(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 5, Issue 6 , Page No: 186-192
November-December 2022

IJMSCR

Variations in Musculocutaneous Nerve – A Cadaveric Study In South Indian Population

[1]Dr. Esther Yamuna, [2]Dr. Linda J. B, [3]Dr. Ganga N. V, [4]Dr. Saranya G

[1,2]Assistant Professor, Department of Anatomy, Kanyakumari Government Medical College Asaripallam, Tamilnadu, India.

[3,4]Assistant Professor, Department of Anatomy, Government Thoothukudi Medical College, Thoothukudi, Tamilnadu, India.

***Corresponding Author:**
Dr. N Esther Yamuna
Assistant Professor, Department of Anatomy, Kanyakumari Government Medical College, Asaripallam, Tamilnadu, India.

Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Background

Musculocutaneous nerve is one of the key nerves of the upper limb which supplies the flexor muscles of arm. Its variations are commonly encountered in brachial plexus dissection. Sound knowledge of its normal anatomy and variations are clinically significant in diagnosing neurological weakness, preplanning surgeries of arm, axilla and management of shoulder joint traumatology. The purpose of the study was to observe the same and to discuss its clinical significance.

Materials and Methods

The present study was conducted at Department of Anatomy, Kanyakumari Government Medical College, Tamilnadu, India. 25 right and 25 left upper limbs (50 specimens) from 25 cadavers with age ranging from 25 to 60 years irrespective of sex were studied.

Results

Musculocutaneous nerve arose from lateral cord of brachial plexus and was present in all the specimens studied. It didn't pierce coracobrachialis in 10 (20%) specimens. Coracobrachialis, brachialis and biceps brachii were supplied by musculocutaneous nerve in all the specimens. Single communicating branch to median nerve was observed in 9 (18%) specimens and it did not pierce the coracobrachialis. Venieratos Type 1and Choi Type2a pattern of communication were observed in 7 (14%) specimens. In 2 (4%) specimens Venieratos type 3 and Choi type 2 b pattern of communication were observed.

Conclusion

Awareness of the variations of musculocutaneous nerve in its origin, course, muscular branches, termination and anastomoses is important to the neurosurgeons, orthopaedicians and general surgeons while examining, diagnosing and managing peripheral nerve lesions or injuries of the upper limb.

Keywords: Brachial plexus, Communicating branch, Coracobrachialis, Median nerve, Musculocutaneous nerve

Introduction

Musculocutaneous nerve (MCN) is the continuation of lateral cord of brachial plexus. It pierces coracobrachialis and then descends between biceps brachii & brachialis. The branch to coracobrachialis is given off before the nerve enters the muscle, while branches to other muscles are given off after piercing coracobrachialis. Apart from muscular branches, it also gives branch to humerus. Also supplies elbow joint indirectly through its muscular branches to

brachialis. Then it pierces the deep fascia just below the elbow and continues as the lateral cutaneous nerve of forearm. Median nerve (MN) is formed by the union of terminal branch of both lateral and medial cords of brachial plexus. MN does not give any branches in the arm.

As both MN and MCN takes origin from lateral cord, sometimes there may be an abnormal formation and separation of nerve trunks, which may result in an improper branching of both nerves. Some fibers of MN may run in the sheath of the MCN for some distance and leave it to join the median nerve and persists as a communicating branch (CB) between MCN and MN [1]. Infrequently MCN may take lower origin from median nerve or shorter course after which joins the median nerve or may be absent. In its absence, motor and sensory fibers will arise from median nerve. Usually, MCN passes between superficial and deep head of Coracobrachialis. In the absence of or degeneration of deep head from coracoid process MCN will not pierce Coracobrachialis.

In the 5th week of intrauterine life, a paddle-shaped limb bud appears. During the 6th week, the limb buds become flattened to form the hand plates. By 7th week, the upper limb rotates so that the thumb lies laterally. The axons of spinal nerves grow distally to reach the limb bud mesenchyme. The peripheral processes of the motor & sensory neurons grow in the mesenchyme in different directions. Once formed, any developmental differences would obviously persist postnatally. Iwata et al stated the failure of differentiation of nerves as a cause for some of the fibers taking an aberrant course as a communicating branch [2]. Chiarapattanakom et al stated that the lack of co-ordination between the formation of limb muscle and their innervations is responsible for the appearance of a communicating branch [3]. In the presence of these variations if injuries occurs either in MCN or MN proximal to the CB it may lead to an abnormal clinical presentation. While performing surgeries of upper arm injury to CB should be avoided and also the variations in MCN origin have to be considered in axillary node dissection.

