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RESEARCH ARTICLE

# Variant formation of the median nerve with its applied importance

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## ABSTRACT

**Introduction:** A detailed knowledge of variations in the formation of the median nerve is crucial for anatomists, surgeons, anaesthesiologists, radiologists, and other medical professionals, particularly when performing clinical investigations or surgical interventions involving the axilla and upper limb. Given the frequency of these variations, this study aims to investigate the anatomical variations of the median nerve with respect to its formation.

**Materials and Methods:** A total of 38 human cadavers of either sex comprising of perinates and adults were included in the present study. After removing the appropriate structures, the median nerve carefully dissected out and observed.

**Results:** In 2.27% and 4.55% of specimens, median nerve formed from two roots and three roots from the lateral cord respectively. And in 2.27% of all specimens, median nerve formed from two roots from the medial cord. With reference to the third part of axillary artery, 2.27% and 2.63% of specimens, there were higher and lower formation of the median nerve respectively.

**Discussion:** The present study confirmed that many variations in the formation of median nerve do exist. This knowledge will be of great help to explain a particular pattern of paralysis in the event of such a nerve being damaged. It may also explain affection of surrounding blood vessels.

**Keywords:** Median nerve, Variant formation, Brachial plexus, Axillary artery.

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## Introduction

The median nerve is formed by the union of the lateral root from the lateral cord (C6, C7), and the medial root from the medial cord (C8, T1) of the brachial plexus, which meet anterior to the third part of the axillary artery [1]. Variations of the median nerve in relation to its formation are fairly common. Given the frequency of these variations, this study aims to investigate the anatomical variations of the median nerve with respect to its formation.

### Embryology

The development of the upper limb is a complex process involving the coordinated growth and differentiation of various tissues, including nerves and muscles. The upper limb buds form opposite the lower five cervical and upper two thoracic segments, and as soon as they form, the ventral primary rami of the spinal nerves penetrate into the mesenchyme of the limb buds.

The growth and path finding of nerve fibres towards their target muscles is dependent on a concentration gradient of cell surface receptors, and early contact between nerve and muscle cells is crucial for their complete functional differentiation. Several signalling molecules and transcription factors induce the differentiation of dorsal and ventral motor horn cells, and misexpression of these molecules can lead to abnormalities in nerve fibre formation and distribution.

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## Materials and Methods

A total of 38 human cadavers of either sex comprising of perinates and adults were included in the present study. This comprised of 22 human perinatal cadavers (out of which 13 were male and 9 were female) and 16 adult cadavers (out of which 9 were male and 7 were female). After removing the appropriate structures, the median nerve carefully dissected out and observed.

## Results

### Number of roots from lateral/medial cord

In the perinatal cadavers, out of 13 upper limbs in male on the left, 1 (7.69%) had two roots from the lateral cord which contributed to the formation of the median nerve. In 1 (2.27%) of perinatal specimen median nerve was formed from two roots from the lateral cord. Out of 9 upper limbs in female on the right, 2 (22.22%) had three roots from the lateral cord. In 2 (4.55%) of perinatal specimens median nerve formed from three roots from the lateral cord. From the medial cord, two roots led to the formation of median nerve in 1 (7.69%) male perinatal specimen on the left. Thus in 1 (2.27%) out of all perinatal specimens, median nerve formed from two roots from the medial cord (Table 1; Chart 1; Figures 1, 2, 3, 4).

None of the adult specimens displayed variation of number of roots from lateral and medial cord in the formation of median nerve.

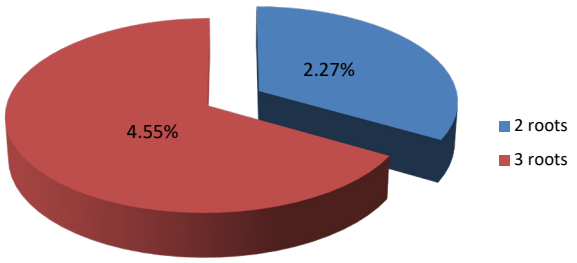


**Chart 1:** Number of roots from lateral cord in Perinate

### Level of formation – Higher/Lower (with reference to third part of axillary artery)

In 1 (7.69%) of the male perinate on the right there was higher formation of the median nerve. 1 (2.27%) of the perinatal specimens was found to have higher formation of median nerve. In 1 (11.11%) of the female perinate on the left there was lower formation of the median nerve. 1 (2.27%) of the perinatal specimens was found to have lower formation of the median nerve (Table 2; Chart 2; Figures 5, 6).

