

# A Morphological Study on the Anatomic Variation of the Musculocutaneous Nerve with its Clinical Implication.

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## ABSTRACT

**Background:** During surgery of the shoulder region the identification of musculocutaneous nerve (MCN) and its variation is important because it is vulnerable to injury from surgical instruments. The MCN is formed as the continuation of lateral cord of brachial plexus. The MCN travels obliquely below the coracoid process and enters the coracobrachialis (CB) muscle. The MCN supplies the muscles of front of arm, namely the CB, the Biceps brachii and Brachialis muscles. **Methods:** The Morphological study included 25 cadavers aged between 21 to 70 years. Both the right and the left upper limbs of each cadaver, 50 limbs were studied and documented. The MCN showed variations in their course, branching pattern and communication with MN (median nerve). **Results:** The lateral cord gives a direct branch to CB, then pierces the muscle in 2 cases (8%) unilaterally. MCN does not pierce the CB but communicates with median nerve in 3 cases (12%) unilaterally, whereas communication between MCN and MN seen in 5 cases (20%). **Conclusion:** The Knowledge of Variation in origin, course, branching pattern, termination and communication of MCN in the arm have the significance in shoulder injuries and reconstructive surgeries.

**Keywords:** Musculocutaneous nerve (MCN), variation, Coracobrachialis (CB), Median Nerve (MN)..

## INTRODUCTION

During surgery of the shoulder region the identification of musculocutaneous nerve (MCN) and its variation is important because it is vulnerable to injury from surgical instruments.

The isolated variety of MCN injury is commonly associated with a form of penetrating trauma, open surgical reconstruction or a direct blow to the chest (near coracoids).and its is also associated with the severe brachial plexus trauma. Although the nerve can be injured in glenohumeral dislocation, it is unusual to diagnose such injury as an isolated neuropathy.<sup>[1]</sup> Occasionally MCN neuropathy can occur after strenuous physical activity such as rowing.<sup>[2]</sup>

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The MCN is formed as the continuation of the lateral cord of the brachial plexus. The MCN travels obliquely below the coracoids process, and enters the coracobrachialis. The MCN supplies the muscles of front of arm, namely the Coracobrachialis, Biceps brachii and Brachialis muscles. This nerve then terminates as lateral cutaneous nerve of forearm and supplies anterolateral region of forearm and thumb .The anatomical variation of MCN has been investigated in several studied. Literatures showing variation in

formation of brachial plexus and termination of its branches in upper Limb have been reported. Buch Hansen 1955 studied these variations in 65.3 % of the population.<sup>[3]</sup> Variations of the musculocutaneous nerve and its branches have been previously reported.<sup>[4,5]</sup> The study of the variations of MCN also includes the nerve not piercing the coracobrachialis muscle.<sup>[6]</sup> Absence of the MCN has also been reported, where the muscles supplied by MCN are innervated by the median nerve.<sup>[7]</sup>

Since there is a high incidence of variations, they are important for neurologists, orthopaedicians and traumatologists. Therefore, the Knowledge of Variation in origin, course, branching pattern, termination and connection of MCN in the arm has the significance in shoulder injuries and in reconstructive surgeries. Our aim of the research is to find out the possibility of variations in the course of MCN in the routine dissection. So we can apply that knowledge for enhancing the surgical skill with special reference to the shoulder injuries.

## MATERIALS AND METHODS

The study was carried out to find out the variation pattern of MCN and it has been performed in the Department of Anatomy, Chhattisgarh Institute of Medical Sciences Bilaspur (CG).

**Study Design-** Observational Cadaveric Study

**Study Setting-** Dissection Hall.

**Sample size-** 25 Cadavers, 50 Limbs, Age ranging 21 year to 70 years.

**Method**

The study of variations in branching pattern of MCN has been observed during routine educational dissection done in the Department of Anatomy, Superior extremities of 25 cadavers, 50 Limbs,

were studied irrespective of their gender and age. All the cadavers were of age ranging from 21 year to 70 years. The course and branching pattern of the MCN was observed and documented for the study on both sides, the right limb and the left.

**Table 1:** ???

Sl. No.	Type of Variant	Number of cases	Percentage(%)
1.	MCN not piercing CB but communicating with MN [Figure 1]	01	4
2.	MCN communicating with Median nerve at different Levels [Figure 2 and 3]	05	20
3.	Branch from lateral cord, Nerve to CB then MCN pierces CB[ Figure 4]	02	8
4.	MCN not piercing CB [Figure 5(a) & (b)]	03	12

**RESULTS**

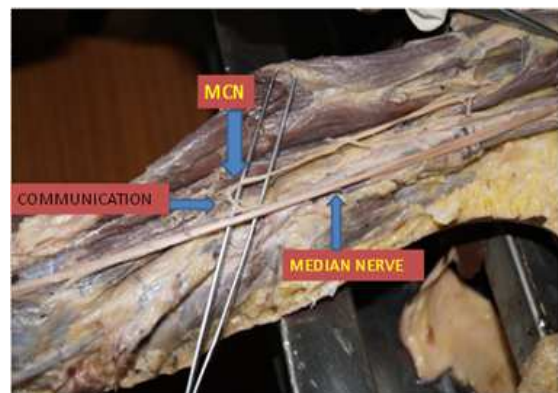
The study included 25 cadavers aged between 21 to 70 years. Both the right and the left upper limbs of each cadaver was studied and documented. It has been found that MCN showed variation in their course and communication with MN in the cadaveric dissection of 10 bodies. We have found mainly four significant variations in ten cadavers .While the rest of the cadavers did not show any such relevant variation during the dissection.

