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RESEARCH ARTICLE

ACCESSORY HEAD OF FLEXOR POLLICIS LONGUS MUSCLE AND ITS CLINICAL SIGNIFICANCE

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ABSTRACT

Flexor pollicis longus muscle may have accessory slips which arise from coronoid process of ulna or medial epicondyle of humerus; known as accessory head of flexor pollicis longus or Gantzer's muscle. It runs downwards and obliquely to join the tendon of flexor pollicis longus. It may compress median, ulnar and anterior interosseous nerves and produce many neurological conditions. Aim of this study was to note incidence and morphology of accessory head of flexor pollicis longus. We used 57 adult Indian cadavers (52 males and 5 females) and each forearm was dissected carefully to see the existence of accessory heads of the flexor pollicis longus and its morphology, its relations with nearby structures. Weobserved it in 76.31 % specimens. It was present bilaterally in 53.84% male cadavers. We noted that, the median nerve ran over the accessory head of flexor pollicis longus while the anterior interosseous nerve ran posteriorly. Compression of these nerves from this muscle could occur and give rise to anterior interosseous syndrome. Therefore, the precise knowledge about this muscle should be kept in mind by clinician and surgeons.

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INTRODUCTION

The Flexor pollicis longus (FPL) belongs to the deep group of flexor compartment of the forearm which originates from the anterior surface of the shaft of the radius (between the anterior oblique line and upper margin of pronator quadratus muscle) and the adjacent interosseous membrane. Its tendon becomes rounded above the wrist; passes below the flexor retinaculum and inserted on the palmar surface of the base of the distal phalanx of the thumb. It is the prime mover of thumb (Standring *et al*., 2008). During evolution, the upper extremity of man has undergone various modifications especially development of manual palpation and prehension. FPL is a recent acquisition in the evolution. FPL is well developed in man but it is absent in primates such as gorilla and chimpanzee in whom a well-developed flexor hallucis longus perform the same function as that of flexor pollicis longus performs in man (Mangini, 1960). It is concerned with precise grasping and functioned initially to stabilize the terminal thumb phalanx against loads applied to the thumb's apical pad during forceful movements (Hamrick *et al*., 1998). It has been noted by many researchers that FPL may have accessory slips which arise from lateral or medial borders of coronoid process of ulna and medial epicondyle of humerus. This accessory slip of FPL called as accessory head of flexor pollicis longus (AHFPL) or Gantzer'smuscle (Wood, 1868; Hemmady *et al*., 1993). AHFPL runs downwards and obliquely parallel to the oblique cord (Phylogenetically degenerated fibers of upper part of the FPL) and join the tendon of FPL. It may compress median, ulnar and anterior interosseous nerves and produce many neurological conditions such as anterior interosseous nerve syndrome (Al Qattan, 1996; Tabib *et al*., 2001; Potu *et al*., 2007). Incidence of the AHFPL is variable which ranges from 39-90%, average being 66.66% (Narayana *et al*., 2004). It may have bilateral and unilateral presentation but more incidences for it to occur bilaterally than unilaterally (Narayana*et al*., 2004; Potu *et al*., 2007; Hemmady *et al*. 1993). The AHFPL was inserted to the ulnar border of the FPL (Al-Qattan, 1996; Shirali *et al*., 1998).

The nerve supply was from and a branch of the anterior interosseous nerve (AIN). The relationship between the AIN, median nerve and the AHFPL was variously reported (Hemaddy *et al*., 1993; Al-Qattan, 1996; Shirali *et al*. 1998).Various anatomical structures may compress the median nerve and anterior interosseous nerve and one of the common structures is the AHFPL muscle (Bilecenoglu and Karalezli, 2005; Kim *et al*., 2007). Therefore precise knowledge of the

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morphology and relations of the AHFPL is essential from the clinical point of view and it should be kept in mind while performing nerve compressions in the forearm.

