

ORIGINAL RESEARCH

A human cadaveric study to measure the distance of origin of branches from posterior cord of brachial plexus in Indian population

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ABSTRACT

Background: The brachial plexus has a complex anatomical structure since its origin in the neck throughout its course in the axillary region¹. The knowledge of distance of origin of the different branches from brachial plexus is helpful to redical neck dissections and other surgical operation of axilla and upper arm³. Thus, the comprehension of variation in the formation and distance of origin of branches from brachial plexus is key to anatomists, radiologists, surgeons, and the anaesthesiologists⁵. **Objective:** To measure the distance of origin of branches from posterior cord of brachial plexus from mid-clavicular point. **Material and Methods:** The study was conducted on 50 brachial plexus (25 on right and 25 on left) in 25 embalmed human cadavers of unknown age from the department of anatomy of Mahatma Gandhi medical college, Jaipur. The Brachial Plexus was dissected in embalmed cadavers and exposed according to Cunningham's Manual of Practical Anatomy by the help of dissecting instruments (scalpel, scalpel blade, blunt scissors, pointed scissors, blunt forceps, pointed forceps and Vernier caliper). **Results:** we have found the lower trunk is formed by the continuation of T1 spinal nerve in one cadaver; 3 out of 50 (6%) were found pre-fixed type of Brachial Plexus; Dorsal scapular nerve was originated from C4 spinal nerve bilaterally in one cadaver and unilaterally from left side in one cadaver and Communication of median and musculocutaneous nerve was found in 12% cases in right side & 8% cases in left side. **Conclusion:** In the present study an attempt has made to know the significance in distance of origin of branches from posterior cord of brachial plexus. Though these measurements mentioned in the present study may not alter the normal functioning of the limbs of individuals but the knowledge should be kept in mind by anatomists, radiologists, surgeons, neurologist, orthopedician and anaesthesiologist during surgeries or treatments.

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INTRODUCTION

The brachial plexus lies in the posterior triangle of neck and axilla. It is formed by the union of ventral primary rami of lower four cervical i.e., C5, C6, C7, C8 and first thoracic i.e., T1 spinal nerve.

The formation of brachial plexus as described in standard books (grays anatomy 41st edition) is as follows -

- The brachial plexus is formed by the union of ventral primary ramii of C5, C6, C7, C8 & T1 spinal nerve.
- The ramii enters into the posterior triangle of neck between scalenus anterior and scalenus medius muscles; divisions are located behind the

clavicle, cords and branches are situated in the axilla.

- **Trunks of brachial plexus-**
 - ✓ The upper trunk is formed by the union of C5 & C6. The middle trunk is formed by the continuation of ventral primary rami of C7 spinal nerve. The lower trunk is formed by the union of ventral primary rami of C8 & T1 spinal nerve.
- **Divisions of brachial plexus-**
 - ✓ Each trunk of brachial plexus is divides into anterior and posterior divisions.
- **Formation of cords of brachial plexus-**
 - ✓ The anterior division of upper and middle trunks unite to form lateral cord of brachial plexus. The

anterior division of lower trunk continues as the medial cord of brachial plexus. The posterior

division of all the three trunks unite to form the posterior cord of brachial plexus.

