

Research Article

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A Cadaveric Study on The Anatomical Variations of Brachial Plexus in Kolkata Based Population

Dr. Anwesa Pal¹, Dr. Soumali Biswas^{2*}, Dr. Sulakshana Pal³

¹Assistant Professor, Department of Anatomy, Institute of Post –Graduate Medical Education and Research, Kolkata, WB, India

²Assistant Professor, Department of Anatomy, Institute of Post–Graduate Medical Education and Research, Kolkata, WB, India

³Assistant Professor, Department of Anatomy, KPC Medical College and Hospital, Kolkata, WB, India

*Corresponding Author: Dr. Soumali Biswas

Email: drsoumali.biswas26@gmail.com

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Abstract: Background: The brachial plexus supplies motor, sensory and sympathetic fibres to the upper limb are vulnerable to damage in radical neck dissection and other surgical operations of the axilla and upper arm. In our present study we intend to elaborate these various anomalies in the branching patterns of brachial plexus by cadaveric dissection which may prove to be helpful in reducing brachial plexus injuries during neck surgeries. **Objectives:** Observation and record of various anomalous branching patterns of brachial plexus in human cadavers. **Materials and Methods:** The dissection was carried out in 50 upper limbs of formalin hardened human cadavers of both the sexes in the Department of Anatomy, IPGME&R, Kolkata, West Bengal. Roots, trunks, divisions, cords and branches of brachial plexus were dissected and observed carefully for any abnormality. **Result:** Out of 50 samples, in 16% cases the Axillary nerve took origin as a common trunk. In 22% cases a communicating branch was found between the musculocutaneous nerve and median nerve. In 4% cases, there was complete fusion between the above two nerves. The mean length of the communicating branch was seen to be 6.5cm. **Conclusion:** The knowledge of variations of brachial plexus is very important for anatomists; orthopaedic surgeons and general physicians during surgical interventions of the axilla and anaesthetists during arthroscopies, coracoid process grafting or shoulder surgeries.

Keywords: Musculocutaneous nerves, Median nerve, Communicating branch, Axillary nerve.

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INTRODUCTION

The brachial plexus supplies motor, sensory and sympathetic fibres to the upper limb, is formed by the ventral rami of lower four cervical nerves and first thoracic nerve (C₅ C₆, C₇, C₈ and T₁) and is located behind the scalenus anterior and medius muscles of the neck. Brachial plexus consists of roots, trunks, divisions and cords.

The errors in distribution, formation and communication between the branches of brachial plexus may occur at any level resulting in anatomical variations of the brachial plexus. These variations are not uncommon and are reported by many authors [1-3]. Some variations are vulnerable to damage in radical neck dissection and other surgical operations of the axilla and upper arm.

In our present study we observed gross variations among the cords and branching pattern of the brachial

plexus. Two main abnormalities that we found in our study were regarding the a) branching pattern and supply of Axillary nerve into the deltoid muscle and b) Anomalous communication between median and musculocutaneous nerves through a communicating branch.

Axillary nerve is one of the terminal branches of the posterior cord of the brachial plexus and is one of the most common nerves which is prone to iatrogenic injuries (6% of all the brachial plexus injuries) during shoulder arthroscopy, fracture of surgical neck of humerus, quadrangular space syndrome and plate fixation or retraction of the deltoid muscle [4]. Knowledge of the anatomical variations of the axillary nerve in respect to its origin from the posterior cord of brachial plexus, its site of division into anterior and posterior branch and its mode of supply to the deltoid muscle is highly important for anatomists, orthopaedic surgeons, radiologists and anaesthetists for proper

exploration of the axillary region. Lack of proper knowledge also leads to increased injury to the nerve during intramuscular injections of the deltoid and infraclavicular brachial plexus block [5].

