TENDON TRANSPLANTATION

Various operations known as tendon transplants have been performed on many patients with disability due to muscle imbalance. The results vary from brilliant success to total failure. Statistical analysis of the results of tendon transplantation yields important clinical information. For example, Gunn and Molesworth in a recent issue of the Journal (November 1957) reported on transplant of the tibialis posterior to act as a dorsiflexor in patients suffering from foot drop caused by paralysis of the lateral popliteal nerve. Although all but two of their patients were suffering from leprosy, the same clinical problem is seen after irreparable injury to the lateral popliteal nerve such as often occurs at the neck of the fibula. These patients characteristically have a foot-drop gait, and in the course of time a fixed equino-varus deformity results from the unopposed pull of the strong plantar flexor and invertor muscles of the foot. Several methods of treatment of this condition are available, such as bracing, stabilisation by posterior bone block or arthrodesis, tenodesis and tendon transplantation. The best approximation to a normal gait is produced by an operation which restores active voluntary dorsiflexion of the foot. Gunn and Molesworth report that forty-nine of fifty-six patients in whom the tibialis posterior tendon was transplanted through the interosseous membrane to the dorsum of the foot had a satisfactory result. They noted that the transplant usually functioned actively and that the patient walked well after this operation. It is well known that a tendon transplant will not correct a fixed contracture. It is therefore important that the transplant be done before deformity has occurred, or, if present, the deformity must be fully corrected before or at the time the transplant is done. The normal posterior tibial muscle is strong enough to act as a very satisfactory substitute for the totally paralysed dorsiflexors of the foot. Although it is stated that transplantation of a muscle is always accompanied by some loss in its power, this loss should be kept to a minimum by paying careful attention to the operative technique and to the post-operative régime. It is worth while during the operation to test the function of the transplant in its new position, using an electric stimulator with a sterile electrode. Among the technical problems connected with the operation there are a few of particular importance. The whole length of the posterior tibial tendon and the muscle fibre distal to the point of entrance of the muscles' nerve and blood supply must be carefully mobilised. The transplanted tendon must glide freely through the interosseous space between the tibia and fibula. An atraumatic extraperiosteal resection of the interosseous membrane minimises formation of adhesions. The new point of insertion for the transplanted tendon must be carefully chosen. If it is too far medial, the foot will develop varus, if it is too far lateral, a valgus deformity will occur. The tendon must be securely anchored to bone so that there will be adequate fixation both in the immediate post-operative period and later when the insertion is subjected to repetitive active muscle function. There is an optimum tension under which the tendon should be sutured to bone. If the tension is excessive the muscle fibres will be stretched beyond physiological limits with resultant loss in strength. If there is insufficient tension the muscle contraction will fail to produce adequate motion in dorsiflexion.

After operation the transplant must be protected from strain until its new insertion is well healed. Four to six weeks should be adequate. Although Gunn and Molesworth state that re-education of the muscle is surprisingly easy and that many patients learn to use the transplant satisfactorily with a minimum of retraining, there is considerable evidence to the contrary. The action of muscle transplants in walking has been studied by the simultaneous use of motion picture photography and electromyography.* Transplants that function well in isolated action may fail to develop proper synchronisation in walking and either cease to function or function out of phase. Normally the posterior tibial muscle in the act of walking is contracting while the dorsiflexors of the foot are relaxing and vice versa. It is illogical to expect that the transplanted muscle will automatically rephase itself. The services of a skilled physical therapist are invaluable in the retraining programme.

The paper of Singer and Fripp in this issue on Tibialis Anterior Transfer in Congenital Club Foot is of more than passing interest. These authors reviewed the results of seventy-six operations in which the anterior tibial tendon was transferred from its original insertion to a more lateral position on the dorsum of the foot in patients with relapsed club foot. There were fifty-two relapses in seventy-six tendon transfers with recurrence of equinus and varus deformity. Such deformities as cock-up of the big toe, excessive forefoot pronation and depression of the head of the first metatarsal also occurred with considerable frequency. Other authors have also reported unsatisfactory results in anterior tibial tendon transfer in club foot and it seems fair to conclude that this operation has an extremely limited place in the management of the relapsed club foot. Although it is difficult to estimate quantitatively the strength of the foot musculature in the infant or young child with a club foot, it is important to do so. The club foot that has been fully corrected by any of the accepted conservative means (Denis Browne splint or the Kite plaster technique), and that has sufficient peroneal and toe extensor power to actively abduct and dorsiflex the foot against gravity and some resistance, is unlikely to relapse. On the other hand, inability of the child to actively fully dorsiflex and abduct the foot, even if the passive motion is good, usually means that relapse will occur unless the musculature is rebalanced. Transfer of the anterior tibial tendon to a new insertion should not be undertaken if the peroneus longus is functioning. A cock-up great toe and depression of the first metatarsal head is to be expected if the balance of these antagonists is seriously disturbed. If the anterior tibial insertion is moved it should not be placed farther laterally than the fourth metatarsal. A severe pronation deformity of the forefoot is likely to occur if this rule is disregarded.

A major deforming factor in club feet is the powerful posterior tibial muscle. In one instance personally observed, a severe equino-cavo-varus deformity with forefoot adduction was converted in a growing child into a severe flat foot after transplantation of the posterior tibial tendon to the dorso-lateral aspect of the foot. It seems fair to conclude that in this instance at least, the posterior tibial muscle was the major factor in producing the club foot deformity and that transfer of the posterior tibial tendon may be a powerful tool in the correction of relapsed club feet. Further operative trial of muscle rebalancing in relapsed club feet, in spite of the discouraging reports in the literature, appears to be justified. The problems of what and when and where remain to be solved.

JOSEPH S. BARR.

* CLOSE, J. R. (Oakland, California): The Phasic Activity of the Muscles of the Lower Extremity and the Effect of Tendon Transfer. American Academy of Orthopaedic Surgeons Annual Meeting, February 1-6, 1958, New York.