Variations In The Formation Of The Median Nerve

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Abstracts: Background**:** Variations in the formation of median nerve can result in misinterpretation of clinical signs due to median nerve palsy and hence they are of great clinical significance. Thus this project was taken up to study these variations and also to measure the distance of the site of formation of the median nerve from the tip of the coracoid process of the scapula. Methodology**:** Ninety-eight formalin fixed upper limbs were used for the study (50 right, 48 left). The variations in the formation of the median nerve were noted. The level of formation of the median nerve was measured from the tip of the coracoid process of the scapula. Results: The median nerve was formed from an anterior cord of brachial plexus in two cases, both on the left side. Double lateral root of the median nerve was present in 4 specimens, 3 on the left side and 1 on the right side. Conclusion**:** Variations in the formation of median nerve have embryological basis and clinical significance and the distance of site of the union of two roots of the median nerve from the tip of the coracoid process will be helpful to surgeons to locate median nerve in surgeries around the shoulder. [Iyer P NJIRM 2016; 7(3):17 - 20]

Key Words: variation, formation, median nerve, cord, brachial plexus.

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Introduction: The knowledge of variations in anatomy has gained more importance due to the wide use and reliance on computer imaging in diagnostic medicine. The presence of anatomical variations of the peripheral nervous system is often used to explain unexpected clinical signs and symptoms. Descriptions of nerve variations are useful in clinical and surgical practice since an anatomical variation can be the cause of a nerve palsy syndrome due to a different relation of a nerve and a related muscle. In most of these cases surgery can lead to a rapid recovery of nerve function[1]. Variant nerves having an abnormal origin, course and distribution are usually more prone to accidental injuries and entrapment neuropathies[2]. Experience reveals that amongst the neurovascular structures, nerves are the most faithful to textbook descriptions and any abnormal finding in relation to nerves can be attributed to an embryological pitfall.

The median nerve is very important clinically and it is indispensable to the anatomists, neurologists, neurosurgeons, plastic surgeons and even orthopaedic surgeons! Knowledge of normal anatomy and variations of the median nerve will not only help the clinicians to see all that their minds know and want to do, but also be beneficial to the anatomists to understand the subject better and teach relevant anatomy accurately.

In 1978, Sunderland has recorded the history of the variations in the nerve supply of the upper limb and has quoted the work of different researchers. He mentioned that Kerr, in 1918, reported regarding the contribution of fibres of roots of different spinal nerves to the median nerve. Subsequently many workers studied different aspects of the median nerve and reported findings in isolation. But it was Linell, in 1921, who was the first to report systematically the distribution of nerves in the upper limb, with reference to variability and their clinical significance[3].

Material and Methods: Ninety-eight upper limbs belonging to 51 cadavers, embalmed using 10% formalin, were used for the study. Of these 51 cadavers, four were females. Of the 98 upper limbs dissected, 50 belonged to the right side and 48 belonged to the left side.

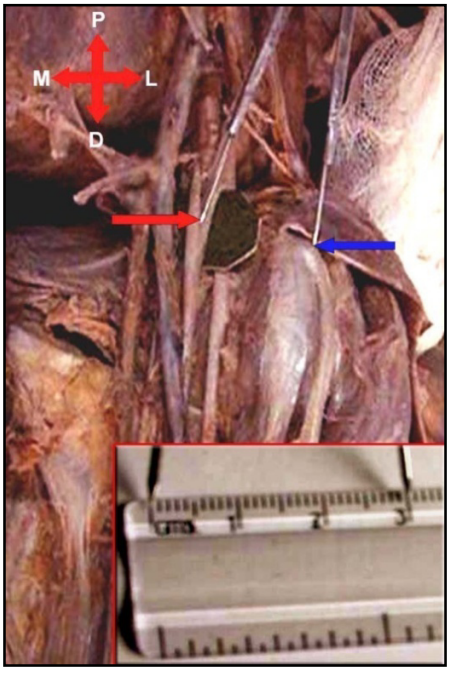
In each cadaver, the upper limb was kept in abducted and laterally rotated position. An incision was made on the front of the arm from the tip of acromion process of the scapula up to the middle of the arm. The axilla was dissected by removing loose connective tissue and fat. Then the axillary fascia was incised and lymph nodes were removed to expose the cords of brachial plexus and the axillary vessels. Then the coracobrachialis and short head of biceps brachii muscle were exposed. The site of median nerve formation (or any variation in its formation) was looked for and its relations with the axillary artery and vein were noted. The roots of median nerve were traced proximally to see its origin from the cords of brachial plexus and any variation in relation to the cords was noted. The tip of the coracoid process of the scapula was located inferior to the lateral 1/3 of the shaft of the clavicle.