Musculocutaneous nerve is one of the branches of brachial plexus (conveying fibres of C5, C6 & C7). Median nerve is formed by joining lateral and medial root from lateral and medial cord of brachial plexus respectively (conveying fibres of C5, C6, C7 and C8, T1 respectively). Variation in communication between musculocutaneous nerve and median nerve have become the area of interest for anatomists, radiologists and orthopaedic surgeons for several years as there may be some unusual clinical symptoms due to variation in their branching pattern [6,7]. Any injury to the musculocutaneous nerve proximal to the communication may cause unexplained weakness of flexors of forearm and thenar muscles. If there is any entrapment of musculocutaneous nerve or the communicating branch within the coracobrachialis muscle, it may exhibit signs and symptoms of median nerve neuropathy, as some fibres of median nerve go

through the musculocutaneous nerve so knowledge about exact topography, types and incidence of these variations of communication between musculocutaneous and median nerve can be very useful.

MATERIALS AND METHODS

The study was carried out in the Department of Anatomy, Institute of Postgraduate Medical Education and Research, Kolkata, West Bengal. The sample size was 50 upper limbs of 25 formalin hardened human cadavers of both sexes. All normal cadavers were included; cadavers with traumatized and deformed upper limbs were excluded from the above study. The dissection was carried out with the help of dissecting instruments. Roots, trunks, divisions, cords and branches of brachial plexus were dissected elaborately and observed carefully for any abnormality. Measurements, as and when recorded, were taken thrice and the mean value of each was considered to avoid observational bias. Photographs were taken with the help of digital camera.

OBSERVATIONS AND RESULTS

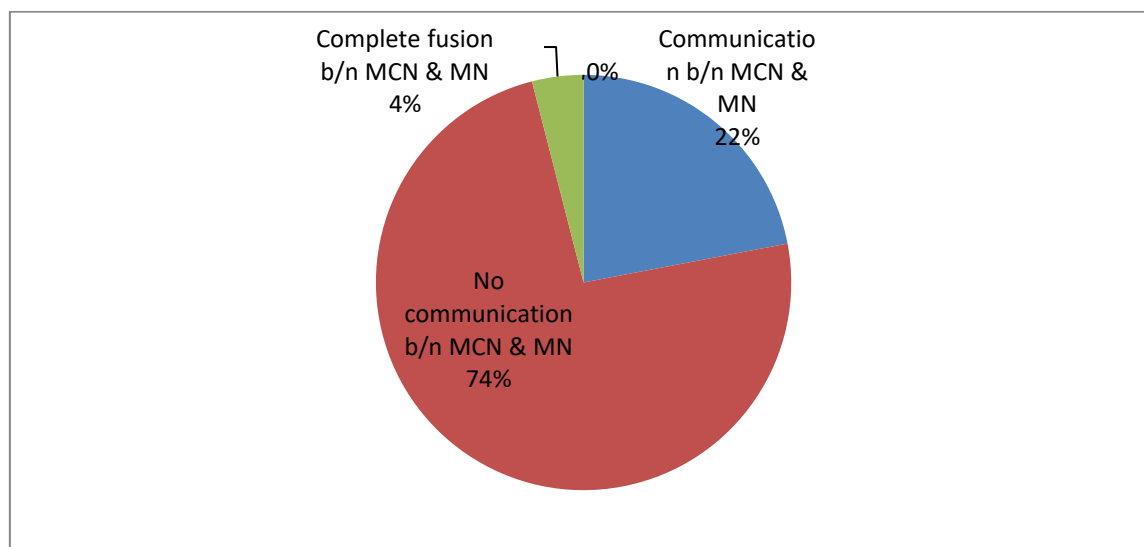


Fig 1: Pie Chart showing the distribution of communication between Musculocutaneous nerve (MCN) and Median nerve (MN); where sample size n=50

Out of the 11 limbs where communication was found, it was seen in 3 limbs (6%), the communicating branch arose from the musculocutaneous nerve within the coracobrachialis muscle (fig1) and in 8 limbs (16%) the branch arose from the musculocutaneous nerve distal to the aforesaid muscle (fig2). We found the mean length of the communicating branch 6.5cm. The mean distance from the tip of the coracoid process to the origin of the

communicating branch from musculocutaneous nerve is 8cm and the same upto the joining with the median nerve is 13.6 cm. In case of complete fusion (4%) we found the mean distance from the tip of the coracoid process to the formation of musculocutaneous nerve is 4.7cm and it is 12.2cm upto its fusion with the median nerve i.e formation of common trunk

Table-1: showing the results regarding the variations in the origin of Axillary nerve in our study:

Origin of Axillary nerve N= 50 Cadavers		
Directly from posterior cord of brachial plexus	42	
As a common trunk	08	Common trunk for axillary, thoracodorsal upper & lower subscapular (05)
		Common trunk for lower subscapular & axillary (03)

The mean distance of origin of axillary nerve from the anteromedial aspect of the tip of coracoid process was found to be 3.82cm.

