

A Unique Variation of Flexor Digitorum Superficialis Muscle and Its Clinical Significance

Takkallapalli Anita¹, Sanjay Kalbande², Krishnamurthy Asha, Dattatray Dombé and Neelee Jayasree

¹Department of Anatomy, ²Department of Medicine, Chalmeda Anandrao Institute of Medical Sciences, Bommakal, Karimnagar, Andhra Pradesh, India

*E-mail: sanjaykalbande@hotmail.com

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ABSTRACT A wide array of supernumerary and accessory musculature of forearm has been described in the anatomical, surgical and radiological literature. In majority of the cases, these accessory muscles are asymptomatic but in some cases, these accessory muscles produce clinical symptoms. They may be present as a palpable soft swelling or as a fibro-osseous mass near carpal tunnel with symptoms of neurovascular compression. In symptomatic cases, recognition and careful evaluation of accessory muscle with electromyographic examination may aid in diagnosis and in finalizing the treatment. We report a rare case of accessory muscle bellies arising from Flexor Digitorum Superficialis (FDS) muscle on right and left sides. During routine dissections of the forearm performed by preclinical students in the department of anatomy, we observed an accessory muscle belly arising from the tendon of index finger of flexor digitorum superficialis muscle on the right and left sides of a cadaver. The accessory muscle belly has taken its origin at the junction of upper two third and lower one third of forearm and traversed in the carpal tunnel and merged with the tendon of FDS to the index finger in the hand at the level of origin of first lumbrical. Although many anatomical variations of FDS muscle were reported in the past, we describe a rare case, first of its kind, which to our knowledge has not been mentioned in the literature till date.

INTRODUCTION

The flexor digitorum superficialis muscle has been grouped as a retrogressive muscle as it represents remnants of connections between two sheets of muscles. On the other hand, the occasional separation [up to their origins] of individual muscle bellies has been considered as a progressive variation in phylogeny (Bergman et al. 2006).

Normally FDS muscle forms the intermediate layer of the forearm musculature and arises by two heads, the humero ulnar head and the radial head. Both heads converge and unite to form a muscle belly. In the lower part of forearm it divides into 4 tendons for medial 4 fingers. These tendons are arranged in two rows to pass beneath flexor retinaculum in the carpal tunnel. In the hand these tendons diverge towards the medial four digits. Close to the digits, each superficial tendon splits to allow the tendon of FDP to pass and then reunites finally

to insert on the base of middle phalanx of associated finger.

Digits of hand perform many fine movements which are essential for our daily life. Therefore a proper anatomical and surgical knowledge of muscular variations is essential to avoid errors in diagnosis and treatment. Variations of forearm flexors have been reported by Anatomists as early as 1813. Gantzer described two accessory muscles in the human forearm which are named Gantzer's muscle. This muscle arises as small belly from forearm flexors and is inserted either into FPL or FDP. The presence of Gantzer's muscle has been noted to be around 50-66%, by (Alquattan 1988; Oh et al. 2000)

We report a rare case of accessory bellies arising from FDS tendon for index finger and inserting into the same tendon in the hand on both sides. The present findings will add to our knowledge of FDS muscle variation and also as a probable cause for carpal tunnel syndrome.

CASE REPORT

During routine dissection of superior extremities of cadavers in the department of Anatomy at Chalmeda Anandrao Institute of Medical Sciences, an approximately 50 year old male cadaver had shown the presence of accessory

Address for correspondence:

Dr. T. Anitha

Associate Professor, Department of Anatomy,
Chalmeda Anandrao Institute of Medical Sciences,
Bommakal, Karimnagar, Andhra Pradesh, India

