



Research Article

VARIATIONS OF MEDIAN NERVE IN HAND FROM SURGICAL POINT OF VIEW

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ABSTRACT

Introduction: The Median nerve or labourer's nerve has wide distribution up to wrist and palm of hand. The aim of this study is to find out the prevalence rates of anatomical variations of Median nerve in carpal tunnel, wrist, along with variations of the median nerve of hand, the thenar recurrent branch. **Materials & Methods:** 50 upper limbs of 25 adult embalmed cadavers were dissected in West Bengal, during routine UG dissections for two academic sessions 2021-22 and 2022-23. All the variations of Median nerve including thenar recurrent nerve were noted. **Results:** In 98% cases two common digital nerves arose from medial division of Median Nerve and in 2% cases lateral common digital nerve arose from lateral division of Median Nerve. In 4% cases accessory Thenar recurrent nerves were present. Thenar recurrent nerve course was found Extragligamentous in 72% cases, Subligamentous in 20% cases and Transligamentous variety in 8% cases.

Conclusion: During repair of traumatic injuries at hand, release of flexor retinaculum for carpal tunnel syndrome, surgeries involving the thenar muscles, awareness of anatomical variations of the Median nerve and its thenar recurrent branch is important for their preservation.

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INTRODUCTION

Median nerve anatomical variations at the wrist are not uncommon and this knowledge is important for precise dissection of the nerve during repair of traumatic injuries and treatment of compression syndrome [1]. In patients of carpal tunnel syndrome knowledge of variation will prevent damage of Median nerve during its release. Standard anatomical books states that at wrist Median nerve enters the carpal tunnel deep to the flexor retinaculum and reaches the palm beyond the distal border of flexor retinaculum and divides into lateral and medial branches [2]. The lateral branch gives off a recurrent muscular branch to supply the three thenar muscles and then subdivides into three proper palmar digital nerves to supply the two sides of the thumb and radial side of the index finger. The branch to the index finger provides a branch to the first lumbrical. The medial branch subdivides into two common palmar digital nerves, lateral and medial. The lateral common digital nerve gives a branch to the second lumbrical and subdivides to supply the adjacent sides of the index and middle finger. The medial common digital nerve receives a communicating branch from the superficial branch of the ulnar nerve and then subdivides to supply the adjacent sides of the middle and ring finger [3,4]. There are a few clinical and electrophysiological clues indicating anatomic variations of

Median nerve at wrist [5]. Therefore, indirect evidences should be sought to anticipate the Median nerve anomalies. Awareness of anatomic variations of the Median nerve and presence of persistent Median artery (PMA) should be a part of the preoperative planning, in order to avoid the risk of the Median nerve injury or incomplete decompression at operation. This study was conducted to determine the incidence of variations of Median nerve in hand with special emphasis on the thenar recurrent branch.

MATERIALS & METHODS

Study Area: Dissection Hall, Department of Anatomy, NRS Medical College and Hospital, Kolkata.

Study Population: Adult properly embalmed cadavers from West Bengal population.

Study Period: UG dissections for 2 academic sessions 2021-22 and 2022-23.

Sample Size: 50 upper limbs of 25 well embalmed adult cadavers of both sexes.

All cases with congenital anomalies, deformities and injuries to the hand and wrist were excluded from the study.

Study Design: Cross-sectional observational study.

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Parameters to Be Studied

- A. Level of division and pattern of division of Median nerve.
- B. Variations of thenar recurrent branch (TRN) in respect to its origin, course and termination.
 - i. Numbers of thenar recurrent nerve.
 - ii. Origin of thenar recurrent nerve: Lateral side /Medial side/ Palmar aspect of Median nerve.
 - iii. Course of TRN: Extraligamentous/ Subligamentous/ Transligamentous.
- C. Communication with ulnar nerve: present or not.
- D. Variations of Common digital nerves.
- E. Lumbricals supplied by Median nerve.
- F. Accessory branch from Median nerve and persistent Median artery - present or not in near proximity to carpal tunnel.

