

# A Morphometric Evaluation of Extensor Digitorum Brevis Manus by Dissection : A Rare Atavistic Muscle of the Dorsum of Hand

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## Abstract

Variations of muscles and tendons of the forearm or hand are often discovered during educational cadaveric dissections and surgical procedures. Knowledge of such anomalies is essential for the surgeons in order to avoid possible damage to adjacent muscles, tendons, blood vessels and nerves. Our objective was to find out, review and discuss the rare anomalies. Extensor digitorum brevis manus muscle is a rare atavistic supernumerary member of the deep stratum of external extensors of hand. During routine dissection of dead bodies, a muscle was found on the dorsum of right hand. The muscle was unusual in position and extent, and was dissected out in detail. This muscle originated from lower end of radius and inserted on the edge of the extensor expansion of the middle finger. The origin, insertion, position and extent of this muscle was compared and discussed with other similar studies, along with its clinical and diagnostic significance. We concluded that this muscle belonged to Type III as per the anatomical classification. Extensor digitorum brevis manus may give rise to dorsal wrist pain on manual exertion due to muscle compression in the fourth extensor compartment which directly or indirectly compresses the posterior interosseous nerve. It is most commonly misdiagnosed as a ganglion, synovial cyst or nodule, exostosis or tenosynovitis. This muscle may be a source of tendon transfer and graft surgery, and thus it plays pivotal role in assessing traumatized or diseased hand for differential diagnosis and reconstructive procedures in this region.

**Key words** : Extensor digitorum brevis manus, atavistic muscle, extensor compartment of wrist

## Introduction

Hand is an exquisite organ in human population for performing various activities in everyday life. Hence a thorough knowledge of the muscles and tendons of hand and their common variants is very important, especially when surgery is planned in this region. These variations are often discovered during educational cadaveric dissections and surgical procedures.

The extensor digitorum brevis manus (EDBM) is one of the rare anatomic variations which occur on the dorsum of the hand. Only 293 articles were found worldwide in an extensive bibliographic review carried out by Nakano M et al [1]. Till date there are a total of 306 articles found and our article is number 307. This muscle was first described by Albinus BS in 1734 as “musculus extensor brevis digiti indicis vel medii”[2]. However Straus WL TR in 1941 and Cauldwell EW et al in 1943 have used the term “extensor digitroum brevis manus” coined by Macalister A [3,4,5]. Samuel Pozzi (1846-1918) was the first to document about this muscle

hence it is also known as Pozzi's muscle. EDBM is also known as “m. extensor anomalus” and “le muscle manieux” [6].

EDBM is a supernumerary deep muscle of the fourth extensor compartment of wrist [7]. According to Hollinshead, EDBM is an anomalous muscle of the dorsum of hand and it normally occurs on the dorsum of the foot which varies from a tiny muscular slip on the dorsum to a well formed muscle [8].

The incidence of EDBM is 2-3%, it occurs bilaterally in approximately 1/3 of cases and there is no difference in incidence between right and left hands or between the genders [1,9]. Thus presence of EDBM in man can be considered as an atavistic manifestation.

## Developmental and Phylogenetic Basis

In the human embryo, the precursor extensor muscle of the forearm differentiates into three parts. The radial portion differentiates into the brachioradialis, the extensor carpi radialis longus and the extensor carpi radialis brevis. Then it divides into a superficial and a

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deep portion. The superficial portion forms the extensor digitorum communis, extensor carpi ulnaris and extensor digiti minimi. At the same time, the deep portion generates the abductor pollicis longus and the extensor pollicis brevis on the radial side with the extensor pollicis longus and extensor indicis on the ulnar side [10].

The superficial and radial groups are more stable with the major divisions of the phylum of the animal species, while the deep portion appears to be highly unstable and undergoes evolutionary changes, as can be found in the great variation in its expression in different species of primates. According to Wood FJ, extensors of digits are arranged as a superficial and deep stratum. The deep stratum is however reduced from its full expression, in which separate tendon is provided for each digit, and this reduction is in process in many members of the primate series. In man, the deep layer of extensors (extensor digitorum profundus) is extremely reduced to four muscles, three of them being attached to the thumb (abductor pollicis longus, extensor pollicis brevis and extensor pollicis longus) and one to the index finger (extensor indicis). This reduction can be attributed to emancipation of hand for the purpose of progression [11].

