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A CADAVERIC STUDY ON JUNCTURAE TENDINAE OF EXTENSOR TENDONS OF THE HAND

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Abstract
Juncturae Tendinae (JT) are intertendinous fibrous bands connecting the extensor tendons on the dorsum of the hand. These structures play a pivotal role in the coordinated extension of the fingers, stabilization of the metacarpophalangeal (MCP) joints, and redistribution of muscular forces across athe extensor apparatus. Anatomical variability of the JT has important clinical implications, especially in planning and executing surgical interventions related to extensor tendon repair or reconstruction. This cadaveric study aimed to investigate the morphological and morphometric patterns of JT and their anatomical relationships with extensor tendons. Twenty adult cadaveric hands were dissected and examined. JT were classified based on morphological appearance (Type 1, Type 2, Type 3r, and Type 3y), dimensions, angulation, and their location across intermetacarpal spaces. The findings revealed a predominance of Type 1 in the second and third intermetacarpal (IMC) spaces and Type 3r in the fourth IMC space. These observations underscore the functional diversity of JT and their relevance in anatomical education and clinical surgical practice.

KEYWORDS: Juncturae Tendinae, Extensor Tendons, Intertendinous Connections, Extensor Digitorum, Morphology, Metacarpophalangeal Joint.

INTRODUCTION
The hand is a complex anatomical and functional unit, whose dexterity depends on a fine balance between flexor and extensor mechanisms. The extensor digitorumcommunis (EDC), originating from the lateral epicondyle of the humerus, plays a central role in extending the fingers. As it courses distally, it divides into four tendons traversing the dorsum of the hand. These tendons pass beneath the extensor retinaculum and insert into the extensor expansions of the digits, aided by accessory extensors such as the extensor indicis and extensor digitiminimi.

Within the dorsum of the hand, the extensor tendons are interconnected by fibrous bands termed Juncturae Tendinae (JT). These intertendinous connections are vital for synchronized finger extension as they facilitate force redistribution and provide structural stability across the MCP joints. JT are typically found in the second, third, and fourth IMC spaces; however, their presence, form, and orientation vary considerably among individuals.

JT are classified into three primary types based on morphology:
- **Type 1:** Filamentous, thin intertendinous fascia
- **Type 2:** Thicker, well-defined, robust connective bands

- **Type 3:** Subdivided into 3r (rectangular) and 3y (Y-shaped) configurations [3]

Although each finger has its own extensor tendon, complete independent extension is often limited due to these interconnections [2]. The presence or absence of JT in certain spaces may explain phenomena such as reduced extension in isolated injuries or compensatory movements following tendon ruptures. Some studies even speculate that JT may have evolved or adapted to support fine motor skills, such as musical performance [2].

A thorough understanding of these structures is essential for clinicians, particularly hand surgeons, during tendon repair, transfers, or dorsal hand surgeries [4–10]. This study aims to elucidate the morphology and morphometry of JT and contribute to a clearer anatomical and surgical roadmap.

AIMS AND OBJECTIVES

- To determine the morphological variations of Juncturae Tendinae in adult human cadaveric hands.
- To assess their relationship with extensor tendons across different intermetacarpal spaces.
- To analyze their angulation, size, and distance from anatomical landmarks such as the extensor retinaculum.

MATERIALS AND METHODS

This cadaveric study was conducted over 1.5 years in the Department of Anatomy at Gauhati Medical College (GMC), from October 1, 2022, to March 31, 2024.

Sample Size and Selection:

- Twenty formalin-fixed adult cadaveric hands (from 10 cadavers, both sexes, right and left sides).
- Hands with no visible trauma, congenital anomalies, tumors, or surgical modifications.

Inclusion Criteria:

- Intact upper limbs from formalin-fixed adult cadavers.

Exclusion Criteria:

- Hands with deformities, surgical scars, traumatic injury, tumors, or congenital hand anomalies.

Dissection Procedure:

The dorsal surface of each hand was dissected to expose the extensor tendons. Juncturae Tendinae between adjacent tendons were identified and assessed for:

- Morphological type: Type 1, Type 2, Type 3r, Type 3y
- Dimensions: Length and width using a calliper
- Orientation/angulation: Relative to extensor tendons
  (i) Radial-to-ulnar: Beginning high from radial and going down to ulnar
  (ii) Ulnar-to-radial: Beginning high from ulnar and going down to radial
  (iii) Straight: without angulation
- Distance from extensor retinaculum: Measured from the distal edge of the extensor retinaculum to the radial end of each JT Photographic documentation was performed during dissection.

