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A study on the communications of median nerve with musculocutaneous and ulnar nerves

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Abstract:

Objective: Communications of median nerve with other nerves of upper limb are commonly reported and this prompted us to conduct the study. In depth study was done on the communications of median nerve with the musculocutaneous nerve and the different types were classified. Also, communications between the superficial branches of median and ulnar nerves were also studied in palm. **Materials and methods:** Sixty four upper limbs were dissected. The different types of communication of the median nerve with the musculocutaneous nerve and its relation to coracobrachialis were studied after a median incision along the anterior aspect of the upper limb. The communicating branch between the superficial digital branches of the median and ulnar nerves was studied in detail. **Results:** Communications between median and musculocutaneous nerves were seen in 15 of the 64 specimens dissected. The communication between superficial branches of median and ulnar nerve was seen in 10 palms. **Conclusion:** Communications between median and musculocutaneous nerves were observed as follows: 6.66% were proximal to coracobrachialis, 73.33% were distal and in 20% of the specimens neither the musculocutaneous nerve nor the communicating branch pierced the muscle. To know the different lesions of median nerve and their level of lesion, the different communications and their incidences are of utmost importance. The communication between superficial branches of median and ulnar nerves in the right and left sided palms were four (12.5%) and six respectively (18.75%).

Key words: Communications; Median nerve; Musculocutaneous nerve, Ulnar nerve; Upper limb

Introduction

The median nerve is susceptible to variations and communications between the nerve and its adjacent nerves are common, the commonest being its communicationwith musculocutaneous nerve. Many authors have studied the communicating branch between the two nerves elaborately [1-4]. As the median and musculocutaneous nerves take origin from the lateral cord, any abnormal expression of genes or abnormal formation and separation of nerve trunks can result in improper branching of the nerves. This can also result in cases where the musculocutaneous nerve is absent and the fibres of musculocutaneous nerve being carried through the median nerve. Such communications have also been classified into various types [3,5,6]. The knowledge of such communications is significant to interpret any abnormal functioning of these nerves due to communications, and to avoid injury to the communicating branch while performing surgeries pertaining to shoulder and anterior compartment of arm [7]

The median nerve usually communicates with the ulnar nerve in the palm between its superficial branches. This anastomosis is referred to as Berrettini anastomosis. The presence or absence of this communicating branch varies between individuals.

The wide range of variations pertaining to the communications related to median nerve made the study worth conducting.

Materials and Methods

Sixty four upper limbs of South Indian population were dissected at Chettinad Hospital and Research Institute. The laterality of the limbs was taken into account. Dissection of the arm was done by making a midline incision in the anterior surface of the arm to study the communications between median and musculocutaneous nerves. In the palm, a skin incision was made between the wrist proximally and was extended along the midline of the palm. The incision was then extended laterally and the skin was raised as two flaps. The palmar aponeurosis which was visible on reflecting the skin was also reflected and the communicating branch between the median and ulnar nerves were studied.

Results

Communications between median and musculocutaneous nerves were observed in 15 limbs. They were classified based on a classification by Venieratos and Anagnostopoulu [5]. Of the 15 specimens exhibiting communicating branches, one belonged to type 1, eleven to type 2 and three to type 3. Out of 64 specimens, 10 showed the presence of the communicating branches between the superficial branches of median and ulnar nerves in the palm, of which 4 belonged to the right side and 6 to the left side.

Discussion

Communications between median and musculocutaneous nerves:

Communications between median and musculocutaneous nerves are very common, though not seen in all cases. They can be of various types based on the classification by Venieratos and Anagnostopoulu [5]. According to their classification, there are three types of such communications.

Type 1: Communication proximal to the entry of musculocutaneous nerve into coracobrachialis muscle.

Type 2: Communication distal to the exit of musculocutaneous nerve from coracobrachialis muscle.

Type 3: Musculocutaneous nerve did not pierce coracobrachialis directly or through its branches but ran alongside the muscle and exhibited a communication between it and the median nerve.

Beheiry [8] added Type 4 to the above classification. According to him, the communicating branch along with musculocutaneous nerve pierced the coracobrachialis muscle following which the communicating branch joined the median nerve.

