

POST OPERATIVE RE-EDUCATION FOR TIBIALIS POSTERIOR TRANSFER FOR CORRECTION OF FOOT DROP CAUSED BY TIBIALIS ANTERIOR MUSCLE PARALYSIS and other causes.

The instructions given here are for the basic Tibialis Posterior transfer. In situations where other tendons are also transferred it may be necessary to adapt this technique. However, many transfers do not require any specific re-education, they just work automatically when the foot moves. But for good results it is essential to have the co-operation of the patient. It is an excellent idea to teach the patient to strengthen the Tib Post muscle (and any others that may be transferred) in the weeks preceding transfer. If the patient will not or cannot strengthen the muscle pre-operation it is unlikely that he/she will be able to use it as an active transfer. It may be better to do some other tendon surgery.

Tibialis Posterior may be transferred by the Subcutaneous or the Interosseous route. There are several different methods of insertion of the tendon at transfer - but the re-education is the same.

BEFORE OPERATION

1. Teach isolation of the Tibialis Posterior muscle with the foot in dorsiflexion keeping the gastrocnemius/soleus relaxed. Strengthen the muscle also. Do not teach this until shortly before the operation is scheduled as strengthening of the Tib Post may increase the inversion of the heel and accentuate the deformity of the foot. Good pre-operative use will enable the patient to use the transfer sooner and more readily after surgery.
2. Check the ankle mobility and tendo-Achillis length are as much as possible. The functional angles of the ankle should be measured in active plantar flexion, and active dorsiflexion, also passive dorsiflexion with the knee straight and with the knee fully flexed. If the dorsiflexion is inadequate a tendo-Achillis lengthening may need to be done at the same time as the tendon transfer. The degree of ankle dorsiflexion that can be achieved will depend on the state of the ankle bones. In some patients it is better NOT to lengthen Achilles. Is there bone deformity or arthritis? Check tarsal mobility. Inversion/eversion passively and actively.
3. Measure angles as previously described and record. Make a full record of the Voluntary Muscle testing (0-5) results before surgery as a guide to the surgeon as to what can be transferred, if needed.

POST- OPERATIVE SPLINTING

The full plaster is applied on the operation table and designed to maintain the ankle in 75 degrees of dorsiflexion (or higher) without any pressure on the ball of the foot. Special care must be taken of the metatarsal head of the 5th toe which is often very vulnerable to pressure, and the plaster is designed to take pressure on the heel and the arch so that excessive pressures on the ball of the foot do not occur. The assistant needs to stand beside the patient so that the patient's knee rests on the assistant's chest. Then one hand is placed with fingers flat on the metatarsal heads to hold the ankle fully dorsiflexed and the foot as everted as possible. That hand remains in position until the cast is fully applied to hold the ankle in as much dorsiflexion-eversion as possible. When the assistant's hand is removed the cast around the toes can be flattened a little to remove any pressure on the sides of the foot. The leg piece of the cast is tightened at 4 days, after adequate padding is added on each side of the tibia, so that there is no movement in the whole cast and then the cast is covered with fibreglass to provide adequate strength, and the patient can walk out of hospital about 6 days after surgery. When the surgeon permits, usually between 4 and 8 weeks, the cast can be bivalved. That back slab is kept to maintain the resting position, the front half kept and replaced between exercise sessions and for sleeping so the fully protected position can easily be achieved again if needed. This will allow the patient to learn to walk in and out of it. It is usual to keep these transfers in the cast for about 4 weeks

before bivalving. Where the physiotherapists are well experienced, the 22nd day is the earliest that I take the casts off so that the patient can start physiotherapy, but when that occurs he requires stricter supervision initially (ie. the patient usually starts physiotherapy at 4-6-8 weeks, but occasionally here in Australia it may be 3 weeks if there is adequate supervision). If there is totally inadequate supervision and/or the patient is unco-operative or elderly it may be better to leave the casts on for 6 weeks or even 8 weeks depending of what action is expected later. Having the casts on for 6 weeks seems a good balance as by then the tendon transfers are strong enough to take some resistance. This means that the strict supervision is not needed. He uses the bivalved splints during the post op physio and sleeps in them for at least the first 3 months after surgery. He is told to keep them and to return to using them when needed for the rest of his life! ie. if there is ever trauma to the foot or it becomes warm and swollen or painful. By replacing the foot in the bivalved casts the whole area is put at rest giving Nature a chance to heal.

