ANATOMICAL VARIATIONS OF BRACHIAL PLEXUS IN THE ARM

BY

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RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES,

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of the requirements for the degree of

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IN

ANATOMY

Under the guidance of

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2010

RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES, BANGALORE

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I hereby declare that this dissertation entitled **"ANATOMICAL VARIATIONS OF BRACHIAL PLEXUS IN THE ARM"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. B. M. BANNUR** $_{\text{M.S}}$ Professor, Department of Anatomy at B. L. D. E. A's Shri. B. M. Patil Medical College, Hospital and Research Centre, Bijapur.

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LIST OF ABBREVIATIONS

MCN – Musculocutaneous nerve

MN – Median nerve

UN – Ulnar nerve

RN – Radial Nerve

AN – Axillary nerve

AA – Axillary artery

BA – Brachial artery

UA – Ulnar artery

RA – Radial artery

crb – coracobrachialis

CB – communicating branch

MC – Medial cord

LC – Lateral cord

PC – Posterior cord.

ABSTRACT

Background and Objectives :

Brachial plexus is responsible for cutaneous and muscular innervation of most of the upper limb. Gross anatomical knowledge of the nerves like origin, course branches and distribution are of vital importance. Most brachial plexus injuries result in severe dysfunction of arm and hand. The anatomical variations of the brachial plexus constitute a potentially important clinical and surgical issue. Even though many studies have taken place involving major nerves of brachial plexus, they are still far from complete.

The present study was done with the aim to study the formation of brachial plexus and find out various anomalies in the arm.

Methods :

The study was carried out on 60 upper limb specimens (30right, 30 left) obtained during the course of dissection from undergraduate students in the department of Anatomy at BLDEA's Shri B.M. Patil Medical College, Hospital and Research Centre, Bijapur. The five major nerves were selected from the cords of brachial plexus and there origin, course and distribution with respect to each nerve was studied in the arm. The nerves include – musculocutaneous nerve, median nerve, ulnar nerve, radial nerve and axillary nerve.

Results :

After detail study of the above nerves following results were obtained.

1. Communication between musculocutaneous and median nerves in eleven limbs.

2. Musculocutaneous nerve was absent in one limb. 3. Median nerve supplied muscles of front of arm in one limb. 4. Musculocutaneous nerve did not pierce coracobrachialis muscle in seven limbs. 5. Communication between radial and ulnar nerve in one limb.

Conclusion :

The anatomical knowledge of the nerves is essential for assessing the functional loss and planned reconstructive surgeries.

Knowledge of the variation that are observed in our study are important to neurologists, orthopaedicians and traumatologists as these may give rise to variable clinical picture.

Key word : Brachial plexus.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Upper limb is one of the most active parts of the body which receive both sensory and motor supply from brachial plexus. The nerves which give sensation and control the upper limb are all connected through the brachial plexus.

Brachial plexus is an arrangement of nerve fibres running from the spinal cord formed by the ventral rami of lower four cervical and first thoracic nerve roots from upper border of fifth cervical vertebra to underneath first thoracic vertebra. It proceeds through the neck, the axilla and to the arm. The brachial plexus is responsible for cutaneous and muscular innervation of most of upper limb with exception of trapezius which is innervated by spinal accessory nerve and area of skin near axilla innervated by intercostobrachial nerve.

Most brachial plexus injuries result in severe dysfunction of arm and hand. Inspite of advances in diagnosis and treatment, recovery in most of the cases is still disappointing. The often catastrophic and permanent paralysis, numbness and pain can have a devastating effect on the patients ability to work and enjoy life.

Gross anatomical knowledge of nerves like origin, course, branches and distribution as well as communication are of vital importance. The relation of a particular nerve to surrounding structures is also important because any relation to major vessels have the risk of damage by trauma or disease, relation to a bone or joint where they are more prone to injury.

In the brachial plexus the intricate manner in which anastamotic connections are formed to give rise to nerves of extensive cutaneous and motor supply with succession of separations and conjugations accounts for the numerous variations in some instances striking[1].

Variations in formation and branching pattern of the brachial plexus are common and have been reported by several investigators. Variations in connection between musculocutaneous nerve and median nerve have some significance in diagnostic neurophysiology[2] .

Injuries involving median nerve and ulnar nerve are quite common making detailed anatomical study of the nerves mandatory.

Even though many studies have taken place involving major nerves of brachial plexus, they are still incomplete. This promoted us to carry the present work of studying the major nerves of upper limb in the arm.

OBJECTIVE

To study the formation of brachial plexus and find out various anamolies in the arm.

REVIEW OF LITERATURE

Anatomical variations of peripheral nerves constitute a potentially important clinical and surgical issue.

The brachial plexus supplies motor, sensory and sympathetic fibres to upper limb. As it is formation of many nerves, variations are common[3].

Anomalies of brachial plexus and its terminal branches are not uncommon. They have been widely documented[4].

Variations may occur in the formation of trunks, divisions, cords and terminal branches. The most common and more obvious variation in the brachial plexus is the level of its of formation, the prefixed and post fixed plexus[5].

Divisions of trunks and formation of the cords may be anomalous, however the arrangement of terminal branches remains unchanged[6].

There have been descriptions in the variations at the level of formation of medial and lateral cords and distribution of branches of brachial plexus[4].

In some individuals trunks, divisions or cords formation may be absent. The lateral and medial cords may receive fibres from anterior divisions directly inferior or superior to usual levels respectively[6].

Although communications between the nerves in the arm are rare, the communication between the median nerve and musculocutaneous nerve were described from nineteenth century[7,8,9].

In a study in the left upper limb of an adult male cadaver the lateral cord was formed in relation to second part of axillary artery. As the formation of the lateral cord was distal than usual, the lateral pectoral nerve arose as two separate branches from anterior divisions of upper and middle trunks instead of lateral cord. A communication was observed between these lateral pectoral nerves. The anterior division of middle trunk gave rise to the nerve to coracobrachialis and an additional root of median nerve. Lateral pectoral nerve arising from anterior division of middle trunk also communicated with the medial pectoral nerve. Communications were also found between additional lateral root of median nrve and medial root of median nerve, medial root of median and ulnar nerves, medial cutaneous, ulnar and radial nerves[5].

Few other investigators also described that the lateral pectoral nerve may arise by one root from lateral cord or by two roots from anterior divisions of upper and middle trunks[10].

Two cases were reported in which lateral pectoral nerve and nerve to coracobrachialis arose from lateral cord as the musculocutaneous nerve was absent[11].

A case in which lateral pectoral nerve arose as two separate branches from anterior divisions of upper and middle trunks were observed but there was no communication between these two branches[4].

The communication between musculocutaneous nerve and median nerve is by far the most common and frequent of all the variations that are observed among the branches of the brachial plexus[12].

The fibres of median nerve, ulnar nerve along with the musculocutaneous nerve after traversing for some distance leave the later to join the parent trunk[10].

These communications between musculocutaneous nerve and median nerve have been classified into 5 types[13].

In another description only three types has been described between musculocutaneous nerve and median nerve in relation to the coracobrachialis muscle[12].

During the routine dissection of the left upper limb of a 60 year old Caucasian male cadaver, observed median nerve formation by three roots, two from lateral cord and one from medial cord of brachial plexus. The lateral root of median nerve crossed anterior to distal part of axillary artery. In the distal half of the arm median nerve contributed a communicating branch to musculocutaneous nerve[14].

During routine dissection of left upper limb of a 60 year old male cadaver, communication between musculocutaneous nerve and median nerve were seen at two sites. The proximal communicating trunk coursed between musculocutaneous nerve and median nerve, was given off before the musculocutaneous nerve pierced coracobrachialis muscle, whereas as distal communicating trunk carried fibres from median nerve to musculocutaneous nerve and joined the later after it supplied coracobrachialis and biceps brachii from the site of union of distal communicating branch to musculocutaneous nerve, branches were given off to brachialis muscle[15].

In a study of 50 upper limb specimens the communications between median nerve and musculocutaneous nerve were found in 13 arms[16].

During the dissection of an adult male cadaver of 66 year old, variation was observed in the formation of median nerve, where this nerve was formed by fusion of

four branches, three of them coming from lateral cord and one from medial cord. There was also communication seen between median nerve and musculocutaneous nerve [17].

In a study of 48 upper limbs connections between musculocutaneous nerve and median nerve were found in five arms. In the same study the radial nerve arose only from union of posterior divisions of lower and middle trunks[18].

In a dissection of 54 cadaveric arms, interconnections between musculocutaneous nerve and median nerve were found in 36% of dissections. The mean length of these interconnections was 1.77 cms[19].

Variations involving the median nerve and musculocutaneous nerve are important in repairs of trauma to the shoulder and understanding of median nerve and musculocutaneous nerve dysfunction[20].

Communications between musculocutaneous nerve and median nerve is considered as a remnant from polygenetic point of view. Alternatively these variations could arise from circulatory factors at the time of fusion of brachial plexus cords[21].

In diagnostic clinical neurophysiology variations in connections between median nerve and musculocutaneous nerve may have some significance[2].

To prevent unwanted outcomes of operations conducted on musculocutaneous nerve, it is suggested that presence of median nerve and musculocutaneous nerve communications should be ruled out[22].

During a routine dissection of an adult male cadaver there was absence of musculocutaneous nerve. The median nerve from its lateral side supplied the

coracobrachialis muscle. Lateral cutaneous nerve of forearm was given from lateral side of median nerve [23]. Similar type of absence of musculocutaneous nerve was observed in another study[24].

Absence of musculocutaneous nerve was also observed on left arm of 28 years old male cadaver, where whole lateral cord was joined to the median nerve which met at two points[25].

Bilaterally dual origin of musculocutaneous nerve was also reported during routine dissection of 33 year old male cadaver where higher origin is reduced to a thin nerve arising normally from the lateral cord and supplies only coracobrachialis muscle, while lower origin is of normal usual thickness supplies biceps and brachialis muscle later continued as lateral cutaneous nerve of forearm[26].

During the dissection done on 24 upper limbs, two cases of absent of musculocutaneous nerve (8%) was seen. Median nerve took over the area of supply of musculocutaneous nerve [11].

A study was done on 40 upper limbs of spontaneously aborted human fetuses to determine branching patterns of musculocutaneous nerve. The mean age of fetuses was 21.3 weeks. Three branching patterns of musculocutaneous nerve to the biceps muscle was seen. Type I with a single primary branch occurred in 47.5% of the cases. Type II with two primary branches, each to a separate head of biceps was observed in 42.5% of cases. Type III consisted of two primary branches, the proximal dividing into two branches, each to a different head of biceps, distal branch supplying common belly was seen in 10% of cases. Communicating branches between median and musculocutaneous nerve was observed in 20% of specimens[27].

A study done on 129 cadavers showed 119 communications in 85 cadavers (63.5%). These communications between musculocutaneous nerve and median nerves have been classified into 4 types. Type I (54 communications, 45%) the communications were proximal to the point of entry of the musculocutaneous nerve into the coracobrachialis. Type II (42 communications, 35%) the communications were distal to the point of entry of the musculocutaneous nerve into the coracobrachialis. Type III (11 communications, 9%), the musculocutaneous nerve did not pierce coracobrachialis. Type IV (9 communications, 8%) the communications were proximal to the point of entry of the musculocutaneous nerve into the coracobrachialis and additional communication took place distally[28].

