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The Role of Tibialis Posterior Tendon Transfer in Correction of Foot Drop Deformity

ARTICLE INFORMATION

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ABSTRACT

Background: The transfer of the tibialis posterior tendon to the anterior aspect of the ankle not only replaces the function of the paralyzed muscles, but also removes the deforming force on the medial aspect of the foot.
Objectives: In this study, we evaluated patients who underwent tibialis posterior tendon transfer for the treatment of foot drop, and comparison through interosseous membrane route versus anterior to lower tibia route of tibialis posterior tendon transfer, with evaluation of the results according to carayon criteria
Methods: Nine patients with foot drop secondary to different causes treated with tibialis posterior tendon transfer from January 2011 to January 2012 were followed up for a mean of 12 months in Al Kindy Teaching Hospital. We use two different techniques, first transfer the tendon through the interosseous membrane (four patients), and the second technique transfer the tendon anterior to tibia (five patients).
Results: In general according to carayon evaluation criteria, the results were excellent in two patients (22.2%), good in five patients (55.6%), and moderate in two patients (22.2%). Through anterior to lower tibia route, 4 patients get excellent to good result (80%), and through interosseous route, 3patients get good to excellent result (75%).
Conclusions: Transfer of tibialis posterior tendon for the treatment of foot drop deformity enables the patients to walk without the aid of orthosis and increase their quality of life. With no differences between anterior to lower tibia route and through interosseous membrane route.

Introduction:

Foot drop is an irreversible lesion of the peroneal nerve or the dorsiflexors muscles of the foot and ankle result in loss of foot dorsiflexion and eversion [(1)]. As a result, the foot cannot be adequately lifted off the ground during swing phase of walking. An extra flexion of the hip and knee is thus required with ipsilateral elevation of the hip. Walking is facilitated with foot-ankle orthosis that prevents plantar flexion more than neutral [(2)].

In time, with the contribution of tibialis posterior tendon, equinovarus deformity develops [(3,4)]. The aim of treatment in foot drop is dorsiflexion of the foot and restoration of normal heel-toe gait [(5)]. Tenodesis, arthrodesis, and tendon transfer are among surgical treatment options for foot drop [(6)]. Anterior transfer of tibialis posterior tendon both serves to adequately restore lost tibialis anterior muscle function, and to eliminate a potent deforming force on the medial aspect of the foot [(4)].

The first tendon transfer for the treatment of foot drop was described in 1933 by Ober, who transferred the tibialis posterior tendon through the circumtibial route and inserts it on the third metatarsal bone. In 1954 Watkins made the same transfer via the interosseous route. Successful results with both techniques are reported in the surgical treatment of foot drop [(5,7)]. The pathway of the transferred tendon (circumtibial versus interosseous), type of insertion (re-insertion of tendon to bone versus tendon to tendon suture), the recipient tendons (tibialis anterior per se versus tibialis anterior/toe extensors/peroneus longus and brevis tendons) and the tension of the transfer are important technical aspects still debated today [(8)].

The trauma is most common cause of foot drop now a day, peroneal neuropathy caused by compression at fibular head is the most common compressive neuropathy in the lower extremity; foot drop is its most notable symptom [(9)]. All age group are affected equally, but is more in males (male -to female ratio 2.8:1), and they can affect right or left side with equal frequency [(10)]. A foot drop of particular concern to orthopedic surgeons is a peroneal nerve palsy seen after total knee arthroplasty or proximal tibial osteotomy. Foot drop has an estimated prevalence of (0.3-4%) after total knee arthroplasty and a (3-13%) occurrence rate after proximal tibial osteotomy. Ischemia, mechanical irritation, traction, crush injury, and laceration can cause intra-operative injury to the peroneal nerve. Correction of valgus or flexion deformity also has been suggested to stretch the peroneal nerve and lead to palsy. Postoperative causes of peroneal nerve palsy include hematoma or constructive dressing as in tight plaster of paris cast [(11)].

The present study was conducted to compare the efficacy of the two techniques of tibialis posterior tendon transfer in the management of foot drop deformity.

Methods:

Nine patients with foot drop due to different causes (Table1) were operated with tibialis posterior tendon transfer to the front of the ankle, at Al Kindy Teaching Hospital, from January 2011 to January 2012.

Table 1: Gender and Causes of foot drop in study patients.