However it is desirable to get the patient walking again about Day 42 unless he has had a considerable period of immobilisation just before the tendon transfers. Immobilisation, in a cast or even just on full bed rest, allows, or rather encourages, decalcification, especially in the neuropathic limb, and this makes the bones more vulnerable to trauma, increasing the chances of a stress fracture occurring if walking is resumed too quickly or energetically. It has been stated that immobilisation for 6 weeks is enough to predispose to stress fractures. Feet that have been infected will also have increased osteopaenia. Feet that have been fractured will have increased osteoporosis round the fracture site, and other local bones will also be osteopaenic. Hence all of these situations require longer immobilisation and more care in the re-training phase. The longer the immobilisation for any reason the slower ought to be the retraining period. For the routine Tibialis Posterior tendon transfer in Australia I bivalve the cast about Day 28 and expect the patient to be able to spend most of his time out of the cast walking by Day 42. Where we do multiple transfers and an osteotomy we often leave the casts for 6 weeks. However, if heavy work is involved or the patient is in a situation where trauma is likely to occur to the foot (eg. football crowd or shopping in a supermarket), this return to normal walking may be considerably modified, and the patient while walking out of the cast at home may be advised to wear the cast to the footy match or in crowds, or even to the supermarket!

Hence the re-education acts very well giving supervised use which will encourage the bones to re-calcify. REMEMBER THESE PATIENTS USUALLY HAVE ALTERED PAIN PERCEPTION AND SO MAY BE UNAWARE WHEN THEY TRAUMATISE THEMSELVES. Protection at all times when there is any risk, please.

AT REMOVAL OF THE PLASTER

The plaster is bivalved and any bandages cut for easy removal from the plaster. Then the therapist takes the forefoot in his hand and tends to dorsiflex the ankle whilst the posterior part (the back slab) of the plaster is removed. Do not just pull the plaster off without supporting the foot or you may accidentally pull the foot into plantar flexion and damage the transfer. At 3 weeks the tendons are joined enough for gentle movement - not until 6 weeks are they reasonably strong and not until 3 months can we consider they are really strong.

The patient is then instructed in placing a bandage round the ball of the foot and holding this with one hand so that it becomes impossible for him to plantar flex the foot without stressing against this bandage. The patient in this way learns to protect the transfer from over plantar flexion, initially. The patient with this bandage (foot support sling) holds the foot in the correct position, as held in the cast, whilst the sutures are removed and the angles are measured, passively. There is no need to pull hard on the foot support sling but the patient should know that if he feels himself pulling against the bandage when it is held just at neutral tension then he must stop pulling with the foot, (ie. relax the leg muscles) or use power with his hand to prevent plantar flexion. This sling is used to protect the foot during the early days of exercises until the patient has control of the transfer. The ankles are measured using this sling initially to obtain "angles at rest and/or passive ankle flexion".

RE-EDUCATION

1. Day 1. With the patient lying on his bed or a plinth, place both legs in the frog position, ie. thighs abducted and externally rotated so that the knees are flexed and the ankles come close together again with the lateral side of the foot resting on the bed. In this way the lateral border of the leg is in contact with the bed. The soles are almost parallel.

Starting with the un-operated foot the patient is instructed to use the tibialis posterior muscle in isolation as instructed before surgery. Once he has seen the movement and the action of the gastrocnemius muscle and the toe flexors/extensors are eliminated, he is told to shut his eyes and repeat the action. Then with the eyes closed he is told to do the same action with both feet at the same time. If he is doing the action correctly the un-operated foot should invert and the operated foot should dorsiflex. Hence, initially, it is best to have his eyes closed or covered so that he cannot see the action or he will become confused.

If he has learnt to use the Tib Post in isolation before surgery he may be able to activate the transfer at once and this is especially desirable if he is having both feet done at the same time (which we commonly do for CMT) .

If he has been well trained before surgery and is young, he may be able to use the transferred muscle without having to use the other leg to provide an "overflow stimulus". Continue the action until he is sure of it, and then progress to doing the action without the un-operated leg moving at all. It may be necessary on a few successive days to go back to the frog position initially until the patient is able to do the action on command with the operated foot only, before any further progress is made. Once he can do it on command in the frog position start straightening the knee and demand the same foot action. It is essential that the patient relax the calf muscles and toe flexors or the action and the range of movement will not be adequate.

2. As the action becomes more definite allow him to have the eyes open, and then encourage him to obtain the action without thinking of inversion. Many young patients can achieve dorsiflexion with the knees straight on the first day.

3. Days 1-4. Concentrate on localisation of action, then increase range of motion and then the holding of the contraction for an increasing length of time, ie. the patient starts counting on each contraction to 5 and then up to 10. This is done with the leg horizontal on the bed.

4. Days 2-7. Once the patient has good control of the transfer it is practical to get him to sit on the edge of the bed or bench so that the knees are at about 90 degrees and the feet flat on the floor. Then he uses the transferred muscle as already taught to lift the toes off the ground, ie. against gravity. If both feet have been done do the feet alternately to teach pattern of usual use. Again build up until good range of movement and strength and duration of pull.

