FOLIA MEDICA CRACOVIENSIA
Vol. LXV, 3, 2025: 185–195
PL ISSN 0015-5616 eISSN 2957-0557
DOI: 10.24425/fmc.2025.156693

Morphologic study on the patterns of communication between median and musculocutaneous nerves in humans

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Abstract: Objective: Several patterns of communication between the median nerve (MN) and the musculocutaneous nerve (MCN) have been described along with a number of classification systems. However, some atypical patterns of communication find no place in the existing classification systems. Knowledge about these variable communications is crucial for the accurate clinical management of peripheral nerve lesions of the upper limb.
Methods: 48 formalin-fixed dissected specimens of upper limb (36 right and 12 left) were examined for presence of communications between MN and MCN. The observed gross anatomical features were recorded and photographed using a digital camera. Measurement of length and thickness of communications was done using a non-stretchable measuring tape and digital Vernier callipers.
Results: A total of 8 communications were observed, all unilateral, extending from MCN to MN and located either in the axilla or in the arm. Five communications were on the right side and 3 on the left. Five communications adhered to typical previously reported patterns, while three were novel and atypical. Most communications arose from the MCN after it traversed the coracobrachialis (CRB) muscle, only one arising proximal to the CRB.
Conclusion: Eight cases of unilateral MN-MCN communication were found among the 48 upper limbs examined, including three atypical cases that cannot be categorized in any existing classification system and may therefore be easily missed during surgery. Their identification is crucial to avoid inadvertent damage during surgical procedures.

Keywords: brachial plexus, median nerve, musculocutaneous nerve, coracobrachialis muscle.

Submitted: 23-Mar-2025; **Accepted in the final form:** 15-Sep-2025; **Published:** 30-Sep-2025.

Introduction

The brachial plexus is formed by the anterior primary rami of the C5 through T1 spinal nerves and has the following components: roots, trunks, divisions, cords and branches. The infraclavicular part of the brachial plexus consists of the three cords and their branches. The anterior primary rami forming the supraclavicular plexus are termed as the roots. The median nerve (MN) and the musculocutaneous nerve (MCN) are two important mixed peripheral nerve branches of the plexus.

The MN has a root value of C5-T1 and the MCN has a root value of C5-C7 [1, 2]. The main trunk of the MN is formed by two roots, the medial root arising from the medial cord (MC) and the lateral root arising from the lateral cord (LC). The medial root of the median nerve has contributions from the anterior divisions of the lower trunk and the lateral root of the median nerve has contributions from the anterior divisions of the upper and middle trunks [3]. The MN descends through the arm without giving any muscular branches, except vascular twigs. It provides motor supply to most forearm flexors, thenar muscles and the first two lumbricals. The sensory supply of the skin of the lateral half of the palm, the palmar aspect of the lateral three and half digits, and the dorsum of the distal phalanges of these digits are also supplied by the MN [1–3]. Damage to the MN has minimal effect on the movements of the arm, but adversely affects pronation, crude flexion at the wrist joint and some intrinsic hand movements with sensory loss in the lateral half of the palm and digits.

The MCN is a terminal branch of the lateral cord, the other terminal branch being the lateral root of MN. The MCN first gives a motor branch to the coracobrachialis (CRB) muscle and then pierces through this muscle to supply the biceps brachii and the brachialis muscles [1–3]. In the arm, just above the elbow, it pierces the deep fascia and descends superficially as the lateral cutaneous nerve of the forearm. Therefore, damage to the MCN manifests as weakness or loss of elbow flexion and sensory deficits in the anterolateral forearm.

Materials and Methods

The axilla and the anterior compartments of the arm and forearm were meticulously examined for the presence of communications between the MN and MCN in 48 dissected cadaveric upper limbs. All the cadaveric specimens were fixed in 10% formalin solution and maintained immersed in the same formalin solution. The origin & course of MN, MCN and other branches of the brachial plexus, as well as their topographical relations with the adjacent structures, were carefully examined. The observed gross anatomical findings were recorded and photographed using a Nikon D3500 DSLR digital camera. Various dimensions (notably, length and thickness of communications) were measured using a non-stretchable measuring tape and digital Vernier callipers.

