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Original Research Article

A STUDY OF ARRANGEMENT OF THE EXTENSOR TENDONS IN THE HAND

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ABSTRACT

Background and Objective: Knowledge of normal anatomy of extensor tendons of forearm and hand, along with the variations which can occur in this arrangement of tendons is necessary for anatomists as well as orthopedic surgeons who deal with it. This knowledge is needed for anatomists for routine dissection of the cadaver for teaching, and for surgeons when they operating injured hand or diseased hand where tendon repair or reconstruction is needed. In this study we tried to document the arrangement of extensor tendons of medial four fingers of human hand.

Materials and Methods: By using 80 upper limb specimens of human cadaver, arrangement of extensor tendons to the medial four fingers are studied from origin to insertion, including middle part of the tendons to observe splitting in the tendons. The tendons studied are extensor digitorum communis (EDC) with four tendons, namely extensor digitorum communis index (EDCI), extensor digitorum communis longus (EDCL), extensor digitorum communis ring (EDCR), extensor digitorum communis small (EDCS), extensor indicis proprius (EIP) tendon, extensor digiti minimi (EDM) tendon. The special findings are photographed; all the findings are tabulated and analyzed statistically.

Results: The important findings are, EDCI is having single tendon in all the 80 specimens (100%). EDCS is absent in 22 specimens (27.5%), 13 right and 9 left limb specimens. EIP is absent in one right side specimen (1.25%). EIP is having double tendons in 10 specimens (12.5%) and triple tendons in 1 specimen (1.25%). EDM is having double tendons in 60 specimens (75%).

Conclusion: Many variations are seen in the arrangement of extensor tendons in this study. Variations are especially seen in the tendons of EIP and EDM. EIP showed multiple tendons and it is absent in one limb, EDM also had double tendons in 75% specimens.

KEY WORDS: Extensor Digitorum Communis, Extensor Indicis Proprius, Extensor Digiti Minimi.

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INTRODUCTION

The dorsum of the hand shows large number of anatomical variations because of the multiple tendons present in this region and also the presence of connections between these tendons. Knowledge about the anatomy of extensor tendons is must for hand surgeons to repair the damaged extensor tendons of the hand and fingers. It is also helpful for plastic surgeons while reconstructing the ruptured extensor

tendons due to arthritis. It is important for anatomists to understand about the normal anatomy as well as variations of extensor muscles and tendons. In most cases, there is more than one tendon for each finger between the wrist and the MCP joints [1]. This multiplicity of tendons increases near the ulnar side of the hand [2]. The common distribution pattern reported in literature is a single extensor indicis proprius (EIP) tendon located ulnar to the extensor digitorum communis index (EDCI) tendon of the second finger, a single extensor digitorum communis index (EDCI) tendon for the second finger; a single thick extensor digitorum communis longus (EDCL) tendon for the third finger; a double extensor digitorum communis ring (EDCR) tendon for the fourth finger; no extensor digitorum communis small (EDCS) tendon for the fifth finger; and a double extensor digiti minimi (EDM) tendon for the fifth finger [3,4]. Suturing of an injured extensor tendon of the hand gives good results; unlike the result frequently obtained when flexors are sutered [5].

We have done this study of extensor tendons of forearm and hand by dissecting 80 upper limbs of human cadaver.

Aims and Objectives: To study the arrangement of extensor tendons of forearm and hand. Work concentrated over the tendons of medial four fingers.

MATERIALS AND METHODS

Source of data:

For this study we used total 80 disarticulated upper limbs of unknown sex. The cadavers were belonged to the south Indian people. Out of 80 limbs 38 are of right side and 42 are of left side. The limbs are selected from the Department of Anatomy, Kanachur Institute of Medical Sciences, Deralakatte. Age of the cadavers/specimens is also unknown. Only good specimens are used.

Method of collection of data:

Using dissection instruments extensor compartment of forearm is dissected. After reflection of skin and superficial fascia of the region, deep fascia is carefully divided so as to retain the superficial extensors, which also take origin from the deep fascia. Once the tendons are identified in their origin, then tendons are traced all along their course. Variations in the arrangement of the tendons and absence of the muscles or tendons in this region were recorded and photographed. All parameters were tabulated and then analyzed statistically. The Fisher's exact test[6] was used to compare the differences between the right and left limbs. If p value is less than 0.05 it was considered significant.

