

A Morphological Study Of The Sensory Innervation Of Hand In South India With Its Clinical Implications

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Abstract

Introduction: The sensory innervation of the hand is getting a lot of attention because of the quick surge in the usage of local anesthesia and the progress of plastic surgeries. It is significant to know the likely disparities in the sensory innervation of the hand to prevent mistakes while analyzing the symptoms or misdiagnosing the nerve pathology. So this study aims to assess the sensory innervation of the hand.

Materials and Method: The study was carried out on 54 upper limbs. All the branches of the median, ulnar and radial nerve were traced. Variations in the distribution and anastomoses were noted.

Results: Anastomosis between the median and ulnar nerve was found in 12.95% of cases. In all cadavers, 3 ½ digits are supplied by the median nerve and 1 ½ digits by the ulnar nerve bilaterally in the palms. In all cadavers 2 ½ digits, each is supplied by radial and ulnar nerve bilaterally on the dorsum of hands.

Conclusion: These anatomic conclusions will aid hand surgeons in identifying differences in sensory losses after either dorsal or palmar injuries.

Keywords: Ulnar nerve, Median nerve, Radial nerve, Anastomosis, Anesthesia

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INTRODUCTION

Due to a rapid surge in the usage of local anesthesia and various operations concerned with the hand, wrist, and digits, it is essential to be familiar with the sensory distribution in both the palmar and dorsum aspects of the hand⁽¹⁾.

The areas of the hand which get cutaneous innervation

by the median nerve are the thenar eminence, the lateral side of the palm and the skin of 3 ½ digits on the lateral side. It also supplies the dorsal side of 3 ½ digits but till the distal phalanges⁽²⁾.

The ulnar nerve supplies cutaneous innervation in the palm to hypothenar eminence, medial side of the palm, medial 1 ½ digits. On the dorsum also it supplies 1 ½ digits⁽³⁾.

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The Knowledge of anatomical variations is essential for quick and appropriate identification of nerve dysfunction and to avoid delay of management. One important variation which can be encountered in hand is Riche-Cannieu anastomoses. This anastomosis happens when the median and ulnar nerves join in the palm. This variant shows the ulnar nerve now carries the motor fibers which are characteristically carried by the median nerve to the hand and later they cross over in the palm. This is clinically important in the cases of carpal tunnel syndrome. Patients who have progressive median nerve pathology could have the usual function of the typical median nerve distribution⁽³⁾.

The superficial branch of the radial nerve divides into two branches. The lateral branch supplies cutaneous innervation to the skin of the radial side and the ball of the thumb. The medial branch will divide into four branches and it supplies the ulnar side of the thumb, both sides of the index finger, the radial side of the middle finger, and the dorsum of the hand⁽⁴⁾.

The sensory distribution of the hand can vary but knowing the most common distribution of nerves and identifying the likely variants is significant to prevent mistakes in the analysis of conduction velocity studies, misdiagnosing the nerve pathology signs and symptoms, and incorrect management⁽⁵⁾.

So this study aims to assess the sensory innervation on both the palmar and dorsal aspects of the hand and its variations.

MATERIALS AND METHODS

The study was carried out on 54 formalin- fixed upper limbs (right 33, left 21). As the study was done on cadavers so the ethical approval by the institutional ethical committee was exempted from review. Following the steps mentioned in Cunningham's manual the incision was given on the dorsal and palmar aspects. The skin, superficial fascia, and palmar aponeurosis were reflected. All the branches of the median, ulnar, and radial nerve were traced to the digits. Any anastomoses between the nerves were noted. Anastomoses distance was measured from the pisiform bone and the head of the 4th metacarpal with the help of the vernier caliper. The Length of anastomosis was measured and the angle which it makes with the ulnar

nerve branch at the starting point was also measured. The variations in the nerve were noted and photographed.

Statistical analysis: Regular statistics were used and results were described in percentages.

RESULTS

Anastomosis of the median and ulnar nerve was found in 7 of 54 (12.95%) dissected anatomical specimens. Five of them were from the right hand (9.25%) and two from the left hand (3.70%).

Description of anastomosis between median and ulnar nerve

In three out of 5 right hands, the anastomotic branch from the common digital branch of the ulnar nerve starts at the level of pisiform and goes obliquely to join the proper digital branch which is supplying the lateral side of 4th digit from the lateral common digital branch of the median nerve 2cm below the head of the 4th metacarpal. The mean length of anastomosis was 5.2cm and the mean angle where the ramus starts from the ulnar nerve was approximately 10°. (Fig 1) On the other 2 hands, the anastomotic branch from the common digital branch of the ulnar nerve starts 3.5cm distal to the pisiform and goes obliquely to join the lateral common digital branch of the median nerve 4cm proximal to the head of the 4th metacarpal. The mean length of anastomosis was 4.5cm and the mean angle where the ramus starts from the ulnar nerve was approximately 30°. (Fig 2)