Ethical consideration

Ethical clearance was not required from the local institutional ethical committee as the study was carried out on donated cadavers. The dissection procedure was in accordance with the ethical guidelines of Declaration of Helsinki (1964) and as per the institutional protocol of our institute for use of human cadavers for medical teaching and research.

Informed consent

The cadavers used in this study were donated to the department with written and informed consent obtained from the family members at the time of body donation.

Statistical analysis

Statistical calculations such as percentage, mean etc. were calculated using Microsoft Excel version 2019.

Results

Communications between the MN and MCN were observed in a total of 8 of the 48 examined upper limbs. Five of these were right-sided and 3 were left-sided. The communications were categorized on the basis of their origin from the MCN (with respect to the CRB) and meeting point with the MN. Most communications were found to connect the MCN with the MN in the middle third of the arm.

Figs. 1A and 1B present images showing the patterns of communication in all the 8 dissected limbs. Fig. 2 depicts a schematic diagram illustrating the mode of MN-MCN communication. The characteristic features and measurements pertaining to these communicating branches are summarized in Table 1.

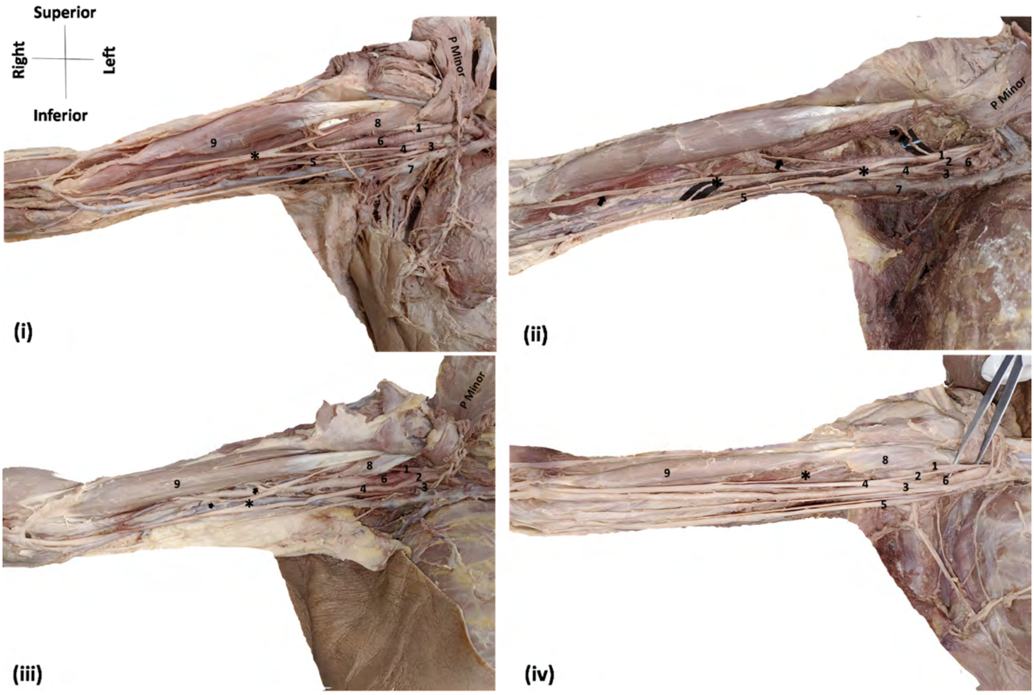

Fig. 1A. Dissected brachial plexus showing MCN-MN communications in first 4 cases.
1 — musculocutaneous nerve, 2 — lateral root of the median nerve, 3 — medial root of the median nerve, 4 — median nerve, 5 — ulnar nerve, 6 — axillary artery, 7 — axillary vein, 8 — coracobrachialis muscle, 9 — biceps brachii muscle; P minor — pectoralis minor muscle, (*) black asterisk — communication, black arrow — muscular branches of musculocutaneous nerve.

