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A novel classification of the anatomical variations of the first extensor compartment

Zheng-Yu Gao, PhD[a], Hao Tao, PhD[b], Hao Xu, PhD[c], Jun-Qiang Xue, MS[a], Yao Ou-Yang, BS[a], Ji-Xia Wu, BS[d,*]

Abstract

The presence of a septum in the first extensor compartment is closely associated with the pathophysiology of de Quervain disease, and affects the efficacy of corticosteroid injection and surgical release. This study aimed to examine the incidence and length of the first extensor compartment septum.

Forty sides of the wrists in 20 cadavers were used. The presence of a septum in the first extensor compartment was examined. The septum length was recorded with the radial styloid process as the reference point.

The anatomical variations of the first extensor compartment were classified into 3 types. Type I compartment was found in 7 sides in males (29.2%) versus 6 sides in females (37.5%, $P=.733$), type II was found in 6 sides in males (25%) versus 1 side in females (6.25%, $P=.21$), and type III was found in 11 sides in males (45.8%) versus 9 sides in females (56.25%, $P=.56$). There was no significant difference in the septum length between males and females (5.3 ± 2.3 vs 4.8 ± 1.1 mm, $P=.54$).

The incidence of a septum in the first extensor compartment is approximately 50%. The mean septum length is 5 mm. Injection at 5 mm proximal to the radial styloid process has a great chance of delivering the steroids into both subcompartments. Exposure to 5 mm proximal to the radial styloid process can avoid the overlook of subcompartment and achieve adequate decompression of the first extensor compartment.

Abbreviations: APL = abductor pollicis longus, EPB = extensor pollicis brevis.

Keywords: de Quervain disease, first extensor compartment, septum, wrist

1. Introduction

The abductor pollicis longus (APL) and extensor pollicis brevis (EPB) tendons are contained in the first extensor compartment. De Quervain disease is the most common disease involving the hand extensor tendons, with a general incidence of 0.5% in males and 1.3% in females.[1] The pathological examination of de Quervain disease, although also known as de Quervain tenosynovitis, shows no signs of inflammation, but signs of degenerative changes, such as mucoid degeneration, fibrocartilage metaplasia, mucopolysaccharide deposition, and neovascularization.[2] These pathological changes restricted the sliding of APL and EPB tendons in the first extensor compartment, which results in pain.[3]

Understanding the anatomy of the first extensor compartment is essential for successful treatment of de Quervain disease.[4] The anatomical variations of the first extensor compartment include the number of the APL tendon slips and the presence of a septum. Multiple APL tendon slips ranging from 3 to 14 have been reported in up to 89% subjects.[5,6] The previously reported incidence of the first extensor compartment septum ranged from 34.6% to 72%, which may completely or incompletely divide the compartment into 2 subcompartments.[7–14] The septum has been classified into the complete type and the incomplete type.[15] It has been shown that the septum plays an important role in the development of de Quervain disease.[9]

Corticosteroid injection is the first line treatment for de Quervain disease with an initial response rate ranging from 50% to 83%.[16–18] However, treatment failure may occur in 14% to 34.5% patients.[16,19,20] Many studies suggested that poor injection techniques and anatomical variations in the first extensor compartment are the reasons of treatment failures.[21,22] It has been indicated that the EPB can be contained in an independent, separate compartment in the first extensor compartment divided by a septum.[19,20] Failed delivery of steroids into the first extensor compartment or the subcompartment may result in undesirable treatment effects and symptom relapse.[23] In a prospective study with 19 patients, delivery of X-ray contrast into the first extensor compartment was confirmed in 84% patients, of whom only 31% patients showed delivery into the EPB subcompartment.[21]

The presence of a septum in the first extensor compartment also affects the efficacy of surgical treatment of de Quervain disease. Inadequate decompression of the first extensor compartment, especially the subcompartment containing the EPB, is due

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[a] Department of Rehabilitation, [b] Department of Trauma Surgery, [c] Department of Joint Surgery, [d] Department of Obstetrics, Affiliated Hospital of Qingdao University, Qingdao, Shandong, China.