RESULTS

Twenty dorsum of hands (right and left) from 10 adult cadavers (both sexes) were dissected. The following observations were made regarding the gross morphology, size, shape, and location of Juncturae Tendinae.

- A gradual increase in length and decrease in width of JT were noted from Type 1 to Type 3r and Type 3y.

- **Type 1 JT** was present in 68% of the second IMC space and 48% of the third IMC space.
- In the fourth IMC space, most JT were of Type 3r rather than Type 3y.

Table 1: Distribution of different types of JT in intermetacarpal space

Intermetacarpal Space	Absent JT	Type 1 JT	Type 2 JT	Type 3 JT
2nd IMC space (3rd JT)	10%	70%	20%	0%
3rd IMC space (2nd JT)	0%	30%	60%	10%
4th IMC space (1st JT)	0%	10%	20%	70%

Table 2: Morphometric Data including length and width of different types of JT (Mean ± SD in mm):

JT Type	Length (mm)	Width (mm)
Type 1	9 ± 2	12 ± 1
Type 2	10 ± 1	6 ± 1
Type 3r	12 ± 2	3 ± 2
Type 3y	14 ± 1	3 ± 1

Angulation Relative to Extensor Tendons:

- **2nd IMC space:**
  - Straight: 80%
  - Radial to ulnar: 10%
  - Ulnar to radial: 10%

- **3rd IMC space:**
  - Radial to ulnar: 90%
  - Ulnar to radial: 10%
  - Straight: 0%

- **4th IMC space:**
  - y-shaped: 40%
  - r-shaped: 60%
  - Straight: 0%

Table 3: Distance of JT from Distal Edge of Extensor Retinaculum:

IMC Space	Distance (cm)
2nd IMC	4 ± 1
3rd IMC	5 ± 1
4th IMC	6 ± 1

FIGURE LEGENDS

Figure 1: Dorsal view of dissected cadaveric hand showing JuncturaeTendinae between extensor tendons.

Figure 2: Cadaveric hand specimen demonstrating Type 3yJT

Figure 3: Cadaveric hand specimen demonstrating Type 3rJTwith absent type1JT

DISCUSSION

This study highlights the structural complexity and anatomical variability of JT on the dorsum of the hand. The predominance of Type 1 JT in the 2nd IMC space aligns with previous literature, suggesting filamentous connections are more common laterally [1,3]. This likely reflects a less demanding functional requirement for coordinated extension between the index and middle fingers.

In the 3rd IMC space, Type 2 JT were dominant, indicating more defined and force-transmitting connections. Such structural integrity likely facilitates the transmission of extension force from the middle to the ring finger, especially during load-bearing or gripping.

The 4th IMC space predominantly exhibited Type 3 JT, especially the 3r subtype. This may be due to increased stability needs between the ring and little fingers, which often act together during fine motor tasks. The increase in length and decrease in width from Type 1 to Type 3 suggest a progression from flexible fascia to stronger connective tissue contributing more mechanically [4,5].

Angulation analysis reveals most JT are obliquely oriented or possess specific configurations (3r/3y), which may help maintain tendon alignment and prevent subluxation. The proximity of JT to the extensor retinaculum has surgical relevance. Preserving or replicating these distances during dorsal hand surgeries or tendon transfers could optimize postoperative function [6–8].

Additionally, the absence of JT in 10% of specimens in the 2nd IMC space indicates anatomical variability that clinicians should consider during tendon exploration or repair.

CONCLUSION

This cadaveric study demonstrates significant anatomical variability in the morphology, orientation, and distribution of Juncturae Tendinae. Type 1 JT predominates in the lateral (2nd IMC) spaces, while Type 3r is most common medially (4th IMC). Morphometric and angulation data provide deeper insight relevant to surgical intervention, rehabilitation, and anatomical education.

Recognizing the spatial and structural relationships of JT enhances intraoperative precision during tendon transfers and helps prevent complications. This knowledge is essential for both clinical and academic applications.

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