clawing of the great toe is a disabling complication of some cases of poliomyelitis and other forms of paralysis. It can be satisfactorily corrected and relapse can be prevented by transplantation of half or all of the flexor digitorum longus tendon into the extensor hallucis longus tendon. If the other four toes are also deformed, they are best treated by looping their extensor tendons around the neck of one of the metatarsals.

1. STILES, SIR H. J., AND FORRESTER-BROWN, M. F.: Treatment of Injuries of the Spinal Peripheral Nerves. London, H. Frowde and Hodder & Stoughton, 1922.