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# A CADAVERIC STUDY OF VARIATION OF TENDONS OF ABDUCTOR POLLICIS LONGUS MUSCLE IN INDIAN POPULATION (SAGAR DISTRICT).

Anatomy

**Dr. Siddharth Shankar Roy** Professor & head Department of Anatomy Bundelkhand Medical College, Sagar M.P

**Dr. Vishal Bhadkaria** Associate Professor Department of Anatomy Bundelkhand Medical College, Sagar M.P

**Dr. Aayshri Srivastava** PG student 1st year Department of Anatomy Bundelkhand Medical College, Sagar M.P

## ABSTRACT

**Background-** Anatomic variation of the tendons of the abductor pollicis longus (APL) and its knowledge is important to assess the diseased and traumatized hand and when considering tendons for repair or graft.Many authors have reported the anatomical variation of abductor pollicis longus (APL) around the wrist and its association with de Quervain tenosynovitis (DQT) , first carpo-metacarpal arthritis and trapezio-metacarpal subluxation .It is the tendon of APL along with tendon of extensor pollicis brevis (EPB) present in first extensor compartment of wrist. Both help in movement and stabilisation of thumb. Variations in the number of tendons of APL muscle may be asymptomatic and often incidental finding. **Method –** Forty (Right side- 20, Left side-20) formaldehyde preserved cadaveric upper limb's wrist ( Female- 08 , Male – 32 Upper limbs) were dissected to look for the anatomical variation of APL in the Indian population. **Results –** In our study ,the tendon of APL was present in all specimen.The APL was found with single tendon in 01 limb(3%), double tendon in 17 limbs(43%), triple tendons in 10 limbs(25%), quadruple tendons in 07limbs (18%), pentad tendons in 03 limbs(8%), heptads tendons in 01 limb(3%) and Nona tendons in 01 limb(3%). In our study we found the two patterns of arrangement of tendons of APL i.e.(1) Superficial & deep pattern (2) parallel pattern .In 22 limbs (55%) the tendon was found parallel pattern while in 17 limbs(43%) it was superficial &deep pattern of tendons. In our study, out of 136 tendons of APL , most common insertion finding was base of 1st metacarpal bone followed by Abductor Pollicis Brevis muscle &its fascia , trapezium bone , & opponens pollicis muscle. **Conclusion –**The aim of the study was to provide information regarding anatomy of variation of tendon of APL in regarding with their numbers, pattern of their arrangements and attachment in upper limbs in Indian population .These variations must be understood by the Orthopedic surgeons as the response to treatment of DQT & reason for the 1st Carpo-metacarpal arthritis can be dependent on this anatomical variation.

## KEYWORDS

APL- Abductor pollicis longus tendon, Metacarpal, Trapezium, Opponens pollicis, Abductor pollicis brevis muscle, Carpo-metacarpal arthritis, Insertion, de Quervains tenosynovitis .

## INTRODUCTION

The extensor compartment of the forearm has twelve muscles that are grouped into Seven superficial and five deep muscles. Out of five deep muscles of forearm, three muscles that move the thumb, these are Extensor Pollicis Brevis (EPB) , Extensor Pollicis Longus (EPL) and Abductor Pollicis Longus (APL) muscles. The Abductor Pollicis Longus acting with Abductor Pollicis Brevis(APB)( Thenar muscle) abducts the thumb and acting with EPL & EPB it helps in extension of thumb at 1st carpo-metacarpal joint [1] .

In our body, the extensor compartment of forearm & hand (Dorsum) has frequent variations of its contents .The comprehensive understanding of variations in tendons of the hand & the finger is necessary for the proper diagnosis of certain neurological disorders [2]. Among all, the abductor pollicis longus muscle is known to exhibit numerous variations .So it is academically, surgically & clinically important that these variations should be in our knowledge. Variations in number of tendons of the APL muscle may be asymptomatic and often incidental finding [2-5] or may present with painful conditions like de Quervain tenosynovitis (DQT) [6-9]. The treatment of such condition in severe cases involves either on injection therapy or surgical decompression of the first extensor compartment. Causes of treatment failure in DQT can be due to the variations in the anatomy of tendons of the APL [10- 13].

