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The pattern of branching and intercommunications of the musculocutaneous nerve for surgical issues: anatomical study

Manal G. Al-Sobhi et al., Musculocutaneous nerve for surgical issues: anatomical study

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Abstract

Background: The aim of the present work was to provide evidence about the anatomical variations as regard the origin, distribution, and branching pattern of the musculocutaneous nerve (MCN).

Materials and methods: Brachial plexus was dissected in 40 upper limbs of 20 male adult cadavers. The pattern of the musculocutaneous nerve was photographed by a digital camera.

Results: The location and length of the nerve branches between left and right arms were recorded and statistically analyzed. In (90%) of specimens the MCN originates from the lateral cord of the brachial plexus, in (5%) it arose from the median nerve (MN), while in the remaining (5%) specimen, it was absent. The musculocutaneous nerve pierced the coracobrachialis muscle in 90% of specimens, and in the remaining (10%) did not pierce it.

The motor branches to biceps brachii muscle were categorized into: Type 1 (90%): one branch that divides to supply the two heads of biceps; Type 2 (5%): double branches, innervating each head of biceps separately. The motor branches to brachialis muscle were categorized into: Type 1 (82.9%): one branch; Type 2 (14.2%): double branches and Type 3 (2.9%): three branches that innervating brachialis muscle. Communications between the MCN and the MN were observed in 35% of specimens.

Conclusions: The knowledge of the common and uncommon musculocutaneous nerve variations is important especially to the surgeons for carrying out surgical procedures in axilla and arm.

Key words: brachial plexus, musculocutaneous nerve, axilla, median nerve, anatomical variations

INTRODUCTION

The brachial plexus is considered the most important part of the peripheral nervous system in the upper limb that has a wide range of variability in its formation, course, pattern of branches, intercommunications and classifications, its percentage of variations reach 12.8% [28]. It has been studied by many investigators since the ancient ages as its variations has critical clinical significance [19].

The musculocutaneous nerve begins at the level of the inferior border of the pectoralis minor muscle. Following the classical manuals, it arises as a terminal branch from the lateral cord of the brachial plexus and passes through the coracobrachialis, then between biceps brachii and brachialis muscles to supply them. After that, it continues as “the lateral cutaneous nerve of the forearm”, which is the cutaneous innervation along the lateral side of the forearm. The branch to brachialis muscle supplies also the elbow joint. So that the musculocutaneous nerve is responsible for motor innervations of the muscles of the anterior compartment of the arm and sensory supply to the skin of the lateral side of the forearm [20, 31].

Isolated musculocutaneous nerve injuries have been diagnosed and reported in a variety of clinical situations, including direct trauma to the anterior shoulder, fractures of the humerus and clavicle, abundant fracture callous formation, anterior shoulder dislocations, gunshot wounds, lacerations, and intravenous catheterization, also, some cases of musculocutaneous nerve palsy were reported after forceful exercise [21, 34]. The nerve is at risk both with open and arthroscopic procedures (especially anterior shoulder surgery) and can be stretched by retractor placement on the coracobrachialis muscle for exposure [13]. So, attention should be taken in shoulder surgeries (e.g., shoulder joint replacement), before placing a retractor on the medial side of the incision to retract the conjoined muscles and pectoralis major, it is essential to identify the musculocutaneous nerve to avoid it injury [22].

Variations of the musculocutaneous nerve and its branches are common, these variations have been described in human by many authors [14, 16, 23, 27, 29] ~~but such variations have not been extensively cataloged~~. This study was conducted to demonstrate the anatomical variations in the origin, course, distribution, and branching pattern of the musculocutaneous nerve in the axilla and arm and to define the intercommunications with the median nerve in the human male adult cadavers to prevent lesions during surgical procedures.

MATERIALS AND METHODS

This study was conducted after the approval from the Unit of Biomedical Ethics Research Committee in Faculty of Medicine, King Abdulaziz University, Saudi Arabia. All methods and techniques used during carrying out the research were in accordance with the protocol approved above. The present study was carried out on 40 upper limbs of 20 male adult cadavers fixed in 10% formalin. Preserved cadavers obtained from the dissection room of the Anatomy Department, Faculty of Medicine.

The brachial plexus was dissected carefully with special concern to the exposure and topographic localization of the musculocutaneous nerve regarding the variations of its origin, course, and branching pattern. These findings were photographed using a digital camera (Canon-EOS-650D, made in Japan). In addition, a Vernier caliper was used to measure the length of the musculocutaneous nerve and its branches. The musculocutaneous nerve was traced from the coracoid process to the lateral epicondyle of the humerus. The musculocutaneous nerve was studied as regards its branches, distribution, and communication with other nerves especially the median nerve. The branches arising from the musculocutaneous nerve to innervate the biceps and brachialis muscles were identified and studied regarding their number, site of exit, length, and variations. Various univariate analyses were used to assess each variation, to clarify some of the relationships between the variables. All data were analyzed using SPSS version 23.

RESULTS

40 upper limbs of 20 cadavers were studied, the brachial plexus was dissected, and the musculocutaneous nerve was studied on both right and left upper extremities. Several variations in the course and the branching pattern of the musculocutaneous nerve were observed.

Origin of musculocutaneous nerve:

In 38 (18 right & 20 left) (95%) out of 40 upper limb specimens, the musculocutaneous nerve (MCN) was appearing from the lateral cord of the brachial plexus as described in the classical manuals (Fig. 1), in only one arm (right) (2.5%) MCN arose from the median nerve (Fig. 2), while in the remaining arm (right) (2.5%) it was absent (Fig. 3). Regarding the coracoid-lateral epicondyle distance it was approximated in both right (29.17±2.45 cm) and left (29.31±2.15 cm) upper limbs (Table 1).