In a study of 60 arms pertaining to 30 human cadavers, one limb (1.7%) the median nerve gave off muscular branches to the brachialis muscle as well as a branch from its lateral root to supply both heads of biceps, concomitantly the musculocutaneous nerve was absent. The same limb demonstrated a branch from lateral cord supplying the coracobrachialis muscle. Three limbs (5%) showed a communicating branch between median nerve and musculocutaneous nerve [29].

Bilateral variations in the formation of median nerve and its recurrent course of its communications with the musculocutaneous nerve are very rare. These bilateral anomalies were observed during a routine dissection of an adult male cadaver[30].

The variations in the formation, location and course of the cords of brachial plexus and median nerve were studied in both axillae of 172 cadavers. The total prevalence of variation was 12.8% and these variations were divided into three groups[31].

There have been reports about the variations in the relationship of median nerve to the axillary artery. During dissection of 57yr old male cadaver it was observed on the right upper limb that the lateral root of median nerve crosses the artery anteriorly and meets medial to third part of axillary artery. In the same cadaver direct branches to pectoralis minor and latissmus dorsi from C6, innervation to deltoid by C6 and C7 roots and origin of lateral pectoral nerve from posterior division of upper trunk.[32.]

Study done on 170 limbs to observe the branching pattern of lateral cord, the incidence of variation in the formation and branching pattern was quite high. In about 20% of limbs median nerve was formed in two stages. Communication between musculocutaneous nerve and median nerve was seen in 14% of cases[1].

Formation of median nerve by two lateral and one medial root is also reported[33].

High origin of nerve to coracobrachialis from lateral cord is also reported[34].

Variation was also seen where the lateral cord pierced the coracobrachialis muscle from medial side in the infraclavicular part of brachial plexus during dissection of right upper limb of a 80yr old Indian male cadaver[35].

In addition to usual musculocutaneous nerve which pierced the coracobrachialis muscle and innervated it, two more anomalous branches from the median nerve were observed to pierce the coracobrachialis muscle on the left side of a 45 year old male cadaver[36].

The anatomical knowledge of variations of the innervations of the coracobrachialis muscle is important for the surgeons performing coracoid transfers[37]. The muscle has also been suggested for possible use as flap for coverage in infra clavicular defects of exposed axillary vessels, especially in post mastectomy reconstructive surgeries[38].

During the dissection of an adult female cadaver revealed absence of musculocutaneous nerve and biceps brachii was supplied by median nerve and ulnar nerve. In the same arm third head of biceps was found[39].

Communication between ulnar nerve and radial nerve is not well documented[5].

Knowledge of anatomical variation of these nerves at the level of upper arm is essential in the light of the frequency with which surgery is performed in the axilla and surgical neck of humerus.

METHODOLOGY

SOURCE OF DATA

The material for the study consisted of adult human cadavers during the course of dissection from undergraduate students in the department of Anatomy at B.L.D.E. A's Shri B. M. Patil Medical College, Hospital and Research Centre, Bijapur

METHOD OF COLLECTION OF DATA

Sample Size

The study was carried out on 60 upper limbs of 30 human cadavers of either sex and age group between 30-60 years over a period from Novermber 2007 to April 2009.

Sampling procedure

The cadavers were preserved with exposure to routine techniques, meticulous dissection and careful observation was done on both sides with naked eye examination.

The brachial plexus was exposed in all the 60 upper limb specimens. The major nerves from branches of cords of brachial plexus were selected because of their common involvement in disease, trauma and injuries and also lions share in nerve supply pertaining to the upper limb. These include :

1. Musculocutaneous nerve,
2. Median nerve,
3. Ulnar nerve,
4. Radial nerve and
5. Axillary nerve.

Inclusion criteria

All cadaveric upper limbs during the course of study

1. Without any gross arm deformities.
2. Without trauma.

Exclusion criteria

Cadaveric upper limbs during the course of study.

1. With burns.
2. Which are traumatized
3. Who have undergone reconstructive surgeries.

OBSERVATION

After meticulous dissection and naked eye examination of 60 upper limb specimens following observations were made with respect to individual nerves.

MUSCULOCUTANEOUS NERVE

The Musculocutaneous nerve was present in all upper limbs except in one limb where it was absent.

In the upper limbs where it was present it took origin from lateral cord of brachial plexus opposite to lower border of pectoralis minor. It pierced the coracobrachialis muscle in 52 limbs and descended laterally between biceps brachii and brachialis muscles.

The distance from tip of coracoid process to point of entry into coracobrachialis was between 7.2 to 9.4 cms (average 8.2 cms) in right arms and 7.3 to 9.2cms (avg 8.1cms) in left arms.

Abnormal communication was seen from musculocutaneous to median nerve in 11 limbs. In 8 limbs the communicating branch was given from musculocutaneous nerve before piercing and in 3 limbs the abnormal branch arose after piercing coracobrachialis muscle.

In one limb, Fig 3 (4L) a branch arose from lateral cord travelled for some distance along with median nerve and continued below as musculocutaneous nerve.

In seven limbs, the abnormal branch was given from medial side of musculocutaneous nerve 5.3 to 8.2 cms from tip of coracoid process (avg 6.8 cms). The communicating branch measured 1.5 to 10.3cms (avg 5.3cms).

In the remaining 3 limbs, the abnormal branch arose from musculocutaneous nerve after piercing coracobrachialis muscle at a distance of 13.3 to 15.2 cms (avg 13.4cms) from tip of coracoid process.

In one limb, Fig 12 (22R) the musculocutaneous nerve was absent. The muscles of front of arm that is coracobrachialis, biceps brachii and brachialis were supplied by median nerve from its lateral aspect.

After supplying muscles of front of arm the nerve pierced the deep fascia at the level of elbow lateral to tendon of biceps and continued as lateral cutaneous nerve of forearm.

Table 1 : Musculocutaneous nerve

Sl No	Particulars	Normal	Variation
1	Existance	Present -59 (98.3%)	Absent - 1 (1.7%)
2	Origin	Lateral cord-59 (100%)	-
3	Relation to IIIrd part of axillary artery	Lateral -58 (98.3%)	Posterior -1 (1.7%)
4	Piercing of coracobrachialis muscle	Present-52 (88.1%)	Absent - 7 (11.9%)
5	Communication with MN a)Before piercing coracobrachialis muscle b) After piercing coracobrachialis muscle	 - -	 Present - 8 (13.6%) Present -3 (5.1%)

MEDIAN NERVE

The Median nerve took origin in the axilla by union of medial and lateral roots from medial and lateral cords of brachial plexus respectively. It was seen anterior in 56 limbs, posterior in 2 limbs and medial in 2 limbs in relation to III rd part of axillary artery. The distance from tip of coracoid process to formation of median nerve by two roots varied from 4.0 to 15.2 cms (avg 5.2 cms) in right limbs and 4.0 to 8.4cms (avg 4.8cms) in left limbs.

After formation, the median nerve passed lateral to brachial artery. In the middle of the arm the nerve crossed the artery from lateral to medial side in 55 limbs. In the remaining limbs the nerve passed posterior to brachial artery.

The median nerve received abnormal communicating branch from musculocutaneous nerve before piercing coracobrachialis in 8 limbs and after piercing the muscle in 3 limbs. The abnormal branch reached median nerve at distance of 7.5 to 16.3 cms (avg 13.1 cms) from the tip of coracoid process.

In one limb where musculocutaneous nerve was absent Fig 12 (22 R), the median nerve supplied muscles of front of arm. Branch to coracobrachialis took origin 5.2cms, branch to biceps originated 14.7cms, branch to brachialis arose 17.6 cms from tip of coracid process respectively. Lateral cutaneous nerve of forearm arose from the lateral side of median nerve just above the elbow.

In all the 60 limbs, the median nerve entered the forearm by passing between two heads of pronator teres.

Table 2 : Median Nerve

Sl No	Particulars	Normal	Variation
1	Existance	Present - 60 (100%)	-
2	Origin	Medial root of MC & lateral root of LC - 60 (100%)	-
3	Relation of IIIrd part of axillary artery	Anterior -56 (93.3%)	Posterior -2 (3.3%) Medial -2 (3.3%)
4	Crossing of brachial artery in middle of arm	Present - 55 (91.6%)	Absent -5 (8.3%)
5	Communicating branch from MCN	Absent - 49 (81.6%)	Present -11 (18.3%)
6	Entry into forearm	Between two heads of pronator teres - 60 (100%)	-

ULNAR NERVE

The Ulnar nerve arose from medial cord of brachial plexus in all the limbs. After origin the nerve was related medial to IIIrd part of axillary artery.

In one limb, Fig 9 (18L), abnormal communicating branch reached the ulnar nerve from radial nerve. This branch measured 6.3 cms. It reached the ulnar nerve at a distance of 14.2 cms from tip of coracoid process.

The nerve pierced medial intermuscular septa about 12.0 to 15.2 cms (avg 13.5 cms) in right limbs and 12.2 to 15.3cms (avg 13.8 cms) in left limbs. The nerve then extends downwards in front of medial head of triceps brachii to appear in the interval between olecranon process and medial epicondyle.

Here, the ulnar nerve lies in a groove on the posterior surface of medial epicondyle and enters the forearm between the two heads of flexor carpi ulnaris.

Table 3 : Ulnar Nerve

Sl No	Particulars	Normal	Variation
1	Existance	Present - 60 (100%)	-
2	Origin	Medial cord - 60 (100%)	-
3	Relation to IIIrd part of axillary artery	Medial - 60 (100%)	-
4	Communication with any nerve	Absent - 59 (98.3%)	Present -1 (1.7%) with radial nerve
5	Course in relation to medial epicondyle	Posterior -60 (100%)	-

RADIAL NERVE

The Radial nerve arose from posterior cord of brachial plexus as its continuation. It was the largest branch of brachial plexus and descended posterior to IIIrd part of axillary artery. The nerve descended behind upper part of brachial artery and anterior to subscapularis and tendons of latissmus dorsi and teres major muscles.

In one limb, Fig 9 (18L) it gave a communicating branch to ulnar nerve at a distance of 8.1cms from the tip of coracoid process.

Then passed through lower triangular space. The nerve enters the spiral groove between long head and lateral head of triceps. Later, the nerve lies in the groove between lateral and medial head of triceps from medial to lateral side.

On reaching the lateral side of humerus the nerve pierces the lateral intermuscular septum to lie in front of lateral epicondyle of humerus.

Table 4 : Radial Nerve

Sl No	Particulars	Normal	Variation
1	Existance	Present - 60 (100%)	-
2	Origin	Posterior cord - 60 (100%)	-
3	Relation to IIIrd part of axillary artery	Posterior - 60 (100%)	-
4	Communication with any nerve	Absent - 59 (98.3%)	Present -1 (1.7%) with ulnar nerve
5	Course in relation to lateral epicondyle	Anterior - 60 (100%)	-

AXILLARY NERVE

The Axillary nerve arose from posterior cord of brachial plexus. It first lied lateral to radial nerve, posterior to axillary artery and anterior to subscapularis at its lower border. It then curved back and with the posterior circumflex circumflex humeral vessels travelled through the quadrangular space.

The nerve finally divided into anterior and posterior branches. The anterior branch with posterior circumflex humeral vessels, curved around surgical neck of humerus supplying anterior part of deltoid muscle. The posterior branch supplied posterior part of deltoid muscle and teres minor.

Axillary nerve was present in all the 60 limb and lied posterior to IIIrd part of axillary artery. No abnormal communication was seen in relation to this nerve.

