Original Research Article

Anatomical Evaluation of First Dorsal Compartment of the Hand – A Study in South Indian Cadavers

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Abstract

Morphology of the first dorsal compartment of the hand is often linked with several surgical or orthopaedic complications. It is frequently associated with splitting of the compartment into two sub compartments and more common in patients with de Quervain disease, which supports the claim that this anatomic variation is involved in the pathogenesis of de Quervain disease. Our aim was to evaluate the different anatomic variations of the first dorsal compartment and its possible clinical complications in south Indian cadaveric hands. We studied 94 formalin fixed isolated hands for the morphological study of the 1st dorsal compartment. The length and width of the compartment ranged between 14.07 to 24.17mm and 4.19 to 10.37mm, respectively and the thickness of the extensor retinaculum over the first dorsal compartment was found to vary between 0.11mm to 1.72mm. Septation was seen in 50.74% of the specimens. In majority of cases, extensor pollicis brevis presented with single tendon and in 2.98% cases, it was absent. In contrary to this, multiple tendons of abductor pollicis longus was common observation. Hence, it is handy to have a prior detailed knowledge of existence of the various anatomic variations of first dorsal compartment for the surgeons who treat de Quervian's tenosynovitis or other related clinical complications, which require steroid treatment as it should be injected to both sub compartments when present.

Keywords: First dorsal compartment, extensor pollicis brevis, abductor pollicis longus, septation, de Quervain tenosynovitis

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Introduction

Extensor retinaculum of the hand is divided into six osseofibrous compartments by intervening septa, and through each compartment number of tendons leave the forearm to enter hand for its distal attachment. Anatomic studies of the first extensor or dorsal compartment showed that the most common pattern is one or two tendons of abductor pollicis longus (APL) and one extensor pollicis brevis (EPB) in a single compartment, but there could be variations in the number of tendons and the division of this compartment (1,2,3,4). These anatomic variations may be a precipitating factor in patients with de Quervain disease, or first dorsal compartment tenosynovitis and may lead to wrist pain and disability (5). Although many studies have been performed in this area regarding intra compartmental septum, there exists a lacunae regarding the morphology of the first dorsal compartment with respect to ethnicity or topography. Hence, our aim was to study and establish anatomical variations in the morphology of first dorsal compartment of the hand in South Indian population.

Materials and Methods

Ninety four formaldehyde fixed isolated hands irrespective of the sides and gender, were used for the study. This study was performed in the department of Anatomy, Kasturba Medical College, Manipal. Lateral side of the wrist was opened to facilitate the exposure of the first dorsal compartment and the radial styloid process. Length and width of the first dorsal compartment was measured by using digital Vernier calliper. The length was measured between the tip of the radial styloid process to the proximal part of the extensor retinaculum, whereas width was measured 1 cm below the styloid process between the sharp anterior margin of the radius and the septa between first and the second compartment. The first dorsal compartment was exposed carefully to identify its contents. The pattern of septa in terms of complete or incomplete, presence or absence of an osseous ridge with and without groove in the bony floor was also noted by retracting the tendons of APL. Further the tendons of EPB and APL were inspected for slip multiplicity. Thickness of the extensor retinaculum over the first dorsal compartment was also recorded by using the digital caliper 1cm below the styloid process of radius. Finally, all the specimens were photographed and the results were documented.

Results

Length of the first dorsal compartment was found ranging between 14.07 to 24.17mm and width between 4.91 to 10.37mm and the thickness of the extensor retinaculum over the 1st dorsal compartment was found to vary between 0.11mm to 1.72mm. When the first dorsal compartment was opened for inspection, in 46.29% of cases, the morphology of the first compartment was found to be normal in terms of position, course and number of tendons of APL and EPB. While a separate compartment for the EPB was noted in 50.73% of the specimens, among which in 22.38% cases, complete septa was seen (Fig. 1) and in 28.35% cases, septa was incomplete (Fig.2). Osseous ridge with a double groove in the bony floor was closely associated with septation (Fig. 3). EPB with 2 tendons (Fig.4) and APL with the maximum 4 tendons (Fig.1) were observed in the present study.

Detailed data of number of tendons of EPB and APL with their percentage incidences were tabulated (Table 1).