Causes of foot drop	No.	Gender	
		Male	Female
Penetrating injury	5	4	1
Fractures around knee and femur shaft	3	2	1
Iatrogenic	1	0	1

Eligibility of patients involves:

1. Complete paralysis of dorsiflexors for at least 24 months, confirmed by EMG study.
2. Passive dosiflexion of ankle joint of at least 15 degrees.
3. Tibialis posterior muscle power grade 4 or 5 by clinical assessment.
4. Cooperative patients.
5. Having normal ankle joint without bony abnormality.

Randomly, with no relevance to cause, five patients were treated with tendon transfer anterior to tibia and four patients through interosseous membrane. All patients were operated by the same surgeons, implementing the same way of tendon insertion to dorsum of foot (all transferred tendons were split and inserted to both bone and tendon), to avoid the differences in outcome related to the method of tendon insertion.

The nine patients were followed with the same postoperative regimes, including; postoperative above knee plaster of paris cast in maximal ankle joint dorsiflexion and knee joint was flexed to about 20 degrees, the cast was removed at three weeks, the wounds were inspected, and the sutures were removed, except the suture in plantar surface, and a short leg below knee plaster of paris walking cast was applied with the foot in neutral position and the ankle in slight dorsiflexion. Six weeks after surgery the cast and plantar suture were removed.

Training program of transferred muscle as dorsiflexor was started and continued under supervision until a full range of active function is obtained. The transfer is protected by a static night ankle-foot orthosis for six months. The assessments of the result were done six months after surgery, according to the evaluation criteria developed by Carayon et.al [6]. The evaluation entails active dorsiflexion, plantar flexion and the addition of the two, and expressed as excellent, good, moderate or poor (Table 2).

The angle of dorsiflexion was measured with patient sitting, his leg was hanged to the ground, and the active dorsiflexion was against gravity. The angle of plantar flexion was measured with patient in supine position. The angle of was measured between the plantar surface line of the foot and the line perpendicular to the longitudinal line of the leg.

During a mean follow up of 12 months, thorough examination of the patients regarding the gait and muscles power was performed in all patients.

Table 2: The evaluation criteria developed by Carayon et.al.

Evaluation Criteria	Excellent	Good	Moderate	Poor
Active dorsiflexion	> 15°	5° -15°	No active dorsiflexion	Presence of plantar flexion that prevent ankle motion
Active plantar flexion	30°	15°-20°	Drop foot totally corrected	
Active range of movement	40°	20°-30°	Plantar flexion is possible up to 10 degrees	

Results:

Preoperatively, angle of active dorsiflexion was zero in all patients, whereas passive dorsiflexion was above 15 degrees. The mean foot drop angle was 26 degrees plantar flexion.

Postoperatively, of the nine patients, two patients were assessed as excellent (22.2%), both through anterior to tibia route. Five patients were assessed as good (55.6%), three through interosseous route and two anterior to the tibia route. the two other patients were assessed as moderate (22.2%), one from each route (Table 3).

Table 3: Post-operative result of tibialis posterior transfer according to the route of transfer.

Route of transfer	Excellent	Good	Moderate	Total
	No. (%)	No. (%)	No. (%)	No. (%)
Anterior to tibia	2 (40)	2 (40)	1 (20)	5 (100)
Interosseous membrane	0 (0)	3 (75)	1 (25)	4 (100)
Total	2 (22.2)	5 (55.6)	2 (22.2)	9 (100)

Regarding route of transfer (Table 3), two patients out of five treated by anterior to the tibia route, were assessed as excellent (40%), two patients as good (40%) and one patient as moderate (20%). For patients treated by interosseous route, three patients out of four were assessed as good (75%) and one patient as moderate (25%).

The mean postoperative ankle dorsiflexion was 7.6°, mean postoperative ankle plantar flexion was 17.8° and mean postoperative range of ankle joint was 24.9°. Postoperative improvement in ankle movement according to the route of transfer is demonstrated in Table 4.

Table 4: Post-operative active ankle movement.

Evaluation Criteria	Route of transfer		
	Anterior to tibia	Interosseous membrane	Total
Active dorsiflexion	8.2°	7°	7.6°
Active plantar flexion	20.6°	14.3°	17.8°
Active range of movement	27.8°	21.3°	24.9°

There were 3 cases of superficial infection, all of them diagnosed clinically and occur with interosseous route, this may be due to number of incision. Two of them were stitch infection, and the last one was infection of the wound in the plantar surface. All of them treated successfully by simple measure like change dressing and local antiseptic.

