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CASE REPORT

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A coexisting anatomical variation of median and ulnar nerves in a cadaver palm

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During a routine dissection we observed an anatomical variation of the median nerve and an atypical anastomosis in the palm region of a male cadaver. There were four distinct recurrent motor branches of the left median nerve, and the palmar cutaneous branch of the ulnar nerve communicated directly with the third common palmar digital nerve. The presence of such an anatomical variant in the hand should keep surgeons alert in the management of hand pathology especially in carpal tunnel syndrome, which is a routine operation for many medical centres. (Folia Morphol 2012; 71, 4: 269–274)

Key words: median nerve variations, recurrent motor branch of median nerve, palmar cutaneous branch of the ulnar nerve, ulnar-median nerve anastomosis

INTRODUCTION

The muscular or motor or recurrent branch is short and thick and arises from the lateral side of the median nerve. It runs radiad, just distal to the flexor retinaculum, with a slight recurrent curve beneath the part of the palmar aponeurosis covering the thenar muscles, and turns round the distal border of the retinaculum to lie superficial to the flexor pollicis brevis (FPB) muscle. It usually supplies the superficial head of the FPB and gives branches to the abductor pollicis brevis (APB) and opponens pollicis (OP) muscles. Its terminal part gives branches to the first and second lumbricales muscles.

The palmar cutaneous branch of the ulnar nerve arises about mid-forearm. It descends to the ulnar artery, which it supplies, and then perforates the deep fascia to supply the hypothenar palmar skin as well as the palmaris brevis muscle. The purpose of this case report is to describe a supernumerary muscular branch of the median nerve and an atypical ulnar to median nerve anastomosis considering the literature and to discuss their clinical impact.

CASE REPORT

During a routine cadaveric dissection of the left hand of a 72-year-old Caucasian male, we observed four distinct muscular branches of the median nerve. The median nerve passed under the flexor retinaculum in the carpal tunnel, coursed laterally, and before its separation to the common palmar digital nerves it gave three branches. The first branch arose from the deep part of the median nerve, ran just distal to the flexor retinaculum, and distributed to the superficial head of the FPB. The origin of this nerve was triangular with three distinct branches, which gathered and shaped a common stem. About 5 mm distal to the first branch from the radial side of the left median nerve arose two distinct branches which ran radiad (5 mm approximately) distal to the flexor retinaculum, continued superficial to the FPB, traversed it, and the proximal branch entered the APB and the distal one entered the OP. The fourth branch originated from the radial side of the second common palmar digital nerve, ran through the deep part of the first common palmar digital nerve, and innervated the superficial head of the FPB (Fig. 1).

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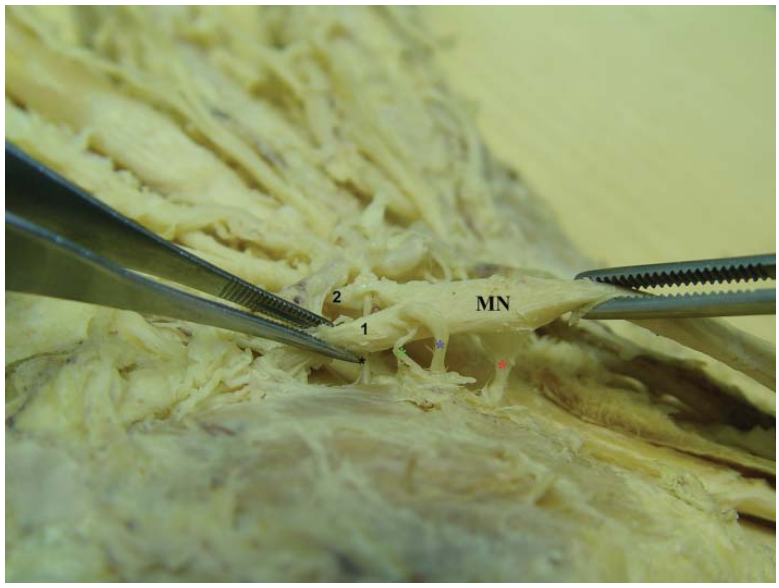

Figure 1. Dissection of the four recurrent motor branches of the median nerve. Red asterisk: first motor branch, blue asterisk: proximal second motor branch, green asterisk: distal third motor branch, black asterisk: fourth motor branch; MN — medial nerve; 1, 2 — first, second common palmar digital nerves. The first common palmar digital nerve has been retracted to show the course of the fourth motor branch.

