

## Variations of extensor pollicis brevis tendon in Indian population: A cadaveric study and review of literature



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### ABSTRACT

**Objectives:** Variations of the tendons of the first dorsal compartment of the wrist may be one of reasons of treatment failure and recurrence in De Quervain's tenosynovitis (DQT). The present cadaveric study was designed to look into the variations of the Extensor pollicis brevis (EPB) tendon in Indian population. **Methods:** Seventy-seven formaldehyde-fixed cadaveric upper limbs of Indian origins were dissected to observe the number of EPB tendons and its variations.

**Results:** The EPB muscle was found to be absent in one hand (1.3%). The EPB muscle was found with single tendon, two tendons and three tendons in 73 limbs (94.8%), 2 limbs (2.6%) and one limb (1.3%) respectively. The muscle originated from the posterior surface of the radius and the adjacent interosseous membrane. The EPB muscle with single tendon was found to be inserted into the distal part of dorsal surface of the proximal phalanx of the thumb in 44 limbs (57.1%). In limbs with bitendinous EPB, the tendon slips were inserted into the base of proximal phalanx and into the base of distal phalanx of the thumb. An Osseo-fibrous septum separating EPB from Abductor Pollicis Longus (APL) was observed in 45 limbs (58%).

**Conclusion:** EPB in first extensor compartment of Indians is usually monotendinous. It mostly inserts into the distal part of dorsal surface of proximal phalanx of thumb and into the base of distal phalanx. In majority of the wrists, one may find an osseofibrous ridge separating EPB from APL. These anatomical variations may be helpful to guide proper treatment in de Quervain's tenosynovitis.

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## 1. Introduction

De Quervain's disease is a painful condition of the first extensor compartment of the wrist because of stenosing tenosynovitis of the abductor pollicis longus (APL) or/and extensor pollicis brevis (EPB) tendons. Despite multimodal treatment approach to this condition, disease recurrence and failure is not uncommon.<sup>1</sup> The anatomic variations on the first extensor compartment in patients with de Quervain's disease may be one of the causes of treatment failure.<sup>1–3</sup> The normal anatomy of the first extensor compartment of wrist joint has been described as the APL and EPB tendon lying in single fibro-osseous canal with single insertions into the first metacarpal and proximal phalanx, respectively. Subsequent

studies revealed its anatomical variations and described this compartment as one of the highly variable anatomical spaces in the hand region.<sup>1–8</sup> Our previous study has revealed that APL in Indian cadavers is usually bitendinous and there is a wide variation in its insertion.<sup>3</sup> To fully understand the anatomy of the first extensor compartment of wrist in Indian population we designed this cadaveric study on EPB tendon.

## 2. Material and methods

Seventy-seven formaldehyde-fixed upper limbs in 40 cadavers (between 32 years and 65 years) were dissected to look for the variations in the origin and insertion of EPB. The limbs were free from any injuries and there was no scar mark over the dissected areas. All cadavers were of Indian origin (*Eastern part of India*). The extensor retinaculum over the first extensor compartment was split vertically and the underlying tendons were identified. The variations of EPB were identified by tracing the tendon distally up

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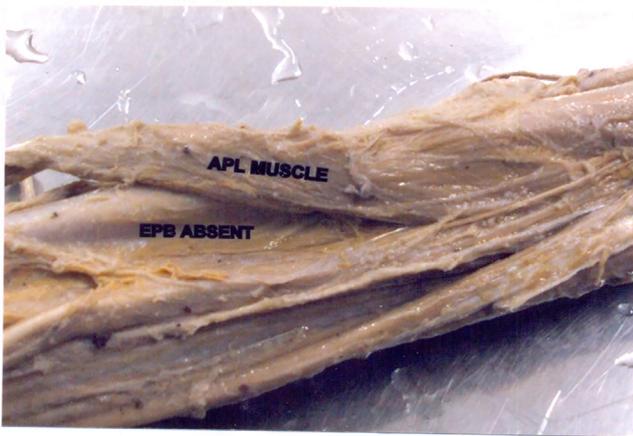


Fig 1. Absent EPB tendon in one cadaveric hand.

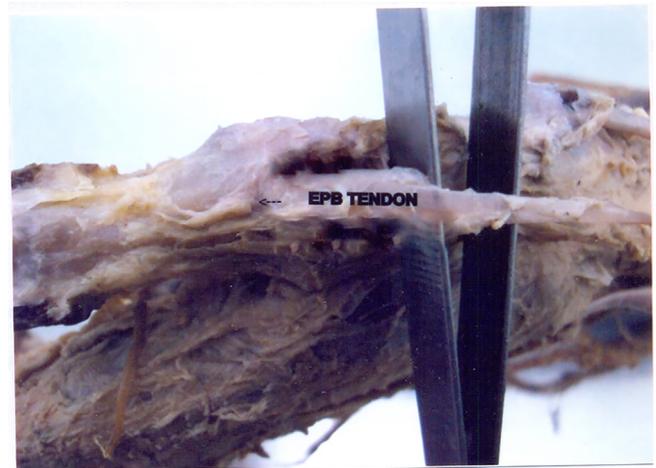


Fig. 2. EPB Attached to the base of proximal phalanx.

