ORIGINAL PROF-660

THE INSERTION OF TIBIALIS ANTERIOR TENDON

DR. LAIQ HUSSAIN, MBBS, M.PHIL.
Department of Anatomy,
Nishtar Medical College, Multan.

DR. ATHAR MAQBOOL, MBBS, M.PHIL.
Department of Anatomy,
Nishtar Medical College, Multan.

DR. ZUBIA ATHAR, MBBS, M.PHIL
Department of Anatomy,
Nishtar Medical College, Multan.

ABSTRACT

Transfer of the tendon of tibialis anterior muscle is a common surgical procedure performed for the correction of equinovarus deformity of the foot. **OBJECTIVE:** To report on variations of insertion of tibialis anterior in the local population. **DESIGN OF STUDY:** Morphological study of 76 human feet by dissection. **SETTING:** Department of Anatomy, Nishtar Medical College, Multan, Pakistan. **PERIOD:** January 1996 to December 2000. **MATERIALS & METHODS:** Seventy six feet of male adult cadavers were dissected and pattern of insertion of tibialis anterior muscle in each cadaver was studied and the findings were recorded. **RESULTS:** Four varieties of insertion pattern were found. In 57.9% feet, the tibialis anterior tendon was inserted by two unequal slips; of these the larger slip was attached to medial cuneiform bone and the smaller one to the base of the first metatarsal bone. In 17.1% feet, the slips of insertion into the medial cuneiform and first metatarsal were of equal size. In 14.5% feet, the muscle inserted into the medial cuneiform by a single slip. In 10.5% feet, the insertion was by two unequal slips, of which the larger one was attached to the first metatarsal and the smaller one to the medial cuneiform bone. **CONCLUSION:** The pattern of insertion of tibialis anterior tendon in Pakistani population is different from the data available for some other regions of the world.

INTRODUCTION

Tibialis anterior muscle is a powerful muscle of the anterior compartment of the leg. It originates mainly from the lateral surface of the tibial shaft and anterior surface of the interosseous membrane of the leg.

The fleshy belly give rise to a tendon in the lower third of the leg that passes through the medial compartments of the superior and inferior extensor retinacula and is generally inserted into the medial and inferior surfaces of the medial cuneiform and the adjoining part of the base of the first metatarsal bone[1-5].

However, many variations in the insertion of tibialis anterior have been reported by different authors[6,7].The tibialis anterior is supplied by the deep peroneal nerve and the major actions of this muscle include dorsiflexion at the ankle joint and inversion of the foot.

Transfer of the tibialis anterior from its normal site of insertion to the dorsum of the foot is a recognized

surgical procedure for the correction of equinus or equinovarus deformities of the foot.

Several author have reported that transfer of tibialis anterior tendon is a useful technique in the surgical treatment of congenital club foot (talipes equinovarus).

In 1947 Garceau and Manning reported that transposition of tibialis anterior tendon to the proximal end of the fifth metatarsal bone gave excellent or good result in 82.7% of the cases operated for the treatment of recurrent congenital club foot[7]. In 1952 Critchley and Taylor carried out transplantation of the tibialis anterior for the treatment of relapsed club foot in 22 patients. Results were reported to be good or fair in 18 of these cases[8].

El-Tayeby[9] operated upon 28 neglected congenital club feet. He reported that satisfactory results were obtained in 89.3% of the cases by employing a combination of surgical procedures including tibialis anterior tendon transfer.

Ezra et al[10] reported that they obtained excellent or good results in all the 27 feet in which the tibialis anterior tendon transfer was done to correct the residual dynamic supination deformity in treated club feet.

Feldbrin et al[11] have reported that those cases of idiopathic club foot who have isolated or combined peroneal nerve abnormality benefit from transfer of the tibialis anterior tendon to the dorsum of the foot.

Bradish and Noor[12] have reported that in the management of relapsed club feet excellent results were obtained by external fixation followed by split tibialis anterior tendon transfer.

