



BILATERAL CONGLOMERATION OF VARIANT EXTENSOR MUSCLES IN FOREARM AND HAND

Anatomy

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ABSTRACT

Purpose: The reported incidence of injuries to extensor muscle in the hand is high. The attempt to identify any variation from the normal anatomy of extensor muscle is important for surgeons planning reconstructive surgeries in hand. **Result:** We report a rare case in which more than one variations existed over the dorsum of hand and forearm. Proximally in the forearm, extensor digitorum communis and extensor digiti minimi displayed bridging muscle fibers. Distally in the hand, these fibers showcased a unique insertion pattern. In the same hand, deeper plane hosted extensor digiti medii/ Extensor digitorum brevis manus muscle. **Conclusion:** Nevertheless, concomitant occurrence of similar variations have been rarely reported in recent anatomical literature thus current report will provide deeper insight about the possibility of intra-operative dilemma.

KEYWORDS

extensor digiti minimi variation, extensor digitorum, extensor muscle variation

INTRODUCTION

Variants of the extensor muscles of forearm especially extensor digitorum communis (EDC), extensor digiti minimi (EDM) and extensor indices are common. Previous studies have reported and quantified the prevalence of extensor muscles variation in terms of origin, trajectories and insertion.^[1,2] Existing literature also covers variations like absence of a muscle or presence of an accessory muscles on dorsum of forearm and hand.^[1,3,4] Extensor digitorum brevis manus muscle (EDBM) is a documented variant supernumerary muscle found over the dorsum of hand. The reported prevalence of this supernumerary muscle varies from 1.2-5.26% more common on right side.^[3,5] On the basis of its distal site of attachment, EDBM has been named as extensor indices brevis, extensor digiti III brevis, extensor medii brevis, extensor brevis digiti indicis medii, etc.^[4,6] Ogura et al. had classified EDBM into three groups based on the distal site of attachment- Type I, Type IIa, b, c and Type III.^[6] The present case report describes a case with Type III variety of EDBM.

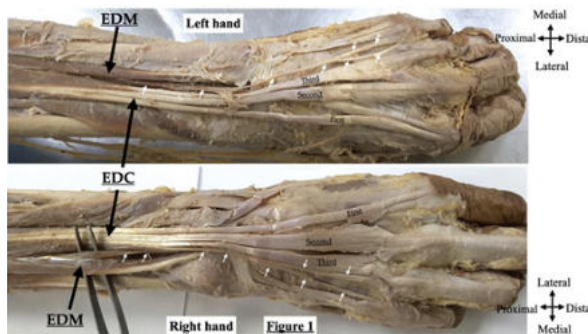
According to the standard literature, EDM and EDC attach proximally to lateral epicondyle and adjacent inter muscular septa. Both these muscles becomes tendinous in forearm which then passes deep to extensor retinaculum. Tendon of EDC divides into four tendinous slips before navigating through fourth dorsal compartment of extensor retinaculum to enter the dorsum of hand. On the dorsum of hand these tendons diverge to insert on dorsal digital expansion of medial four fingers. The tendon of EDM passes through fifth dorsal compartment of extensor retinaculum and commonly bifurcate before inserting on the dorsal digital expansion of fifth digit.^[7]

These extensor muscular variations are often asymptomatic hence remain undiagnosed until operated. Thus documentation of these variations will help surgeons and radiologist to know the prevalence and type of possible variations.^[8] The present case report is unique as it highlights the co-existence of multiple variations in hand which existed in different muscular planes. This conglomeration of multiple variations in the same hand has been rarely reported.

Case Report

While dissecting the upper extremity as a part of routine medical undergraduate teaching on a voluntarily donated and formalin preserved male cadaver, multiple variations in extensor muscles were recorded.

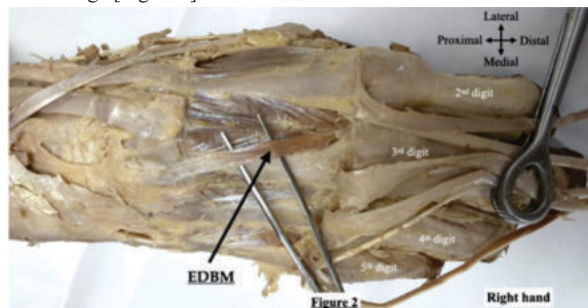
Bilaterally superficial variant strata in forearm was formed by EDC and EDM. The tendon of EDC divided into three tendinous slips which crossed the extensor retinaculum to attach distally on dorsal fibrous extension of second, third and fourth digit. Hence dorsal fibrous extension of fifth digit received no direct contribution from EDC [Figure 1].



