

**Research Article**

## **Lower level of formation of lateral cord, variable formation of median nerve and communications between median and musculocutaneous nerve**

**Gangadhara<sup>\*</sup>**, Shakunthala Rao N, Krishna Kishore G, Manivannan K and H. R. Krishna Rao

*Department of Anatomy, PES Institute of Medical sciences and Research, Kuppam (AP), India*

**\*Correspondence Info:**

Dr. Gangadhara  
Associate Professor of Anatomy  
PES Institute of Medical sciences and Research, Kuppam (AP), India  
E-mail: [drganga1980@gmail.com](mailto:drganga1980@gmail.com)

### **Abstract**

Brachial plexus are the bunch of nerves which are formed in the neck and axilla for supplying the upper limb. During routine dissection of the axilla for academic purpose we have noticed the variation in the formation of lateral cord, median nerve and its communications with the musculocutaneous nerve on both the upper limbs. The variations of brachial plexus even though they are common, have got very important clinical and surgical importance, knowledge of which is very important for surgeons, orthopedicians and anesthetists. An attempt has made to add the information of case to the existing knowledge in the literature.

**Keywords:** Brachial plexus, Median nerve, Musculocutaneous nerve, Lateral cord, Communication.

### **1. Introduction**

Normally the union of the ventral rami of the fifth, sixth, seventh and eighth cervical nerves and first thoracic nerve form the brachial plexus. These rami unit, divide and unit again to form the trunks, anterior and posterior divisions and the cords of brachial plexus and ultimately these cords and their branches appear in the axilla grouped around the axillary artery<sup>1</sup>. In the infraclavicular part of the brachial plexus the cords lie posterior to the first part of the axillary artery but, descending posterior to pectoralis minor, they pass into positions relative to the second part of the axillary artery which correspond to their names. The plexus ends at the lower border of pectoralis minor by dividing into a number of nerves<sup>2</sup>.

Median nerve is formed by two roots derived from lateral cord and medial cord, which embrace the third part of the axillary artery, and unite anterior or lateral to it. If the lateral root is small, the musculocutaneous nerve connects with the median nerve in the arm. Median nerve supplies all the muscles of the forearm except flexor carpi ulnaris and ulnar half of the flexor digitorum profundus. In the hand it supplies thenar muscles, radial two lumbricals and carries cutaneous sensations from palmar aspect of thumb, index, middle fingers and radial half of ring finger. Musculocutaneous nerve is the terminal branch of the lateral cord, arises at the lower border of the pectoralis minor. It pierces the coracobrachialis muscle and enters the arm. It supplies coracobrachialis, biceps brachii and brachialis muscles and also skin on the lateral side of the forearm. Musculocutaneous nerve has frequent variations. It may adhere for some distance to the median nerve and passes behind the biceps. Some fibres of the median nerve may run in the musculocutaneous nerve, leaving it to join their proper trunk; less frequently the reverse occurs, and the median nerve sends a branch to the musculocutaneous nerve<sup>3</sup>.

The communication between musculocutaneous and median nerve is the most frequent of all the variations that could be observed in the brachial plexus<sup>4</sup>.

Formation of median nerve by two lateral and one medial root is reported earlier<sup>5,6</sup> and the communications between musculocutaneous and median nerve are also well documented<sup>7-10</sup>.

These variations of the cords of brachial plexus and its terminal branches become important for surgeons and anesthetists during surgical exploration of the axilla and arm region to avoid damage to the important nerves<sup>11</sup>.

### **2. Materials and Methods**

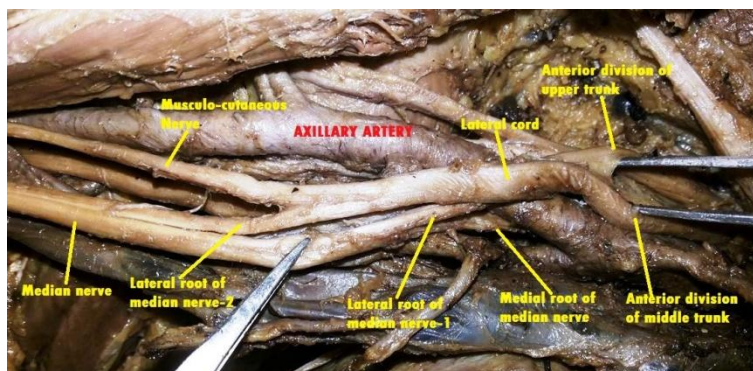
During routine dissection of well embalmed, around 50 years old adult male cadaver for teaching the first year medical undergraduate students, we have observed the variations of lateral cord, its branches and median nerve on the both sides. The axillary region was meticulously dissected and variant nerves were traced, observation was noted then photographed immediately.

