# Incidences and Clinical Implications of Communications between Musculocutaneous Nerve and Median Nerve in the Arm – A Cadaveric Study

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### *ABSTRACT*

***Objectives:*** *Variations such as communications between the median nerve and musculocutaneous nerve or in their abnormal branching pattern constitute a major concern in clinical and surgical field. Knowledge of these variations not only provides the clinician with a proper interpretation of the case, but also minimizes the complication in surgical approaches in this region.*

***Method:*** *We examined 50 isolated upper limbs to investigate the possible incidences of various types of communications between these two neighbouring peripheral nerves.*

***Result:*** *Twenty-eight per cent of limbs were found to have communication between these two nerves. When categorized according to Venieratos and Anagnostopoulou's classification method, 11 out of 14 cases (79%) showed type I communications, two out of 14 (14%) showed type II and the remaining one (7%) showed type III communication pattern.*

***Conclusion:*** *Prior knowledge of communications between these two neighbouring nerves, both in terms of their incidences and pattern of communications, may be of considerable significance to neurologists and orthopaedic surgeons in dealing with nerve entrapment syndromes in the upper limb of patients.*


**Keywords:** Brachial plexus, communication, entrapment syndrome, median nerve, musculocutaneous nerve

# Incidencias e Implicaciones Clínicas de las Comunicaciones entre el Nervio Musculocutáneo y Nervio Mediano en el Brazo – Un Estudio Cadavérico

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### *RESUMEN*

***Objetivos:*** *Las variaciones tales como las comunicaciones entre el nervio mediano y el nervio musculocutáneo o en su patrón de ramificación anormal constituyen un interés principal en el campo clínico y quirúrgico. El conocimiento de estas variaciones no sólo proporciona una interpretación adecuada del caso clínico, sino que también minimiza la complicación en abordajes quirúrgicos en esta región.*

***Método:*** *Se analizaron 50 miembros superiores aislados para investigar las posibles incidencias de diversos tipos de comunicaciones entre estos dos nervios periféricos vecinos.*

***Resultado:*** *Se halló que el veintiocho por ciento de los miembros tenía comunicación entre estos dos nervios. Cuando fueron categorizados según el método de clasificación de Venieratos y Anagnostopoulou, 11 de 14 casos (79%) mostró comunicaciones de tipo I, dos de 14 (14%) mostraron el tipo II, y el restante (7%) mostró un patrón de comunicación de tipo III.*

***Conclusión.*** *El conocimiento previo de las comunicaciones entre estos dos nervios vecinos, en términos tanto de sus incidencias como patrones de comunicación, puede ser de una importancia considerable para los neurólogos y ortopédicos a la hora de tratar con el síndrome del atrapamiento del nervio en la extremidad superior de los pacientes.*


**Palabras claves:** Plexo braquial, comunicación, síndrome del atrapamiento, nervio mediano, nervio musculocutáneo

**West Indian Med J 2013; 62 (8): 744**

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## INTRODUCTION

The median nerve (MN) is formed by the union of two roots. Its lateral root is derived from the lateral cord (C5, C6 and C7) and medial root from the medial cord (C8, T1) of the brachial plexus. It enters the arm at first lateral to the brachial artery. Near the insertion of the coracobrachialis (CB), it crosses in front of the artery, descending medial to it, to the cubital fossa, where it is posterior to the bicipital aponeurosis and anterior to the brachialis. It usually enters the forearm between the heads of the pronator teres (1). It does not give any branches in the arm. It innervates the flexor muscles in the anterior compartment of the arm (except the flexor carpi ulnaris and medial part of the flexor digitorum profundus muscle). It also contributes in supplying the skin of the palmar region.

The musculocutaneous nerve (MCN) is solely derived from the lateral cord of the brachial plexus, given off opposite the lower border of pectoralis minor muscle. It pierces the CB muscle and then passes between the biceps brachii and brachialis to the lateral side of the arm. Just above the elbow, the nerve pierces the deep fascia and then continues as the lateral cutaneous nerve of the forearm (lateral ante brachial cutaneous nerve). Musculocutaneous nerve gives motor branches to the muscles of the anterior compartment of the arm.