Caption: Shows variant division of the tendon of EDC into three parts and partial fusion of EDC and EDM with characteristic distal attachment.

In lower one-third of forearm, partial fusion of EDC and EDM was observed. It was noted that, few muscle fibres of EDM separated from the main muscle and joined EDC. These bridging fibers became tendinous (EDMv) in forearm before passing deep to extensor retinaculum. EDMv navigated deep to extensor retinaculum by passing through fourth extensor compartment with EDC. On entering into the dorsum of hand EDMv bifurcated into medial and lateral slips. The lateral tendinous slip inserted on the dorsal digital expansion of the fourth digit. Whereas the medial tendinous slip coursed towards the fifth digit and inserted on its dorsal digital expansion. The distal attachment of the lateral slip of EDMv on the fourth digit signifies the variant functional anatomy of EDMv [Figure 1].

The third anatomical variation was recorded unilaterally in deeper plane where an accessory muscle was present on the dorsum of right hand. This variant muscle was placed deeper to the tendons of EDC. Proximally it had aponeurotic origin from the dorsal carpal ligaments which then coursed obliquely to insert on the dorsal digital expansion of third digit [Figure 2].



Caption: displays variant supernumerary muscle present deep to EDC.

This deeper variant muscle has been termed as Extensor digitorum brevis manus (EDBM).

These variations in the extensor muscles of forearm and hand may alter the biomechanics of hand. Awareness about these variations is pivotal for radiologist reading MRI scans and plastic surgeons planning hand reconstruction.

DISCUSSION

Variation in the morphology of EDC is common and have been previously reported.^[1,2,3] In this cadaveric report bilaterally multiple variations in extensor muscles of forearm and hand have been reported. EDC became tendinous which thereby divided into three tendinous slips which attached to the dorsal digital expansion of second, third and fourth digit. The fibers of EDC going towards fifth digit exhibited variant trajectory. In lower one-third of forearm EDC variably received few muscle fibres (EDCv) from EDM which represents partial fusion of EDC with EDM. After thorough review of literature authors could not find similar variation in EDC and EDM in existing literature. Although we found a relatable report which highlighted partial fusion of EDC with extensor pollicis longus.^[9]

On the dorsum of hand, tendon of EDCv bifurcated into medial and lateral slip which inserted on DDE of fourth and fifth finger. Mestdagh et al., and Godwin and Ellis^[10,11] had reported bifurcation of the fifth tendon of EDC which inserted on DDE of fourth and fifth digit. Carlos JS et al., reported variant insertion of EDM on base of proximal phalanx of middle i.e. third finger after traversing fifth extensor compartment deep to extensor retinaculum.^[12] Unlike previously documented, present report signifies unusual contribution of muscle fibers by EDM to EDC which followed the same trajectory as EDC and inserted as fourth tendinous slip of EDC along with additional extension to ring finger.

The existence of this variation can be justified by unfolding the embryonic origin of forearm muscles. During embryonic life precursor of extensor muscles differentiate into 3 layers- superficial, intermediate lateral and deep medial group. Superficial mass split to differentiate into EDC, ECU & EDM. Intermediate mass forms Brachioradialis and ECRL & ECRB. Deep mass forms APL, EPB, EPL, EI. Superficial and intermediate mass are phylogenetically more stable compared to the deep mass which is yet undergoing evolutionary changes. This report encloses variation in stable muscle precursor group which had undergone incomplete separation during prenatal development making the finding embryologically significant.^[13]

The report also highlights unilateral presence of a variant supernumerary muscle on dorsum of hand. Literature reveals encloses multiple patterns of EDMB on the basis of distal site of insertion.^[1,5,6,14] Ozturk K et al., reported multiple tendinous slips of EDM one of which inserted on fourth finger and hence regulated movement of fourth finger however remaining tendons were attached to fifth finger.^[2]

There are multiple schools of thought regarding existence of EDMB. Oliveira KM et al., has considered existence of EDBM as sign of phylogenetic regression and had compared this muscle with the intrinsic muscles in amphibian hand.^[5] Souter considered the aforesaid muscle atavistic in humans, formed due to failure of proximal migration of antebrachial muscle mass^[15]. Wood had described EDMB as derivative of dorsal interossei.^[16] Appearance of this variant muscle EDMB in hand may be of medical concern as this need to be differentiated from soft tissue mass on ultrasound and MRI and may be a probable cause of pain and swelling on the dorsum of hand.^[9]