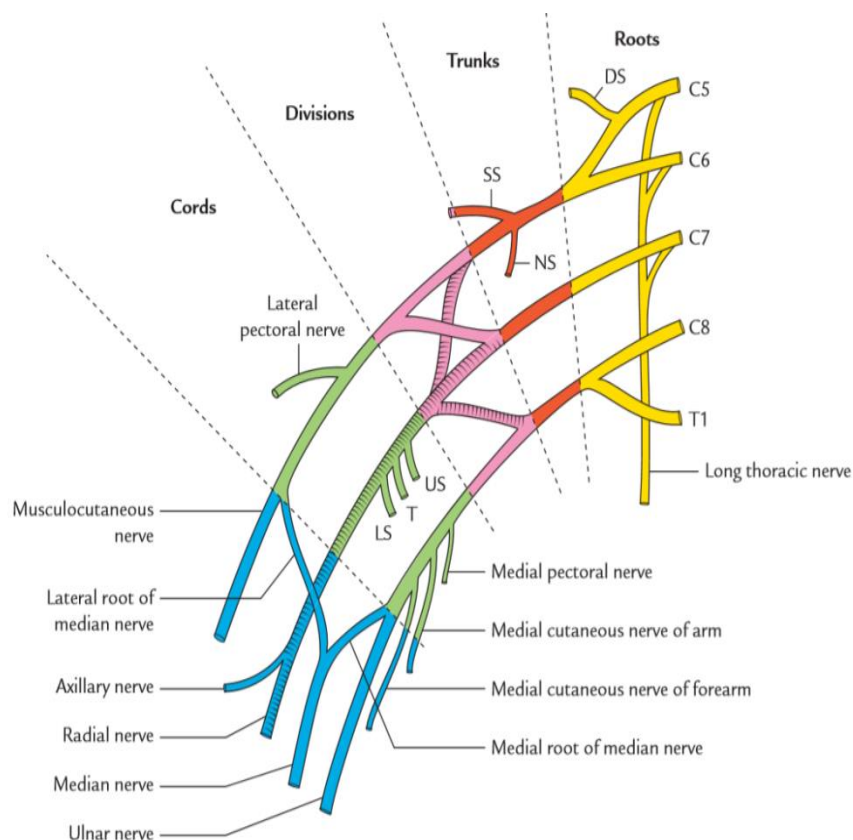


Figure: The formation and branches of Brachial Plexus⁸ (SS- suprascapular nerve, NS- nerve to subclavius, US- upper subscapular nerve, LS-lower subscapular nerve, T-thoracodorsal nerve)

Branches from posterior cord of brachial plexus (table: 1)-

Cords	Nerves	Root value
Posterior cord	1.Upper subscapular nerve	C5,C6
	2.Lower subscapular nerve	C5,C6
	3.Thoracodorsal nerve	C6,C7,C8
	4.Radial nerve	C5,C6,C7,C8,T1
	5.Axillary nerve	C5,C6

The knowledge of distance of origin of branches from cords of brachial plexus are helpful to redical neck dissections and other surgical operation of axilla and upper arm².

Thus, the measurement distance of origin of branches from cords of brachial plexus is key to anatomists, radiologists, surgeons, neurologist, orthopedician and anaesthesiologist³. So, present study tries to explain the significance in distance of origin on right and left upper limbs.

MATERIAL AND METHODS

The study was conducted on 50 brachial plexus (25 on right and 25 on left) in 25 embalmed human cadavers of unknown age and sex from the department of anatomy of Mahatma Gandhi medical college, Jaipur.

Institute Ethics Committee approval was obtained before the start of the study.

The Brachial Plexus was dissected in embalmed cadavers and exposed according to Cunnigham’s Manual of Practical Anatomy by the help of dissecting instruments (scalpel, scalpel blade, blunt scissors, pointed scissors, blunt forceps, pointed forceps and Vernier caliper). Posterior cord and its branches will be dissected and cleaned. All the measurements will be taken by measuring scale.

The following parameters were observed and tabulated:

1. Distance of origin of branches from mid-clavicular point (in cm)
2. P values by comparing right and left upper limb to find significance in distance of origin on right and left upper limb

RESULT

The observation of variations in root, trunk, division, cords and branches of brachial plexus are as follows-

1. Distance of upper sub scapular nerve from origin (Table:2) -

Distance range (in cm)	Right		Left	
	No.	%	No.	%
3.1 - 3.5	7	28	6	24
3.6 - 4.0	5	20	6	24
4.1 - 4.5	6	24	7	28
4.6 - 5.0	5	20	5	20
5.0 <	2	8	1	4

- The mean range of distance of origin of upper sub scapular nerve was founded 4.07 ± 0.647354 cm in right side and 4.09 ± 0.601387 cm in left.

