

Anatomical variation of abductor pollicis longus in Indian population

A cadaveric study

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ABSTRACT

Background: 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. From Indian subcontinent, there is only one original article and a few case reports on the variability of APL tendon insertion.

Materials and Methods: Fifty formaldehyde preserved cadaveric wrists were dissected to look for the anatomical variation of APL in the Indian population.

Results: The APL was found with single tendon in 2, double in 31, triple in 8, and quadruple in 8 extremities. A maximum of 6 tendon-slips were found in one cadaveric wrist. In all hands, the APL had at least one attachment to first metacarpal bone and in 46 hands (92%), there was second insertion to the trapezium bone. Of all tendon-slips of APL ($n = 126$), 44% of tendons (68 tendons) were inserted into the base of the first metacarpal bone. This was followed by the insertion into the trapezium in 42% tendons (52 tendons).

Conclusion: Bi-tendinous APL is commonly observed on the dorsal compartment of the wrist in Indian population and these tendon-slips are commonly attached to the first metacarpal base and trapezium. This variation must be understood by the Indian Orthopedic surgeons as the response to treatment of DQT and reason for first carpo-metacarpal arthritis can be dependent on this anatomical variation.

Key words: Abductor pollicis longus, anatomical snuff box, first dorsal compartment of wrist, Indian, wrist

MeSH terms: Tendons, cadaver, tenosynovitis, wrist

INTRODUCTION

Abductor pollicis longus (APL) is the tendon of the first extensor compartment of the wrist. It helps in movement and stabilization of thumb.¹ Multiple tendinous insertion of APL has been reported by many authors.²⁻³² The anatomical variation may remain asymptomatic or may present with painful conditions like de Quervain tenosynovitis (DQT).^{2,5,6,19} The treatment of such condition in severe cases involves either an 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 tendons of the APL.³³⁻³⁶ The other clinical implications of multiple tendinous slips insertion of APL is its association with first carpo-metacarpal arthritis or subluxation and its use as a tendon graft.^{28,32,37,38} It seems essential to understand the anatomic variation of APL by the orthopedic surgeons as it has been associated with many orthopedic conditions. This cadaveric study was designed to look for tendinous variations of APL in the Indian population.

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MATERIALS AND METHODS

In a cadaveric study, 50 formaldehyde-fixed forearms

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in 25 cadavers (between 32 years and 65 years) were dissected. There were no injuries or scar marks over the extremity, and the cadavers were of Indian origin. The extensor retinaculum covering the first extensor compartment was split vertically, and the underlying tendons of APL were exposed carefully. The variations of the insertion of APL were noted by tracing the tendon up to its insertion point.

RESULT

There were 3 female and 22 male cadavers. The APL muscle was found with a single tendon in 2 [Figure 1], double in 31 [Figure 2], triple in 8 [Figure 3] and quadruple in 8 extremities [Figure 4]. A maximum of 6 tendons were found in one cadaveric hand [Figure 5]. 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 and in 46 hands (92%), it had second insertion into the trapezium. Of the total tendinous slips of APL ($n = 126$), 44% of the tendons were inserted into the base of the first metacarpal bone. This was followed by insertion into the trapezium in 42% tendons [Tables 1 and 2].



Figure 1: Single tendon of abductor pollicis longus in a cadaveric wrist inserted to the base of first metacarpal bone



Figure 3: Superficial belly of abductor pollicis longus with three tendinous-slips in a cadaveric wrist inserted into the base of first metacarpal bone and the deep belly with 1 tendon inserted to the trapezium

DISCUSSION

Variation in the anatomy of the APL muscle plays an essential role to understand the different disease processes associated with it and their treatment.^{28,32,37,38} Usually, APL originates from the posterior surface of radius, ulna and the interosseous membrane. In the lower third of the forearm, the APL and EPB occupy the most lateral compartment of the extensor retinaculum in a single synovial sheath, crossing superficial to the radial styloid process. The APL is usually inserted into the radial side of the base of the first metacarpal bone or the trapezium.