The present study was done based on the classification by Venieratos and Anagnostopoulu [5]. According to the data collected, 15 out of 64 specimens showed communications between median and musculocutaneous nerves, out of which, one communication (6.66%) was seen proximal to coracobrachialis muscle (type 1) (Figure 1), 11 (73.33%) distal to coracobrachialis (type 2) (Figure 2) and 3 (20%) showed both the musculocutaneous and the communicating branch, running alongside the muscle with neither of them piercing the muscle (type 3) (Figure 3).The fourth variant as described by Beheiry [8] was absent. Among the third type, all the specimens except one showed the presence of a single communicating branch only. In the specimen with two communicating branches, neither the communicating branches nor the musculocutaneous nerves were seen piercing through the

coracobrachialis (Figure 3). The communicating branches were not seen to pierce the coracobrachialis muscle in any of the specimens. The overall incidence of communications between median and musculocutaneous nerves was 23.44% (15 of 64 specimens) and the incidence of the various types is shown in Table 1.

However, Anrkooli et.al., [9] reported a variation where the median nerve was formed by union of two lateral roots and a medial root. The second lateral root, which was long, was seen piercing the coracobrachialis along with the musculocutaneous nerve and finally joined the main trunk of the median nerve distal to the insertion of coracobrachialis. No similar findings were observed in the study carried out at present.

In the present study, majority of the specimens showed the presence of only a single communicating branch between median and musculocutaneous nerves. Only one specimen (Figure 3) showed two communicating branches, as reported by Arora et.al., [10]. The proximal communicating twig was given before the level of insertion of coracobrachialis. The distal communicating branch joined the musculocutaneous nerve below the insertion of coracobrachialis. However, in the present study, both the musculocutaneous nerve as well as the communicating branch did not pierce the coracobrachialis muscle. Chauhan and Roy [11] also reported similar findings though he reported an additional third branch coming from the musculocutaneous nerve which also gave a communicating branch to the median nerve. Shukla et.al., [12] observed four communications present between the musculocutaneous and median nerves whereas in the present study, all the cases except one showed the presence of single communicating branch only.

One of the studies [13] reported a new type of classification depending on the site of communications between the musculocutaneous and median nerves. Their study revealed that 84.6% were proximal, 7.7% distal and 7.7% had two communications, one being proximal and the other distal. The results of the study done by Guerri-Guttenberg and Ingolotti [13] are highly contrasting to the present study where among the proximal and distal communications, 90% of the specimens showed a distal communication and the proximal communication was observed only in 10% of the specimens. The results were highly contradictory when compared. A single case with one proximal and one distal communication was however reported by Arora et.al., [10]. The present study differed again when compared to the findings reported by Badawoud [14] because only one interconnecting branch was found between the median and musculocutaneous nerves of an upper limb in 48 cases examined (2.1%). This is very low when compared with the present study. In yet another case, the communication between musculocutaneous and median nerve was observed in 20.7% of the specimens [15]. These values however seem to be consistent with the values obtained in the present study where communications between median and musculocutaneous nerves were observed in 15 cases of 64 upper limbs (23.43%).

There are many signaling molecules and transcription factors which are involved in the formation and division of nerves. A disruption in the normal functioning of these factors results in variations. It is significant for the anatomists as well as surgeons and radiologists to have knowledge about such anatomical variations in order to avoid any damage to the peripheral nerves. Based on the fact that ontogeny repeats phylogeny, this communication can possibly be related to the single nerve trunk which represents the median nerve in the thoracic limb of lower vertebrates [11]. The knowledge of the communications can also be of use in neurophysiological studies [7].

Communication between superficial branches of median and ulnar nerves in palm:

Communications also exist between superficial branches of median and ulnar nerves in the palm. This type of communication is referred to as Berrettini anastomosis,as first illustrated by Berrettini in the year 1741 [16]. The Berrettini anastomosis is usually seen between the third common digital branch of median nerve and the fourth common digital branch of ulnar nerve. In the present study, communication between the digital branches of median and ulnar nerves was observed in 10 out of 64 limbs (Figure 4) with an incidence of 15.625%. Among the ten limbs examined, the communications were seen in four palms (40%) on the right and six palms (60%) on the left sides (Table 2)

However, it was observed that the occurrence of the communicating branch was seen only in about one-sixth of the specimens dissected. This is highly in contrast with the results obtained by Meals and Shaner [17] wherein of the50 palms that

were dissected only 40 (80%) showed the presence of the communicating branch.