RESULTS

Fig. 1: Dorsum of left hand showing extensor tendons which are studied.

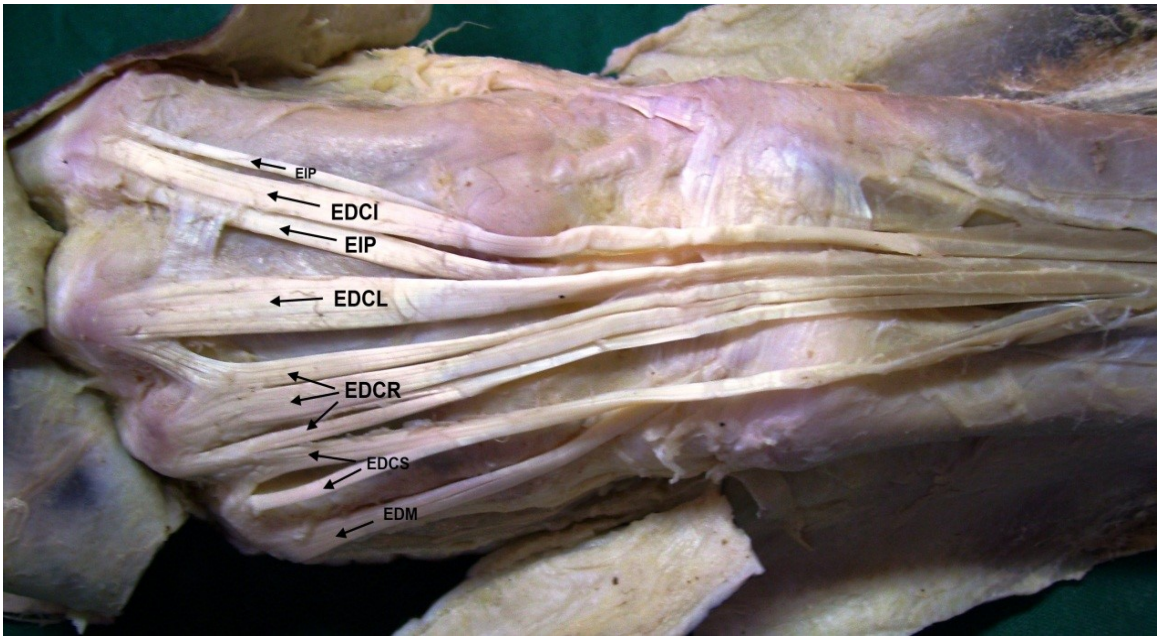
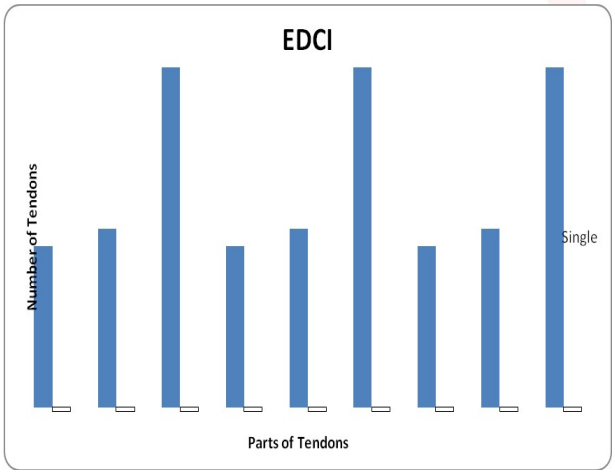