[*] Correspondence: Ji-Xia Wu, Department of Obstetrics, Affiliated Hospital of Qingdao University, No.16, Jiangsu Road, Qingdao, Shandong 266003, China (e-mail: wujx_med@126.com).

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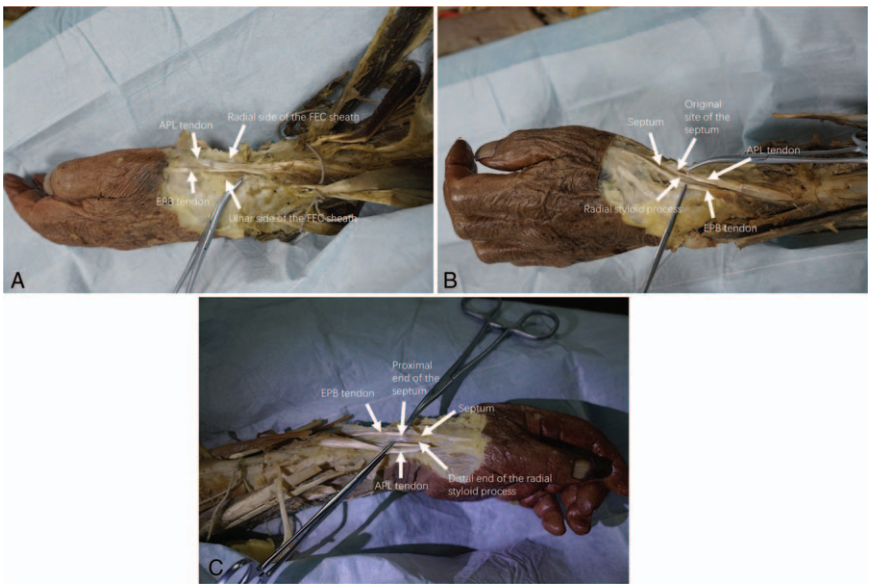

Figure 1. Three types of the anatomical variations of the first extensor compartment (FEC). The type I compartment (A) has no septum and the abductor pollicis longus (APL) and the extensor pollicis brevis (EPB) tendons are contained in the same tendon sheath. The type II compartment (B) contains a septum distal to the radial styloid process, which separates the APL and the EPB tendons. The type III compartment (C) contains a septum proximal to the radial styloid process, which separates the APL and the EPB tendons.

to anatomical variations.[24] This can result in failure of the surgical treatment, as well as relapsed pain after the surgery.[6,25,26] Unawareness of the septum presence may lead to mistakenly recognizing the multiple APL tendon slips as the EPB. Therefore, opening the first extensor compartment and confirming the presence of 2 tendons are no guarantee of effective decompression of the first extensor compartment.[27]

However, there is still a paucity of data on the length of the septum. Our study aimed to examine the incidence of first extensor compartment septum and its length. The anatomical variations of the first extensor compartment were classified and its clinical implications were discussed.

2. Materials and methods

Twenty adult cadavers were provided by the Department of Anatomy, Qingdao University. The cadavers were preserved in 10% formalin. There were 12 males (24 sides) and 8 females (16 sides). The wrists of all cadavers showed intact skins and no signs of previous trauma or surgery. Our study was approved by the ethics committee of the Affiliated Hospital of Qingdao University.

The cadaver was put into the supine position with both arms lying on the sides of the body. The thumb was upwards with the arm in the neutral position. The wrist skin, subcutaneous tissues, the cephalic vein and its tributaries, and the superficial branch of the radial nerve and its branches were removed. The dissection area was from the proximal interphalangeal joint of the thumb to 10 cm proximal to the wrist. Caution was used when dissecting and exposing the retinaculum of the first extensor compartment. Dissection was carried out along the APL tendon, then the APL tendon was retracted to the ulnar side, and the presence of a septum was examined. Upon presence of a septum, the most distal end of the radial styloid process was exposed. The septum length was defined as the distance from the proximal end of the septum to the distal end of the radial styloid process. The measurement was performed using a digital caliper (accuracy 0.01 mm). Pictures were taken using a digital camera.

