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Original Article

A study of the extensor tendons of the hand from point of view of evolution

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ABSTRACT

Introduction: Both anatomists and the surgeons need to have knowledge of anatomy of extensor muscles and their variations but the analysis of characteristics of each of these muscles can also improve our understanding of evolution of modern human beings.
Methods: 100 upper limbs preserved in 10% formalin were dissected to study the extensor muscles on the dorsum of forearm and hand.
Results: 28% incidence of variation was observed. Variant muscles such as extensor carpi radialis tertius (4%), extensor digitorum brevis manus (2%) and extensor medii proprius(4%) were observed. Duplication and triplication of extensor digitorum communis tendons to the 2 nd, 3 rd and 4 th digits was noted. A 28% incidence of absence of extensor digitorum communis tendon to the little finger was observed.
Discussion: Present study attempted to explain the presence of these extra muscles on the basis of their actions. Increased supination and pronation movements have been associated with more number of muscles/tendons in the extensor carpi radialis muscle and could explain the formation of extensor carpi radialis tertius muscle observed in the present study. The need to extend wrist and throw an object in a precise direction which was the need of the primate evolving to be the human being, could explain the extra extensors seen over the wrist and digits. A very well developed extensor mechanism is needed for precise functioning of the hand. The present study attempts to link together the functioning of individual extensor muscles to the trajectory of events involved in evolution of primates.

1. Introduction

It is known that the knowledge of anatomy of extensor muscles and their variations on the dorsum of the hand is necessary for the anatomists and the surgeons.[4] But the analysis of characteristics of each muscle can also improve our understanding of the evolution of modern human beings.[5]

Extensor muscles of the forearm and hand and their detailed anatomy is studied by medical students during cadaveric dissection. During this period they learn to identify the muscles of this region on the basis of their origin and tendons of insertion. At times the medical students may find themselves confused due to the existence of more tendons and muscles than are described in the standard textbooks of anatomy.

The present study was undertaken to study the extensor muscles of the forearm and hand and to note the variations therein. The study then attempts to explain the existence of these variations on the basis of their function and its place in evolution of human beings.

2. Materials and methods

110 upper limbs of adult cadavers, of unknown sex, preserved in 11% formalin were selected for present study which was carried out in the dissection hall of our Medical College. The limbs that were mutilated or otherwise damaged were excluded from the study. The limbs were tagged from 1 to 110.

Skin and superficial fascia from the back of forearm and hand were reflected. The extensor retinaculum was dissected and divided longitudinally to completely expose the extensor tendons lying in the underlying compartments. Each tendon was traced proximally to its muscle and distally to its insertion. Any additional bellies of muscle and additional tendons of insertion or splitting of

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the tendons was noted. Variations in tendons or presence of accessory muscles in this region were noted.

3. Results

Overall incidence of variation among the extensors was observed to be 28%.

The tendons of extensor carpi radialis longus and brevis(ECRL, ECRB) muscles lie in the 2 nd osseo-fascial compartment. The muscles were seen taking origin from the lateral supracondylar ridge and common extensor origin and were inserted into the dorsal surface of base of 2 nd and 2 nd and 3 rd metacarpal bones respectively. A 4% incidence of variation was observed in these muscles. In 4 hands, an extensor carpi radialis tertius(ECRT) was observed. In 3% of hands the additional belly of ECRT was found taking origin from posterolateral surface of radius lying deep to ECRB muscle, and was inserted via a thin long tendon into dorsal surface of 3 rd metacarpal bone. In 1% of the hands the additional muscle ECRT was found lying deep to ECRB muscle and its tendon was observed to split into two before getting inserted into the dorsal surface of the 3 rd metacarpal bone (Fig. 1).

The four tendons of extensor digitorum communis (EDC) and the extensor indicis proprius (EIP) muscle were placed in the 4 th osseofascial compartment deep to the extensor retinaculum. The EDC muscle arose from the common extensor origin, formed 4 tendons to the medial 4 digits in the middle of the forearm. The tendons passed deep to the extensor retinaculum passing on the dorsal surface of the corresponding metacarpal and proximal phalange to be inserted into the corresponding dorsal digital expansion and the dorsal surface of the middle and distal phalange. 28% of the EDC muscles showed variations. Details of the variations of both the above muscles are given in Table 1 (Figs. 2–5).

Placed deep to the four tendons of EDC in the same 4 th osseofascial compartment was the EIP muscle. The muscle took origin from the posterior surface of ulna and adjacent interosseous membrane. Its tendon joined the tendon of EDC to the index finger on its ulnar side and contributed to the formation of the corresponding dorsal digital expansion. In one hand the tendon of EIP was found to be duplicated. Both muscles arose from posterior surface of shaft of ulna and adjacent interrosseous membrane. The muscle attached proximally formed a tendon and was attached to the EDC tendon to index finger from the medial side, while the additional muscle formed a thin long tendon that joined the EDC tendon to index finger from the lateral side.