5. Days 4-7 (approx). The patient needs to wear his shoes and socks from this time on. Train him now that for the rest of his life he should never take a step without suitable shoes that require resilient innersoles as for a diabetic. Even when swimming, and certainly when running on a beach, he MUST wear shoes and socks. He needs good resilient shoes which lace or buckle on so they do not easily fall off but protect the foot from trauma while walking. Patients with neuropathy should never go without socks inside their shoes and never walk anywhere without shoes. Having fixed the foot wear start the patient standing. Patient stands erect using a support initially - not to take the weight but to provide stability. (Many of these patients have a problem with balance and a walking aid assists in obtaining balance while learning to walk. There is no good reason why they cannot fully weight bear from the beginning in most cases.) The support can be a walking frame, parallel bars, the bed end or crutches. Both feet are initially flat on the floor. Keeping the heels on the floor he raises the front of the operated foot off the floor by using the transferred tendon. He alternately raises the front of each foot getting used to the idea of the feet being moved as in walking. If he can do this with knees straight it will be harder at first but will encourage a better gait eventually. Later he can progress to knees bent but the degree of elevation of the operated foot will depend very much on the tension of the transfer, the length of the Achilles tendon and also on the mobility (shape of bones) of the ankle.

6. Transference of weight from foot to foot. In the position described in No. 5, the patient is instructed to place the good foot just in front of the operated foot so that the heel of the un-operated foot is level with the toe of the operated foot. Then he is instructed to lift the forefoot of the operated foot, and when it is clear of the ground to lift the whole foot and swing it through, holding the transfer contracted all the time, to place the foot just in front of the un-operated foot as he would in walking, striking the ground with the heel, allowing the foot to relax as the step is completed. He MUST learn to keep the muscle contracted for the whole of the swing through. He can then take the good foot forward as if stepping, put it down but then lift it (toes lift first) and bring it back and replace it behind the operated foot and lift the operated foot in reverse, ie. lift toes, and hold the muscle contracted as the foot goes backward for heel strike and to its original position to get ready for the next step forward.

The patient should stand upright and not watch his feet by bending his head forward.

Preferably there should be a mirror so he is not trying to bend forward to watch the feet.

A long mirror at the end of parallel bars is useful at this stage but not essential. But it is essential that the patient's actions be carefully watched, initially at least. If there is any tendency to a high stepping gait, ie. the patient is returning to the high knee lift that he would have used before surgery, he should be encouraged to walk with NO knee flexion at all, ie. straight knees will help to eliminate the high knee lift that is so characteristic. It is more difficult to walk and there may be less range of motion but after about a week, once the patient has a good gait with knees straight, he can be told to let the knees relax and he ought to go into a normal gait with partly flexed knees but no high stepping gait. It is probably safest to insist on straight knee walking for at least the first week to break the bad habit of high knee lifting. Some technicians concentrate on making the patient rise up on the ball of the toes during take-off which is a normal action. It does take concentration on the part of the patient to do this as he must bend the knee to plantar flex the foot to get the heel off the ground while the toes remain on the ground. How do you expect him to deliberately dorsiflex the foot while the foot is of necessity plantar-flexing to rise up on the toes. He may drop the hip on that side and develop a limp. I find the stiff knee walking much better and the other actions will follow once free walking is allowed. INITIALLY PUT ALL ACCENT ON THE ANKLE DORSIFLEXION AND HOLDING IT WITH EVERY STEP AND WHEN THAT IS AUTOMATIC A MORE NORMAL GAIT WILL FOLLOW, once patient is allowed to flex the knee as desired (not force knee flexion).

7. Days 7-14. Patient has alternate periods of sitting and exercising and standing and walking, but being supervised enough to ensure that the correct action is obtained. It is essential that the correct action becomes a habit. Many patients can move a TPT transfer on command but never use it in walking and complain "down the track" that they scuff their toes, just because they do not dorsiflex on take-off. Do not allow long steps. Short steps are less traumatic in take-off and strike than long steps, and all patients with sensory abnormalities of the foot should be encouraged to take short steps and wear RESILIENT (NOT SOFT) insoles in their shoes such as Poron or EVA220. (Even if they have a custom-made orthotic if it is rigid and not resilient add a layer of 4mm Poron on top and it will make walking more comfortable and safer).