The distance between the site of formation of median nerve and the tip of the coracoid process was measured using a divider and a meter scale as shown in Fig. 1 and readings were recorded in mm.

Results:

1. The median nerve was formed from an anterior cord of brachial plexus in two cases, both on the left side.
2. Double lateral root of the median nerve was present in four specimens, three on the left side and one on the right side.
3. The average distance of the site of the union of the two roots of the median nerve from the tip of the coracoid process of the scapula was found to be 40.94 mm (SD=13.92) on the right side (50 specimens) and 38.11 mm (SD=12.53) on the left side (46 specimens).
4. In two cases where the median nerve was formed from an anterior cord of the brachial plexus, the distance of the site of origin of the median nerve from the tip of the coracoid process of the scapula was 40 mm and 42 mm respectively.

Figure 1: Illustration showing measurement of distance between tip of the coracoid process and formation of the median nerve. Red Arrow – Site of median nerve formation, Blue Arrow – Tip of the coracoid process



Discussion: The median nerve is formed in the axilla by two roots, one from the medial cord and the other from the lateral cord of the brachial plexus. The larger lateral root conveys fibres from the ventral rami of the fifth, sixth and the seventh cervical spinal nerves and the smaller medial root carries fibres from the ventral rami of the eighth cervical spinal nerve and the first thoracic spinal nerve thus making its root value C5,6,7,8,T1. The medial root crosses the third part of the axillary artery to unite with the lateral root on the lateral or anterolateral aspect of the artery. Thus the axillary artery is clasped between the two roots and at its commencement, the nerve lies between the axillary artery medially and the musculocutaneous nerve and the coracobrachialis muscle laterally.

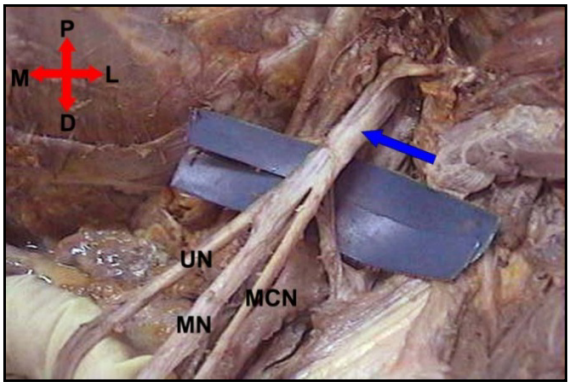
Variations in the formation of the median nerve have been reported by several researchers. In his study of 175 specimens Kerr had found that the median nerve was formed by lateral and medial roots from the respective cords of brachial plexus in 86.85% of the specimens[4]. In our study the median nerve was formed usually by the union of medial and lateral roots from the respective cords in 97.96% of the specimens.

Ahmet and Sait reported the formation of the median nerve by union of three branches, two from the normal medial and lateral cords and one from the branch of anterior division of the middle trunk of the brachial plexus, in four out of 130 specimens studied[5]. Kerr reported the presence of an anterior cord of brachial plexus formed by the union of the medial and lateral cords of the brachial plexus in front of the axillary artery, in three out of 175 specimens[4, 6]. Median nerve arose from such an anterior cord. Bergman quoted Buch – Hansen who reported 1.1% incidence of the anterior cord of the brachial plexus in their study. He also quoted Hirasawa reporting a similar case of anterior cord[6]. Embryological basis of this anomaly is that axillary – subclavian artery develops from the ninth intersegmental artery instead of the seventh, hence the artery lies inferior and posterior to the medial and lateral cords of brachial plexus in which case they unite to form an anterior cord of the brachial plexus[7]. In our study, the median nerve arose from an anterior cord of brachial plexus in two specimens.

Hence we also report the absence of the medial root and the lateral root of the median nerve in two cases where median nerve arose from an anterior cord of brachial plexus (Fig. 2).

To measure the level of origin of the median nerve, we used the tip of the coracoid process of the scapula as the reference point because it is an easily palpable bony landmark inferior to the junction between the median 2/3 and lateral 1/3 of the shaft of the clavicle, in the infraclavicular fossa (deltopectoral groove)[9]. Also this point is a useful guide for surgeries pertaining to the structures in and around the shoulder. In our study the average distance between the tip of the coracoid process of the scapula and the site of origin of the median nerve was found to be 40.94 mm. on the right side and 38.11 mm. on the left side, the maximum distance being 102 mm. i.e. approximately the middle of the arm (Fig. 3).