Phone: +91 98 490 36363, +91 0878 2222102

Fax: +91 0878 2285318

E-mail: tanita_205@yahoo.com

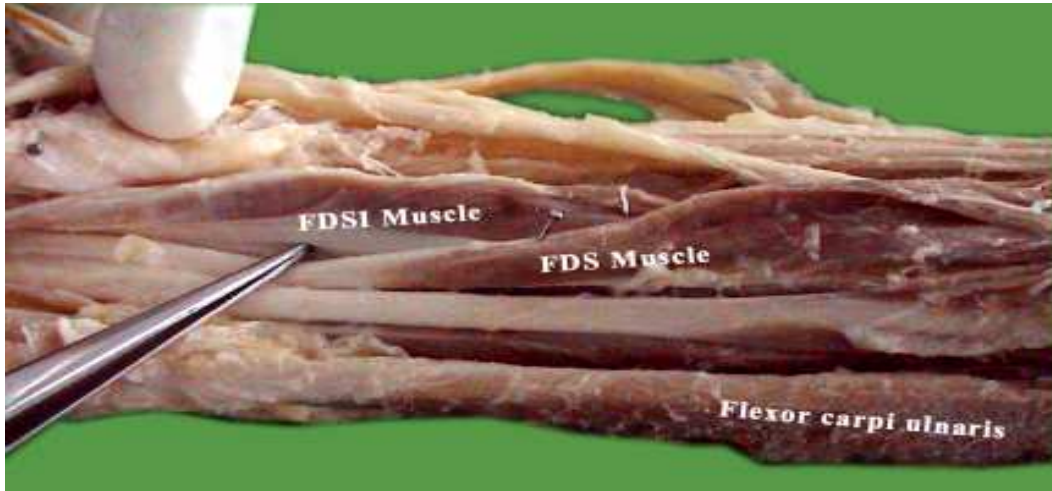


Fig. 1. Right sided - flexor digitorum superficialis indicis (Origin and course on carpal tunnel)

muscle belly arising from the tendon for index finger of FDS muscle on both sides.

On the right side, a unipennate muscle belly was observed arising from the radial side of tendon of index finger of FDS at the junction of upper two third and lower one third of forearm (Fig. 1). At its origin, the muscle belly was deeply situated in its course and then appeared superficially close to the wrist. The muscle belly traversed beneath the flexor retinaculum along with other structures but superficial to the median nerve. In the hand the muscle merged on the ulnar side of the tendon for index finger of

FDS at the level of origin of first lumbrical. The muscle belly was supplied by a branch from the trunk of median nerve close to its origin in the forearm (Fig. 2).

On the left side a unipennate bulky muscle was observed arising from ulnar side of the tendon of FDS to the index finger at the junction of upper two third and lower one third of forearm. The muscle belly coursed beneath the flexor retinaculum but superficial to the median nerve in the carpal tunnel. In the hand the muscle belly merged on the radial side of tendon of index finger of FDS close to the metac-