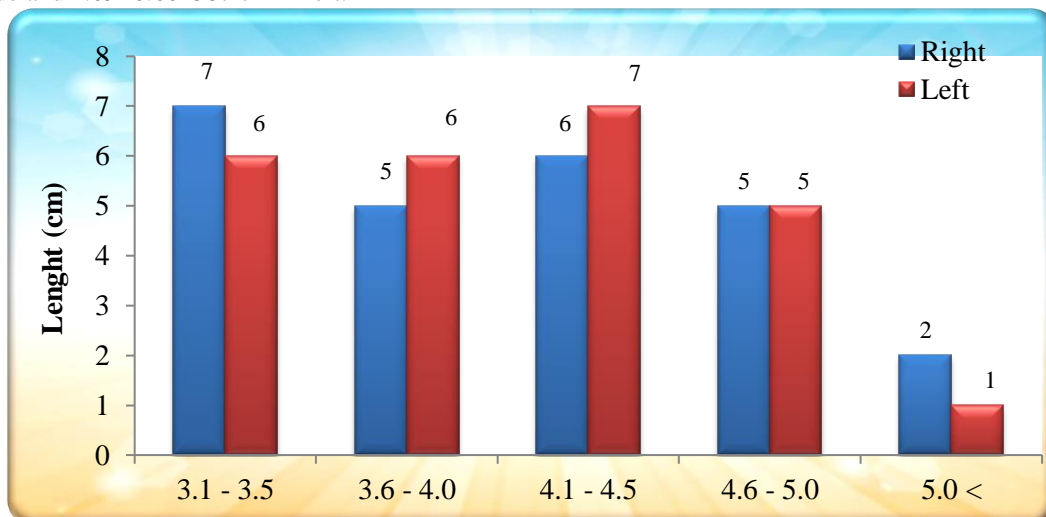


Figure 2:- Distance of upper sub scapular nerve from origin

2. Distance of Thoraco dorsal nerve from origin (Table: 3)-

Distance range (in cm)	Right		Left	
	No.	%	No.	%
3.6 - 4.0	0	0	0	0
4.1 - 4.5	8	32	8	32
4.6 - 5.0	8	32	11	44
5.1 - 5.5	7	28	6	24
5.5 <	2	8	0	0

- The mean distance of Thoraco dorsal nerve from origin was founded 4.79 ± 0.442982 cm in right side and 4.75 ± 0.347755 cm in left.

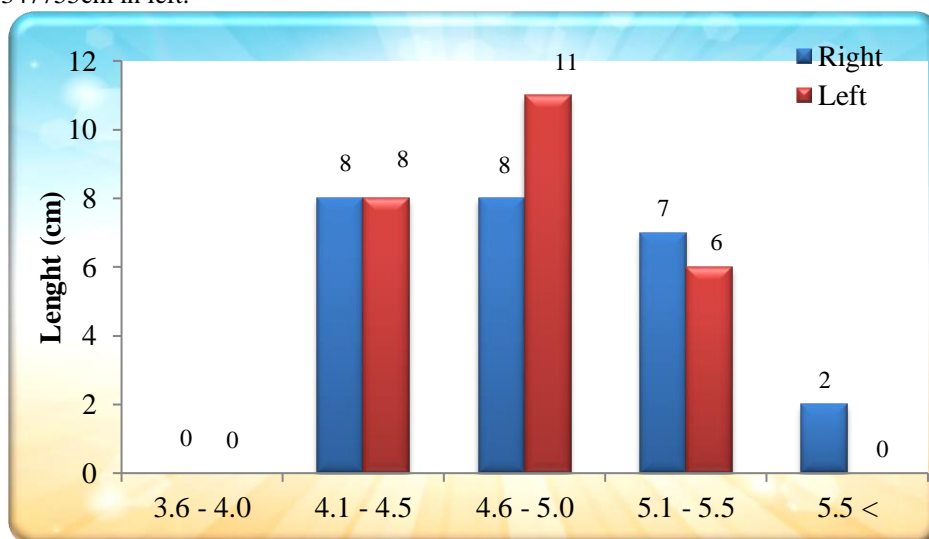


Figure 3:- Distance of Thoraco dorsal nerve from origin

3. Distance of Lower subscapular nerve from origin (Table: 4)-

Distance range (in cm)	Right		Left	
	No.	%	No.	%
4.1 - 4.5	10	40	6	24
4.6 - 5.0	3	12	6	24
5.1 - 5.5	6	24	6	24
5.6 - 6.0	5	20	6	24
6.0 <	1	4	1	4

- The mean distance of Lower sub scapular nerve from origin was founded 4.9 ± 0.619758 cm in right side and 4.81 ± 0.610382 cm in left.