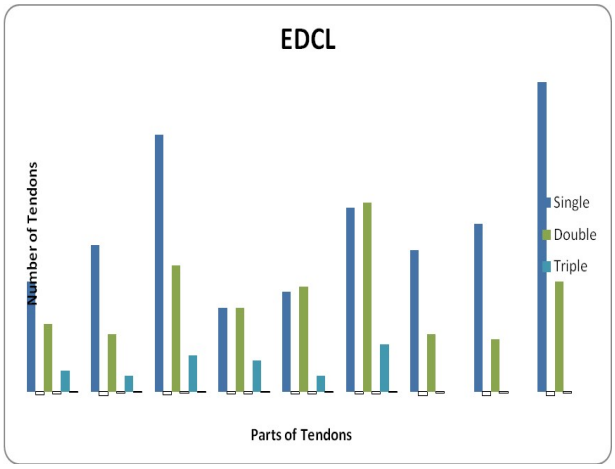
Table 1: Arrangement of the Extensor tendons in the hand. (Number of specimens=80)

	No. of tendons	Origin			Middle part			Insertion		
		Right	Left	Total	Right	Left	Total	Right	Left	Total
EDCI	Single	38 100%	42 100%	80 100%	38 100%	42 100%	80 100%	38 100%	42 100%	80 100%
EDCL	Single	21 55.30%	28 66.70%	49 61.25%	16 42%	19 45.20%	35 43.75%	27 71.10%	32 76.20%	59 73.75%
	Double	13 34.20%	11 26.20%	24 30%	16 42%	20 47.60%	36 45%	11 28.90%	10 23.80%	21 26.25%
	Triple	4 10.50%	3 7.10%	7 8.75%	6 16%	3 7.20%	9 11.25%	0 0%	0 0%	0 0%
EDCR	Single	23 60.50%	21 50%	44 55%	9 23.70%	13 31%	22 27.50%	18 47.50%	26 61.90%	44 55%
	Double	12 31.60%	17 40.50%	29 36.25%	22 57.90%	20 47.60%	42 52.50%	16 42.10%	13 31%	29 36.25%
	Triple	2 5.30%	4 9.50%	6 7.50%	6 15.80%	6 14.30%	12 15%	3 7.90%	3 7.10%	6 7.50%
	Quadruple	1 2.60%	0 0%	1 1.25%	1 2.60%	3 7.10%	4 5%	1 2.60%	0 0%	1 1.25%
EDCS	Absent	13 34.20%	9 21.40%	22 27.50%	13 34.20%	9 21.40%	22 27.50%	13 34.20%	9 21.40%	22 27.50%
	Single	23 60.50%	31 3.80%	54 67.50%	16 42.10%	20 47.60%	36 45%	19 50%	25 59.50%	44 55%
	Double	2 5.30%	1 2.40%	3 3.75%	8 21.10%	12 28.60%	20 25%	6 15.80%	7 16.70%	13 16.25%
	Triple	0 0%	1 2.40%	1 1.25%	1 2.60%	1 2.40%	2 2.50%	0 0%	1 2.40%	1 1.25%
EIP	Absent	1 2.60%	0 0%	1 1.25%	1 2.60%	0 0%	1 1.25%	1 2.60%	0 0%	1 1.25%
	Single	32 84.20%	37 88.10%	69 86.25%	31 81.60%	37 88.10%	68 85%	31 81.60%	37 88.10%	68 85%
	Double	3 7.90%	5 11.90%	8 10%	4 10.50%	5 11.90%	9 11.25%	5 3.20%	5 11.90%	10 12.50%
	Triple	2 5.30%	0 0%	2 2.50%	2 5.30%	0 0%	2 2.50%	1 2.60%	0 0%	1 1.25%
EDM	Single	22 57.90%	26 61.90%	48 60%	7 18.40%	9 21.40%	16 20%	8 21.10%	13 31%	21 26.25%
	Double	16 42.10%	16 38.10%	32 40%	28 73.70%	32 76.20%	60 75%	30 78.90%	28 66.70%	58 72.50%
	Triple	0 0%	0 0%	0 0%	3 7.90%	1 2.40%	4 5%	0 0%	1 2.30%	1 1.25%