Materials And Methods

The study was conducted in 50 upper limb specimens of both sides.25 adult embalmed cadavers of age approximately between 25 to 60 years, irrespective of sex, allotted for undergraduate students' dissection in Kanyakumari Government medical college were chosen for the study. Cadavers with the congenital anomalies and the damaged brachial plexus were excluded from the study. The brachial plexus was dissected as per the standard procedures mentioned in Cunningham's manual [4]. The study was focused on

1) Presence of MCN
2) Whether MCN Pierces coracobrachialis
3) Existence of communication between MCN and MN
4) Number of communicating branches
5) Site of origin of communicating branch
6) Whether Communicating branch Pierces coracobrachialis
7) Types of communication (According to Venieratos and choi et al system of classification).

All the above-mentioned parameters were observed carefully and photographed.

Venieratos et al described three types of communication between median and musculocutaneous nerve based on the site of communication. Type I-The communication being proximal to the entrance of the musculocutaneous nerve into coracobrachialis. Type II-The communication being distal to the muscle. Type III-MCN as well as the CB did not pierce the muscle [5].

Choi et al classified the communication into three types based on the number of CB. First pattern - Fusion of both nerves. Second pattern - presence of one CB. This was further subdivided as pattern 2a, where a musculocutaneous nerve as a single root contributes to the connection, while in pattern 2b musculocutaneous nerve exists as two roots. Third pattern- presence of two CB [6].

Results

MCN was present in all the 50 upper limbs (100%) studied and pierced the coracobrachialis muscle in 38% of the right limb and 42% of the left limb. In 6 right (12%) & 4 left (8%) limbs, the musculocutaneous nerve didn't pierce the muscle (table 1). In this case, the nerve passed superficially, gave branches to all the three flexor muscles of arm

Volume 5, Issue 6; November-December 2022; Page No 186-192

and then continued as lateral cutaneous nerve of forearm. MCN existed as two roots-medial & lateral in 2 specimens.

Communicating branch was present in 9 specimens (18%) out of which 4 was on right and 5 on left side (table 2, table 3). Single communicating branch was observed in all specimens in the study and the site of origin was at the middle (14%) and distal (4%) part of coracobrachialis muscle. Communicating branch neither pierced nor supplied coracobrachialis muscle.

In our study, two patterns of communication with MN were observed. MCN arose from the lateral cord of brachial plexus and gave one CB before piercing the coracobrachialis. CB joined the median nerve in the middle of the arm and continued as a median nerve which is of Venieratos Type 1and Choi Type2a pattern (Fig 1). This pattern of communication was observed in 7 (14%) specimens.

In 2 (4%) specimens, MCN arose from the lateral cord of brachial plexus and existed as two roots-medial & lateral. The lateral root gave a muscular branch to coracobrachialis without piercing it and passed between the biceps & brachialis, then continued as lateral cutaneous nerve of forearm. The medial root divided into medial & lateral divisions just below the middle of the arm. The lateral division joined the musculocutaneous nerve and the medial division joined the median nerve 6cm above the bend of the elbow (fig 2) which is similar to Venieratos type 3 and Choi type 2 b pattern of communication.

Table 1: Number of limbs and their percentage of Musculocutaneous Nerve piercing the coracobrachialis

S.No	**Pierce the coracobrachialis**		**Not pierce the coracobrachialis**	
Total 50 limbs	Right (25)	Left (25)	Right (25)	Left (25)
	19	21	6	4
Percentage	38%	42%	12%	8%

Table 2: Presence of communication between MCN and MN

Sl.no	**Communicating branch**		
Total 50 limbs	Right (25)	Left (25)	Total (50)
	4	5	9
Percentage	8%	10%	18%