Relations of musculocutaneous nerve with the muscles of the arm:

Coracobrachialis muscle:

In 26 (14 right & 12 left) (65%) of the specimens, the musculocutaneous nerve entered the upper part of coracobrachialis muscle (Fig. 4), while in four (2 right & 2 left) (10%) it entered its middle part (Fig. 5, 6), in another four (1 right & 3 left) (10%) it entered the lower part of the muscle (Fig. 7), and in two specimens (left) (5%) it entered the upper part of the coracobrachialis muscle and gives a branch to biceps muscle, then the main trunk entered again the lower part of the muscle (Fig. 8). While in the remaining four specimens (3 right & 1 left) (10%) the MCN did not enter the coracobrachialis muscle, in this case an isolated branch originated from the lateral cord of the brachial plexus and pierced the coracobrachialis muscle to supply it instead of the MCN (Fig. 2, 9). Average distance (cm) from coracoid process to coracobrachialis muscle was approximated in both right (7.71±1.23) and left (7.78±2.01) arms, representing a percentage of coracoid-lateral epicondyle distance equal to (26.39±3.22) in right arm and (26.47±5.88) in left arm (Table 1).

Biceps & brachialis muscles:

In 35 (15 right & 20 left) (87.5%) out of 40 specimens, the branches of the musculocutaneous nerve that innervate the biceps and brachialis muscles arose from it after it leaves the coracobrachialis muscle (Figs. 4). In five specimens (right) (12.5%) the branches to both biceps and brachialis muscles, along with the lateral cutaneous nerve of the forearm, arose from the median nerve itself (Fig. 2, 3).

Distribution of musculocutaneous nerve:

Patterns of the branches supplying the biceps brachii muscle (35 specimens):

The average distance (cm) from the coracoid process to emergence of motor branches to both short and long heads of biceps brachii muscle is shorter; statistically non-significance; in the right (12.14±2.56) than the left (12.72±2.18) arms, representing a percentage of coracoid-lateral epicondyle distance which is also shorter; statistically non-significance; the right (41.29±6.24) than that in the left (43.44±6.93) arms (Table 1). Regarding the length of branches to the short head of biceps brachii it is shorter; statistically non-significance; in the left (3.22±1.02) than in the right (3.47± 0.91) arms (Table 2). Also, the length of branches to the long head of biceps brachii is shorter; statistically non-significance; in the left (3.88±1.36) than in the right (4.27± 1.23) arms (Table 2). So, the length of branches to short head of biceps brachii are shorter than that of long head without statistically significance difference (Table 2).

Two anatomical variations were observed for the innervation of the biceps brachii muscle in this study:

Type 1: A solar branch from the musculocutaneous that is divided to supply the two heads of the biceps muscle individually; seen in 33 (14 right & 19 left) (94.3%) of studied arms. Type 2: In two limbs (1 right & 1 left) (5.7%), two separate branches arose from the musculocutaneous, one to supply the long head while the other one to supply the short head of the biceps. There was an additional branch innervating the distal part of the long head of biceps (Fig. 2).

Patterns of the branches supplying the brachialis muscle (35 specimens):

The average distance (cm) from the coracoid process to emergence of motor branches innervating the brachialis muscle is shorter; with statistically significant difference $P<0.05$; in the right (15.38±3.39) than the left (17.19±3.93) arms, representing a percentage of coracoid-lateral epicondyle distance which is also shorter; with statistically significant difference $P<0.05$; in the right (52.34±8.62) than that in the left (58.15±11.04) arms (Table1).

Regarding the length of branches to brachialis muscle it is shorter; statistically non-significance; in the left (5.04±1.2) than in the right (5.35± 1.86) arms (Table 2).

Three types of anatomical variations were observed:

Type I: It is found in 29 specimens (19 right &10 left) (82.9%) of arms, where there was a single branch innervating the brachialis muscle from the main trunk of MCN (Fig. 9).

Type II: In five specimens (4 right & 1 left) (14.2%) of arms, there were two branches that innervate the brachialis muscle from the main trunk of MCN (Fig. 10, 11).

Type III: In one right specimen (2.9%) of arms, three branches innervating the brachialis muscle, these branches originated also from the main trunk of MCN. (Fig. 6)

Patterns of communication between musculocutaneous and median nerves:

This communication was observed in 24 (11 right & 13 left) (60%) out of 40 specimens. The average distance (cm) from the coracoid process to emergence of communicating branch to Median nerve is shorter; statistically non-significance; in the right (11.73±4.13) than the left (13.07±2.79) arms, representing a percentage of coracoid lateral epicondyle distance which is also shorter; statistically non-significance; the right (42.22±8.43) than that in the left (44.47±8.36) arms (Table 1).

The communicating branches were categorized based on their origin from the musculocutaneous nerve and its union with the median nerve:

There are three different types of communications:

Type A: The proximal part of the MCN sharing a common trunk with the proximal part of the median nerve. This finding was observed in four specimens (3 right & 1 left) (16.7%) (Fig. 9).

Type B: The proximal part of the musculocutaneous nerve gives a communicating branch to join the middle part of the median nerve, it was observed in six specimens (2 right & 4 left) (25%) (Fig. 12). In two arms (1 right & 1 left) (8.3%), of the previous specimens, a branch arising from this communication supplying the brachialis muscle (Fig. 8).

Type C: In the remaining twelve specimens (4 right & 8 left) (50%), within the coracobrachialis muscle, a communicating branch arose from the middle part of the musculocutaneous nerve to join the middle part of the median nerve (in eight specimens) and joined the distal part of the median nerve (in other four specimens) (Fig. 5, 7, 11).

