

ORIGINAL ARTICLE

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Morphometric anatomic study and clinical significance of the collateral ligaments of the thumb interphalangeal joint Merve Onder¹,  Cengiz Aldemir²¹*Department of Anatomy, Akdeniz University Medicine Faculty, Antalya, Turkey*²*Clinic of Orthopedics and Traumatology, Antalya Education and Research Hospital, Antalya, Turkey*

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Abstract

We aimed to emphasize the clinical significance of the collateral ligaments of the thumb interphalangeal joint through a morphometric anatomical study. Our study was performed on the thumbs obtained from 10 fresh cadavers in Akdeniz University Faculty of Medicine Anatomy Department Laboratory. The collateral ligaments in the thumb interphalangeal joint were examined and morphometric analysis was carried out using MicroScribe G2X. It was observed that the collateral ligaments are made up of proper (pCL) and accessory (aCL) components. pCL extends from the dorsal surface of the proximal phalanx head to the palmar surface of the proximal end of the distal phalanx, while aCL extends obliquely from dorsal to palmar and from proximal to distal and attaches to the palmar plate. The mean vertical and transverse diameters of the collateral ligament in the proximal interphalangeal joint were 12 ± 2 mm (10 mm min – 14 mm max) and 3 ± 1 mm (2 mm min – 4 mm max), respectively. Knowing the anatomy and morphometry of the collateral ligaments of the thumb interphalangeal joint will shed light on the surgical techniques that are to be applied in the reconstructions of injured ligaments.

Keywords: Thumb, collateral ligament, interphalangeal joint**Introduction**

Our hands are organs that we frequently use in our daily lives. Half of all hand movements are achieved through thumb movements [1-3]. A lesion that might develop on the thumb for any reason can restrict hand movements such as gripping and squeezing [4-6]. Thumb collateral ligament injuries may result in mild or even severe impact on thumb functions [7]. Injuries to collateral ligaments of the interphalangeal joints are commonly associated with work or physical activities [8].

The advances in the understanding of anatomy in the last 10 years, and the physiology and biomechanics of the ligament have resulted in novel clinical approaches regarding the IP (interphalangeal) joint [9].

The head of the proximal phalanges articulates with the phalanx head located distally and form the IP joint. This joint

is categorized in the ginglymus type of joints due to the shape of the joint surfaces that resemble a pulley. They only allow flexion and extension movements in the transverse axis [10]. The joint capsule wraps around the joint, and the synovial membrane covers the inner surface of the fibrous joint capsule and attaches to the sides of the joint surfaces. The collateral ligaments situated at both sides of the IP joint are sturdy and tight [11]. Cadaveric studies have demonstrated that the collateral ligaments are made up of proper (pCL) and accessory (aCL) components [9, 12, 13]. pCL extends from the dorsal part of the proximal phalanx head to the palmar surface of the proximal end of the distal phalanx. aCL extends obliquely from dorsal to palmar and from proximal to distal and attaches to the palmar plate [8,9].

The anatomy of pCL may vary. Generally, pCL is oriented obliquely and/or stripe-shaped and has a narrow anteroposterior size [12,13]. aCL, on the other hand, is generally presented as a triangular structure with stabilizing functions [13-16].

Our review of the literature revealed that there are no morphometric anatomical studies of the collateral ligament of the thumb IP joint. In our study, we aimed to emphasize the clinical importance of the collateral ligament in the thumb IP joint through morphometric measurements.

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Materials and Methods

In our study, we amputated the thumbs of 10 fresh cadavers (We did not use baby cadavers in our study. The cadavers used in the study are male and the mean age was 49) from the Akdeniz University Faculty of Medicine Anatomy Department Laboratory and examined the collateral ligaments of the interphalangeal joints.

Cadavers with undamaged interphalangeal joints were selected in our study, and infant cadavers were excluded from the study. Age range of cadavers used min. 28, max. 62. The skin and subcutaneous structures around the interphalangeal joint between the distal and proximal phalanges were removed. The ligaments and joints were exposed (Figure 1).