Fig. 1B. Dissected brachial plexus showing MCN-MN communications in last 4 cases.
1 — musculocutaneous nerve, 2 — lateral root of the median nerve, 3 — medial root of the median nerve, 4 — median nerve, 5 — ulnar nerve, 6 — axillary artery, 7 — axillary vein, 8 — coracobrachialis muscle, 9 — biceps brachii muscle; P major — pectoralis major muscle, P minor — pectoralis minor muscle, (*) black asterisk — communication.

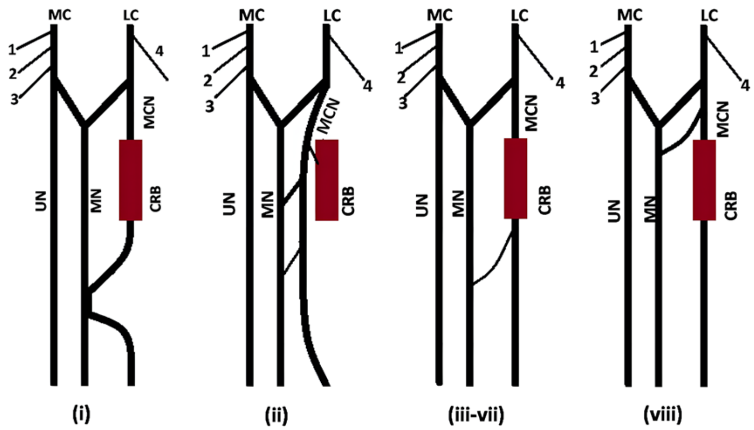

Fig. 2. Schematic illustration of the morphology and location of MCN-MN communications.
MC — medial cord, LC — lateral cord, UN — ulnar nerve, MN — median nerve, MCN — musculocutaneous nerve, CRB — coracobrachialis muscle, 1 — medial pectoral nerve, 2 — medial cutaneous nerve of the forearm, 3 — medial cutaneous nerve of the arm, 4 — lateral pectoral nerve.

Table 1. Communicating branches between the median and musculocutaneous nerves.

S. No.	Side	Length (cm)	Width (mm)	Description of communicating branch; origin w.r.t passage through coracobrachialis (CRB)
1	Right	—	—	Nerves joined for a distance of 2.48 cm, separating to follow their respective courses thereafter; **distal**
2	Right	1.73	0.72	Short thick communicating branch; **distal**
		2.32	0.42	Short thin communicating branch; **distal**
3	Right	1.07	0.62	Short communicating branch after musculocutaeous (MCN) emerges out from CRB; **distal**
4	Right	5.6	0.31	Long slender communicating branch distal to the CRB insertion; **distal**
5	Right	2.04	0.35	Short slender communicating branch after MCN emerges from CRB; **distal**
6	Left	3.14	0.34	Short slender communicating branch after MCN emerges from CRB; **distal**
7	Left	5.32	0.67	Long communicating branch after MCN emerges out from the CRB; **distal**
8	Left	2.71	0.48	Short communicating branch before MCN pierces the CRB; **proximal**

