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Original Research Article

ANALYSIS OF FIBULARIS TERTIUS IN TERMS OF FREQUENCY, MORPHOLOGY, MORPHOMETRY AND CLINICAL SIGNIFICANCE IN NORTH INDIAN CADAVERS

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ABSTRACT

Introduction: The fibularis tertius muscle has always enjoyed the distinction of being an exclusively human structure and as such it has helped to separate man from the lower animals. Myocutaneous flaps have been progressively used in surgical reconstruction in the lower limb injuries requiring the use of muscles which result in less functional damage as flaps.

Aim: Our study is aimed to evaluate frequency, morphology, morphometry and use of the fibularis tertius muscle as flaps in lower limb injuries.

Materials and Methods: Sixty lower limbs from formalin preserved cadavers (28 male and 2 female) were dissected and evaluated for the following parameters: origin of muscle, distal insertion, nerve supply, frequency, morphology, morphometry and any variation regarding this muscle.

Results: The fibularis tertius muscle was detected in all the cases (60 limbs). Origin of all the cases were found at the interosseous membrane, anterior border of the fibula, and anterior intermuscular septum. Most distal insertions were found at the medial and dorsal sides of base of the 5th metatarsal bone (98.34%). Mean value of muscle belly length was 21 cm and width was 1.9 cm. The mean length of the distal tendon with no muscle fibers up to insertion was 6 cm, and the mean width was 0.5 cm.

Conclusions: The fibulari stertius muscle is frequent and has a distinct morphology, making it a feasible option for use as graft. Knowledge of these variations may have useful clinical applications in cases of leg or foot trauma requiring tendoplasty or tendon transfer operations.

KEY WORDS: Myocutaneous flaps, Intermuscular septum, Tendoplasty.

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INTRODUCTION

Fibularis tertius, a muscle of the anterior compartment of the leg, was primitively confined to dorsum of foot as a part of extensor digitorum brevis but due to functional demands of bipedal gait and plantigrade foot, it has migrated upwards in to the leg [1]. The fibularis tertius muscle originates from the distal third or more of medial surface of the fibula and the interosseous membrane and inserts into the medial side of the dorsal region of the base of the fifth metatarsal bone [2]. Frequent variations

seen in the musculature of the leg as regards their mode of origin and insertion indicate that they have not yet reached their final stage of evolution. The musculature of the human lower limb has greatly modified, because of the peculiar mode of progression. Some of the muscles are still in the process of evolution, they are either degenerating like the plantaris or are appearing like the fibularis tertius. Variations in the arrangement of muscles, as regards their mode of attachment and degree of subdivision are encountered frequently [3]. Based upon the belief that right and left limbs of an embryo tend to develop as mirror images, certain symmetry is expected 'a priori. It is pertinent here to point out that the percentage of cadavers with unilateral variations outnumbered the percentage of limbs with bilateral variations. The occurrence of unilateral variations more than the bilateral ones had been aptly explained by Keen that the bilateral variations are influenced by genetic factors only whereas in unilateral variations, other factors like position assumed by fetus in utero, early movements of limbs or unusual muscle development may also play a role [4]. It had been suggested that the degree of subdivision depends on the action of some organizer and on this basis classifies anomalies. Only some of these can be explained on the basis of comparative study. Function modifies the structure greatly and these changes are independent of the organizer theory [3]. If the organizers starts working prematurely or prolongs its action, this results in abnormal splitting of the muscle mass, giving rise to supernumerary muscles. If the organizer starts functioning late or its action is too short, we have fusion of muscles belonging to the same or fundamentally different muscle mass [5]. The function of the fibularis tertius is eversion and dorsiflexion of the foot. These two strength parameters have been identified as important parameters in the development of ankle ligament injuries [6].

Fibularis tertius muscle is helpful in the swing phase of the bipedal mode of locomotion. The pull of the fibularis tertius may be responsible for causing stress on the fifth metatarsal and account for all stress fractures in any individual [7]. Plastic surgeons use a range of surgical approaches to treat injuries to ensure sufficient coverage and preservation of the structure, and to avoid complications and long hospital stays [8]. Soft tissue reconstruction of the lower limbs is particularly challenging with the small amount of subcutaneous tissue and the lack of muscle protection for the osteotendinous and neurovascular structures, so it often requires several surgical interventions using myocutaneous flaps [9]. In this study, the fibularis tertius muscle was explored in terms of frequency, morphology, morphometry, origin and distal insertion, and investigated the use of this muscle for reconstruction of the lower limb injuries as an alternative source of flaps for the repair of injuries of lower limb. Blood supply is provided by branches of the anterior tibial artery, which irrigate the anterior segment of the leg, and the deep fibular nerve provides innervation to the muscle [10]. The negligible function of the fibularis tertius muscle means it can be used in myocutaneous flaps without conceding motor function.