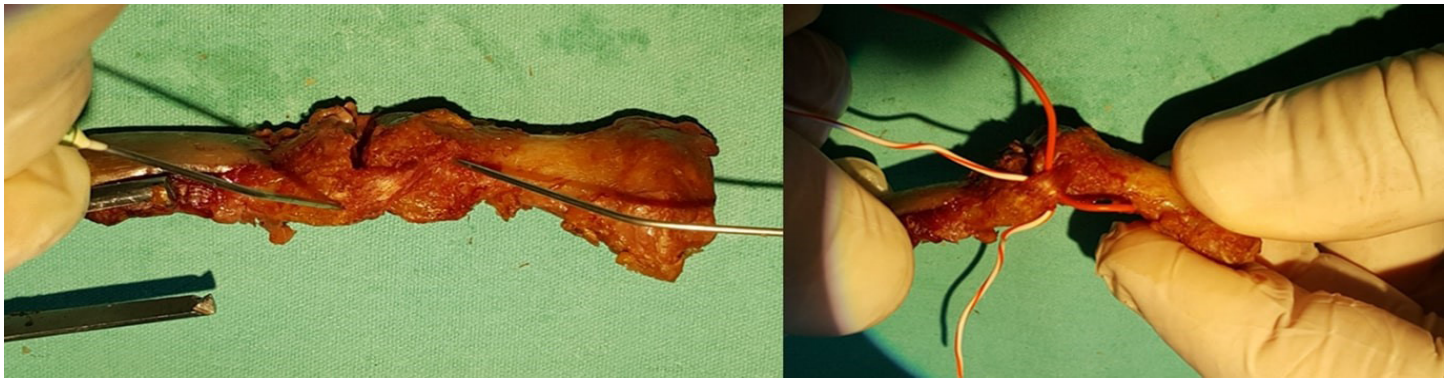


Figure 1. Collateral ligament in the exposed interphalangeal joint after the skin and subcutaneous structures are removed (A: thumb in extension, B: thumb in flexion)

The direction of the collateral ligaments of the thumb IP joint was observed. The extension of collateral ligaments was defined. Total vertical and transverse diameters of the collateral ligaments of the exposed interphalangeal joint were measured. Measurements were made using the MicroScribe G2X from the MicroScribe G series that is capable of precisely measuring vertical and transverse diameters with an accuracy of one-thousandth of a millimeter (Figure 2).

The volar edge is more oblique than the dorsal edge, giving it a fan shape and it extends from its origin to the insertion like a stripe.

aCL is adjacent to the transverse retinacular ligament and the volar plate. aCL has a triangular shape and extends obliquely from dorsal to palmar and from proximal to distal, attaching to the volar plate.

The mean vertical and transverse diameters of the collateral ligament in the proximal interphalangeal joint were determined as 12 ± 2 mm and 3 ± 1 mm, respectively (Table 1).



Figure 2. The MicroScribe-Gx device used in measurements

Results

The direction of pCL is parallel to the dorsal edge of the proximal phalanx. pCL extends from the dorsal part of the proximal phalanx head to the palmar surface of the proximal end of the distal phalanx.

Table 1. The mean vertical and transverse diameters of the collateral ligament in the proximal interphalangeal joint

Cadaver	Age	vertical diameters of the collateral ligament	transverse diameters of the collateral ligament
1	40	12 mm	3 mm
2	44	11 mm	4 mm
3	50	10 mm	2 mm
4	55	14 mm	3 mm
5	60	12 mm	3 mm
6	62	10 mm	4 mm
7	28	14 mm	2 mm
8	56	12 mm	3 mm
9	47	14 mm	2 mm
10	44	11 mm	4 mm

Discussion

In our review of the literature, we observed numerous studies on injuries of and treatment options for the collateral ligament of the thumb metacarpophalangeal joint. However, there were only a few studies concerning the thumb interphalangeal joint.