Discussion

Embryology: The upper limb bud appears by the end of 4th week of gestation. During the 5th week, limb musculature develops under the influence of the homeobox D genes. Radicular cones of axons develop and form a primary plexus in the mesenchymal tissues of the developing limb bud. Subsequently the primary plexus divides into anterior and posterior divisions. The MN and the ulnar nerve (UN) are first to develop from the anterior divisions. Subsequently the MCN gets separated from the MN. Peripheral nerves from the developing brachial plexus grow into the mesenchyme of the upper limb bud by forming growth cones of motor axons. Under the influence of factors such as brain derived nerve growth factor, ephrins, neutrin-1, neutrin-2, semaphorins etc. these growth cones of motor axons grow, differentiate and form accurate neural connections to innervate specific muscles and target tissues [4]. Neurons of the corresponding dorsal root ganglia project peripheral axons to the developing limb bud under the influence of runt-related transcription factor-3 (RUNX3). Peripheral innervations are also regulated by transcription factor neurotrophin-3 (NT3, secreted by limb mesenchyme), with support from the simultaneously developing motor neuron axons [5]. It is believed that deviation from the normal molecular signalling pathway results in anatomical variations of the brachial plexus. Altered signalling between nerve growth factors and mesenchymal cells during the critical time of fusion of the cords of the brachial plexus may result in aberrant communications [3, 5]. These communications can be correlated with similar communications found in monkeys and apes. Therefore, aberrant communications seen in humans may be considered as arising from the persistence of primitive nerves supplying the flexor muscles of the arm in our predecessors. Interestingly, these lower vertebrates possess a single ventral nerve trunk equivalent to the MN, whose branches provide innervation to the entire forelimb [6].

Different types of communications between the MN and the MCN, including atypical variants, are known [7–9]. These nerve communications are sometimes referred to as anastomosis [10], but we are using the term 'nerve communication' to denote such connections between MCN and MN nerves. The currently reported prevalence of the MN-MCN communications ranges between 3.3 and 35%, a vast majority of them unilaterally present in the arm, without any known correlation with gender or laterality [11–15]. The morphometric dimensions of these communications are believed to have clinical relevance, as in nerve grafting procedures. A few authors have attempted to systematically classify some of these commonly encountered communications. Le Minor (1990) provided a systematic classification of the anatomical variations of the MCN and observed the following five subtypes of MN-MCN communications: Type I — typical appearance of MCN in brachial plexus, Type II — MN-MCN communications at variable levels, Type III — lateral root of the MN originating from MCN, Type IV — all the branches of the MCN directly arising from the lateral cord, and Type V — absence of MCN with MN taking over its distribution [11]. Venieratos *et al.* (1998) described the location of the communications in relation to the CRB muscle, classifying them into three varieties: Type I — the communication arises proximal to the point of entry of MCN into the CRB, Type II — the communication is located distal to CRB muscle, Type III — MCN does not course through the CRB muscle [9]. Choi *et al.* (2002) later introduced a simpler modified system, classifying the MN-MCN communications into three categories: Type 1 — fusion of the nerves in the arm, Type II — single communication, Type III — two communications [16]. Hayashi *et al.* (2016) introduced a comprehensive system of classification and categorized the variants into five different types, addressing the deficiencies of the earlier classification systems [17]. However, none of the existing classification systems is explicit enough to allow atypical patterns to be placed in a definite sub-category. In most cases, the communicating branch arises distal to the CRB insertion in the middle third of the arm, terminating in the arm itself [18, 19]. A brief account of the reported patterns of communication between the MN and MCN in the arm across various population groups is presented in Table 2.

Among the atypical variety of communications, the notable ones include origin of the third root of the MN from the MCN, distal communication in the elbow or below the elbow, fusion of MN and MCN throughout, communication of MN with one of the muscular branches of MCN etc. Previously Chauhan *et al.* (2002) reported communications between MCN and MN from our department [20]. In our study, we found all the eight unilateral MN-MCN communications in the axilla or the arm, of which five were on the right side and three on the left. In six cases, the communicating branch was found to arise from the MCN after its emergence from the CRB. In the first atypical case (Fig. 1A (i) & Fig. 2 (i)) the MCN and MN joined for a short distance in the upper third of the arm, exchanged fibres and then separated. In the second atypical case, double communications were seen between the MCN and MN. A separate distinct tiny branch of the MCN was observed supplying the CRB. The MCN was then seen to descend without piercing the CRB, supplying the biceps and brachialis muscles and communicating twice with the MN (Fig. 1A (ii) and Fig. 2 (ii)). The proximal thick communication in this case may be considered as the third root of the median nerve. The third atypical case in the present study, showed a communication proximal to the MCN piercing the CRB muscle (Fig. 1B (viii) and Fig. 2 (viii)). A very few reports of complete absence of MCN with functional compensation by the MN exist in literature [21]. Rarely, a tiny branch of the lateral cord is observed to supply the CRB in the absence of MCN [22]. Other atypical communications are described in the elbow or the forearm.