Discussion

Extensor pollicis brevis and abductor pollicis longus belonging to the deep group of extensor muscles emerge downward and laterally from the undercover of

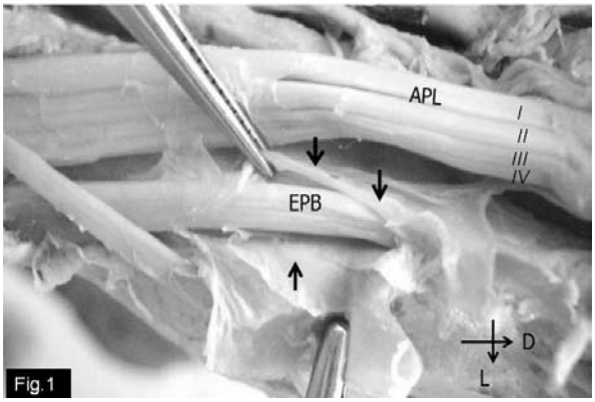

Figure 1: Sub-compartment formed by complete septa is exposed to show the tendon EPB; Abductor pollicis longus (APL) with 4 tendons; EPB- Extensor pollicis brevis, Arrows pointing cut edges of the intra-compartmental septum.

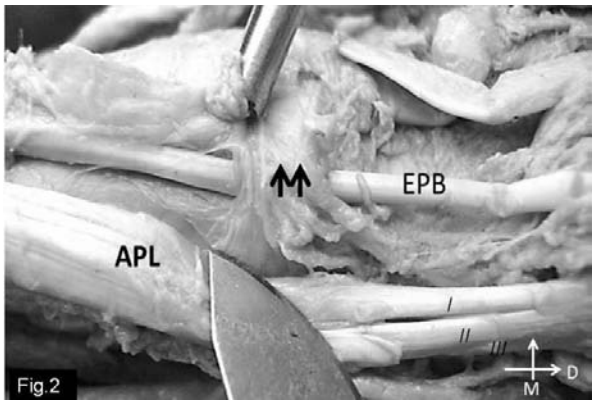

Figure 2: Showing proximal incomplete septation separating EPB tendon from APL tendon; arrows pointing incomplete septation; Abductor pollicis longus (APL) with 3 tendons, EPB- Extensor pollicis brevis.

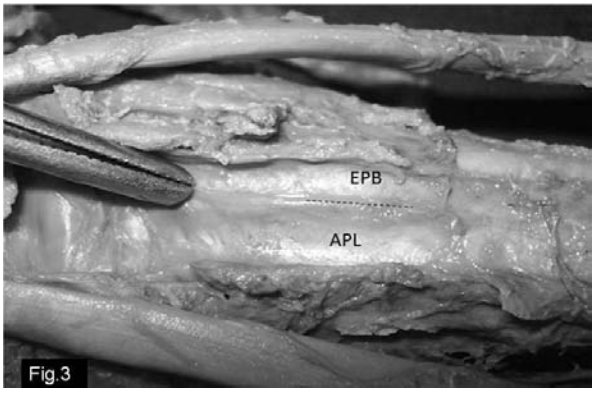

Figure 3: Showing the bony floor of the first dorsal compartment. Tendons of Abductor pollicis longus (APL) and Extensor pollicis brevis (EPB) are displaced to show the osseous ridge (dotted lines) with double bony groove.

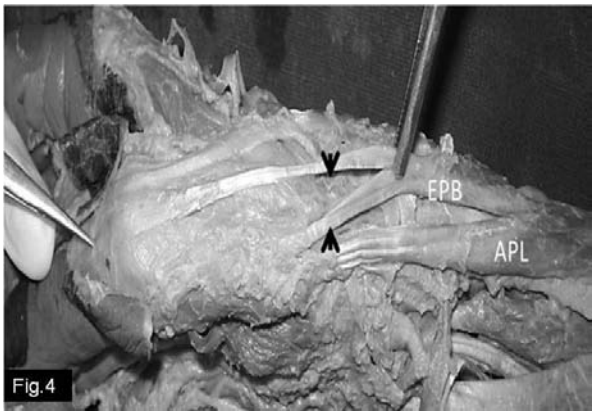

Figure 4: Exposure of first dorsal compartment showing extensor pollicis brevis (EPB) with two tendons (arrows) and multiple tendons of abductor pollicis longus (APL).

the posterior group and wind superficial to lateral group of muscles and pass through the first dorsal compartment of the wrist before reaching the thumb for insertion. There are occasions where these two tendons may pass separately with intervening complete or partial septa with or without additional tendons.

Based on the variable morphology in the first dorsal compartment of the hand, Hiranuma et al. (6) classified the compartment in to 4 types as summarized in Table 2.

However, subsequent studies with the frequent incidences of variations in this region, additional 3 types were introduced by Shiraishi & Matsumura (7) which is depicted in Table 3.

Much attention is given to the morphological studies of first dorsal compartment as this compartment is frequently overcrowded by the multiple tendons of APL and or EPB. This phase brainstormed us to take up this study to establish variant morphological pattern of first dorsal compartment among South Indian population. Results of our study according to Hiranuma classification which may be compared to the results of studies by Shiraishi & Mitsumura (7) and Motoura et al. (8) (Table 4).

Incidence of the septum in the first dorsal compartment is well documented in relation to the de Quervain disease. As per the cadaveric study, incidence of septum between the APL and the EPB tendons varies widely from 20% - 77.5% (9,10).

