CASE REPORT

Multiple variations of the extensor tendons of the forearm

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Abstract

Anatomic variations of the extensor tendons of the forearm are frequent and its knowledge is important to assess the diseased and traumatized hand. During routine cadaveric dissection in the Department of Anatomy, Kasturba Medical College, Mangalore, India, we came across unusual variations in the left upper limb of a 51-years-old male cadaver. The variants are, the complete absence of the extensor pollicis brevis (EPB), the abductor pollicis longus (APL) having six slips of insertion with additional muscle slip from the brachio-radialis (BR). The extensor digitorum communis (EDC) had five tendon slips, the extra tendon splits close to the metacarpo-phalangeal (MP) joint and contribute to the tendons of the ring and little fingers. The number of accessory tendons of APL has functional significance in the development of de Quervain's stenosing tendovaginitis. The present case is unique in the sense that, all the three variations are present in the ipsilateral upper limb. The occurrence of these anomalies and its clinical and embryological significance are discussed.

Keywords: extensor pollicis brevis, abductor pollicis longus, extensor digitorum communis, anatomical variation.

Introduction

The extensor compartment of the forearm is one of the regions of the human body with frequent variations of its contents. Bergman RA *et al.* (2007) have stated that EPB muscle is individualized to a greater degree in humans. It is sometimes absent, being fused with APL, its tendon is often united with that of the long extensor and is inserted with it, or it may be continued as an independent slip to the base of the distal phalanx [1]. Brunelli GA *et al.* (1992) reported the absence of EPB in two out of fifty two hands he dissected [2]. Aydinlioglu A *et al.* (1998) reported that the APL and EPB attached together into the first metacarpal bone [3]. Variations of the distal attachment sites of the APL have been well documented by various authors. The most common variation of the distal attachment sites of the APL is the insertion into the abductor pollicis brevis muscle [4–13] and into the opponens pollicis muscle [5–8, 10, 12]. Additionally, its attachment into the scaphoid bone [14], into the flexor pollicis brevis muscle [12], into the carpometacarpal joint capsule [10], into the anterior oblique ligament of the carpometacarpal joint [10], and anomalous thenar muscles [15] have also been reported.

The supernumerary tendons of APL has been reported by various authors [4, 6, 7, 9, 12–14, 16–21].

Bergman RA *et al.* (2007) have stated that EDC include the occasional deficiency of one or more tendons of insertion or an increase in their number to five, supplying the five digits. If one of the tendons is absent, it is usually that to the fifth digit. More frequently, however, the tendons are limited to the index or middle finger alone, although an additional slip to the thumb is occasionally seen [22]. Wood J (1868), Macalister A (1875) and Mori M (1966) have also reported variants of EDC in their literature [23–25].

Material and methods

During routine dissection of the left upper limb of a 51-years-old male cadaver, we came across multiple variations in the extensor tendons of the forearm. APL had six tendon slips of insertion, EPB was absent, and EDC had five tendons.

Results

The APL originated from the posterior surfaces of both radius and ulna, and from the intervening interosseous membrane. It was innervated by a branch of posterior interosseous nerve. An additional muscle slip (length 3 cm, width 0.4 cm) from the tendon of BR joined the medial most tendon of the APL. The medial two tendons were inserted into the trapezium and the thenar muscles; the remaining four tendons were inserted into the palmar aspect of the base of the first metacarpal bone (Figure 1). The first compartment of extensor retinaculum had only the APL, as EPB was absent. The second compartment had three tendons, extensor carpi radialis longus (ECRL) and extensor carpi radialis brevis (ECRB), with extensor pollicis longus (EPL) thus reducing the number of compartments of the extensor retinaculum to five. There were five tendons of EDC; the extra tendon splitting in to two, close to the MP joint and contributing to the tendons to the ring and little fingers (Figure 2).