A study conducted by Malcic-Gürbüz et.al., [18] revealed the communicating branch between the superficial branch of the ulnar nerve and the third common palmar digital branch of the median nerve to be present in 67% of hands, while in the present study it is almost 25%The differences in the incidence of the occurrence of the communicating branch can probably be related to the racial changes in the specimens examined.

Another study reveals the presence of the communicating branch to be present in 20% of the limbs [19]. This study however goes hand in hand with the present study where, though there is a variation in incidence, it is very minimal. Multiple communications between median and ulnar nerves were also observed in a single hand and reported [19]. No such multiple communications were observed between the nerves in the present study. All the communications showed only a single communicating branch.

Sraj et.al., [20] described the presence of the Berrettini branch to be in 81 % of the cases and also added that it is a purely sensory communication. This branch is reported to be more at risk for injury during endoscopic carpal tunnel release. Ferrarri and Gilbert [21] found the communicating branch between the superficial digital branches of median and ulnar nerves to be in 45 out of the 50 cadaveric palms they dissected. Another study reported the patients presenting with sensory disturbances following a two portal endoscopic carpal tunnel release [22]. They presented with hyperaesthesia or tingling sensation and in most cases the lateral side of the ring finger was involved. Loukas et.al., [23] reported the presence of the branch in 85% of the specimens dissected. On comparing the findings of our study with the others, it is evident that the presence of the communicating branch is relatively low in the present study.

The probable reason for the occurrence of such communicating branches may be due to the hitch-hiking of the fibres of a nerve through another nerve. However, the fibres which have to supply its assigned region end by supplying it after coursing over for a short distance following which it joins its parent nerve. This sort of travelling and shifting of some nerve fibres from adjacent nerves to the parent nerve may result in the formation of communicating branches. This supposedly occurs due to improper division of the nerve fibres at the different levels of brachial plexus. Care should be taken to avoid injury to the communicating branch while performing release of the recurrent motor branch of median nerve in case of carpal tunnel syndrome. These branches are also in close proximity to the superficial palmar arterial arch. Damage to the communicating branch or ~~the~~ severing of the branch might result in sensory loss which may be difficult to diagnose owing to the large number of variations in the origin of the communicating branch. The patterns of sensory impairment may vary depending upon the branch of median and ulnar nerve it is seen connecting.

The development of forelimb takes place during the fifth week of embryonic life. The mesenchyme of the paraxial mesoderm gives rise to the muscles of the upper limb. The upper limb nerves develop from the peripheral processes of spinal nerves. Within the mesenchyme, the peripheral processes of both the motor and sensory axons develop in different directions with the aid of various chemoattractants. The route taken up by the axons may vary while they ultimately reach the main trunk to which they belong. The developmental changes present during the formation of the nerve persist even after its formation and this result in communicating branches in adults. Many chemoattractants and chemorepulsants are involved in co-ordinating the development of a nerve. Some circulatory factors are also believed to be involved in its formation. Differences in the signaling system maybe the causative factor for the abnormal development of nerves which ultimately results in variations [24].

Conclusion

The median nerve is highly susceptible to variations. The knowledge of the above mentioned variations can be of significance for physicians and surgeons apart from anatomists while examining a case of median nerve lesion proximal to a communication between the median nerve and musculocutaneous nerve as the functions of the median nerve can still be restored due to the fibres travelling via the communicating branch through musculocutaneous nerve. Care should to be taken while performing surgeries pertaining to repair of the nerve. The study shows the presence of a single communicating branch predominantly.

