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Research Article - Human Anatomy Case Report

An unusual variation of abductor digiti minimi manus and its clinical significance

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Abstract

The abductor digiti minimi manus muscle usually has two heads and two insertions, often close to each other. Accessory bellies of this muscle have been vastly described in anatomy textbooks. During routine dissection of an adult male cadaver left forearm and hand we observed a rare variation of this muscle, in which there was an accessory muscle band which originated from the palmaris longus muscle tendon and traversed through the Guyon's canal, an anatomical tunnel that is occupied by the ulnar nerve and artery. This type of anatomic variation is often associated with ulnar tunnel syndrome, in which the accessory belly is the source of a neurovascular compression causing pain, weakness of the muscles in the hand, and loss of motor and sensitive functions.

Key words

Anatomic variation, autopsy, cadaver, Guyon syndrome, ulnar nerve compression.

Introduction

The abductor digiti minimi muscle (ADMM) is one of the most variables muscles that form the hypothenar eminence and its usual origins are: the pisiform bone, the flexor carpi ulnaris tendon, and the pisohamate ligament. Its tendon usually divides into two (sometimes three) slips that insert onto the ulnar side of the fifth finger proximal phalanx, additionally, the muscle emits thin aponeurotic fibers to the metacarpophalangeal joint of the fifth finger. The main action of the ADMM is the abduction of the fifth finger, although it also plays an important role while gasping large objects with outspread fingers. This muscle is innervated by the deep branch of the ulnar nerve (Testut and Jacob, 1967; Uzel et al., 2012; Afshar, 2015).

The palmaris longus muscle (PLM) is located at the forearm, and it is one of the most variable muscles of the human body. It usually originates from a common tendon from the medial epycondile of the humerus, and its insertion is generally the palmar aponeurosis and the flexor retinaculum. In a few number of cases, this muscle is absent. The PLM is innervated by the median nerve. It is a flexor of the hand and also produces a tension on the palmar aponeurosis, althought it is not an essential muscle for the mechanics of the hand movements (Testut and Jacob, 1967; Lokanathan et al., 2014).

Accessory bands of the ADMM are sometimes associated with neurovascular compression, although, recently, there have been a few published cases regarding the

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subject (Afshar, 2015; Gil et al., 2015). Ulnar tunnel syndrome and hypothenar hammer syndrome are clinical entities related to a neurovascular compression, which causes pain, weakness of the area muscles, and loss of motor and sensorial function (Uzel et al., 2012; Claassen et al., 2013; Lokanathan et al., 2014; Afshar, 2015). The ulnar tunnel is a triangular shaped space that is formed by the pisiform bone, palmar carpal ligament, and the flexor retinaculum (Gil et al., 2015).

We report a rare variation of the ADMM in a male cadaver and discuss its embryology and clinical significance.

Case report

During the dissection of a male cadaver left forearm and hand a thin muscle band was observed originating from the antebrachial fascia and the palmaris longus muscle tendon. This accessory belly had an oblique trajectory, and ran distally to the palmar carpal ligament, between the hamulus of the hamate bone and the pisiform bone, through the ulnar canal. In the palmar region of the hand, the muscle band joined both bellies of the ADMM, which had its regular distal insertions.

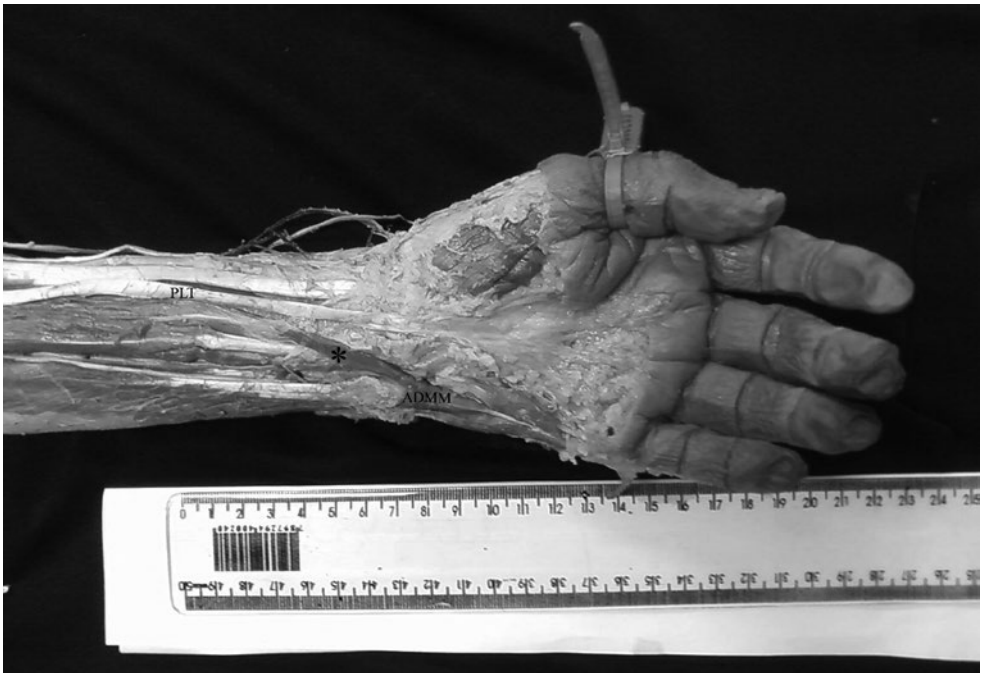

Figure 1. Photograph of the dissected forearm. PLT: palmaris longus muscle tendon; *: accessory slip of the abductor digiti minimi manus muscle; ADMM: abductor digiti minimi manus muscle.