Table 5 : Axillary Nerve

Sl No	Particulars	Normal	Variation
1	Existance	Present 60 (100%)	-
2	Origin	Posterior cord -60 (100%)	-
3	Relation to III part of axillary artery	Posterior -60 (100%)	-
4	Communication with any nerve	Absent -60 (100%)	-

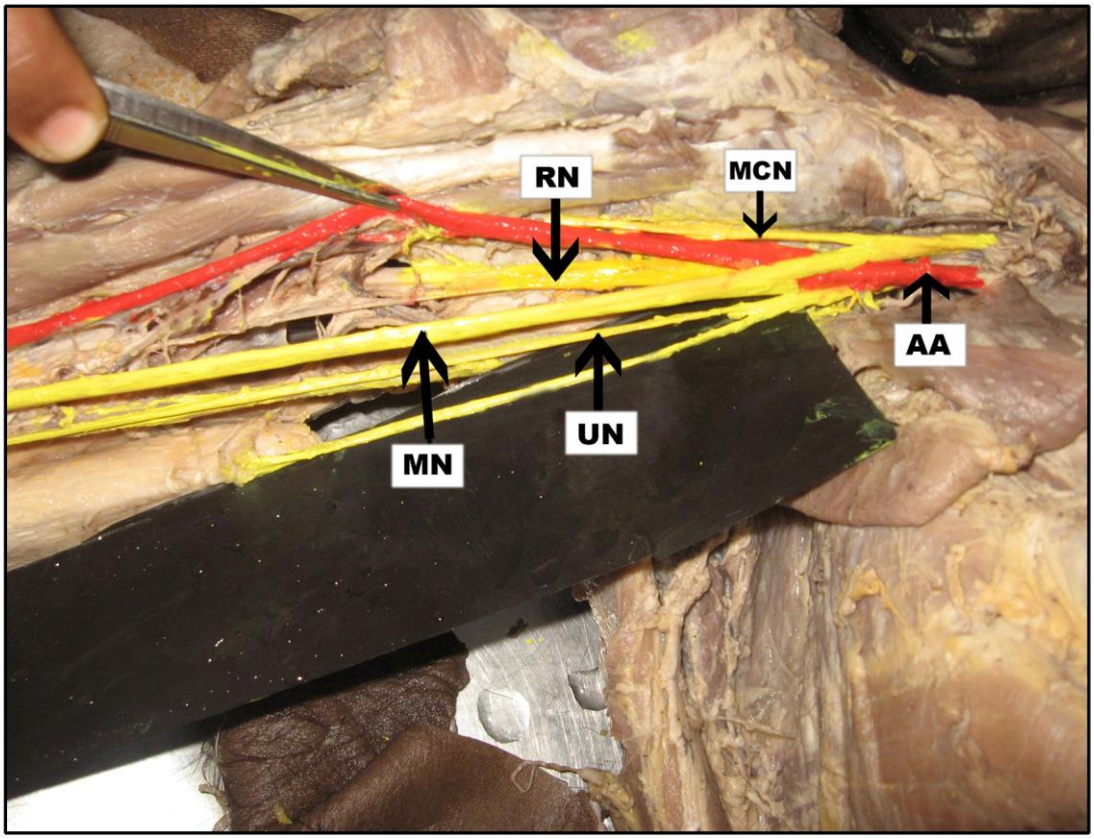

FIG 1: NORMAL BRACHIAL PLEXUS SHOWING MN, MCN, RN & UN.

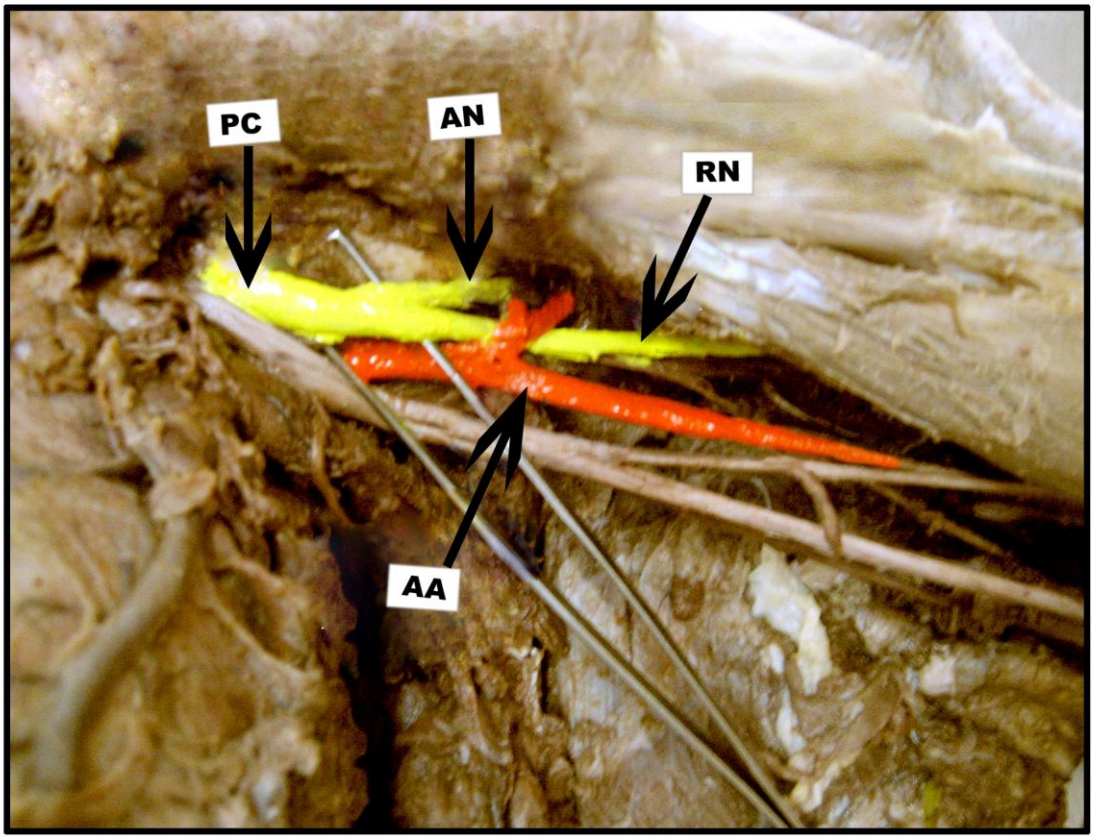

FIG 2: NORMAL BRACHIAL PLEXUS SHOWING AN & RN FROM POSTERIOR CORD.

