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Original Research Article

Morphometry and Variations of Junctura Tendinae in South Indian Population

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Abstract:

Background: Junctura tendinae are fibrous intertendinous connections between the extensor tendons on the dorsum of the hand. They play a crucial role in coordinated finger extension, force transmission, and stabilization of the metacarpophalangeal joints. Anatomical variations and morphometric differences in these structures can influence hand biomechanics and surgical outcomes. However, detailed data regarding juncturae tendinae in the South Indian population are limited**.**

Aim: To analyse the morphometry and morphological variations of junctura tendinae in cadaveric hands of a South Indian population**.**

Materials and Methods: A descriptive cadaveric study was conducted on 30 adult embalmed human hands (18 right and 12 left) in the Department of Anatomy at a tertiary care hospital in South India. The dorsal extensor compartments were dissected to expose junctura tendinae. Measurements of length, breadth, thickness, and distance from the metacarpophalangeal joint were obtained using digital callipers. Junctura tendinae were classified into Type 1 (filamentous), Type 2 (fibrous band), and Type 3 (tendon-like) based on von Schroeder's classification. Data were analysed using descriptive statistics and Student's t-test**.**

Results: Junctura tendinae were present in all specimens, predominantly in the second and third intermetacarpal spaces (100%), with slightly reduced frequency in the fourth space (93.3%). Morphometric analysis revealed a mean length of 8.5 ± 1.4 mm, breadth of 3.1 ± 0.7 mm, thickness of 1.2 ± 0.4 mm, and an average distance of 12.7 ± 2.1 mm from the metacarpophalangeal joint. Type 3 junctura were most common (42%), followed by Type 2 (35%) and Type 1 (23%). No statistically significant difference was observed between right and left hands ($p > 0.05$). Accessory and hypertrophied slips were identified in a few specimens.

Conclusion: The present study demonstrates considerable morphological variation in junctura tendinae among the South Indian population, with predominance of tendon-like (Type 3) connections. The morphometric values obtained provide useful baseline data that can assist clinicians and surgeons in planning and executing extensor tendon procedures, thereby improving diagnostic accuracy and surgical outcomes

Keywords: Junctura Tendinae, Extensor Tendons, Dorsal Hand Anatomy, Morphometry, Anatomical Variations, South Indian Population.

Introduction

The human hand is a highly specialized structure designed to perform complex movements that require precision, strength, and coordination. The extensor mechanism of the hand plays a vital role in enabling these functions by facilitating extension of the fingers and maintaining the stability of the metacarpophalangeal (MCP) joints. Among the important anatomical components of the extensor system are the juncturae tendinae (JT), which are fibrous interconnections between the extensor digitorum communis (EDC) tendons on the dorsum of the hand. Junctura tendinae are located within the dorsal intermetacarpal spaces and extend between the tendons supplying the index, middle, ring, and little fingers. These structures act as stabilizing bands that distribute extension forces among adjacent digits, thereby contributing to synchronized finger movements. They also prevent

excessive independent motion of individual tendons and protect against tendon displacement and rupture during forceful finger extension. The absence or disruption of these connections can result in weakened finger extension and impaired hand function. Anatomically, junctura tendinae have been classified into three major types based on their morphology. Type 1 consists of thin, filamentous fascia-like connections; Type 2 are thicker, well-defined fibrous bands; and Type 3 are strong tendon-like slips that resemble miniature tendons. The type and thickness of these structures influence the degree of force transmission between tendons and the independence of finger movement. These anatomical variations hold particular importance in surgical interventions involving tendon repair, tendon transfer, and reconstructive procedures of the hand. From a clinical perspective, knowledge of juncturae tendinae is essential during procedures such as repair of extensor tendon injuries, treatment of mallet finger deformity, and reconstruction following trauma. Unrecognized variations in JT may lead to incomplete surgical correction, residual deformities, or altered postoperative functional outcomes. In addition, JT may mask underlying tendon injuries by transmitting extension force from adjacent intact tendons, thereby delaying diagnosis. Hence, a precise understanding of their anatomy is crucial for accurate clinical assessment and operative planning.