Table-2: showing the site of division of Axillary nerve in our study

Site of division of Axillary nerve (N=50)	
Above the quadrangular space	12%
Within the quadrangular space	88%

Table-3: showings the results of mode of supply of deltoid muscle in our study :

Part of Deltoid muscle	Division of Axillary Nerve	Percentage	Mean Distance of entry of nerve into the deltoid from deltoid tuberosity	Mean Distance of entry of nerve into the deltoid from acromian process
<i>Anterior</i>	Anterior division	100%	7.46cm	10.98cm
<i>Middle</i>	Solely by anterior division	60%	5.80cm	5.40cm
	Dual supply(fig-3)	40%	5.06cm	7.32cm
<i>Posterior</i>	Posterior division	100%	8.26cm	7.49cm

In our study we did not find any anomalous connection between radial and ulnar nerves at any level.

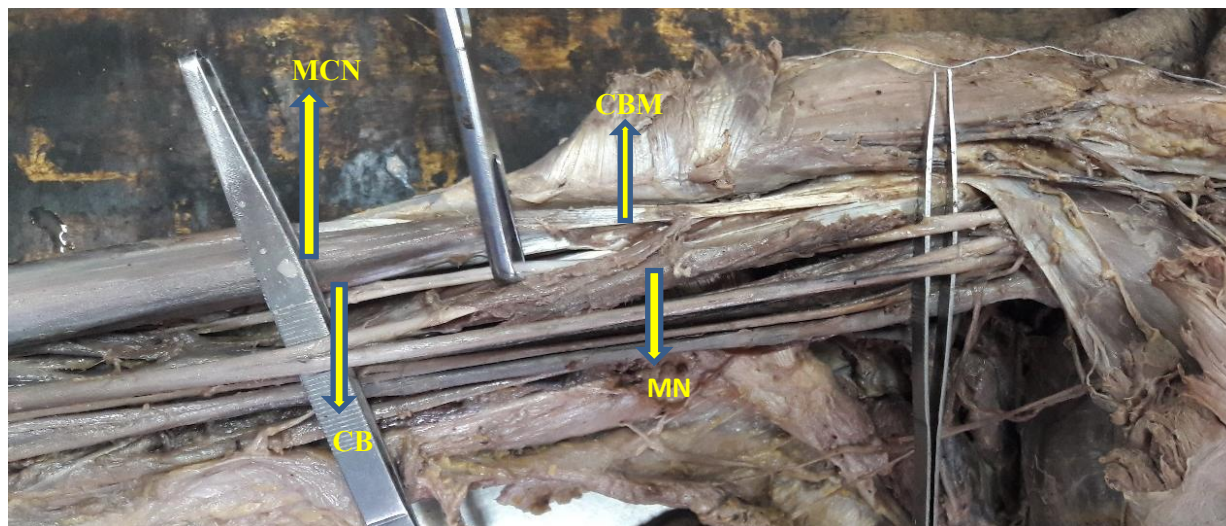


Fig. 2 showing CB (communicating branch) arising within CBM (coracobrachialis muscle)
MN: median nerve, MCN: musculocutaneous nerve