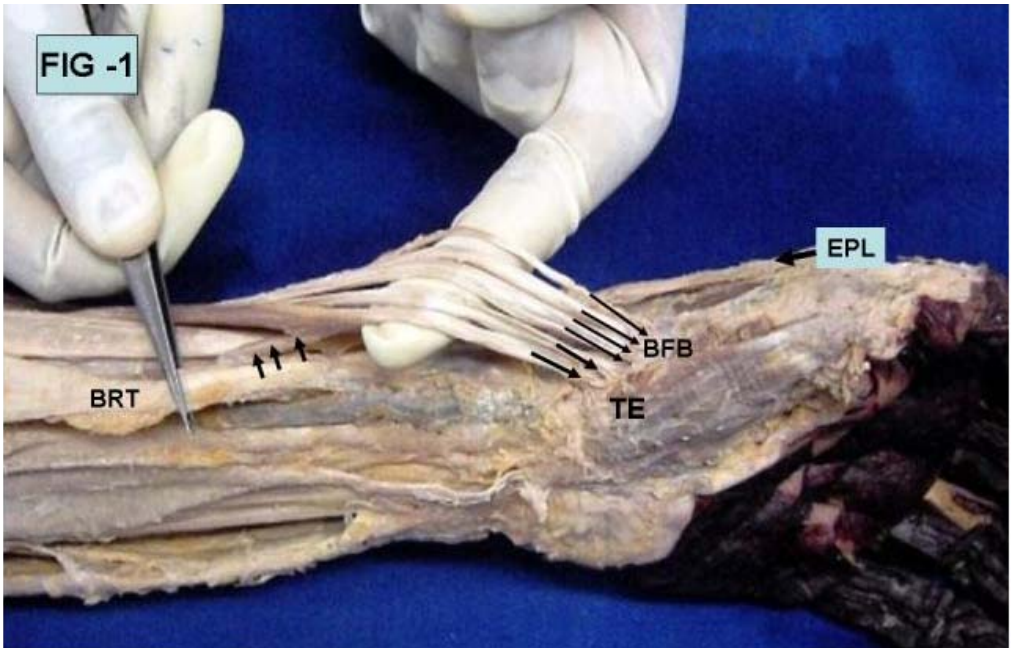

Figure 1 – ***Left antero-lateral view of forearm and hand showing accessory muscle bellies of the APL (EPL– extensor pollicis longus; BFB – base of the first metacarpal bone; TE – thenar eminence; BRT – brachio-radialis tendon; down ward facing six arrows indicates the tendon slip of abductor pollicis longus; upward facing arrows (3) indicates the additional muscle slip for the medial most tendon of the abductor pollicis longus)***

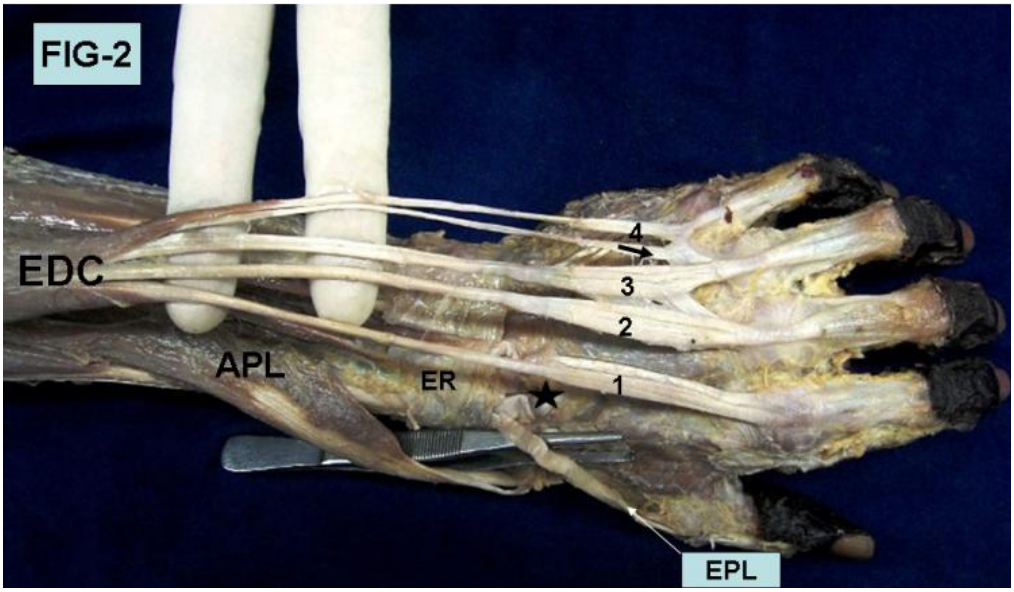

Figure 2 – ***Left extensor surface of forearm and hand showing tendons of EDC (APL – abductor pollicis longus; EDC – extensor digitorum communis; ER – extensor retinaculum; EPL – extensor pollicis longus; ★ indicates the insertion of extensor carpi radialis longus and extensor carpi radialis brevis tendons, sharing common compartment with EPL; 1–4 indicates the tendons of EDC; arrow indicates the anomalous extra tendon)***

Discussions

The APL, EPB, and EPC are important muscles of dexterity, knowledge about their variations are important in clinical assessment and reconstructive surgery. Anomalies of muscles and tendons in hand and wrist are significant during hand surgery. When found at random during operation, they are often neglected, but they are sometimes the cause of different syndromes in and around wrist. They may also necessitate a modification of planning tendon transfers or grafting [26].

Cihak R (1972) stated that in the early stages of embryogenesis (crown-rump length 15–17 mm), the APB lies independently in the mesenchyme and is not connected anywhere. When the crown-rump length rise to 20 mm the differentiating tendon of the APL divides into three strips {the middle always inserts into the

trapezium, the dorsal strip extends to the first metacarpal, and the palmar strip lies in a distal direction and attaches to the opponens pollicis (OP)}.