8. ONCE THE PATIENT HAS CONTROL OF THE TRANSFER HE IS ALLOWED TO WASH THE FOOT – in fact is encouraged to soak it every day in plain water, and to scrape off (using a dry green nylon pot scraper eg. Scotchbrite). I never allow the foot to be washed in a bowl or bucket till the patient has conscious control or he forgets and uses his plantar flexors which could wreck the whole result. He needs to learn to remove any hard callus that may be developing on the foot, or is left from excessive pressure pre-operation. This should ideally be started before surgery and should become a routine part of daily foot care for the patient with neuropathy of the lower limb. It should be taught and practised before surgery and continued for as long as the neuropathy persists. After the scrape, the foot should be oiled to keep the water in the autonomic deficient foot which is usually excessively dry. Ordinary moisturising creams do not rehydrate dry skin. Ideally diabetic and similar skin ought to be rubbed with lanoline as that is absorbed by human skin and will improve the quality of the skin. The so called "moisturising cream" is basically mineral oil and moisturises by preventing dehydration so if applied when the skin is dry is really not much help. Vegetable oil is absorbed better than mineral oil but not as good as lanoline or fish oil. However, soaking the foot in a bowl of water should mark the fact that the patient has good

control of the transfer and starts the training for daily care. My patients are not allowed to wash the foot or soak the foot until they have good control of the transfer. It has been observed that even the best intentioned patients can forget and may use the gastroc to plantar flex the ankle to get the foot into the water or make other undesirable movement.

Our Rule - "A CLEAN FOOT IS A CONTROLLED FOOT".

9. If the patient does not use the transfer habitually in walking he may have a better walk because of the tenodesis effect (even the effect of a transferred paralysed Tib Post will improve the situation) that reduces plantar flexion and when walking with a heel toe gait the ankle will passively move but he will not drag the toes as much. However the tendon is more likely to stretch when balanced against a strongly functioning gastroc muscle if the patient does not make the muscle fibres function regularly, In these patients a slight heel rise in the shoe will help to prevent the foot drop gait becoming a real problem again.

10. Days 7-14. The patient is allowed to walk for increasing long periods, slowly increasing the duration if there is no evidence of heat and swelling in the affected foot. While the patient is in hospital or the clinic, the therapist needs to see the patient from time to time, preferably when the patient does not think he is being watched, to check that he is using the transfer correctly. He needs to learn to cope with steps and rough terrain. Once it is seen he is using it correctly, say about Day 10-14, he can be instructed to let the knee bend if he wants to - not to deliberately flex the knee and he ought to go into a near normal gait.

11. Heat and swelling of the foot needs to be watched for. In the neuropathic foot minor fractures and bone trauma may not present with pain but will present with some warmth or heat and swelling. If heat and swelling occur replace the foot in the cast and leave without exercise for the rest of the day and check again in the morning. If the heat and swelling have subsided let the patient resume walking at a slower rate, i.e each walk shorter. If the heat and swelling recur the foot needs to be rested for several days and then try again with less walking. If in doubt, continue to exercise while sitting using some resistance but NO walking until the foot has been x-rayed and the surgeon is satisfied that there is no stress fracture. It is heat that is the main indicator of a bone lesion, heat that subsides rapidly on complete rest and returns as soon as walking is resumed. See also last section (No. 3) in the first part of tendon transfers.

12. Resistance may be advisable but is rarely given by mechanical means before Day 42 after surgery (in tendon joins, longer after tendon bone joins.) This can be provided by a cuff that fits round the foot and a pulley on the wall and some known weights. If the bed has a raised foot rail or end it may be possible for the rope to just fall over the end of the bed. The weight should not be so great as to limit the range of motion, but should be just enough to make the muscle work a bit harder to maintain the same range or motion. Alternately the handles of a plastic bag can be placed over the arch of the foot so the bag falls down below and then increasing weights by use of tinned food can be added into the bag, then the patient can exercise at home sitting on a table or over the edge of an elevated verandah. Patients can achieve a good strength over a period - to be able to lift a weight of 4 kg is not uncommon. If there is doubt about the integrity of the bones it is still possible to do resistance with weights but no weight-bearing. Usually the damage (fractures or chips) is done during weight-bearing. But if there is definite bone damage the patient will have to go into a full plaster cast for a long period (2-3 times as long as for the same fracture in a normally sensate foot).

TENDON TRANSFERS FOR CLAW TOE CORRECTION

This does not require any re-education as the long flexor tendon should produce the required pull when it is contracted as usual. But this operation does increase the efficiency of weight spread over the foot, and helps to protect the toe tips and ball of foot from damage. The long flexor of each toe is freed from the distal phalanx and rerouted on the medial side of the proximal phalanx to be sutured into the long extensor over the proximal phalanx. This removes the deforming force that flexes the IP joints and corrects the deformity of dorsiflexion of the MTP joints so making the toe straight and bringing the pulp down to help protect the ball of the foot during weight-bearing.

Post Script

After any tendon transfer it is necessary to protect the transfer from undue stress. Hence any uncontrolled actions are dangerous, especially in limbs with reduced pain perception. Consequently I do not allow the operated limb to be washed until control of the transfer has been achieved. A clean washed limb indicates a limb that can be controlled.