Although several studies have documented the anatomy and classification of junctura tendinae, most of the available literature is derived from Western populations. Ethnic and regional differences in musculoskeletal anatomy have been well documented, suggesting that morphometric variations may exist across different populations.

However, detailed morphometric data and prevalence patterns of juncturae tendinae in the South Indian population remain sparse. Therefore, the present study aims to analyse the morphometry and morphological variations of junctura tendinae in cadaveric hands obtained from a South Indian population. By providing baseline data on their dimensions, distribution, and types, this study seeks to enhance anatomical knowledge and contribute to improved surgical precision and functional outcomes in hand-related clinical practice.

Aim and Objectives:

The present study aims to analyse the morphometry and morphological variations of junctura tendinae in cadaveric hands obtained from a South Indian population.

Materials and Methods

Study Design and Ethical Approval: A descriptive cadaveric study was conducted on 30 adult hand specimens obtained from routine anatomy dissections after institutional ethical committee approval.

Inclusion Criteria:

- Adult human cadaveric hands, embalmed and free of gross deformity.
- Complete dorsal extensor tendon region intact from wrist to MCP joints.

Dissection Protocol: The dorsal skin and subcutaneous tissue were reflected to expose extensor compartments. Intertendinous connections were carefully identified and cleared of surrounding fascia.

Morphometric Measurements: Using precision digital callipers, the following were measured:

- Length of JT (proximal to distal)
- Breadth at mid-portion
- Thickness (anteroposterior)
- Distance from the MCP joint

Each measurement was taken three times and averaged.

Classification of JT: Junctura tendinae were categorized based on von Schroeder's classification: Type 1, Type 2, and Type 3.

Data Analysis: Descriptive statistics were computed using mean, standard deviation, minimum and maximum. Comparison between right and left hands was performed using Student's t-test (significance set at $p < 0.05$).

Results

Table 1: Distribution of Cadaveric Hands Studied

Side of Hand	Number (n)	Percentage (%)
RIGHT	18	60%
LEFT	12	40%
TOTAL	30	1005

Table 2: Frequency of Junctura Tendinae in Intermetacarpal Spaces

Intermetacarpal Space	JT Present (n)	Percentage (%)
2nd (Index–Middle)	30	100%
3rd (Middle–Ring)	30	100%
4th (Ring–Little)	28	93.3%

Table 3: Distribution of Junctura Tendinae Based on Morphological Types

JT Type	Description	Number (n)	Percentage (%)
Type 1	**Filamentous fascia-like**	**21**	**23%**
Type 2	**Thick fibrous bands**	**32**	**35%**
Type 3	**Tendon-like slips**	**39**	**42%**
Total	**-**	**92**	**100%**

Table 4: Morphometric Measurements of Junctura Tendinae

Parameter	Mean ± SD (mm)	Minimum (mm)	Maximum (mm)
Length	8.5 ± 1.4	6.2	10.8
Breadth	3.1 ± 0.7	2.0	4.5
Thickness	1.2 ± 0.4	0.7	1.9
Distance from MCP	12.7 ± 2.1	9.0	16.4

Table 5: Comparison of Morphometric Measurements between Right and Left Hands

Parameter	Right (Mean ± SD)	Left (Mean ± SD)	p-value
Length	8.6 ± 1.3	8.3 ± 1.5	0.42
Breadth	3.2 ± 0.6	3.0 ± 0.8	0.36
Thickness	1.2 ± 0.3	1.1 ± 0.4	0.48
Distance from MCP	12.9 ± 2.0	12.4 ± 2.2	0.39

P > 0.05 – not statistically significant

Table 6: Observed Anatomical Variations of Junctura Tendinae

Variation Observed	Number (n)	Percentage (%)
Multiple accessory tendon slips	3	10%
Absent JT in 4th intermetacarpal space	2	6.7%
Thickened hypertrophied JT	4	13.3%
Thin filamentous JT (poorly developed	5	16.7%