MATERIALS AND METHODS

We received institutional approval from ethical committee for this research work performed at Government medical college, Amritsar. We dissected 60 lower limbs (30 left side and 30 right side) from male (28) and female (2) well embalmed adult cadavers. All cadavers were adults between the ages of 30 to 70 years. Dissection was done by giving incisions to expose the muscle and tendon on the leg, and dorsum of the foot. The fibularis tertius muscle was identified in all the 60 dissected lower limbs and was analyzed for the following characteristics: proximal attachment (origin), distal insertion, morphology, morphometry and any variation regarding the muscle. The muscle belly was evaluated both for total length (from origin up to extent of muscle fibers) and width Three parameters were evaluated during tendon analysis: extent of the tendon part without muscle fibre up to insertion and width of tendon and any variation at insertion site (Figure 1). Length of the fleshy part of each muscle was measured as the distance from the origin of the most proximal muscle fibers to the insertion site of most distal muscle fibers. Unbraided silk thread was placed along the

whole length of the fleshy part of the muscle. The most proximal and most distal points were marked with Indian ink. The length and width was calculated by keeping the marked unbraided silk thread on metal measuring ruler. Length and width of the tendons was also taken in a similar manner.

RESULTS

Frequency: Out of the 60 cadaveric dissected human lower limbs, the fibularis tertius muscle was found in all the lower limbs (100%).

Morphology and variations: In all the 60 cases muscles took origin normally but insertion in one limb (1.66%) was on whole shaft of 5th metatarsal and in (98.35%)cases it was normally inserted. In all of the cases the fibers of the fibularis tertius muscle were lying at an oblique angle to the insertion tendon. In our study, we found that the fibularis tertius fibers were inserted to one side of the tendon, defining the muscle as unipennate. In 1.66% cases muscle was joined with extensor digitorumlongus by a muscular slipand in 1.66% cases muscle was not differentiated from extensor digitorumlongus.

Morphometry: The mean length of the muscle belly was 21 cm, and the mean width was 1.9 cm. The mean length of the distal tendon with no muscle fibers was 6 cm, and the mean width was 0.5 cm. Based on the results of this study and the ease of access by longitudinal incision on the anterior-lateral side of the leg, the fibularis tertius muscle can be used to make lower limbs grafts.

Table 1: Morphology and Morphometry of Fibularis tertius muscle.

Cd. No./ Sex	1 Male		2 Male		3 Male		4 Female		5 Male		6 Male		7 Male		8 Male		9 Male		10 Male		11 Male		12 Male		13 Male		14 Male		15 Male	
	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
Origin	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Insertion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Nerve Supply	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fleshy part length(cm)	18	20	23	20	21	22	15	16	25	26	17	16	18	18	20	19	24	28	21	20	22	20	20	20	22	22	21	21	26	26
Tendon length (cm)	8	6	8	8	7	8	8	7	10	9	7	8	7	7	7	8	8	9	7	8	9	10	10	10	8	8	8	7	7	8
Fleshy part width(cm)	1.6	1.6	1.7	1.7	1.7	1.6	1.8	1.8	1.7	1.6	1.8	1.9	1.6	1.8	2	2	1.8	1.7	1.9	1.9	1.8	1.8	2.1	2.1	1.6	1.6	1.8	1.7	1.8	1.7
Tendon width (cm)	0.5	0.6	0.6	0.6	0.5	0.5	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.7	0.7	0.6	0.6	0.7	o.8	0.6	0.5	0.7	o.6	0.7	0.6

Table 2: Morphology and Morphometry of Fibularis tertius muscles.

Cd. No./ Sex	16 Male		17 Male		18 Male		19 Male		20 Male		21 Male		22 Male		23 Male		24 Female		25 Male		26 Male		27 Male		28 Male		29 Male		30 Male	
	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
Origin	N	N	N	V	V	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Insertion	N	N	N	N	N	N	N	N	N	N	N	V	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Nerve Supply	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fleshy Part length(cm)	21	20	14	16	24	26	20	17	18	20	18	17	23	18	15	17	19	20	16	18	16	18	18	20	18	22	22	20	24	26
Tendon length(cm)	7	6	6	7	8	7	6	7	8	6	8	9	10	8	7	8	9	8	8	6	8	9	10	9	8	9	8	9	10	8
Fleshy part width(cm)	1.7	1.6	1.7	1.7	1.7	1.6	1.8	1.8	1.7	1.6	1.8	1.9	1.6	1.8	2	2	1.8	1.7	1.9	1.9	1.8	1.8	2.1	2.1	1.6	1.6	1.8	1.7	1.8	1.7
Tendon width(cm)	0.5	0.6	0.6	0.6	0.5	0.5	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.7	0.7	0.6	0.6	0.7	o.8	0.6	0.5	0.7	o.6	0.7	0.6