MATERIALS AND METHODS

For this study 114 upper extremities of 57 adult Indian cadavers (52 males and 5 females) were examined which were free from any scar, fracture or anomalies. All these specimens were pairs. All were collected from the dissecting room of the Department of Anatomy of PDVVPF'S Medical College, Ahmednagar, Maharashtra, India. Specimens were partly dissected by medical students and further dissected with reflection or removal of the superficial flexor muscles of the anterior compartment of the forearms. Each forearm was examined carefully for the existence of accessory heads of the FPL. We traced the origin, insertion, shape, blood supply and nerve supply of this accessory muscle and its relations to the median nerve, anterior interosseous nerve and other structures. The distribution of this muscle in the right and left upper limbs and the varieties of presentation were tabulated and photographs were taken with digital camera.

RESULTS

We observed AHFPL in 87 (76.31 %) upper limbs out of 114 (Fig. 1, 2). Only in one right upper limb of female cadaver we observed AHFPL. Details of distribution of AHFPL muscle is shown in Table 1.

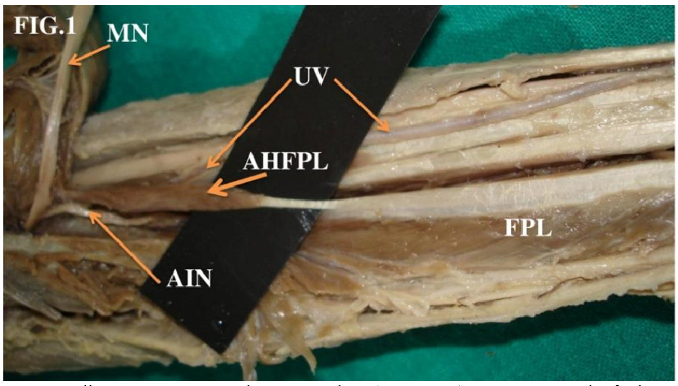
Table 1. Distribution of AHFPL muscle in right and left upper limbs in male and female

	Male (n= 104)	Female (n=10)
Right	50 (87.71%)	01(10%)
Left	36 (63. 15%)	-
Total	86 (82.69%)	01 (10%)

Table 2. Shape, origin, insertion, nerve supply and blood supply of AHFPL (Accessory Head of Flexor Pollicis Longus) muscle in male upper limbs

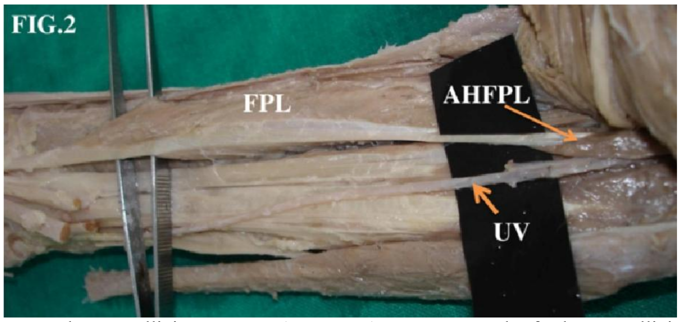
AHFPL	Male (n=86)		
	Right n= 50	Left n=36	Total n= 86
ORIGIN			
Medial border of coronoid process of ulna	03	02	05(5.81%)
Lateral border of coronoid process of ulna	24	21	45(52.32%)
Medial epicondyle	14	05	19(22.09%)
Medial epicondyle and coronoid process of ulna	07	07	14(16.27%)
Flexor digitorumsuperficialis	02	01	03 (3.48%)
INSERTION			
Upper third of flexor pollicislongus tendon	34	25	59(68.60%)
Middle third of flexor pollicislongus tendon	15	10	25(29.06%)
Lower third of flexor pollicislongus tendon	01	01	02(2.32%)
SHAPE			
Fusiform	32	24	56(65.11%)
Papillary	02	05	07 (8.13%)
Slender	14	06	20(23.25%)
Triangular	02	01	03(3.48%)
NERVE SUPPLY			
Anterior interosseous nerve	37	24	61(70.93%)
Median nerve	11	10	21(24.41%)
Both	02	02	04(4.65%)
BLOOD SUPPLY			
Ulnar artery	41	29	70 (81.39%)
Anterior recurrent ulnar artery	06	05	11(12.79%)
Anterior interosseous artery	03	02	05(5.80%)
Median artery	-	-	

It was present bilaterally in 28 (53.84%) male cadavers. Details of site of origin, insertion, shape, nerve supply and blood supply of AHFPL in male cadavers is tabulated in Table 2.It originated mainly from the lateral border of the coronoid process of ulna and it was inserted into the upper third of the FPL tendon (Fig. 1, 2). The study revealed that the median nerve ran over the AHFPL (Fig. 3; 4), while the anterior interosseous nerve ran posteriorly (Fig.3). Hence the AHFPL was sandwiched between the median and the anterior interosseous nerves (Fig. 3).