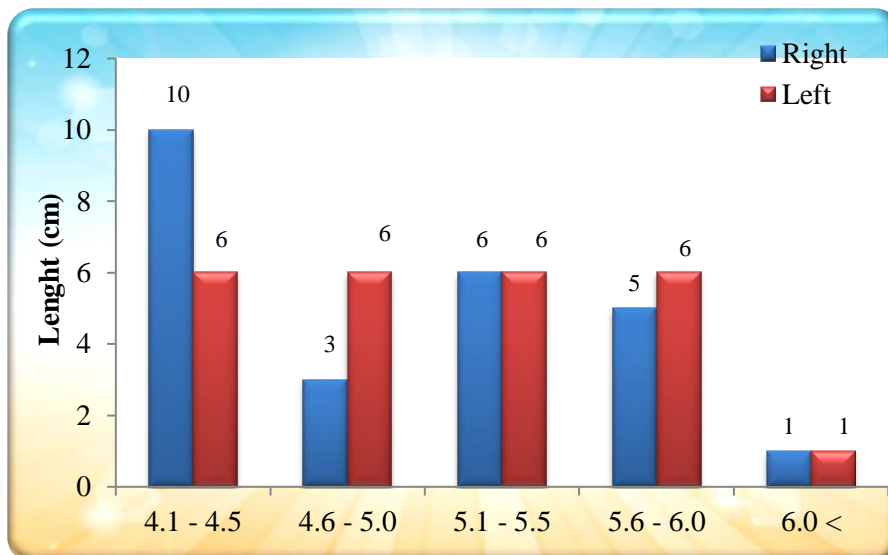


Figure 4:- Distance of Lower subscapular nerve from origin

4. Distance of Axillary nerve from origin (Table: 5)-

Distance range (in cm)	Right		Left	
	No.	%	No.	%
4.0 - 4.5	11	44	7	28
4.6 - 5.0	3	12	6	24
5.1 - 5.5	6	24	7	28
5.6 - 6.0	4	16	5	20
6.0 <	1	4	0	0

The mean distance of Axillary nerve from origin was founded 4.87 ± 0.614736 cm in right side and 4.96 ± 0.59 cm in left.

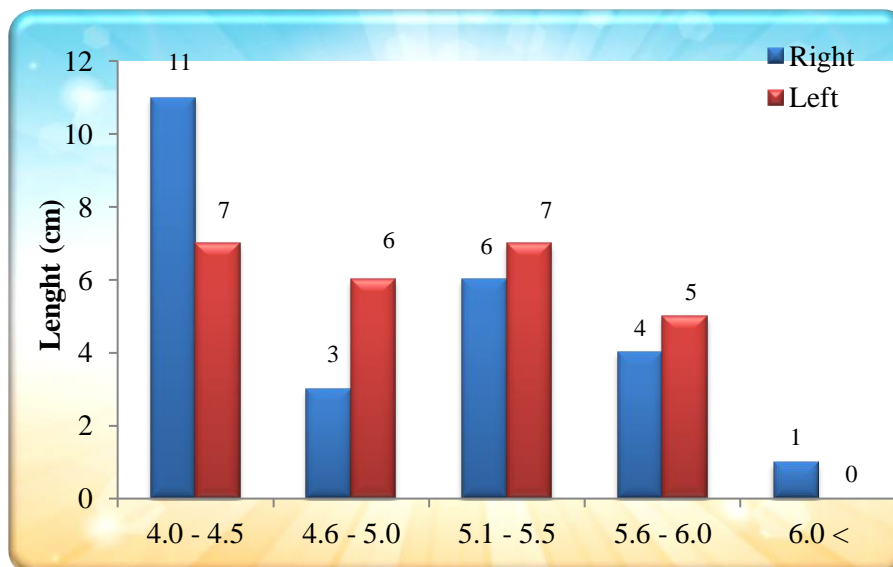


Figure 5:-Distance of Axillary nerve from origin

5. Distance of Radial nerve from origin (Table: 6)–

Distance range (in cm)	Right		Left	
	No.	%	No.	%
4.1 - 4.5	5	20	7	28
4.6 - 5.0	6	24	6	24
5.1 - 5.5	7	28	4	16
5.6 - 6.0	6	24	7	28
6.0 <	1	4	1	4

- The mean distance of Radial nerve from origin was founded 5.08 ± 0.587367 cm in right side and 4.06 ± 0.644205 cm in left.