The MN normally communicates with the ulnar nerve in the arm but its communication with the MCN is not very common. Moreover, the presence of communication between these two nerves in the arm is not as uncommon as it was thought earlier (2). Precise knowledge of variations in MCN and MN communications is vital during treatment of trauma-tology of the shoulder joint, in plastic and reconstructive repair operations (3), as well as to the anaesthetist performing pain management therapies on the upper limb.

## MATERIALS AND METHODS

In the present study, we studied 50 upper limbs (24 right and 26 left). The axillary region of all the disarticulated limbs were exposed neatly and carefully in order to note the presence and type of communication between MCN and MN in the arm. The communication pattern between these two neighbouring nerves was segregated into three types according to Venieratos and Anagnostopoulou's classification (4). Their percentage incidences with respect to each category were calculated. One photograph from each of the three types of communications was taken.

## RESULTS

We observed an overall communication between MCN and MN in 14 of 50 upper limbs, accounting for 28% of overall incidences. When we categorized them according to Venieratos and Anagnostopoulou's type of classification, 11 out of 14 cases (79%) fell under type I (Fig. 1) communications, two out of 14 (14%) under type II (Fig. 2) and the remaining one (7%) showed type III pattern (Fig. 3).

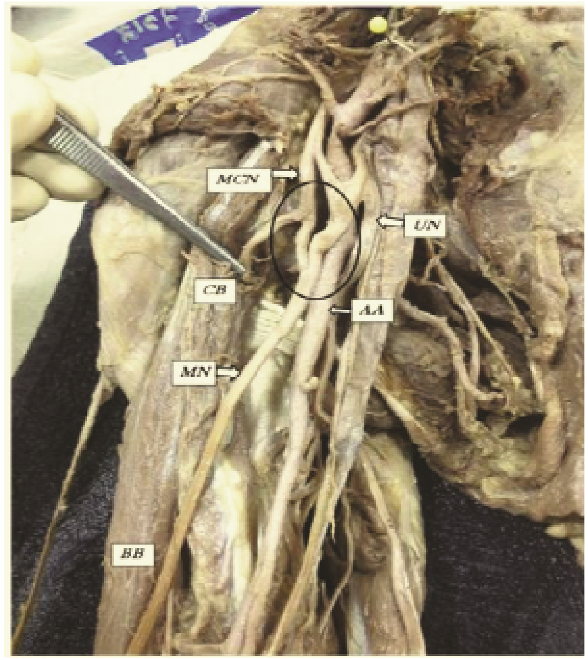


Fig. 1: Type 1 pattern of communication between the musculocutaneous nerve (MCN) and median nerve (MN) [within circle].
CB – coracobrachialis muscle, BB – biceps brachii muscle, AA – axillary artery, UN – ulnar nerve.

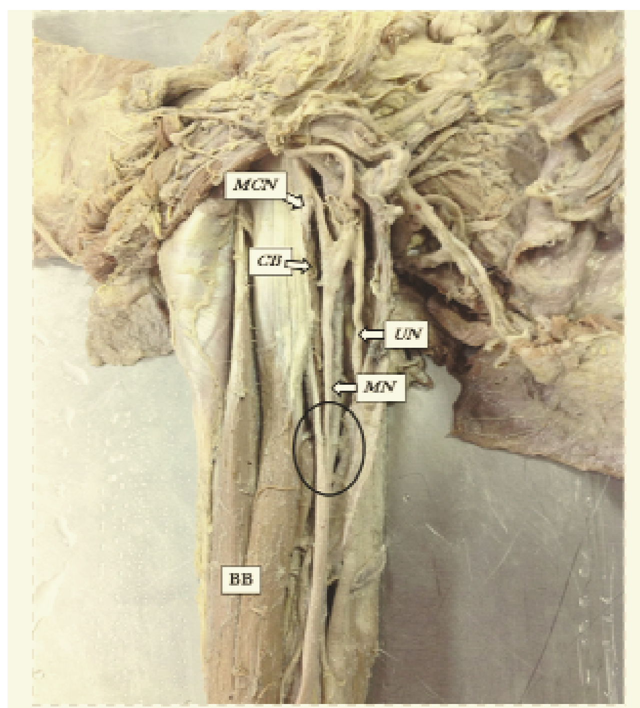


Fig. 2: Type II pattern of communication between the musculocutaneous nerve (MCN) and median nerve (MN) [within circle].
CB – coracobrachialis muscle, BB – biceps brachii muscle, UN – ulnar nerve.