### **3. Observations**

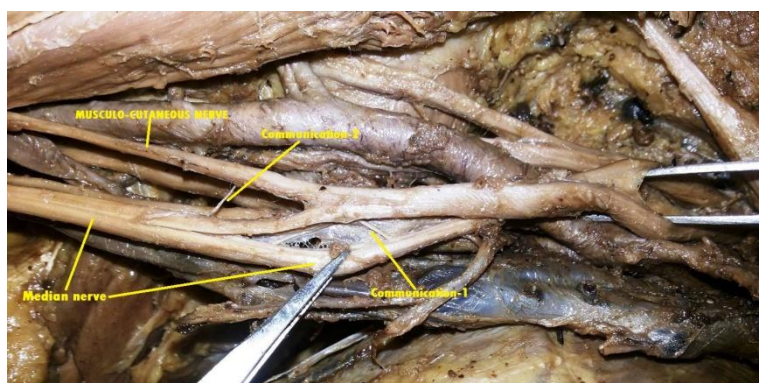
#### **3.1 Right side**

Anterior divisions of the upper and middle trunk are seen in the axilla, united to form the lateral cord at the level of origin of lateral thoracic and thoracoacromial trunk, i.e., at the level of 2<sup>nd</sup> part of the axillary artery. So the lateral cord is formed at lower level. The lateral cord was present anterior to the axillary artery. The lateral cord is very short and measured 8 mm in length and immediately divides into musculocutaneous nerve and lateral root of median nerve. The medial cord was situated posterior to the axillary artery. The median nerve was formed at the level of second part of the axillary artery by the combination of lateral root and medial root from medial cord anteromedial to the axillary artery and formation appeared like a clamp around the artery. Median nerve again joined by an additional root coming from the musculocutaneous nerve at the level of third part of axillary artery. Distal to that again a small cutaneous twig was communicating between median nerve and musculocutaneous nerve. Lateral pectoral nerve was arising from the anterior division of the upper trunk immediately below the clavicle.

**Figure 1:** Showing formation of lateral cord by the fusion of anterior divisions of upper and middle trunk around 2<sup>nd</sup> part of axillary artery, formation of Median nerve by two roots from lateral cord and one root from medial cord on Right side.



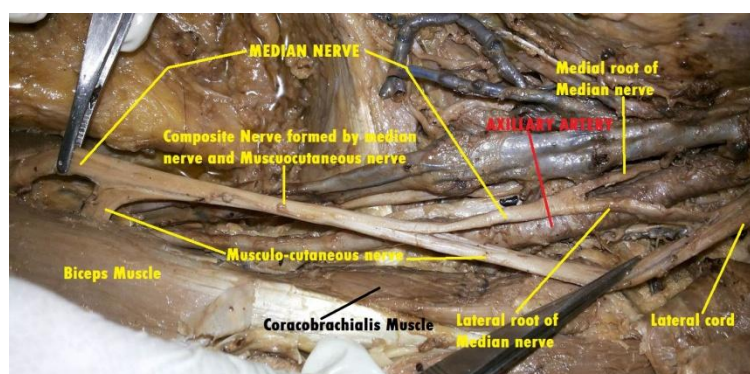
**Figure 2:** Showing the two communications between the Median and Musculo-cutaneous Nerve on Right side.



### 3.2 Left side

Lateral cord is terminated by dividing into the thin lateral root of median nerve and thick musculocutaneous nerve at the level of second part of axillary artery. Median nerve is formed by the combination of medial root from medial cord and lateral root from lateral cord normally at the level of second part of the axillary artery. In the following course the thick musculocutaneous nerve and the median nerve again joined together at the lower border of teres major and continued into the arm, measuring 6.2cms. In the arm the single trunk was medial to the coracobrachialis muscle and lateral to the brachial artery, finally terminated by dividing into musculocutaneous nerve and median nerve. The musculocutaneous nerve later followed normal in course and distribution.

**Figure 3:** Showing the fusion of Median and Musculo-Cutaneous Nerve to form a Composite Nerve at the level of third part of axillary artery on left side.



## 4. Discussion

Gupta *et al*<sup>12</sup> have reported that the formation of lateral cord was distal than usual, in relation to the second part of axillary artery behind the pectoralis minor muscle by the union of anterior division of upper trunk and anterior division of middle trunk of brachial plexus. The similar variation we have observed in our case on right side.