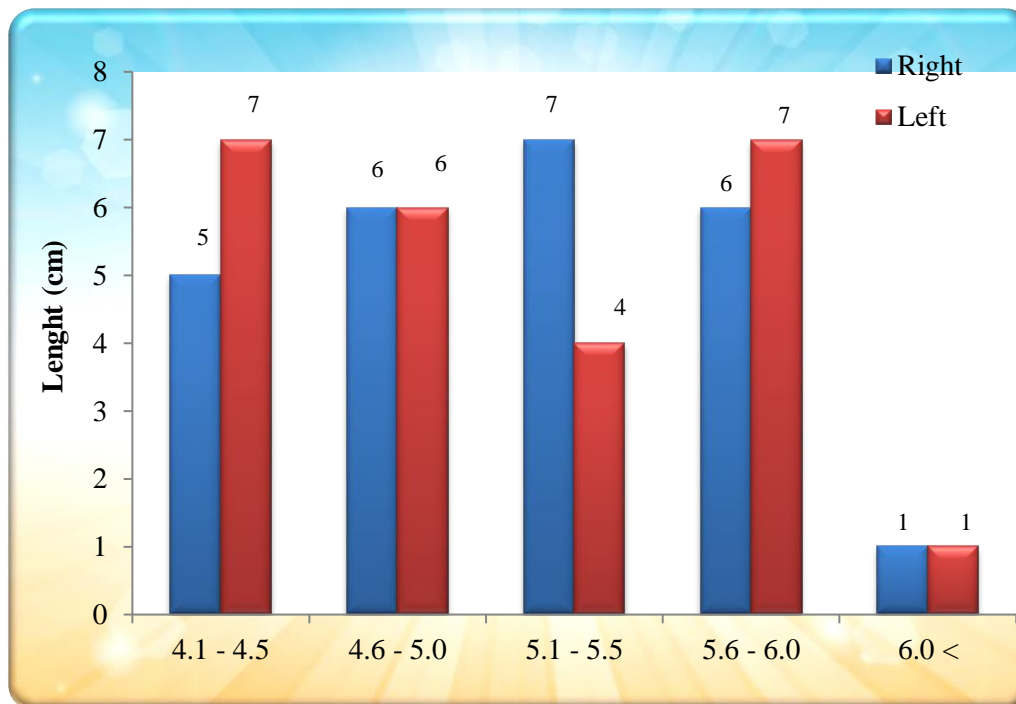


Figure 6:- Distance of Radial nerve from origin

DISCUSSION

Table 7: Frequency in distance of upper subscapular nerve from origin on comparison with other authors

Author	No. of specimens	Distance range (in cm)	Right (%)	Left (%)
Bhosle S et al ⁷ (2017)	N=40 (right=20,Left=20)	3.1 - 3.5	40.9%	Nil
		3.6 - 4.0	40.9%	84%
		4.1 - 4.5	18.2%	16%
Present study	N=50 (right=25, Left=25)	3.1 - 3.5	28%	24%
		3.6 - 4.0	20%	24%
		4.1 -4.5	24%	28%
		4.6 - 5.0	20%	20%
		>5.0	8%	4%

Distance range grouping 3.1-3.5 and 3.6-4 cm was found higher in Bhosle's observation in contrast to 4.1-4.5, 4.6-5.0 and >5.0 cm grouping was highest in present study, but 3.1-3.5 cm group was 24% on left side in contrast to absence and upper subscapular nerve.

Table 8: Frequency in distance of lower subscapular nerve from origin on comparison with other authors

Author	No. of specimens	Distance range	Right (%)	Left (%)
Bhosle S et al ⁷ (2017)	N=40 (right=20,Left=20)	4.1 - 4.5	10 %	10 %
		4.6 - 5.0	30 %	25 %
		5.1 - 5.5	45 %	30 %
		5.6 - 6.0	5 %	25 %
		>6.0	10 %	10 %
Present study	N=50 (right=25,	4.1 - 4.5	40 %	24 %
		4.6 - 5.0	12 %	24 %

	Left=25)	5.1 - 5.5	24 %	24 %
		5.6 - 6.0	20 %	24 %
		>6.0	4 %	4 %

4.1-4.5 and 5.6-6.0 cm distance range group frequency was highest in present study but Bhosle et al (2017) reported higher for 4.6-5.0, 5.1-5.5 and > 6.0 cm this group frequency.