R – Right, L – Left V – Variable, EDL – Extensor DigitorumLongus, FT – Fibularis tertius, N – Normal

Table 3: Length of fleshy belly of Fibularis tertius muscle (Sex wise distribution)

S. No.	Length of fleshy belly (cm)	No. of limbs in that range							
		Male				Female			
		Rt (n)	% age	Lt (n)	% age	Rt(n)	% age	Lt (n)	% age
1	14.1-17	5	16.67%	5	19.23%	1	50%	1	50%
2	17.1-20	9	30%	14	53.85%	1	50%	1	50%
3	20.1-23	9	30%	4	15.38%	-	-	-	-
4	23.1-26	6	20%	3	11.54%	-	-	-	-
5	26.1-29	1	3.33%	-	-	-	-	-	-
	Total	30	100%	26	100%	2	100%	2	100%

Table 4: Length of tendon of Fibularis tertius muscle. (Sex wise distribution)

S. No.	Length of tendon (cm)	No. of limbs in that range							
		Male				Female			
		Rt (n)	% age	Lt (n)	% age	Rt (n)	% age	Lt (n)	% age
1	6.1-7	10	34.48%	9	33.33%	-	-	1	50%
2	7.1-8	13	44.83%	9	33.33%	1	50%	1	50%
3	8.1-9	1	3.45%	7	25.93%	1	50%	-	-
4	9.1-10	5	17.24%	2	7.41%	-	-	-	-
	Total	29	100%	27	100%	2	100%	2	100%

Fig. 1: Fibularis Tertius muscle and its tendon.

DISCUSSION

Fibularis tertius muscle is peculiar to man and man is the only member among the primates in whom this muscle occurs. The muscle is variable in its development and attachment. Because of functional demands of bipedal gait and plantigrade foot, part of Extensor digitorum brevis (EDB) has migrated upwards into the leg from the dorsum of foot. Fibularis tertiusis a muscle, evolution of which concentrates more importance [1]. This is one of the important muscles which aid a man to stand upright and to walk; but it is found in no other animal. It is purely human. Further, it is found in the human embryo early in its development. Therefore, it, like the foot to which it belongs, must be a specific character evolved early in the growth of the human stock [11]. The ideal muscle, with insignificant function and minimal esthetic aspect, provides for use as a myocutaneous flap. Reconstruction surgery of the distal extremities of the lower limbs is technically challenging due to the shortage of subcutaneous tissue, absence of intense vascularization, and presence of bony prominences and, most importantly, the few options for generating myocutaneous flaps. Our results recognized a high frequency (100%) of the Fibularis tertius muscle, demonstrating that these findings are statistically significant. Our results are in agreement with those from Le Double, who reported a frequency of 91.2%,and other authors described it in 98.6% demonstrating that the presence of this muscle is almost constant [10]. The Fibularis tertiusis usually considered to be a differentiated portion of the Extensor digitorum longus and its variations therefore, are commonly interpreted as mere variations in the degree of differentiation from this muscle [12]. In our study in 1.66% cases muscle belly was fused with Extensor digitorum longus. Fibularistertiusmay be completely absent in 4% [2]. The additional Fibularis tertiusaccessories if present originates from the lower end of the anterior surface of fibula and immediately ends in a slender tendon and is inserted in the styloid process of the fifth metatarsal with Peroneus brevis [12]. The tendon of Fibularis tertiusmay insert into the extensor tendon of the fifth toe or sometimes the tendon may insert into the third or fourth metatarsal bones [12]. In study by Joshi et al on 110 cadavers, in 12% the tendon of fibularistertiuswas thick or even thicker than the tendon of Extensor digitorum longus [1]. In 4%, the tendon extended beyond fifth metatarsal up to metatarso phalangeal joint of fifth toe, and in 1.5%, it extended up to the proximal phalanx of little toe. In study by Rourke et al in all cases the tendon inserted into the dorsal surface of the shafts of both the fourth and fifth metatarsals[13]. In a study by Figen et al fibularis tertius tendon descended anteriorly

and laterally and fanned out near its attachment point towards the almost entire dorsolateral surface of the fifth metatarsal [14]. In our study, in 1.66% tendon was inserted on whole shaft of 5th metatarsal. According to Vertullo et al the insertion of the fibularistertius might play an important role in the causation of torsional stresses as observed in Jones fractures and stress fractures [15]. Foot surgeons might use the fibularis tertius muscle flap for transposition and also for correcting any laxity in the ankle joint [6]. So, greater area of insertion may increase the stability of the joint. Behnckein his study on human dorsal and flexor muscles suggested that increase in gross muscle length, muscle – tendon ratio in indicating a longer muscle length, is positively related to maximal isokinetic strength in lower limb [16].