The other clinical implications of multiple tendinous slips insertion of APL is its association with the 1st carpo-metacarpal arthritis or subluxation & its use as a tendon graft [14-17]. It seems essential to understand the anatomic variation of the APL by orthopedic surgeons as it has been associated with many orthopedic conditions. Our cadaveric study has designed to look for tendinous variations of APL in Indian population [ Sagar district].

Normally, the APL lies distal to supinator and closely related to EPB.It arises from the lateral part of the posterior surface of the shaft of the ulna below the anconeus ,from the interosseous membrane , & from the middle third of the posterior surface of the radius immediately distal to the attachment of the supinator [18]. It ends in a tendon which becomes free of muscle fibers just proximal to the wrist. It then runs in a groove on the lateral side of the lower end of the radius accompanied by the tendon of EPB and inserts most commonly at radial side of the base of the 1st metacarpal bone [18].

## MATERIALS AND METHODS –

This study was carried out on a total of 40 upper limbs [ Female : 08, Male : 32] of adult cadavers collected from the dissection hall at the Department of Anatomy, Bundelkhand Medical College, Sagar (M.P.). There were no injuries or scars marks over the extremity, and the cadavers were of Indian origin. The muscles of extensor compartments were dissected ,extensor retinaculum was defined and the superficial structures on the lateral part of dorsum of hand and the thumb were displayed . The extensor retinaculum was split vertically opposite the first extensor compartment and the underlying tendons of APL & EPB were exposed.

In each specimen, the APL tendon was identified and followed to its insertion. The incidence of variations in its number and sites of attachment were observed. Using a calibrated caliper, the length of the tendon was measured from the point of insertion to the beginning of muscle belly.

## RESULTS :

There were 04 female & 16 male cadavers.

**(A) Variation in number of tendons – In our study :**

1. APL muscle was found with a single tendon in 01 specimen (3%) (left side)( fig.1), at insertion point tendon was bifurcated, one slip attached to base of 1st metacarpal & another slip merged with Abductor pollicis Brevis muscle

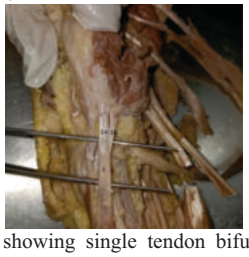

**Fig.1:**APL muscle showing single tendon bifurcating(1a,1b) near distal end

2. Double tendon in 17 specimens (43%) (08 right side & 09 left side) (fig.2)

**Fig.2:** APL muscle showing double tendon

3. Triple tendon in 10 specimens (25%) ( 06 right side & 04 left side) (fig.3).

**Fig.3:** APL muscle showing three tendons most lateral tendon attached on base of 1st Metacarpal while most medial merged with APB muscle. Intermediate one merged with opponens pollicis.

4. Quadruple tendon in 07 specimens (18%) ( 03 right side & 04 left side) ( fig.4).

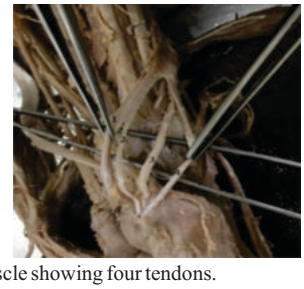

**Fig.4:** APL muscle showing four tendons.

5. Pentad tendon in 03 specimens (8%) (02 right side & 01 left side ) (fig.5).

**Fig.5:** APL muscle showing five tendons

6. Heptads tendon in 01 specimen (3%) (right side)( fig.06).

**Fig.6** APL muscle showing seven tendons

7. Nona tendon in 01 specimen (3%) ( left side) (fig.07).

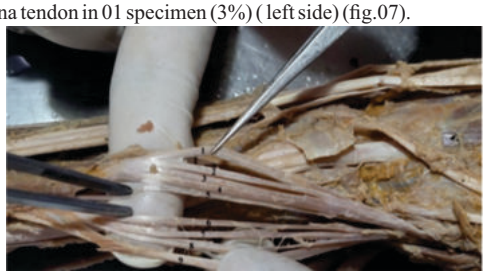

**Fig.7:** APL muscle showing nine tendons

**(B) Variation in pattern of arrangement of tendons of APL –**

In our study , we found that multiple tendons of APL were generally arranged in two patterns and were connected to each other by transverse tendinous interconections.The pattern were (1) Superficial & deep pattern