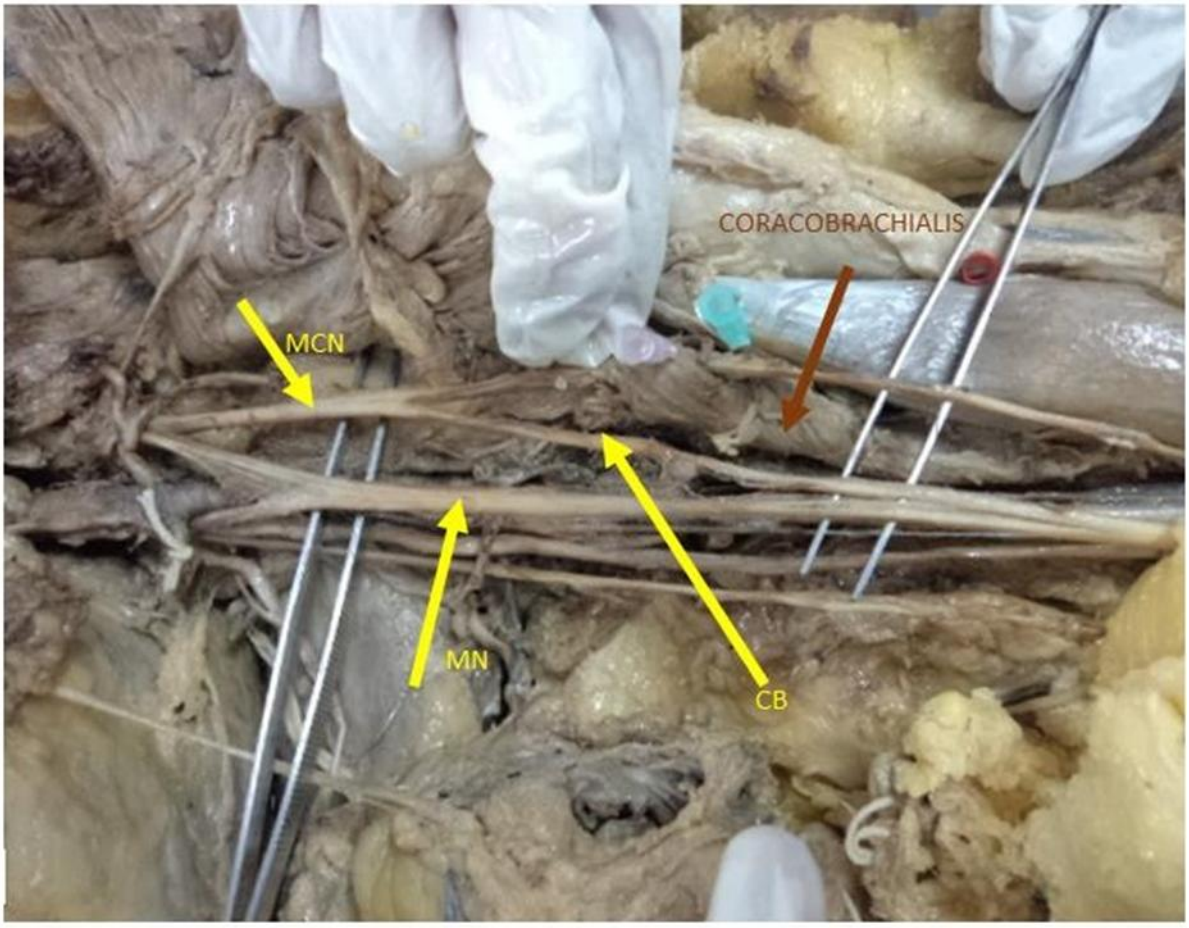
Table 3: Incidence of communication between MCN and MN in comparison with different studies

Author	**Total no of limbs studied**	**Incidence of MCN & MN communication**
Venieratos (1998)	158	13.9%
Chiarapattanakom (1998)	112	16%
Prasada Rao (2000)	24	33%
Choi (2002)	276	26.4%
Beheirg (2004)	60	5%