**Table 1**  
Site of attachment of tendons of EPB.

Site of Insertion	Number of tendons	Percentage
Base of proximal phalanx	47	58.75%
Base of distal phalanx	29	36.25%
Base of 1st MC	2	2.5%
Shaft of 1st MC	2	2.5%
Total	80	100%

to its insertion site. Careful dissection was done to look for the presence of an osseous-fibrous septum in the first extensor compartment of the wrist.

### 3. Results

There were three female and 37 male cadavers. Of 77 limbs dissected, EPB muscle was found to be absent in one hand (1.3%, Fig. 1). The EPB muscle was found to be originating from the posterior surface of the radius and the adjacent interosseous membrane. In 73 limbs (94.8%) the muscle was found with single tendon. Forty-four of these (57.1%) were inserted into the base of the proximal phalanx of the thumb (Tables 1 and 2, Fig. 2). Twenty-seven (35%) tendons were inserted into the distal phalanx with a slight variation; 24 tendons (31.1%) were fused with Extensor Pollicis Longus tendon prior to its insertion into the distal phalanx (Fig 3); remaining 3 tendons were directly inserted into the distal phalanx beside the tendon of EPL (3.9%). In 2 upper limbs (2.6%) with single tendon, the tendons were inserted into the shaft of the first metacarpal bone. Surprisingly, in one limb the EPB was found to be inserted to the volar aspect of first metacarpal bone along with APL.

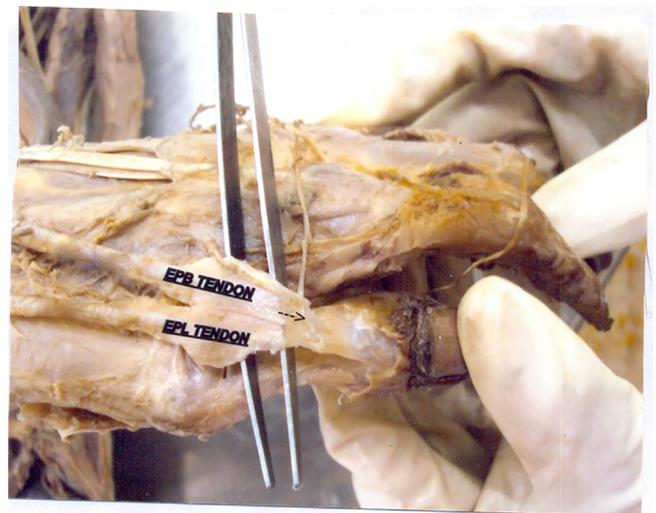


Fig. 3. EPB fused with EPL and inserted to distal phalanx.

In two upper limbs, EPB had two tendon slips (Fig 4), one tendon slip inserted into the base of proximal phalanx and the other into the base of the distal phalanx of the thumb. One upper limb (1.3%) had 3 tendon slips (Fig. 5); 2 tendinous slips inserted into the base of 1st metacarpal and the other tendinous slip inserted into the base of the proximal phalanx of thumb (Tables 1 and 2). In 58% (45) of the limbs, the tendons of the EPB were separated from the tendons of APL by an Osseo-fibrous septum in the first extensor compartment.

**Table 2**  
Details of the insertion of EPB tendon slips in the cadaveric hands.

Number of wrist	Number of tendinous slips	Insertion
73 hands	Single tendon	In <b>44 hands</b> : Base of proximal phalanx of thumb In <b>24 hands</b> : Fused with EPL and inserted in base of distal phalanx of thumb In <b>3 hands</b> : directly to distal phalanx of thumb In <b>2 hands</b> : Shaft of 1st MC
2 hands	Two tendons	One tendon inserted at the base of proximal phalanx of thumb and another tendon to base of distal phalanx of thumb
One hand	Three tendons	Two tendons inserted to the base of 1st MC and one tendon inserted in the base of proximal phalanx of thumb
One hand	Absent	



Fig. 4. Bitendinous EPB.



Fig. 5. Tritendinous EPB.