#### Anatomic Classification

The EDBMs were classified into three types according to their insertion and relationship with the extensor indicis proprius (EIP). In type I, the EDBM tendon inserts onto the dorsal aponeurosis of the index finger, as would the EIP, although it is absent. In type II, both the EIP and EDBM insert on the index finger. This type was further classified into three subtypes. In type IIa, the tiny or vestigial EIP arises from the ulna but is confluent with the EDBM belly which inserts on the index finger. In type IIb, the distal end of the EDBM belly joins with the EIP tendon. In type IIC, the EIP inserts normally but the thin EDBM tendon also inserts more ulnarly than the EIP tendon, often with a membranous accessory slip, which inserts on the long finger. In type III, the EIP inserts on the index finger, but the EDBM inserts on the long finger with or without an accessory EIP to the long finger [12].

#### Materials and Methods

During routine undergraduate dissection an anomalous muscle was found on the dorsum of the right hand in a formalin embalmed 63 year old male cadaver deep to the long extensor tendons. The extensor retinaculum was exposed and the dorsum of the hand was diligently dissected. The muscle was clearly delineated and photographed. The level of origin and mode of insertion were defined and nerve filaments entering the deep surface of the muscle in its proximal

part were also seen. As this muscle was unusual in its position and extent, we reviewed the literature and tried to correlate it clinically.

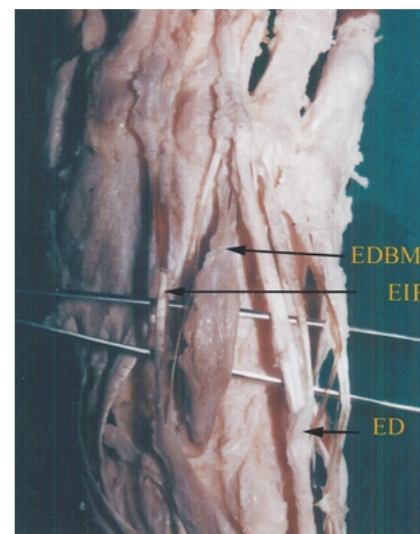
#### Observation

EDBM was present unilaterally on the dorsum of the right hand (Figure 1).



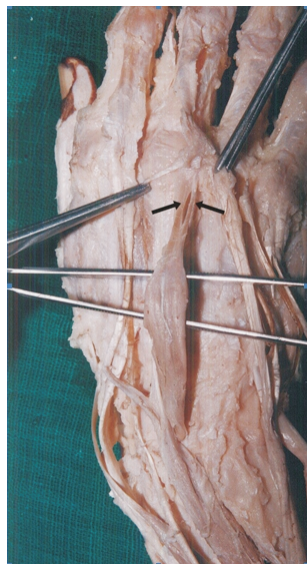
**Figure 1. Extensor digitorum brevis manus (EDBM) on the dorsum of the right hand.**

It was originating from the dorsal surface of lower end of radius and the adjoining part of the capsule of wrist joint. Its origin was medial to the tendons of extensor carpi radialis longus and extensor carpi radialis brevis. The muscle was also medial to the extensor indicis and was deep to the tendon of extensor digitorum (Figure 2).



**Figure 2. Extensor digitorum brevis manus (EDBM) lying medial to the extensor indicis proprius (EIP) and deep to the tendon of extensor digitorum (ED).**

The direction of muscle fibres was downward with slight medial inclination. Distally the muscle split into two tiny slips which inserted on the base of the extensor expansion of the middle finger (Figure 3).



**Figure 3. Extensor digitorum brevis manus muscle splitting into two tiny slips (marked by black arrows) and inserting on the base of the extensor expansion of the middle finger.**

Thus, this EDBM belonged to type III as per the anatomic classification. The muscle belly was 5.7 cms long and the mean width was found to be 1.4 cms.

Posterior interosseous branch of the radial nerve was supplying this muscle from its deep surface. The EDBM was absent on the left side and no other anomalies were detected during the dissection of the same cadaver.

### Discussion

EDBM is a supernumerary atavistic muscle present on the dorsum of the hand. It is potentially misdiagnosed as a lymph nodule on the carpal dorsum, ganglion, a synovial condition (tenosynovitis, synovial tumour and tendon sheath cyst), benign soft tissue tumour, carpal bossing or exostosis.

EDBM may originate from posterior aspect of lower end of radius and adjoining ligaments [13,14] or from the bones of ulnar half of carpus – lunate (semilunar), triquetrum (cuneiform), hamatum (unciform) and capitatum (magnum) and adjoining ligaments [15]. In the present case the muscle originated from the dorsal surface of lower end of radius and adjoining part of capsule of wrist joint.