Volume 5, Issue 6; November-December 2022; Page No 186-192

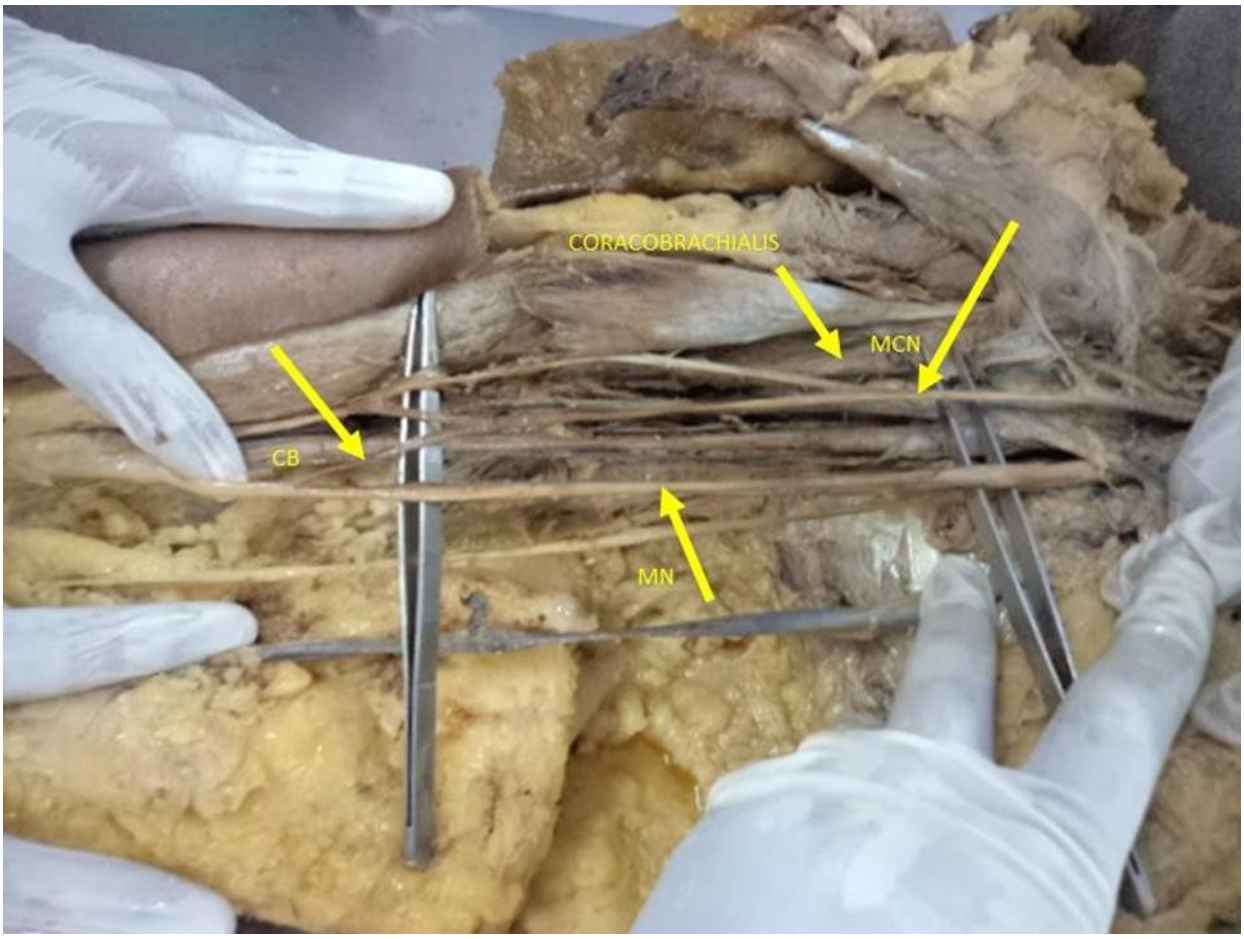
Budjiraja (2011)	116	20.7%
Present study (2022)	50	18%

Figure 1: Communication between MCN and MN in left side arm (Venieratos Type 1/ Choi Type2a)



Volume 5, Issue 6; November-December 2022; Page No 186-192

Figure 2: Communication between MCN and MN in Right side arm (Venieratos Type III/ Choi Type2b)



Discussion

In our study MCN was present in all specimens. Complete absence of MCN is a very rare anomaly. If there is any absence of the musculocutaneous nerve which is usually not revealed because its fibers run with the median nerve, any lesion of the median nerve in the region of the axilla or shoulder may results in unexplainable clinical condition. Here apart from common symptoms such as the loss of pronation and reduction in flexion of the hand and wrist, paralysis of the thenar muscles and loss of sensation in certain regions of the hand which are revealed when the median nerve has its normal anatomical course, clinicians may also encounter additional symptoms such as weakness in forearm flexion and supination and hypoesthesia of the lateral part of the forearm [7]. This reflects the primitive embryological origin of MCN from MN.