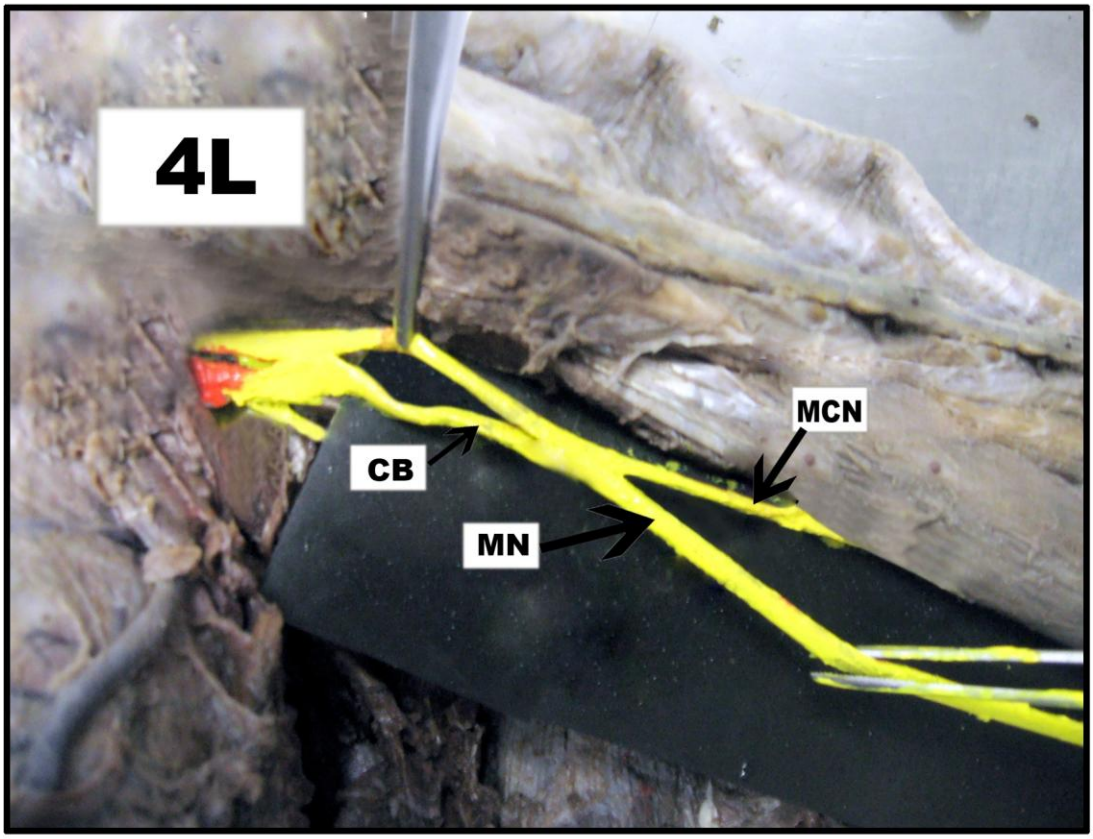

FIG 3: SHOWS INTER COMMUNICATION BETWEEN MCN & MN
BEFORE PIERCING CORACOBRACIALIS

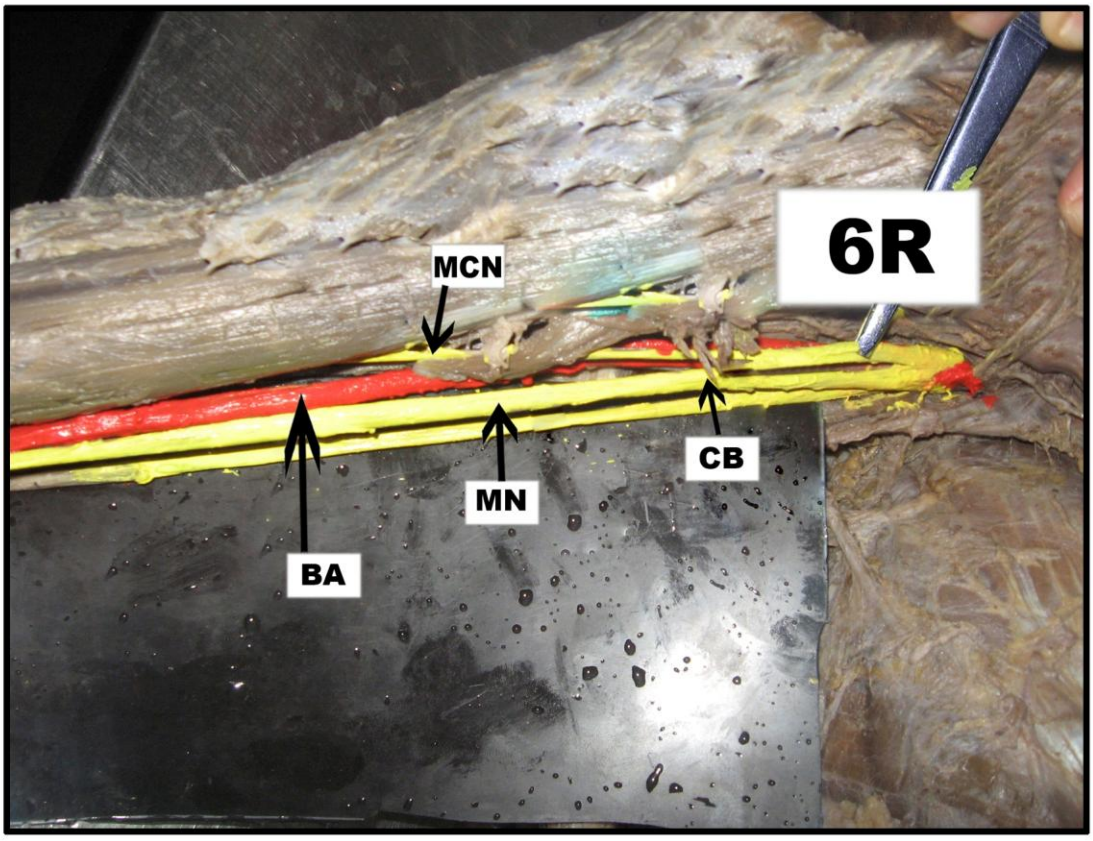

FIG 4: SHOWS COMMUNICATION BETWEEN MCN & MN
BEFORE PIERCING CORACOBRACIALIS

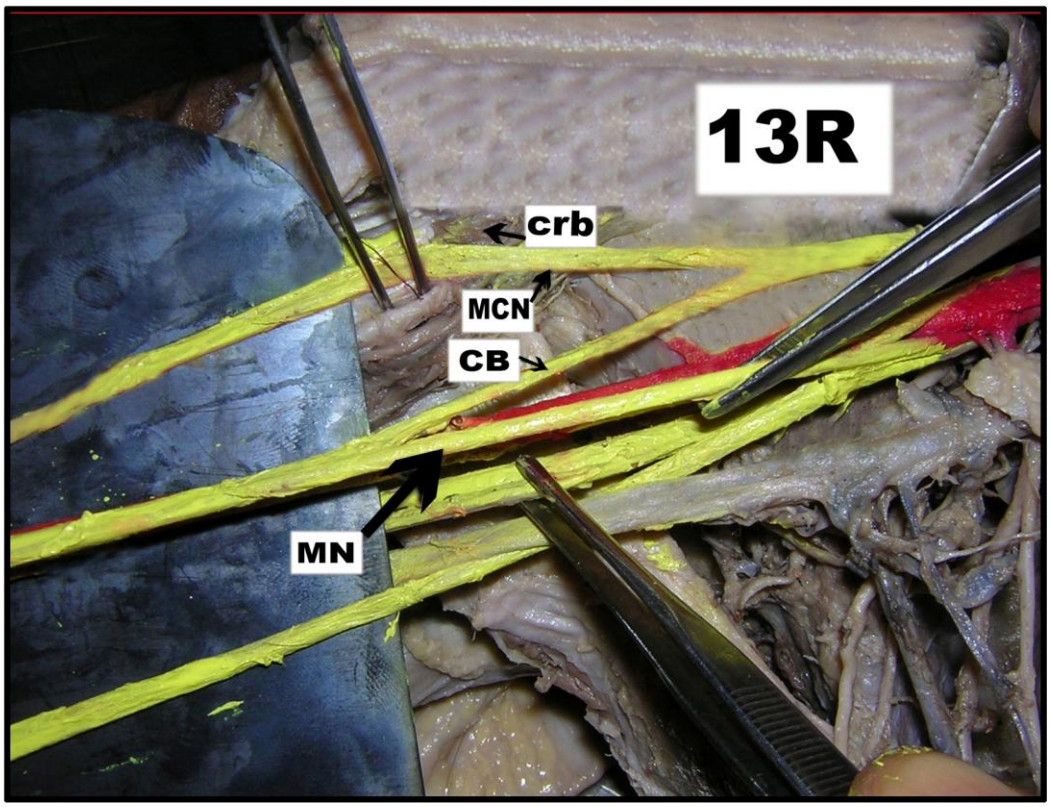

FIG 5: SHOWS COMMUNICATING BRANCH FROM MCN TO MN

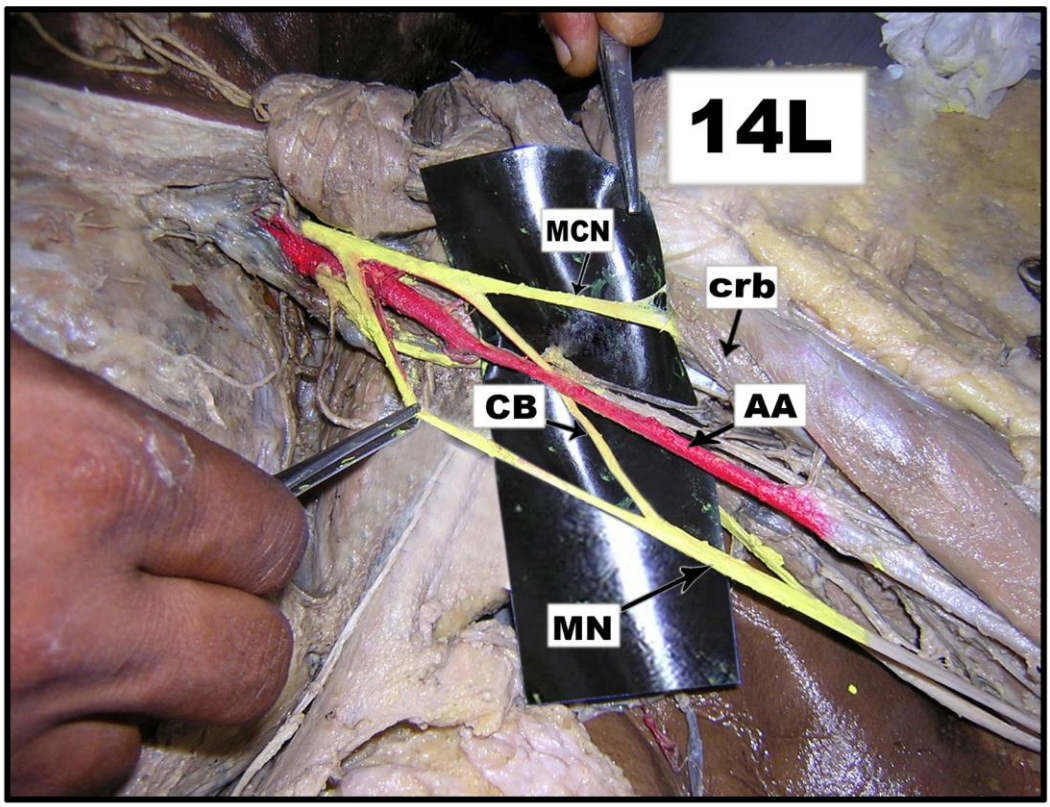

FIG 6: SHOWS COMMUNICATING BRANCH FROM MCN TO MN

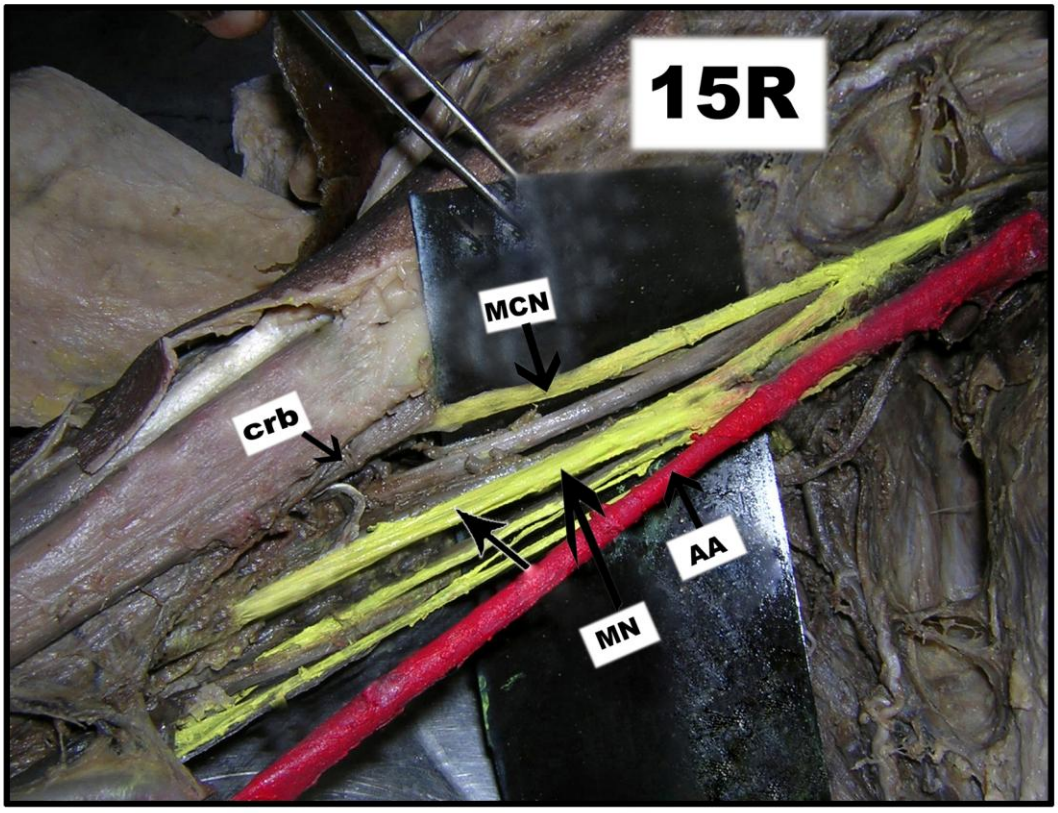

FIG 7: SHOWS MN FORMATION POSTERIOR TO AXILLARY ARTERY

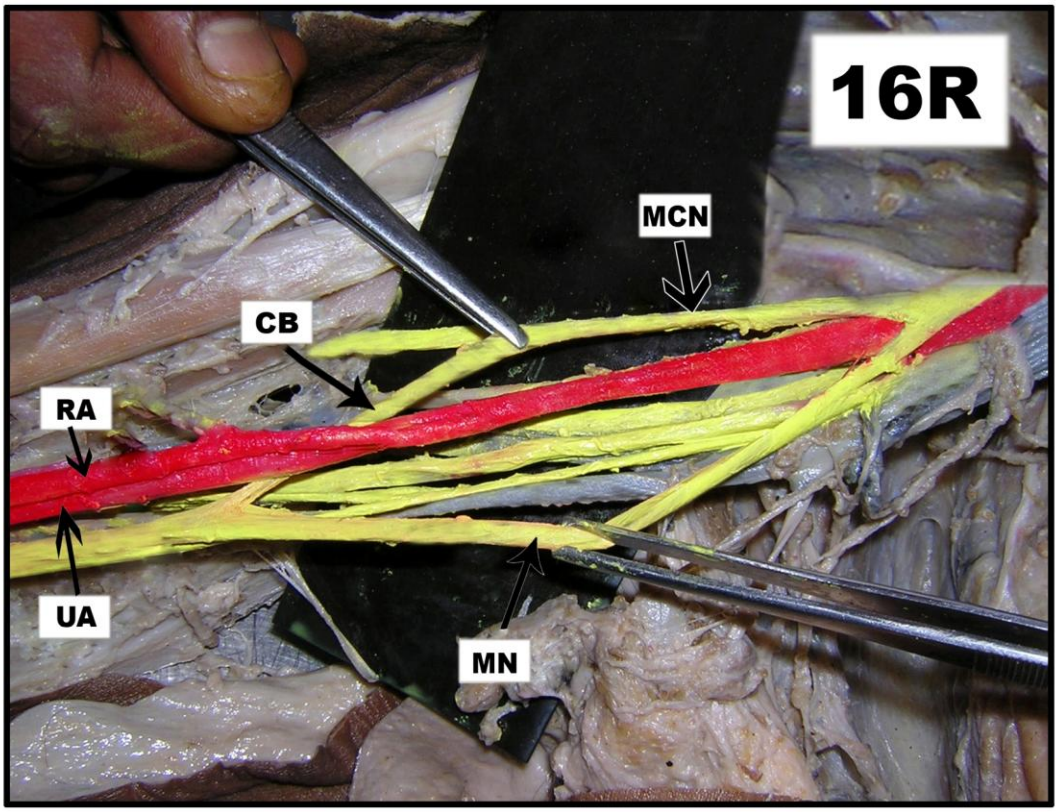

FIG 8: SHOWS COMMUNICATING BRANCH
FROM MCN TO MN WITH HIGHER DIVISION OF AA

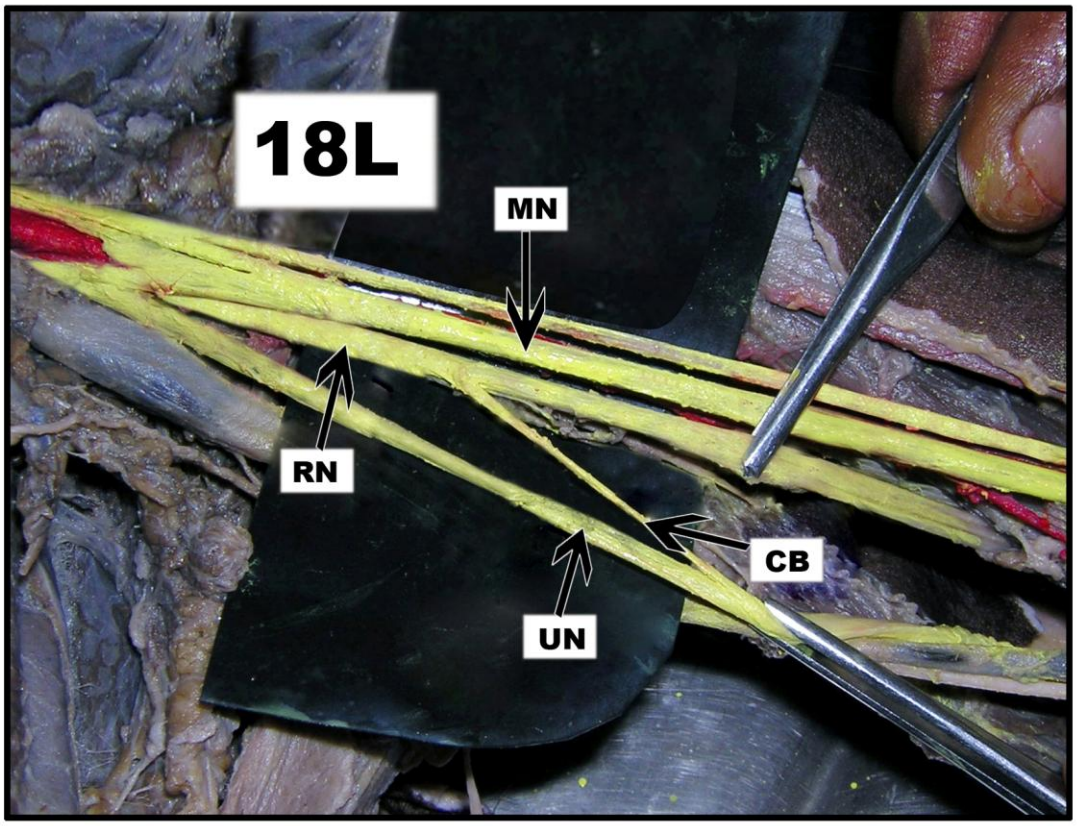

FIG 9: SHOWS COMMUNICATION BETWEEN RN & UN

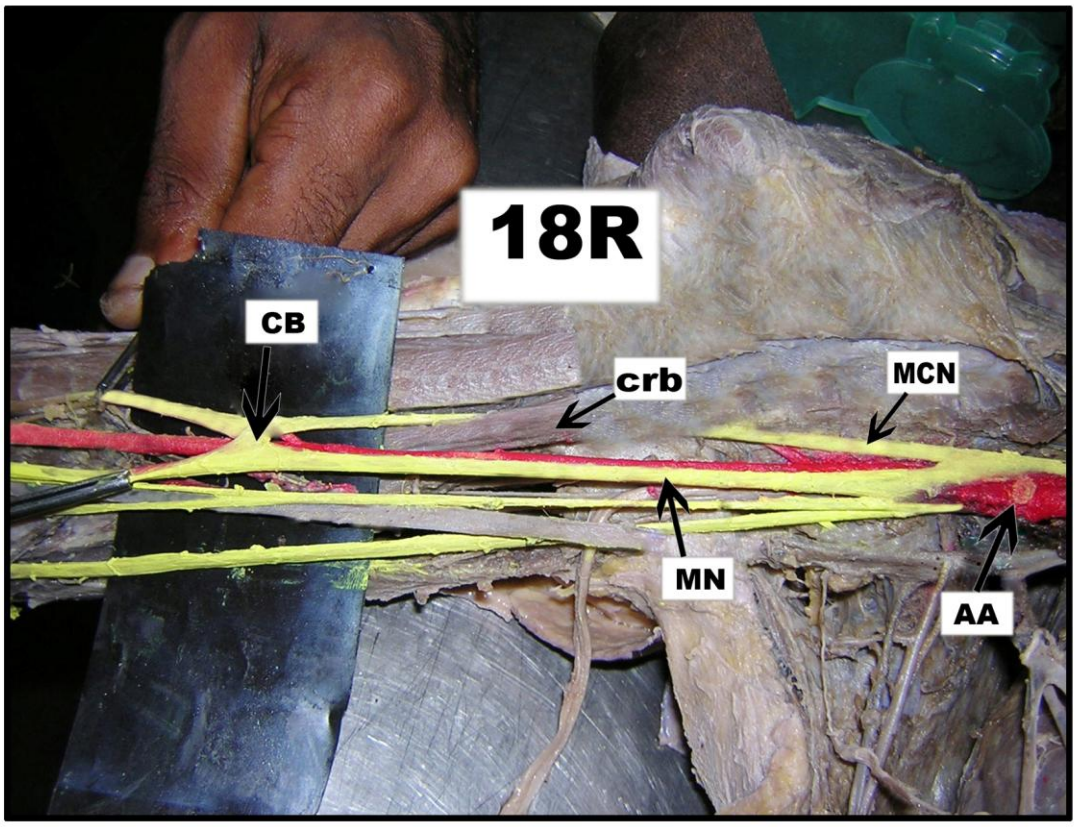

FIG 10: SHOWS COMMUNICATION BETWEEN MN & MCN
AFTER PIERCING CORACOBRACHIALIS

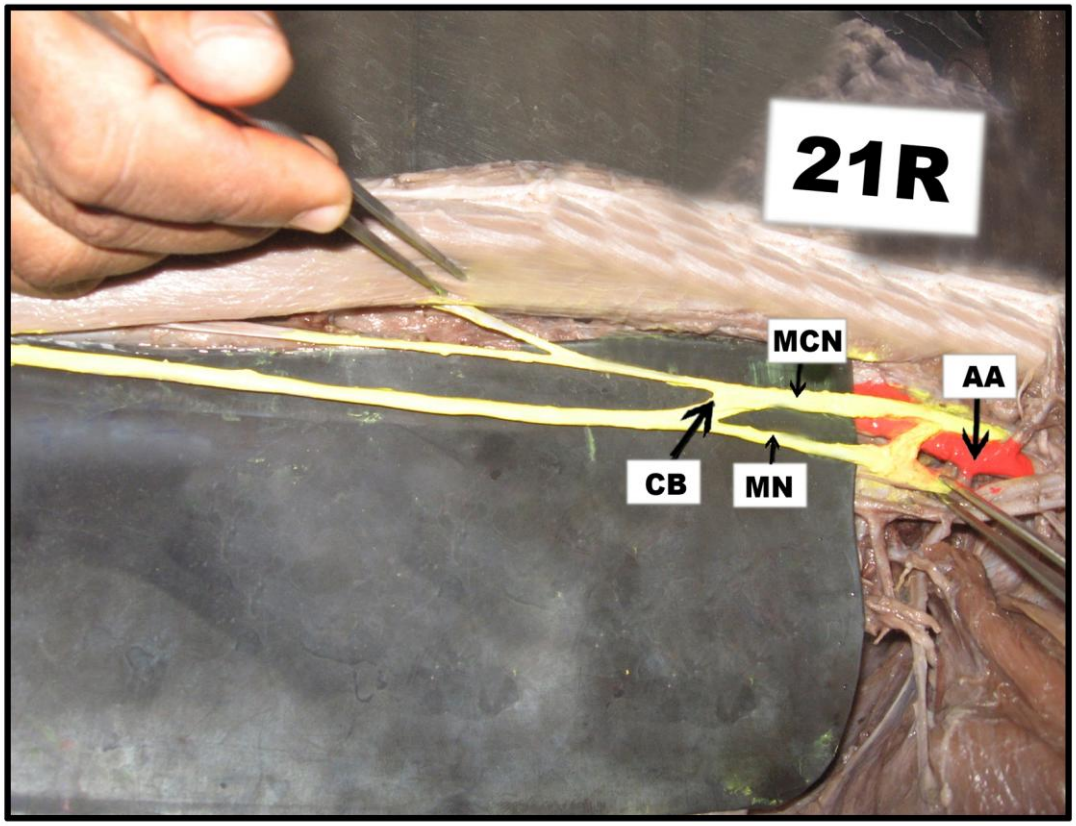

FIG 11: SHOWS COMMUNICATING BRANCH FROM MCN TO MN

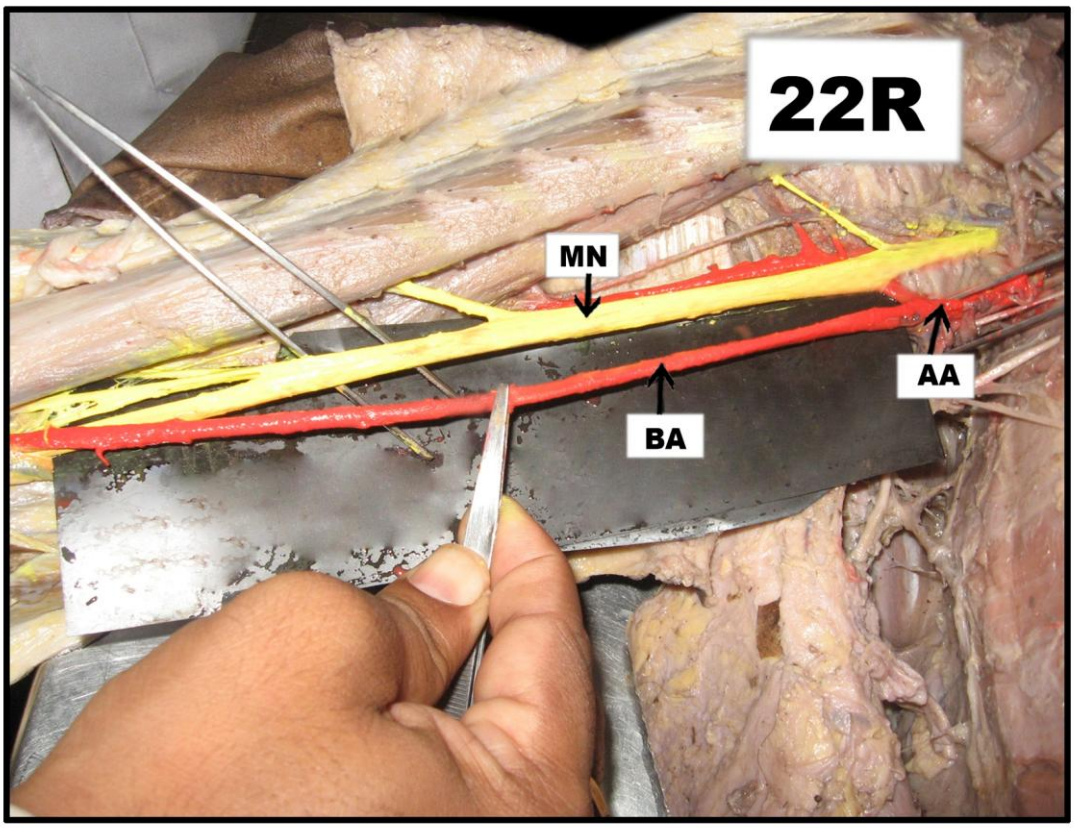

FIG 12: SHOWS ABSENT MCN WITH HIGHER DIVISION OF AA

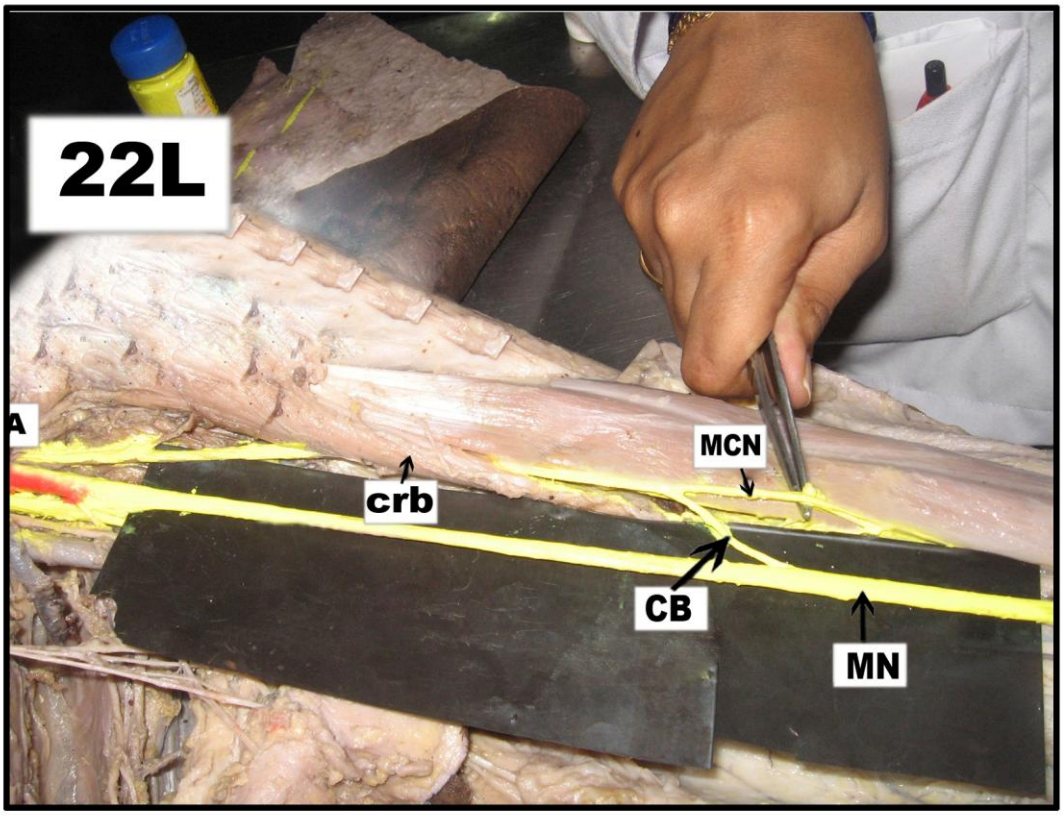

FIG 13: SHOWS COMMUNICATING BRANCH FROM MCN TO MN AFTER PIERCING CORACOBRACHIALIS

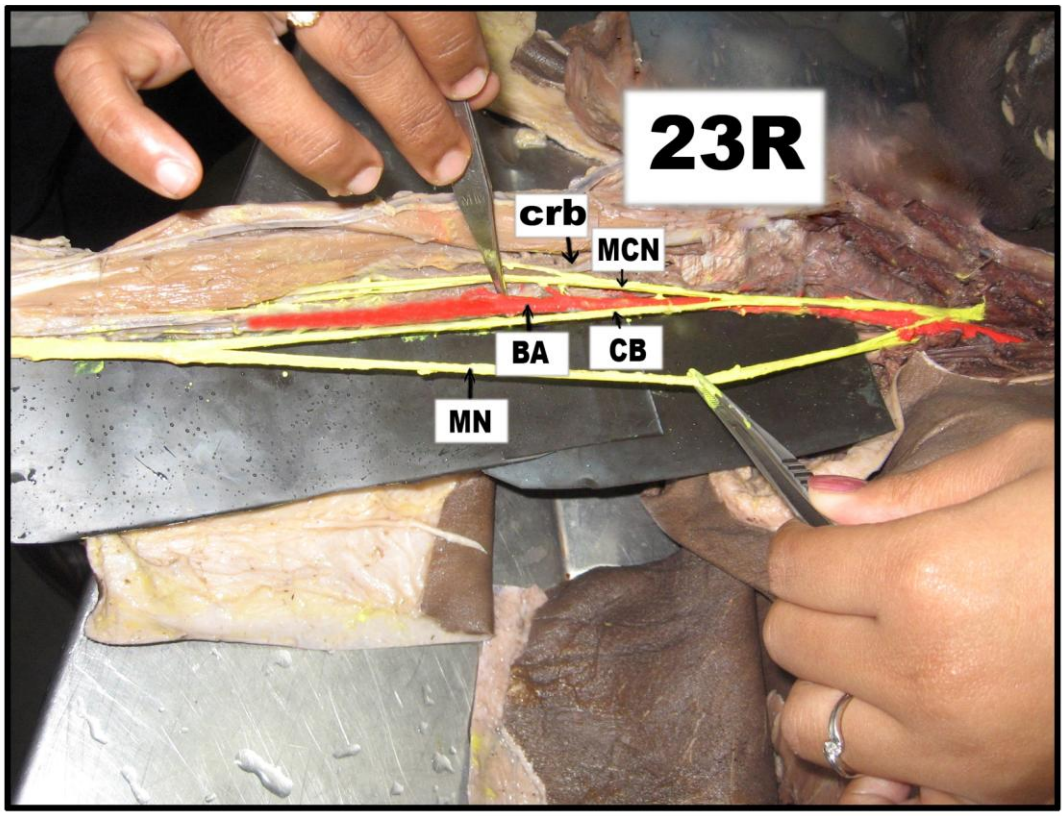

FIG 14: SHOWS COMMUNICATING BRANCH FROM MCN TO MN

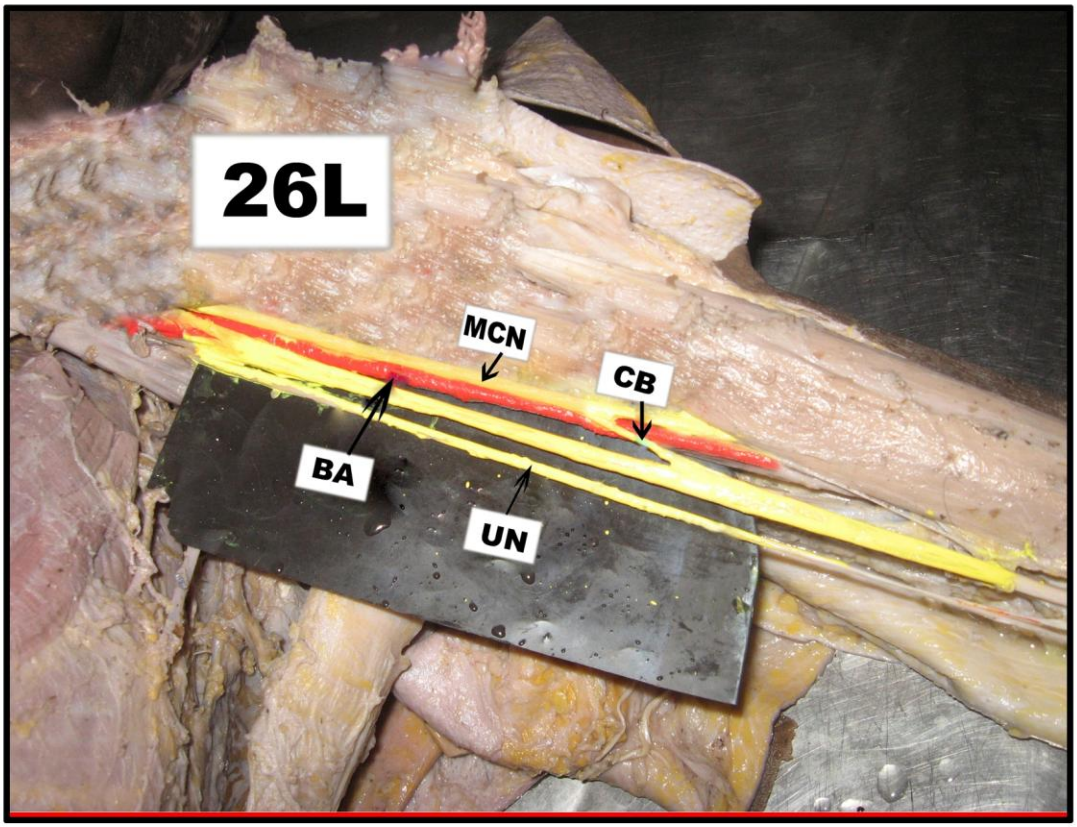

FIG 15: SHOWS COMMUNICATING BRANCH FROM MCN TO MN

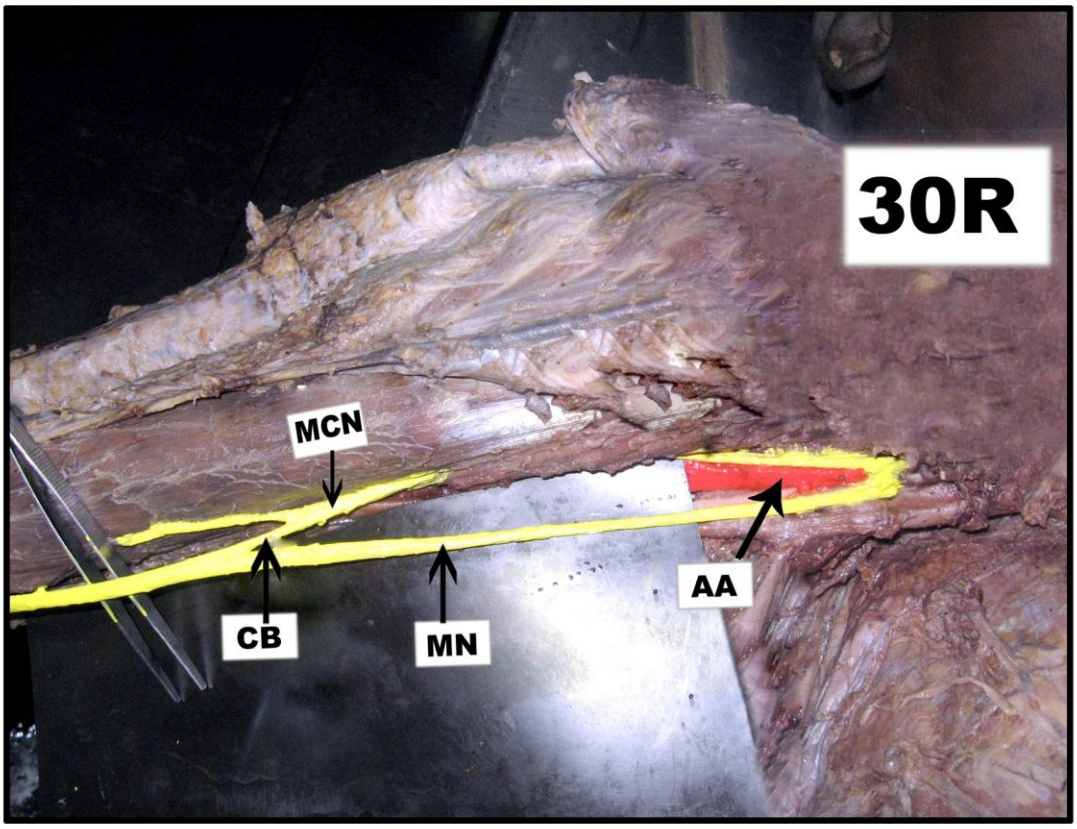

FIG 16: SHOWS COMMUNICATING BRANCH FROM MCN TO MN AFTER PIERCING CORACOBRACHIALIS

RIGHT UPPER LIMB SPECIMENS

LEFT UPPER LIMB SPECIMENS

DISCUSSION

The brachial plexus may be visualized simply as beginning with five nerves and terminating in five nerves. It begins with the anterior rami of C5, C6, C7, C8 and T1. It terminates with the formation of musculocutaneous, median, ulnar, axillary and radial nerves. The intermediate portions are displayed in sets of threes : three trunks are formed, followed by three divisions, then three cords. Each trunk gives rise to two divisions and each cord gives rise to two branches. The lateral cord divides into the musculocutaneous nerve and lateral root of the median nerve. The medial cord divides into medial root of median nerve and ulnar nerve. The posterior cord divides into axillary and radial nerve. The anatomy of brachial plexus can be confusing, especially because of frequent variations in length and caliber of each of its components[40].

MUSCULOCUTANEOUS NERVE

In the present study of 60 upper limbs musculocutaneous nerve arose from lateral cord of brachial plexus. It was absent in one limb (1.7%). This was already reported by several workers.

Prasad Rao PV and Chaudhary SC observed two cases of absent musculocutaneous nerve in 24 upper limbs. This was found to be absent in 8% of cases. Median nerve took over the area of supply of the musculocutaneous nerve by giving both muscular and sensory branches[11].

Hollinshed (1982)[41] has stated that very occasionally the musculocutaneous nerve is not found and its various branches arise from median nerve[33]. The absence of musculocutaneous nerve was noted by Le Minor(1990)[13], Nakata et.al (1997)[42], Sud M Sharma (2000)[29] and Gumusburn (2000)[43].