## 5. Discussion

The APL and EPB tendons show wide variations and anomalies in human wrist.<sup>1–8</sup> Its clinical implication in the treatment of De Quervain's tenosynovitis has already been substantiated. The EPB has shown variations in respect to its number, site of insertion, thickness and subcompartmentalization.<sup>1,2</sup> Multiple compartments have been attributed as one of the most common factors for failure to injection therapy and surgical release in DQT.<sup>1,2,9</sup> Mahakkanukrauh, Alemohammad, and Jackson reported a higher incidence of a subcompartment in patients with De Quervain's disease compared to normal wrists. A systematic review by Lee et al. has also clarified the presence of a dividing septum as a possible contributing factor in the pathophysiology of De Quervain syndrome.<sup>10–12</sup> This subcompartment is most often observed on the dorsoulnar aspect of the first extensor compartment, although it can also be found within the compartment floor.<sup>1</sup> Lee et al. reported a septum in 43.7% of normal cadavers versus 62.2% in De Quervain patients.<sup>1</sup> In our study we observed an osseofibrous ridge between EPB and APL in 58% cadavers. In previous Indian studies, Roy et al. and Nayak et al. reported a septum in 57% cadavers of Eastern India and 35% cadavers of South India.<sup>4,6</sup> Thus, about half of the Indians have a dividing septum in the first dorsal compartment of the wrist. This may be the reason of success in only 50% of

patients of DQT after corticosteroid injection therapy, as the drug may not communicate to both compartments.<sup>13</sup> Leslie has already mentioned that if the first injection fails in DQT, one may attempt second injection with target being the EPB lying in one separate tight sub-compartment.<sup>14</sup> Sawaizumi et al. reported that the outcome and efficacy of local steroid injections increases to 100% if both APL and EPB tendons are injected.<sup>13</sup> Again while doing surgical release, the surgeon need to decompress all compartments and the osseofibrous septum has to be disrupted from the periosteum.<sup>1,2,13,14</sup>

Absence of EPB has been reported in 0% to 9.2% of normal wrists.<sup>1–8</sup> The review by Lee et al. noted it in 3.3% of DQT patients.<sup>1</sup> EPB was shown to be absent in 1.3% of cadavers in this study and this is in consistent with other Indian studies.<sup>4,6,7</sup> Unlike APL which is usually bitendinous, EPB in Indians are monotendinous.<sup>3,4</sup> Ninety-five percentages of cadavers in our series had single tendon. The insertion point varies and it usually inserts into the distal aspect of proximal phalanx followed by proximal part of distal phalanx of the thumb. While inserting into the distal phalanx the tendon usually joins the extensor pollicis longus. Lee et al. reported single EPB tendon in 92% (1402/1519) of normal wrists and 94% of DQT patients.<sup>1</sup> Alemohammad et al. reported that the EPB tendons were more likely to insert into distal phalanx when it was housed in a separate sub-compartment.<sup>11</sup> If the surgeon can extend the interphalangeal joint of the thumb by EPB, there is a high suspicion for the presence of a subcompartment and needs exploration. The fusion and unusual insertion patterns of the APL and EPB merit documentation for reconstructive procedures such as tendon transfer and interposition arthroplasty as well. The unique insertion of EPB into the base of first metacarpal on its palmar aspect along with APL advocates that USG/MRI evaluation prior to surgical procedure may provide hints about such wide variations.<sup>15</sup>

Bitendinous EPB in Indians is less common and the reported incidence in cadaveric study varies between 1 and 5%.<sup>4,6,7</sup> The review by Lee et al. also reported a similar incidence worldwide.<sup>1</sup> Two or more EPB tendon slips were observed in 6% of normal wrist in their study. Hence we can assume that APL is usually multi-tendinous and EPB is monotendinous.

This study has certain limitations. Anatomical details of whole of the first compartment might have given more information. *Bilateral variations of the tendon could have provided extra information on the variation of EPB in our ethnicity. As we studied the disarticulated limb from the cadavers, it was difficult for us to gather information.* The dimensions of the tendon could have been measured that may directs its feasibility for tendon transfer. However, as our previous study<sup>3</sup> has already revealed the detailed anatomy of APL tendon we believe that the anatomy of EPB will add to it and will provide a comprehensive knowledge about first dorsal compartment of the wrist in Indian population.

## 6. Conclusion

The number and sites of insertion of EPB tendon should be taken into account while performing surgical decompression of the first extensor compartment of the wrist in de Quervain's syndrome. EPB in first extensor compartment of the wrist joint among Indians is usually monotendinous. It inserts into the distal part of dorsal surface of proximal phalanx of thumb and into the base of distal phalanx. In majority of the wrists, one may find an osseofibrous ridge separating EPB from APL. These anatomical variations may be helpful to guide proper treatment in de Quervain's tenosynovitis/tendon transfer and other reconstructive procedure.

## Conflict of interest

The authors of this manuscript declare that they have no conflicts of interest to disclose.

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