

## A Cadaveric Study on Anatomical Variations of Median Nerve Formation: Embryological and Clinical Correlations



### Medical science

**KEYWORDS :** Median nerve, Brachial Plexus, Medial cord, Lateral cord

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### ABSTRACT

*The median nerve is formed lateral to the third part of the axillary artery by the union of the lateral and medial roots originating from the lateral and medial cords of the brachial plexus.*

*Variations of median nerve, musculocutaneous nerve and their communicating branches are of interest for anatomists and surgeons. These variations may be vulnerable to damage in surgical procedures.*

*The median nerve is one of the commonest nerve showing variations from the level of its formation to its termination. This is an important region where anatomists, radiologists, anesthetist, plastic surgeon and oncologist land up with problems more frequently, if they are not aware of these variations. We studied the variation in the formation of the median nerve in 40 upper limbs of formalin preserved cadavers at the department of Anatomy, MGM Medical College, Navi Mumbai, India.*

### Introduction-

Median nerve (C5-T1) is formed in axilla lateral to the third part of the axillary artery by union of lateral root (C5-7) and medial root (C8, T1) of lateral & medial cord of brachial plexus respectively.<sup>1</sup>

Knowledge of anatomical variation of these nerves in axilla and arm are very important for surgical purpose. Knowledge of these variations is essential for performing nerve repair, nerve transplant and reconstructive surgeries. Hence this study would be of great help to the plastic surgeons and orthopedic surgeons. Anatomical variations of the median nerve have been described in humans by many authors although such variations have not been extensively catalogued.<sup>2,3</sup> The variations of the median nerve are of interest to anatomists, radiologists and surgeons. These variations may be vulnerable to damage in surgical operations, but their knowledge also helps in the interpretation of a nervous compression having unexplained clinical symptoms.<sup>4</sup>

### Material and Methods-

Forty upper limbs of adult human formalin fixed cadavers, irrespective of sex were used in this study. The cadavers were obtained from the Department of Anatomy, MGM Medical College and the study was conducted between June and December 2014. The axillary regions, arm of each limb were dissected to clarify the different patterns of median nerve formation and distribution within the arm.

### Result-

Variations in the formation of the median nerve included an additional root/roots taking part in the formation, High level formation, low (distal level) formation, Nerve of anterior compartment of arm instead of musculocutaneous nerve, splitting of median nerve in the middle of arm into musculocutaneous nerve & median nerve proper.

In our study variations in the formation of the median nerve included -

1. An additional root taking part in the formation is 12.5% (5/40), of which in 4 cases additional root arises from lateral root of median nerve (fig.1), in 1 case it arises from musculocutaneous nerve (fig.1& 3).

2. An unusual formation of median nerve at low level (Distal) in front of brachial artery was seen in 15% (6/40) seen. Out of which in 1 case it is formed in middle of arm.(fig. 2).

3. In 2.5% cases(1/40) It is the nerve of anterior compartment of arm instead of musculocutaneous nerve through a common trunk which is continuous in forearm as a lateral cutaneous nerve of forearm.(fig.2)

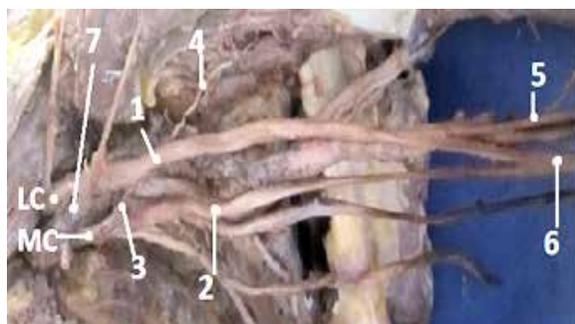


Fig-1. showing additional root (3) & low level formation (6) of Median Nerve . LC,MC-Lateral and Medial Cord of brachial plexus, 1- lateral root of Median nerve, 2- medial root of median nerve, 3-3rd root of median nerve, 4- br. to Coracobrachialis, 5- common trunk, 6- Median nerve, 7- 2nd part of axillary artery

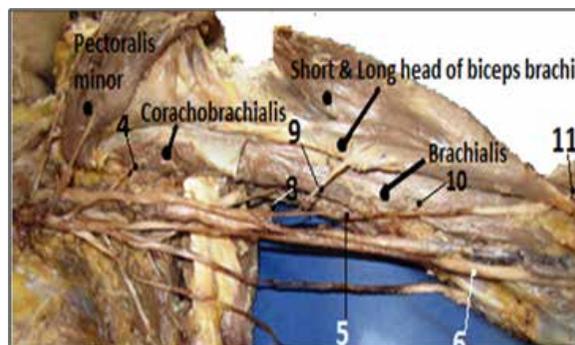


Fig-2- Showing variation in formation of Median nerve and its supply to anterior compartment muscles.5- common trunk, 8,9- Br. To short & long head of biceps, 10- Br. to Brachialis, 11- Lateral cutaneous nr. of forearm