DISCUSSION

Embryologically, the limb buds are developed from the lateral plate of the mesoderm and the mesenchyme of those buds discriminate into the deep structures of the limbs, whereas the axons of the peripheral nerves develop in a distal direction from the ectoderm to reach the muscles and skin [11]. The somite migration led to formation of the extremities, where they bring their own nerve supply, so every dermatome and myotome keeps the original segmental innervation. During somite migration, some of the nerves come into close proximity and fuse in a particular pattern, forming a plexus early in fetal life [1-2]. The existence of anatomical neuromuscular variations maybe due to different factors that enhance the pathway of muscle formation in the limbs. Factors guiding nerve growth are chemo-attractive and repellent that control cellular proliferation to proper tissue formation. Butz et al. [6] stated that signaling mechanisms during embryogenesis could have a role during the 5th week of gastation, the axons of spinal nerves propagate distally to reach the mesenchyme of the limb, and insufficient signaling may negatively impact the normal formation of the brachial plexus. This embryological clarification justifies what we observed in our finding.

The anatomical variations from the expected pattern of peripheral nerve course and relations can be a challenge for the surgeons. In the arm, variations of the nerves that innervate the anterior compartment (musculocutaneous, median, and ulnar nerves) are more common than those of the posterior compartment [7, 25].

MCN is a terminal branch of the brachial plexus, which provides the chief motor innervation for the arm flexors besides the sensory innervation for the lateral side of the forearm. In the present study, MCN originated from the lateral cord of the brachial plexus in 90% of cases while from the median nerve in only 5% of cases. These findings were in agreement with Bergman et al. [4], who reported that this nerve arose from the lateral cord in (90.5%), but on the contrary to this study they found that the MCN arose from the median nerve in only (2%) of specimens. Moreover, they reported that it might be doubled, unusually short or absent.

In the present study, the MCN was found to be absent in 5% of cases. The absence of the musculocutaneous nerve was reported by many anthers in previous studies [27, 29].

In particular, a case study was similar to the present study, in that the motor nerve to the coracobrachialis muscle arose from the lateral cord, while the motor nerve to the biceps brachii and brachialis muscles arose from the MN [15].

Variable pathways and relations of the musculocutaneous nerve within the coracobrachialis muscle were described. Ozturk et al. [24] stated that the musculocutaneous nerve pierced the coracobrachialis muscle in all studied 42 specimens of upper limb, whereas Pacha Vicente et al. [26] and Eglseder and Goldman [10] observed that the musculocutaneous nerve did not enter the coracobrachialis muscle in 29.6% and 6.5% of their samples respectively. Furthermore, Macchi et al. observed a range of differences in the entry site of the musculocutaneous nerve into the coracobrachialis muscle, and that was correlated with a low variability in the exit site of the nerve from the muscle [19]. However, the exit point was positively related to the length of the muscle. Choi et al. stated that the musculocutaneous nerve penetrated the coracobrachialis muscle at a lower level in a single arm but did not pierce it in 4.7% of the specimens [8]. Uysal et al. observed that the MCN pierced the upper part of the coracobrachialis muscle in 43% of studied limbs and its middle part in 37% and its lower part in 17%, while it did not pierce it in only 3% of samples [32]. In the present study, the musculocutaneous nerve pierced the upper part of coracobrachialis muscle in 65% of the specimens, while in only 10%, it pierced its middle part and in another 10% it pierced its lower part. In only 5% of specimens, it entered the upper part of the coracobrachialis muscle and gives a branch to biceps muscle then the main trunk entered again the lower part of the muscle. While in the remaining 10% of specimens, the MCN did not penetrate the muscle.

These observations demonstrated the relations between the MCN and the coracobrachialis muscle. Furthermore, it shows the probability of nerve injury particularly when the upper and middle parts of the coracobrachialis muscle are exposed to trauma.

Earlier studies revealed the appearance of the MCN using ultrasound. Schafhalter-Zoppoth and Gray observed that if this nerve was not visible in the coracobrachialis muscle, it was probably fused with the median nerve, later it is separated from it [30]. The MCN innervates the coracobrachialis and the biceps brachii, plus the majority of brachialis muscle. The branch supplying the coracobrachialis arose from the musculocutaneous nerve prior to piercing the muscle, while the branches supplying the biceps and brachialis muscles originating from it after its exit from the muscle (18, 30].

The significance of the nerves supplying the biceps and brachialis in the surgeries of the brachial plexus has been extensively acknowledged [26]. In a previous study on the branches of the musculocutaneous nerve to both biceps and brachialis muscles; it was stated that there are three types of the innervation pattern to biceps muscle observed in 24 studied cadavers [35]. Type I, one main branch arose from the main trunk of the musculocutaneous nerve distal to the coracobrachialis muscle and consequently divided into two branches to supply each (short & long) heads of the biceps muscle. Type II, two main branches for each head of the biceps separately, the proximal branch for the short head and the distal one for the long head of the muscle. Type III, two main branches; a proximal branch gives two subdivisions, each one to supply a head of the biceps muscle, plus a distal one to supply the common belly. A study found Type I in 83.3% of cases while in this study it was found in 95.5% of cases [35], while in Pacha Vicente's findings, it was 60.5% [26]. Type II and III were stated in 8.3% and 8.3% of cases respectively by Yang et al. [35], while it was 27.9% and 11.6% respectively by Pacha Vicente et al. [26]. In 5% of specimens in this study, there was no example found of Type III branching pattern to the biceps that was defined by Elgammal et al. [12], which was three isolated main branches: first to long head, second to short head and the third one to the common belly.

The measurements that were carried on the exit point of the first branch to biceps and brachialis muscles are specified in past reports [12]. In this study the methodology described by Yang et al. and Elgammal et al. was applied, which uses the coracoid process of the scapula and the medial epicondyle of the humerus as reference points for these measurements was followed [12, 35].