Figure 2. Dissection demonstrating the atypical ulnar-median nerve anastomosis. Anastomosis (green asterisk) between the palmar cutaneous branch (red asterisk) of the ulnar nerve and the third common palmar digital nerve (blue asterisk). Black asterisk: fourth recurrent motor branch of median nerve.

The palmar cutaneous branch of the ulnar nerve arose about mid-forearm, descended on the ulnar artery, which it supplied, and then perforated the deep fascia. It supplied the hypothenar palmar skin, as well as the palmaris brevis muscle, and communicated directly with the third common palmar digital nerve (Fig. 2). No other arterial, muscular, or neural anatomical variations were present in the left hand (Fig. 3).

DISCUSSION

In Gray's anatomy [17] the course of the median nerve distal to the flexor retinaculum is described as being variant with regard to the mode and level of division of its branches. It is also highlighted that the muscular (motor or recurrent) branch may be either the first palmar branch or a terminal branch that arises level with the digital branches whereas it is not rare for it

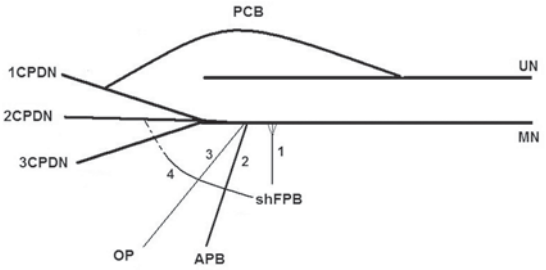

Figure 3. Schematic representation of the recurrent motor branches distribution and the atypical anastomosis; UN — ulnar nerve; MN — median nerve; shFPB — superficial head of flexor pollicis brevis; APB — abductor pollicis brevis; OP — opponens pollicis; 1, 2, 3 CPDN — first, second, and third common palmar digital nerves; PCB — palmar cutaneous branch of the ulnar nerve; 1, 2, 3, 4 — the first, second proximal, third distal, and fourth recurrent motor branches of the median nerve.

to arise within the carpal tunnel and pierce the flexor retinaculum.

The acknowledgement of the highly variable anatomy of the motor branch is probably due to the fact that carpal tunnel syndrome, the most common entrapment mononeuropathy, is treated surgically and has triggered the publication of many clinical series. Multiple motor branches have been reported extensively in the literature. Bennett and Crouch [12] reported that 12% of transretinacular motor branches were multiple. In a prospective study by Ahn et al. [2] multiple motor branches were found in 10.5% of patients. Moreover, they found that although the anatomy of the carpal tunnel in Koreans was somewhat different, in part, from the results obtained from studies in Caucasians, the overall results were not significantly different. Al-Qattan [4] found in his study of Middle Eastern subjects one hand with a double thenar motor branch while he pointed out that the ulnar origin of the thenar branch and the double (or triple) thenar branches seemed to be rare in all races. Hurwitz [19], in a prospective study of 80 operations, also found multiple motor branches in 12.5% of cases.

Formerly, the lack of knowledge of the highly variable anatomy of the median nerve has been expressed with the publication of complications during carpal tunnel release including laceration of the palmar cutaneous branch, the motor branch or other branches of the median nerve [5] as well as the persistent median artery [35]. Beris et al. [11] emphasised the usefulness of knowledge of anatomical variations of the median nerve and the frustrating results an inadequate operation for carpal tunnel syndrome could cause. According to Mizia et al. [32] the median nerve should be approached from the ulnar side when opening the carpal tunnel. As a consequence, researchers tried to classify anatomical variations of the median nerve.

Olave et al. [36] and Ajmani [3] grouped their specimens by the muscular innervation pattern of the thenar branch, whereas Mumford et al. [34] studied the number of terminal branches. The innervation of the thenar muscles is generally described as being derived from the muscular branch of the median nerve [9].

In 1977 Lanz [27], based on cadaveric studies, classified median nerve anomalies into four categories: Group 0 — extraligamentous thenar branch (standard anatomy); Group 1 — variations of the thenar branch; Group 2 — presence of accessory branches in the distal part of the carpal tunnel; Group 3 — proximal division of the median nerve; and Group 4 — presence of accessory branches proximal to the carpal tunnel. According to Lanz [27], our case is classified as group 2 although it does not reflect the anatomy that we present.

Amadio [6] classified patients into five groups. Group 1 consisted of proximal division anomalies with an incidence of 3%. Group 2 included the variations of the motor branch (19%), which could be divided further by location and number of branches. Anatomic variations of the palmar cutaneous branch constituted Group 3 with an incidence of 2.5%. Group 4 included anomalies of the median-ulnar sensory ramus (1%), and Group 5 was reserved for unclassified anomalies. Based on this classification system our case is classified as group 5.