Categorical data were compared using the Fisher exact test and continuous data were compared using the Student t test. All statistical analyses were performed using the SPSS 18.0 software (SPSS, Chicago, IL). A P value less than .05 was considered statistically significant.

3. Results

Three types of anatomical variations of the first extensor compartment were identified. The type I compartment has no septum and the APL and the EPB tendons are contained in the same tendon sheath (Fig. 1A). There are no significant differences in the septum incidence between males and females (7/24 sides, 29.2% vs 6/16 sides, 37.5%; $P = .733$) (Table 1). The septum incidence also did not differ significantly between the left and right sides (Table 2).

Table 1

Comparison of the first extensor compartment between males and females.

	Males (n = 24)	Females (n = 16)	*P*
Type I	7 (29.2%)	6 (37.5%)	.733
Type II	6 (25%)	1 (6.25%)	.210
Type III	11 (45.8%)	9 (56.25%)	.563

Table 2

Comparison of the first extensor compartment between the left and right sides.

	Left sides (n = 20)	Right sides (n = 20)	*P*
Type I	7 (35%)	6 (30%)	.975
Type II	3 (15%)	4 (20%)	.677
Type III	10 (50%)	10 (50%)	1.0

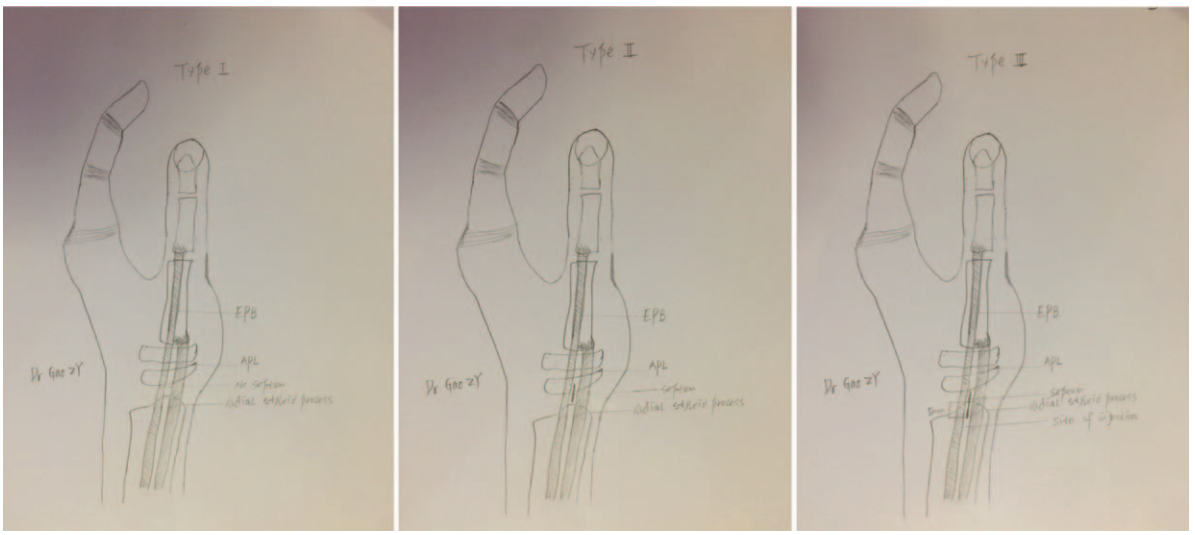

Figure 2. The diagrams of the 3 types of the anatomical variations in the first extensor compartment.