CONCLUSION

Phylogenetically, fibularis tertiusis peculiar to humans who are associated with bipedal gait. The fibularis tertius muscle is frequent, which is a fundamental trait for its prospective use as a source of local flaps, and it has unique features, including morphometric ones, which allows for its use in reconstruction surgery of the lower limb. Thus the musculature of the human lower limb has greatly modified, because of the peculiar mode of progression. Frequent variations seen in the lateral musculature of the leg as regards their mode of origin and insertion indicate that they have not yet reached their final stage of evolution. Muscle's fibers become increasingly flat as they approach insertion so this favors use in myocutaneous flaps, because it permits the use of greater muscle thickness in the reconstruction oflower limb injuries. The length and width of the muscle belly of the fibularistertius muscle was compatible with use as flaps, even though no previous research provides similar surveys. Thus variation is important for anatomists, plastic surgeons and orthopedic surgeons.

Conflicts of Interests: None

REFERENCES

[1]. Joshi SD, Athavale SA. Morphology of peroneus tertius muscle .Clinical Anatomy. 2006; 19 (7):611-14.

[2]. Borley NR, Healy JC, Collins P, Johnson D, Crossman AR, Mahadevan V et al. Leg. In: S Standring (Ed.): Gray's Anatomy.40th Edition. New York: Churchill Livingstone Elsevier, P.2008; 1419.

[3]. Bhargava KN, Sanyal KP, Bhargava SN. Lateral musculature of the leg as seen in hundred Indian Cadavers. Ind J Med Sci. 1961;15(3):181-85.

[4]. Keen JA. A study of the arterial variation in the limbs with special reference to symmetry of vascular patterns. Am J Anat. 1961;108:245-61.

[5]. Bhatt CR. Variation in Peroneus Tertius Tendon and its Clinical Implications. J Orthopaedics, 2010;7(2):e1.From <http://www.jortho.org/2010/7/2/e1.> (Retrieved March 19, 2011).

[6]. Witvrouw E, Borre KV, Willems TM, Huysmans J, Broos E, De Clercq D . The significance of Fibularistertius muscle in ankle injuries: a prospective study. Am J Sports Med.2006 ;34(7):1159-63.

[7]. Das S, Haji SF, Latiff A, Hiaing K, Ghafar AN, Othman F. Absence of the Fibularistertius muscle: cadaveric study with clinical considerations. Romanian Journal of Morphology and Embryology. 2009;50(3):509–11.

[8]. Civantos FJ, Netterville JL. Complications of myocutaneous flap surgery. In: Eisele DW, ed. Complications in head and neck surgery. St. Louis: Mosby;1993;733-42.

[9]. Visweswar B, Partha SB, Saurabh R, Gaurab RC, Neeraj KA, Sid- dhartha B, et al. Cadaveric study and clinical application of turnover fascial flap for lower-limb defects. Eur J Plast Surg. 2011;34(5):387-94.

[10]. Le Double AF. Traitédês variations du systémemusculaire de l'homme. 2a ed. Paris: Schleicher Frères; 1897.

[11]. PuruckerG. Man in evolution. In: GFKnoche: Theosophical University Press online edition,Altadena,CA.Fromhttp://www.theosophy-nw.org/theosnw/evol/ev-gdp3. Httm (Retrieved March 20,2011)

[12]. Bhadkamkar AR and Mysorekar VR. Anomalous peroneus tertius and extensor digitorumlongus muscles. J AnatSocInd 1962;10-11:37-38.

[13]. RourkeK ,DafyddH, ParkinIG. Fibularistertius. Revisiting the Anatomy.2007;20(8):946-49.

[14]. FigenT,QaiserS,Serdar T. Coexistence of anomalous m.peroneusbrevistendon.Joint Diseases and Related Surgery Case Report.2009;20(3):165-68.

[15]. Vertullo CJ, GlissonRR,NunleyJA.Tortional strains in the proximal fifth metatarsal :Jones and stress fraturemanagement.Foot Ankle Int.2004;25:650-56.

[16]. BehncekeRelationships between muscle-tendon ratios, muscle morphology, isokinetic strength and reactive strength characteristic in human dorsi and plantar flexor muscles. Faccioni Publications, Australia.1998.

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