One result shows that the lateral cord gives a direct branch to CB, MCN does not pierce the CB but gives a communicating branch to the median nerve. This nerve gives separate branch to biceps brachii and brachialis muscle then small communicating branch to median nerve at the mid of the arm. After giving the communicating branch, the main trunk of (MCN) continues as lateral cutaneous nerve of forearm [Figure 1], in one case 4%. This was found to be unilateral.

Another result showed that there were communication between (MCN) and the median nerve, which was found bilateral. MCN gives off a branch to coracobrachialis, pierces the coracobrachialis and emerges out giving branches to Biceps Brachii and Brachialis muscle. It then runs downwards and medially to give a communicating branch to the median nerve, just at the distal 1/3 of the arm [Figure 2]. On the other side the course of the nerve remains same except that the MCN communicates with median nerve at the level of cubital fossa [Figure 3]. These types of communication of MCN with MN at different levels were seen in 5 cases (20%), as shown in [Figures 2 and 3]. We have also observed one variation that the direct branch from the lateral cord of the brachial plexus to CB then it pierces CB, [Figure 4], in 2 cases 8%.



**Figure 1:** MCN not Piercing CB & communicating with MN.



**Figure 2:** Communication between MCN & MN at distal third of Arm.

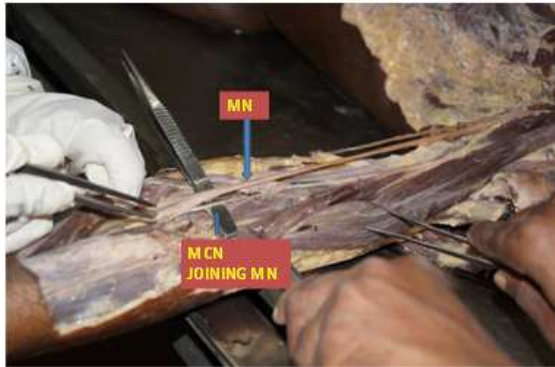


Figure 3: Communication between MCN & MN at Cubital fossa.



Figure 5b: Branch to CB from MCN.

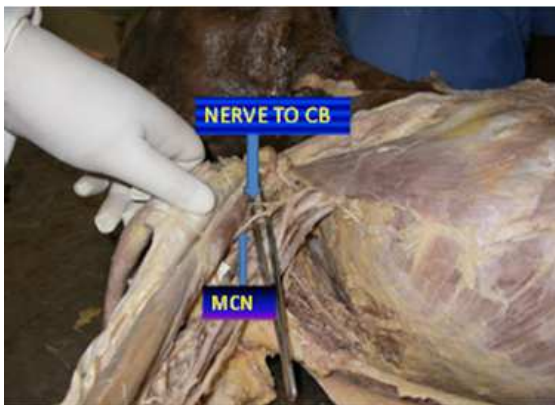


Figure 4: Direct branch from Lateral cord to CB then MCN pierces CB.

Another result shows that the MCN does not pierce the coracobrachialis muscle, in 3 cases all being unilateral 12%, The other sided limb had the course of the nerve. MCN despite of piercing coracobrachialis muscle gave the 1<sup>st</sup> branch to coracobrachialis near corocoid process, the 2<sup>nd</sup> branch to Biceps Brachii (BB) almost at the mid of the arm and gave the 3<sup>rd</sup> branch to Brachialis (Br). It finally coursed downwards forming the lateral cutaneous nerve of the forearm [Figure 5a, 5b].



Figure 5a: Direct branch from Lateral cord to CB then MCN pierces CB.

## DISCUSSION

The Knowledge of Variation in origin, course, branching pattern, termination and connection of MCN with MN in the arm has the significance in shoulder injuries and in reconstructive surgeries. We have observed the mainly four types of variation pattern in ten cadavers while the rest of fifteen cadavers did not show any significant variations.