One case treated by anterior to lower tibia, the tendon of tibialis posterior inserted too far laterally and dorsiflexion was accompanied by eversion, the deformity was not sever enough to worry the patient.

In two cases treated with tendon transfer through interosseous membrane, mild pain in the lower leg started after removal of plaster of pairs cast and starting of active exercises, the pain was responded to rest, and simple analgesia and exercises was started 2 week later.

Discussion:

Drop foot has diverse etiologies, such as neurologic causes (peripheral nerve injury, neuropathy, lumbar radiculopathy, cerebral lesions) or muscular causes (extensor muscle injury, compartment syndrome). The most common cause of drop foot is peroneal injury; all of the cases in our study are due to peroneal nerve injury at different level. In addition to being more prone to injury due to its location, the peroneal division of the sciatic nerve has poor regeneration potential compared with the tibial division [11].

Despite advances in nerve physiology and micro-neurosurgery, a significant percentage of patients with peroneal nerve injury and subsequent drop foot require tendon transfer for restoration of normal gait [12]. The aim of tibialis posterior tendon transfer in these cases is to restore a normal heel toe gait; success depends on a surgical technique which maximizes the potential of the transfer, and on reeducation of the patients to using active dorsiflexion during swing phase of gait. When compared with other surgical options such as arthrodesis or tenodesis, the golden standard in the treatment of drop foot is tendon transfer, although some authors suggest that tibialis posterior transfer act solely as a tenodesis in adult because cerebellar education is difficult in adult age group, an active dorsiflexion of 15-20° is reported in numerous series [13].

The most controversial aspect of tibialis posterior transfer is the route by which the tendon be carried to the dorsum of the foot. Although the interosseous route is more physiologic from the viewpoint of direction, the greatest disadvantage of this method is the risk of adhesion, especially if the window is kept narrow [5,14]. This method also carries the risk of vascular injury. The circumtibial route has a longer movement arm, which increases the mechanical advantage with respect to power [13].

Clinical studies comparing both methods have remained inconclusive. In their biomechanical study, Goh et.al found that the interosseous route was more effective in dorsiflexion [8]. On the other hand, Soares's study shows that both methods yield above neutral dorsiflexion in 80% of the patients, and from the viewpoint of dorsiflexion both methods are equally successful [15].

In our study, we did not face the previously described problems for the circumtibial route, such as foot inversion that lead to ulceration on the lateral aspect of the foot or cosmetic problems like the visibility of the tendon in the subcutaneous tunnel, because we avoid insertion of transferred tibialis posterior tendon to tibialis anterior tendon.

The degree of active dorsiflexion correlates with swing phase of gait. In our study 77.8% of patients get excellent to good result of active dorsiflexion.

Richard reported results of 15 patients (82%) achieving excellent to good active dorsiflexion [13], as well, Gunn and Molesworth reported a rate of success as 78% (11 patients) [16]. The study of Yeap et.al, involving 37 patients stated that 61% of the patients were improved in both gait and ankle dorsiflexion measures [17]. Moreover, some author mention up to 90% success of this procedure [15]. This variation can partly be attributed to the different methods used to evaluate the results of tibialis posterior transfer. In this study, the evaluation was made with the criteria developed in 1967 by Carayon et.al [6].

Seventy five percent of our patients treated through interosseous membrane route have excellent or good results, and 80% of patients treated by anterior to tibia route attain excellent to good results. So anterior to tibia route give some better result because the use of a subcutaneous tunnel for the transfer creates a long moment arm for the joint. This increases the mechanical advantage for power of transferred muscle and suggests that the transfer through interosseous membrane acts to some extent as a tenodesis. The difference in range of movement compared with circumtibial route is probably to adhesions in the interosseous space [13]. All our patients discard orthosis six months post-operation and regain nearly normal heel toe gait.

An important aspect of tendon transfer is the type of fixation, which is either to the bone, to the tendon, or both to the bone and tendon, on the dorsum of foot. In our technique, we split the tendon longitudinally into two, and suture one half to intermediate cuneiform bone, the other half is passed through the extensor digitorum longus and fixed. This prevents inversion and although the second half of the transfer shows a tenodesis effect and does not provide active toe extension; the inclusion of these tendons to transfer prevents dropping of the toes and forefoot. The tendon to tendon technique equally distributes traction forces on the forefoot and therefore enables a more physiologic function. The transfer of the tendon to the bone may cause neuropathic arthropathy in tarsal joints many years after the surgery [17,18], we did not encounter such complication due to a relatively short follow up duration.

