

ULNAR NERVE, ITS TERMINATION AND SUPERFICIAL BRANCHES IN HAND: A CADAVERIC STUDY

A Priyadarshini ¹, Sudakshina Chakrabarti ^{*2}, Gunapriya Raghunath ³.

¹ Tutor, Department of Anatomy, Saveetha Medical College, Chennai, Tamilnadu, India.

^{*2} Assistant Professor, Department of Anatomy, Saveetha Medical College, Chennai, Tamilnadu, India.

³ Professor and Head, Department of Anatomy, Saveetha Medical College, Chennai, Tamilnadu, India.

ABSTRACT

Introduction: Nerves supplying the hand are notoriously variable in their divisions and their course; do not follow any standard pattern. The palmar aspect of hand is supplied by median and ulnar nerve. The clinical importance of Guyon's canal is emphasized due to the various branching patterns of the ulnar nerve in this canal. The palmar aspect of hand is usually supplied by ulnar nerve and median nerve. Medial one and a half fingers are supplied by ulnar nerve and lateral three and a half fingers are supplied by the median nerve. The branches of ulnar nerve are notoriously variable morphologically and no standard pattern can be given regarding the course of these branches. Presence of trifurcation of ulnar nerve or communications of superficial branches to median nerve do not cause symptoms usually but becomes important during surgical and orthopaedic interventions.

Material and Methods: The study was conducted on 40 hands (20 left and 20 right) of preserved adult human cadavers. The roof of the Guyon's canal was opened with care not to disturb the structures. The ulnar nerve observed for its terminal branches, the course of its superficial branches was observed. The point of division of superficial branch into digital branches was measured from bistyloid line. The point of origin of superficial communicating branch from superficial branch or digital branch of ulnar nerve to median nerve was observed from bistyloid line.

Observations: In 29 hands the ulnar nerve showed bifurcation, in 10 hands it trifurcated in the Guyon's canal and in 1 right hand of a male cadaver there was higher division of the ulnar nerve and trifurcation. The superficial branch was observed for its course and division from bistyloid line. The superficial branch gave rise to 2 digital branches in 27 hands and it gave 3 branches i.e. 2 digital branches and 1 communicating branch to medialmost digital branch of median nerve in 13 hands. The typical ramus communicans from digital branch of ulnar nerve to the medial most digital branch of median nerve was observed in 27 hands. (67.5%).

Conclusion: This study attempted at exploring the superficial anatomy of ulnar nerve in hand. The branching pattern of the ulnar nerve in Guyon's canal is variable as there is no exact level at which the nerve terminates. The superficial communicating branch to median nerve though present in all the hands but the typical ramus communicans was observed in 67.5% of specimens. Thus surgical procedures in hand should be planned carefully keeping in mind in advance such variations which can be encountered.

KEY WORDS: Ulnar Nerve, Palmar Aspect, Guyon's Canal, Median Nerve, Trifurcation.

Address for Correspondence: Dr. Sudakshina Chakrabarti, Assistant Professor, Department of Anatomy, Saveetha Medical College, Chennai, Tamilnadu, India. **E-Mail:** sudhianat@gmail.com

Access this Article online

Quick Response code



DOI: 10.16965/ijar.2015.270

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 15 Sep 2015 Accepted: 02 Oct 2015
Peer Review: 15 Sep 2015 Published (O): 31 Oct 2015
Revised: None Published (P): 31 Dec 2015