The muscle may have one or more fascicule (belly), most frequently one, and commonest one to the

extensor tendon of index finger, and one for the middle finger is nearly as frequent [15]. Paraskevas G et al. and, Stith JS and Browne PA have reported cases of EDBM with two bellies with variable sizes [16,17]. The present study showed EDBM as a single fascicule going to the middle finger.

According to McMinn RMH, in the fourth compartment of extensor tunnel all the four tendons of extensor digitorum communis lie crowded together over the tendon of extensor indicis along with the posterior interosseous nerve and artery [18]. So presence of one additional muscle in this rigid fibro-osseous compartment can increase the possibilities of muscle compression and subsequent pain not only in the EDBM but also in other members of the same compartment. This is called the “fourth compartment” syndrome wherein the pain in the dorsal wrist is produced by the increase of pressure in the fourth compartment, which leads to a direct or indirect compression of the posterior interosseous nerve [19].

Pain in EDBM can be aggravated by patient pushing palm against a table with the wrist extended [1]. Symptomatic patients seek medical assistance, complaining of pain and edema on the dorsum of the hand during manual exertion. It is more intense in the dominant hand. Edema is poorly defined and more evident through the finger extension against resistance. Complementary tests can be useful for the proper diagnosis, such as electromyography, ultrasound and magnetic resonance imaging (MRI) [20]. MRI is a reliable non-invasive method to distinguish this pseudotumour from other conditions in the dorsum of hand [21,22]. MRI scans usually display EDBM as an intermediate- to low- density signal with extreme homogeneity on both T1- and T2- weighted images, an appearance similar to that of normal skeletal muscle [6]. Electrophysiological study is the invasive option for diagnosis [1].

Clinically EDBM may also present as a soft tissue mass in the dorsum of the hand. In this condition it is important to differentiate it from the swellings on dorsum of hand like dorsal wrist ganglion, synovial cyst or nodule, exostosis, synovitis, etc. [1,7,22]. On physical examination, EDBM becomes more prominent with active extension of the wrist whereas a ganglion becomes more prominent with wrist flexion. This may help in proper diagnosis [23].

Souter WA, Bunnell S in 1942 and 1956, and Boyes JH believe that EDBM is atavistic, representing parts of the old extensor brevis, a throwback to the intrinsic amphibian extensor due to failure of proximal migration of the ulnocarpal elements of the antebrachial muscle mass in humans [10,24,25,26].



The EDBM has been used as a source for tendon transfer and graft surgeries to restore malfunctioning muscles such as a damaged extensor pollicis longus or abductor pollicis longus [27]. Resection of EDBM should be avoided in cases where EDBM is compensating for the absence of the extensor indicis proprius [7].

EDBM giving rise to pain or limitation in grasping movement calls for surgical intervention. Minor surgery can relieve the symptoms but, if unsuccessful, the need for further operation is indicated. A partial section of the distal portion of the extensor retinaculum allows muscle contraction and decreases the cause of the pain during hand movement. This technique presents better results when there is muscle hypertrophy [28]. Muscle resection with partial section of the extensor retinaculum has proved to be the most efficient procedure to relieve symptoms, and has been used successfully when other techniques have failed [29].

### Conclusion

EDBM is a rare atavistic muscle of the dorsum of hand. Only 306 articles have been found in the available literature, the present case being number 307. This muscle belonged to type III as per the anatomic classification. Anatomical knowledge of variant muscles present in the extensor compartment of forearm and dorsum of hand is not only important for differential diagnosis but can also eliminate a surgical procedure. It plays a vital role in assessing the traumatized or diseased hand for differential diagnosis and in planning tendon transfer, graft surgeries and reconstructive procedures in this region.