After the formation of musculocutaneous nerve, it descended down to pierce coracobrachialis in 52 limbs (88.1%). The distance from tip of coracoid process to point of entry into coracobrachialis varied from 7.2 to 9.5cms (avg 8.2cms).

Study done by Joshi et al have found that point of entry of musculocutaneous nerve into coracobrachialis is variable which ranges from 1.5 to 9.5cms[1].

In 7 limbs (11.9%) of our study the musculocutaneous nerve passed between biceps brachii and brachialis muscles without piercing coracobrachialis. Hollinshed (1982)[41] quoting Rao et al has described that 9.3% musculocutaneous nerves did not pierce coracobrachialis muscle.

The musculocutaneous nerve ordinarily enters coracobrachialis muscle from its medial aspect approximately 5cm distal to tip of coracoid process. It may run behind the coracobrachialis muscle or adhere for some distance to the median nerve or pass behind the biceps or may be accompanied by fibres from the median nerve as it transits coracobrachialis, less frequently the reverse occurs[44].

Anastomosis between musculocutaneous nerve and median nerve is by far the most common and frequent of the variations that are observed among the branches of brachial plexus.

Le Minor (1992)[13] classified communications between musculocutaneous nerve and median nerve into 5 types.

Type I - No communication between musculocutaneous nerve and median nerve

Type II - Fibres of medial root of median nerve pass through musculocutaneous nerve and join the median nerve in the middle of the arm.

Type III - The lateral root fibres of median nerve pass along the musculocutaneous nerve and after some distance, leave it to form lateral root of median nerve.

Type IV - The musculocutaneous nerve fibres join lateral root of median nerve and after some distance the musculocutaneous nerve arise from median nerve.

Type V- The musculocutaneous nerve is absent and entire fibres of musculocutaneous nerve pass through the lateral root and fibres to the muscles supplied by musculocutaneous nerve branch out directly from median nerve.

Choi et al (2002)[2] broadly classified the communications between musculocutaneous nerve and median nerve into three patterns.

Patterns I : Two nerves are fused.

Pattern II : One communicating branch between musculocutaneous nerve and median nerve.

Pattern III :Two communicating branches between musculocutaneous nerve and median nerve.

Venieratos and Anagnostopoulou (1998)[9] classified the communication between two nerves into 3 types.

Type I - Communication between musculocutaneous nerve and median nerve is proximal to the entrance of musculocutaneous nerve into the coracobrachialis

Type II - Communication is distal to the muscle.

Type III - The nerve or communicating branch did not pierce the muscle.

The variation in our study in relation to above classification include

Type I - 13.6%, Type II – 5.1%, Type III – 11.9%