INTRODUCTION

The ulnar nerve in the hand has a complex anatomy. The ulnar nerve is the continuation of medial cord of brachial plexus. Its root value is C8 and T1 but it often receives fibres from ventral ramus of C7 to form the root of ulnar nerve. The branches of ulnar nerve are notoriously variable morphologically and no standard pattern can be given regarding the course of these branches. The presence of trifurcation of ulnar nerve usually does not cause any symptoms and is of academic interest only. It can become problem for surgeons and hand surgeons when they perform surgery on hand [1]. The ulnar nerve along with the ulnar artery enters the hand superficial to the flexor retinaculum in Guyon's canal which is a fibro osseous tunnel undercover of volar carpal ligament and palmaris brevis muscle and over the pisiform and hook of hamate. Variations of the ulnar nerve in the hand have been reported in cadaveric dissection and in individual practice. In a very early anatomical study which was based on the dissection of fifty adult hands the classic configuration of the ulnar nerve was found in thirty-nine cases out of fifty, and in eleven cases there were variations with respect to division [2]. Georgios Paraskevas et al, stated that nerve variation in the ulnar area of hand is important and could explain sensory loss or pain in patients following surgical procedures and trauma. Unusual presentations following nerve injury can often be explained by anomalous neural inter-communications [3]. The incidence of superficial communications between the median and ulnar nerve varies throughout literature. It was found in 80% of 50 cadaveric specimens [4]. The communicating branch between common digital nerves that arise from the ulnar and median nerves in the palmar surface of hand is called 'Berretini Anastomosis, ramus communicans or superficial communicating branch' [5]. Because, many investigators [5] found its incidence to be over 80%, the Berretini anastomosis should be considered a normal structure rather than an anatomic variation. The main trunk of ulnar nerve continues sub adjacent to the flexor carpi ulnaris and becomes relatively superficial covered by fascia and skin. The ulnar nerve along with the ulnar artery enters

the Guyon's canal within which it divides into superficial and deep branches and further continues into hand and re-divides to form digital nerves. The deep or motor branch of ulnar nerve accompanied by the deep branch of ulnar artery then passes between the abductor digiti minimi and flexor digiti minimi brevis. This typically occurs just distal to the pisohamate ligament, which serves as an important landmark isolating the motor branch. The motor branch then perforates the opponens digiti minimi and courses radially and deep to curve around the hook of hamate. It then follows the course of deep palmar arch beneath the flexor tendons. At its origin it supplies the hypothenar muscles. As it courses the deep part of the hand, it supplies all the interossei muscles and 3rd and 4th lumbricals. It ends by supplying the adductor pollicis and medial head of the flexor pollicis brevis and articular branches to adjacent carpal joints [6]. This study was undertaken to determine the anatomy of ulnar nerve in Guyon's canal and hand to detect variations which will facilitate to design the neurocutaneous flaps for reconstructive surgery and serve as donor site for nerve grafts.

MATERIALS AND METHODS

The study was conducted on 40 hands (20 left and 20 right) of preserved adult human cadavers. Inclusion criteria: Well preserved and embalmed human cadavers with arm, forearm and hand intact. Exclusion criteria-Infant, children and adolescent cadavers. Hands with gross morphological abnormalities, damage and deformities. Incision was put along the radial border of flexor carpi ulnaris tendon then in a zigzag fashion across the proximal palmar crease as shown in Fig 1. The roof of Guyon's canal was opened by dissecting the palmar carpal ligament and palmaris brevis muscle. Care was taken not to disturb the content. The division of superficial branch into 2 digital branches from the bistyloid line was measured. The point of origin of communicating branch to median nerve from bistyloid line was measured. All measurements were taken with help of digital callipers.

OBSERVATION AND RESULTS

In 29 out of 40 (72.5%) dissected hands the ulnar nerve bifurcated within the Guyon's canal into

superficial and deep branches. The superficial sensory branch divided into 2 components a medial branch which continued as medial proper palmar digital nerve of little finger and a lateral branch the common digital branch. In another 10 out of 40 (25%) hands the division of ulnar nerve resulted in 3 branches approximately at the same level in the Guyon's canal which consisted of a deep branch and a superficial branch and the latter redivided into 2 branches almost immediately giving rise to a trifurcation pattern.(Fig 2 & 3 & 4). In 1 right hand of a male cadaver the ulnar nerve showed a higher division and trifurcation pattern which included a branch to wrist joint, a deep branch supplying the muscles of hand and a superficial branch, later in the hand again the superficial branch showed a trifurcation pattern of branching which is discussed below (Fig-4).