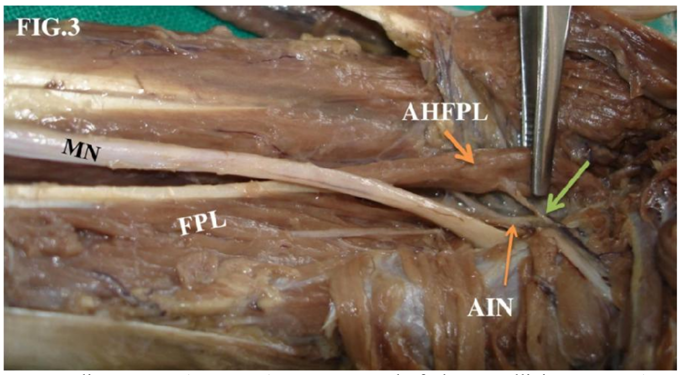
MN- Median Nerve, UV- Ulnar Vessels, AHFPL- Accessory Head of Flexor Pollicis Longus, AIN- Anterior Interosseous Nerve, FPL- Flexor Pollicis Longus.

Fig. 1. AHFPL muscle which was inserted in upper 1/3rd part of FPL



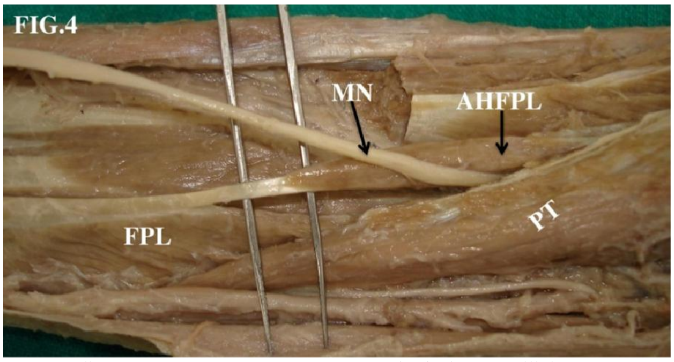
FPL- Flexor Pollicis Longus, AHFPL- Accessory Head of Flexor Pollicis Longus, UV- Ulnar Vessels

Fig. 2 Showing AHFPL muscle crossing the ulnar vessels



MN- Median Nerve, AHFPL- Accessory Head of Flexor Pollicis Longus, AIN- Anterior Interosseous Nerve, FPL- Flexor Pollicis Longus, Green arrow shows nerve to AHFPL

Fig. 3 Showing relation of AHFPL muscle with MN (passes anterior to AHFPL) and AIN (passes posterior to AHFPL)



MN- Median Nerve,AHFPL- Accessory Head of Flexor Pollicis Longus, PT-Pronator teres, FPL- Flexor Pollicis Longus

Fig. 4 Showing MN between AHFPL muscle and Pronator teres (PT) muscle

However, in 3 upper limbs the anterior interosseous nerve passed deeply slightly away from the AHFPL and it was innervated by anterior interosseous nerve in the majority of cases.

DISCUSSION

Flexor pollicis longus is uniquely human. In other primates there is only one common deep flexor that provides a tendon to the thumb (Bergman *et al*., 2006). Accessory bellies attached to either flexor pollicis longus or flexor digitorumsuperficialis are described by Gantzer in 1813 (Potu *et al*., 2007). Muscular variations in the flexor compartment of the forearm are important because they form etiological factors of many neurological conditions; such as anterior interosseous nerve syndrome which is a pure motor palsy and it presents with weakness or paralysis of flexor pollicis longus, flexor digitorumprofundus of index finger as “spinner’s sign”, making ‘O’, is disturbed due to inability to flex inter-phalangeal joint of the thumb and distal inter-phalangeal joint of the index finger. It is also known as square pinch deformity as there is a classical attitude of weak pinch due to weakness of thumb and index finger muscles (Vasavi *et al*., 2009).