Valeria *et al*<sup>13</sup> have found that the median nerve formed by 2 lateral roots and 1 medial root (from the medial cord) in 28 (52%) cases, being 25 from male and 3 from female, 9 from white and 19 from black cadavers. In 4 cases, one of the two lateral roots came from the anterior division of the middle trunk and 1 from the lateral cord. On the other 24 cases, the two lateral roots came from the lateral cord of the plexus. Darji *et al*<sup>14</sup> have studied 100 limbs and in which one limb (1%) showed the formation of median nerve by two lateral roots and one medial root. Dahiphale *et al*<sup>15</sup> have observed the formation of median nerve by three roots in 5% of cases.

Sargon *et al*<sup>16</sup> have described the formation of the median nerve by three roots on a male cadaver. In this case, the authors reported the presence of two roots coming from the lateral cord, one of them with a very close course over the axillary artery. one must be aware that this kind

of variation is more prone to injury in surgical operations of the axilla and that, the very close course of the second lateral root of the median nerve to the axillary artery may lessen the blood supply of the upper extremity by compressing the vessel. This is to very similar to our case on right side.

Le Minor *et al*<sup>17</sup> have studied the variations of median and musculocutaneous nerves and classified the findings into five types. The formation of median nerve by two roots in our case fits into type III variety and small communicating branches between median nerve and musculocutaneous nerve in the right limb fits into type II variety. The musculocutaneous nerve joining with the median nerve trunk and in the arm branched out again leaving the median nerve to supply the flexor of arm which we have observed in the left limb fits into type IV variety. It was found sometimes that if lateral root was small and the musculocutaneous nerve was connected with median nerve in the arm<sup>18</sup>.

In a recent study by Choi *et al*<sup>8</sup> the communications between musculocutaneous nerve and median nerve have been broadly classified into three types. In type I: the musculocutaneous nerve and median nerve were fused; in type II: there was one connecting branch between the musculocutaneous nerve and median nerve and in type III: two connecting branches were present between musculocutaneous nerve and median nerve. Our observation on left side fits into type I variety and on right side into type III variety.

**Table 1: Shows the incidence of communications between the median nerve and musculocutaneous nerve in other studies.**

Study	Percentage
Darji <i>et al</i> <sup>13</sup>	6% (6/100)
Eglseder WA Jr, Goldman M <sup>19</sup>	36%
Venieratos and Anagnostopoulou <sup>4</sup>	21% (16/79)
Asly Aktan <sup>20</sup>	11% (5/48)
Dahiphale.V.P <sup>14</sup>	25% (5/20)

#### 4.1 Embryological Basis

The upper limb muscles develop from mesenchyme of paraxial mesoderm in the fifth week of intrauterine life. The motor axons arrive at the base of limb bud; they mix to form brachial plexus in upper limb. The growth cones of axons continue in the limb bud<sup>21</sup>. As the guidance of the developing axons is regulated by the expression of chemo-attractants and chemo-repulsants in a highly coordinated site specific fashion any alterations in signalling between mesenchymal cells and neuronal growth cones can lead to significant variations<sup>22</sup>.

#### 5. Conclusions

The anatomical variation in the median nerve has practical implication, since any injury caused to this nerve in the axilla or arm could cause unexpected paralysis of the flexor musculature of the elbow and hypoesthesia of the lateral surface of the forearm. Knowledge on the variations of the brachial plexus is also important during nerve blocks which are formed on infraclavicular part of brachial plexus. Normal functioning of the limbs may not be altered by these variations, but it is important to remember these variations during performance of surgical and anaesthesiological procedures<sup>23</sup>. The existence of communicating branches may be of importance in the evaluation of unexplained sensory loss after trauma or surgical intervention in a particular area<sup>24</sup>.

The variations of brachial plexus in the axilla and arm are very important for general surgeons, oncosurgeons, vascular surgeons, radiologists, orthopedicians and anaesthesiologists. Being anatomists feel very happy to add the information by presenting this case to the existing knowledge in the literature.