In both left hands, the anastomotic branch from the common digital branch of the ulnar nerve starts 2cm distal to the pisiform and goes obliquely to join the lateral common digital branch of the median nerve 6.5cm proximal to the head of the 4th metacarpal. The mean length of anastomosis was 5.5cm and the mean angle where the ramus starts from the ulnar nerve was approximately 10°. (Fig 3)

Distribution of median, ulnar, and radial nerve in the hand

100% on the right and left side palm- 3 ½ digits are supplied on the lateral side by the median nerve and 1 ½ digits on the medial side by the ulnar nerve. 100% on the right and left side dorsum- 2 ½ digits on the lateral side are

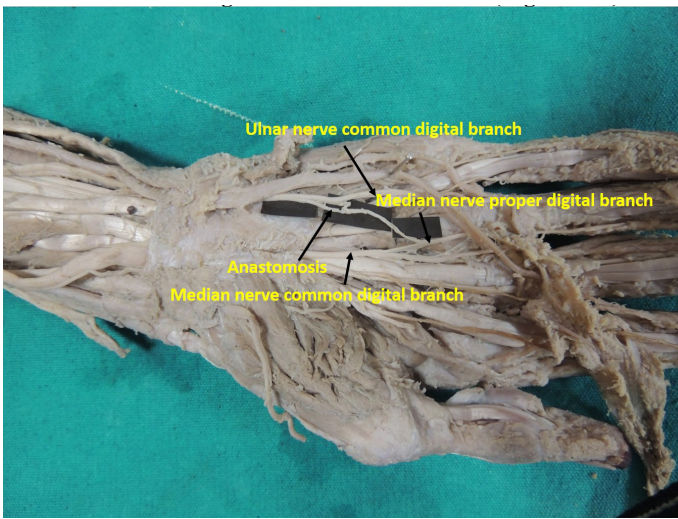


Fig. 1. Anastomosis between a proper digital branch of the median and the common digital branch of the ulnar nerve (Right hand).

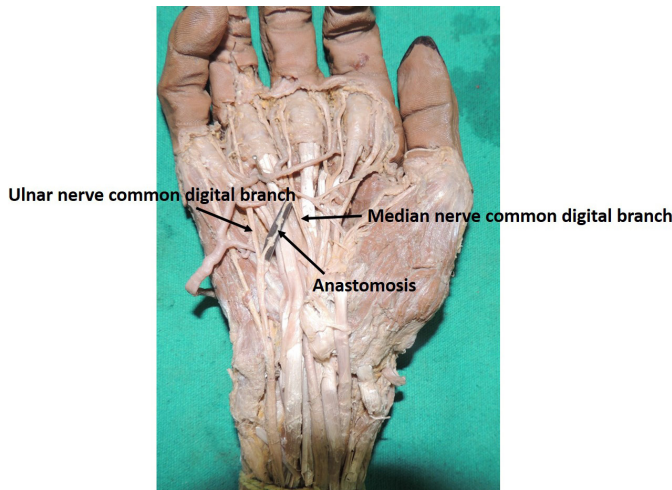


Fig. 2. Anastomosis between a common digital branch of the median and the common digital branch of the ulnar nerve (Right hand). The anastomotic branch from the common digital branch of the ulnar nerve starts 3.5cm distal to the pisiform and the mean length of anastomosis was 4.5cm.

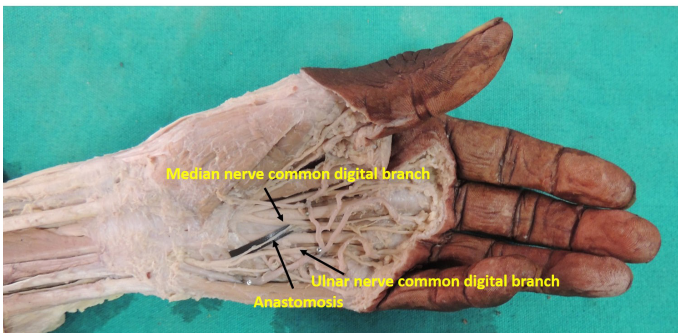


Fig. 3. Anastomosis between a common digital branch of the median and the common digital branch of the ulnar nerve (Left hand). The anastomotic branch from the common digital branch of the ulnar nerve starts about 2cm distal to the pisiform and the mean length of anastomosis was 5.5cm.

supplied by the radial nerve and 2 ½ digits on the medial side by the ulnar nerve.

DISCUSSION

Median and ulnar nerve anastomosis is the most prevalent form of abnormal innervation. This can lead to disparities in the distribution of sensory innervation and motor supply to the intrinsic muscles of the hand⁽⁶⁾.

Thorough information about the anatomy of the cutaneous supply to the dorsum of the hand is essential. Since the surgical entrance to the wrist is through the dorsal skin it is necessary to define a zone where surgical incisions would not damage the underlying nerves⁽⁷⁾.