### References

- Nakano M, Watanabe Y, Masutani M. A case of extensor digitorum brevis manus. *Dermatol Online J* 2003; 9(5):21-3.
- Albinus BS. *Academicarum annotationum*. Book 4. Leidae, J & H Verbeek; 1754. p. 28.
- Straus WL TR. The phylogeny of the human forearm extensors. *Hum Biol*. 1941; 13: 203-238.
- Cauldwell EW, Anson BJ, Wright RR. The extensor indicis proprius muscle: a study of 263 consecutive specimen. *Quart Bull Northwestern Univ Med School*. 1943; 17: 267-9.
- Macalister A. Note on muscular anomalies in human anatomy. *Proc R Irish Acad*. 1866; 9: 444-67.
- Bolla SR, Vollala VR, Bovindala B, Madabhshi C. Extensor digitorum brevis manus: Its clinical significance and morphology. *Int J Anat Var*. 2008; 1: 32-4.
- Patel MR, Desai SS, Bassini-Lipson L, Namba T, Sahoo J. Painful extensor digitorum brevis muscle. *J Hand Surg [Am]*. 1989; 14(4): 674-8.
- Hollishead WH. The wrist and hand. In: *Anatomy for surgeons*. 3<sup>rd</sup> Edn. Vol. III Harper and Row Publishers, Philadelphia; 1982.p. 537-8.
- Ranade AV, Rai R, Prabhu LV, Rajanigandha V, Prakash, Janardhan JP, Ramanathan L, Prameela MD. Incidence of extensor digitorum brevis manus muscle. *Hand [NY]*. 2008; 3(4): 320-3.
- Souter WA. The extensor digitorum brevis manu. *Br J Surg*. 1966; 53(9): 821-3.
- Wood FJ (ed.). The morphology of the extrinsic muscles. In: *The principles of anatomy as seen in the hand*. 2<sup>nd</sup> Edn. Bailliere, Tindall and Cox, London; 1946.p. 243-55.
- Ogura T, Inoue H, Tanabe G. Anatomic and clinical studies of the extensor digitorum brevis manus. *J Hand Surg [Am]*. 1987; 12(1): 100-7.
- Shehata R. Extensor indicis brevis muscle. *J Anat Soc India*. 1967; 16(2): 86-8.
- Bhandari GJ, Mainker AV, Monteiro VJ. Extensor digitorum brevis in hand. *J Anat Soc India*. 1976; 25(2): 105-6.
- Schaffer JP. Morris' Human Anatomy. In: *Musculature*. 11<sup>th</sup> Edn. McGraw-Hill Book Company. New York, Toronto, London; 1953.p. 479.
- Paraskevas G, Papaziogas B, Spanidou S, Papadopoulos A. Unusual variation of the extensor digitorum brevis manus: a case report. *Orthop Traumatol*. 2002; 12:3.
- Stith JS, Browne PA. Extensor digitorum brevis manus: a case report and a review. *Hand*. 1979; 11(2): 217-23.
- McMinn RMH. The posterior compartment of forearm. In: *Last's Anatomy* 8<sup>th</sup> Edn. The Educational Low Priced Book Scheme and Churchill Livingstone Edinburgh and London; 1992.p. 106.
- Hayashi H, Kojima T, Fukumoto K. The fourth compartment syndrome: its anatomical basis and clinical cases. *Handchir Mikrochir Plast Chir*. 1999; 31: 61-5.
- Gama C. Extensor digitorum brevis manus: A report on 38 cases and a review of the literature. *J Hand Surg*. 1983; 8(5): 578-82.
- Peh WCG, Ip WY, Wong LLS. Diagnosis of dorsal interosseous pseudotumours by magnetic resonance imaging. *Australas Radiol [Aust]*. 1999; 43(3): 394.

22. Rodrigues-Niedenfuhr M, Vazquez T, Golano P, Parkin I, Sanudo JR. Extensor digitorum brevis manus: anatomical, radiological and clinical relevance. A review. *Clin Anat.* 2002; 15(4): 286-92.
23. Fernandez Vazquez JM, Linscheid RL. Anomalous extensor muscles simulating dorsal wrist ganglion. *Clin Orthop Relat Res.* 1972; 83: 84-6.
24. Bunnell S. Surgery of the intrinsic muscles of the hand other than those producing opposition of the thumb. *J Bone Jt Surg.* 1942; 24: 1-31.
25. Bunnell S. Surgery of the hand. 3<sup>rd</sup> Edn. London: Pitman Medical; 1956.p. 4.
26. Boyes JH. Phylogeny and comparative anatomy. In: Bunnell's Surgery of the hand. 5<sup>th</sup> Edn. Philadelphia, JB Lippincott; 1970.p. 28-34.
27. Vossman H, Zellner PR. Opponens plastic surgery using the tendon of the m. extensor indicis. *Handchir.* 1981; 13: 52-5.
28. Jacobina C, Bastos P, Siqueira SL, Issa MJ, Baumfeld D, Orlandi C, Barroso T, Duarte P, Villela R, Nelson A, Toledo J, Teixeira MA, Finch F. Extensor digitorum brevis manus: a rare muscle on the dorsum of the hand. *Braz J Morphol Sci.* 2007; 24(4): 208-10.
29. Ross JA, Troy CA. The clinical significance of the extensor digitorum brevis manus. *J Bone Jt Surg [Br].* 1969; 51(3): 473-8.

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