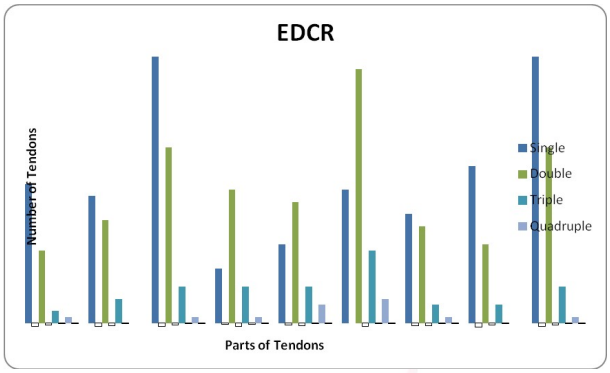
Bar Chart showing distribution of EDCI tendons in 80 specimens



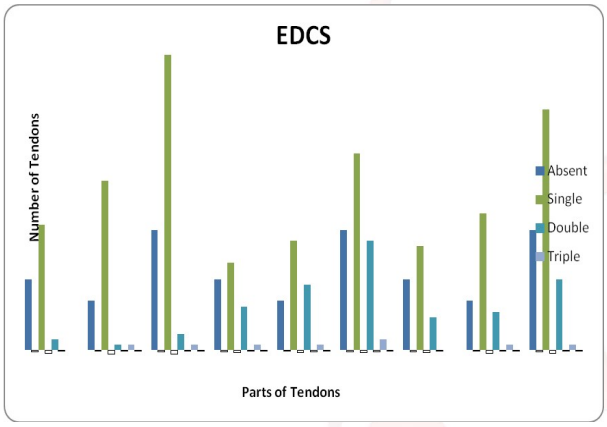
Bar Chart showing distribution of EDCL tendons in 80 specimens



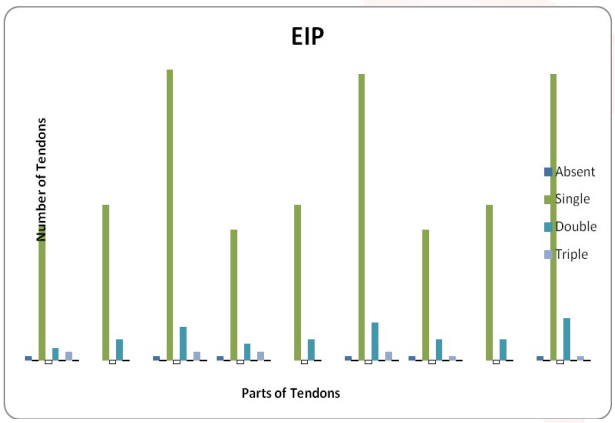
Bar Chart showing distribution of EDCR tendons in 80 specimens



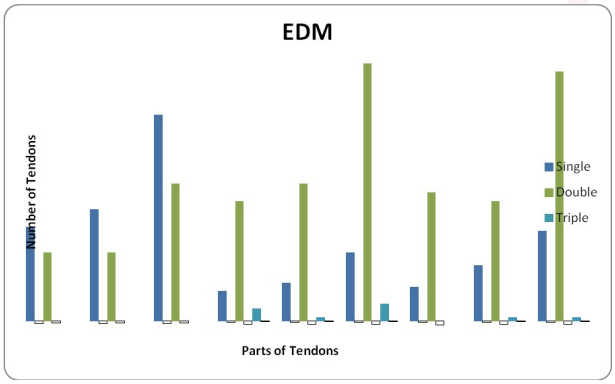
Bar Chart showing distribution of EDCS tendons in 80 specimens



Bar Chart showing distribution of EIP tendons in 80 specimens



Bar Chart showing distribution of EDM tendons in 80 specimens



DISCUSSION

Many workers have studied the extensor tendons of hand, which showed great variability in their arrangement. This may be due to different definitions in different studies [7]. The causes of these differences are obscure but some research persons suggest differences in racial grouping [8]. The most frequent distribution pattern reported in literature is a single extensor indicis (EIP) tendon located ulnar to the extensor digitorum communis (EDCI) tendon of the second finger, a single extensor digitorum communis (EDC) tendon for the second finger; a single thick extensor digitorum communis (EDCL) tendon for the third finger; a double extensor digitorum communis (EDCR) tendon for the fourth finger; no extensor digitorum communis (EDCS) tendon for the fifth finger; and a double extensor digiti minimi (EDM) tendon for the fifth finger [3,4].

