

A Morphological Study of Juncturae Tendinae of Hand in Adults and Fetuses

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Abstract:

On the dorsum of the hand, proximal to the metacarpo-phalangeal joints, interconnecting bands called 'juncturae tendinae' extend between the tendons of extensor digitorum longus. These juncturae tendinae are clinically important since the finger extension can be preserved when the extensor digitorum longus is lacerated proximal to the juncturae tendinae connecting that finger to an intact extensor tendon. Varying morphologies of juncturae tendinae have been described in the literature. The knowledge of morphology of juncturae tendinum is important as it has functional and surgical importance. This study was undertaken to observe the morphology of juncturae tendinae in adult cadavers and still born fetuses of South Indian origin. A total of 50 forearms and dorsum of the hands were dissected. This included 30 adult cadaveric hands and 20 still born fetal hands of either sex. The following features of juncturae tendinae were noted: their gross morphology, size, shape and location. Juncturae tendinae were absent in the 1st intermetacarpal space of all the dissected hands. Type 1 juncturae tendinae was present in 68 % of the second intermetacarpal space and in 48% of the third intermetacarpal space. In the 4th intermetacarpal space most of the juncturae tendinae were of '3r' type rather than '3y' type; these types of juncturae tendinae were absent in the second intermetacarpal space as described in the literature. The present anatomical data may help the hand surgeons to modify their surgical procedure for better outcome.

Key Words: Juncturae tendinae, Intertendinous connections

Introduction:

The extensor tendons enter the dorsum of hand through six compartments formed by the extensor retinaculum-a fibrous band that prevents the bow stringing of the tendons. At the wrist the extensor tendons are more round and have sufficient bulk to hold a suture. As the tendons continue into the fingers, they become flat and thin with longitudinal fibers that do not hold sutures well.¹ Despite all tendons involved in finger extension, complete independent extension of each finger is difficult. This is because the mechanism by which the long extensor muscle tendon act is complex. This is in part attributable to the 'juncture tendinum' and 'intertendinous fascia' between the long extensor tendons on the dorsum of the hand. Three different morphological types of juncture tendinum (JT) of the extensor tendons have been described in the literature: *Type 1*- filamentous with inter tendinous fascia, *Type 2*- much thicker and well defined connecting band, *Type 3*- classified into *r* and *y* sub types depending upon the shape². Juncture tendinum are functionally important as they are mainly involved in spacing of extensor digitorum (ED) tendons, force redistribution and stability

of metacarpophalangeal joints.^{2,3,4,5,6} Juncture tendinum is involved in stabilizing the extensor communis tendons at the metacarpophalangeal joint and also may have a potential destabilizing role, depending on the finger positioning.⁷ There are very few studies in the literature describing the morphology of juncturae tendinae, its type and dimensions especially in fetuses. Knowledge of their morphology is of immense importance to surgeons when considering the operative stabilization of unstable extensor tendons. Hence, this study was taken up with the objective to document the morphological types of juncturae tendinae both in adult and fetal cadavers of South Indian origin.

Material & Methods:

The data for the present study was collected from formalin fixed adult cadavers allotted for undergraduate dissection in the Department of Anatomy, St. John's Medical College, Bangalore and also from a collection of embalmed still born full term fetuses. Extensor compartment of the forearm and the dorsum of the hands were dissected in both the upper extremities of 15 adult cadavers and 10 still born fetuses of either sex. Cadavers with hand anomalies, hematomas, fractures, tumors or lacerations were excluded from the study. A longitudinal incision was made on the back of the forearm and dorsum of the

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hand. Three transverse incisions were made, one each at the posterior aspect of elbow, wrist and the base of the proximal phalanges. The extensor muscles and their tendons were exposed in the forearm and the dorsum of hand by reflexion of the skin and the fascia. The extensor tendons to each finger were identified, cleaned and the morphology of the juncturae tendinae were studied using following parameters: gross appearance, size, shape, location and distribution on the dorsum of the hand.⁸ The JT were categorized into Types 1 to 3 based on their morphological appearance.² The length of the juncturae tendinum was measured as the intertendinous distance along the middle of the JT. The width was measured as the average distance of the juncturae tendinum perpendicular to the length. The location of the JT to the adjacent tendons of origin and insertion in the intermetacarpal (IMC) space were recorded. The first IMC space was defined as the space between the metacarpals of the thumb and index finger, and second, third and fourth spaces as spaces between the index and middle, middle and ring, ring and little finger respectively. Measurements were recorded by means of a digital caliper to the nearest 0.01 mm. All the dissected specimens were photographed with a digital camera.