In our study coracobrachialis muscle was not pierced by musculocutaneous nerve in 10 specimens. In such cases only the superficial head persists and the deep head might have degenerated. In some mammals its origin is tricipital. During the process of evolution only the first two parts are retained and get fused enclosing the MCN, whereas the third part has disappeared, its function as adductor became insignificant in man. Knowing its relationship with MCN will be helpful while using this muscle as transposition flap in post-mastectomy reconstruction.

Communication between musculocutaneous nerve and median nerve has been reported by various authors. Considering the large number of variations in the formation of both nerves, Le Minor widely categorized these communications into five types

Type I-There is no communication between the median & musculocutaneous nerve

Type II-The fibers of medial root of median nerve pass through the musculocutaneous nerve & join the median nerve in the middle of the arm.

Volume 5, Issue 6; November-December 2022; Page No 186-192

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

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

Type V-The musculocutaneous nerve is absent and the entire fibers of musculocutaneous pass- through lateral root & fibers to the muscles supplied by musculocutaneous nerve branch out directly from median nerve [8].

In our study none of the observed cases comes under the classification of Le Minor type of communication. These variations are not infrequent and any lesions in the communicating nerve may give rise to muscle weakness, which may impose difficulty in diagnosis [9]. According to Beheirg et al, the CB along with MN pierced the coracobrachialis muscle following which the CB joined the median nerve [10]. In our study neither MN nor CB pierced coracobrachialis.

According to Bergman et al communicating branch usually joins the median nerve in the middle third of the arm. If it joins the median nerve in the upper third of the arm, it is generally considered as third (double lateral) root of the median nerve [11]. Understanding this type of variations of communication between these two nerves in the middle of the arm are more important for the treatment of humeral fracture. This fact is also useful in nerve transfers technique in case of treatment of lower brachial plexus injury, in recovery of elbow flexion and treatment of tetraplegic patients. MCN has been used as a receiver nerve and its motor branch to brachialis has been used as donor nerve to both anterior and posterior interosseous nerve.

Anrooki et al reported median nerve was formed by the union of two lateral roots and a medial root. The second lateral root, which was long that pierce the coracobrachialis along with the musculocutaneous nerve and joined the main trunk of the median nerve which is distal to the insertion of coracobrachialis [12]. Arora et al studied two communicating branches in only one specimen. The proximal communicating twig was given above the level of insertion of coracobrachialis. The distal communicating branch joined the musculocutaneous nerve below the insertion of coracobrachialis [13].

Chauhan & Roy et al reported that the additional third branch coming from the musculocutaneous nerve which also give a communicating branch to the median nerve [14]. Shukla et al observe four communicating branches that were present between the musculocutaneous and median nerve [15]. These variations are apparently not rare, if injury in musculocutaneous nerve which lie proximal to anastomotic branch between both nerves may lead to unexpected presentation of weakness of forearm flexors & thenar muscles that may impose difficulty in diagnoses [16]. Budjiraja V had reported that the communication between the musculocutaneous & median nerve was observed in 20.7% of the specimen and in our present these types of communication were observed in 18% which is lower than that of Budjiraja [17]. Prasada Roa and Chaudhary reported the communication between musculocutaneous nerve & median nerve were observed in 33% cases [18]. Kerr has been reported that the incidence of the communication between median nerve and musculocutaneous nerve was found to be less than 24% in his study [19].

Kosugi et al commented that with respect to phylogeny the communicating branch between the two nerves is a remnant of fetal developmental process. He observed only one trunk that could be compared to the median nerve in thoracic limb in lower vertebrae (reptiles, birds & amphibians) [20].

Conclusion

The knowledge of variations in MCN including its communication with MN in the arm is clinically significant in traumatology of arm as well as in plastic and reconstructive procedures. These variations gain significance in administration of neuromuscular blocks in axillary region and neurophysiological studies also.