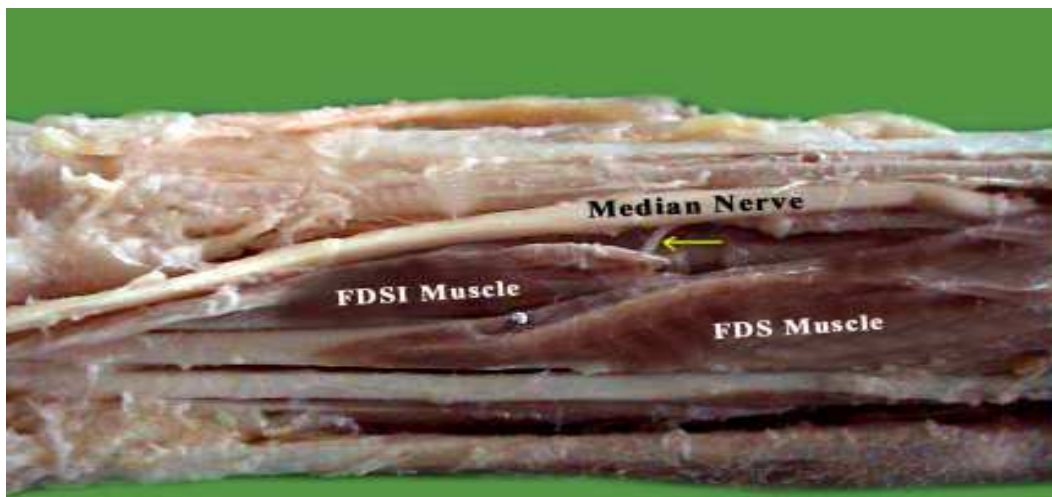


Fig. 2. Right sided - flexor digitorum superficialis indicis - Nerve supply

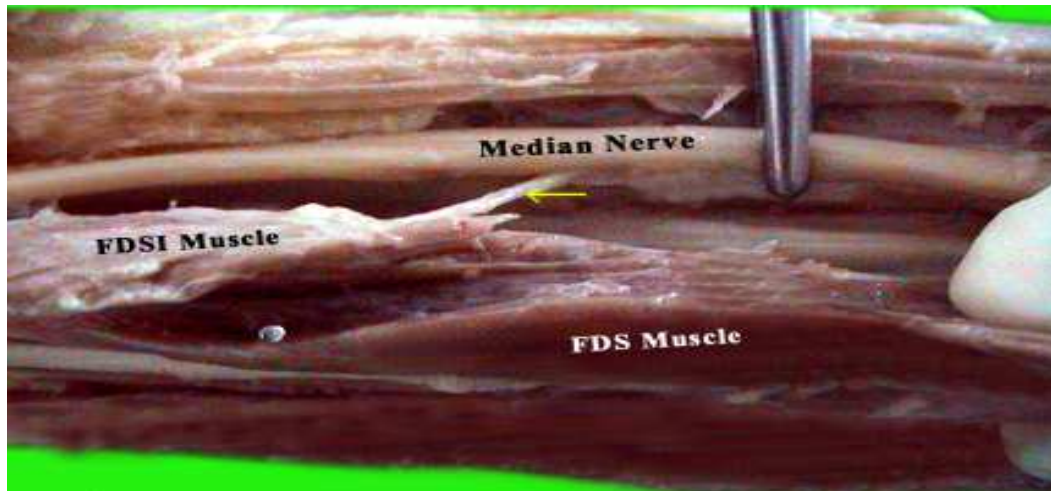


Fig. 3. Left sided - flexor digitorum superficialis indicis - Nerve supply

arpophalangeal joint. It was supplied by a twig arising directly from median nerve close to its origin in the forearm (Fig. 3).

DISCUSSION

The anatomical variations and abnormalities of the muscles can be detected by imaging techniques, such as computed tomography and magnetic resonance imaging. Identification of variations is important for clinical diagnosis and to plan for any surgical procedures. Presence of an accessory muscle may simulate a ganglion or a soft tissue tumour or if in close proximity to a nerve, it may cause pressure neuritis and produce symptoms such as carpal tunnel syndrome, Kiloh-Nevin Syndrome or Pronator Syndrome. FDS has been used as a motor for a wide variety of tendon transfer operations in the hand. Keeping in view of the above clinical manifestations we describe the present case.

Variations of FDS muscle were first described by Mac Alister in 1868 after postmortem dissections. Subsequently explained that this muscle can pose a diagnostic and therapeutic dilemma (Elias and Schuller 1985).

Jones et al. (1997) observed a super numerary muscle in the right side of forearm [Gantzer Muscle] of 59 yrs old male cadaver. The muscle arose from the undersurface of FDS and was inserted into FPL (Flexor pollicis longus) and FDP (Flexor digitorum profundus). But the present cadaveric variation does not correlate with these findings.

Prescher (1987) found an accessory muscle in both forearms. On the right side, the accessory muscle originated from the main muscle belly of the FDS and inserted on the index finger tendon of the FDS. On the left side, the accessory muscle belly originated from the medial epicondyle of the humerus and inserted on the index finger tendon of FDS.

Paul et al. (2008) stated that an accessory FDS indicis muscle is rare but if present the accessory muscle originated from the FDS tendon adjacent to the transverse carpal ligament and inserted into the index finger.

Three types of anomalies based on the functional unit of the FDS that serves the index finger have been described by Probst and Hunter (1975), Christensen (1997), (a) First type involves a muscle belly originating in the forearm and extending distally upto the carpal tunnel. This form can develop few pressure symptoms. (b) Second type, a digastric form exhibiting continuity by way of a tendon between the forearm and palmar bellies. Patients with this form may present with a palmar mass or carpal tunnel syndrome. (c) Third form exists in which the proximal tendon of the muscle attached either to the base of the thenar eminence or to the transverse carpal ligament. Patients can present with a palmar mass that may or may not be painful. The present case does not correlate with any of the above description.