Table 3 summarizes some of the notable atypical communications that have been recently reported in literature. Usually these communications are incidental findings during cadaveric dissection or surgery and do not seem to have any clinical implications. The high variability of these communications however, especially the occurrence of atypical ones, makes them prone to iatrogenic injuries and hence they become clinically relevant. Entrapment of MCN is a common condition which can occur following passive forceful movement. The MCN entrapment may also occur because of an abnormal position adopted during sleep [23]. In the presence of MN-MCN communications, MCN neuropathy may present with symptoms of MN neuropathy [24]. In such a scenario, a patient of MCN neuropathy may be wrongly subjected to carpal tunnel release procedure, incorrectly presuming it to be MN entrapment neuropathy. Similar confusing findings may be obtained during functional assessment of these nerves while performing clinical examination or nerve conduction studies. Where clinical confusion persists, its resolution lies in confirming presence of these communications by electrophysiological or electromyography methods. Electrophysiological studies facilitate identification of the specific distribution of communicating fibres, thus aiding clinical decision-making. Such communications have the potential for clinical application in nerve-grafting procedures following damage to the MN. Similarly, in pathological lesions involving the MN such as neurofibroma that require resection of a segment of the nerve, these communications may be therapeutically utilized. Hence, awareness about the typical and atypical variations in communications between these two important nerves is extremely important.

Table 2. Reported patterns of communication between musculocutaneous and median nerves.

Authors	Type of study, population & sample size	Location of MN-MCN communications in arm, with associated anomalies
Patil *et al.* 2012 [1]	Cadaveric case, Indian, 1	Communicating branch on right side; MN formed only by lateral root on left side
El-Falougy *et al.* 2013 [6]	Cadaveric cases, Slovakian, 4	3 communications on right side, 1 on left side; 1 showed bilateral communications
Caetano *et al.* 2016 [10]	Cadaveric study, Brazilian, 40	25% prevalence: MCN to MN in 9 specimens, MN to MCN in 1; 4 on right side & 6 on left
Al-Sobhi *et al.* 2023 [14]	Cadaveric study, Saudi, 40	35% prevalence
Hayashi *et al.* 2016 [17]	Cadaveric study, Japanese, 130	Proposed a novel classification system with 5 sub-types; also classified transposed innervation of arm flexors into three sub-types
Ballesteros *et al.* 2015 [22]	Cadaveric study, Columbian, 106	19.8% prevalence; 2.8% specimens exhibited MN to MCN communication
Moasses *et al.* 2024 [25]	Cadaveric study, Iranian, 26	1 of 16 specimens exhibited communication from MCN to MN, communicating branch arising from MCN just distal to CRB insertion
Antonopoulos *et al.* 2022 [26]	Cadaveric case, Greek, 1	Communication from MCN to MN on right side

Table 2. Cont.

Authors	Type of study, population & sample size	Location of MN-MCN communications in arm, with associated anomalies
Ghosh *et al.* 2022 [27]	Cadaveric study, Indian, 60	3.3% prevalence
Chrysikos *et al.* 2020 [28]	Cadaveric case, Greek, 1	Communication on the left, communicating branch from MCN arising proximal to CRB
Paraskevas *et al.* 2019 [29]	Cadaveric case, Greek, 1	Bilateral communications
Nasrabadi *et al.* 2017 [30]	Cadaveric case, Iranian, 1	MCN arising from lateral cord on left side, descending without piercing CRB and communicated with MN
Taib *et al.* 2017 [31]	Cadaveric study, Malaysian, 44	13.6% prevalence; all on left side
Liu *et al.* 2014 [32]	Cadaveric Case, Korean, 1	Communication on right side

Table 3. Atypical MN-MCN connections reported in literature.