In adult cadavers, out of 9 upper limbs in male on the left, 1 (11.11%) had lower formation of median nerve. In 1 (3.13%) of adult specimens, there was lower formation of the median nerve. *None of the adult specimens showed higher formation of the median nerve* (Table 3; Figures 7).

In 2 (2.63%) of both perinatal and adult specimens, there were lower formation of the median nerve (Table 4).

To summarise, in 2.27% and 4.55% of specimens, median nerve formed from two roots and three roots from the lateral cord respectively. And in 2.27% of all specimens, median nerve formed from two roots from the medial cord. With reference to the third part of axillary artery, 2.27% and 2.63% of specimens, there were higher and lower formation of the median nerve respectively.

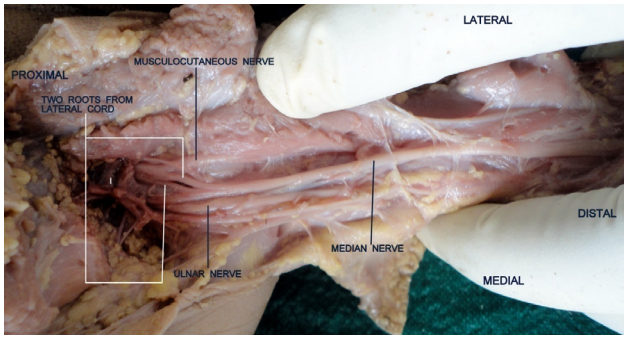


**Figure 1:** Photograph showing the formation of median nerve by two roots from lateral cord in the anterior aspect of the left arm of a perinate.

**Table 1:** Number of roots from lateral/medial cord in Perinate

| | *No. of Roots* | *No. of Specimen/S (n)* | | | | |
|---|---|---|---|---|---|---|
| | | *Male (n=26)* | | *Female (n=18)* | | *Both (n=44)* |
| | | *Right (n=13)* | *Left (n=13)* | *Right (n=9)* | *Left (n=9)* | |
| Lateral Cord | 2 | ---------- | 1 (7.69%) | --------- | --------- | 1 (2.27%) |
| | 3 | ---------- | ---------- | 2 (22.22%) | --------- | 2 (4.55%) |
| Medial Cord | 2 | ---------- | 1 (7.69%) | --------- | --------- | 1 (2.27%) |

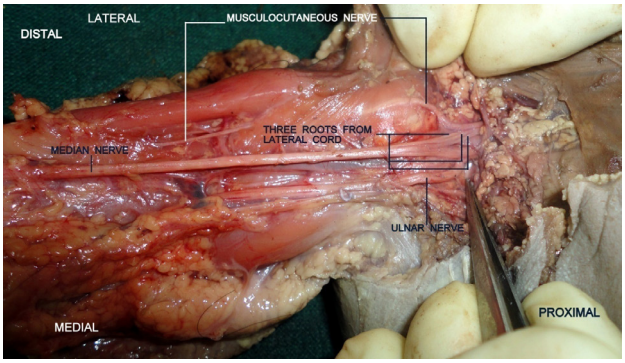


**Figure 2:** Photograph showing the formation of median nerve by three roots from lateral cord in the anterior aspect of the right arm of a perinate.

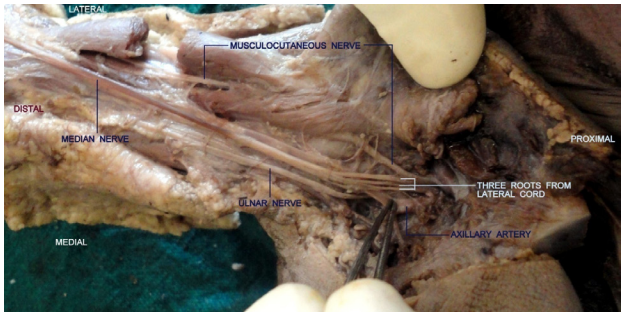


**Figure 3:** Photograph showing the formation of median nerve by three roots from lateral cord in the anterior aspect of the right arm of a perinate.