Results :

Juncturae tendinae was absent in all 1st IMC spaces of adults as well as fetal hands.

In the adult hand, juncturae tendinae was absent in six sides (20%) of the 2nd IMC space; type 1 JT was observed in 22 hands (73.33%); Type 2 JT was found only in two hands (6.66%). Both 3r and 3y types of JT were absent in all the 2nd IMC space (Fig. I; Table I).

In the fetal hand, in 2nd IMC, type 1 JT was present in 12 (60%) hands; types 2 JT was present in only one (5%) hand. Both, type 3r and 3y JT were absent in all the 2nd IMC spaces of fetal hands (Fig. II; Table I).

In 3rd IMC space of adult hands, type 1 JT was found in six (20%) hands; type 2 JT was present in 15 (50%) hands; type 3r JT was present in six (20%) hands and type 3y JT was present in three hands (10%; Fig. I).

In 3rd IMC space of fetal hands, type 1 JT was found in three hand (15%); type 2 JT was observed in nine (45%) hands. Type 3r JT was found in five (25%) and type 3y JT was present in three (15 %) hands (Fig. II).

In 4th IMC space of adult hands, type 1 JT was found in two (6.66%) hands; type 2 JT was observed in six (20%) hands. Type 3r JT was present in 12 hands (40 %) and type 3y JT was present in ten hands (33.33%).

In 4th IMC space of fetal hands, type 1 JT was found in one (5%) hand; type 2 JT was observed in two (10%) hands. Type 3r JT was present in 12 (60%) hands and type 3y JT was present in five (25%) fetal hands.

The dimensions of JT in adults and fetus in each IMC space are shown in the Table II.

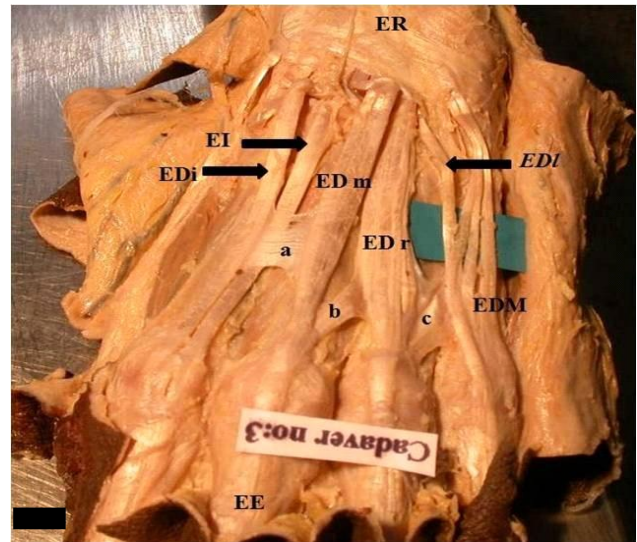


Fig. I: Dorsal view of the adult left hand showing the long extensor tendons. a, b, and c represent the juncturae tendinae (JT) in the second, third and fourth inter- metacarpal spaces (IMCS) respectively. Letter 'a' represents JT type 1 (filamentous type), 'b' is type 2 (thicker and well-defined connecting bands) and 'c' is type 3r.