Authors	Features
Agarwal *et al.* 2011 [3]	Communicating branch from MCN given above elbow joined MN below elbow after spiralling around persistent median artery
Gelmi *et al.* 2018 [18]	Long communicating branch on right side, extending from MCN in axilla to MN in cubital fossa
Chentanez *et al.* 2016 [33]	Double communication: proximal one directed from MCN to MN; distal one directed from MN to MCN
Ozturk *et al.*, 2010 [34]	Atypical branch of MCN on left side, piercing CRB without supplying it and then joining MN; bilaterally associated with third head of biceps brachii

Proper clinical evaluation of MN and/or MCN dysfunction together with accurate clinical correlation of functional loss thereof, requires sound prior knowledge about various types of MN-MCN communications. Communicating branches between the MN and MCN are much more prevalent than previously believed. Their recognition is crucial as their location is highly variable and hence prone to iatrogenic damage. A surgeon must therefore be quite vigilant for detecting or ruling out such communications, considering their susceptibility to injuries during surgeries of the upper-limb.

Conclusions

Eight cases of unilateral MN-MCN communication were found among a total of 48 upper limbs that were examined for the present study. The most noteworthy among these were three atypical cases, including one showing fused musculocutaneous and median nerves, another with two communications between the nerves, and one instance of communication proximal to MCN entry into the coracobrachialis muscle. These atypical communications do not readily find a place in any existing system of classification and thus may be easily missed during surgery. Their identification is crucial in order to avoid inadvertent damage during surgical procedures. They may yield unusual findings in nerve conduction studies, thereby impacting the therapeutic protocol, while additionally subjecting the patient to unnecessary investigations and procedures.

Author contributions

Protocol development — D.B., R.D., R.S.; Data collection and management — D.B., R.S.; Data analysis — D.B., R.D., A.G., R.S.; Manuscript writing — D.B., R.D., A.G., R.S.; Final approval of manuscript — R.S.; Data collection — J.B.; Manuscript editing — J.B.

Conflict of interest

None declared.

Funding statement

This research received no funding from any source.

Acknowledgement

The authors acknowledge the invaluable contribution of all body donors and their families for their noble gesture towards the advancement of medical knowledge.

References

1. *Patil S.T., Meshram M.M., Kasote A.P., Kamdi N.Y.*: Formation of median nerve from single root on left side and communicating branch from median nerve to musculocutaneous nerve on right side. Morphologie. 2012; 96 (313): 51. http://dx.doi.org/10.1016/j.morpho.2012.06.001.
2. *Hunter D.D., Zdilla M.J.*: The absent musculocutaneous nerve: A systematic review. Transl Res Anat. 2021; 22: 100092. http://dx.doi.org/10.1016/j.tria.2020.100092.
3. *Agarwal S., Tuli A., Raheja S.*: Communication between median and musculocutaneous nerves in the forearm hooking around the origin of the median artery: a rare variation. Anat Sci Int. 2011; 86 (3): 175–177. http://dx.doi.org/10.1007/s12565-011-0105-y.
4. *Raza K., Singh S., Rani N., Mishra R., Mehta K., Kaler S.*: Anomalous Innervation of the Median Nerve in the Arm in the Absence of the Musculocutaneous Nerve. Sultan Qaboos Univ Med J. 2017; 17 (1): e106–108. http://dx.doi.org/10.18295/squmj.2016.17.01.019.
5. *Wang Y., Wu H., Zelenin P., et al.*: Muscle-selective RUNX3 dependence of sensorimotor circuit development. Development. 2019; 146 (20): dev181750. http://dx.doi.org/10.1242/dev.181750.
6. *El-Falougy H., Selmeciova P., Kubikova E., Stenova J., Haviarova Z.*: The variable communicating branches between musculocutaneous and median nerves: a morphological study with clinical implications. Bratisl Lek Listy. 2013; 114 (05): 290–294. http://dx.doi.org/10.4149/bll_2013_061.
7. *Prasada Rao P.V.V., Chaudhary S.C.*: Absence of musculocutaneous nerve: Two case reports. Clin Anat. 2000; 14 (1): 31–35. http://dx.doi.org/10.1002/1098-2353(200101)14:1<31::aid-ca1005>3.0.co;2-y.
8. *Budhiraja V., Rastogi R., Kumar Asthana A., Sinha P., Krishna A.*: Concurrent Variations of Median and Musculocutaneous Nerves and Their Clinical Correlation: a Cadaveric Study. Ital J Anat Embryol. 2011; 116 (2): 67–72.