STEPS OF DISSECTION

The hand dissection was started with an incision at the junction of upper 2/3rd and lower 1/3rd of front of forearm. Next horizontal incision was given at the level of the webs of the fingers. 3rd incision given along the midline of palm extending up to the tip of middle finger and last incision was given obliquely along the medial border of the thenar eminence. After reflection of skin and superficial fascia, the palmar aponeurosis was dissected off from its proximal attachment over carpal tunnel. Careful dissection of margins of palmar aponeurosis near thenar eminence was done to protect the thenar recurrent branch of Median nerve. For Carpal Tunnel dissection, a probe was inserted deep to flexor retinaculum proximo-distally and flexor retinaculum was incised using a scalpel in line of underlying probe to open carpal tunnel. Here Median nerve was identified and then traced proximally from flexor retinaculum up to the division of the common digital nerve to proper digital nerves distally. Nerve supply to the lumbricals and communication of Median nerve with ulnar nerve was recorded. All the recurrent muscular branches to the thenar eminence were dissected carefully. The course of the thenar recurrent nerve was studied in detail according to the parameters described above. The presence of PMA was also noted. All the findings were studied and tabulated to compare with other studies and photographs were taken.

RESULTS

A. At the distal border of flexor retinaculum Median nerve presented as bifurcated trunk was most common presentation, noted in 84% cases (42 out of 50) cases. Out of these 42 cases in 2 cases (4%) high division of Median nerve (divided in forearm) were identified (**Fig 1 and 2**). Trifurcation, quadrifurcation, penta-furcation of Median nerve at distal border of flexor retinaculum was noted in 10%, 2% and 4% cases respectively.

B. Thenar recurrent nerve variations

i. Numbers: In 96% cases thenar recurrent nerve was present as single ramus. In 2 cases out of 50 specimens (4%) accessory thenar recurrent nerve was noted. In one hand proximal accessory thenar branch was identified which was having transligamentous course and another thenar recurrent branch which was arising from the lateral side of lateral division of Median nerve was extraligamentous in course.

Another hand showed 2 thenar recurrent nerves arising from the lateral side of lateral division of Median nerve and entering within the thenar muscle.

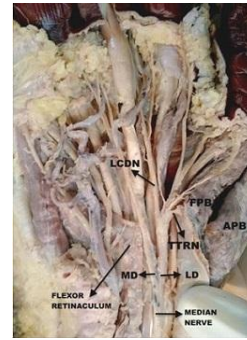


Figure 1 High division of Median nerve with lateral common digital nerve (LCDN) arising from lateral division of Median nerve in palm. Here thenar recurrent nerve is transligamentous variety (TTRN) and common digital artery passing through nerve loop formed by proper digital branches of Median nerve.

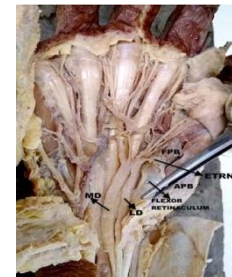


Figure 2 Showing high division of Median nerve in lower forearm with extraligamentous thenar recurrent nerve branch (ETRN).

ii. Site of origin: In this study the TRN was originating from the radial side of the Median nerve in 74% cases, in 20% cases was arising from palmar aspect of Median nerve and arising from ulnar side of the Median nerve in 6% cases.

iii. Course: In 72% cases (36 out of 50) TRN is presented as extraligamentous course, which is the most common variety presented in our study. The second most common type is subligamentous variety which was noted in 20% cases (10 out of 50) and the least common type was Transligamentous variety present in 8% cases.

C. Communication: Medial common digital branch of Median nerve with ulnar nerve was noted in 94% cases (47 out of 50) (**Fig 3**). Such clear communication was absent in rest 3 hands (6%).



Figure 3 Trifurcation of Median nerve noted at distal border of flexor retinaculum (1 lateral and 2 common digital branches) with extraligamentous thenar recurrent nerve (ETRN). Here communication with ulnar nerve (CB) was noted.

D. In 98% cases 2 common digital nerves were arising from medial division of Median nerve. In 2% of cases (1 case out of 50) the lateral common digital nerve arose from lateral division of Median nerve in hand (**Fig 1**).