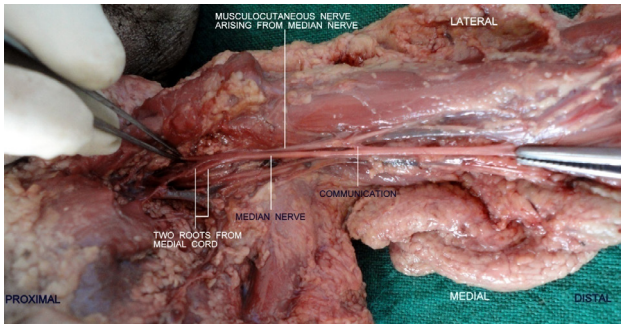


**Figure 4:** Photograph showing the formation of median nerve by two roots frommedial cord in the anterior aspect of the left arm of a perinate. Musculocutaneous nerve is seen arising from the median nerve.

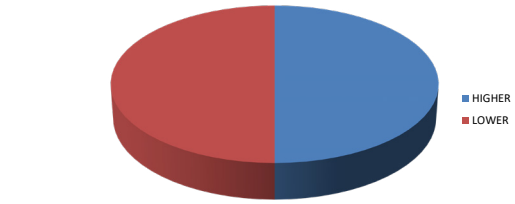


**Chart 2:** Level of formation of median nerve in Perinate

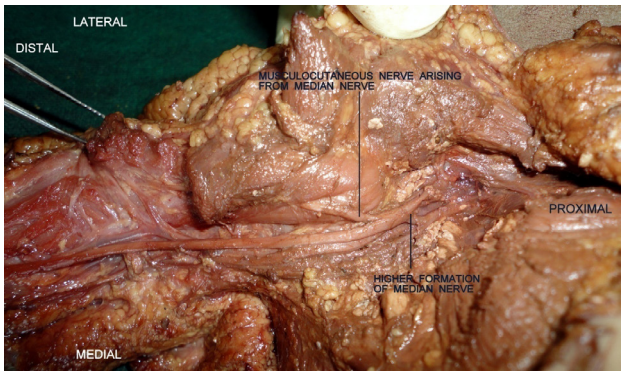


**Figure 5:** Photograph showing higher formation of median nerve in the anterior aspect of the right arm of a perinate. Musculocutaneous nerve is seen arising from the median nerve.

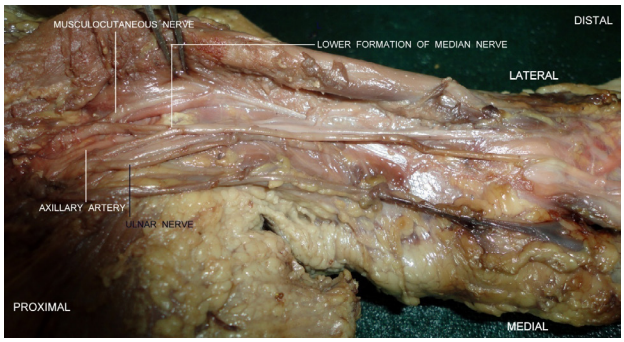


**Figure 6:** Photograph showing lower formation of median nerve in the anterior aspect of the left arm of a perinate.

**Table 2:** Level of formation of median nerve in Perinate

| | *No. of Specimen/S (N)* | | | | |
|---|---|---|---|---|---|
| | *Male (N=26)* | | *Female (N=18)* | | *Both(N=44)* |
| | *Right (N=13)* | *Left (N=13)* | *Right (N=9)* | *Left (N=9)* | |
| Higher | 1 (7.69%) | --------- | --------- | --------- | 1 (2.27%) |
| Lower | --------- | --------- | --------- | 1 (11.11%) | 1 (2.27%) |