A study done by Atkan et al showed connections between musculocutaneous nerve and median nerve were found in five arms. The connections were not bilateral in any cadaver. They left the musculocutaneous nerve 0.95 ± 0.42cms from the formation of this nerve. The point of entering the median nerve was 10.25cms ± 2.32cms from the formation of median nerve. The mean length of this interconnection was 5.50 ± 2.50cms[18].

In our study abnormal communicating branch measured 1.5 to 10.3cms (avg 5.3cms).

Communication between the musculocutaneous and median nerves in the arm is considered as remnant from the pylogenetic or comparative point of view. Kosugi[21] reported that there was one trunk equivalent to the median nerve in the thoracic limb of lower vertebrates (amphibians, reptiles, birds). In man, the forelimb muscles develop from the mesenchyme of the paraxial mesoderm during the fifth week of intrauterine life[45]. The axons of spinal nerves grow distally to reach the mesenchyme. The peripheral processes of the sensory and motor neurons grow in the mesenchyme, in different directions[46]. As the guidance of the developing axons is regulated by the expression of chemoattractants and chemorepulsants in a highly co-ordinated site specific fashion, significant variations in the nerve patterns may be a result of altered signalling between mesenchymal cells and neuronal growth cones or circulatory factors at the time of fusion of brachial plexus[47].

After supplying muscles of front of the arm, it continued below as lateral cutaneous nerve of forearm after piercing the deep fascia lateral to the tendon of biceps brachii.

MEDIAN NERVE

This nerve arose in the axilla by the union of medial root from medial cord and lateral root from lateral cord of brachial plexus. In our study, median nerve was present in all the 60 limbs. No variation was seen as far as the origin was concerned.

The combination from first thoracic nerve to the formation of median nerve may be missing. The site of union between the lateral and medial branches is quite variable and has been as far down as the elbow. The two branches may enclose the axillary vein as well as the axillary artery[48].

In our study the site of union between two roots varied from 4.0 to 15.2cms from tip of coracoid process. The median nerve may pass either in front or behind the axillary artery.

In the present study the nerve passed anterior in 56 limbs (93.3%), posterior in 2 limbs (3.3%) and medial in 2 limbs (3.3%). In a study done by Pandey and Shukla on 172 cadavers, in 8 cadavers the median nerve was formed medial to the artery and travelled as such.

The nerve usually passed lateral to brachial artery and crossed it from lateral to medial side near the insertion of coracobrachialis muscle. In our study crossing of brachial artery was seen in 55 limbs (91.6%) and no crossing in 5 limbs (8.3%).

Many authors have reported abnormal communications between median and other nerves. Thomson J observed 4% communication between median nerve and ulnar nerve and 3% between medial root of median nerve and ulnar nerve[49].

In our study the median nerve received abnormal communicating branch from the musculocutaneous nerve in 11 limbs (18.3%).