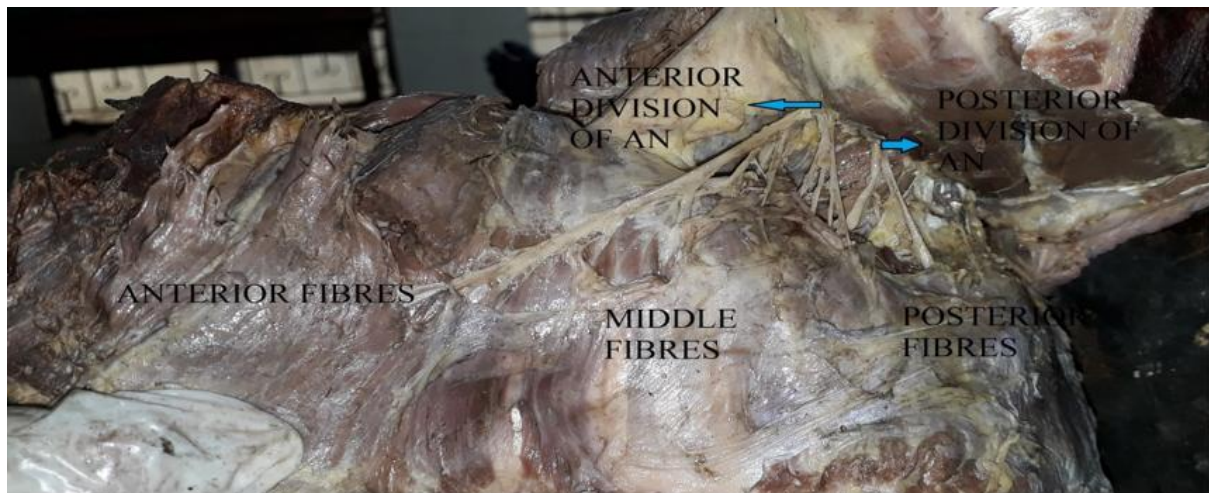
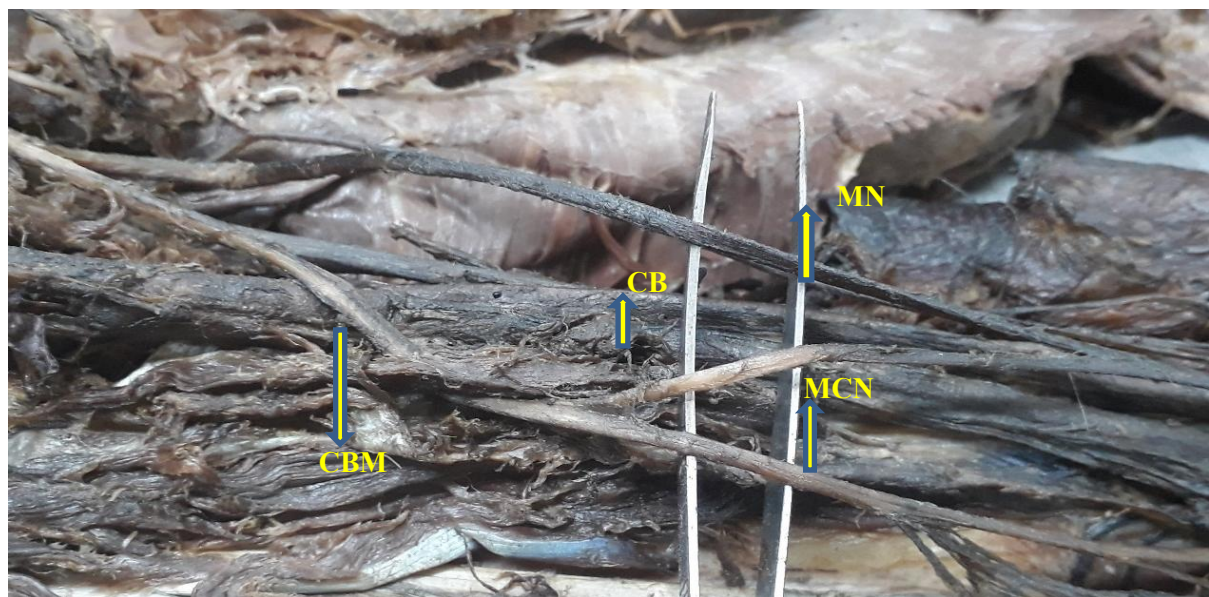