Other authors have reported that transfer of tibialis anterior tendon is an effective surgical procedure for the correction of spastic equinovarus deformity in adults.

Hoofer et al[13] have reported that good results were obtained by the split transfer of tibialis anterior tendon for the correction of spastic equinovarus deformity in patients suffering from cerebral palsy.

Pinzur et al[14] performed lengthening of the Achilles tendon and lateral transfer of tibialis anterior tendon in 54 adult patients for the correction of acquired spastic equinus and equinovarus deformity which had developed after stroke or head injury; good results were obtained in most of these patients.

Edwards and Hsu[15] reported that split anterior tibial tendon transfer (SPLATT) was performed on 42 adults with cerebrospastic equinovarus deformity. Good or excellent results were obtained in 83% of the feet.

Vogt[16] studied the long term results of split anterior tibial tendon transfer in 69 patients who had suffered from stroke, cerebral palsy or brain damage due to injury, tumor, or infection. He reported that this procedure is safe and yields good results with minimum complications.

Keenan et al[17] have reported that split tibialis anterior tendon transfer combined with other surgical procedures yields excellent results in correction of spastic equinovarus deformity in patients with UMN syndrome.

The insertion of tibialis anterior is subject to many variations[6,7,10]. A knowledge of these variations is important for the surgeons. Present study was carried out to find out the pattern of insertion of the tibialis anterior tendon in the normal Pakistani population. The study was carried out in the department of Anatomy, Nishtar Medical College, Multan from 1996 to 2000.

MATERIALS & METHODS

Thirty eight embalmed adult male cadavers were selected for this study. All these cadavers belonged to people of Pakistani origin and no cadaver belonging to any foreigner was included in this study. Lower limbs of all the selected cadavers were dissected and both the feet of each cadaver were studied to find out the pattern of insertion of tibialis anterior muscle in all the seventy six feet.

RESULTS

Our results (shown in Table-1) reveal that in 65 feet (85.5%) the tibialis anterior was inserted by two slips: one into the medial surface of the medial cuneiform bone and the other into the medial surface of the base of the first metatarsal bone. The attachment to the medial cuneiform bone also extended onto its inferior surface.

In the remaining 11 feet (14.5%) the tendon of tibialis anterior was attached only to the medial cuneiform bone (Fig. 1).

Further study of 65 feet showed that tibialis anterior was inserted by two slips showed that in 52 feet (68.4% of the total 76 feet studied) slips of insertion into the medial cuneiform and base of the first metatarsal were of unequal width, while in only 13 feet (17.1%) the two slips of insertion were of equal width (Fig. 2).
Study of the width of the two slips of insertion of tibialis anterior in those 52 feet in which the slips were of unequal size revealed the following results: in 44 feet (57.9% of the total 76 feet studied) the slip of insertion into the medial cuneiform bone was of larger size than the slip of insertion into the base of the first metatarsal bone (Fig. 3). In 8 feet (10.5%) the slip of insertion into the base of the first metatarsal bone was larger in size than the slip of insertion into the medial cuneiform bone (Fig. 4).

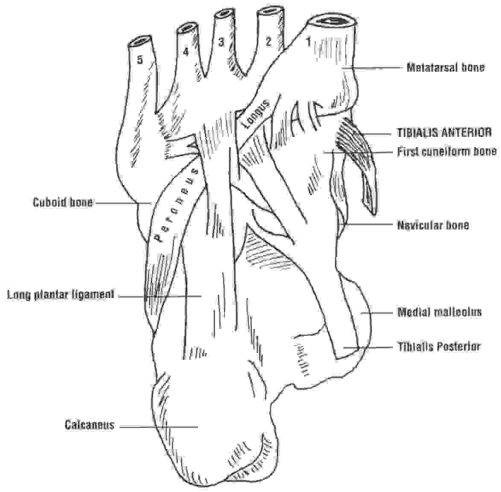

Figure-1. Diagram showing single slip insertion of the tibialis anterior tendon into the medical cuneiform bone.