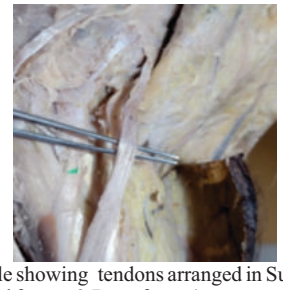

**Fig.8:** APL muscle showing tendons arranged in Superficial and Deep pattern(Superficial forcep & Deep forcep).

(2) Parallel pattern.

**Fig.9:** APL muscle showing tendons arranged in Parallel pattern

In our study , in 22 (12 right side & 10 left side) limbs (55%) tendons of APL were found parallel arranged (fig.8) while in 17 (08 right side & 09 left side) limbs (43%) tendons of APL were found Superficial & deep pattern (fig.9).In single limb only one tendon was present.

**(C) Variation in site of attachment of tendon of APL –**

There were variations in the insertion of the APL tendon as well. In all hands, the APL tendon had insertion into the first metacarpal bone . In parallel pattern, most lateral slip was considered as main tendon that attached to base of 1st metacarpal while medial one considered as accessory slip attached to other site. While in case of superficial and deep pattern , superficial slip were considered as main tendon that attached to the base of 1st metacarpal while deep slip considered as accessory slip attached on other sites. In our study most common site of attachment of tendon of APL was base of the 1st metacarpal bone followed by APB muscle & its fascia , trapezium &oponens pollicis muscle & its fascia.

**Table 1 : Site of attachement of tendon of APL**

| Site of insertion | Number of tendons | Percentage |
|---|---|---|
| 1. Base of first metacarpal bone*<br>1a. Antero-lateral surface<br>1b. Lateral surface<br>1c. Anterior surface | 85*<br>73<br>10<br>02 | 63%<br>54%<br>7%<br>2% |
| 2. Abductor Pollicis Brevis muscle & its fascia | 35 | 26% |
| 3. Trapezium | 13 | 10% |

| | | |
|---|---|---|
| 4. Opponens Pollicis muscle& its fascia | 03 | 2% |
| Total Tendons | 136 | |

**DISCUSSION -**

Variation in the anatomy of the APL muscle plays an important role to understand the different disease processes associated with it & their treatment [14-17].

Different authors have studied the variation of APL tendons [6,15,19,20] but only few reports are available from the Indian Subcontinent [ 4,20-26].Hence it is essential to study the anatomical variation of APL in the Indian population.

In the cadaveric study of Indian population [22] ] Roy et al.reported two abductor pollicis longus and one extensor pollicis brevis as the most common arrangement (48 of 86 wrist, 56% ) in first dorsal compartment of the wrist. They found supernumerary tendons in 74.41% cases. The insertion of the APL was on the radial side of the first metacarpal base in all cadaveric wrist , but among other sites ,the most common site of insertion of the APL tendon slips was the trapezium ( 56.14% , 32 in 143 tendons) followed by abductor pollicis brevis ( 18 in 143 tendons) , opponens pollicis ( 5 in 143 tendons) and it was mostly found if there were 2 tendon slips of APL present . They found that if there was a single APL tendon, then it was inserted in the base of the first metacarpal.

Our study had observations that show some similarity to that of Roy et al [22]. The most common pattern of APL on the dorsum of the wrist was two tendinous slips ( 17 of 40 limbs). The most common site of insertion was the base of first metacarpal ( all limbs and 63 % of APL tendons ) followed by Abductor Pollicis Brevis ( 26% of APL tendon ). In our study out of 10 limbs with three tendon slips, in 02 limbs tendons were superficial & deep pattern in which superficial tendons ( 2 in each ) were attached on base of first metacarpal on its anterolateral surface while deep tendon were attached in base of first metacarpal ( on lateral surface ) in one case while on trapezium in another case. In 08 of 10 limbs with three tendons, they were parallel arranged. In all most lateral & intermediate tendon attached to base of first metacarpal on its anterolateral surface while most medial tendon either merged with abductor pollicis brevis muscle or on trapezium or with opponens pollicis muscle.