Kozin [26] found multiple recurrent branches with a common origin (4%). Multiple (double or triple) thenar branches seem to be rare in all races, and only a few cases have been reported worldwide [15, 16, 31, 42, 45]. Mumford et al. [34] described in 25% of specimens the presence of two, three or four branches.

Alp et al. [5] classified their specimens into four types according to the number of the thenar branches entering the thenar fascia. In group 3, three branches were identified entering the thenar fascia. These branches had a common origin and supplied the APB, OP, and FPB separately. Despite the fact that Alp's classification comprises three muscular branches, our case cannot be classified as group 3. Moreover, Alp et al. [5] described the accessory thenar nerve (ATN), which was described previously by Mumford et al. [34].

It arose from the first common digital nerve or radial proper digital nerve [3, 37]. It supplied the superficial head of FPB [3, 37] or OP [36, 37, 39]. They found 12 specimens (8.3%) in which ATN arose from the common digital nerve and supplied FPB exclusively. FPB was also innervated by the thenar branch and ATN in two specimens. In our case the accessory thenar branch originated from the radial side of the third common palmar digital nerve and innervated the superficial head of the FPB.

Bennett and Crouch [12] reported independent motor branch compression, which appears to exist in the presence of carpal tunnel symptomatology or as an independent entity. Tate [41] reported a fascial band compression of the recurrent motor branch while he referred to other reports of recurrent motor branch compression [18, 20, 22, 23, 25, 44, 46]. Mondelli et al. [33] reported thenar mononeuropathy in vineyard workers due to chronic compression on the motor thenar branch. Repaci et al. [38] showed that exclusive electrophysiological involvement of median motor fibres is rare. They proposed that there was a preferential compression of the intraneural motor fascicles clumped superficially in the most volar-radial nerve quadrant or, more probably, that the recurrent thenar branch may exit the carpal tunnel through a separate ligamentous tunnel within the transverse carpal ligament where it may be preferentially or selectively compressed. Johnson et al. [21], in eight out of ten dissections of the human hand, found a definitive tunnel for the passage of the thenar branch. We assume that our case could be more prone to an independent motor thenar mononeuropathy.

Communications between the ulnar and median nerves in the upper limb have been reported in the literature [1, 10, 14]. The Riche-Cannieu anastomosis occurs in the palm between the recurrent branch of the median nerve and the deep branch of the ulnar nerve. Berrettini anastomosis, ramus communicans, or superficial communicating branch is the communicating branch between common digital nerves that arise from the ulnar and median nerves in the palmar surface of the hand. Loukas et al. [30], in their description of palmar communications between the median and ulnar nerves, distinguish ramus communicans from Berrettini anastomosis. Ramus communicans is a deep sensory communication branch between the ulnar fourth common digital palmar nerve and the median third common digital palmar nerve whereas the Berrettini branch is a sensory communication between the ulnar and median nerves in the palmar aspect of the hand, with distribution to the ulnar part of the middle finger and the radial part of the ring finger. Our case, which is a palmar anastomosis between the ulnar and median nerve, cannot be classified as either Riche-Cannieu or the Berrettini anastomosis. It is an anastomosis between the palmar cutaneous branch of the ulnar nerve and the third common palmar digital nerve.

Nowadays, mini incision and arthroscopic techniques necessitate a good appreciation of the regional anatomy in order to achieve an optimal outcome. These techniques formulated research questions with regard to more detailed anatomy [43]. Although Bande et al. [8] showed that there was no difference between endoscopic and open decompression of the carpal tunnel, Beredjiklian et al. [13] explained that wrist arthroscopy is a safe procedure with a low rate of major and minor complications for various types of procedures being used for the treatment of wrist joint disorders. Therefore, a thorough exploration of the local anatomy must be considered regardless of the operative method.

The presence and prevalence of superficial communicating branches in the hand between the ulnar and median nerves has been described [29, 40]. Neural communications in the upper limb are not rare and knowledge of them is important in surgical procedures so that iatrogenic injury does not occur. These branches could be of clinical significance. In our case, complete transection or lesion to the median nerve, the sensation to the middle finger would be retained due to the existence of the anastomosis. A thorough clinical examination of the peripheral nerves must be conducted where neurological symptoms exist and if possible should be completed with electrodiagnostic studies. In the same fashion, findings from electrodiagnostic studies alone should not exclude the possibility of pathology if findings are unable to explain unusual symptoms [24]. Unusual clinical presentations and discrepancies between the history and the physical examination should raise suspicion of anatomical variations.