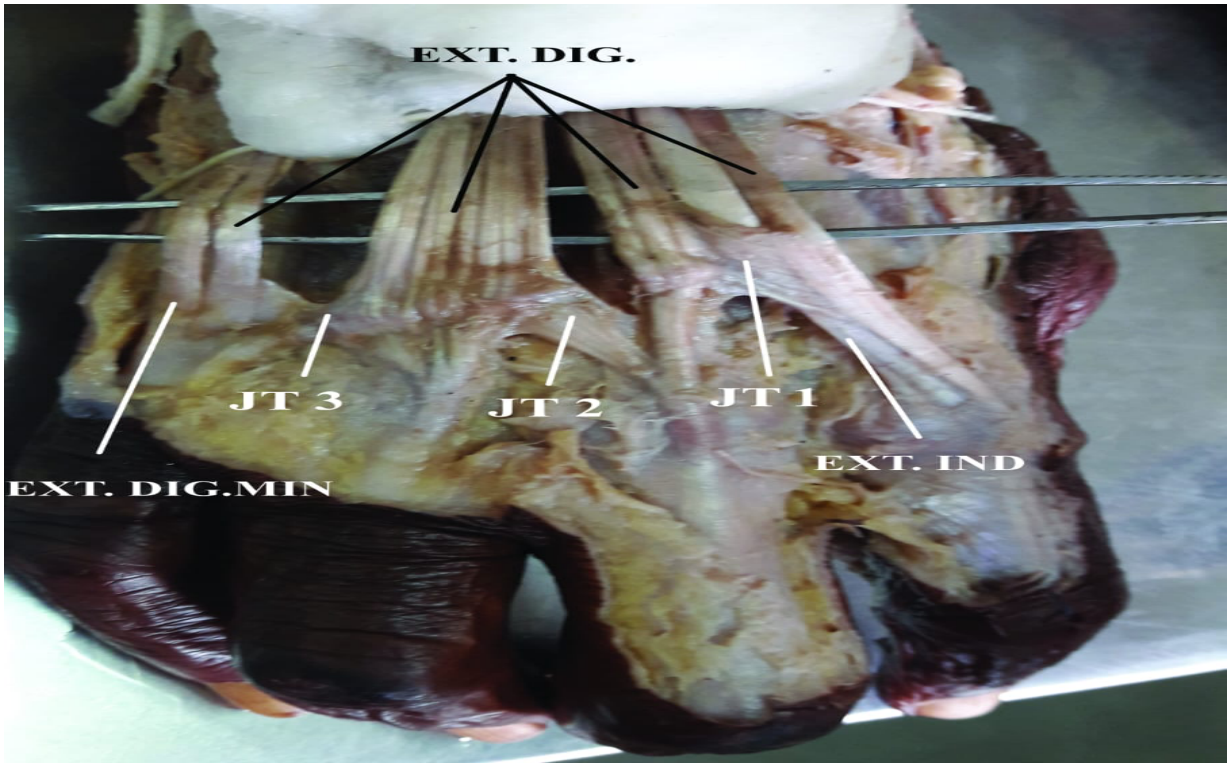

Figure 1: Showing the location of junctura tendinae –JT-Juntura Tendinae, EXT DIG- Extensor Digitorum, EXT DIG MIN-Extensor digiti minimi, EXT IND-Extensor Indicis

Discussion

Junctura tendinae (JT) are essential anatomical structures that provide intertendinous connections between the extensor tendons on the dorsum of the hand. They contribute to coordinated finger extension, stabilization of metacarpophalangeal joints, and protection against tendon rupture.

The present study analysed the morphometry and variations of JT in 30 cadaveric hands from a South Indian population and provides valuable baseline data for this ethnic group.