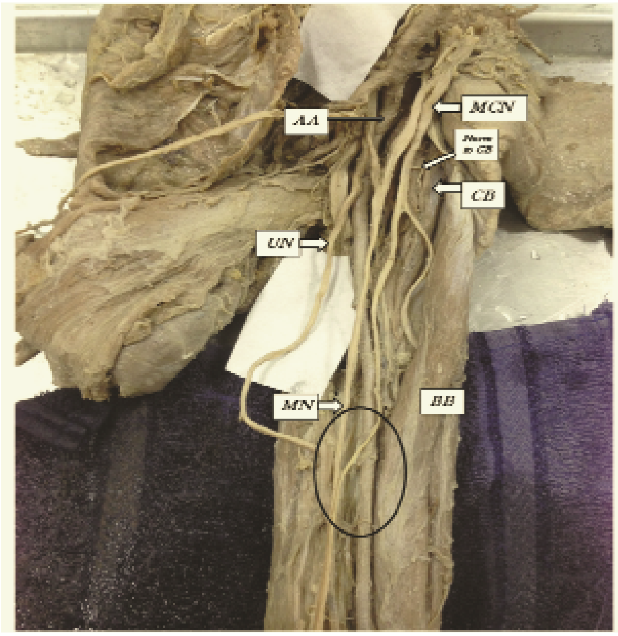


Fig. 3: Type III pattern of communication between the musculocutaneous nerve (MCN) and median nerve (MN) [within circle].
CB – coracobrachialis muscle, BB – biceps brachii muscle, UN – ulnar nerve, AA – axillary artery.

## DISCUSSION

Variations in the formation and branching array in terms of intercommunications of neighbouring nerves of the brachial plexus constitute an important anatomical as well as clinical scenario. Knowledge of anatomical variation of these nerves in the axilla or in the arm is necessary as there has been an increasing frequency of surgeries performed in these areas (5). Although the communications between the different nerves in the arm are rare, those between MCN and MN have been reported earliest by Harris in 1904 (6). Since then, this aspect might have assumed great clinical importance and more and more investigators have performed studies to evaluate the incidence of communication between these two nerves. In the meantime, various authors have attempted to simplify the type of pattern of communication by their own way of classification. Thus, in the available literature, four different ways of classification can be noted.

Le Minor (7), in his study on the relation between MN and MCN, introduced in 1992 a five-type pattern of communication. According to him, in type I, there is no communication between the MN and the MCN, in type II, the fibres of the lateral root of the MN pass through the MCN nerve and join the MN in the middle of the arm, whereas in type III, the lateral root fibres of the MN pass along the MCN and after some distance, leave it to form the lateral root of the MN. In type IV, the MCN fibres join the lateral root of the MN and after some distance the MCN arises from the MN. In type V, the MCN is absent and the entire fibres of the MCN pass through the lateral root and fibres go to muscles supplied by a branch directly from the MN.

Later, in 1998, Venieratos and Anagnostopoulou (4) came up with a modest classification with three types. In type I, the communication between the nerves is proximal to the piercing of the MCN into CB muscle, in type II, the communication is distal to the CB muscle and in type III, the nerve as well as the communicating branch do not pierce the CB muscle. This classification pattern is currently being used by many investigators.

A similar study carried out by Guerri-Guttengerg (8) in 2002 used a different mode of classification based on the topographic position of the communication between MCN and MN. It corresponded with type I and II of Venieratos and Anagnostopoulou's classification (4) and type IV of Le Minor's (7) classification.