Different authors have studied the variation of APL tendon.^{2-32,39-49} But only few reports are available from the Indian subcontinent.^{9,14,30,31,46-49} There seems to be an ethnical variation in the origin, insertion, and arrangement of these tendons.^{28,50} Hence, it is essential to study the anatomical variation of APL in the Indian



Figure 2: Two tendinous-slips of abductor pollicis longus in a cadaveric wrist inserted into the base of first metacarpal bone and to the trapezium



Figure 4: Quadruplicate abductor pollicis longus tendon inserted into the first metacarpal base (3 tendon-slips of superficial belly) and trapezium (1 tendon slip of deep belly)

population. On the search of PubMed with key word “abductor pollicis longus” published between January 1, 1960 and February 15, 2014, we found 319 articles.

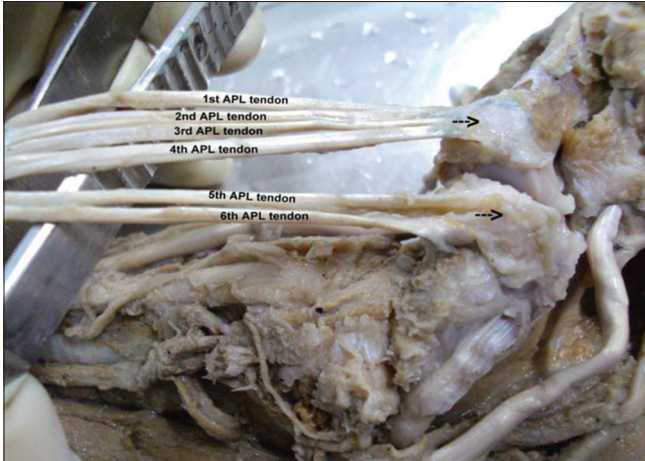


Figure 5: The superficial belly of six-tendon slips of abductor pollicis longus inserted into the base of the first metacarpal bone and opponens pollicis and the tendon arising from deep belly inserted into the trapezium bone

Table 1: Site of attachment of tendons of APL

Site of insertion	Number of tendons
Base of first MC bone	68
Lateral surface	31
Anterolateral surface	33
Anterior surface	4
Trapezium	52
Opponens pollicis	4
Thenar fascia	2
Total	126

APL=Abductor pollicis longus, MC=Metacarpal

Table 2: Details of the insertion of APL tendon slips in this cadaveric study

Number of wrist	Number of tendinous slips	Insertion
2 hands	Single tendon	Base of 1 st MC
31 hands	Two tendons (APL divides into superficial and deep belly proximal to wrist)	Superficial: Anterolateral part of 1 st MC in 17 hands and lateral part of 1 st MC in 14 hands Deep: Trapezium in 29 hands, anterior surface of 1 st MC in 2 hands
8 hands	Three tendon slips (superficial and deep belly proximal to wrist: 2 tendons from superficial belly and one from deep belly)	In 6 hands: Two tendons from superficial belly were inserted into anterolateral surface and lateral surface of 1 st MC, in 2 hands: Lateral surface of the base of the first MC bone and into the thenar fascia Deep belly tendon: Trapezium in all 8 hands and in 3 hands additional fibers were attached to opponens pollicis
8 hands	Four tendon slips (superficial and deep belly proximal to wrist): In 3 hands, superficial belly had 3 tendons and deep belly had 1 tendon In 5 hands (superficial and deep belly proximal to wrist): Each belly had 2 tendons	In 2 hands, the 3 tendons of superficial belly: Anterolateral, lateral and anterior surface of the base of 1 st MC, in one hand the 3 tendons of superficial belly: Anterolateral, lateral surface of the base of 1 st MC, opponens pollicis Deep belly: Trapezium Superficial tendons: The anterolateral and anterior surface of 1 st MC Deep tendons: In 4 hands, 2 tendons of deeper belly into trapezium and in one hand into the trapezium and thenar fascia
One hand	Six tendon slips (superficial belly and deep belly proximal to wrist): Four tendons from superficial belly and 2 tendons from deep belly	Three tendons of the superficial belly: Lateral, anterolateral and anterior surface of 1 st MC, other tendon of superficial belly: Opponens pollicis Deep belly: Trapezium

