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Original Paper

# Study on accessory abductor digiti minimi

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## ABSTRACT

**Background**: Abductor digiti minimi (ADM) along with other hypothenar muscles, is prone to lot of variations. Its close relation to the ulnar neurovascular bundle makes it an important muscle. The most common being the presence of accessory slips (accessory ADM [AADM]). The embryological basis for such slips, their morphology and their relation to ulnar neurovascular bundle were studied in detail. **Materials and Methods:** A total of 100 upper limbs (80 males and 20 females) were studied for the presence or absence of AADM and its relation to ulnar nerve (UN) and vessels were studied in detail. **Results:** Of these 100, four limbs had AADM, in which three were superficial to the ulnar artery and nerve and hence compressing them. **Conclusion:** Presence of AADM can result in hypothenar hammer syndrome of ulnar artery and/or in compression neuropathy of UN and cause undue problems during any flap surgeries and other procedures of the hand.

**Keywords**: Accessory abductor digiti minimi, compression neuropathies, hypothenar hammer syndrome, ulnar artery, ulnar nerve

## INTRODUCTION

Hypothenar muscles consisting of abductor digiti minimi (ADM), flexor digiti minimi brevis (FDMB), opponens digiti minimi show a lot of variations either in the form of additional bellies or partial absence. Their relation to the ulnar nerve (UN) may vary. 2.9% cases of UN compression are due to the existence of an aberrant muscle.[1] In rare cases, accessory fascicles of the ADM (AADM) have been found arising from the antebrachial fascia, the radius, and the ulna. The muscle might be joined by accessory slips from the tendon of the flexor carpi ulnaris, the flexor retinaculum, the fascia of the distal forearm, or the tendon of the palmaris longus. AADM when present usually joins the main muscle belly, though occasionally, the muscle is partially inserted onto the fifth metacarpal bone. Murata *et al.*[2] confirmed that due to the presence of multiple compression sites of the UN in the hand, for Ulnar Tunnel syndrome patients the release of Guyon's canal and/or the pisohamate tunnel is an effective way to relieve symptoms.

The presence of accessory slips as in ADM can be attributed to the differential process occurring during the development of hand.

## MATERIALS AND METHODS

A total of 50 cadavers, 40 male and 10 female were studied over a period of 5 years in the Department of Anatomy, Chettinad Hospital and Research Institute, Kelambakkam, Tamil Nadu, Chennai. A total of hundred upper limbs were taken for this particular study. The incision as made in the midline and flaps were reflected. ADM was looked for after dissection of skin and fasicia. It was defined separately from ADM. The ulnar neurovascular bundle was identified. The presence of ADM having accessory slips, along with the length, site of origin, insertion, course and its relation to UN and vessels were studied in detail.

## RESULTS

Out of the 100 hands studied, four hands showed anomalous slips of ADM. Case 1 - A fleshy anomalous slip originating from palmaris longus tendon, was seen on the right hand. The whole length of the slip measuring about 7.7 cm, was fleshy till it joined with the lateral aspect of ADM muscle 3 cm distal to the virtual line joining pisiform and scaphoid. Both ulnar artery (UA) and UN were seen

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under the anomalous slip throughout its whole course, being compressed at the distal end of the forearm and at the Guyon's canal. A twig from the deep branch of UN was seen supplying this slip (Figure 1).

Case 2 - An anomalous slip taking a tendinous origin from the distal end of palmaris longus tendon was seen on a left hand. Its length was 6.5 cm. The tendon becomes fleshy and fans out to get inserted into the lateral border of ADM 3 cm distal to the piso-scaphoid line. This slip too has UA and UN as its deeper relations whole throughout its length, at the forearm, as well as at Guyon's canal. The deep branch of UN supplies it (Figure 2).

Case 3 - Another anomalous slip, 5.5 cm of length, took origin from the antebrachial fascia of the left hand. It blends with the lateral aspect of ADM at 1.5 cm diatal to piso-scaphoid line. Both UA and UN were found posterior to this slip just before they enter the Guyon's canal. The deep branch of UN supplied a twig to this slip (Figure 3).

