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Original Research Article

An Anatomical Study of Median and Musculocutaneous Nerve Variations and Their Clinical Significance

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Abstract:

Background: Variations involving the median nerve (MN) and musculocutaneous nerve (MCN) are among the most frequently encountered anomalies of the brachial plexus. Knowledge of these variations is essential for anatomists, surgeons, anesthesiologists, and neurologists because abnormal nerve patterns may lead to diagnostic errors and intraoperative complications.

Aim: To study the anatomical variations of the median and musculocutaneous nerves in adult cadavers and assess their clinical significance.

Materials and Methods: A descriptive cadaveric study was conducted on 60 upper limbs obtained from 30 embalmed adult cadavers in the Department of Anatomy. The formation, course, branching pattern, communications, and variations of the median and musculocutaneous nerves were carefully dissected and documented. Data were analyzed using descriptive statistics.

Results: Normal anatomy was observed in 48 (80%) upper limbs. Variations were identified in 12 (20%) specimens. Communication between MCN and MN was the most common variation (10%). Absence of musculocutaneous nerve was observed in 3.3%, while anomalous formation of the median nerve by three roots was found in 5%. Variations were more frequent on the right side (58.3%) than the left side (41.7%).

Conclusion: Variations of the median and musculocutaneous nerves are common and clinically important. Awareness of these patterns is crucial during surgical procedures involving the axilla and arm, regional anesthesia, and interpretation of nerve injuries.

Keywords: Median nerve, Musculocutaneous nerve, Brachial plexus, Anatomical variation, Cadaveric study, Nerve communication.

Introduction

The brachial plexus is a complex neural network formed by the anterior rami of spinal nerves C5–T1 [1]. Among its terminal branches, the median nerve and musculocutaneous nerve play critical roles in motor and sensory innervation of the upper limb [2]. Conventionally, the musculocutaneous nerve arises from the lateral cord, pierces the coracobrachialis muscle, and supplies the anterior compartment muscles of the arm [3]. The median nerve is formed by the union of lateral and medial roots originating from the lateral and medial cords respectively [4]. Numerous studies have documented variations in the origin, course, branching pattern, and communications between these nerves [5]. Such anomalies are

attributed to altered embryological development of the brachial plexus [6]. These variations may complicate surgical interventions, nerve repair procedures, trauma management, and interpretation of electrophysiological studies [7].

Therefore, a detailed anatomical understanding of these variations is necessary to minimize iatrogenic injuries and improve clinical outcomes.

Aim: To study the anatomical variations of the median and musculocutaneous nerves in adult cadavers and evaluate their clinical significance.

Objectives

1. To determine the formation pattern of the median nerve.
2. To identify variations in the course and branching of the musculocutaneous nerve.
3. To study communications between the median and musculocutaneous nerves.
4. To assess the prevalence of these variations and discuss their clinical relevance.

Materials and Methods

This descriptive cross-sectional cadaveric study was conducted in the Department of Anatomy, Annapoorana Medical College and Hospitals, Salem, Tamil Nadu, over a period of one year from January 2021 to December 2021.

The study was performed on 30 embalmed adult cadavers comprising a total of 60 upper limbs available for routine undergraduate dissection. Cadavers of both sexes with well-preserved upper limbs and intact brachial plexus anatomy were included in the study.

Cadavers with damaged upper limbs, evidence of previous surgical interventions, traumatic injuries affecting the brachial plexus region, or congenital deformities of the upper limb were excluded. Standard anatomical dissection procedures were followed to expose the brachial plexus, median nerve, and musculocutaneous nerve. Careful dissection was carried out in the axillary and arm regions to observe the origin, formation, course, branching pattern, communications, and variations of the median and musculocutaneous nerves. All findings were documented systematically, photographed, and analyzed to determine the frequency and pattern of anatomical variations.

The collected data were tabulated and expressed as frequencies and percentages for descriptive analysis.

Dissection Procedure: Standard dissection procedures described in Cunningham's Manual of Practical Anatomy were followed. Skin, fascia, and muscles of the axilla and arm were carefully reflected.

The brachial plexus was exposed and the median and musculocutaneous nerves were identified. Their formation, roots, branching pattern, communications, and terminal distribution were documented and photographed.

Data Collection Variables: During the dissection of each upper limb, detailed observations were made regarding the anatomical characteristics of the median and musculocutaneous nerves.

The parameters recorded included the number of roots contributing to the formation of the median nerve, the presence or absence of the musculocutaneous nerve, and the course of the musculocutaneous nerve in relation to surrounding structures, particularly its relationship with the coracobrachialis muscle.

Special attention was given to identifying any communicating branches between the musculocutaneous and median nerves.

The side of occurrence (right or left upper limb) was noted to assess side predominance of the observed variations. Additionally, any associated anatomical

variations involving the brachial plexus, nerve branching patterns, or unusual nerve distributions were carefully documented and analyzed.

All observations were systematically recorded, photographed, and tabulated for subsequent descriptive statistical analysis.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS Version 25.0.Descriptive statistics were expressed as frequency and percentage.

P value <0.05 was considered statistically significant.

Results

Table 1: Distribution of Anatomical Variations Observed (n=60)

Variation	Frequency	Percentage
Normal Anatomy	48	80.0
MCN-MN Communication	6	10.0
Median Nerve by Three Roots	3	5.0
Absence of MCN	2	3.3
MCN not piercing Coracobrachialis	1	1.7

The majority of specimens (80%) showed normal anatomy. Communication between musculocutaneous and median nerves was the commonest variation observed (10%).

Table 2: Side-wise Distribution of Variations

Side	Number	Percentage
Right	7	58.3
Left	5	41.7

Variations were more common on the right side than the left side.