The developing skeleton of the shoulder splits the brachial plexus into dorsal and ventral laminae. Musculocutaneous, median and ulnar nerves arise from the ventral lamina. Both median and ulnar nerves give branches to the deep flexor mass and anastomose within the mass. The distal end of the median nerve splits into a peculiar fan-like arrangement of its branches [7, 28]. Since the median and ulnar nerves have a common embryologic origin and anastomose at an early stage, we speculate that the median and ulnar anastomosis persisted in our specimen.

CONCLUSIONS

It is obvious that there are many variations of the recurrent branch of the median nerve and many variations between median and ulnar nerve anastomosis. The purpose of this case presentation is to inform the specialists about the complexity of human hand anatomy. The diversity of the recurrent branch of the median nerve could cause surgical complications. In addition, recognition of the communicating branches during clinical examination and management will assist the clinician in preventing misdiagnoses.

REFERENCES

1. Adachi B (1928) Das arteriensystem der Japaner. Maruzen, Kyoto.
2. Ahn DS, Yoon ES, Koo SH, Park SH (2000) A prospective study of the anatomic variations of the median nerve in the carpal tunnel in Asians. Ann Plast Surg, 44: 282–287.
3. Ajmani ML (1996) Variations in the motor nerve supply of the thenar and hypothenar muscles of the hand. J Anat, 189: 145–150.
4. Al-Qattan MM (2010) Variations in the course of the thenar motor branch of the median nerve and their relationship to the hypertrophic muscle overlying the transverse carpal ligament. J Hand Surg Am, 35: 1820–1824.
5. Alp M, Marur T, Akkin SM, Yalcin L, Demirci S (2005) Ramification pattern of the thenar branch of the median nerve entering the thenar fascia and the distribution of the terminal branches in the thenar musculature anatomic cadaver study in 144 hands. Clin Anat, 18: 195–199.
6. Amadio PC (1988) Anatomic variations of the median nerve within the carpal tunnel. Clin Anat, 1: 23.
7. Arey LB (1965) Developmental anatomy: a textbook and laboratory manual of embryology 7th Ed. W.B. Saunders Company, Philadelphia and London.
8. Bande S, De Smet L, Fabry G (1994) The results of carpal tunnel release: open versus endoscopic technique. J Hand Surg Br, 19: 14–17.
9. Bruce J, Walmsleyr, Ross J (1964) Manual of surgical anatomy. Livingstone, Edinburgh.
10. Beheiry EE (2004) Anatomical variations of the median nerve distribution and communication in the arm. Folia Morphol, 63: 313–318.
11. Beris AE, Likissas MG, Kontogeorgakos VA, Vekris MD, Korompilias AV (2008) Anatomic variations of the median nerve in carpal tunnel release. Clin Anat, 21: 514–518.
12. Bennett JB, Crouch CC (1982) Compression syndrome of the recurrent motor branch of the median nerve. J Hand Surg Am, 71: 407–409.
13. Beredjiklian PK, Bozentka DJ, Leung YL, Monaghan BA (2004) Complications of wrist arthroscopy. J Hand Surg Am, 29: 406–411.
14. Dogan UN, Uysal II, Seker M (2008) The communications between the ulnar and median nerves in upper limb. Neuroanatomy, 8: 15–19.
15. Entin MA (1968) Carpal tunnel syndrome and its variants. Surg Clin North Am, 48: 1097–1112.
16. Graham WP (1973) Variations of the motor branch of the median nerve at the wrist. Plast Reconstr Surg, 51: 90–92.
17. Standring S ed. (2005) Gray's anatomy: the anatomical basis of clinical practice. 39th Ed. Churchill Livingstone. Edinburgh.
18. Herskovitz S, Strauch B, Gordon M (1992) Shiatsu massage-induced injury of the median recurrent motor branch (letter). Muscle Nerve, 15: 1215.
19. Hurwitz PJ (1996) Variations in the course of the thenar motor branch of the median nerve. J Hand Surg Br, 21: 3: 344–346.
20. Jensen TT (1990) Isolated compression of the motor branch of the median nerve by a ganglion. Scand J Plast Reconstr Surg, 24: 171.
21. Johnson RK, Shrewsbury MM (1970) Anatomical course of the thenar branch of the median nerve-usually in a separate tunnel through the transverse carpal ligament. J Bone Joint Surg Am, 52: 269–273.
22. Josty I, Sykes P (2001) An unusual schwannoma of the median nerve: effects on the motor branch. Br J Plast Surg, 54: 71–73.
23. Kato H, Ogino T, Nanbu T, Nakamura K (1991) Compression neuropathy of the motor branch of the median nerve caused by palmar ganglion. J Hand Surg Am, 16A: 751–752.
24. Kimura I, Ayyar DR, Lippmann SM (1983) Electrophysiological verification of the ulnar to median nerve communications in the hand and forearm. Tohoku J Exp Med, 141: 269–274.
25. Kobayashi N, Koshino T, Nakazawa A, Saito T (2001) Neuropathy of motor branch of median or ulnar nerve induced by midpalm ganglion. J Hand Surg, 26A: 474–477.
26. Kozin SH (1998) The anatomy of the recurrent branch of the median nerve. J Hand Surg Am, 23: 852–858.
27. Lanz U (1977) Anatomical variations of the median nerve of the carpal tunnel. J Hand Surg Am, 2: 44–53.
28. Lewis WH (1902) The development of the arm in man Am J Anat, 1: 145–183.
29. Loukas M, Bellary SS, Tubbs RS, Shoja MM, Cohen Gadol AA (2011) Deep palmar communications between the ulnar and median nerves. Clin Anat, 24: 197–201.
30. Loukas M, Abel N, Tubbs RS, Matusz P, Zurada A, Cohen-Gadol AA (2011) Neural interconnections between the nerves of the upper limb and surgical implications. J Neurosurg, 114: 225–235.
31. Mackinnon SE, Dellon AL (1988) Anatomic investigations of nerves at the wrist: I. Orientation of the motor fascicle of the median nerve in the carpal tunnel. Ann Plast Surg, 21: 32–35.
32. Mizia E, Klimek-Piotrowska W, Walocha J, Rutowski R, Wojtala R (2011) The median nerve in the carpal tunnel. Folia Morphol, 70: 41–46.
33. Mondelli M, Baldasseroni A, Aretini A, Ginanneschi F, Padua L (2010) Prevalent involvement of thenar motor fibres in vineyard workers with carpal tunnel syndrome. Clin Neurophysiol, 121: 1251–1255.