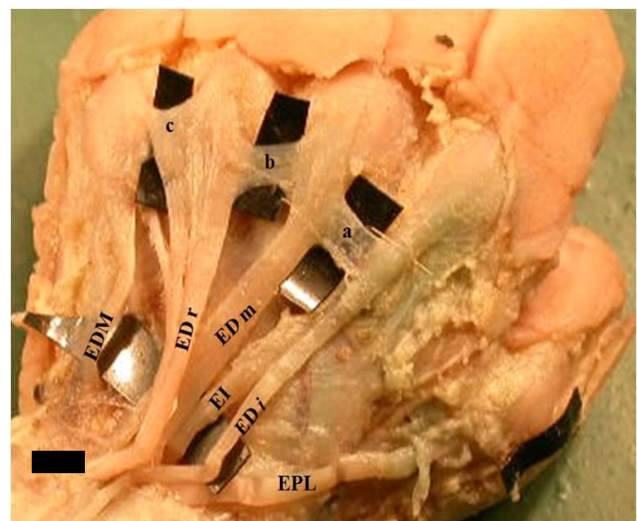


Fig. II: Dorsal view of the left hand of a fetus showing the long extensor tendons and the juncturae tendinae (JT). a, b, c represent the juncturae tendinae (JT) in the second, third and fourth inter- metacarpal spaces (IMCS) respectively. a and b represents JT type 1 (filamentous type), and c is type 3y.

Table I: Distribution of Juncturae Tendinae in the Intermetacarpal Spaces of Adult and Fetal Hands.

<i>Type of juncturae</i>	2 ND IMCS			3 RD IMCS			4 TH IMCS		
	Adult	Fetus	Total (%)	Adult	Fetus	Total (%)	Adult	Fetus	Total (%)
TYPE 1	13 R/9 L	4 R/8 L	34(68)	4R/2L	0R/3L	9(18)	1R/1L	1R/0L	3(6)
TYPE 2	1R/1L	1R/0 L	3(6)	8R/7L	5R/4L	24(48)	3R/3L	1R/1L	8(16)
TYPE 3r	0R/0L	0R/0L	0R/0L	3R/3L	2R/3L	11(22)	4R/8L	6R/6L	24(48)
TYPE 3y	0R/0L	0R/0L	0R/0L	0R/3L	1R/2L	6(12)	3R/7L	1R/4L	15(30)
Absent	2 R/4 L	2R/5 L	13(26)	0R/0L	0R/0L	0R/0L	0R/0L	0R/0L	0R/0L

R-Right side; L-Left side; IMCS-Intermetacarpal space.

Table II: Size of JT in Adults and Fetus

TYPE of JT	ADULT		FETUS	
	Length(mm) (Mean±SD)	Width(mm) (Mean±SD)	Length(mm) (Mean±SD)	Width(mm) (Mean±SD)
TYPE 1	9.2± 3.2	11.3 ±2.2	4.73 ±1.2	3.16 ±0.2
TYPE 2	10.1± 1.7	5.1± 1.4	6.1± 1.4	2.3± 1
TYPE 3r	12.3± 1.3	3.8± 1.4	9.6± 1.3	2.1± 0.8
TYPE 3y	15.3± 2.4	3.7± 1.8	8.1 ±1.5	2.1± 0.8

Table III: Comparative Prevalence of Variations in Junture Tendinae

Types of JT		Dass et al, (2011) n=100	Celik et al, (2008) n=54	Von Schroeder, et al, (1990) n=40	Present study (2012) n=30 adult & 20 fetus
*Type1	Between Index & middle finger	83	57.4	88	68
	Between middle and ring finger	9	16.7	28	18
	Between ring and little finger	1	1.8	0	6
*Type 2	Between Index and middle finger	4	3.7	0	6
	Between middle and ring finger	67	59.3	40	48
	Between ring and little finger	15	7.27	20	16
*Type 3r	Between Index and middle finger	0	0	0	0
	Between middle and ring finger	8	14.8	32	22
	Between ring and little finger	73	53.7	80(3r+3y)	48
*Type 3y	Between Index and middle finger	0	0	-	0
	Between middle and ring finger	16	5.5	-	12
	Between ring and little finger	11	37	-	30
*Absent	Between Index and middle finger	13	38.8	12	26
	Between middle and ring finger	0	3.6	0	0
	Between ring and little finger	0	0	0	0