Acknowledgements

The authors would like to pay respect to all who have donated their body for education and research purposes.

Legend

MN – Median nerve

MCN – Musculocutaneous nerve

CB – Communicating branch

Volume 5, Issue 6; November-December 2022; Page No 186-192

References

1. Standring S, Borley NR, Collins Crossman AR, Gatzoulis MA, Healy JC, et al. gray's anatomy: The Anatomical Basis of Clinical Practice.41st ed. London: Elsevier Ltd;2015. P.781-5.
2. Iwata Studies on the development of brachial plexus in Japanese embryotropic Dept Anat Mie Prefect Univ Sch Med 1960; 13:129-144.Cited by Prasad Rao PV, Chaudhary SC. Communication of the musculocutaneous nerve with the median nerve. East Afr Med J 2000; 77(9):498-503.
3. Chiarapattanakon P, Leechavengvoongs S Witoonchart K, Verpairojkit C, Thunasethakul P. Anatomy and internal topography of the musculocutaneous nerve the nerves to the biceps and brachialis muscles Hand Surg Am 1998; 23:250-5.
4. Koshi Cunningham's manual of clinical anatomy, 16th edition. Oxford University Press; 2018. P.978-0198749363.
5. Venieratos Anagnostopoulos Classification of communications between musculocutaneous and median nerves. Clin Anat.1998; 11:327-331.
6. Choi D, Rodriguez-Niedenfuhr Vazquez Parkin I, Sanudo JR. Patterns of connections between the musculocutaneous and median nerves in the axilla and arm. Clin Anat.2002; 15:11-17.
7. Renata Pacholczak. Wiesiawa Klimek-Piotrowska ·Jerzy A. Walocha Surg Radiol Anat 2010
8. Le Minor JMA.Rare variant of the median and the musculocutaneous nerves in man. Arch Anat Histon Embryol.1990; 73:33-42.
9. Gumusburun E, Adiguizel, E. (2000): A Variation of the brachial plexus characterized by the absence of the musculocutaneous nerve: case report. Surgical and Radiologic anatomy.22:63-65.
10. Beheirg Unanatomical variations of the median nerve distribution and communication in the arm. Folia Morphol (Warsz).2004; 63(3):313-8.
11. Bergman, R.A., Thompson, S.A., Afifi, A.K.and Saadeh, f.A.: Compendium of human anatomic variation. Urban & Schwarzenberg Munich 139-143. (1988).
12. Anrooki Mahmoudabad AR, Karin far MH. A Rare Bilateral Variation in the Formation of Median nerve Iran Anat Sci.2007.4 (17):383-387.
13. Arora J, kapur V, Suri RK, Khan RQ. Intercommunications between median and musculocutaneous nerves with dual innervations of brachialis muscle-a case report Anat Soc India.2003; 52(1):66-68.
14. Chauhan R, Roy TS. Communication between the Median and Musculocutaneous Nerve-A Case Report Anat Soc India.2002; 51(1):72-75.
15. Shukla L, Soni Gaur Four Communications between Median and Musculocutaneous Nerves. International Journal of Anatomical Variations.2010; 3:186-187.
16. Sunderland S. Nerve and Nerve Injury In: The Median nerve: Anatomical and Physiological features.2nd edn Edinburg: Churchill Livingstone; 1978:672-677,691-727.
17. Budhiraja V, Rastogi R, Asthana Ak, Sinha Krishna A, Trivedi Concurrent variations of median and musculocutaneous nerves and their clinical correlation. A cadaveric study. Tal J Anat Embryol.2011; 116(2):67-72.
18. Prasada Rao PV, Chaudhary SC. Communication of musculocutaneous nerve with the median nerve. East Afr Med J 2000; 77(9):498-503.
19. Kerr AT. The brachial plexus of nerves in man, the variations in its formation and branches. Am J Anat 1918; 23:285-395.
20. Kosugi Shibata Yamashita Supernumerary head of biceps brachii and branching pattern of the musculocutaneous nerve in Japanese's Radial Anat.1992;14:175-185.

Volume 5, Issue 6; November-December 2022; Page No 186-192