Case 4 - Another anomalous slip originating from the antebrachial fascia blended with ADM at its origin itself. It was a very thin slip on the left hand, being fleshy all through its length of 2.5 cm. Both the UA and UN were above this slip (Figure 4).

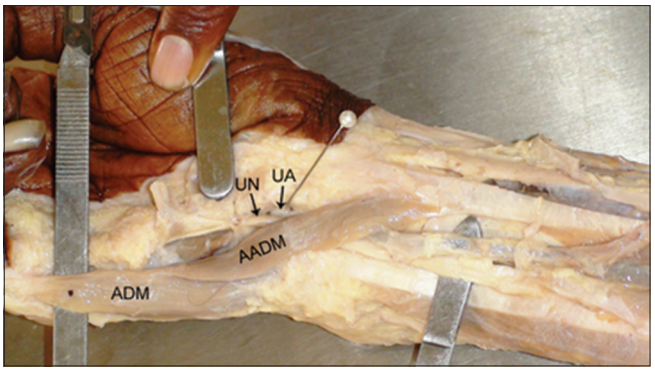


**Figure 1:** Case-1,ADM - Abductor digiti minimi,AADM - Accessory abductor digiti minimi, UN - Ulnar nerve, UA - Ulnar artery


**Figure 2:** Case-2,ADM - Abductor digiti minimi,AADM - Accessory abductor digiti minimi, UN - Ulnar nerve


**Figure 3:** Case 3,ADM - Abductor digiti minimi,AADM - Accessory abductor digiti minimi, UN - Ulnar nerve, UA - Ulnar artery

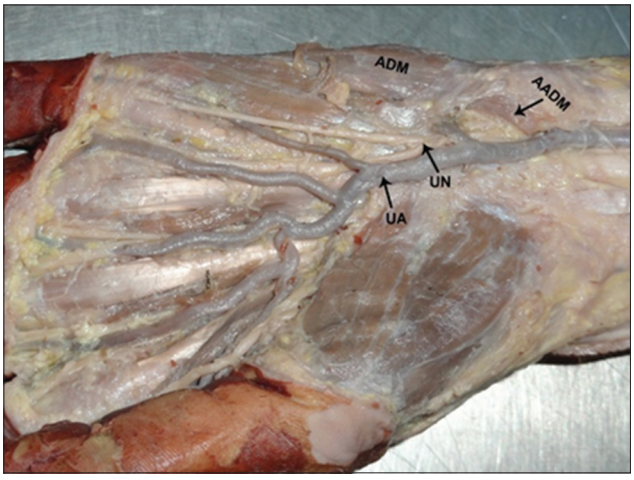


**Figure 4:** Case-4,ADM - Abductor digiti minimi,AADM - Accessory abductor digiti minimi, UN - Ulnar nerve, UA - Ulnar artery

## DISCUSSION

ADM arises from the pisiform bone, the pisohamate ligament, and the flexor retinaculum. Its distal tendon ends in three slips that are inserted into the ulnopalmar margin of the proximal phalanx, the palmar plate of the metacarpophalangeal joint, and the sesamoid bone when present. It is an abductor of the little finger at the metacarpophalangeal joint. It is possible that the muscle contributes to the extension of the middle phalanx of the little finger through its connection to finger's extensor mechanism. It plays an important role when the hand is grasping large objects with outspread fingers. It is innervated by the deep branch of the UN (C8–T1).

The fossil record indicates that adaptation for throwing and clubbing began to influence hand structure and continued for millions of years thereafter. During this prolonged period of evolution, the hand underwent a profound remodeling. Two unique human handgrips were thereby produced. Called the "power" and "precision" grips by Napier[3] who identified and described them, they can also be referred to as clubbing and throwing grips on the basis of their evolutionary origins.[4]

Limb muscles develop by epitheliomesenchymal transformation from myogenic precursor cells, which originate from the somatic mesoderm and also from the ventral dermomyotome of somites in response to molecular signals from nearby tissues. The primordial muscle cells form myoblasts and myotubes due to the molecular activation of MyoD family of muscle-specific factors.[5] An unusual persistence of an undifferentiated group of mesenchymal cells during development results in AADM. These belong to the superficial muscular anlagen layer of the hand, just between the flexor digitorum superficialis muscle blastema and that for the ADM.[6] Hence, depending on the differentiation of different group of muscles, either persistence or absence of a particular muscle mass happens.