The communication between median and ulnar nerve also plays a significant role in the cutaneous innervations of the hand. Though the communication was seen only in 15.625 % of specimens, the presence of the communicating branch between the two nerves may compromise the

sensory loss occurring due to lesion in median nerve to a certain extent. This can also be of significant use to neurologists and orthopedicians while examining cases with sensory loss over the distal part of the upper limb. Further diagnosis can be done using the preliminary methods of examination of the different peripheral nerves and nerve stimulation studies. Care should also be taken to prevent injury of the nerve while performing endoscopic release of carpal tunnel for carpal tunnel syndrome by looking out for the communicating branch prior to the surgery.

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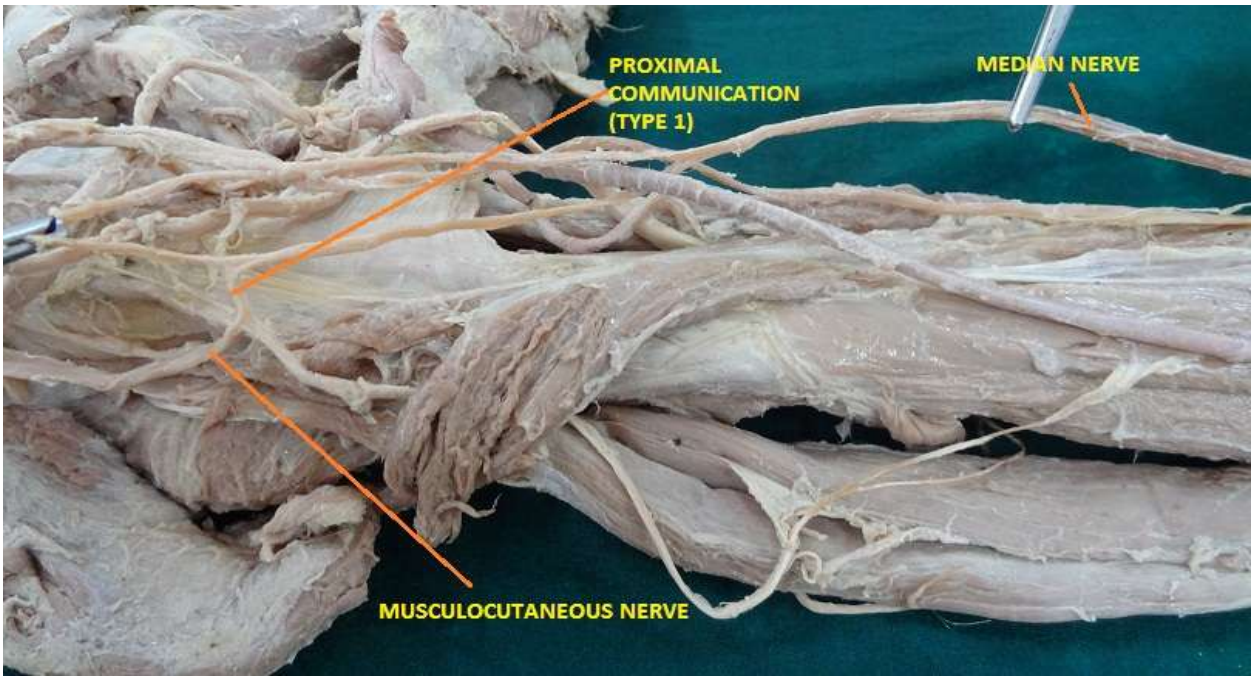