In the present study, JT were observed in all hands, predominantly in the second and third intermetacarpal spaces, while absence was occasionally noted in the fourth space.

This finding corresponds well with the observations of von Schroeder and Botte (1990), who reported consistent presence of JT between the index, middle, and ring fingers, with variable development toward the ulnar side of the hand. Palatty et al. (2013) also documented a higher prevalence of JT in the second and third intermetacarpal spaces compared to the fourth, suggesting that functional demand and mechanical load may influence their development.

Morphologically, Type 3 juncturae (tendon-like slips) were the most common in the present study (42%), followed by Type 2 (35%) and Type 1 (23%). Similar predominance of Type 3 JT has been reported by Hirai et al. (2001) and by Ferreira et al. (2014), who emphasized that Type 3 juncturae play a major role in force transmission between extensor tendons. The high prevalence of tendon-like JT in our study suggests a strong intertendinous coupling pattern in the South Indian population, which may limit independent finger extension but enhance synchronized hand movements.

The mean length (8.5 ± 1.4 mm) and breadth (3.1 ± 0.7 mm) of JT observed in the present study are comparable to the measurements reported by Palatty et al., who documented mean lengths ranging from 7 to 10 mm. However, slight variations in thickness and distance from the MCP joint were noted when compared to Western population studies. These differences may be attributed to ethnic, genetic, and occupational factors influencing musculoskeletal development.

Clinically, the presence of well-developed JT has significant implications. Strong Type 3 juncturae can mask extensor tendon injuries by allowing adjacent tendons to compensate for a damaged tendon, thereby delaying diagnosis.

This phenomenon has been highlighted by Elgafy et al. (2004), who reported delayed presentation of extensor tendon lacerations due to intact juncturae tendinae. Furthermore, during reconstructive surgeries, unrecognized variations may lead to incomplete tendon release or abnormal postoperative biomechanics.

Accessory and multiple JT slips observed in 10% of specimens in the present study further highlight anatomical variability. Similar accessory slips have been documented by Ferreira et al. and Choudhry et al., emphasizing the need for meticulous surgical dissection during tendon repair and transfer procedures. Awareness of such variants can prevent iatrogenic injury and improve surgical outcomes.

The absence or poor development of JT in the fourth intermetacarpal space, as noted in a few specimens, may explain the relatively independent movement of the little finger observed clinically. This finding is consistent with reports by Zancolli and others, who described greater mobility and weaker intertendinous connections toward the ulnar digits.

Overall, the findings of the present study corroborate previously reported patterns while providing new morphometric data specific to the South Indian population. These data may serve as a reference for anatomists and clinicians, particularly hand surgeons, when planning surgical interventions involving extensor tendons.

Conclusion

The present descriptive cadaveric study provides comprehensive morphometric data and documents the anatomical variations of juncturae tendinae in a South Indian population.

The consistent presence of juncturae tendinae in the second and third intermetacarpal spaces and the predominance of Type 3 tendon-like junctura highlight their important role in coordinated finger extension and stabilization of the metacarpophalangeal joints. The morphometric values obtained in this study serve as baseline reference data for this population.

Understanding the variations and dimensions of junctura tendinae is of significant clinical importance, especially in reconstructive hand surgery, tendon transfer procedures, and management of extensor tendon injuries.

Awareness of these anatomical variations can help prevent misdiagnosis, avoid iatrogenic injury, and improve surgical outcomes. The findings of this study thus contribute valuable anatomical information that can support both educational and clinical practices.

Limitations

This study was conducted on a relatively small sample size of 30 cadaveric hands, which may limit the generalizability of the findings to the entire

South Indian population. The use of embalmed cadaveric specimens may also influence the accuracy of morphometric measurements due to tissue shrinkage and fixation-related changes. Additionally, demographic details such as age, sex, and occupational history of the cadavers were not available, which may have influenced morphological variations. Future studies with larger sample sizes, fresh specimens, and demographic correlation are recommended to further validate and expand upon the findings of this study.

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