The superficial branch was observed for its termination. It divided into 3 components in 13 hands which are a communicating branch to medial most common digital branch of median nerve, a common palmar digital nerve for 4th digit and 5th digit and a proper palmar digital nerve for little finger.(Fig 4). In 27 hands the superficial branch divided into 2 branches the common digital for 4th and 5th digit and a proper digital for little finger (Fig 3). The communicating branch to the medial most common digital branch of median nerve was given off from the common digital nerve of the 4th digit which is the typical ramus communicans. (Fig 3). The typical ramus communicans as described in literature was thus present in 27 hands(67.5%). in another 13 hands the communicating branch originated directly from the superficial branch of ulnar nerve and joined distally the medial most common digital branch of median nerve. In 22 hands the ramus traversed perpendicular to these common digital nerves of ulnar and median nerve as in Fig 3.

In Fig 5 the morphometric analysis of the point of division of superficial branch into its components from the bistyloid line have been shown. In 6 hands the division was within 23 to 23.9 mm from bistyloid line. All the specimens showed division of superficial branch was within 29 mm from bistyloid line. In 27 specimens the superficial branch divided into 2 components the

proper digital branch to little finger and a common digital branch for the ring and little finger.(Fig 3). In 13 hands the superficial branch either trifurcated or gave rise to communicating branch to median nerve then divided as shown in Fig 4.

Similarly the point of origin of communicating branch from the common digital nerve of ulnar nerve or from the superficial branch was measured from bistyloid line. In 13 hands it was within 26.9 mm, and maximum in 9 specimens which ranged from 36.1 to 38 as shown in Fig 6 .In Fig 7 the bistyloid line is shown and the distance is marked at the point the superficial branch divided and also the origin of communicating branch.

Fig. 1: Pattern of incision put on hand.

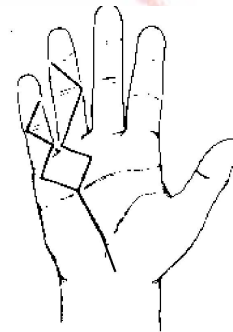


Fig. 2: Percentage of specimens showing bifurcation, trifurcation and higher division of ulnar nerve .

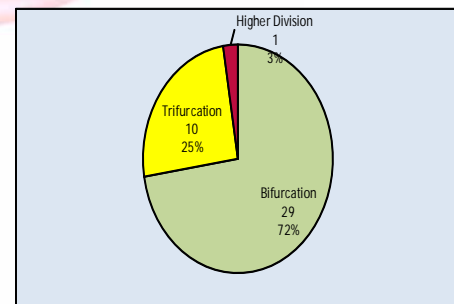


Fig. 3: Trifurcation type of branching pattern of ulnar nerve,1 superficial branch, 2&3-digital branches,4 deep branch.

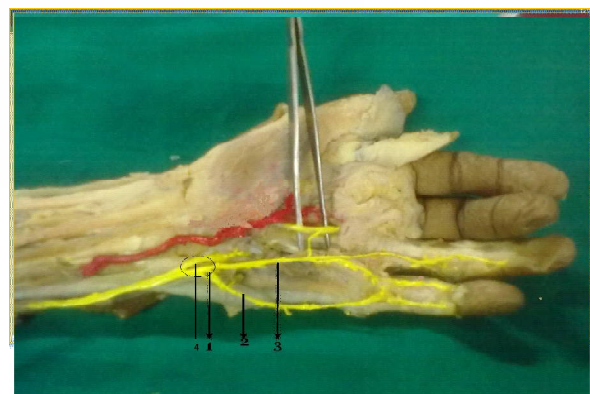


Fig. 4: Higher division showing trifurcation into 1-branch supplying wrist joint, 2 deep branch for muscles of hand, 3 superficial branch. trifurcation of superficial branch in hand into one communicating branch to median nerve, and 2 digital branches.