In the present study, a single tendon of APL was found in one limb only. Coleman et al.[27] declared that a single tendon APL is odd in 175 examined specimens. However Vollala [28] detected a single tendon in 30% of 100 specimens studied. In the present investigation, triple tendons were noted in 35% of the specimens. This triplication was observed by Bravo et al [14] in 8% only and by Gonzalez et al.[29] in 13.6% . Although 4 tendons were found in 18% of specimens of the current work, it was observed only in 4 % of the cases dissected by Bravo et al [14] and merely as a case report by Mehta et al [20].5 , 7 & 9 tendons were detected in 8% , 3% & 3% of the current specimens . Recently ,case report discovered 5 tendons for APL [17] , 6 tendons [30] & 9 tendons [31] .

Nayak et al. [25] & Mehta et al. [20] presumed an embryological basis for the accessory APL tendons. The differentiating APL tendon is divided into 3 slips attached to the trapezium , first metacarpal &opponens pollicis. Subsequently , new attachement may develop to adjacent abductor pollicis brevis , whereas the link with opponens pollicis disappears. In the current research , this could be explained by the presence of transverse tendinous fibres connecting the various APL tendons.

In agreement with Mehta et al. [20], the APL tendons were classified in the present study into lateral [main] and medial [ accessory] ones. Van Oudenaarde&Oostendrop [32] and also Zancolli and Cozzi [33] classified the muscular components of the APL into deep and superficial ones. The deep portion is more proximal and has multiple sites of insertion around the trapezio- metacarpal joint. The superficial portion is more distal and inserts at the base of the first metacarpal. The APL tendons were classified in the present study into superficial [main] and deep [accessory ] ones. This explains why two pattern of arrangement of tendons were shown in our study.

In our study, 09 tendons & 07 tendons were found in one specimen each. In case of 09 tendons ,most lateral 08 tendons were attached on base of first metacarpal on its lateral aspect while medial most tendon bifurcated at its insertion site & merged with abductor pollicis brevis &opponens pollicis .

In case of 07 tendons, lateral 05 tendons were attached on base of first metacarpal on its antero lateral aspect while medial 02 tendons merged with abductor pollicis brevis.

The recommended length of tendon used in TMC arthroplasty for treatment of osteoarthritis was 5 cm. The average length of APL in our cadaveric specimens was almost 7.5 cm. The use of APL for extensor tendon reconstruction after chronic EPL ruptures also has been reported [34] with good functional scores and patient satisfaction . The APL has been considered more relevant for thumb mobility and presumed more important for TMC stability [14,35].

A good knowledge of the variations of the APL is important from the clinical point of view. For example, de Quervain's tenosynovitis often develops due to repetitive and continued strai of the APL and EPB tendons as they pass under a thickened and swollen extensor retinaculum [35]. Symptoms include pain at the radial side of the wrist , spasms, tenderness , an occasional burning sensation in the hand and swelling over the thumb side of the wrist, and difficulty griping with the affected side of hand .The onset is often gradual and pain is made worse by movement of the thumb and wrist , and may radiate to the thumb or forearm[35]. The presence of additional APL bands running in separate sheath may influence the choice of treatment, as they can reduce the penetration of steroids used in conservative approaches and prevent full surgical release, thus resulting in failure .Similarly ,abnormal insertion into the phalanx or metacarpal can cause trapezio-metacarpal subluxation or arthritis.

**CONCLUSIONS**

Our study is concerned with the anatomical structure and variation of tendons of APL & its application for Orthopedic surgeries.The APL is characterised by high morphological variability associated with presence of accessory tendons. This study provide an insight into the variation of APL muscle insertion in the Indian Population.Further studies with a large sample size on this anatomical variation are warranted.

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**Conflicts Of Interest –** None

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