9. *Venieratos D., Anagnostopoulou S.*: Classification of communications between the musculocutaneous and median nerves. Clin Anat. 1998; 11 (5): 327–331. http://dx.doi.org/10.1002/(sici)1098-2353(1998)11:5<327::aid-ca6>3.0.co;2-m.
10. *Caetano E.B., Vieira L.Â., Cavalheiro C.S., Razuk Filho M., Almargo M.A.P., Caetano M.F.*: Anatomic study of the nervous communication between the median and musculocutaneous nerve. Acta Ortop Bras. 2016; 24 (4): 200–203. http://dx.doi.org/10.1590/1413-785220162404159372.
11. *Le Minor J.M.*: A rare variation of the median and musculocutaneous nerves in man. Arch Anat Histol Embryol. 1990; 73: 33–42.
12. *Krishnamurthy S., Shruthi B., Ruthvik K., Rahul B.*: Communication between the median nerve and the musculocutaneous nerve: Occurrence and significance. Natl J Clin Anat. 2020; 9 (2): 66. http://dx.doi.org/10.4103/njca.njca_7_20.
13. *Kimura S., Amatani H., Nakai H., et al.*: A novel case of multiple variations in the brachial plexus with the middle trunk originating from the C7 and C8. Anat Sci Int. 2020; 95 (4): 559–563. http://dx.doi.org/10.1007/s12565-020-00541-3.
14. *Al-Sobhi M.G., Zaki A.I., Abd El Hamid F.A., Alshali R.A., Mustafa H.N.*: The pattern of branching and intercommunications of the musculocutaneous nerve for surgical issues: anatomical study. Folia Morphol. 2023; 82 (1): 79–87. http://dx.doi.org/10.5603/fm.a2021.0139.
15. *Chitra R.*: Various types of intercommunications between musculocutaneous and median nerves: An analytical study. Ann Indian Acad Neurol. 2007; 10 (2): 100–104.
16. *Choi D., Rodríguez-Niedenführ M., Vázquez T., Parkin I., Sañudo J.R.*: Patterns of connections between the musculocutaneous and median nerves in the axilla and arm. Clin Anat. 2002; 15 (1): 11–17. http://dx.doi.org/10.1002/ca.1085.
17. *Hayashi M., Shionoya K., Hayashi S., et al.*: A novel classification of musculocutaneous nerve variations: The relationship between the communicating branch and transposed innervation of the brachial flexors to the median nerve. Ann Anat. 2017; 209: 45–50. http://dx.doi.org/10.1016/j.aanat.2016.08.004.
18. *Gelmi C.A.E., Pedrini F.A., Fermi M., Mariani G.A., Cocco L.I., Billi A.M.*: Communication between median and musculocutaneous nerve at the level of cubital fossa — A case report. Transl Res Anat. 2018; 11: 1–4. http://dx.doi.org/10.1016/j.tria.2018.04.001.
19. *Beheiry E.E.*: Anatomical variations of the median nerve distribution and communication in the arm. Folia Morphol. 2004; 63 (3): 313–318.
20. *Chauhan R., Roy T.S.*: Communication between the median and musculocutaneous nerve — a case report. J Anat Soc India. 2002; 51 (1): 72–75.
21. *Uzel A.P., Bulla A., Steinmann G., LaurentJoye M., Caix P.*: Absence of the musculocutaneous nerve and its distribution from median nerve: About two cases and literature review. Morphologie. 2011; 95 (311): 146–150.
22. *Ballesteros L.E., Forero P.L., Buitrago E.R.*: Communication between the musculocutaneous and median nerves in the arm: an anatomical study and clinical implications. Rev Bras Ortop. 2015; 50: 567–572.
23. *Kissel J.A., Leonardelli C.*: Isolated musculocutaneous neuropathy: a case report. J Can Chiropr Assoc. 2019 Dec; 63 (3): 162.
24. *Wertsch J.J., Melvin J.*: Median nerve anatomy and entrapment syndromes: A review. Arch Phys Med Rehabil. 1982; 63 (12): 623–627.
25. *Moasses Z., Aryan A., Hassanpour-Dehnavi A., Zarenezhad M., Dorodchi A.*: The anatomical variations of median nerve in Shiraz, Iran. Anat Cell Biol. 2024; 57 (1): 18–24. http://dx.doi.org/10.5115/acb.23.229.
26. *Antonopoulos I., Ampadiotaki M.M., Tsikouris G., et al.*: Fusion of the median and musculocutaneous nerves masquerading as biceps' innervation from the median nerve. J Brachial Plex Peripher Nerve Inj. 2023; 18 (1): e42–45. http://dx.doi.org/10.1055/s-0043-1767674.
27. *Ghosh B., Dilkash M.N., Prasad S., Sinha S.K.*: Anatomical variation of median nerve: cadaveric study in brachial plexus. Anat Cell Biol. 2022; 55 (2): 130–134. http://dx.doi.org/10.5115/acb.22.022.