Gunn, in his series of fifty-six patients, declare a case of severe infection in one patient, emphasizing that the patient was already suffering from diabetes, tuberculosis, and leprosy [16]. Richard reported two medial insertion of tendon, severe inversion of foot with ulceration of skin over the lateral aspect of midfoot and forefoot [13]. None of the patients enrolled in the present study has developed complications severe enough to make surgical treatment by tendon transfer unworthy.

Furthermore, bowstringing of the tendon, this complication happened when the tendon of tibialis posterior inserted in the tendon of tibialis anterior muscle, in our study we insert the split tendon of tibialis posterior to bone and to the tendons of extensor digitorum longus, so we avoid this problem. Even so this complication unsatisfactory from cosmetic point of view, and none of patients wished to further operation for correction, it should be remember that the anterior tibial tendon is normally prominent when the muscle contract against resistance [16].

Conclusions:

1. Although our study done on a small group of patients, tibialis posterior tendon transfer is a safe and successful operation, with few simple complications encountered.

2. The degree of active dorsiflexion, active plantar flexion, and active range of ankle movement are improved post operatively in both anterior to lower tibia route and through interosseous route.
3. There is no difference in the final result of active dorsiflexion between through interosseous membrane, and anterior to lower tibia route of tibialis posterior tendon transfer.

References:

1. Gilchrist RV, Bhagia SM, Lenrow DA, Chou LH, Chow D,Slipman CW. Painless foot drop: an atypical etiology of a common presentation. Pain Physician 2002; 5:419-21.
2. Rodriguez RP. The Bridle procedure in the treatment of paralysis of the foot. Foot Ankle 1992; 13:63-9.
3. D'Astous JL, MacWilliams BA, Kim SJ, Bachus KN. Superficial versus deep transfer of the posterior tibialis tendon. Journal of Pediatr. Orthop. 2005; 25:245-8.
4. Wiesseman GJ. Tendon transfers for peripheral nerve injuries of the lower extremity, Clin. Orthop. North Am 1981; 12:459-67.
5. Hove LM, Nilsen PT. Posterior tibial tendon transfer for drop- foot. 20 cases followed for 1-5 years. Acta Orthop Scand 1998; 69:608-10.
6. Carayon A, Bourrel P, Bourges M, Touze M. Dual transfer of the posterior tibial and flexor digitorumlongus tendons for Drop foot. Report of thirty-one cases. J Bone Joint Surg [Am] 1967; 49:144-8.
7. Lipscomb PR, Sanchez JJ. Anterior transplantation of the posterior tibial tendon for persistent palsy of the common peroneal nerve. J Bone Joint Surg [Am] 1961; 43:60-6.
8. Goh JC, Lee PY, Lee EH, Bose K. Biomechanical study on tibialis posterior tendon transfers. Clin Orthop Relat Res 2011 ;(319):297-302.
9. Terranpva WA. McLaughlin RE, Morgan RF: An algorithm for the management of ligament injury of the knee associated with common peroneal nerve palsy. Orthopedic 1986 Aug 1135-40.
10. Pritchett JW, Porembski MA. Foot drop. Retrieved from Emedicine Medscape; (Updated: May 17, 2013): http://emedicine.medscape.com/article/1234607-overview.
11. Kline DG, Kim D, Midha R, Harsh C, Tiel R. Management and results of sciatic nerve injuries: a 24-year experience. J Neurosurg 1998; 89:13-23.
12. Yeap JS, Birch R, Singh D. Long-term results of tibialis posterior tendon transfer for drop-foot. Int Orthop 2011; 25:114-8.
13. Richard BM. Interosseous transfer of tibialis posterior for common peroneal nerve palsy. J Bone Joint Surg [Br] 1989; 71:834-7.
14. Andersen JG. Foot drop in leprosy and its surgical correction. Acta Orthop Scand 1963; 33: 151-71.
15. Soares D. Tibialis posterior transfer in the correction of foot drop due to leprosy. Leprosy Review 1995; 66:229-34.
16. Gunn DR, Molesworth BD. The use of Tibialis posterior as a dorsiflexor, J Bone Joint Surg Br November 1957: 39-B (No.4):674-678.
17. Yeap JS, Singh D, Birch R. A method for evaluating the results of tendon transfers for foot drop. Clin Orthop Relat Res. 2001 Feb ;(383):208-13.
18. John Grawford Adams, Standard Orthopedic Operations, Third edition, 405 1985.