The musculotendinous variations in hand are of academic interest. The available scientific literature does not enclose any report highlighting conglomeration of multiple variations in same hand making the present report rare. These variations may hold medical significance as they may predispose to tenosynovitis, neurovascular compression and mimic with soft tissue mass on ultrasound and MRI scans. Hence knowledge about the anatomical variation associated with the extensor tendons in hand is important for radiologist as well as surgeons as additional tendons may be used for tendon flap and tendon transfer surgeries.

Conflict Of Interest

The authors have no conflict of interest. No financial support has been received by the authors for the report.

REFERENCES

1. Suwannakhan, A., Tawonsawatruk T., Meemon K. (2016). Extensor tendons and variations of the medial four digits of hand: a cadaveric study. *Surg Radiol Anat.*, 38(9), 1083-1093
2. Ozturk, K., Kastamoni, Y., Dursun, A., Albay, S. (2020). Prevalence of the extensor digitorum, extensor digiti minimi and extensor indicis tendons and their variations. *Hand Surg Rehabil.*, 9(4), 320-327
3. El-Badawi, M.G.Y., Butt, M.M., Al-Zuhair, A.G.H., Fadel, R.A. (1995). Extensor tendons of the fingers: Arrangement and variations-II. *Clinical Anatomy*, 8, 391-398
4. Tanaka, T., Moran, S.L., Zhao, C., Zobitz, M.E., Kai-Nan, A., Amadio, P.C. (2007). Anatomic variation of the 5th extensor tendon compartment and extensor digiti minimi tendon. *Clinical Anatomy*, 20, 677-682
5. Oliveira, K., Grecco, L., Barbosa, L., Fatima, M.D., Conclaves, G.R., Brandao, G.T., Guilherme, M., Trancoso, B., Correa, R.C., Henrique, B., Correa, M., Alves, L.G. (2023). The rare extensor digitorum brevis manus: an anatomical study in Brazilian cadavers. *J Morphol Sci.*, 40, 19-24
6. Ogura, T., Inoue, M., Tanabe, G. (1987). Anatomic and clinical studies of the extensor digitorum brevis manus. *The Journal of Hand Surgery*, 12A(1), 100-107
7. Standring S. (2021). *Gray's Anatomy: The anatomical basis of clinical practice* (42nd edition). Elsevier limited.
8. Stein, A.H. (1951). Variations of the tendons of insertion of the abductor pollicis longus and the extensor pollicis brevis. *Anat Rec.*, 110, 49-55
9. Taradolisut, N., Suwannakhan, A., Berkban, T., Chaiyamon, A., Yurasakpong, L., Iwanaga, J., Tubbs, R.S., Kruepunga, N., Georgiev, G.P., Samrid, R. (2023). Accessory extensor pollicis longus from the extensor digitorum: a rare case report and review of the literature. *Surg Radiol Anat.*, 45, 911-916
10. Mestdagh, H., Bailleul, J.P., Vilette, B., Bouquet, F., Depreux, R. (1985). Organisation of the extensor complex of the digits. *Anat. Clin.*, 7, 49-53
11. Godwin, Y. and Ellis, H. (1992). Distribution of the extensor tendons on the dorsum of the hand. *Clin. Anat.*, 5, 394-403
12. Carlos, J.S., Goubran, E., Ayad, S. (2011). The presence of extensor digiti medii muscle-anatomical variant. *Journal of Chiropractic Medicine*, 10, 100-104
13. Straus, W.I. (1941). Phylogeny of human forearm extensors. *Ann Hum Biol.*, 13, 203-38
14. Georgiev, G.P., Tubbs, R.S., Iliev, A., Kotov, G., Landzhov, B. (2018). Extensor indicis proprius muscle and its variants together with the extensor digitorum brevis manus muscle: a common classification. Clinical significance in hand and reconstructive surgery. *Surg Radiol Anat.*, 40:271-80
15. Souter, W.A. (1966). The extensor digitorum brevis manus. *Br J Surg.*, 53, 821-823
16. Wood, J. (1864). On some varieties in human myology. *Proc R Soc Lond B Biol Sci.*, 13, 299-303