In our study, in one limb where musculocutaneous nerve was absent, median nerve supplied muscles of front of arm.

It entered the forearm by passing between two heads of pronator teres without giving any muscular branches in the arm.

ULNAR NERVE

This nerve arose from medial cord of brachial plexus. Variation in the origin was described by many workers. In our study in all the 60 limbs the nerve arose from medial cord of brachial plexus.

The ulnar nerve was lying medial to third part of axillary artery in all the 60 upper limbs. No variation was observed in this regard. It ran distally through the axilla between axillary artery and vein and was lying medial to brachial artery as far as midarm in all the limbs.

In one limb of our study, the nerve received an abnormal communicating branch from radial nerve. This variation is not well documented from previous investigators.

In the middle of the arm the nerve pierced the medial intermuscluar septa. It descended to the forearm by passing posterior to medial epicondyle of humerus.

RADIAL NERVE

Radial nerve is the continuation of posterior cord of brachial plexus. It was present in all the 60 limbs. No variation was observed with respect to its origin. Atkan

et al reported a case in which radial nerve arose from the union of posterior divisions of inferior trunk and middle trunk in the left upper extremity.

In our study the nerve lied posterior to III part of axillary artery in all the limbs. In one limb it gave an abnormal communicating branch to ulnar nerve. This variation is not observed by previous workers.

The nerve then descended behind the brachial artery and entered the spiral groove by passing through lower triangular space. On reaching the lateral side of humerus it pierced the lateral intermuscular septum and comes to lie infront of lateral epicondyle of humerus in all the 60 limbs.

AXILLARY NERVE

This nerve arose from posterior cord of brachial plexus. It was present in all the 60 limbs of our study. In all the limbs it lied posterior to axillary artery and anterior to subscapularis muscle. The nerve along with posterior circumflex travelled in quadrangular space.

The axillary nerve divided into two branches – anterior and posterior. The anterior branch supplied anterior part of deltoid and posterior branch supplied posterior part of deltoid and teres minor in all the limbs of our study.

Bergman et al (2000)[50] described origin of nerve to teres major muscle from axillary nerve instead of lower subscapular nerve. No variation with respect to origin, course and branching pattern was observed in our study.

CONCLUSION

Nervous system is very much essential for the survival of an individual. Thorough anatomic knowledge of the nerves is essential for assessing the functional loss and planned reconstructive surgeries.

The brachial plexus lesions may occur following trauma, compression of nerves, shoulder dislocation, intraoperative nerve damages, traumatic delivery in infants and malposition of the patient during general anaesthesia.