*All figures represent % of incidence;

Discussion:

Juncturae tendinae are oblique intertendinous fiber bands between extensor tendons in the IMC space passing in a distal direction from middle finger to index finger and from ring finger to middle and little fingers. Three distinct morphologic types of JT have been described: Type 1 JT consists of filamentous regions within the intertendinous fascia which is attached to the extensor tendons on either side of the IMC space in a transverse or oblique direction. The type 2 JT consists of much thicker and well-defined connecting bands and type 3 consist of tendon slips from the extensor tendons and are sub-classified into “y” or “r” subtypes depending on its shape.² In another study 240 hands were explored and three types of Juncturae tendinae namely: fascia, ligament and tendon were identified.⁸ Each hand had three juncturae. The most frequent presentation was for the three juncturae to be fascia-ligament-tendon, from radial to ulnar. Harai et al in a study of 548 upper limbs for intertendinous connections (juncturae tendinae) classified them into type 1 with a filamentous band, type 2 with a fibrous band and type 3 with a tendinous band subdivided into r-shape and y-shape.⁹ The most common pattern in their study was type 1 in the second intermetacarpal space (IMCS), type 3r in the third IMCS, and type 3y in the fourth IMCS.

In the present study, the type 1 JT was present most frequently in the second IMC space (68%) followed by the third IMC space (18%) and least in the fourth IMC space (6%). The findings of the present study are comparable with other studies.^{10,11} Whereas, von Schroeder et al did not find type 1 JT in the fourth IMC space in his study.²

In the present study, highest frequency (48%) of the type 2 JT was found in the 3rd IMC space followed by 16% in the 4th IMC space and the least (6%) in the 2nd IMC space. They are comparable with the other studies.^{10,11} von Schroeder et al on the other hand did not find the presence of type 2 JT in the second space in their study.²

Type 3 JT can be categorized into r and y types according to the shape. Most of the JT were of ‘r’ type rather than ‘y’ type. The r and y types were absent in the second IMC space as described in the literature. The length of the type 3 JT was maximum in adult.

The length and width of the JT in fetal hands was smaller as expected than the adult hands and could not be compared with any other study as there were no reports in the literature related to length and width

of JT in fetus. In fetus, type 3 JT was not found in second and third IMC space, type 3y was not found in any of the spaces. Juncturae were absent in all of the first IMC spaces.

The JT between the extensor tendons are of paramount importance in identifying the extensor tendons and to space the extensor tendons, force distribution and stabilization of the metacarpophalangeal joints.³ The type and direction of JT also explains the interaction between the adjacent fingers which is maximum on ulnar side than radial side due to thick JT on radial side.² Morphology of JT is also very important for surgeons in tendinoplasty on dorsum of hand for extensor tendon repair or in reconstruction of the dorsal aponeurosis with JT. Juncturae tendinae reconstruction has been reported as a surgical management for ulnar tendon dislocation after injury without sagittal band damage.¹² The JT also seemed to provide tendon stability after complete sectioning of the small finger radial sagittal band.¹³

A child’s hand is not a miniature adult hand. The pediatric musculoskeletal system differs greatly from that of an adult. Although these differences diminish with age, they present unique injury patterns and challenges in the diagnosis and treatment of pediatric orthopedic problems.¹⁴ A child’s hand is the most vulnerable body part to get injured. Anatomy of the extensor tendons is extremely important in dealing with the neonatal hand injuries.

Accidental fetal injury is a serious but under reported complication during Caesarean delivery, especially lacerations of the extensor tendons. A number of reports are available in the literature regarding extensor tendon injuries during emergency Caesarean delivery.^{15,16,17} These authors have reported an excellent outcome following surgical repair of the lacerated tendons. Miller and Hauge are of the opinion that in contrast to the flexor tendon injuries, extensor tendon repairs have good functional outcome.^{18,19}

The present anatomical data may help the hand surgeons operating on new born to modify their surgical procedures for better outcomes.

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