Figure 2. Closer view of the accessory slip. PLT: palmaris longus muscle tendon; *: accessory slip of the abductor digiti minimi manus muscle; FCU: flexoris ulnaris carpi muscle; PIS: pisiform bone; ADMM: abductor digiti minimi manus muscle.

Discussion

The muscles of the hand are formed after the fourth week of embryonic development when there is a migration of myogenic cells from the brachial somites. More specifically, the ADMM is formed by the ulnar blastema from the superficial layer of the muscular anlagen. Furthermore, the vascular and nervous components of the hand are also originated from differentiated cells pertaining to the upper limb mesoderm (Cihák, 1972; Christ et al. 1986).

The arrangement of the muscle mass into individual muscles and the differentiation of somatopleural cells into connective tissue, cartilage, and smooth muscle cells is given by autonomous local factors. Moreover, the position of the structures also determines their differentiation into specific tissues. In the upper limb, an apoptosis mechanism regulates the persistence or the elimination of cells and tissues in order to define morphological characteristics of single structure, this process must happen precisely, as deregulation of this mechanism can cause morphological variations which could cause pathological anomalies (Cihák, 1972; Christ et al. 1986).

The development of the hand joint and bones also exerts influence during the final muscle attachments of the region, and the carpal tunnel and Guyon's canal

favor the displacement of such attachments. Since the PLM is located superficially to the flexor retinaculum and it is a muscle connected to a number of variations, this embryologic mechanism could explain variant origins of the hypothenar eminence muscles (Cihák, 1972; Christ et al., 1986).

The hypothenar eminence muscles are often target of variations (Bozkurt et al., 2004; Uzel et al., 2012; Claassen et al., 2013; Lokanathan et al., 2014; Gil et al., 2015). We believe that they are targeted by lesser stimuli during ontogenic process, causing them to be less compartmentalized, thus more susceptible to vary.

Many variations regarding the insertions of the ADMM, the presence of an accessory slip, its duplication (either unilateral or bilateral), absence and even its fusion with the flexor digiti minimi brevis muscle have been described in the literature (Le Double, 1897; Bergman et al. 1988). Muscles such as the palmaris longus, flexor carpi radialis, flexor carpi ulnaris, the pronator quadratus tendon, and other structures like the ulna, the radius, the bicipital aponeurosis, the flexor retinaculum and the deep antebrachial fascia have been reported to originate an accessory slip of the ADMM, labeled as "accessory abductor digiti minimi muscle" (Le Double, 1897; Bergman et al. 1988).

Moreover, its innervation is also prone to vary, a double nerve supply from the ulnar nerve, and another case of median nerve contribution have been described (Uzel et al., 2012; Claassen et al., 2013). Uzel et al. (2012) described an accessory slip of the ADMM that originated from the PLM tendon and traversed through the Guyon's canal. Their work also reported 19 cases in the literature - since 1846 - that described the ADMM accessory slip originating from the palmaris longus tendon. Only one case similar to ours has been recently described, in which the muscle belly passed above the ulnar nerve and artery (Afshar, 2015).

The ulnar tunnel is a triangular shaped space that is formed at the lateral side of the pisiform bone. This space was first described in 1861 by Guyon, giving rise to the "Guyon's canal" eponym (Gil et al., 2015). Its anterior wall is formed by the palmar carpal ligament, the posterior and medial wall are formed by the flexor retinaculum and the pisiform bone, respectively. The ulnar nerve enters the canal – anteriorly – between the pisiform bone and the hamate hamulus, and during its course it divides into superficial and deep branches. Its deep branch runs deep between the ADMM and the flexor digiti minimi muscle and supplies both muscles (Testut and Jacob, 1967; Gil et al., 2015).

The ulnar artery, on the other hand, is located laterally to the ulnar nerve, dividing into the following branches: palmar carpal branch, dorsal carpal branch (inconsistent), superficial palmar branch, and deep palmar branch, the latter follows the deep branch of the ulnar nerve and joins the deep palmar branch of the radial artery in order to form the deep palmar arch (Testut and Jacob, 1967; Gil et al., 2015).

The ulnar canal can be divided in three zones according to the ulnar nerve trajectory: zone 1 is the area proximal to the ulnar nerve bifurcation, zone 2 lodges the deep branch of the ulnar nerve, and zone 3 houses the superficial branch (Uzel et al., 2012).

Anatomical variations causing nerve or vascular compression on the Guyon's canal have been described in the literature (Bergman et al., 1988; Uzel et al., 2012; Claassen et al., 2013; Afshar, 2015). Muscular hypertrophy and forceful exercise have been theorized as possible causes of ulnar nerve or artery extrinsic compression (Afshar, 2015). Nerve compression can cause symptoms of pain, paresthesia and decreased sensation on the ulnar side of the hand, and vascular compression can

cause numbness, pain, cold sensation and ulnar artery thrombosis (Bozkurt et al., 2004; Claassen et al., 2013; Afshar, 2015).

Treatment for Guyon's canal syndrome and hypothenar hammer syndrome involves massage and physical therapy; when they are caused by an accessory slip, decompression surgery with anterior transposition is usually the main choice, although some authors perform a partial excision of the muscle (Bozkurt et al., 2004; Afshar, 2015).

We conclude that even though ulnar nerve compression due to anatomical variations is a rare entity, it is a clinical condition that physicians and surgeons must not ignore. Knowledge regarding the anatomy and anatomical variations of the hand muscles are important to diagnose this condition through image exams and minimize iatrogenic lesions during surgical treatment.

Conflicts of interest

None.

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