



Documented variations of extensor digitorum attachments: the new normal

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Abstract

Findings associated with the presented case study combined with subsequent additional cadaver dissections confirmed that the extensor digiti minimi is significantly more common as the sole extensor of the 5th digit and the extensor digitorum has minimal or no direct contribution to the extensor mechanism of the 5th digit. These findings are contrary to what most textbooks have discussed and therefore contrary to what is commonly taught in most anatomy curriculums. These cadaveric observations represent a more common dorsal extrinsic muscle tendon arrangement which is of particular importance when corrective surgical procedures are indicated.

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Key words [extensor digitorum] [extensor digiti minimi] [extrinsic extensor hand muscles]

Introduction

Anatomical variations of the muscles of the hand have important clinical implications particularly as it relates to surgical intervention such as; muscle transfers, tendon repairs, and tendon graft surgeries [1, 2]. In a landmark study outlining variations of the extensor tendons of the fingers and their surgical significance conducted by Robert Schenck in 1964, he pointed out the significance primarily for surgeons to be aware of the high variability of dorsal hand extensor attachments. He further discussed the importance of using sufficient exposure techniques to assure successful operative outcome, particularly as it related to tendon transfers and repairs in this area [3].

Our initial observation spurred our interest to perform additional cadaver dissections and compare our findings with what was being commonly taught in the classroom. Based on our textbook review and dissection finding, variations of attachment of the extrinsic extensor tendons of the hand is more variable than one might expect and anatomical discussion of variability in the didactic setting appears to be limited.

The case report outlined discusses a common variant involving the extrinsic extensor muscles of the hand that

deserves further attention and investigation particularly because of its clinical relevance.

Case Report

Routine dissection of the dorsal surface of the left forearm and hand of a 68-year-old female cadaver revealed a variation of distal attachment involving the extensor digitorum (ED). Proximally, the primary origin of attachment was what would normally be expected (lateral epicondyle via common extensor tendon). Distally, running deep to the extensor retinaculum, its tendons incorporated their attachment into the extensor mechanisms of the 2nd, 3rd, and 4th digit. The expected tendon attachment to the 5th digit's extensor mechanism was absent and only the extensor digiti minimi (EDM) contributed to the extensor mechanism of the 5th digit (Figure 1).

Discussion

Classically, a summarization of what most textbooks describe as extrinsic extensor hand muscle attachments is as follows: The ED muscle originates proximally at the lateral epicondyle of the humerus through its incorporation to the common extensor tendon and distally splits into four

tendons; inserting at the level of the metacarpophalangeal (MCP) joints to join the extensor mechanism of the 2nd to 5th digit. Additionally, the EDM being a slender muscle located on the ulnar side of the ED, shares a common attachment proximally. It arises from the common extensor tendon by a thin tendinous slip, from the intramuscular septa between it and the adjacent muscles. Its tendon runs adjacent to ED, through a compartment of the extensor retinaculum running above the distal radio ulnar joint and then divides into two as it crosses the dorsum of the hand to insert distally at the extensor mechanism of the 5th digit [4-15]. This description is photographically represented by Figure 2.

A study conducted by Das et al. states that variations of ED and its attachments are not an uncommon occurrence. Most variations occur at the index or middle finger and involve a doubling or tripling of the tendinous insertions to a single digit [1]. Additionally, the article documents a variation of the ED with the tendon to the ring finger having four slips.

A study conducted by Zibler and Oberlin involved examination of 50 cadavers. In this study 71% of the right hands and 50% of the left hands exhibited no tendon from the ED to the 5th digit. They also noted that when there were no ED tendinous contributions to the 5th digit, the EDM was doubled 80% of the time [16].

Several studies have indicated the importance of having appropriate anatomical knowledge of variations when planning surgery and point out the need for the surgeon to be particularly cognizant of this when performing surgery involving the dorsum of the hand [1-3].

Twelve textbooks commonly used to teach anatomy in allied health programs were also reviewed by the authors which had publishing dates ranging from 1980 to 2013 [4-15]. Both descriptive text and images were reviewed to arrive at a consensus regarding the specific distal attachments of the ED and EDM. In most cases the text and images show the ED

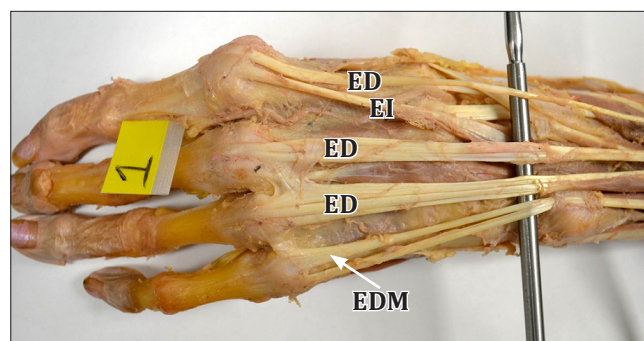


Figure 1. The above represents the more common dorsal ED distal attachments to digits 2-4 only. (**ED:** *extensor digitorum*; **EDM:** *extensor digiti minimi*; **EI:** *extensor indicis*)

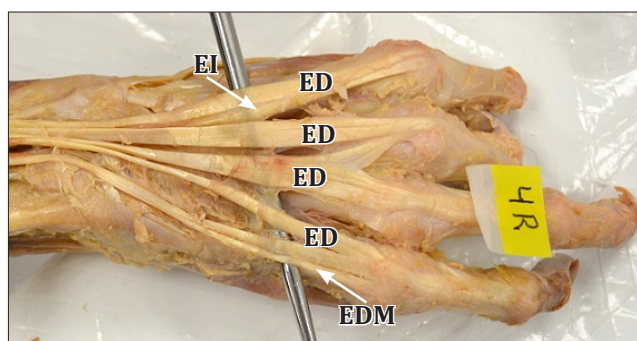


Figure 2. The above represents the classically taught dorsal ED anatomy. (**ED:** *extensor digitorum*; **EDM:** *extensor digiti minimi*; **EI:** *extensor indicis*)

with a tendinous contribution to the 5th digit. Over all, 83% of the textbooks reviewed described the classically taught description of the ED with respect to the distal attachments and did not refer to variation.

To further elucidate the frequency of this occurrence associated with our case and to investigate this variant further, 24 additional cadaver upper extremities were dissected bilaterally. In our study, 76 percent of the dissections showed that the EDM is the primary extensor muscle for the 5th digit (Figure 1). In most cases the ED does not have direct attachment to the extensor mechanism of the 5th digit and therefore does not contribute to its extensor function.

The literature and results of our dissections are contrary to what most textbooks have discussed and from what is taught in most anatomy curriculums. This supposition relates to the fact that 83% of the textbooks reviewed by the authors did not accurately describe the anatomical configuration and relationship of the distal attachments associated with the extrinsic extensor hand muscles. It is the opinion of the authors that the currently taught model describing the ED splitting distally into four tendons to contribute to the extensor mechanism of the 2nd through 5th digits is more of a rarer occurrence than common one. In the large majority of the cases, the ED contributes to the extensor mechanism of the 2nd through the 4th digits only, leaving the EDM as the sole extrinsic extensor of the 5th digit.

The presented case, subsequent 24 cadaver dissections, textbook and literature review verify the need for surgeons in particular to have a thorough knowledge of these common variations. Being aware of the most common anatomy and prevalence of the ED with regard to its distal attachments and functions can influence surgical decisions and avoid complications when assessing hand injuries. Realizing that there is a great degree of variation of ED attachment is important particularly to improve surgical outcomes [2, 3].

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