Variations of brachial plexus apparently are not rare. Lesions of communicating nerve may give rise to pattern of weakness that may impose difficulty in diagnosis.

So it is important to be aware of the variations that are observed and discussed in our study.

Knowledge of these variations is important for neurologists, orthopaedicians and traumatologists as these may give rise to variable clinical picture depending upon the variations present.

SUMMARY

The present study was undertaken in 60 upper limbs of 30 human cadavers. The detailed examination of the following nerves that is musculocutaneous, median, ulnar, radial and axillary nerves was done in the arm and following variations were observed.

1. Communication between musculocutaneous and median nerves in eleven limbs.
2. Musculocutaneous nerve was absent in one limb.
3. Median nerve supplied muscles of front of arm where musculocutaneous nerve was absent in one limb.
4. Musculocutaneous nerve did not pierce coracobrachialis muscle in seven limbs.
5. Communication between radial and ulnar nerve in one limb.

BIBLIOGRAPHY

1. Joshi SD, Joshi SS, Athavale SA. Hitch hiking fibres of lateral cord of brachial plexus in search of their destination. J Anat Soc India 2008 ; 57(1) : 26 – 9.
2. Choi D, Rodriquiz – Niedfur M, Vazquez T, Parkin I, Sanudo JR. Patterns of communication between musculocutaneous and median nerves in the axilla and arm. Clin Anat 2002 ; 15 : 11- 7.
3. Singhal S, Rao VV, Ravindranath R. Variations in brachial plexus and relationship of median nerve with axillary artery : a case report. J Brachial Plex Pheripher Nerve Inj 2007 ; 2 : 21.
4. Kerr AT. The brachial plexus of nerves in man, the variations in its formation and branches. Am J Anat 1918 ; 23 : 285 – 395.
5. Gupta M, Goyal N, Harjeet. Anomalous communications in the branches of brachial plexus. J Anat Soc India 2005 ; 54 (1) : 22-5.
6. Moore KL, Dalley AF. Upper limb. Clinically Oriented Anatomy. 4th ed. Philadelphia : Lipincott, Williams and Wilkins ; 1999 . p 714 -5.
7. Testut. Trait : d" Anatomie. 4th ed. 1899 (3) . p 176.
8. Villar F. Quelques recherches sur lesanastomoses des nerfsdu member superieur. Bull Soc Anat De Paris(Abstract) ; 1888. p 607-15.
9. Harris W. The true form of brachial plexus. J Anatomy Physiol 1904 ; 38 : 399-422.
10. Williams PL. Nervous system. In : Berry MM, Standring SM, Bannister SH, editors. Gray's anatomy. 38th ed. Edinburgh : Churchill Livingstone; 1996. p 1266 – 72.
11. Rao PV, Chaudhary SC. Absence of musculocutaneous nerves : two case reports. Clin Anat 2001 ; 14 : 31- 5.

12. Venieratos D, Anagnostopoulou S. Classification of communications between musculocutaneous and median nerves. Clin Anat 1998 ; 11 : 327 – 31.
13. Le Mnior JM. A rare variant of the median and musculocutaneous nerve in man. Arch Anat Histol Embryol 1990 ; 73 : 33 – 42.
14. Saeed M, Rufai AA. Median and musculocutaneous nerves : variant formation and distribution. Clin Anat 2003 ; 16 (5): 453 – 7.
15. Arora J, Kapur V, Suri RK, Khan RQ. Intercommunications between median and musculocutaneous nerve with dual innervation of brachials muscle : a case report. J Anat Soc India 2003 ; 52 (1) : 66 – 8.
16. Chaitra R. Various types of intercommunication between musculocutaneous and median nerve : an analytical study. Ann Indian Acad Neurol 2007 ; 10 : 100-4.
17. Uzan A, Seeling LL Jr. A variation in the formation of median nerve : communicating branch between the musculocutaneous and median nerves in man. Folia Morpol (Warsz) 2001 ; 60 (2) : 99-101.
18. 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 2001 ; 31 : 147 – 50.
19. Egsleder WA, Goldman M. Anatomic variations of the musculocutaneous nerve in the arm. Am J Orthop 1997 ; 26 (11) : 777 – 80.
20. Sunderland S. Nerves and nerve injury. Anatomical and Physiological features. 2nd ed. Edinburgh : Churchill Livingstone; 1978. p 672 – 7.
21. Kosugi L, Mortia T, Yamashita H. Branching pattern of the musculocutaneous nerve in case possessing normal biceps brachii. Jikeakai Med J 1986 ; 33 : 63 – 71.

22. Leffert RD. Anatomy of brachial plexus. Brachial plexus Injuries. New York : Churchill Livingstone; 1985. p 384.
23. Bergman RA, Thompson SA, Afifi AK, Saadeh FA. Compendium of human anatomic variation. Munich : Urban and Schwarzenberg; 1988. p 139 – 43.
24. Sud M, Sharma A. Absence of musculocutaneous nerve and innervation of coracobrachialis, biceps brachii and brachials from median nerve. J Anat Soc India 2000 ; 42 (2) : 176 – 7.
25. Song WC, Jung HS, Kim HJ, Shin C, Lee BY, Koh KS. A variation of the musculocutaneous nerve absent.
26. Abhaya A, Bhardwaj R, Prakash R. Bilaterally symmetrical dual origin of musculocutaneous nerve. J Anat Soc India 2006 ; 55(2) ; 56 – 9.
27. Kwolezak – Mc Grath A, Kolensik A, Cizek B. Anatomy of branches of musculocutaneous nerve to biceps and brachialis in human fetuses. Clin Anat 2008 ; 21 (2) : 142 – 6.
28. Loukas M, Aqueelah H. Musculocutaneous and median nerve connections within, proximal and distal to coracobrachialis. Folia Morphol (Warsz) 2007 ; 64 (2) : 101 – 8.
29. Beheiry EE. Anatomical variations of the median nerve distribution and communication in the arm. Folia Morphol (Warsz) 2004 ; 63 (3) : 313 – 8.
30. Goyal N, Harjeet, Gupta M. Bilateral variant contributions in the formation of median nerve. Surg Radiol Anat 2005 ; 27 (6) : 562 – 5.
31. Pandey SK, Shukla VK. Anatomical variations of the cords of brachial plexus and the median nerve. Clin Anat 2007 ; 20 (2) : 150 – 6.

32. Suruchi S, Vani VR, Roopa R. Variations in brachial plexus and the relationship of median nerve with axillary artery : a case report. J Brachial Plex Pheripher Nerve Inj 2007; 2 : 21.
33. Chauhan R, Roy TS. Communications between median and musculocutaneous nerve – a case report. J Anat Soc India 2002 ; 52 (1) : 72 – 5.
34. Flatow EL, Bigliani LU, April EW. An anatomic study of musculocutaneous nerve and its relationship to the coracoid process. Clin Orthop 1989 ; 244 : 166 -71.
35. Abhaya A, Khanna J, Prakash R. Variation of the lateral cord of brachial plexus piercing coracobrachialis muscle. J Anat Soc India 2003 ; 52 (2) : 162 – 70.
36. Das. An unusual case of additional branches of median nerve innervating the coracobrachialis muscle and its clinical implications. Clin Terr 2009 ; 160 (1) : 25 -7.
37. Laburthe–Tolra Y. Anatomical basis of operative lesions of the musculocutaneous nerve in injury of the shoulder. Chirurgil 1994 – 95 ;120(3):171-6.
38. Hober PC, Rohrich RJ, Mickel TJ. The coracobrachialis muscle flap for coverage of exposed axillary vessels : a salvage procedure. Plastic and Reconstructive surgery 1990 ; 85 (5) : 801 – 4.
39. Arora L, Dhingra R. Unusual nerve supply of biceps from ulnar nerve and median nerve and a third head of biceps. Indian J Plast Surgery 2006 ; 39 : 172 – 4.
40. Leinberry CF, Wehbe MA. Brachial plexus Anatomy. Available from leinberry @ pahand center.com.

41. Hollinshed WH. The back and limbs. Anatomy for surgeons. 3rd ed. Philadelphia : Harper and Row ; 1985. p 797.
42. Nakata T, Tanaka SH. Absence of musculocutaneous nerve with innervation of coracobrachialis, biceps and lateral border of forearm. J Anat 1997 ; 191 : 459.
43. Gumusburn E, Adigauzel E. A variation of the brachial plexus characterized by the absence of musculocutaneous nerve – a case report. Surg Radiol Anat 2000 ; 22 : 63-5.
44. Kaus M, Wotowicz Z. Communicating branch between musculocutaneous and median nerves in humans. Folia Morphol (Warsz) 1995 ; 54 : 273 – 7.
45. Larsen WJ. Development of limbs. 2nd ed. Edinburgh : Churchill Livingstone; 1997. p 311 – 39.
46. Brown MC, Hopkins WJ, Keynes RJ. Axon guidance and target recognition. Cambridge : Cambridge University press ; 1991. p 46 – 66.
47. Sannes HD, Relh TA, Harris WA. Development of Nervous System. New York : Academic press ; 2000. p 189 – 97.
48. Snell RR. The upper limb. Clinical Anatomy for Medical Students. 5th ed. Boston : Little, Brown and Company ; 1995. p 393 – 98.
49. Thomson J. Abnormal communications between median and ulnar nerves in the arm, forearm and hand. J Anat 2002 ; 61 : 154 – 64.
50. Bergman RA, Adel K, Afifi AK, Ryoscuke M. Nervous System plexus. Encyclopedia of human anatomic variations. Munich : Urban and schwarzenberg ; 2000. p 116 – 23.

MASTER CHART OF AXILLARY NERVE (LEFT ARM)

Sl No	Age in years	Sex	Existance	Origin	Relation to I	Comunication with any nerve
1	50-55	M	Present	PC	Posterior	Nil
2	55-60	M	Present	PC	Posterior	Nil
3	40-45	M	Present	PC	Posterior	Nil
4	50-55	F	Present	PC	Posterior	Nil
5	55-60	M	Present	PC	Posterior	Nil
6	45-50	M	Present	PC	Posterior	Nil
7	35-40	M	Present	PC	Posterior	Nil
8	45-50	M	Present	PC	Posterior	Nil
9	55-60	M	Present	PC	Posterior	Nil
10	45-50	M	Present	PC	Posterior	Nil
11	40-45	M	Present	PC	Posterior	Nil
12	50-60	M	Present	PC	Posterior	Nil
13	45-50	M	Present	PC	Posterior	Nil
14	35-40	F	Present	PC	Posterior	Nil
15	40-45	M	Present	PC	Posterior	Nil
16	50-55	M	Present	PC	Posterior	Nil

17	50-60	M	Present	PC	Posterior	Nil
18	40-50	M	Present	PC	Posterior	Nil
19	50-55	M	Present	PC	Posterior	Nil
20	40-45	M	Present	PC	Posterior	Nil
21	45-50	M	Present	PC	Posterior	Nil
22	55-60	M	Present	PC	Posterior	Nil
23	45-50	M	Present	PC	Posterior	Nil
24	35-40	M	Present	PC	Posterior	Nil
25	55-60	M	Present	PC	Posterior	Nil
26	45-50	M	Present	PC	Posterior	Nil
27	30-40	F	Present	PC	Posterior	Nil
28	55-60	M	Present	PC	Posterior	Nil
29	55-60	M	Present	PC	Posterior	Nil
30	40-45	M	Present	PC	Posterior	Nil

Note:- I. Third part of axillary artery.