In few cases 6 out of 50 hands (12%) one additional finding was noted, the medial common digital nerve was dividing into two proper digital nerves, then reuniting to form a nerve loop, then splitting again to give proper digital nerves. The common digital artery arising from the superficial palmar arch is passing through this closed nerve loop.

E. Lumbricals supplied by Median nerve: 3 out of 50 cases third lumbrical was supplied by Median nerve and 1 out of 50 cases showed only first lumbrical was supplied by Median nerve.

F. PMA: No Persistent Median Artery was recorded.

Usually the recurrent branch is the motor branch, short and thick, arising from the lateral side of the Median nerve. This muscular branch may also arise in the carpal tunnel and pierce the flexor retinaculum. Anomalies of the Median nerve occur in approximately 10% of patients undergoing a carpal tunnel release. These branches usually arise from the ulnar side of the nerve and may be motor or sensory [7].

According to the study of Ahn DS et al. [8], site of origin of TRN from the Median nerve is from the lateral side of lateral division of Median nerve recorded most commonly, but the origin may vary and the TRN may arise from palmar or ulnar side of Median nerve.

Author	Population of study	Source (Sample size)	Extra-ligamentous	Subligamentous	Transligamentous
Tountas ³	America(N America)	IO(286) C(92)	95.10% 81.52%	2.79% 9.78%	1.40% 8.70%
Poisel ⁶	German(Europe)	C (100)	46%	31%	23%
Ahn ⁸	Korea(Asia)	IO(354)	96.1%	2.8%	1.1%
Hurwitz ⁹	Swiss(Europe)	IO(80)	55%	29%	16%
Pernecky ¹⁰	French(Europe)	C(163)	51%	23%	26%
Mizia E ¹¹	Polish(Europe)	C (60)	78.34%	20%	1.66%
Al-Qattan ¹² *1	Saudi Arabian(Asia)	IO(100)	56%	34%	9%
Olave ¹³ #	Brazil(S America)	C(60)	80%	18.3%	0%
Kozin ¹⁴	America(N America)	C(101)	93%	0%	7%
Agarwal ¹⁵	India(Asia)	C(52)	36.53%	21.15%	42.30%
Raviprasanna ¹⁶	India(Asia)	C(51)	78.39%	19.6%	1.96%
Sacks ¹⁷	America(N America)	C(48)	92%	0%	8%
Present study	India(Asia)	C(50)	72%	20%	8%

Table I Showing distribution of cases according to the course of thenar recurrent nerve in relation to flexor retinaculum. [# Lanz group III – 1.66%*1-Preligamentous-1, C-Cadaver, IO-Intraoperative]

DISCUSSION

Poisel S et al. [6] classification of thenar recurrent branch of Median nerve is standard one and used by most of the previous authors. According to Poisel S et al. [6] TRN (Thenar recurrent nerve) or TMB (Thenar muscular branch) can be classified into 3 main types -

a) Extraligamentous variety- where TRN arises distal to the Transverse carpal ligament (TCL) or flexor retinaculum and winds backward to supply the thenar muscles.

b) Subligamentous variety- where TRN arises from the Median nerve within the carpal tunnel deep to flexor retinaculum, runs deep to it then curves around the distal border of flexor retinaculum to supply the thenar muscles.

c) Transligamentous type-TRN arises from Median nerve within carpal tunnel and pierces the flexor retinaculum to directly supply the thenar muscles.

Amongst all these 3 varieties the most common one is Extraligamentoustype [3-10].

In 1977 Lanz [1] has done more extensive study on this topic and extended the classification system. According to the study of Lanz [1], **Group I** (Thenar recurrent nerve variations), **Group II** is presence of accessory branch of the Median nerve in distal carpal tunnel; **Group III** is high division of the Median nerve associated with the presence of persistent Median artery; and **Group IV** depicts accessory branches of the Median nerve proximal to the carpal tunnel.