Bas H and Kleinert JM did the microscopic anatomic dissections on 30 fresh cadaveric hands to show the path and anastomosis of the sensory nerves to the digits. They found that 20 out of 30 (67%) specimens had ulnar and median nerve communication in the palm⁽⁸⁾. Vashishtha K dissected 50 hands of twenty-five cadavers in three years. He observed that a communicating branch between the median and ulnar nerves is seen in 10 hands (20%)⁽⁹⁾. But in our study, it was found only in 12.95% of cases⁽⁸⁾. The difference might be because Bas H and Kleinert JM conducted the study in USA and Vashishtha K conducted the study in the Punjabi population. But our study was conducted in the south Indian population so there can be racial differences.

Sulaiman S et al studied the sensory innervation in the dorsum of the hand in 150 hands. They found that the most common pattern was the superficial branch of the radial nerve supplying the dorsal surface of the lateral 2½ digits and the dorsal branch of the ulnar nerve innervating the dorsal surface of the medial 2½ digits. Dual supply was also noticed because of communicating branches or overlapping of nerves in 41 cases. In 10 cases it was found that the whole of the dorsum of the hand was innervated by the superficial branch of the radial nerve.⁽⁵⁾ Even in all our cases, we found their most common pattern that is the dorsum was supplied by the superficial branch of the radial nerve innervating the lateral 2½ digits and the dorsal branch of the ulnar nerve innervating the medial 2½ digits.

These anatomic findings will aid hand surgeons in identifying differences when there is a loss of sensation after either dorsal or palmar injuries.

The information on the above variants will help surgeons to avoid median, ulnar and, radial nerve injuries. The anastomotic communication will be “at risk” when performing a transection of the ulnar aspect of the transverse carpal ligament or during exploration of Guyon’s space as these are near the pisiform bone. So, the distance of those communications should be known to surgeons while exploring these areas. Even during open or endoscopic carpal tunnel release, these anastomotic branches are at risk of being injured.⁽¹⁰⁾ Wrist lacerations can lead to median nerve injuries which can cause motor deficits like ape hand deformity and sensory deficit in lateral 3 ½ digits as well as their nail beds and the thenar zone. Ulnar nerve injuries can be caused by penetrating wounds leading to loss of sensation in the ulnar half of the palm 1 ½ digits and dorsum 2 ½ digits causing claw hand deformity. Radial nerve injuries can cause a sensory deficit in the radial half of the dorsum of the hand 2 ½ digits not including the nail beds. The results of this study will also help neurosurgeons in identifying these deficits if they know the typical distributions of these nerves and their variations.

REFERENCES

1. Neha and Krishna H. Unusual bilateral sensory innervation of the dorsum of hand by lateral antebrachial cutaneous nerve: a case report. *Anat Cell Biol.* 2018; 51(1): 66–69. DOI.10.5115/acb.2018.51.1.66.
2. Meyer P, Lintingre PF, Pesquer L, et al. The Median Nerve at the Carpal Tunnel and Elsewhere. *J Belg Soc Radiol.* 2018; 102(1): DOI.17. 10.5334/jbsr.1354.
3. Becker RE, Manna B. Anatomy, Shoulder and Upper Limb, Ulnar Nerve. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL), Dec 15; 2018. Last Update: July 31, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK499892/>.
4. Spindler HA and Felsenthal G. Radial Sensory Conduction in the Hand. *Arch Phys Med Rehabil.* 1986; 67:821-823.
5. Sulaiman S, Soames R and Lamb C. Ulnar nerve cutaneous distribution in the palm: Application to surgery of the hand. *Surg Radiol Anat.* 2015; 37(7): 779-785. <https://doi.org/10.1002/ca.22626>.

6. Kimura J, Murphy MJ, Varda DJ. Electrophysiological study of anomalous innervations of intrinsic hand muscles. *Arch Neurol*. 1976; 33(12):842–844. DOI: 10.1001/archneur.1976.00500120046007.
7. Mok D, Nikolis A, Harris PG. The Cutaneous Innervation of the Dorsal Hand: Detailed Anatomy With Clinical Implications *J Hand Surg [Am]*. 2006; 31A: 565 – 574. DOI: 10.1016/j.jhsa.2005.12.021.
8. Bas H, Kleinert JM. Anatomic variations in sensory innervation of the hand and digits. *J Hand Surg [Am]*. 1999; 24(6):1171-84. DOI: 10.1053/jhsu.1999.1171.
9. Vashishtha K. Variations of median nerve in carpal tunnel and its distribution in hand. *J. Anat. Soc. India*. 2011; 60(2): 193-198.
10. Don Griot, JPW, Zuidam JM, Kooten EO, Poliacu Prose' L, Joris Hage J. Anatomic Study of the Ramus Communicans Between the Ulnar and Median Nerves. *The Journal of Hand Surgery*. 2000;25A(5):948-954.