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Anatomical Variation of three roots of Median Nerve in a 72-year-old male cadaver : A Case Report

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Abstract

The median nerve typically forms by the fusion of a lateral root from the lateral cord and a medial root from the medial cord of the brachial plexus. These components, which carry fibres from the ventral rami from C6 to T1, usually come together anterior to the third part of axillary artery to form the nerve's classical configuration. Each root contributes distinct sensory and motor fibres that collectively supply the forearm and hand. In the present case, however, the formation of the median nerve diverged from the typical pattern, indicating an unusual configuration of its contributing roots. During routine undergraduate dissection sessions in the Department of Anatomy, JSS Medical College, Mysuru. An atypical pattern of median nerve formation was observed in the infraclavicular region of axilla The variation was meticulously documented and analysed. Concerning its potential embryological origin, anatomical connections, and clinical significances. Such deviations are of considerable significance to surgeons, anaesthesiologists, and clinicians performing interventions in the axilla, where unexpected nerve patterns may increase the risk of iatrogenic injury during nerve block.

Keywords: Anatomical variation, Brachial plexus, Brachial artery, Median nerve

Introduction

The median nerve is formed by the union of the lateral root (C6, 7) from the lateral cord, and the medial root (C8, T1) from the medial cord, which meet anterior to the third part of the axillary artery. Fibres in the lateral root innervate the palmar skin of the thumb, index, and most of the middle fingers, as well as the pronator teres, flexor carpi radialis, and some flexor digitorum superficialis. The lateral root transports the majority of sympathetic fibres to the hand's median distribution. The medial root sends fibers to the skin on the medial and lateral sides of the middle and ring fingers, as well as palmaris longus, flexor digitorum superficialis and the lateral part of flexor digitorum profundus, flexor pollicis longus, pronator quadratus, and the median innervated muscles in the hand [(1,2)].

The median nerve is a major terminal branch of the brachial plexus, normally formed by the union of two roots, a lateral root and a medial root in approximately 70.0% to 77.4% of cases. However, anatomical studies frequently report variations in its formation, with an overall incidence ranging from 22.6% to 30.0%. The most common variations involve the nerve forming from three or more roots, with the additional roots typically originating from the lateral cord. Knowledge of these variations is of paramount importance for the surgical and clinical teams, as their presence can significantly impact procedures like axillary dissection, lead to misdiagnosis of peripheral nerve lesions, or cause failure of brachial plexus block anaesthesia [(3,4)].

The present study is to report and document the observed variations of the median nerve encountered during routine dissection. Understanding this specific anatomical variation will contribute to existing knowledge by explaining its morphological features and reinforcing its clinical significance.

Case Report:

In the Department of Anatomy, a variation of the median nerve was identified in the right upper extremities of a male cadaver following dissection of the upper limb for medical undergraduate students. In a male cadaver aged around 72 years was preserved in 10% formalin and lacked any upper limb trauma or surgical lesions. Dissections of the upper limbs were guided by Cunningham's manual of practical anatomy. Both the left and right upper limbs. Were dissected the median nerve is normally formed by two roots: one from the lateral cord and another from the medial cord of the brachial plexus. In this study, left Upper limb specimen was showing the variation in the formation of varying median nerve. Three roots contribute to the formation of the median nerve in upper limb specimens, one from the medial cord and two from the lateral cord of the brachial plexus as shown in (Fig. 1) relation to axillary artery.

FIGURE 1: Formation of the median nerve by three roots, in which an additional root comes from the Lateral cord root, 1. Axillary artery, 2. Medial root of the median nerve, 3. Lateral root of the median nerve, 4. Additional root coming from the lateral cord, arrow mark in the image, 5. Median nerve, 6. Musculocutaneous nerve, 7. Short head of Biceps brachii muscle with coracobrachialis muscle