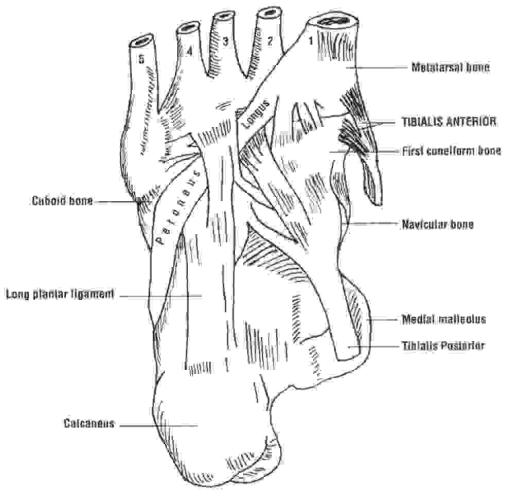

Figure-2. Diagram showing equal double slip insertion of the tibialis anterior tendon into the medical cuneiform and base of first metatarsal bone.

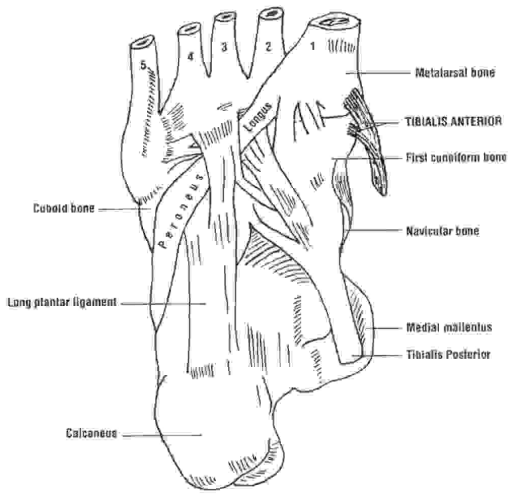

Figure-3. Diagram showing unequal double slip insertion of tibialis anterior tendon (large slip into the medial cuneiform and small slip into base of first metatarsal bone).

Table-I. Frequency and pattern of single or double insertion of tibialis anterior tendon.

Tibialis Anterior Tendon Insertion	Foot		Total	
	Right	Left	Number	Percent
Double Insertion				
Larger slip into MC* and smaller slip into FM**	18	26	44	57.9
Larger slip into FM** and smaller slip into MC*	5	3	8	10.5
Equal slips into MC* and FM**	8	5	13	17.1
Total:	31	34	65	85.5
Single Insertion				
Into MC*	7	4	11	14.5

* Medical cuneiform bone, ** First metatarsal bone

Figure-4. Diagram showing unequal double slip insertion of tibialis anterior tendon (large slip into the base of first metatarsal and small slip into medial cuneiform bone)

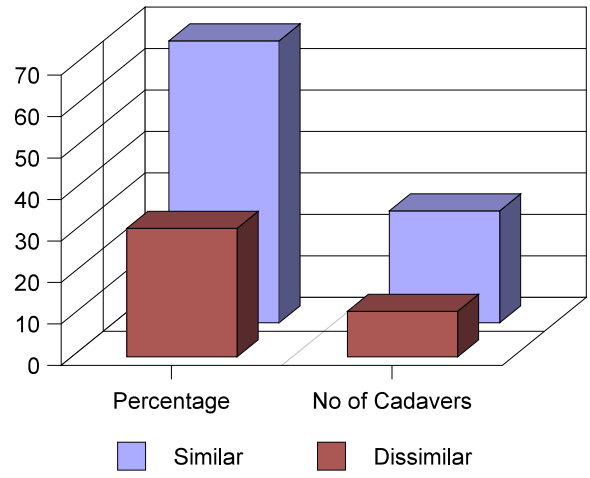

Figure-5. Comparison of pattern of insertion of the tibialis anterior muscle on two sides (i.e., right and left

Comparison of the pattern of insertion of the tibialis anterior on the two (i.e., right and left) sides of each cadaver (Fig. 5) revealed that the insertion was identical on both sides in 26 cadavers (68.4%), while the pattern of insertion was different on the right and left sides in 12 cadavers (31.6 %).