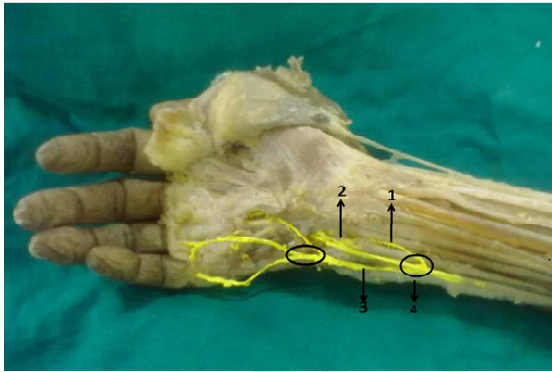


Fig. 6: Measurement of distance for origin of communicating branch from bistyloid line.

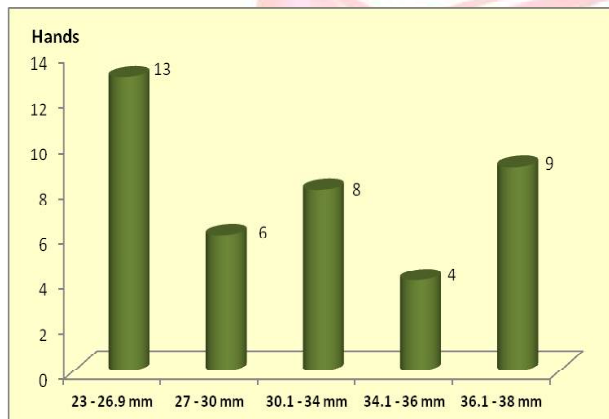


Fig. 5: Measurement of distance in millimeters of division of superficial branch from bistyloid line.

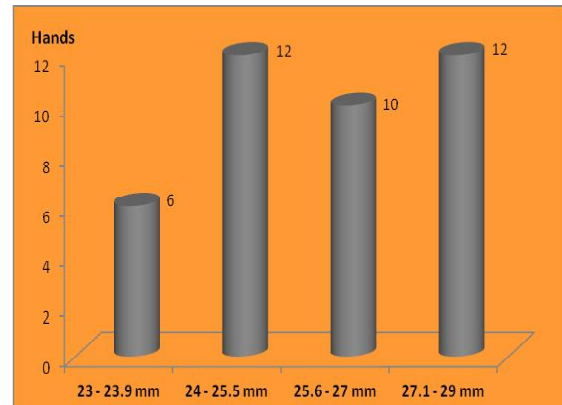
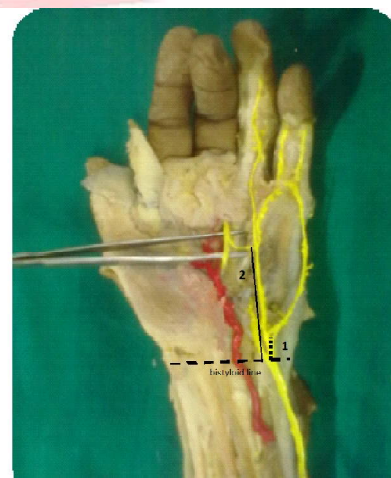


Fig. 7: Bistyloid line, division of superficial branch and origin of communicating branch to digital branch of median nerve is shown.



DISCUSSION

Classical descriptions of ulnar nerve branching state that it divides into deep and superficial branches, a pattern seen in 78% of cases as the nerve passes in Guyon's canal resting on the pisohamate ligament and covered by the transverse volar ligament. Trifurcation was reported previously in 11 out of 50 cases, and in four of these, the trifurcation occurred in Guyon's canal. (2). In the present study the classical pattern of bifurcation of ulnar nerve was observed in 29 hands. The trifurcation pattern of branching was seen in 11 specimens out of which 1 hand showed a higher division rest trifurcated in Guyon's canal.