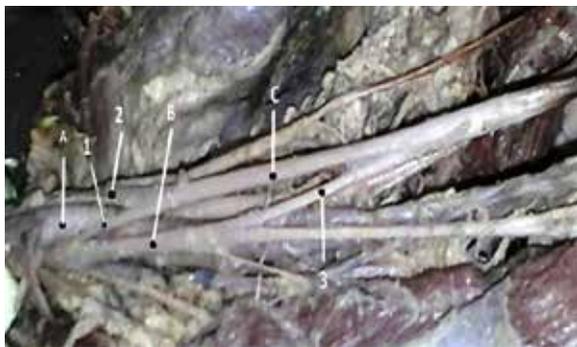


Fig.3\_ showing additional root from Musculocutaneous Nerve. 1- Medial root of Median nerve, 2- Lateral root. 3- Additional 3rd-root, A- Axillary artery, B- Musculocutaneous Nerve, C- Median nerve

#### Discussion-

Median nerve as reported in literature is associated with several variations which include abnormal communication with other nerves such as Musculocutaneous nerve, Ulnar nerve, splitting of Median nerve and unusual innervation of flexor muscles in arm by median nerve.<sup>4</sup>

In our study, Musculocutaneous nerve is absent and all flexor group of muscles in arm are supplied by Median nerve in 1 case.

Uzan (2001) found that 3 roots of lateral cord and 1 root of medial cord form Median nerve.<sup>5</sup>

In our study, 12.5% additional root took part in formation median Nerve-7.5% from lateral cord, 2.5% from medial cord & in 2.5% from musculocutaneous nerve.

Jahanshali (2003) found that, absence of Musculocutaneous nerve, and muscles supplied by it were supplied by Median nerve. Here the formation of Median nerve is normal i.e. lateral and medial root from lateral and medial cord of brachial plexus respectively.<sup>6</sup>

In our study, Musculocutaneous nerve is absent, and muscles supplied by it are supplied by Median nerve (Lateral root) which is formed at middle arm level and also receives IIIrd root from medial cord. In the present study we also observed low formation of the median nerve in 15% (6/40) of cases, where the medial and lateral roots were very long and joined in front of the brachial artery to form the median nerve. Such cases of low origin of median nerve might lead to confusion in surgical procedures and nerve block anesthesia. Normally, median nerve formation occur lateral to the third part of the axillary artery as the medial root crosses the axillary artery anteriorly to join with the lateral root.

The incidence of distal formation of median nerve was more common (8.5%, Uysal et .al. 2003; 12%, Matejcik 2003; 2.1%, Badawoud MHW, 2003) than that of high level formation. Due to these neural variations, sometimes the arm muscles are innervated by median nerve and in most of such cases, musculocutaneous nerve was found to be absent (Prasada Rao and Chaudhary, 2000; Song et al., 2003, Satheesha Nayak 2007, Beheiry 2004). Sarala Devi et.al (2011) noted that in 1.66% the formation of median nerve at the junction of middle and lower 1/3rd of arm. Lateral cord of brachial plexus after giving the lateral pectoral branch, continued down in the arm. The musculocutaneous nerve was absent. The lateral cord supplied branches to Coracobrachialis, biceps brachii, and brachialis, also in 1.66% was noticed with median nerve formation at a higher level than usual. 7-14

In our study, an unusual formation of median nerve at low level (Distal) in front of brachial artery major was seen in 15% (6/40) seen. Out of which in 1 case it is formed in middle of arm. Also we noticed that in 2.5% cases (1/40) Median nerve is the nerve of anterior compartment of arm instead of musculocutaneous nerve through a common trunk which is continuous in forearm as a lateral cutaneous nerve of forearm.

Satyanarayana (2009), described 3 unilateral cases of variation of formation of Median nerve. In 1st case he described Median nerve formed on medial side of Axillary artery at higher level. Later median nerve continued behind brachial artery and receives a communicating branch from lateral cord. In the 2nd case -formation of Median nerve by three roots- 2 from lateral and 1 from medial cord of brachial plexus. In 3rd case -formation of Median nerve by four roots- 3 from lateral and 1 from medial cord of brachial plexus.<sup>15</sup>

In present study in 12.5% (5/40) an additional root taking part in the formation, of which in 4 cases additional root arises from lateral root of median nerve, in 1 case it arises from musculocutaneous nerve.

#### Embryology-

The embryological development of upper limb may help in explaining these anatomical variations.

Significant variations in nerve patterns may be result of altered signaling between mesenchymal cells and neuronal growth cones<sup>16</sup> or circulatory factors at the time of fusion of brachial cords.<sup>17</sup>

The axons of somatic motor fibers in dorsal and ventral rami seek out specific muscle or bundle of muscles fibers and form synapses with the muscle fibers. The specific signals that guide motor fibers to their targets are unknown. Axons have remarkable ability to reach their appropriate targets.

The motor axons that innervate the limb perform an intricate feat of path finding to reach their target muscles. The axons destined for the limb apparently travel to the base of limb bud by growing axon permissive pathways. Once the motor axons arrive at the base of limb bud, they mix in specific pattern to form brachial plexus in upper limb. This zone constitutes the decision making region. Once axons have sorted out in plexus, growth cones continue into the limb bud, travelling along permissive pathways that lead in general direction of appropriate muscle compartment.<sup>18</sup>

#### Conclusion-

The variation in Median nerve formation and its innervation, and absence of Musculocutaneous nerve have no effect on the functions of upper limb but knowledge of various patterns of brachial plexus is essential for medical professionals who explore axilla for treatment, interventions or block dissection.

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