Fig. 3: Dual Supply of Middle Fibres of Deltoid by Divisions of AN



**Fig. 4: Showing CB (communicating branch) arising distal to CBM (coracobrachialis muscle)
MN: median nerve, MCN: musculocutaneous nerve.**

DISCUSSION

The communication between the musculocutaneous nerve and median nerve has been the topic of discussion for decades all over the world. Venieratos and Anagnostopoulou in 1998 described that the most common variation of these nerves is the communication between them [8] though others have described the absence of musculocutaneous nerve as the most common variation, where muscles of anterior compartment of arm are supplied by the branches from median nerve [9-13]. Different studies have been reported about it from different parts of India [14-16].

Worldwide different authors have taken different methods for classification of musculocutaneous nerve as well as the variation of communication between the musculocutaneous and median nerve [8, 17-20]. In India also there are different studies and case reports on this variation from different regions of this country [14-16, 19, 21-27]. In our study we also noted the distances from the tip of the coracoid process. Being a bony point it is fixed and may have immense value for surgeons during operating procedures and anaesthetists during regional blocks.

Table-4: Comparison of anomalous communication of Median nerve with musculocutaneous nerve between present study and previous studies

Name of the Authors	CB proximal to the CBM	CB within the CBM	CB distal to the CBM	Total CB	Absence of MCN	Complete fusion
Watanabe <i>et al.</i> (1985)						



[30]	----	----	----	1.4%	----	1.4%
Yang <i>et al.</i> (1995) [18]	----	----	----	12.5%	----	4%
Chaudhary <i>et al.</i> (2013) [14]	----	----	----	10%	10%	6.66%
Gopal <i>et al.</i> (2016) [21]	2.25%	----	5%	----	----	----
Jamuna <i>et al.</i> (2011) [28]	----	----	----	----	6%	2%
Vanisree <i>et al.</i> (2016) [15]	6.66%	----	18.3%	----	----	----
Zarna <i>et al.</i> (2017) [16]	----	----	----	6.66%	----	----
Present study (2026)	0%	6%	16%	22%	0%	4%

CB: communicating branch, CBM: coracobrachialis muscle, MCN: musculocutaneous nerve, MN: Median nerve.

Table-5: Comparison of different distances of formation and fusion of communicating branch of the present study with previous studies

Name of the Authors	Total no of limbs studied	% of limbs having CB	Dis b/w formation of MCN & of CB (mean)	Dis b/w formation of MN & joining of CB (mean)	Length of CB (mean)
Rao and Chaudhury (2000) [10]	24	33.33%	15.5	NR	8.95
Aktan <i>et al.</i> (2000) [29]	48	10.40%	0.95 ± 0.42	10.25 ± 2.32	5.50
Chaudhury <i>et al.</i> (2013) [14]	60	10.00%	2.98	5.21	4.3
Present study	50	22.00%	3.38	8.20	6.5

NB: all mean values are in cm. CB: communicating branch, CBM: coracobrachialis muscle, MCN: musculocutaneous nerve, MN-Median nerve.

Another significant abnormality that we found in our present study was regarding the variation in the origin of axillary nerve. The incidence of origin of axillary nerve as a common trunk varies from 1%- 22.9% in various studies [21-36] and is given in **table 3**. In the present study it was seen to be 16% which is within normal range and no bilateral variation was noted.

Clinically, trauma of posterior wall of the axillary region could present with a wide range of degrees of muscle impairment. For example, lesions involving common trunk for axillary nerve and thoracodorsal nerve may produce more extensive functional lesions including latissimus dorsi, deltoid and teres minor muscles.

Table-6: Showing the percentage of origin of axillary nerve as a common trunk from posterior cord by various authors in previous studies

Author (year of study)	Origin from posterior cord of brachial plexus	Origin as a common trunk from posterior cord of brachial plexus
Darji <i>et al.</i> (2013) [31]	99%	1%
Bhosale SM <i>et al.</i> (2014) [32]	87.5%	12.5%
Rastogi R <i>et al.</i> (2012) [33]	77.1%	22.9%
Gaur S <i>et al.</i> (2012) [34]	92%	8%



Chaudhary P <i>et al.</i> (2011) [35]	96.67%	3.33%
Gurushantappa PK <i>et al.</i> (2015) [5]	100%	0%
Tiwari S <i>et al.</i> (2017) [36]	82%	18%
Present study (2026)	84%	16%

The mean distance of origin of axillary nerve from the anteromedial aspect of the tip of coracoid process and posterolateral aspect of acromion process as found in various studies is compared with our present study and is given in table 4.