In his study, Rozmaryn emphasized that the collateral ligament of the thumb interphalangeal joint consists of two components: pCL and aCL [9]. In our study, we demonstrated that the collateral ligament consists of two components: proper (pCL) and accessory (aCL).

Allison and Rozmaryn indicates that the direction of pCL is parallel to the dorsal surface of the middle phalanx and that pCL extends from the dorsal surface of the proximal phalanx head to the palmar surface of the proximal end of the distal phalanx [9, 15]. The study emphasized that aCL is deep to the transverse retinacular ligament and adjacent to the volar plate [9, 15]. In our study, we observed that pCL extends from the dorsal surface of the proximal phalanx head to the palmar surface of the proximal end of the distal phalanx, while aCL extends from the dorsal to palmar and from proximal to distal, and attaches to the palmar plate.

Rozmaryn studied the anatomy, physiology, biomechanics, injuries, and treatment of the collateral ligaments of the fingers and showed that the radial and ulnar collateral ligaments of the thumb MCP (metacarpophalangeal) joint are 4 to 8-mm-wide and the 12 to 14-mm-long [9]. Measurements by Harris et al. were radial and ulnar collateral ligaments of the thumb MCP (metacarpophalangeal) joint are 4 to 8-mm-wide and the 12 to 14-mm-long [17]. Eldestein et al. measured in the the radial collateral ligaments of the thumb MCP 4 to 8 mm wide and 12 to 14 mm in length 6,9 with the average width of its metacarpal origin being 6.7 mm (range, 5–8 mm) and the average width of the proximal phalanx insertion being 5.8 mm (range, 4–7 mm) [18]. Gluck et al. indicated The ulnar collateral ligament is a thick band measuring 4 to 8 mm wide and 12 to 14 mm long and the radial collateral ligament, too, has been measured from 4 to 8 mm in width and 12 to 14 mm in length [19]. Dy et al. The center of the metacarpal attachment of the RCL was located 5.4 ± 1.1 mm from the dorsal border of the metacarpal, 8.0 ± 2.2 mm from the volar border of the metacarpal, and 10.3 ± 3.2 mm from the articular surface of the MP joint. The total width and height of the metacarpal origin site were 5.8 ± 1.6 and 6.4 ± 1.4 mm, respectively. The center of the proximal phalanx attachment of the RCL was located 6.8 ± 1.4 mm from the dorsal border of the proximal phalanx, 5.7 ± 0.9 mm from the volar border of the proximal phalanx, and 4.4 ± 0.8 mm from the articular surface of the MP joint. The total width and height of the phalangeal origin site were 5.0 ± 1.1 and 5.7 ± 0.9 mm, respectively [20]. In our study, The mean vertical and transverse diameters of the collateral ligament in the proximal interphalangeal joint were determined as 12 ± 2 mm and 3 ± 1 mm, respectively.

We did not find a study concerning the morphometry of the collateral ligament of the thumb interphalangeal joint. With this study, we demonstrated the morphological and morphometric properties of the collateral ligaments of the interphalangeal joint.

Conclusion

According to the morphometric anatomical study of collateral ligament of the thumb IP joint revealed that it is 12 ± 2 -mm-long and 3 ± 1 -mm-thick on average. In the reconstruction of thumb interphalangeal joint collateral ligament injuries, particularly in thumb interphalangeal joint instabilities, knowing the anatomical points and morphometric dimensions is the basis of a successful treatment. The surgeon should utilize these measurements and

anatomical points and determine the tendon graft and prepare the bone points accordingly.

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Conflict of interests

No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

Financial Disclosure

We have no financial disclosures for this article.

Ethical approval

Ethics committee approval was obtained from Antalya Education and Research Hospital by the Ethics Committee for the study, ethics number 2020-3/20.

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