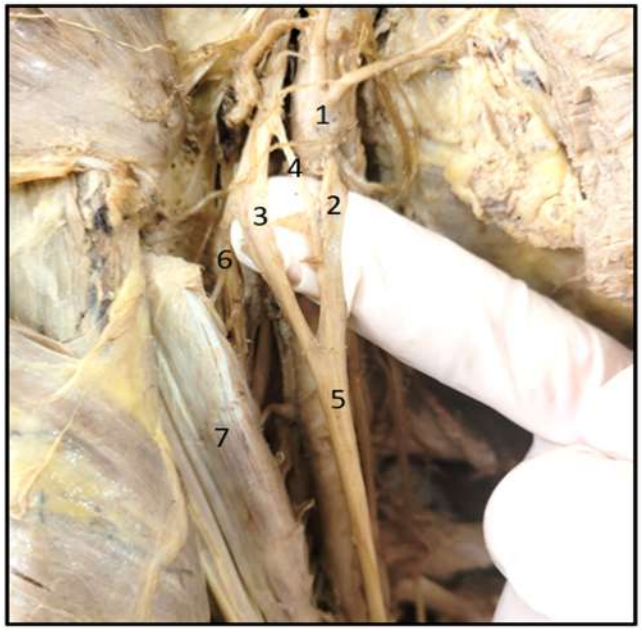

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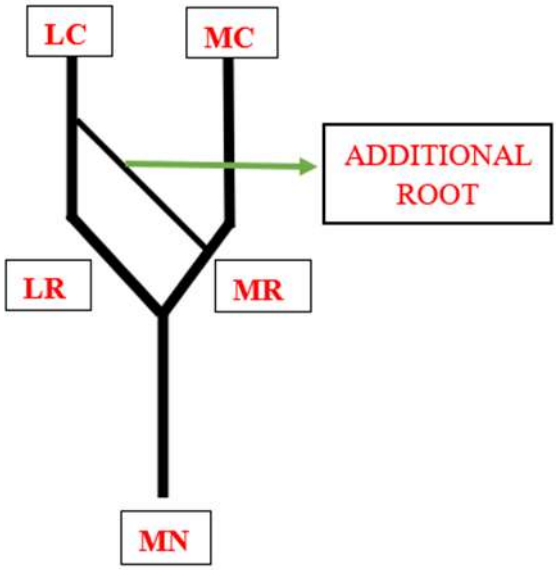
FIGURE 2: Diagrammatic presentation of the findings of the present study. LC: lateral cord; MC: medial cord; LR: lateral root of the median nerve; MR: medial root of the median nerve; MN: median nerve



Discussion:

The median nerve and its anatomical variations are significant concerns in clinical practice and surgery, especially for treatments involving the brachial plexus or peripheral nerve restoration. A typical Median nerve emerges from two roots lateral and medial which unite to produce the characteristic "loop of the median nerve" covering the axillary artery. Knowledge of fascicular orientation and its variations, such as the observed partial fusion with the musculocutaneous nerve, is critical for neurosurgeons to prevent axonal misrouting during nerve grafting and thereby enhance surgical outcomes. Ultimately, knowing these variances allows clinicians to appropriately interpret abnormal innervation patterns of the upper limb, which is crucial for accurate diagnosis and therapy [(5)].

The embryological basis for median nerve variations stems from the complex development of the upper limb buds opposite the C5–T2 segments. Specifically, anomalies such as a trifid lateral root may result from the incomplete contact of the ventral primary rami as they penetrate the mesodermal tissue. The formation of the median nerve is further dependent on growth cones guiding axons to their target tissues; this process is regulated by the expression of signaling molecules like N-CAM, L1, and cadherins. Dysregulation of these factors, or the influence of external trophic agents, can lead to developmental irregularities in the nerve's roots and course [(6)].

The Variations in the formation of the median nerve may arise from circulatory factors present at the time of brachial plexus cord fusion. Additionally, because axon guidance is regulated by chemo-attractants and chemo-repellants, alterations in signaling between mesenchymal cells and neuronal growth cones can lead to significant anatomical variations [(7)].

The classical description involves two roots, the studies have highlighted the prevalence of three-root formations[(8)]. For instance, Mat Taib et al. observed that the median nerve was formed by three roots in 36.4% of left upper limbs and 18.2% of right upper limbs in their sample. Similarly, Agarwal et al. reported cases where the median nerve was formed by three roots, with the additional root typically arising from the lateral cord. These additional roots often join the median nerve proximal to the union of the medial and first lateral roots [(9,10)].These embryologically consistent anomalies necessitate surgical caution during brachial plexus procedures and nerve transplants [(11,12)].

The median nerve, typically a non-branching trunk in the arm, showed critical anatomical variability in this case by forming communications with the musculocutaneous nerve and notably innervating muscles of the front of the arm. This functional

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crossover is extremely important for medical professionals, as an injury high in the axilla could unexpectedly result in motor defects of elbow flexion (weakness in biceps and brachialis), a symptom normally indicative of musculocutaneous nerve damage [13].

A variety of anatomical differences in the median nerve, one of the most researched nerves because of its significance in the sensory and motor activities of the upper limb, are covered in the section presented. The study highlights how crucial it is to comprehend these anatomical variances in order to practice clinical medicine. Understanding median nerve abnormalities is essential for doctors, anesthetists, and surgeons doing upper limb procedures as well as for delivering the best treatment possible for diagnosing and treating nerve-related conditions such entrapment syndromes [14].

The current study reports that a variation in the median nerve's development was noticed during the standard dissection of the right upper limb of a male cadaver that had been preserved in formalin. Three roots, rather than the usual two, created the median nerve: two distinct lateral roots from the brachial plexus's lateral cord and one medial root from the medial cord. These roots came together in front of the axillary artery's third segment. After running parallel to the primary lateral root, the extra lateral root joined the medial root. In the dissected area, there was no indication of trauma, pathology, or surgical intervention.

Conclusion:

Anatomical variations in the formation of the median nerve, such as the presence of an additional lateral root, are of significant clinical importance. Such deviations from the classical two-root configuration may pose challenges during surgical procedures, nerve blocks, or diagnostic interventions involving the brachial plexus. Recognizing these variations enhances surgical safety, aids in accurate anatomical localization, and helps prevent iatrogenic injuries. This case reinforces the need for meticulous anatomical knowledge during upper limb dissections and clinical practice.

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