Nayak S et al., 2006<sup>[8]</sup> reported that in one limb, the MCN had a low origin and that the nerve was found not piercing the coracobrachialis, similar finding we also observed in our case [Figure 5a]. The Chitra R., 2007<sup>[9]</sup> also observed in 2 cases, that the musculocutaneous nerve did not pierce the coracobrachialis. The musculocutaneous nerve was rejoining the median nerve after piercing the coracobrachialis is a rare variation and this is rarely reported in the literature. It was reported by Josh S.D.et al., 2008<sup>[10]</sup> in one case and in 3.125 % cases by Bhattaray.<sup>[11]</sup> We have also observed in two cases that Communication between MCN and MN at distal third of the arm [Figure 2]. One another case we also observed a very rare variation that communication between the MCN and MN at cubital fossa [Figure 3], in 3 cases. Gurri – Guttenberg RA<sup>[12]</sup> also report a review on musculocutaneous variation and communication between MCN and MN and he analyzed that in 53.6% cause amongst which 84.6 % was proximal, 7.7% distal of 7.7% had one, proximal and one distal communication to the entry of MCN nerve into coracobrachialis –MCN did not pierce coracobrachialis in 11% (13). In two cases the lateral cord did not give off MC nerve Prasada Rao.<sup>[14]</sup> Kerr AT, 1918<sup>[15]</sup> found a branch from musculocutaneous nerve to the median nerve from 8.1 % to 36.19 % and incidence was about 24 %.

The molecular development of gene of the upper limb may help in explaining this anatomical variation. Regional expression of five Hox (D1-D5) genes regulate the molecular development of upper limb.<sup>[16]</sup> The limb outgrowth is initiated by TBX5



& FGF10 in the forelimb.<sup>[17]</sup> We can also explain the anatomical variation embryologically. The mesenchyme, which is derived from the somites, migrates and forms the muscle of the limb bud and same time it is penetrated by the ventral primary rami of spinal nerve. Further, the mesenchymal condensation forms the muscle. The disturbance in these processes, taking place in the 4<sup>th</sup> -7<sup>th</sup> weeks of development, leads to anatomical variation. Lack of co-ordination between formation of limbs muscles & their innervations may be responsible for appearance of communicating branch.<sup>[18]</sup>

The following researcher has showed the variation in the pattern of MCN. Choi et al., 2002<sup>[16]</sup> studied 138 cadavers and grouped them into three patterns Pattern I – both nerve fused,

Pattern II<sub>a</sub> –one supplementary branch between both nerves and single root of from musculocutaneous nerve contributes 69.9 %

II<sub>b</sub> – There are two roots from MSN nerve 2.7 %,

Pattern 3 – two branches between both nerves 6.8 %. Altered Signalling between mesenchymal cell and neuronal growth comes may result into variations in nerve patterns.

Based on the site of communication and variation the Venieratos and Anagnostopoulou 1998<sup>[19]</sup> also observed the three types of communication between median nerve and musculocutaneous nerve in relation to coracobrachialis muscle.

TYPE I: Communication between median nerve and musculocutaneous nerve in proximal to coracobrachialis muscle;

TYPE II: Communication between median nerve and musculocutaneous nerve in distal to muscle;

TYPE III: Neither the between median nerve and musculocutaneous nerve nor the communicating branch pierce the coracobrachialis muscle.

Le minor also observed variation in MCN and median nerve in to five types.<sup>[20]</sup>

Type 1: The musculocutaneous nerve and median nerve.

Type 2: The fibers of medial root of median nerve pass through the musculocutaneous nerve and join the median nerve in the middle of the arm.

Type 3: Fibers of the lateral root of the median nerve pass through the musculocutaneous nerve and after some distance leave it to for lateral root of the median nerve.

Type 4: The musculocutaneous nerve fibers join the lateral root of the median nerve and after some distance the musculocutaneous nerve arise from the median nerve.

Type 5: The musculocutaneous nerve is absent and the entire fibers of musculocutaneous nerve pass through lateral root of median nerve and fibers to the muscles supplied by musculocutaneous nerve branch out directly from median nerve. In this type the musculocutaneous, nerve does not pierce the coracobrachialis muscle.

### **Clinical Implication**

During surgery of the shoulder region and fracture, shaft humerus identification of musculocutaneous nerve and its variation is important, as it is vulnerable to injury from surgical instruments. Knowledge of communication between MCN and MN is of significance in shoulder injuries and in reconstructive surgeries.

Surgeons should particularly take into consideration these possible anatomical variations when trying unusual symptoms which may occur during examination of patients with median nerve injury or thoracic outlet syndrome.<sup>[21]</sup> As it is vulnerable to injury from retractors which are placed under the coracoid process. During the coracoid process grafting, shoulder dislocations and frequent arthroscopies may damage the muscle as well as the nerve.<sup>[22]</sup> It is important for surgeons, clinicians and anatomists to be aware of possible anatomical variations to avoid unexpected complications.

### **CONCLUSION**

During surgery of the shoulder region the identification of musculocutaneous nerve (MCN) and its variation is important because it is vulnerable to injury from surgical instruments. The high incidence of variations, they are important for neurologists, orthopaedicians and traumatologist to avoid unexpected complications.

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