Koizumi et al. (2002) reported a case of accessory lumbrical muscles originating in the forearm in both arms of a cadaver. This muscle

originated from the intermediate tendon of the deep layer of the FDS for the index finger, passed through the carpal tunnel and joined with the insertion of the first lumbrical muscle. A muscle belly is present near the origin on the left and at the insertion on the right side. The left one was supplied by median nerve and the right one received a twig from the nerve to the first lumbrical muscle. When these nerve fibres were traced by peeling off the epi and perineurium it was clarified that the nerve fibres supplying the left accessory muscle formed a common bundle with the fibres of first lumbrical muscle. Therefore, these accessory muscles were considered to be the accessory lumbrical muscles arising from the forearm. The occurrence of these unusual accessory lumbrical muscles indicated that the distal belly of FDS and the first lumbricals are derived from a common muscle origin and presents an important clue to the phylogenetic origin of FDS. The morphology of the muscle bellies studied in the present case appears like a lumbrical as it is unipennate, but the nerve supply is directly from the trunk of median nerve.

D'costa et al. (2006) described an unusual variation of FDS. The FDS had normal origin and insertion, except to the index finger, where a muscle belly replaced the tendon of FDS. The unusual belly originated as a continuation of FDS tendon extending into the carpal tunnel, inserted normally into the middle phalanx and was supplied by a branch of median nerve.

Nicholas et al. (2007) reported a case of anomalous FDS muscle belly presenting as a mass within the palm of a 17 year old male patient with a slowly enlarging, nontender, mobile, soft mass on the radial aspect of the left mid palm. The mass interfered with his daily exercises. MRI report was non diagnostic. Surgical exploration of hand revealed an accessory FDS muscle with a musculo tendinous origin within the carpal tunnel and musculo tendinous insertion. The mass was debulked and range of motion returned to normal within six weeks without pain or recurrence of masses.

Structural Compression of median nerve can cause carpal tunnel syndrome and Entin (1968) grouped causes of carpal tunnel syndrome into 3 categories:

- i. Those reducing the capacity of the tunnel,
- ii. Those increasing the volume of its contents.
- iii. Those that form part of a systemic condition.

The additional flexor tendon in the present case can increase the volume of the carpal tunnel and may cause carpal tunnel syndrome.

The flexor muscles of the forearm develop from the flexor mass of mesoderm which subsequently divides into two layers, superficial and deep. The deep layer gives rise to the FDS, FDP and FPL. The existence of accessory muscles which connect the flexor muscles can be explained due to the incomplete cleavage of the flexor mass during development (Lewis 1910).

We undertook this study with the aim of providing a more accurate account of detailed morphology of another accessory muscle variation. Till date, there have been 20 reported cases and most have involved the right hand's small finger FDS tendon. As per our knowledge this seems to be the first case reported where unipennate accessory muscle belly originated in the lower third of forearm from the tendon to index finger of the FDS on both sides, which traversed through the carpal tunnel, superficial to the median nerve and merged with same tendon in the hand. Accessory flexor bellies are extremely rare in the hand and represent arrests of development, or atavisms, in which accessory parts retain the form they had in lower species of the evolutionary tree. Structural compression of the median nerve which in the present case passes deep to the accessory belly can cause carpal tunnel syndrome. Other possible causes of such a compression include: Synovitis and ganglion, lumbrical muscles originating from the distal part of the forearm, aberrant muscles and tumors etc. Hence it is concluded that such accessory muscle bellies should be kept in mind while approaching the forearm for FDS tendon transfer and other surgical procedures around it (Agee et al. 1991; Nincovik et al. 1995; Jamar et al. 2001).

CONCLUSION

Accessory flexor bellies are extremely rare in the hand and represents arrests of development or atavisms in which accessory parts retain the form they had in lower species of the evolutionary tree. Structural compression of the median nerve, which in the present case passes deep to the accessory belly can cause carpal tunnel syndrome. Other possible causes of such compression are synovitis and ganglion, lumbrical muscles originating from the distal part of the forearm, aberrant muscles and tumours.

RECOMMENDATIONS

The study of accessory muscle bellies arising in the lower part of forearm should be kept in mind while approaching the forearm for FDS tendon transfer and other surgical procedures around it.

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