Yang et al. observed two innervation patterns of the brachialis muscle (Type I showing one main branch, and Type II showing two main branches). The type II innervation pattern was demonstrated in 8.4%, in the present study, but it was 4.2% of the samples of Yang et al. while 27.9% of the samples of Pacha Vicente [16, 26, 35]. An additional type to those described by Yang et al. was seen in a single specimen (5%) in this study, where there were three branches innervating the brachialis muscle, these branches originated also from the main trunk of MCN [9, 14, 35].

Intercommunications between the MCN and MN had an important clinical significance, especially in relative to the accurate explanation of clinical neurophysiology, realizing the anatomy of the anterior shoulder repairs after trauma, and recognizing the dysfunction of median and musculocutaneous nerves [8-9]. The frequency of these communications has been reported to differ between 5% and 46.4% [23]. Interestingly, a case was reported in a cadaver showing that the MCN gives a third root to form the MN [6]. Although intercommunicating branches most commonly originates from the musculocutaneous nerve and joined the median nerve, both reported incidents where the intercommunicating branch originates from the median nerve and joined the musculocutaneous nerve [18, 26]. In the present study, the reverse was observed; the intercommunicating branch arose from the MCN and joined the MN in 35% of arms.

Similar to Uysal et al., a branch originating from the communicating branch between the musculocutaneous nerve and the median nerve to the brachialis was seen in this study in only a single arm [16, 32].

Choi et al. detected that in 26.4% of cases, there was communicating branches or fusion of the MCN and MN [8, 16]. The communicating branches were classified into three patterns; 1st pattern (19.2%) revealed merging of the musculocutaneous nerve and median nerve, 2nd pattern (74%) had one branch communicating between the musculocutaneous nerve and median nerve, while 3rd pattern (6.8%) had two branches communicating between the two nerves. It has been also described that the communicating branch originated from the musculocutaneous nerve proximal to the entry point to the coracobrachialis muscle in 29.4%, through the muscle in 2%, distal to it in 54.9%, and from it as the MCN did not enter the muscle in 13.7% of cases [8, 14].

On the other hand, Venieratos and Anagnostopoulou studied 22 specimens and they categorized the communicating branches into three types: (Type I) proximal to the entry point of the musculocutaneous nerve into the coracobrachialis in 9 specimens, (Type II) distal to coracobrachialis in 10 specimens, and (Type III) beyond coracobrachialis in 3 specimens [23, 33]. In this work, the communicating branches between the musculocutaneous nerve and median nerve were observed and categorized into three types according to where they arose and merged the respective nerves.

Type A: The proximal part of the MCN sharing a common trunk with the proximal part of the MN in only one specimen (14.2%), Type B: The communicating branch arose from the proximal part of the musculocutaneous nerve to merge the middle part of the median nerve in two specimen (28.4%) and in Type C (57.2%), the most observed type, the communicating branch arose from the middle part of the musculocutaneous nerve within the coracobrachialis muscle to merge the middle part of the median nerve, these observation was in agreement with findings of Ballesteros et al. [3]. These finding were in the contrary to Nascimento et al. who stated that the point of joining the MCN with the MN is distal to the coracobrachialis muscle in Type II, and Type III, where neither the nerve nor the communicating branch pierce the coracobrachialis muscle [3, 5].

The site of nerve communication and the number of branches that originate from the musculocutaneous nerve to merge the median nerve may change the clinical symptoms and case progression along with management. Therefore, these differences should be considered during the clinical examination and treatment of traumatic injuries to upper limb.

CONCLUSIONS

The presented data in our work that demonstrate the branches of the musculocutaneous nerve are significant for surgical doctors who performe operational procedures in the axilla and upper arm region.

CONFLICT OF INTEREST the authors declare that they have no conflict of interest.

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Table 1: Location of branches of musculocutaneous nerve in the arm

	Right Arm "mean±SD"	**Left Arm** "mean±SD"
Coracoid-lateral epicondyle distance (cm)	29.17±2.45	29.31±2.15
Average distance from coracoid process to coracobrachialis muscle (cm)	7.71±1.23	7.78±2.01
Average distance from coracoid process to coracobrachialis muscle as %	26.39±3.22	26.47±5.88

of coracoid-lateral epicondyle distance		
Average distance from coracoid process to emergence of nerves supplying Biceps brachii muscle (cm)	12.14±2.56	12.72±2.18
Average distance from coracoid process to emergence of nerve(s) supplying Biceps brachii muscle as % of coracoid-lateral epicondyle distance	41.29±6.24	43.44±6.93
Average distance from coracoid process to emergence of nerves supplying Brachialis muscle (cm)	15.38±3.39	17.19±3.93*
Average distance from coracoid process to emergence of nerve(s) supplying Brachialis muscle as % of coracoid-lateral epicondyle distance	52.34±8.62	58.15±11.04*
Average distance from coracoid process to emergence of communicating branch to Median nerve (cm)	11.73±4.13	13.07±2.79
Average distance from coracoid process to emergence of communicating branch to Median nerve as % of coracoid-lateral epicondyle distance	42.22±8.43	44.47±8.36

Student t-test:

* $P<0.05$ compared to the right side.

Table 2: Length of musculocutaneous nerve branches in the arm

Length of motor branch supplying	**Right Arm** "mean±SD"	**Left Arm** "mean±SD"
Long head of Biceps brachii muscle	4.27±1.23	3.88±1.36
Short head of Biceps brachii muscle	3.47±0.91	3.22±1.02
Brachialis muscle	5.35±1.86	5.04±1.21

Figure 1. A photograph of the left axilla and arm showing the normal origin of musculocutaneous nerve (MCN): It arises from the lateral cord (LC) of the brachial plexus and piercing the coracobrachialis muscle (cb); MN: median nerve, UN: ulnar nerve, MC: medial cord.