In this study, ADM was present in all the cases and hence there was no absence reported. Four cases of AADM were

seen out of the 100 upper limbs, which were studied. The incidence of AADM is 4%. All the anomalous slips were observed in males only. This shows that the incidence of AADM in males is 5% whereas in females the incidence is nil (Table 1).

Macalister[7] has reported absence of ADM as early as 1875. Sañudo *et al*.[8] in 1993 has reported existence of two bellies of ADM arising from the antebrachial fascia compressing both the ulnar (at Guyon's canal) and median (near carpal tunnel) nerves along with ulnar vessels. The origin of AADM seems to vary between the antebrachial fascia, palmaris longus and flexor digitorum superficialis in the distal forearm.

Common insertion pattern of AADM seems to be into the belly or tendon of ADM. Jackson and Harkins[9] in 1972 have reported the relation of AADM to median nerve in contrary to its relation to UN which has been reported in all cases of AADM. Tubiana[10] in 1981 has reported an AADM where the UN lies below and the UA lies above it. Only Sañudo *et al*.[8] has reported that the AADM to be perforated by palmar digital nerve to the fifth finger. Bakinde *et al*.[11] in 2005 has reported a rare bilateral AADM from flexor carpi radialis. In case of polydactyly, it may insert to the sixth finger. Wingerter *et al*.[12] has reported an AADM originating from distal antebrachial fascia and inserting into fifth proximal phalanx causing flexion at metacarpophalangeal joint, which is usually not the action of ADM. The absence of FDMB along with the presence of AADM has also been observed and documented.[13]

UN entrapment is common next to median nerve in the upper limb entrapment syndromes. To know whether the UN entrapment is proximal or at Guyon's canal, the involvement of dorsal cutaneous branch is taken as the guide as it is given before UN enters into Guyon's canal. Decompression with anterior transposition is the treatment of choice, but if AADM is the cause, then the treatment options will vary. Sheppard *et al*.[14] has described subjective paraesthesia in UN distribution due to anomalous ADM. In three out of the four cases of AADM observed in this study, the ulnar neurovascular bundle is deep to AADM. Hence, AADM can be included as a cause of ulnar entrapment syndrome.

Similarly there is a condition called hypothenar hammer syndrome, wherein the UA gets compressed and kinked. The main reason is the presence of constant pressure on the hypothenar area, mostly occupational though the presence of AADM can be a contributory factor.[15] Hence, the knowledge of presence of AADM is of utmost importance for diagnosing pathologies of the hand like compression of UA and UN and for any surgeries done for their treatment.

Bloom *et al*.[16] have described the use of ADM flap for coverage of a dorso-ulnar defect of the hand following excision of a tumor as it appears to have minimal donor site morbidity and a reliable vascular supply and is straightforward to raise. Upton and Taghinia[17] in 2008 has reported that in select cases of congenital thumb hypoplasia, opponens plasty using the ADM myocutaneous flap is more advantageous than the traditional muscle transfer. Ogino *et al*.[18] in 1986 has confirmed that the transferred ADM were strong enough to abduct the thumb and provide good functional and cosmetic results. When there is AADM, the flaps need to be taken carefully. There can be collateral damage to the ulnar neurovascular bundle supplying the accessory slip. This can lead to complications in the donor hand.

**Table 1: Incidence of AADM**

| Sex | Number of specimens | AADM | Incidence |
|---|---|---|---|
| Males and females | 100 | 4 | 4% |
| Males | 80 | 4 | 5% |
| Females | 20 | 0 | Nil |

AADM: Accessory abductor digiti minimi

## CONCLUSION

AADM is a variation, which is seen more commonly than we suspect and hence its presence needs to be acknowledged. They have been clearly documented as the reason behind the compression of the ulnar neurovascular bundle and hence their importance needs to be known among the practicing physicians and surgeons.

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## PEER REVIEW

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## CONFLICTS OF INTEREST

Nil

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