Niitsu, Kokubo & Nojima studied the ulnar nerve in 30 cases by using ultrasound and 3T MRI. They reported that out of 30 hands, 21 (70%) revealed bifurcation and 9 (30%) had trifurcation branching pattern of the ulnar nerve. In 16 hands (54%), imaging demonstrated that a single nerve

entered the canal and divided into two trunks, one superficial and one deep, then exited the canal. The bifurcation occurred predominantly just after entering the canal inlet. The typical trifurcation pattern indicated that a single trunk entered the canal and divided into two, then one of the two bifurcated, producing a trifurcated pattern with two superficial and one deep bundle [7]. In this present study 29 specimens showed bifurcation and 10 showed trifurcation in the Guyon's canal, 1 hand showed a higher division proximal to the Guyon's canal and trifurcation of ulnar nerve.

Lindsey and Watumull studied 31 fresh adult upper extremities to delineate the regional anatomy of the ulnar nerve and artery at the wrist. Two pattern of division of the ulnar nerve trunk were identified: A and B. Pattern A occurred in 25 of the specimens where the ulnar nerve bifurcated into a main sensory trunk and a motor branch. Pattern B occurred in 6 of the specimen

ulnar nerve trifurcated into two common digital sensory branches and a motor branch [8]. Similarly in the present study the trifurcation was observed in 10 hands into 2 digital sensory branches and one motor deep branch. The pattern A type of branching was observed in 29 hands in the present study. Gabriel & Maker (2011) described trifurcation of the ulnar nerve just proximal to the pisiform bone. In their study the nerve divided into deep and superficial divisions and a separate muscular branch that supplied three heads for the abductor digiti minimi [9]. Trifurcation of the ulnar nerve proximal to Guyon's canal was seen in 1 right hand of a male cadaver into 3 branches one branch to wrist joint, one deep branch supplying the intrinsic muscles of hand and one superficial branch which entered the Guyon's canal.

Gindha G S et al. studied the termination of ulnar nerve in 50 cadaveric hands in which trifurcation was observed in 7 hands. In 4 out of 7 hands the trifurcation resulted in 2 superficial and 1 deep branches. In the remaining 3 hands the ulnar nerve trifurcated into 2 deep branches and 1 superficial branch. In this present study 10 specimens showed trifurcation which gave rise to 2 superficial and 1 deep branch whereas in 1 hand the trifurcation was at a higher level proximal to Guyon's canal and it gave rise to 1 branch to wrist joint 1 deep branch and 1 superficial branch [1].

The communications between common digital nerves that arise from the ulnar and median nerves in the palmar surface of hand is called 'ramus communicans cum nervi ulnari' in Terminologia Anatomica [11]. Overlap and variations of this division exist and communicating branch between the ulnar fourth common digital nerve and the median third common digital nerve can explain further variations in digital sensory patterns. Berretini's anatomic drawings from 1741 are the earliest illustrations of communicating branch [10].

The communicating branches between the fourth and third common digital nerves in the palm of the hand were studied in 53 dissected cadaveric hands. A communicating branch was found in 50 hands. It originated proximally from the fourth common digital nerve to joint the third common digital nerve distally in 44 hands and traversed

perpendicularly between the third and fourth common digital nerves in 4 hands. In the 2 remaining hands the branch left the third common digital nerve proximally to joint the fourth digital common nerve distally. In 90% of the hands the ramus communicans crossed over in the middle third of the palm of the hand [10]. In present study the ramus communicans was observed in all the 40 hand specimens in 13 hands it directly originated from the superficial branch whereas in remaining 27 it originated from the 4th common digital branch of ulnar nerve and joined the 3rd common digital branch of median nerve as in Fig. 7.