Figure 2. A photograph of the right axilla and arm showing, the musculocutaneous nerve (MCN) arising from the lateral root (LR) of the Median nerve (MN). MCN gives 3 branches; 1 to brachialis (br), 2 to short head of biceps (S), and 3 to long head (L) and then continues as lateral cutaneous nerve of the forearm (LCN). Additional branch to (L) from nerve to brachialis muscle (arrow).

Figure 3. A photograph of the right axilla and arm showing, the absence of musculocutaneous nerve. The median nerve (MN) gives 2 branches; 1 supplying biceps (B) muscle and 2 supplying brachialis (bbr) muscle and then continues as lateral cutaneous nerve of the forearm (LCN). Lateral cord (LC) gives (bcb) branch to coracobrachialis muscle.

Figure 4. A photograph of the right axilla and arm showing, the musculocutaneous nerve (MCN) entered the superior part of the coracobrachialis muscle (Cb). It gives branch 1 which bifurcates to supply biceps (B) muscle. It gives also communicating branch (arrowhead) with the median nerve (MN).

Figure 5. A photograph of the left axilla and arm showing, the musculocutaneous nerve (MCN) gives a communicating branch (C) which pierces coracobrachialis (Cb) muscle to join the median nerve (MN). MCN supplies brachialis muscle (br) by only one branch (arrow).

Figure 6. A photograph of the right axilla and arm showing, the musculocutaneous nerve (MCN) gives (bb) branch which bifurcates into a and b branches to supply short (S) and long (L) heads of biceps muscle and gives also 1,2,3 to supply brachialis muscle (br) then continues as lateral cutaneous nerve of the forearm (LCN); Cb: coracobrachialis muscle.

Figure 7. A photograph of the left axilla and arm showing, the musculocutaneous nerve (MCN) gives 3 branches (a) to biceps (bs), (b) to brachialis and (C) communicating with the median nerve (MN); UN: ulnar nerve, Cb: coracobrachialis.

Figure 8. A photograph of the left axilla and arm showing, the musculocutaneous nerve (MCN) gives branch 1 to supply biceps muscle (bs) muscle and communicating branch (C) to join the median nerve (MN) which gives (B1) to supply brachialis (br) muscle. The main trunk of MCN gives (B2) to supply also (br) muscle, then continues as lateral cutaneous nerve of the forearm (LCN); cb: coracobrachialis muscle.

Figure 9. A photograph of the right axilla and arm showing, the musculocutaneous nerve (MCN) joins the median nerve (MN) by a short trunk (arrow). MCN gives branch 1 to biceps (B) and bbr branch to brachialis (br) muscle and continues as lateral cutaneous nerve of the forearm (LCN); UN: ulnar nerve.

Figure 10. A photograph of the right axilla and arm showing, the musculocutaneous nerve (MCN) gives branch 1 which bifurcates to supply short (S) and long (L) heads of biceps muscle and branches 2 & 3 to supply brachialis (br) muscle; cb: coracobrachialis muscle, LCN: lateral cutaneous nerve of forearm.

Figure 11. A photograph of the right axilla and arm showing, the musculocutaneous nerve (MCN) gives a communicating branch (C) to join the median nerve (MN) at the distal part of the arm and supplies brachialis muscle (br) by 2 branches a and b.

Figure 12. A photograph of the right axilla and arm showing, the musculocutaneous nerve (MCN) gives a communicating branch (C) to join the median nerve (MN) before piercing the coracobrachialis muscle (cb).

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MC
MN
UN


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2
br
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1
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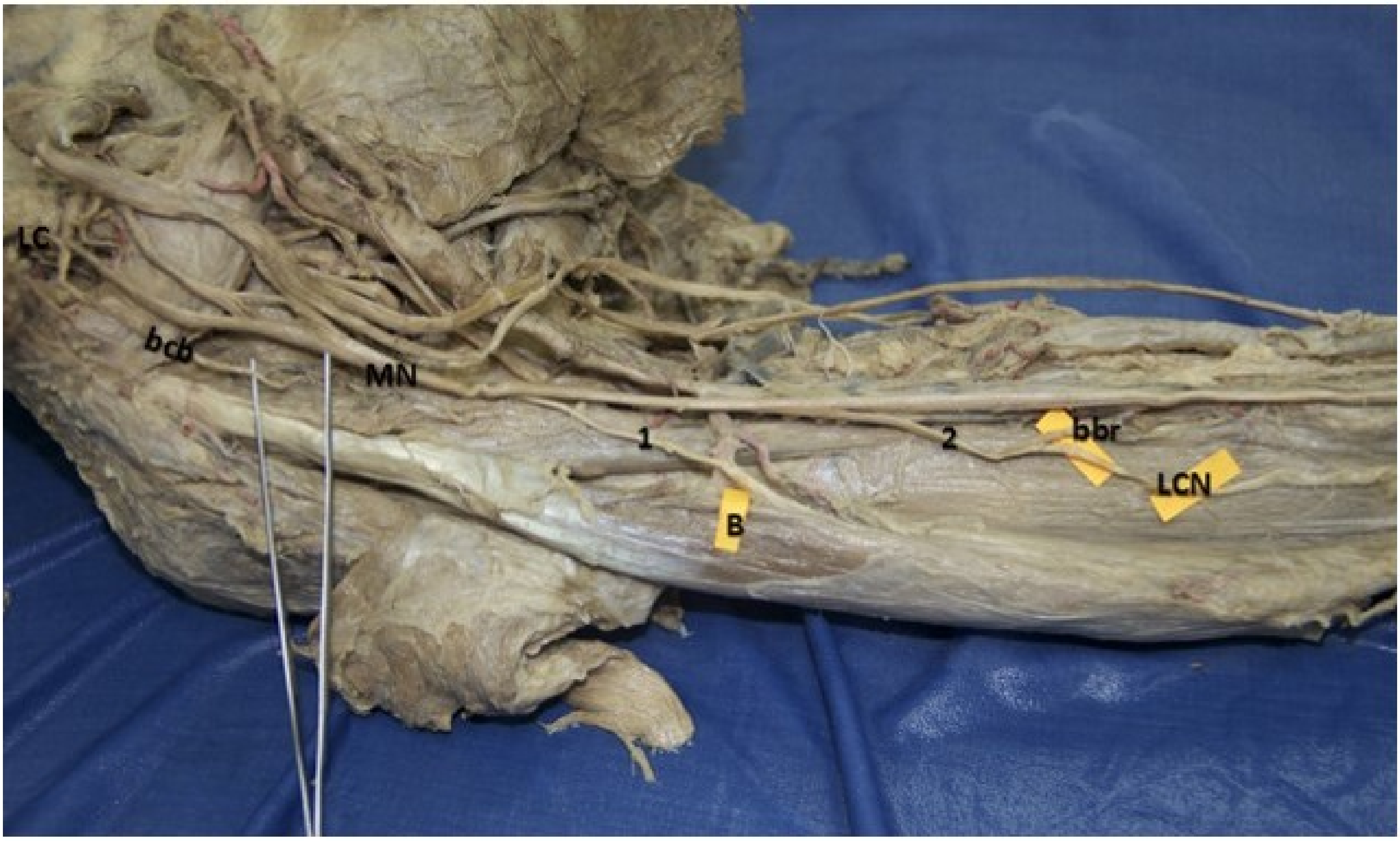
LR