AHFPL muscle is responsible for incomplete type of presentation of anterior interosseous nerve syndrome where there is only isolated paralysis of the flexor pollicis longus (Degreef, and De Smet, 2004). Number of researchers described AHFPL muscle as being of varying incidence and morphology. Present study showed a prevalence of it in 76.31% which is on higher side when we compared our results with other researchers (Jones *et al*., 1997; Oh *et al*., 2001; Mahakkanukrauh *et al*., 2004; Gunnal *et al*., 2013). However, (Chakravarthi, 2013) observed its incidence in 72% specimens. The FPL muscle is made up of unipennate muscle fibres while AHFPL is made up of fusiform muscle fibres.

The function of these muscle fibres is in direct opposition to each other and which may lead to loss of precise and skillful movements (Levangie and Norkin, 2006). The flexor muscles of the forearm develop from the flexor mass, which divides into two superficial and deep layers. The FPL and flexordigitorumsuperficialis muscles originate from the deep layer. The incomplete differentiation of the deep layer of the flexor mass during development gives rise to AHFPL (Hollinshead, 1964; Jones *et al*., 1997). Bilateral occurrence of AHFPL muscle is more common than unilateral occurrence (Hemmady *et al*., 1993; Al-Qattan, 1996; Shirali *et al*., 1998; Oh *et al*., 2001) and our study reported the same. Regarding the right and left distribution of AHFPL muscle, was found more frequently on the right side in present study and other researchers reported the same (Jones *et al*., 1997; Domiaty *et al*., 2008). (Domiaty *et al*., 2008) had given the explanation that; it is probably because in the general population the right hand is dominant. Present study demonstrated that the AHFPL had variable four shapes (Table 2) and almost same findings are reported by various authors (Gunnal *et al*., 2013).

The AHFPL muscle was sandwiched between the median and the anterior interosseous nerves in 91% specimens and (Domiaty *et al*., 2008) also observed the same in their study. (Shirali et al., 1998) noted that the accessory head passed anterior to the anterior interosseous nerve in 100% specimens and posterior to the median nerve in 95% of specimens. Compression of the AIN from this muscle could occur and give rise to anterior interosseous syndrome and it should be kept in mind by clinician and surgeons. The nerve supply of the AHFPL came from the anterior interosseous nerve and less frequently from the median nerve and both. This was in agreement with many authors (Al-Qattan, 1996; Hemmady *et al*., 1993) but (Jones *et al*., 1997) reported that AHFPL received dual innervations from both nerves in 88% specimens. In this study we observed that, emerging of median nerve between AHFPL and deep surface of FDS muscle (Fig. 2) in 21 specimens. This abnormal course of the median nerve may lead to compression of it. Usually the ulnar artery is separated from median nerve by ulnar head of pronator teres muscle, whereas in our study we observed that AHFPL muscle separated the median nerve from the ulnar artery (Fig. 2) and (Chakravarthi, 2013) reported the same and this may leads to vascular neuropathies.

The AHFPL muscle may cause entrapment neuropathy or pressure neuritis of anterior interosseous nerve. Cicatricle contraction of this muscle as seen in Volkmann’s ischemic contracture or following surgical or non-surgical trauma around the proximal forearm and elbow may lead to entrapment of the median and anterior interosseous nerve because they are closely related to this muscle. In these cases AHFPL muscle may have to be lengthened along with FPL muscle (Hemmady*et al*., 1993).Therefore precise knowledge of AHFPL muscle is necessary while doing the diagnosis and surgery of various compartment syndromes of the forearm.

Conclusion

This study confirmed the higher incidence of the AHFPL muscle and its relation to the median nerve, anterior interosseous nerve and ulnar artery which will help the clinician, surgeon and radiologist to determine the exact cause of entrapment and diagnosis. The advancement of new imaging techniques such as computer tomography and magnetic resonance imaging, are helpful to detect the anatomical variations and abnormalities of the muscles of the forearm (Degreef, and De Smet, 2004). Hence these techniques should be used before surgery for better outcome and to prevent iatrogenic trauma during surgery.

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