Table-7: Comparing the distance of origin of Axillary nerve from the anteromedial aspect of tip of coracoid process and posterolateral aspect of acromion process among various previous studies with that of present study

Author (year of study)	Mean distance (cm) from the anteromedial aspect of coracoid process	Mean distance (cm) from the posterolateral aspect of acromion process
Gurushantappa PK <i>et al.</i> (2015) [5]	3.56	7.46
Tubbs RS <i>et al.</i> (2011) [37]	4	-
Uz A <i>et al.</i> (2007) [38]	-	7.8
Burkhead WZ <i>et al.</i> (1992) [39]	-	5
Tiwari S <i>et al.</i> (2017) [36]	3.67	6.43
Present study (2026)	3.82	-

The site of division of axillary nerve into anterior and posterior branches was found to be above the quadrangular space in 12% cases (high up division) and in the remaining 88% cases it was within the quadrangular space. We have not found any case where

the division has occurred below the quadrangular space i.e within the deltoid muscle. The site of division of axillary nerve into anterior and posterior division has been compared with that of previous studies in the table 5.

Table-8: Comparing the site of division of axillary nerve into anterior and posterior division among previous studies with that of present study

Author (year of study)	Division above quadrangular space	Division within quadrangular space	Division below quadrangular space
Gurushantappa PK <i>et al.</i> (2015) [5]	0%	88%	12%
Tiwari Set. al. (2017) [36]	0%	100%	0%
Leechavengvongs S <i>et al.</i> (2015) [40]	0%	100%	0%
Loukas M <i>et al.</i> (2009) [4]	0%	65%	35%
Elizabeth C <i>et al.</i> (2005) [41]	0%	33%	66%
Present study (2026)	12%	88%	0%

In the present study we noted the mode of innervation of the deltoid muscle. In all the specimens the anterior part of the deltoid was supplied only by the anterior division: the middle part in 60% cases only by anterior division and in remaining 40% cases has got dual innervation i.e both by anterior and posterior division; the posterior part of the muscle was supplied by posterior division in all the cases. This when compared to a study done by Gurushantappa *et al.* [5] revealed that anterior part of muscle supplied by anterior division in 100% cases; middle part 56% only by anterior division and 44% dual nerve supply by both divisions; posterior part only by posterior division in 92% cases and 8% cases has dual innervation. Proper anatomical knowledge of the axillary nerve and its mode of supply to the deltoid including the topography reduce the risk of injury to the nerve during

intramuscular injections of the deltoid, intra-articular and intra-bursal steroid injections.

CONCLUSION

The anomalous variations between the various branches of brachial plexus are of great importance for anatomists, surgeons as well as anaesthetists. During shoulder surgeries, coracoid process grafting, dislocation of shoulder and arthroscopies, it is important to identify these variations, as it is prone to get injured during placement of retractors under the coracoid process. Similarly, anomaly of axillary nerve arising as a common trunk from the posterior cord of brachial plexus is a common phenomenon (12%). This knowledge is very important for orthopaedic surgeons while exploring the axillary region in treatment of fractures of surgical neck of humerus and also surgeons and anesthetists during brachial plexus blocks. Also,



the mode of supply of deltoid muscle from the anterior and posterior divisions of axillary nerve is very important during intramuscular injections to reduce the risk of injury to the axillary nerve.