APL=Abductor pollicis longus, MC=Metacarpal

After going through the abstracts, only 64 articles were found discussing the anatomical variation of APL. To exclude ethnical variability, we concentrated only on Indian studies. Only 8 articles from India were found reporting the anatomical variation of APL,^{9,14,30,31,46-49} of which 7 were case reports^{9,30,31,46-49} and 1 was an original article (cadaveric study).¹⁴ In this cadaveric study of Indian population,¹⁴ Roy *et al.* reported two abductor pollicis longus (APL) and one extensor pollicis brevis (EPB) as the most common arrangement (48 of 86 wrists, 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 wrists, but among other sites, the most common site of insertion of the APL tendon-slips was the trapezium (56.14%, 32 in 143 tendons or tendon-slips) followed by abductor pollicis brevis (18 in 143 tendons), opponens pollicis (5 in 143 tendons), and carpo-metacarpal joint (2 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 similar to that of Roy *et al.*¹⁴ The most common pattern of APL arrangement on dorsum of the wrist was two-tendinous slips (31 of 50 wrists). The most common site of insertion was the base of first metacarpal (all hands and 54% of APL tendons) followed by trapezium (in 92% of hands and 41% of APL tendons). In 6 of 8 wrists with 3 tendon-slips, 2 tendon-slips were inserted into the base of the first metacarpal bone and the third one into the trapezium. Paul and Das from

India reported a case of three APL tendinous slips which were close to each other and joined near its insertion as a flattened aponeurosis before it finally got inserted into first metacarpal bone.⁴⁸

In 8 wrists with 4 tendon-slips, 2 tendon-slips of the superficial belly were inserted into the base of the first metacarpal bone and the two-slips of the deep belly were inserted into the opponens pollicis and into the trapezium. In the present study, a maximum of six tendinous slips of APL was seen in only one cadaveric hand where the superficial belly ended in 4 tendons and the deep belly ended in 2 tendons. The tendons arising from the superficial belly were inserted into the base of the first metacarpal bone and opponens pollicis and the tendon arising from deep belly inserted into the trapezium bone. In a case report, Nayak *et al.*⁴⁶ reported six APL tendinous slips in an adult cadaveric specimen; the medial 2 tendons were inserted into the trapezium and thenar muscle, the remaining 4 tendons were inserted into the palmar aspect of the base of the first metacarpal bone. The EPB was absent in their specimen, thus reducing the compartment to five. In our case, the EPB was present.

Researchers have tried to understand the embryological evaluation of APL and correlated the variability of APL insertion to its embryology.^{2,14,49} In the early developmental period, the APL tendon is usually divided into three strips. The dorsal strip is attached to the first metacarpal bone, the middle strip is inserted into the trapezium, and the palmar strip is connected to the opponens pollicis. Later on, the palmar strip gets disconnected from opponens pollicis and establishes new connections with the APB. It is possible that the persistence of developmental tendinous patterns of APL leads to the existence of multiple tendons that are observed later in life.^{9,49}

The clinical implications of APL variations have already been discussed. Merely finding 2 tendons (EPB and APL) during surgical release may not be a complete release in DQT. One has to be careful about the additional tendon-slips of APL. Again, it may be very difficult to inject steroid into the sheath of different tendon-slips. Hence, multiple tendons of APL may be the reason of failure to treat DQT. Similarly, the abnormal insertion into the phalanx or metacarpal can cause trapezio-metacarpal subluxation or arthritis. Another major clinical implication is its usage as tendon-graft.^{28,32,33-38}

There are few limitations of this study. The cadavers available for dissection were of Indian origin and direct extrapolation of the data presented in this study may not be applicable to other ethnical groups. As the other

muscle content of first dorsal compartment (EPB) was not studied, it is difficult to comment that supernumerary tendons/multiple tendinous slip of APL is the sole factor for treatment failure in DQT. The dimension of APL tendinous slips was not evaluated which could have helped in deciding its suitability as a tendon-graft.²⁸ The number of cadavers evaluated was less, and hence it is very difficult to generalize the findings of this study to whole Indian population. Though this study is small, its clinical implication is of importance to the orthopedic surgeons.

CONCLUSION

This study provided an insight into the variation of APL muscle insertion in the Indian population. The usual pattern of APL insertion in Indians is two-tendinous slip attached commonly to the first metacarpal base and the trapezium. Further studies with a large sample size on this anatomical variation are warranted.

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Conflicts of interest

There are no conflicts of interest.

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