Figure 2: Absent medial and lateral roots of the median nerve. UN – Ulnar nerve, MCN – Musculocutaneous nerve, MN – Median nerve

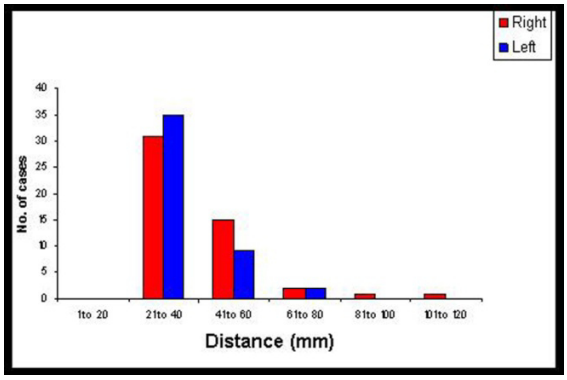


However we did not find three roots of median nerve as reported by Ahmet and Sait in any of our specimens studied.

Bergman[8], Sunderland[3] and Cliffton[9] have reported that the site of union of the two roots of the median nerve i.e. origin of the median nerve is variable and may be as low as the elbow. Sarala Devi et al reported formation of the median nerve at a higher level in 1/60 limbs with fusion of the medial root with the lateral cord. They also found a case where median nerve was formed at a lower level and it supplied arm muscles[10].

Sunderland stated the possibility of duplication of either of the two roots of the median nerve, either in isolation or together[3]. Venieratos and Anagnostopoulou defined double lateral root of the median nerve as an abnormal communication between the musculocutaneous nerve and the median nerve in the upper one third of the arm. They quoted Buch – Hansen who reported an incidence of 8% of cases with double lateral root in their study.

Figure 3: Graph showing distance between the tip of the coracoid process and site of formation of the median nerve

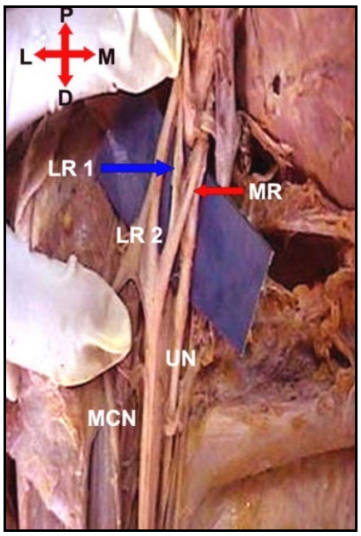


However Buch – Hansen stated that if the communication was thick then it is to be considered as a double lateral root and if thin it is to be considered as an anastomosis[11]. Saeed and Rufai reported a case of double lateral root[1]. Budhiraja et al reported an additional lateral root of the median nerve in 16.1 % of cases out of 174 limbs[12]. Bharti et al reported the formation of median nerve from more than two roots in two cases[13]. Nene et al reported multiple accessory communications between the lateral cord and the median nerve[14]. Talhar et al report a case of double lateral root of the median nerve[15]. Budhiraja et al , in their study on 196 limbs reported three roots of the median nerve in 22.4% cases, and four roots in 3.57 % cases[16]. In our study we found double lateral root of the median nerve in 4.08% of the specimens (Fig. 4). But we did not find any case with four roots of the median nerve. We also did not find any case with either double medial root or duplication of both roots of the median nerve.

In humans, the muscles of the upper limb develop from the mesenchyme of the paraxial mesoderm and the nerves penetrate this mesenchyme in different directions. Immediately after the rearrangement of nerves, they enter the limb buds and establish an intimate contact with the differentiating mesoderm condensations. This early contact between the nerve and muscle cells is a prerequisite for their complete functional differentiation. These variations of the nerves are a result of alterations in signaling between mesenchymal cells and neuronal growth cones during development which once formed could persist postnatally[10]. Hence variations that were found in our

study could have been as a result of such alterations in signalling.

Figure 4: Illustration showing double lateral root of the median nerve. UN – ulnar nerve, MCN – musculocutaneous nerve, MR – medial root, LR – lateral root



Conclusion: Thus the variations in the formation of the median nerve have some embryological basis and also the site will be helpful for surgeons while operating in the shoulder region.

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