Table 9: Frequency in distance of thoracodorsal nerve from origin on comparison with other authors

Author	No. of specimens	Distance range	Right (%)	Left (%)
Bhosle S et al⁷ (2017)	N=40 (right=20, Left=20)	3.6 - 4.0	20 %	5 %
		4.1 - 4.5	25 %	40 %
		4.6 - 5.0	35 %	30 %
		5.1 - 5.5	10 %	25 %
		>5.5	10 %	Nil
Present study	N=50 (right=25, Left=25)	3.6 - 4.0	Nil	Nil
		4.1 - 4.5	32 %	32 %
		4.6 - 5.0	32 %	44 %
		5.1 - 5.5	28 %	24 %
		>5.5	8 %	Nil

3.6-4.0 distance range group was absent in present study in contrast Bhosle et al (2017) reported 20% and 5%, 4.1-4.5 cm group on right is higher than Bhosle, but on left it is lower 5.1-5.5 cm group was 28% on right and 24% on left side in comparison to lower on right side in Bhosle’s observation. > 5.5 cm range group was higher in Bhosle's reporting than 8% in present study but on left side, both reported absence of this group.

Table 10: Frequency in distance of axillary nerve from origin on comparison with other authors

Author	No. of specimens	Distance range	Right (%)	Left (%)
Bhosle s et al⁷ (2017)	N=40 (right=20, Left=20)	4.0 - 4.5	15 %	25 %
		4.6 - 5.0	45 %	20 %
		5.1 - 5.5	30 %	35 %
		5.6 - 6.0	5 %	5 %
		>6.0	5 %	15 %
Present study	N=50 (right=25, Left=25)	4.0 - 4.5	44 %	28 %
		4.6 - 5.0	12 %	24 %
		5.1 - 5.5	24 %	28 %
		5.6 - 6.0	16 %	24 %
		>6.0	4 %	Nil

4.0-4.5 and 5.6-6.0 cm range group was bilaterally observed higher than **Bhosle et al (2017)** who in contrast reported bilateral high frequency of group 5.1-5.5 and > 6.0 cm.

Table 11: Frequency in distance of radial nerve from origin on comparison with other authors

Author	No. of specimens	Distance range	Right (%)	Left (%)
Bhosle s et al⁷ (2017)	N=40 (right=20, Left=20)	4.0 - 4.5	15 %	25 %
		4.6 - 5.0	45 %	20 %
		5.1 - 5.5	30 %	35 %
		5.6 - 6.0	5 %	5 %
		>6.0	5 %	15 %
Present study	N=50 (right=25, Left=25)	4.0 - 4.5	20 %	28 %
		4.6 - 5.0	24 %	20 %
		5.1 - 5.5	28 %	35 %
		5.6 - 6.0	24 %	5 %
		>6.0	4 %	15 %

In present study 4.0-4.5 cm group was bilaterally higher than **Bhosle et al (2017)** who reported 4.6-5.0, 5.1-5.5 and > 6.0 on right side but on left side frequency was similar with our findings. 5.6-6.0 group was higher in present study but on left side observed same frequency with **Bhosle et al (2017)**.

Table 12: Significance in length of nerves of right and left upper limbs.

NERVE		Mean length	Standard deviation	p value
USN	Right	4.07	0.647354	0.9103*
	Left	4.09	0.601387	

LSN	Right	4.9	0.619758	0.6070*
	Left	4.81	0.610382	
TDN	Right	4.79	0.442982	0.7235*
	Left	4.75	0.347755	
AN	Right	4.87	0.614736	0.5996*
	Left	4.96	0.59	
RN	Right	5.08	0.587367	0.0001
	Left	4.06	0.644205	

*P Value above 0.05 are not significant and below 0.05 are significant

- On comparison between right and left side, mean length of branches from posterior cord found statistically non-significant difference except radial nerve which is significant(**0.0001**).

SUMMARY AND CONCLUSION

The present study was conducted on 25 embalmed human cadavers to study the formation and branching pattern of brachial plexus. Though the measurements of length mentioned in the present study may not alter the normal functioning of the limbs of individuals but the knowledge is to be kept in mind by anatomists, radiologists, surgeons, neurologist, orthopedician and anaesthesiologist⁵. The knowledge is essential to medical practitioners in dealing with surgery around axilla in order to prevent post-operative complications⁶.

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