28. *Chrysikos D., Athanasopoulos A., Georgakopoulos P., Antonopoulos I., Samolis A., Troupis T.*: Anatomical variation of a communicating branch between the musculocutaneous and the median nerve: a case report. Acta Med Acad. 2020; 49 (1): 71–74. http://dx.doi.org/10.5644/ama2006-124.286.
29. *Paraskevas G.K., Koutsouflianiotis K.N., Asouhidou I., Iliou K., Noussios G.*: Neural loop by the median nerve's roots associated with multiple neurovascular anomalies: A cadaver-based case report with clinical aspects. Cureus. 2019; 11 (11). http://dx.doi.org/10.7759/cureus.6163.
30. *Nasrabadi H.T., Abedelahi A., Shoorei H., et al.*: A variation of musculocutaneous nerve without piercing the coracobrachialis muscle while communicating to the median nerve: A case report and literature review. Int J Surg Case Rep. 2017; 41: 453–455. http://dx.doi.org/10.1016/j.ijscr.2017.11.020.
31. *Taib C.M., Hassan S.N., Esa N., Moklas M.M., San A.A.*: Anatomical variations of median nerve formation, distribution and possible communication with other nerves in preserved human cadavers. Folia Morphol. 2017; 76 (1): 38–43. http://dx.doi.org/10.5603/fm.a2016.0045.
32. *Liu H.F., Won H.S., Chung I.H., Kim S.M., Kim I.B.*: Rare communication between the musculocutaneous and median nerves in the forearm: its clinical significance. Am J Phys Med Rehabil. 2014; 93 (10): 920–924. http://dx.doi.org/10.1097/phm.0000000000000164.
33. *Chentanez V., Jaruprat P., Udomchaisakul P., Agthong S., Huanmanop T.*: Multiple variations in the course and motor branching pattern of the musculocutaneous nerve with unusual communication with the median nerve. Folia Morphol. 2016; 75 (4): 555–559. http://dx.doi.org/10.5603/fm.a2016.0014.
34. *Ozturk N.C., Uzmansel D., Ozturk H.*: An unreported pattern of musculocutaneous and median nerve communication with multiple variations of biceps brachii: a case report. Surg Radiol Anat. 2010; 32: 887–890. http://dx.doi.org/10.1007/s00276-009-0616-6.