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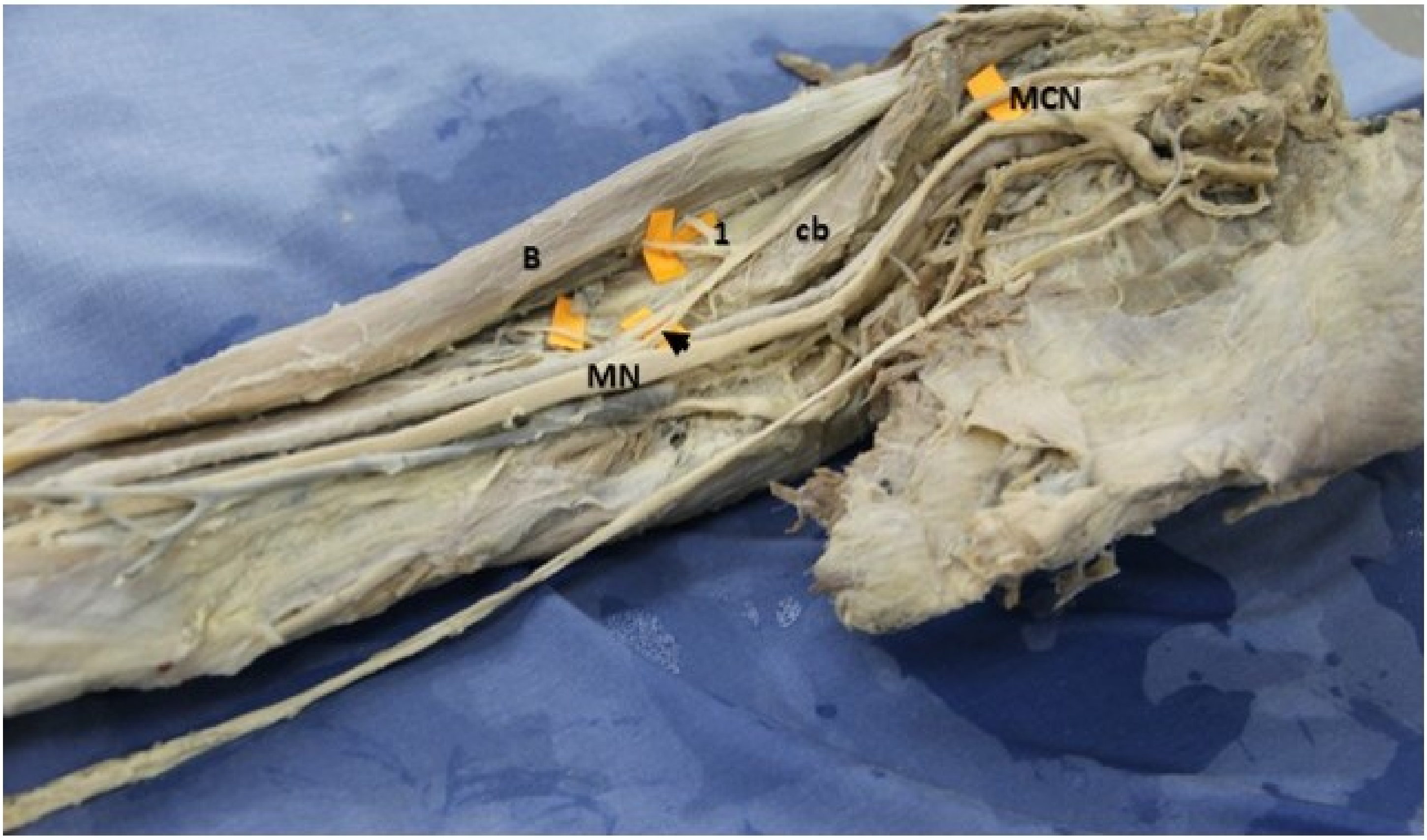
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