Figure 1: Type 1 communication between median and musculocutaneous nerves

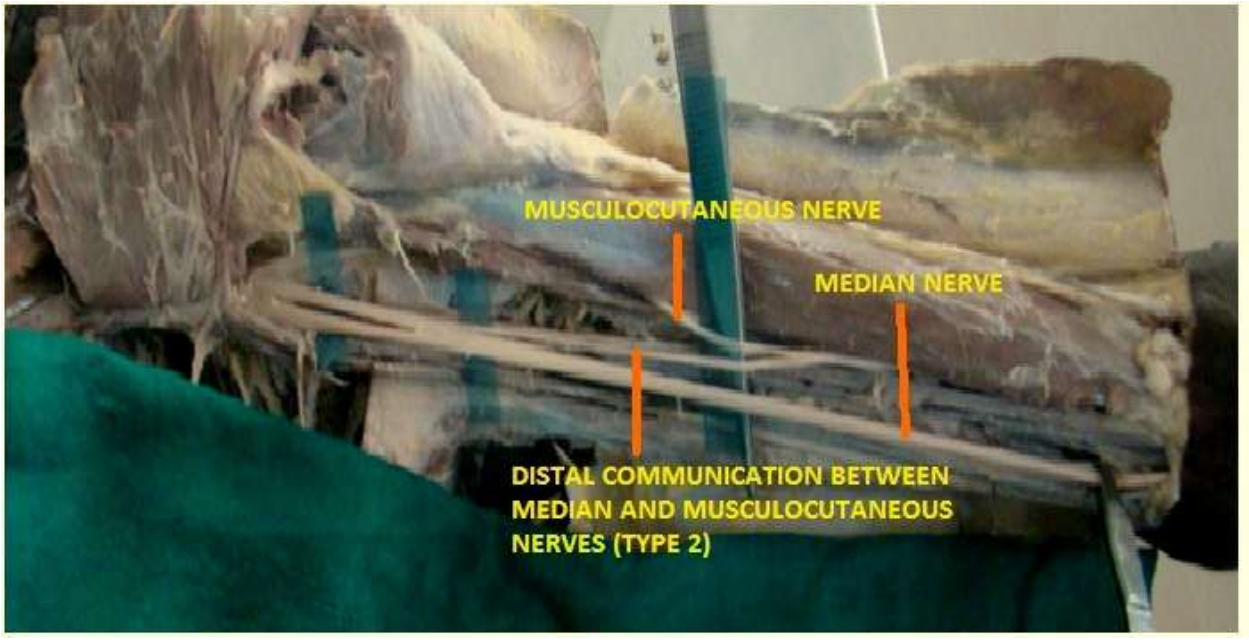

Figure 2: Type 2 communication between median and musculocutaneous nerves

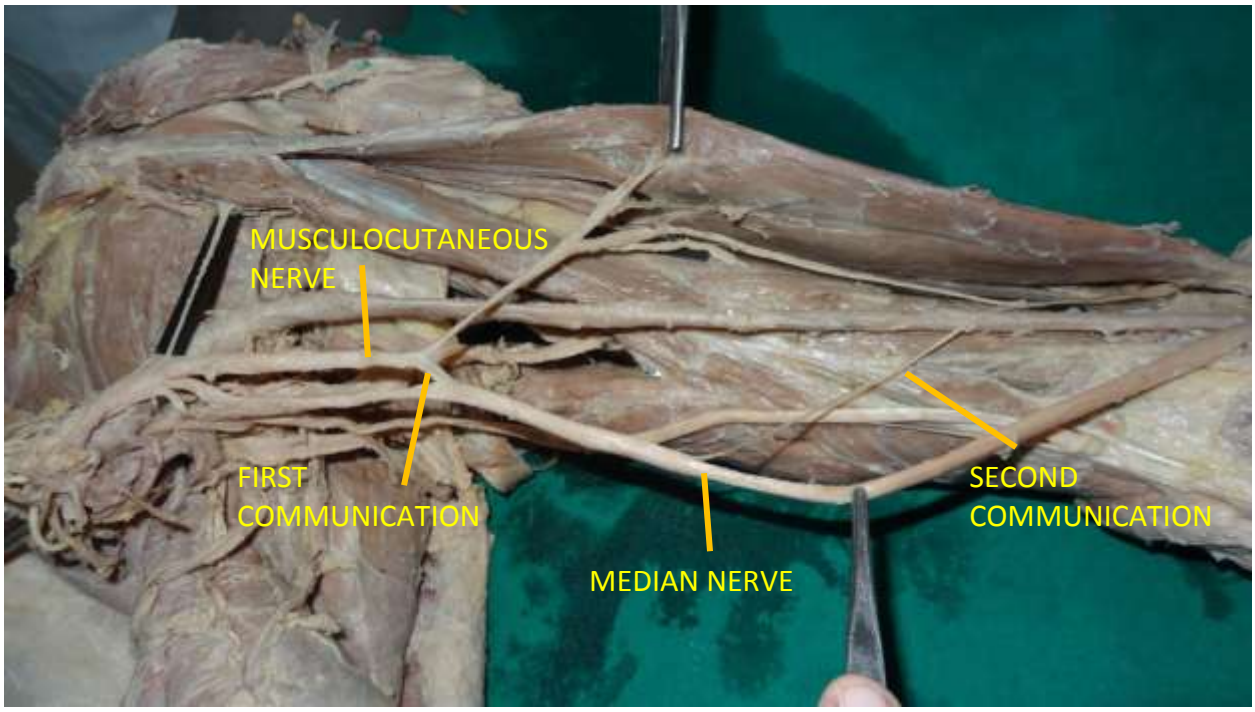

Figure 3: Type 3 communication between median and musculocutaneous nerves

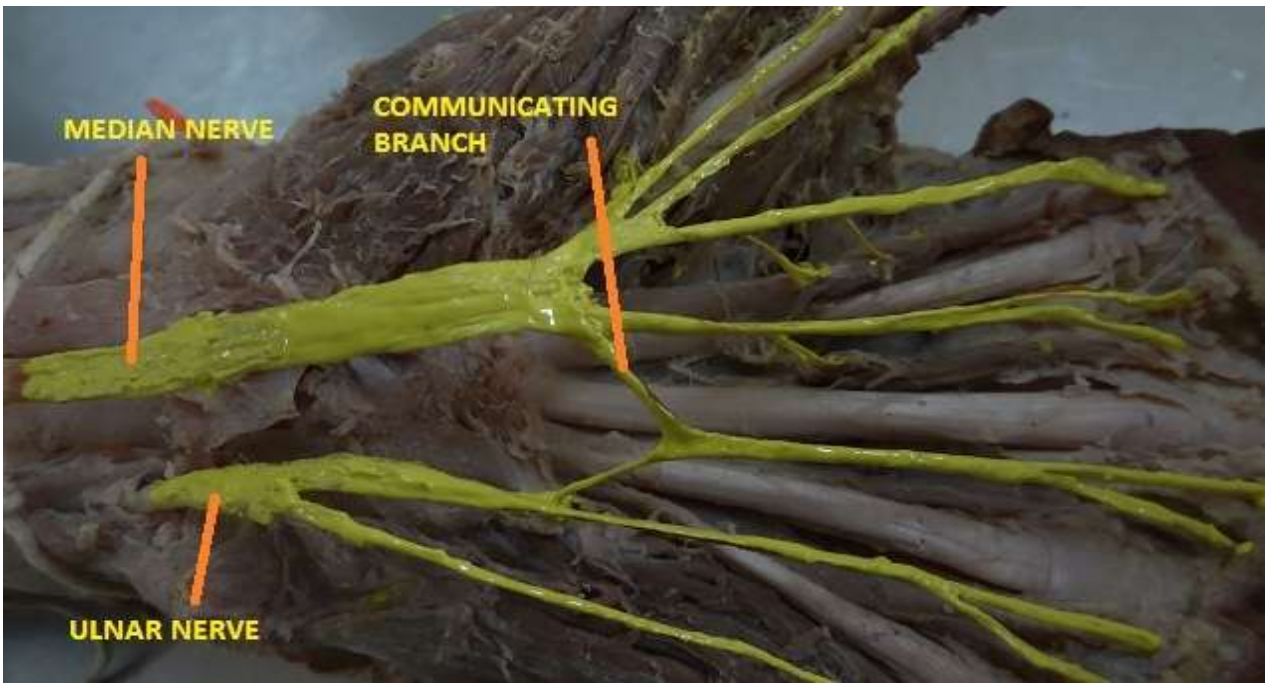

Figure 4: Berrettini anastomosis

Table 1: Table showing the types of communications between median and musculocutaneous nerves

S.No.	Type of communication	Number	Incidence
1.	Type 1	1	6.66%
2.	Type 2	11	73.33%
3.	Type 3	3	20%
4.	Type 4	-	-

Table 2: Table showing average cases with communication between median and ulnar nerves in palm

S.No.	Side	Number of cases and incidence
1.	Right palm	4 (40%)
2.	Left palm	6 (60%)

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