34. Mumford J, Morecraft R, Blair WF (1987) Anatomy of the thenar branch of the median nerve. J Hand Surg Am, 12A: 361–365.
35. Natsis K, Iordache G, Gigis I, Kyriazidou A, Lazaridis N, Noussios G, Paraskevas G (2009) Persistent median artery in the carpal tunnel: anatomy, embryology, clinical significance, and review of the literature. Folia Morphol, 68: 193–200.
36. Olave E, Prates JC, Del Sol M, Sarmento A, Gabrielli C (1995) Distribution patterns of the muscular branch of the median nerve in the thenar region. J Anat, 186: 441–446.
37. Olave E, Prates JC, Gabrielli C, Pardi P (1996) Short report morphometric studies of the muscular branch of the median nerve. J Anat, 189: 445–449.
38. Repaci M, Torrieri F, Di Blasio F, Uncini A (1999) Exclusive electrophysiological motor involvement in carpal tunnel syndrome. Clin Neurophysiol, 110: 1471–1474.
39. Homma T, Sakai T (1992) Thenar and hypothenar muscles and their innervation by the ulnar and median nerves in the human hand. Acta Anat (Basel), 145: 44–49.
40. Tagil SM, Bozkurt MC, Ozçakar L, Ersoy M, Tekdemir I, Elhan A (2007) Superficial palmar communications between the ulnar and median nerves in Turkish cadavers. Clin Anat, 20: 795–798.
41. Tate DE (2006) Isolated fascial compression of the recurrent motor branch of the median nerve: a case report. Hand (NY), 1: 102–105.
42. Tountas CP, Bihrle DM, MacDonald CJ, Bergman RA (1987) Variations of the median nerve in the carpal canal. J Hand Surg, 12A: 708–712.
43. Tubbs RS, Salter EG, Sheetz J, Zehren S, Lee DH, Oakes J, Oakes WJ (2005) Novel surgical approach to the carpal tunnel: cadaveric feasibility study. Clin Anat, 18: 350–356.
44. Widder S, Shons A (1988) Carpal tunnel syndrome associated with extra tunnel vascular compression of the median nerve motor branch. J Hand Surg Am, 13: 926–927.
45. Wolf AW, Packard S, Chow JC (1993) Transligamentous motor branch of the median nerve discovered during endoscopically assisted carpal tunnel release. Arthroscopy, 9: 222–223.
46. Yamanaka K, Horiuchi Y, Yabe Y (1994) Compression neuropathy of the motor branch of the median nerve due to an anomalous thenar muscle. J Hand Surg Br, 19: 711–712.