On the other hand, Choi *et al*, in 2000, introduced pattern-wise classification, in which pattern I comprised fusion of MN and MCN and pattern II, the presence of one supplementary branch between both nerves. This pattern was further subdivided into pattern 2a, where a single root from MCN provides a connection, and pattern 2b, where two roots from the MCN form the communication with MN. Pattern 3 often shows two branches of communication between both nerves (2).

In 2005, Loukas, and Aqueelah added an additional type (IV) to Venieratos and Anagnostopoulou's classification. In this type, the first communication is proximal to the point of entry of the MCN into the CB muscle and an additional communication takes place distally (3).

The percentage occurrence of communication between MCN and MN by different authors and its comparison with our study has been tabulated (Table). Reports on the study of the overall incidence of the communication between MN and MCN in India are scanty. With the available literature, we compared our findings (28% of incidences) with the study by Sawant *et al* [30%] (9) and the results were comparable. This could be sensitization to the investigators for the further study in terms of topographical variations in its occurrence.

When the MCN is absent, the MN may compensate by supplying the muscles of the front of the arm. This observa-

Table: Comparison of percentage occurrence of various patterns of communication between the musculocutaneous nerve (MCN) and median nerve (MN) reported by other authors with the findings of the current study

| | **Venieratos and Anagnostopoulou (4)** | **Loukas and Aqueelah (3)** | **Guerri-Guttenberg (8)** | **Present study** |
|---|---|---|---|---|
| Type I | 41 | 45 | 84.6 | 79 |
| Type II | 45 | 35 | 7.7 | 14 |
| Type III | 14 | 9 | – | 7 |
| Type IV | – | 8 | 7.7 | – |
| Overall incidences | 13.9 | 63.5 | 53.6 | 28 |

tion was supported by some authors who reported such cases (10–12). If such is the case, when there is damage to the MN, paralysis of the flexor musculature of the elbow and hypoesthesia of the lateral surface of the forearm is also manifested in addition to other complications of MN injury. Nevertheless, MN giving a branch to coracobrachialis in addition to MCN has also been stated as a rare phenomenon (13).

Unusual formation of MCN and MN in addition to variations noticed in both origin and distribution of MN and MCN were also reported (7, 14). Splitting of the median nerve in the arm into the median nerve proper and musculocutaneous nerve in 5.12% of the upper extremities has been reported by Budhiraja *et al* (12).

Cross communication between MCN and MN may be the common and frequent variations among the branches of the brachial plexus confined in the arm; however, its communication in the forearm is rarest of all. One such case was reported by Agarwal *et al* (15).

Abnormal communication between peripheral nerves can be attributed to defective embryology basis whereby arbitrary factors influence the mechanism of formation of limb muscles and the peripheral nerves during embryonic life. Significant variations in nerve pattern may be a result of altered signalling between mesenchymal cells and neuronal growth cones (16) or circulatory factors at the time of fusion of the brachial plexus cords (17). According to Chiarapattanakom *et al* (18), since the limb muscle develops from the mesenchyme of local origin, and the axons of spinal nerve grow distally to reach these muscles, any incoordination between the formation of muscles and their innervations can lead to deviations from the normal pattern and thus an appearance of communicating branches persists. Hence, Chauhan and Roy (19) strongly recommended the consideration of phylogeny and the development of the nerves of the upper limb for the elucidation of the nerve anomalies of the arm as it recapitulates the phylogeny. To support this, studies of comparative anatomy have observed the existence of such connections in monkeys and in some apes; the connections may represent the primitive nerve supply of the anterior arm muscles (20).

Irrespective of the reason for the existence of communication between these nerves, knowledge of these variations provides the clinician with proper assessment of the case, failure of which may complicate various surgical approaches in this area. Moreover, it may result in futility while performing nerve blockades and in correctly interpreting anomalous innervation patterns of the upper limb (21).

In summary, understanding of the communications between musculocutaneous nerve and median nerve may be of considerable significance to neurologists and orthopaedic surgeons when dealing with nerve entrapment syndromes of the upper limb in patients.

**Authors' note**

N Kumar, A Guru and J Patil conceived and designed the study; N Kumar and MR D'Souza prepared the manuscript, and S Nayak B approved the final version.

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