In **Table I**, studies of various authors based on course of thenar recurrent nerve in relation to flexor retinaculum are compared. Variations of branching pattern of median nerve in hand and variations in the thenar recurrent nerve is a significant finding noted in almost all the previous studies, both intra-operative as well as cadaveric. According to previous studies [3-10] most common pattern is extraligamentous variety. Although the percentage varies in different ethnicity but a common pattern is noted. In American origin population, extraligamentous type of thenar recurrent nerve was noted in 80-95% cases. But the second most common variety differed from author to author. Study conducted by Olave [13] in Brazilian population showed absence of any transligamentous variety but he noted presence of accessory branch of Median nerve in distal carpal tunnel in 1.66% cases. Other American population-based studies like Kozin [14] and Sacks [17] found no subligamentous presentation, but transligamentous presentation was in 8% and 7% cases respectively.

On the other hand European population based studies showed most common pattern extraligamentous variety present mostly in 46-55% cases (except study conducted by Mizia [11], who noted in to be present in 78.34% cases) and Second most common variety in is subligamentous variety noted in 20-30% cases, followed by transligamentous variety, which is the least common type.

In few studies authors has noted that variations of thenar recurrent branch of median nerve, mostly presence of

accessory thenar recurrent branches is often associated with hypertrophied thenar eminence [12].

Asian studies showed great variations in subtypes of Lanz I group. Study conducted by Agarwalet al.[15] showed most common variety was transligamentous type which was present in 42.30% cases amongst 52 cadaveric samples, followed by extraligamentous type in 36.53% cases and least common variety was subligamentous type noted in 21.15% cases. These findings are significantly different from other Asian origin studies.

In 2008 Neelanjitkaur et al. [18] conducted a study in north Indian population where they found single thenar recurrent nerve in 90% limbs. In rest of the cases thenar nerve presented as two rami in 5 out of 60 limbs (8.3%) and multiple branches in one case only.

Narayana VK et al. [20] conducted a study on variations of Median nerve in hand on 100 cadavers and noted that, Median nerve is always communicating with ulnar nerve (100%), though the site of communication varies. Communication between main trunk of Median nerve with common digital branch of 4th web space was noted in 8% cases and communication of digital branch for index finger with deep branch of ulnar nerve after piercing adductor pollicis was noted in 4% cases. In present study clear communication between digital branches of ulnar nerve and Median nerve was absent in 3 out of 50 hands. More the site of communication, greater is the chance of injuring the nerve intraoperatively.

Narayana VK et al.[20] noted third lumbrical receiving supply from common digital branch of Median nerve in 10% cases and Vashisththa K. [21] noted such finding in 12% cases, which is slightly higher than present findings i.e. in 6% hands innervation of 3rd lumbrical from Median nerve common digital branch of 3rd web space.

Study conducted by Palmer and Toivonen [21] showed, 63.55% cases of hand surgeries of Open and endoscopic carpal tunnel release, are associated with intraoperative complications like Median nerve lacerations, ulnar nerve lacerations, adjacent vessels injury, tendon injuries etc commonest being the vascular injury noted in 121 out of 708 operative cases. Digital nerve injuries were also common and injury of common digital nerve of 3rd web space was the commonest [21].

Observation in the present case about the common digital nerve of 3rd web space having loop like course to give passage to the common digital artery in between may be a reason of its being more prone to injury.

On comparison of this study with the study of Raviprasanna [16], Z score for transligamentous variety is 4.63 and p value is less than 0.0001, which is extremely significant statistical finding. It means transligamentous variety which is prone to injury is not so rare finding and surgeons must be careful to prevent intraoperative injury of thenar recurrent nerve especially when it is transligamentous type.

CONCLUSION

In transligamentous type there is potential chance of compression of thenar recurrent nerve as it traverses the flexor retinaculum producing entrapment neuropathy. When the thenar recurrent nerve arises from palmar aspect or ulnar

aspect of Median nerve, there are more chances that TRN gets injured during different operative procedures.

High division of Median nerve and variations of origin, course of common digital nerve of 3rd web space also to be kept in mind, as these variations are not rare. So, researchers of the present study are suggesting for considering the variations of Median nerve before proceeding for surgeries. More studies required in this field with more sample size for designing precise surgery techniques.

Conflict of Interest: None

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Ethical Approval:

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Availability Of Data & Materials

Not applicable.

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