2% of the limbs showed presence of extensor digitorum brevis manus (EDBM) muscle. The muscle took origin from the lower end of radius and adjacent carpal bones and from capsule of wrist joint.

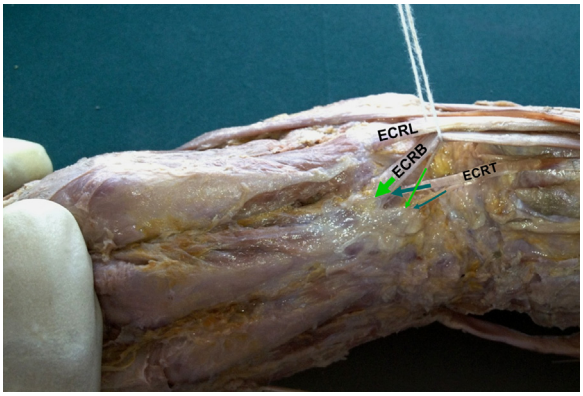

Fig. 1. The photograph shows ECRL, ECRB (tendon splitting into two) and ECRT (tendon splitting into two) lying deep to ECRB.

Table 1
Details of the variations observed in the Extensor Digitorum Communis and Extensor indicis proprius muscles along with the percentage of incidence of each variation in present study.

	Name of the Variation	Incidence of the variation
1	Absence of tendon to little finger	28% (Fig. 2A)
2	Absence of Extensor indicis proprius muscle	2%
3	Duplication of extensor indicis proprius muscle	1% (Fig. 2B)
4	3 tendons to middle and ring finger	2%
5	Duplication of tendon to	
	Index finger	1%
	Middle finger	1% (Fig. 3B)
	Ring finger	12% (Fig. 3A)
	Little finger	2% (Fig. 3A)
6	Triplication of tendon to ring finger	5% (Fig. 3B)
7	Triplication of tendon to middle finger	1%
8	Extensor medii proprius: Single	3% (Fig. 4A)
	Double	1% (Fig. 4B)

It formed a muscle belly lying deep to the EDC tendons, the tendon being attached to the extensor expansion over the 3 rd digit (Fig. 5A).

Placed medial to the above muscles, in the 5 th osseofascial compartment beneath the extensor retinaculum, was the extensor digiti minimi (EDiMi) muscle. It was also seen to arise from the common extensor tendon, passed deep to the extensor retinaculum, receiving the attachment of the EDC muscle to the 5 th digit, and finally getting attached to the dorsal digital expansion of the 5 th digit. 20% incidence of variation in the EDiMi muscles was observed.

16% of the muscles showed the tendon of insertion splitting into 2 and both getting attached to the little finger (Fig. 2A). In 3% of the muscles, three tendons were formed, two tendons being inserted into little finger and lateral one tendon into the ring finger by joining the EDC tendon to the ring finger (Fig. 5B).

The extensor carpi ulnaris was observed most medially. The muscle was observed taking origin from the common extensor tendon and posterior border of ulna, passing in the groove between the head and styloid process of ulna, through the 6 th compartment beneath the extensor retinaculum and attaching distally to the tubercle on the medial side of 5 th metacarpal bone. No variations were observed in this muscle.

All the muscles were supplied by the posterior interosseous nerve.

4. Discussion

The present study involved dissection of hundred upper limbs to study the extensor tendons on the dorsum of the hand.

The ECRL and ECRB muscles showed a 4% incidence of variation. In 4 hands, an ECRT was observed. Thus in these four hands the 2 nd compartment below the extensor retinaculum had 3 muscles in it instead of the usual two with the ECRT lying deep to the ECRB. Nayak et al. have also reported finding of the ECRT muscle which took origin from the common extensor origin and was attached distally to the bases of 2 nd and 3 rd metacarpal bones.[12] Bergman et al. have reported an *extensor carpi radialis intermedius* which took origin from the lateral epicondyle of humerus and was inserted similar to above muscle.[1] However the additional muscle reported in this study was found to lie between ECRL and ECRB muscles. Similar additional bellies have also been reported by Srimani et al. and Shetty and Nayak.[17,16] In both cases the muscle had its proximal attachment to the ECRL muscle and formed a separate tendon distally. In the present study all 4 additional muscles took origin separately from the proximal end of radius. None of the earlier studies report a split tendon of the additional muscle.