The type II compartment contains a septum distal to the radial styloid process, which separates the APL and the EPB tendons (Fig. 1B). There are no significant differences in the septum incidence between males and females (6/24 sides, 25% vs 1/16 sides, 6.25%; $P = .210$) (Table 1). The septum incidence also did not differ significantly between the left and right sides (Table 2).

The type III compartment contains a septum proximal to the radial styloid process, which separates the APL and the EPB tendons (Fig. 1C). There are no significant differences in the septum incidence between males and females (11/24 sides, 45.8% vs 9/16 sides, 56.25%; $P = .563$) (Table 1). The septum incidence also did not differ significantly between the left and right sides (Table 2). The diagrams of the 3 types of the anatomical variations in the first extensor compartment are shown in Fig. 2.

In our 20 cadavers, dual-sided septa were found in 11 (55%) cadavers, single-sided septum was found in 5 (25%) cadavers, and no septum was found in 4 (20%) cadavers. The overall septum incidence among the 40 wrists was 67.5% (27/40 wrists).

4. Discussion

Our study identified 3 types of anatomical variations of the first extensor compartment. The type I compartment has no septum and the APL and the EPB tendons are contained in the same tendon sheath. The type II compartment contains a septum and its proximal end is distal to the radial styloid process, which separates the APL and the EPB tendons. The type III compartment contains a septum and its proximal end is proximal to the radial styloid process, which separates the APL and the EPB tendons. The type I and II compartments are theoretically at a lower risk of de Quervain disease, and may have better treatment efficacy than the type III compartment. The septum has been classified into the complete type and the incomplete type.[15] We speculate that the length of the septum is more meaningful for clinical treatment.

In our 20 cadavers, dual-sided septa were found in 11 (55%) cadavers, which is higher than that of the single-sided septum in 5 (25%) cadavers. The overall septum incidence among the 40 wrists was 67.5% (27/40 wrists). A previous study found that the septum incidence was 40% (120/300 wrists). [28] This disparity might be caused by our small sample size.

Ultrasound guidance can improve injection accuracy in the treatment of de Quervain disease without compromising safety.[29] Increasing to 2 or 4 injection points can improve the injection accuracy and achieve better efficacy.[17,30,31] Unfortunately, more injection points are associated with prolonged treatment time and more pain. Another study showed that injecting into the proximal subcompartment can increase the chance of delivery into both subcompartment than injecting into the distal subcompartment.[4] However, this study did not specify the proximal injection point. Our study showed that the proximal end of the septum is 5 mm proximal to the radial styloid process and has no significant differences between different sexes and sides. Therefore, we propose that injection at 5 mm from the radial styloid process may increase the injection accuracy and treatment efficacy without concerning the presence of the septum.

Failure in recognizing the subcompartments in the first extensor compartment may lead to inadequate decompression, and finally resulting in undesirable treatment effects or symptom relapse.[14] The multiple APL tendon slips may be mistakenly recognized as the EPB tendon.[6] This can result in missed decompression of the EPB tendon, which is in another subcompartment. During operation, the presence of a subcompartment can be examined by retracting a tendon and observing the movement of the corresponding finger. Retracting the EPB tendon extends the metacarpophalangeal joint of the thumb, and retracting the APL tendon abducts the first metacarpal. It is also important to note that the presence and length of the septum are not bilaterally symmetrical. Our findings suggest that exploration from 5 mm proximal to the radial styloid process is useful in identifying the septum and subcompartments. By doing so, it is possible to fully release the first extensor compartment and improve surgical efficacy while minimizing the incision.

There are some limitations in our study. First, the cadavers were fixed using formalin solution, which may cause differences in the measurement of the septum length between the cadavers and physiological conditions. Second, removal of the skin and subcutaneous tissues may also make the measurement results

smaller. Finally, the medical history of previous de Quervain disease of the cadavers was not clear.

5. Conclusion

Our study identified 3 types of the anatomical variations of the first extensor compartment. The type III variation is theoretically associated with the development of de Quervain disease. The mean septum length is 5 mm, which is a useful reference data for injection treatment and surgical exploration.

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