Variations in the EDCI tendon: In our study arrangement of EDCI is almost similar to the earlier studies [1,9-11]. Except for studies 1,8,7,12conducted. Agarwal and Tirthani G found absence of tendon in 0.83% of specimens and they also found 10% double and 0.83% triple tendons. Hirai et al found 92% single and 8% double tendons and Mestdagh et al found 95% single and 5% double tendons. It shows that EDCI will have maximum single tendon. Absence of tendon is very rare but few hands may have double tendons.

Variations in the EDCL tendon: We found almost equal single (43.75%) and double (45%) tendons in EDCL in its middle part which is unique for our study, but in origin (61.25%) and insertion (73.75%) single tendon was common, which is accordance with all other studies. In earlier studies [1-9]. Single tendons are predominant, except in the studies of Godwin and Ellis (92%) and Prameela Dass et al (83%) all others found single tendons in the range of 50 to 60%.Double tendons in the range of 4 to 39% and triple tendons in the range of 2 to19% except for Mestdagh et al (0%). Four tendons are noted by three authors [7,11,12]. By this we can conclude that single tendon is most common in EDCL and four tendons are rarely present.

Variations in the EDCR tendon: We found 42% double tendons in EDCR which is common according to 75% of studies, except for[10,13,12] studies, where single tendons are common. Godwin and Ellis found 96% single tendons. All studies showed triple tendons it was in the range of 1 to 22% and four tendons are found by studies [8,7,11,12]. It shows that double tendons are common in EDCR. Single and double tendons are found normally but four tendons are rare for EDCR.

Variations in the EDCS tendon: In our study EDCS was absent in 27.5% of specimens which is accordance with the studies of [10,12]. All studies showed the absence of this tendon ranging from 2 to 66%. We found that single tendons (45%) are common in EDCS which is similar to[12]where it is 51.66%. According to other's studies absence of EDCs is common. Some authors considered splitting of tendon between EDCR and EDCS as a common tendon for both digits. Von Schroeder and Botte [7] described that in general there is favorable agreement between studies, and the differences may be largely due to differences in definition because longitudinal fissures in EDC tendons are present but tendon slips were not clearly defined. In contrast, tendons that could be readily divisible along fissures without sharp dissection were defined as tendon slips and therefore yielded higher numbers for multiplicity. Another reason for multiplicity is the juncturae from the EDCR to EDCS may be mistakenly defined as the EDCS. In some specimens the EDCS tendon is often replaced by an aponeurotic expansion between the EDCR and EDM, known as the slip of Testut [12]. It is defined as fibrous bands passing obliquely between the diverging tendons of the extensor digitorum on the dorsum of the hand. This also one of the causes for difference in the studies.

Variations in the EIP tendon: In our dissection, we observed absence of EIP tendon in one (1.25%) specimen, it is also noted by [1,10-12]. Single tendons are commonly seen ranging from77 to 98%, we found 85% of single tendons. Double tendons are observed with a range of 2 to 16%. Triple tendons are found in 2(2.5%) specimens in middle part and 1(1.25%) specimens in the insertion, similar observations are made by [7,10]. In our study we noted 10(12.5%) specimens with double tendons in insertion, out of these specimens both tendons are inserted to index finger in 5specimensand in remaining 5 specimens to the middle finger. We observed 1(1.25%) specimen with triple tendon in insertion, in this 2 tendons are inserted to index finger one on each side of EDCI tendon, third tendon was inserted to middle finger. In this we also noted a tendinous slip connecting redial sided tendon of EIP to EPL tendon. Tountas and Bergmann [14] observed that EIP could be absent or duplicated and could provide a tendon to the thumb, the fourth finger or more often to the third finger.