Table 3: Pattern of Median Nerve Formation

Formation Pattern	Frequency	Percentage
Two Roots (Normal)	57	95.0
Three Roots	3	5.0

Three-root formation was observed in three specimens.

Table 4: Types of Musculocutaneous Nerve Variations

Variation Type	Frequency
Communication with Median Nerve	6
Absence of MCN	2
MCN not piercing Coracobrachialis	1

Communication between MCN and MN represented the most frequent anomaly.

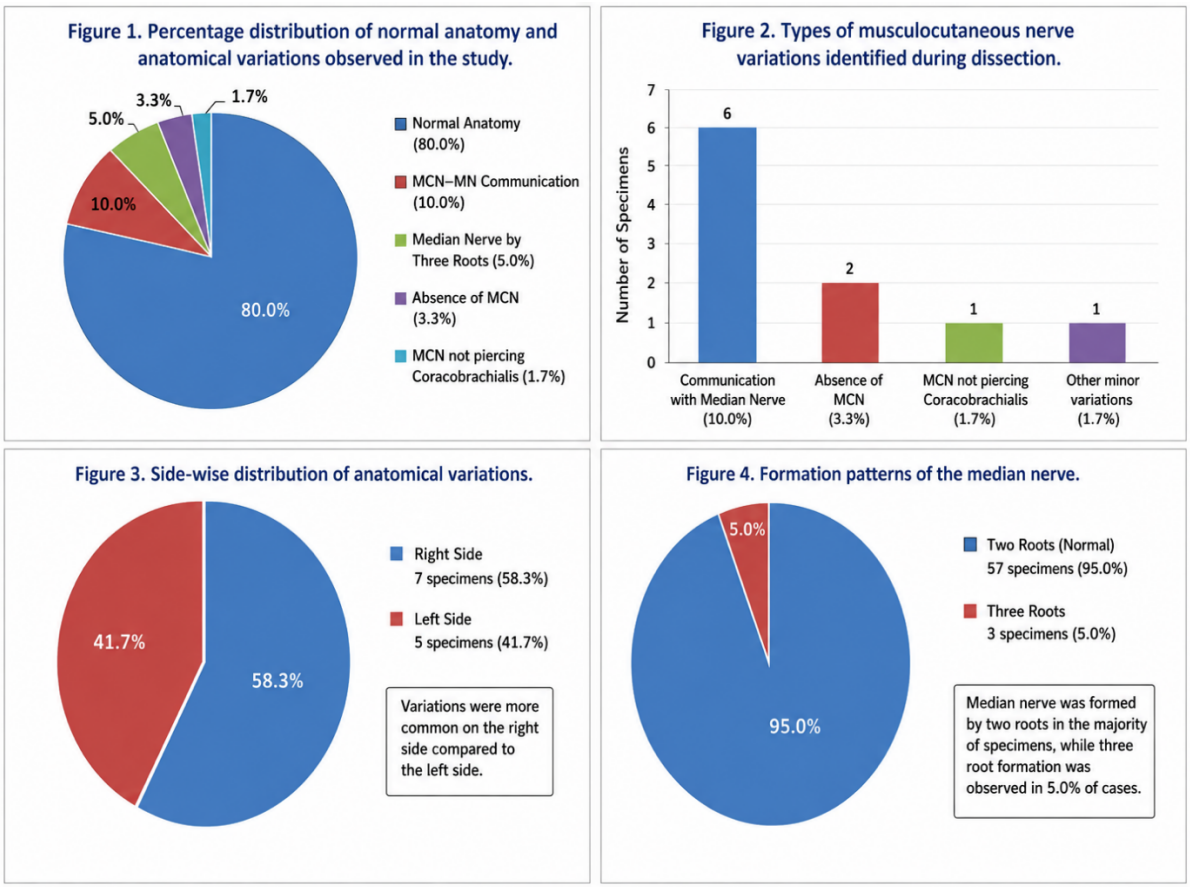

Figure 1-4:

Formation patterns of the median nerve.

In the present study, Figure 1 demonstrates that normal anatomy predominated in 80% of specimens, while Figure 2 highlights communication between MCN and MN as the most common variation. Figure 3 illustrates right-sided predominance of anomalies and Figure 4 depicts variations in median nerve formation.

Discussion

The present study observed anatomical variations in 20% of upper limbs, which is comparable to the findings of Sirico et al., who reported a pooled prevalence of approximately 19% for musculocutaneous nerve variations [8].

Communication between the musculocutaneous and median nerves was identified in 10% of specimens. Similar findings were reported by Chandrika et al. and Radunović et al., who documented communication frequencies ranging from 8–20% [9-11]. Three-root formation of the median nerve was found in 5% of specimens, consistent with the observations of Degene et al., who described additional lateral root contributions during median nerve formation[12-16].

Absence of the musculocutaneous nerve was observed in 3.3% of cases. Comparable findings were reported by Sarkar and Saha and Parchand and Patil, who noted compensatory innervation by the median nerve in such cases [17-18].

Embryologically, these variations may result from altered signaling between developing mesenchyme and growing nerve fibers during limb bud formation. Variations may significantly influence outcomes during brachial plexus surgery, nerve grafting, trauma repair, and regional anesthesia procedures [19-20]. Knowledge of these anomalies can prevent inadvertent

nerve injury and improve interpretation of unusual neurological deficits.

Conclusion

The median and musculocutaneous nerves exhibit considerable anatomical variability.

Communication between the two nerves is the most common variation. Awareness of these patterns is essential for surgeons, anesthesiologists, radiologists, and neurologists to prevent iatrogenic injury and improve diagnostic accuracy.

Detailed anatomical knowledge of these variations contributes significantly to successful surgical and clinical outcomes.

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