DISCUSSION

The common pattern of insertion of tibialis anterior is as follows: near its insertion the tendon divides into two slips one of which is attached to the medial surface of medial cuneiform bone while the other is attached to adjoining part of the base of the first metatarsal bone[2,3,5,6].

Singer and Fripp[18] have reported that in 76 feet dissected by them, the tibialis anterior tendon was found to be inserted into the medial cuneiform bone and the

base of the first metatarsal bone. Similar findings have been reported by Irani and Sherman[19]. However, some authors have described anatomical variations in the insertion of tibialis anterior tendon. Garceau and Manning[7] who performed transfer of the anterior tibial tendon in 86 patients and 110 feet reported that one of the frequent abnormality of insertion of tibialis anterior tendon found during operations was separation of the tendon into three slips. Williams et al[6] have also described that, in addition to its attachment to the medial cuneiform and base of the first metatarsal bone, the tibialis anterior tendon may have extra attachment to the talus, first metatarsal head or base of the proximal phalanx of the big toe. Ezra et al[10] who performed tibialis anterior tendon transfer in 27 feet, have also described that they noted abnormal insertions of tibialis anterior tendon in some of their patients. However in our study no additional attachment of tibialis anterior tendon was noted.

In our study, single insertion of the tibialis anterior tendon into the medial cuneiform bone was found in 14.5% of the feet dissected. This finding is in corroboration with the findings of Arthornthurasook and Gaew[20] who found single insertion to the medial cuneiform in 15.9% of the feet studied by them. Hoffer et al[13] have also described single insertion of tibialis anterior tendon on the dorsomedial aspect of the medial cuneiform bone. However our results do not support the findings of Lehman[21] and Herndon[22] who have described only single insertion of tibialis anterior tendon at the base of the first metatarsal bone.

In our study 85.5% feet exhibited double insertion of the tibialis anterior tendon by two slips: one into the medial cuneiform bone and the other into the base of first metatarsal bone. Arthornthurasook and Gaew[20] have also described double insertion of tibialis anterior tendon by two slips (one into the medial cuneiform and the other into the base of the first metatarsal) in 84.1% of the feet studied by them. In our study the two slips of insertion were of equal size in only 17.1% feet, while in majority of the feet (68.4%) the slips of insertion were of unequal size (Table-1). These findings differ markedly from those of Arthornthurasook and Gaew[20] who have described that in their study 56.8% feet had equal slips of insertion while unequal slips were found in only 27.3% of the feet. This difference in findings may have a racial basis. Arthornthurasook and Gaew[20] have reported that in all of the feet having unequal slips of insertion of tibialis anterior the larger slip was inserted into the medial cuneiform and the smaller one into the first metatarsal. In our study this pattern was found in 57.9% of the feet while in 10.5% of the feet the larger slip was inserted into the base of the first metatarsal and the smaller one into the medial surface of medial cuneiform. These differences in findings in two different regions of the world may also be an expression of ethnic variations.

Thompson[23] has described the insertion of tibialis anterior tendon on the inferior surface of the medial cuneiform and first metatarsal bones but in our study the attachment was found to be present on the medial as well as inferior surface of these bones as described by Hollinshed and Rosse[4]. Romanes[3] has described that the insertion of tibialis anterior blends with insertion of peroneus longus but no such finding was recorded in our study. Garceau and Manning[7] have reported that they found fusion of the anterior tibial tendon with extensor hallucis longus in one of the cases operated by them. No such finding was observed in any of the feet dissected by us.

Arthornthurasook and Gaew[20] have reported that in their study the pattern of insertion of tibialis anterior tendon on the right and left sides was similar in 50% of the cadavers and dissimilar in the rest of 50%. However, our study shows that the difference in the anatomy of the right and left feet of cadavers was not so high and majority (68.4%) of the cadavers had identical pattern of insertion of tibialis anterior tendon in the right and left feet.

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