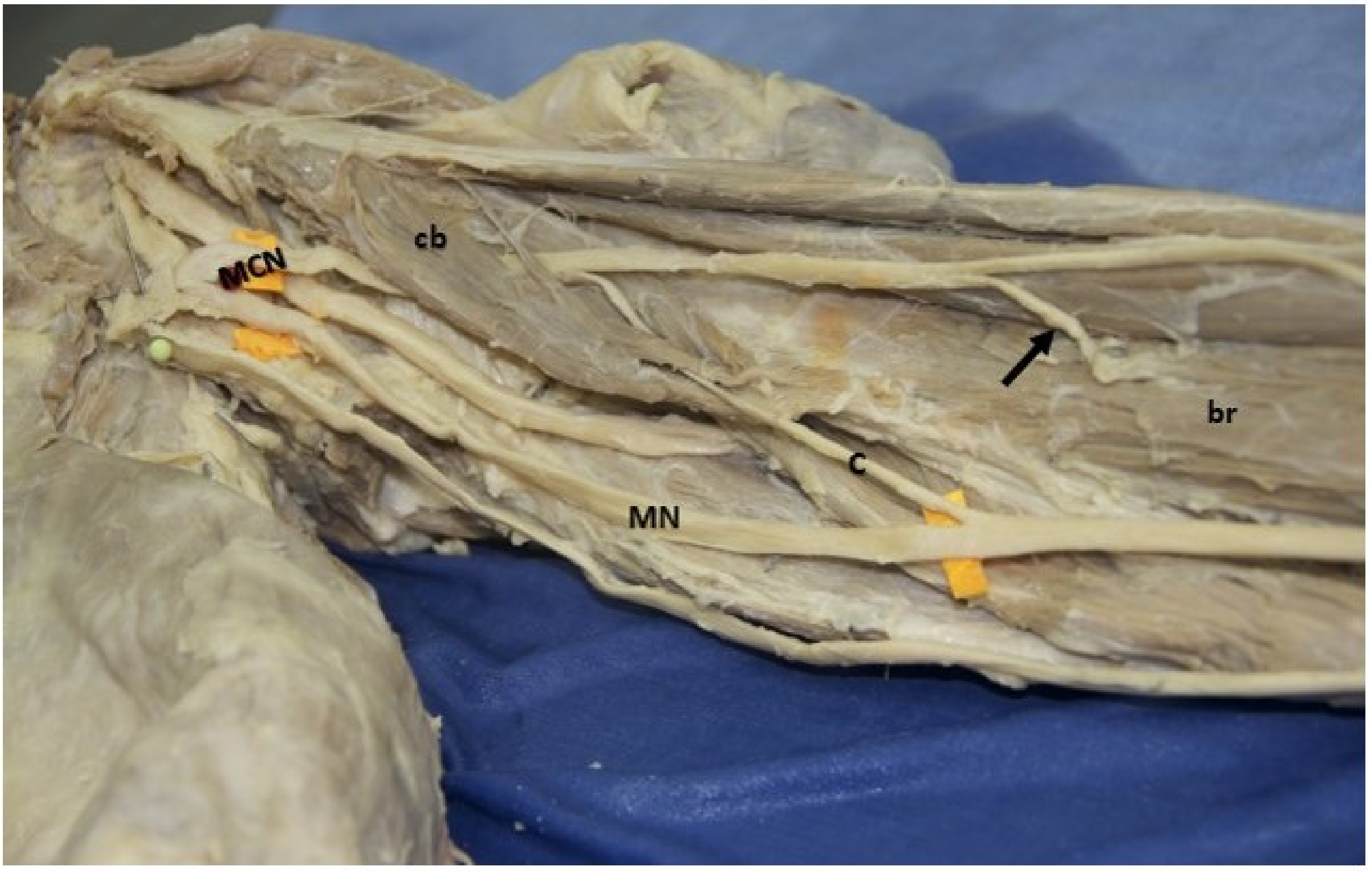
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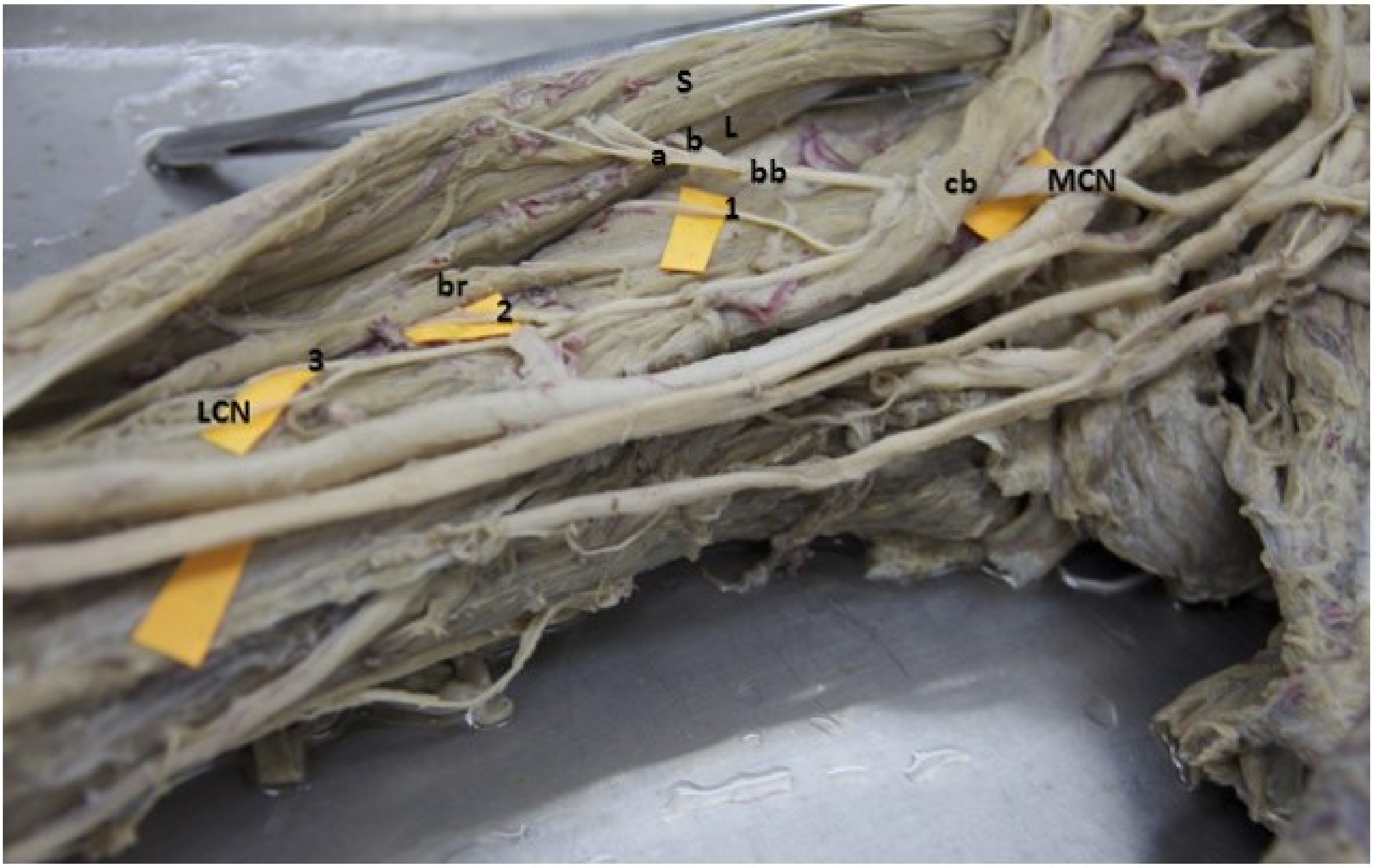