ABBREVIATIONS

USN- Upper subscapular nerve
LSN- Lower subscapular nerve
TDN- Thoracodorsal nerve
AN- Axillary nerve
CT- Common trunk
MCN- Musculocutaneous nerve
MN- Median nerve
CB- Communicating branch
CBM-Coracobrachialis muscle

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REFERENCES

1. Uzun A, Seeling LL Jr. A variation in the formation of the median nerve: communicating branch between the musculocutaneous and median nerves in man. *Folia Morphol.* 2002; 60:99-101.
2. Nayak S, Somayaji N, Vollala VR, Raghunathan D, Rodrigues V, Samuel VP, Malloor AP. A rare variation in the formation of the upper trunk of the brachial plexus - a case report. *Neuroanatomy.* 2005; 4:37-8.
3. Williams PL, Bannister LH, Berry MM. Gray's Anatomy. In: Embryology and development. 38th ed. London Churchill Livingstone. 1999:231-2.
4. Marios Loukas, Joanna Grabska, Shane Tubbs, Nihal Apaydia, Robert Jordan. Mapping the axillary nerve within the deltoid muscle. *Surgical and Radiologic Anatomy.* 2009;31(3):43-47
5. Gurushantappa PK, Kuppasad S. Anatomy of Axillary Nerve and Its Clinical Importance: A Cadaveric Study. *Journal of Clinical and Diagnostic Research.* 2015;9(3):AC13-AC17
6. Gatzoulis MA. Thorax. In ; Gray's Anatomy. 40th ed. Edinburgh, Churchill Livingstone; 2008: p.831-832
7. Necdet K, Bulent Y, Cent K, Hasan O. Multiple anomalies of brachial plexus: a case report. *Neuroanatomy* 2007; 6: 21-3
8. Venieratos D, Anagnostopoulou S. Classification of communications between the musculocutaneous and median nerves. *Clin Anat* 1998;11(5): 327-31
9. Le Minor JM. A rare variation of the median and musculocutaneous nerves in man. *Arch Anat Histol Embryol* 1990;73:33-42
10. Prasada Rao PV, Chaudhary SC. Communication of the musculocutaneous nerve with the median nerve. *East Afr Med J* 2000;77(9):498-503
11. Sud M, Sharma A. Absence of musculocutaneous nerve and the innervation of coracobrachialis, biceps brachii and brachialis from the median nerve. *J Anat Soc India* 2000;49(2):176-7
12. Rajashree B, Arati D, Mamata S, Chinmayi M, Charulata S. Absence of musculocutaneous nerve – a case report. *J Anat Soc India* 2003;52(1):94
13. Saritha S. Variations in the median and musculocutaneous nerves – A surgical prospective. *J Anat Soc Ind* 2004;53(1):31-66
14. Chaudhary P, Kalsey G, Singla R, Arora K. Communication between musculocutaneous and median nerve – Different types and their incidence in north Indian population. *Indian Journal of Clinical Practice* 2013;24(3):364-71
15. Vanisree S. K., Jayamma Ch., Kumari V. S., Sugavasi R. Study of variations of musculocutaneous nerve in relation to the coracobrachialis muscle. *International journal of contemporary medical research* 2016;3(10):2863-65
16. Patel Z K, Gupta S, Chaudhary S. Cadaveric study of abnormal communication between cords and branches of brachial plexus. *Int J Anat Res* 2017;5(2.1):3741-45
17. Kosugi K, Shibata S, Yamashita H. Supernumerary head of biceps brachii and branching pattern of the musculocutaneous nerve in Japanese. *SurgRadiol Anat* 1992;14: 175-85
18. Yang ZX, Pho RW, Kour AK, Pereira BP. The musculocutaneous nerve and its branches to the biceps and brachialis muscle. *J Hand Surg Am* 1995;20: 671-75
19. Choi D, Rodriguez-Niedenfuhr M, Vazquez T, Parkin I, Sanudo JR. Patterns of connections between the musculocutaneous and median nerves in the axilla and arm. *Clin Anat* 2002;15:11-17
20. Buch-Hansen K. Variations of the median nerve and the musculocutaneous nerve and their connections. *Anat Anz* 1955;102:187-203
21. Gopal K, Anurag, Singh O. Anatomical variations of brachial plexus: anomalous branching pattern. *Int J Res in Med Sciences* 2016;4(8):3376-80
22. Chauhan R, Roy TS. Communication between the median and musculocutaneous nerve – a case report. *J Anat Soc India* 2002;51(1):72-75
23. Ghosh I, Sengupta G, Basu P, De (Bose) A. Anomalous branches of median nerve in the arm. *Int J Anat Res* 2014;2(4):653-56
24. Babu DJ, Pillai TJ, Priyanka KD, Jalaja Y, Kumar US. A study on variations of musculocutaneous nerve in adult cadavers. *IOSR J Dental and Med Sci* 2016;15(5):14-17
25. Saha D, Bhattacharya S. Variations in formation of median and musculocutaneous nerves and their unusual branches – a case study. *Indian J of Basic and applied Med Res* 2016;5(4):111-15