The overall incidence of septation of EPB is compared with findings of other authors were tabulated in Table 5.

Table 1: Number of tendons of EPB and APL and their percentage of incidences in the first dorsal compartment.

Number of tendons	EPB	APL
One	92.54%	34.33%
Two	4.48% (Fig. 4)	53.73%
Three	-	10.45% (Fig 2)
Four	-	01.49% (Fig 1 and Fig 1)
Absent cases	2.98%	-

In our present study, the overall incidence of septation was 50.73% (Type B and C together) and it is much higher than the incidence of 37% reported by Kulthanan et al. (4), 44% by Shiraishi & Matsumura (7) and 32.1% by Motoura et al. (8).

It was observed that the splitting of first dorsal compartment into two sub compartments was more frequent in patients with de Quervain disease, which supports the claim that this anatomic variation is involved in the pathogenesis of de Quervain disease (11,12). The septum may be a cause for overcrowding in the fibro-osseous tunnel and may predispose to local tendon friction, especially in the EPB tendon sub-compartment (13). Recognition of this septum plays a role in the nonsurgical management of de Quervain disease. Harvey et al. (14) reported 10 of 11 patients were treated surgically after a failure of locally injected steroids because of the presence of a septum. Presence of a septum constitutes a barrier to the diffusion of locally injected steroids (14,15) and is a well-known cause of unsuccessful blind injection of steroids (16,17,18), especially if the EPB tendon sub-compartment is not injected (19). Sawaizumi et al. (17) found that the outcome, and the efficacy rate of local steroid injections increased to 100% when the two sites (APL and EPB tendons) were injected. Moreover, recognition of the multiple tendons of APL tendon may have surgical implications since the APL tendon slips are sometimes used in interposition arthroplasty for trapezometacarpal osteoarthritis (20) or for tendon translocation in chronic subluxation of the carpometacarpal joint of the thumb (21).

Concerning the supernumerary tendons of EPB, a single slip is the common aspect (3,22). However, presence of EPB with two tendons in 3% of the cases, was reported by few authors (5,9,23,24). This percentage is slightly higher in our study (4.47%). However, Daenen et al. (24) reported that EPB tendon is absent in up to 6% of healthy individuals.

Table 2: Hiranuma classification of first dorsal compartment.

Type	Morphology	Description
Type A	No septa (Common type)	APL and EPB pass through the same tendon sheath without septa in between
Type B	Complete septum type	APL and EPB pass through their individual sheaths
Type C	Incomplete septum type	APL and EPB partially separated by the septum
Type D	Absence of EPB (Rare type)	-

Table 3: Additional types of first dorsal compartments by Shiraishi & Matsumura

Type	Description
Type E	APL and EPB are completely separated with no septa between these two
Type F	APL and EPB are anatomically close but no septum between two tendons
Type G	EPB locating inside the APL

Table 4: Comparison of results of current study results of types of incidence of 1st dorsal compartment with that of other authors.

Type	Present study	Shiraishi & Matsumura	Motoura et al.
Type A	46.29 %	47.8 %	63.4 %
Type B	22.38 %	30.8 %	23.2 %
Type C	28.35 %	13.2 %	8.9 %
Type D	2.98 %	-	4.5 %
Type E	-	8.1 %	-

Table 5: Comparison of overall incidence of presence of septa for EPB with the study of other investigators

Present study	Kulthanan et al.	Shiraishi & Matsumura	Motoura et al.
50.73 %	37%	44%	32.1%

This incidence is much higher than what we have observed in our study (2.98%). In this case, a ligamentous structure was replacing the EPB tendon in the same location. The similar observation was also reported by Brunelli et al. (25). Shiraishi et al. reported a rare case of presence of three tendons of EPB passing through the 1st compartment (7).

Hazani et al. (26) in their study found the average length of the extensor retinaculum is ranging between 2.19 ± 0.37cm, which is almost similar to our study (approximately 2 ± 0.5mm).

Aktan et al. (27) in their cadaveric study reported the presence supernumerary tendons of APL in about 85.4% of the cases which is almost similar to the incidence observed by Kulthanan et al. (4) wherein the frequency of multiple tendons of APL was 89%, duplicated EPB tendons in 2%, and septation in 37% of the cadaveric wrists.

Conclusion

Our study confirms the variability noted in previous studies, with supernumerary APL tendons in the majority of the cases (65.67%) and an intra-compartmental septation in 50.73% of the specimens. With the anatomical variability demonstrated in the current study and its comparison with other investigators, we strongly believe that, the septations within the osteofibrous tunnel and supernumerary tendons of APL are possible causes of de Quervain's tenosynovitis. Further, it may be one of the causes for failed steroid injections in the treatment of such cases as well.

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