#### Acknowledgments

We are very thankful to our postgraduates for assisting in this work. We are very grateful to the authors of various journal articles we have referred in our article for providing the valuable information

#### References

- Hollinshead, W. H. Anatomy for surgeons In: The back and limbs vol.3 1<sup>st</sup> Edn. Harper and Row. New York. 1966: pp 220-240.
- Romanes GJ. Cunningham's Manual of Practical Anatomy. Volume 1, Upper and Lower Limbs. 15th Ed., Oxford, Oxford University Press. 1990; 33-69.
- Susan Standring gray's anatomy the anatomical basis of clinical practice. Churchill Livingstone Elsevier. 40<sup>th</sup> edition; 780-81, 821-22, 828-29.
- Venieratos D, Anagnostopoulou S.; Classification of communications between the musculocutaneous and median nerves. *Clin Anat*. 1998; 11 (5): 327-31.
- Saeed, M. and Rufai, A.A. Median and musculocutaneous nerves: variant formation and distribution. *Clinical Anatomy*. 2003; 16: 453-457.
- Satyanarayana N, Reddy C.K, Sunitha P, Jayasri N, Nitin V, Praveen G, Guha R, Datta A. K., Shaik M. M. Formation of median nerve by three roots: A case report, *Journal of College of Medical Sciences-Nepal*, 2010; 6 (1): 47-50.
- Chauhan, R. and Roy, T. S. Communication between the median and musculocutaneous nerve – a case report. *Journal of the Anatomical Society of India*. 2002; 52(1): 72-75.
- Choi, D.; Rodríguez-Niedenführ, M.; Vazquez, T.; Parkin, I. and Sanudo, J. R. Patterns of connections between the musculocutaneous and median nerves in the axilla and arm. *Clinical Anatomy* 2002; 15: 11-17.
- Yang, Z.; Pho, R.W.H.; Kour, A. and Pereira, B.P. The musculocutaneous nerve and its branches to the biceps and brachialis muscles. *Journal of Hand Surgery*. 1995; 20A (4): 671-675.
- Chiarapattanakom, P.; Leechavengvongs, S.; Witonchart, K. Uerpairojkit, C. and Thuvasethakul, P. Anatomy and internal topography of the musculocutaneous nerve: the nerves to the biceps and brachialis muscle. *Journal of Hand Surgery* 1998; 23A (2): 250-255.
- Abhaya, A.; Khanna, J. and Prakash, R. Variation of the lateral cord of brachial plexus piercing coracobrachialis muscle. *Journal of the Anatomical Society of India* 2003; 52(2): 168-170.
- Gupta M, Goyal N, Harjeet. Anomalous communications in the branches of brachial plexus *J. Anat. Soc. India* 2005; 54 (1) 22-25.
- Valeria Paula Sassoli Fazan, Andre de Souza Amadeu, Adilson L. Caleffi2, Omar Andrade Rodrigues Filho3 Brachial plexus variations in its formation and main branches *Acta Cirúrgica Brasileira* 2003; 18 (Supl. 5).
- Darji Apurva, Chauhan Hitesh, Khatri Hardik, Aterkar Swati, Pensi C.A., Variations In Branching Pattern of Brachial Plexus : A Cadaveric Study. *Int J Biomed Adv Res* (2013) 04 (03) 174-178.
- Dahiphale V.P, Porwal S.S, Joshi D.S Variations in the infraclavicular part of brachial plexus – a dissection study. *Anatomica Karnataka*, 2012; 6 (1): 62-65.
- Sargon MF, Uslu SS, Celik HH, Akait D. A Variation of the Median Nerve at the Level of the Brachial Plexus. *Bull Assoc Anat* 1995; 79: 25-6.

17. Le Minor JM. A rare variation of the median and musculocutaneous nerves in man. *Arch Anat Histol Embryol*. 1990; 73:33-42.
18. Standring S, Ellis H, Healy JC, et al - Gray's Anatomy; General organisation and surface anatomy of the upper limb. 39th ed. Philadelphia Elsevier Churchill Livingstone, 2005; 803-4
19. Eglseider WA Jr, Goldman M.; Anatomic variations of the musculocutaneous nerve in the arm. *Am J Orthop* 1997, 26 (11):777-80.
20. Asly Aktan Z.; A Cadaveric Study of the Anatomic Variations of the Brachial Plexus Nerves in the Axillar Region and Arm. 2000.
21. Moore KL, Persaud TVN. The muscular system. In: Moore KL, Persaud TVN, eds. The Development Human Clinically Oriented Embryology. 7<sup>th</sup> ed. Philadelphia: Elsevier Sciences; 2003: 410-424.
22. Sannes HD, Reh TA, Harris WA. Axon growth and guidance. In: Sannes HD, Reh TA, Harris WA, eds. Development of the Nervous System. 1<sup>st</sup> ed. New York: Academic Press; 2000: 189-197.
23. Harris W. The true form of brachial plexus. *Journal of Anatomy and Physiology*. 1904; 38:399-422. PMID: 17232613. PMCID: 1287350.
24. Hoogbergen MM, Kauer JM. An Unusual Ulnar Nerve-Median Nerve Communicating Branch. *J Anat* 1992; 181: 513-6.