Variations in the EDM tendon: In our study EDM had 60% single tendons in its origin, which spited in to two forming double tendons in 40% of specimens. This doubled tendons continued as separate tendons and inserted separately in 97% specimens. In middle part 20% tendons are single, 75% tendons are double and only 5% specimens had triple tendons, it is almost similar to earlier studies [1,9,10,11]. Except for [12] where single tendons are predominant (75.88%) and absence (0.83%) of tendon also seen. If EDCS tendons are absent, the EDM had thick tendon. By this we can conclude that the growth condition of the EDM is related to the presence or absence of the EDCS [9].

These variations can be explained by the fact that embryologically, the precursor muscle superficially differentiates into three bundles, the EDC, extensor carpi ulnaris and extensor digiti quinti proprius, and developmental defects are related to alterations in these developing extensor sheets in the forearm [15].

CONCLUSION

From our study we came in to a conclusion that, Extensor tendons and JT of the hand can show great variability in their arrangement. EDCI will have maximum single tendons but few hands may have double tendons. Absence of tendon is very rare. Single tendon is most common for EDCL and four tendons are rarely present. Double tendons are common for EDCR. Single tendons are also found, but four tendons are rare for EDCR. Different studies showed the absence of EDCS tendon ranging from 2 to 66%. This may

be due to different definitions in different studies. EIP can be absent or may give multiple tendons and it can give a tendon to the thumb, or more often to the middle finger. Splitting of the tendon in middle part is common for EDM. Number and thickness of the tendon of EDM is related to the presence or absence of the EDCS.

Conflicts of Interests: None

REFERENCES

[1]. Mestdagh H, Bailleul P, Vilette B, Bocquet F, Depreux R. Organization of the extensor complex of the digits. AnatClin. 1985;7: 49.

[2]. Von Schroeder HP, Botte MJ.Functional anatomy of the extensor tendons of the digits.Hand Clin. 1997;13:51-62.

[3]. Standring S. Gray's Anatomy, The anatomical basis of clinical practice. 39th Edition. Elsevier Churchill Livingstone, New York, 2005. Page 880.

[4]. Sinnatamby CS. Last's Anatomy, Regional and applied.10th Edition. Churchill Livingstone, Edinburgh, 2001 Page 71.

[5]. Wood-Jones F. The Extrinsic Muscles. The Principles of Anatomy as Seen in the hand. 2nd Edition. London: Baillier, Tindall and Cox, 1946:235-42.

[6]. Von Schroeder HP, Botte MJ, Gellman H. Anatomy of the juncturae tendinum of the hand. J Hand Surg Am 1990;1:595-602.

[7]. Von Schroeder HP, Botte MJ. Anatomy of the extensor tendons of the fingers; Variations and multiplicity. J Hand Surg 1995;20:27-34.

[8]. Hirai Y, Yoshida K, Yamanaka K, Inoue A, Yamaki K, Yoshizuka M. An anatomic study of the extensor tendons of the human hand. J Hand Surg Am 2001;26:1009-15.

[9]. Prameela Dass, Latha V. Prabhu, Mangala M. Pai, VarshaNayak, Ganesh Kumar, Jiji P. Janardhanan.A comprehensive study of the extensor tendons to the medial four digits of the hand. Chang Gung Med J 2011;34:612-9.

[10]. El-Badawi MG, Butt MM, Al-Zuhair AG, Fadel RA. Extensor tendons of the fingers; arrangement and varia-tions –II. ClinAnat 1995;8:391-8.

[11]. Zilber S, Oberlin C. Anatomical variations of the tendons to the fingers over the dorsum of the hand; a study of 50 hands and a review of the literature. Plast Reconstr Surg 2004;113:214-21.

[12]. Agarwal P, Tirthani G.Cadaveric study of the long extensor tendons of the finger over the dorsum of the hand.Eur J Anat. 2011;15: 129-135.

[13]. Godwin Y, Ellis H. Distribution of the extensor tendons on the dorsum of the hand. ClinAnat 1992;5:394-403.

[14]. Tountas CP, Bergmann RA. Anatomic variations of upper extremities.Churchill Livingstone, New York. 1993. Pages117-135.

[15]. Abu-Hijleh MF. Extensor pollicis tertius: an additional extensor muscle to the thumb. Plast Reconstr Surg 1993;92:340-3.

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