**Table 3:** Level of formation of median nerve in Adult

| | *No. of Specimen/S (N)* | | | | |
|---|---|---|---|---|---|
| | *Male (N=18)* | | *Female (N=14)* | | *Both(N=32)* |
| | *Right (N=9)* | *Left (N=9)* | *Right (N=7)* | *Left (N=7)* | |
| Higher | -------- | -------- | --------- | --------- | --------- |
| Lower | -------- | 1 (11.11%) | --------- | --------- | 1 (3.13%) |

**Table 4:** Level of formation of Median Nerve In Both Perinate And Adult

| | *No. Of Specimen/S (N)* | | | | |
|---|---|---|---|---|---|
| | *Male(N=44)* | | *Female (N=32)* | | *Both (N=76)* |
| | *Right (N=22)* | *Left (N=22)* | *Right (N=16)* | *Left (N=16)* | |
| Lower | --------- | 1 (4.55%) | --------- | 1 (6.25%) | 2 (2.63%) |

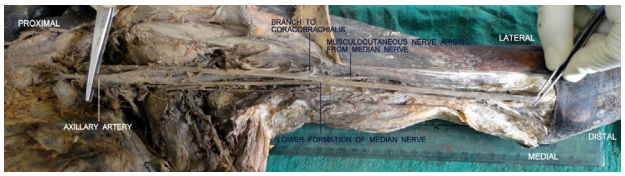


**Figure 7:** Photograph showing lower formation of median nerve in the anterior aspect of the left arm of an adult. Before formation of the median nerve, a thick branch is given by the lateral cord to coracobrachialis. Musculocutaneous nerve is seen arising from the median nerve

## Discussion

In our study 1 (2.27%) of perinatal specimen had formation of median nerve from two roots from the lateral cord. This is in accordance with the findings of Sargon *et al* [2], Eglseder WA and Goldman M [3], Fazzan Sassoli VP *et al* [4], Saeed and Rufai [5], Arora L, Dhingra R [6], Anrkooli *et al* [7], Joshi *et al* [8] and Pais, Casal, Santos *et al* [9] who found formation of median nerve by two roots originating from the lateral cord of the brachial plexus and one root originating from the medial cord of the plexus. Eglseder and Goldman [3] found this variation in about 14%. Anrkooli *et al* [7] in a case report observed this variation bilaterally. The present study did not find any such bilateral variation. In our findings, musculocutaneous nerve was present in all. This contradicts Arora L, Dhingra R [6] who found this variation with the absence of musculocutaneous nerve.

In 2 (4.55%) of perinatal specimens, median nerve formed from three roots from the lateral cord. This matches the finding of Uzun *et al* [10]. But Uzun *et al* did not mention about the percentage. As found by Sarith S [11] and Ramachandran Kanakasabapathy and Holla [12], the present study did not find a root from the musculocutaneous nerve leading to the formation of median nerve.

In 1 (2.27%) of all the perinatal specimens, median nerve was formed from two roots from the medial cord. On searching relevant literature, no such result was found. However, Aggarwal *et al* [13] found anomalous formation of the median nerve on the left side by the union of two medial and two lateral roots. This was not found in the present study.

In our study, 1 (2.27%) of the perinatal specimen was found to have higher and 1 (2.27%) had lower formation of the median nerve and in 1 (3.13%) of adult specimen, there was lower formation of the median nerve with reference to the third part of axillary artery. None of the adult specimens showed higher formation of the median nerve. Thus in 2 (2.63%) of all the specimens, there were lower formation of the median nerve. The higher formation of the median nerve was not observed in the literature. In line with our study, Jakubowicz and Ratajczak [14] and Nayak, Samuel and Somayaji [15] found lower formation of median nerve, though they did not mention about the percentage.

## Conclusion

From the present study we come to the conclusion that the median nerve has got multifarious variations. Besides its normal anatomy, the median nerve is formed from two roots from the lateral cord in 2.27% and three roots from lateral cord in 4.55% of the perinatal specimens. In 2.27% of the perinatal specimens, median nerve is formed from two roots from the medial cord. In 2.27% of the perinatal specimens, there is higher formation of the median nerve. In 2.63% of all the specimens, there is lower formation of the median nerve. This higher and lower formation is in reference to

the third part of axillary artery. This knowledge will be of great help to explain a particular pattern of paralysis in the event of such a nerve being damaged. It may also explain affection of surrounding blood vessels.

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