In another study grossly and endoscopically examined 200 formalin-fixed adult human hands obtained in 100 cadavers, the communicating branch in palmar surface of hand between the digital branches of ulnar and median nerves were observed and a communicating branch was found to be present in 170 hands (85%) [12]. In the present study the communicating branch was present in all the 40 hands.

CONCLUSION

Understanding the branching pattern of ulnar nerve in the Guyon's canal and its variation can be informative not only in presurgical planning to avoid nerve injuries but also its important for diagnosis of ulnar nerve compressive syndromes of the hand. Sensation in the palmar surface of the digits is supplied by the median and ulnar nerves, with the boundary classically being the midline of the ring finger. Overlap and variations of this division exist, and a communicating branch between the ulnar and median nerve could potentially explain further variations in digital sensory innervations. Thus this study tries to add to the existing knowledge of the anatomy of ulnar nerve in hand and calls for further studies.

Conflicts of Interests: None

REFERENCES

- [1]. Gindha G S, Kaushal S, Kalyan G. S, Sharma A. Variation in termination of ulnar nerve in hand (trifurcation of ulnar nerve). Journal of advance researches in Biological Sciences 2013;5(4):326-330.
- [2]. F Bonnel, R M Vila. Anatomical study of the ulnar nerve in the hand. J Hand Surg Eur. 1935;10(2):185-188.

- [3]. Georgios Paraskevas, Christos Ch Gekas, Alexandros Tzaveas, Ioannis Spyridakis, Alexandra Stoltidou, and Parmenion Ph Tsitsopoulos. Kaplan anastomosis of ulnar nerve a case report. *J Med Case Reports* 2008;2:107.
- [4]. Meals RA, Shaner M. Variations in digital sensory patterns: a study of the ulnar nerve-median nerve palmar communicating branch. *J. Hand Surg. [Am]*. 1983;8:411–41.
- [5]. Nadire UNVER DOGAN Ismihan Ilknur UYSAL Muzaffer SEKE. The communications between the ulnar and median nerves in upper limb: Review article. *Neuroanatomy* 2009;8:15-19.
- [6]. Daniel B. Polatsch, Charles P. Melone Jr., Steven Beldner, Angelo Incorvaia. Ulnar nerve anatomy. *Hand clinics*. 2007;23(3):283–289.
- [7]. Niitsu M, Kokubo N, Nojima S . Variations of the ulnar nerve in Guyon's canal: in vivo demonstration using ultrasound and 3 T MRI. *Acta Radiol*. 2010 Oct;51(8):939-46.
- [8]. John T Lindsey, Denton Watumull. Anatomic study of the ulnar nerve and related vascular anatomy at Guyon's canal: A practical classification system. *Journal of hand surgery* July 1996;21(4):626-633.
- [9]. Mounir N. GHABRIEL Philip H. MAKAR Anatomical variations in the ulnar nerve and hypothenar muscle. *International Journal of Anatomical Variations* 2011;4:131–133.
- [10]. Don Griot JP, Zuidam JM, Kooten EO, Prose LP, Hage JJ. Anatomic study of the ramus communicans between the ulnar and median nerves. *J. Hand Surg*. 2000;25(5):948–954.
- [11]. Federative committee on Anatomical Technology. *Terminologia Anatomica*. Stuttgart, Thieme.
- [12]. Marios Loukas, Robert G. Louis Jr, Lynsey Stewart, Barry Hallner, Terry DeLuca Walter Morgan, Ranjil Shah, and Jim Mlejnek. The surgical anatomy of ulnar and median nerve communications in the palmar surface of the hand. *Journal of Neurosurgery* May 2007;106(5):887-893.

How to cite this article:

A Priyadarshini, Sudakshina Chakrabarti, Gunapriya Raghunath. ULNAR NERVE, ITS TERMINATION AND SUPERFICIAL BRANCHES IN HAND: A CADAVERIC STUDY. *Int J Anat Res* 2015;3(4):1481-1486. DOI: 10.16965/ijar.2015.270