The connection between palmar strip and the OP persists until the embryo has a crown-rump length of 50 mm. Later, the OP is bounded by the developing fascia on its superficial and deep surface and thus looses the contact with the tendon of the APL. When the crown-rump length rises to 60 mm, a new connection establishes between the palmar strip and the abductor pollicis brevis (APB). The variations in the connection between the APL tendon and the neighboring structures can be explained as the persistence of an early embryonic developmental state [27].

Van Oudenaarde E (1991) reported the deep division of the APL tendon inserting to a variety of sites including the trapezium, APB, OP, carpometacarpal joint capsule, and the anterior oblique ligament of the carpometacarpal joint [10]. Additionally, the APL was found by Yuksel M *et al*. (1992) to split into two bellies and give off two tendons, one of which inserted to the APB, OP and flexor pollicis brevis muscles, whereas the other tendon inserted to the first metacarpal bone [12].

Baba MA (1954) studied one hundred and thirty four limbs; of these limbs, only two specimens (1.5%) showed a normal insertion of APL. He observed that the accessory tendons' insertions were into the trapezium (34%); into the APB (25%); and into both the trapezium and APB (39%) [28]. Stein AH (1951) found fifty-seven among eighty-four limbs (68%) with one or more accessory tendons. He reported that in the majority of the cases, accessory tendons inserted into the muscles or fascia of the thenar eminence (28.5%) or into the trapezium (28.5%) [29].

Gonzalez MH *et al.* (1995) studied sixty-six limbs and found a single slip of the APL inserting to both the OP and APB in twenty-four of sixty-six cases, and a single slip inserting to the OP in eight of sixty-six cases. They found additional slips in fifty-seven of sixty-six cases, of these fifty-seven, forty-five inserted into the APB. They also observed a single tendon in nine cases (13.6%), two slips in forty-six (69.7%), three slips in nine (13.6%), and four slips in two cases (3%) respectively [6].

Brandsma JW *et al*. (1996) studied eighty-four limbs and found that the APL tendon inserted into the trapezium in fifty-one limbs and into the OP in eight limbs [5]. Fabrizio PA and Clemente FR (1996) found accessory muscle belly of the APL in fifteen out of fifty specimens [30].

Lacey T *et al*. (1951) found that among thirty-eight limbs, the APL was single and inserted into the base of the first metacarpal bone in seven limbs. Of the remainder, one aberrant tendon was present in nineteen limbs, two in ten limbs, and three in two limbs. The aberrant tendons inserted primarily into the APB (63.1%), and the others inserted into the trapezium, palmar carpal ligament, and the OP [7].

Khoury Z *et al*. (1991) studied fifty-four limbs and found the insertion was by one slip in 24.1%, by two slips in 55.1%, by three slips in 18.5%, and by four slips in 1.9% of their cases. They reported that two slips commonly inserted into the base of the first metacarpal bone (in 55.1%, two slips inserted into the base of the first metacarpal bone; in 10.1%, one slip into the base of the first metacarpal bone, the other slip into the trapezium; in 34.4%, one slip into the base of the first metacarpal bone and the other to the trapezium). When three slips were present, two of them inserted into the base of the first metacarpal bone, the rest into the thenar muscle (in 70%, two slips inserted into the base of the first metacarpal bone, the rest into the thenar muscles; in 15%, two slips into the base of the first metacarpal bone, the rest into the trapezium; in 15%, one slip into the base of the first metacarpal bone, one slip into the trapezium, and one slip into the thenar muscles). When four slips were present, two of them inserted into the base of the first metacarpal bone, the others into the thenar muscles [19].

High number of anatomical variations in the first compartment of the wrist can cause tendovaginitis stenosans de Quervain [31]. Sufficient improvement in de Quervain disease is not always achieved even by tendosynovectomy, and the reason for this appears to be anatomical variation in the first extensor compartment of the hand [32].

Bunnell S (1948) regards the deviant mechanism of the aberrant tendon as causing the development of the pain in de Quervain chronic tendovaginitis, the accessory tendon also should be considered. He explains the occurrence of a supernumerary, aberrant tendon in the human as an example of atavism, since in most primates – e.g. chimpanzees, gorillas, and gibbons – this muscle normally exhibits two tendons, one inserting at the first metacarpal bone and the other at the trapezoid bone [33]. Variation of APL may cause de Quervain's tenosynovitis and with the absence of EPB and an additional tendon of EDC, it may cause hindrance to the independent finger extension. Present variations should be kept in mind while dealing with the wrist and hand extensors.

Conclusions

The presence of accessory tendons of APL in the present case may cause de Quervain's tenosynovitis, further the clinicians and surgeons should be aware of such anatomical variations while operating for tendon transfer in the vicinity of the wrist and dorsal surface of the hand.

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