26. Saha DK, Majumdar S, Pradhan S, Sarkar A, Bapuli C. Variations in the musculocutaneous and median nerves in a single cadaver. *Int J Anat* 2014;3(4):4-6
27. Bergman RA, Thompson SA, Afifi AK, Saadeh FA. *Compendium of human anatomic variation*. Urban & Schwarzeberg Munich. 1988;139-43
28. M Jamuna, G Amudha. A cadaveric study on the anatomic variations of the musculocutaneous nerve in the infraclavicular part of the brachial plexus. *J Clin Diagn Res (JCDDR)* 2011; 5(6):1144-47
29. Atkan ZA, Ozturk L, Bilge O, Ozer MA, Pinar YA. A cadaveric study of the anatomic variations of the brachial plexus nerves in the axillary region and arm. *Turk J Med Sci* 2000;31:147-50
30. Watanabe M, Takatsuji K, Sakamoto N, Morit Y, Ito H. Two cases of fusion of the musculocutaneous and median nerves. *Kalbo gakiZasshi* 1985; 60: 1-7
31. Darji A, Chauhan H, Khatri H, Aterkar S, Pensi CA. Variations in Branching Pattern of Brachial Plexus:A Cadaveric Study. *Int Journal of Biomedical and Advance Research*. 2013;4(3):174-174.
32. Bhosale SM, Mallashetty NS. Study of variations in the origin and distance of origin of axillary nerve of the posterior cord of brachial plexus. *Int J Cur Res Rev*. 2014;6(15):41-44.
33. Rastogi R, Buddhiraja V, Bansal K. Posterior Cord of Brachial Plexus and its Branches:Anatomical Variations and Clinical Implication. *Hindwai Publishing Corporation* ISRN Anatomy. 2012;2013:1-3.
34. Gaur S, Katariya SK, Vaishnani H, Wani IN, Bondre KV *et al.* A cadaveric study of variation of posterior cord of brachial plexus. *Int J Biol Med Res*. 2012;3(3):2214-2217.
35. Chaudhary P, Singla R, Kalsey G, Arora K. Branching pattern of the posterior cord of brachial plexus: A cadaveric study. *Journal of Clinical and Diagnostic Research*. 2011;5(4):787-790.
36. Tiwari S, Nayak JN. Study of variations in the origin of axillary nerve from the posterior cord of brachial plexus and its clinical importance. *Int J Anat Res*. 2017;5(3.2):4242-46.
37. Tubbs RS, Oakes PAC, Blount JP, Salter G *et al.* Surgical landmarks for the proximal portion of the axillary nerve. *Journal of Neurosurgery*. 2001;95(6):998-1000.
38. Uz A, Apaydin N, Rozkut M, Fihaan A. The anatomic branch pattern of the axillary nerve. *Journal of Shoulder and Elbow Surgery*. 2007;16(2):240-44.
39. BurkheadWZ, Scheinberg RR, Box G. Surgical anatomy of the axillary nerve. *Journal of Shoulder and Elbow Surgery*. 1992;1:31-36.
40. Leechavengvongs S, Teerawutthichaikit T *et al.* Surgical anatomy of the axillary nerve branches to the deltoid muscle. *Clin Anat*. 2015;28(1):118-22.
41. Elizabeth C, Tyler K *et al.* Surgical anatomy of the axillary nerve within the quadrangular space. *Journal of Neurosurgery*. 2005;102(5):912-14