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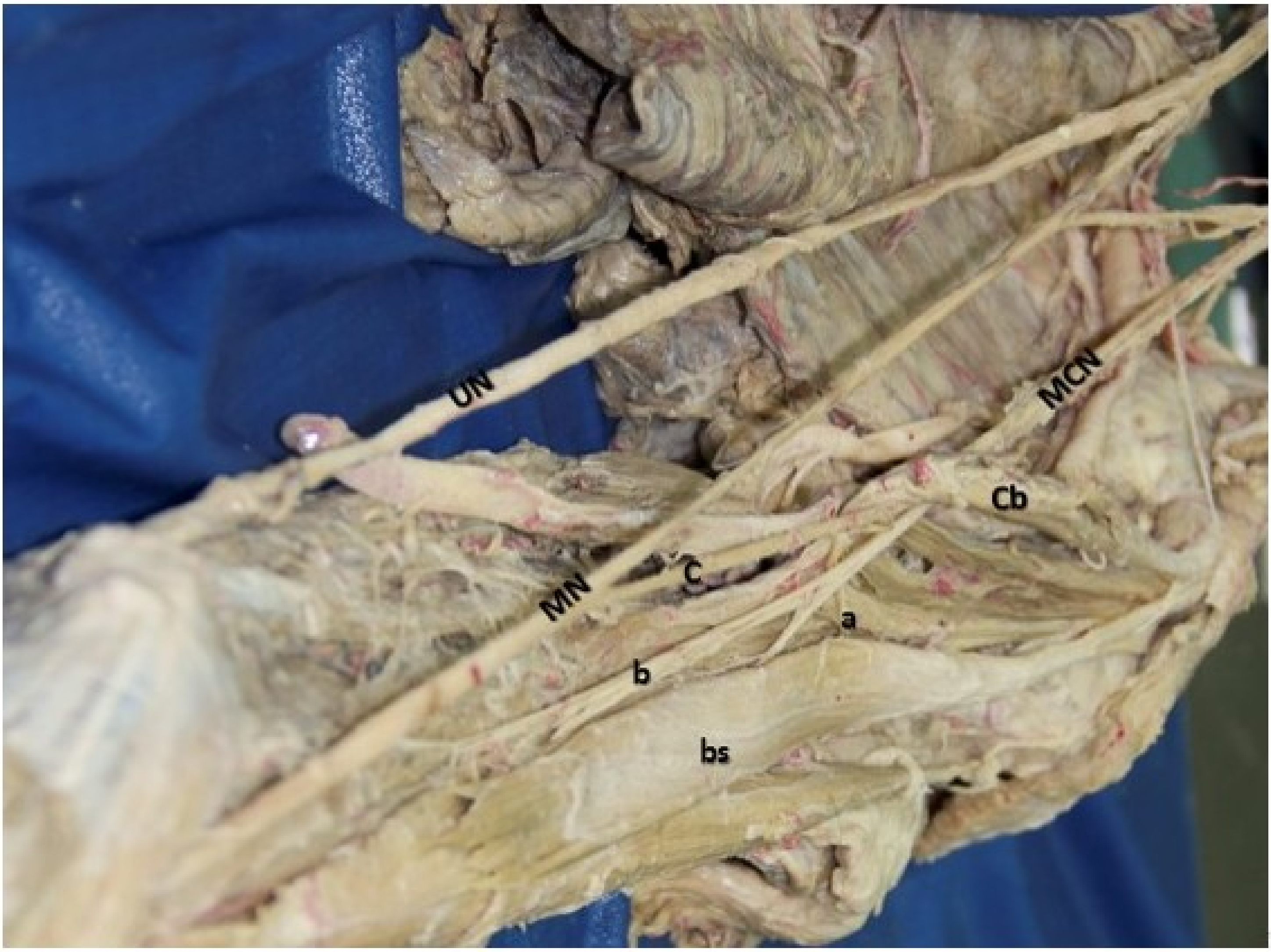
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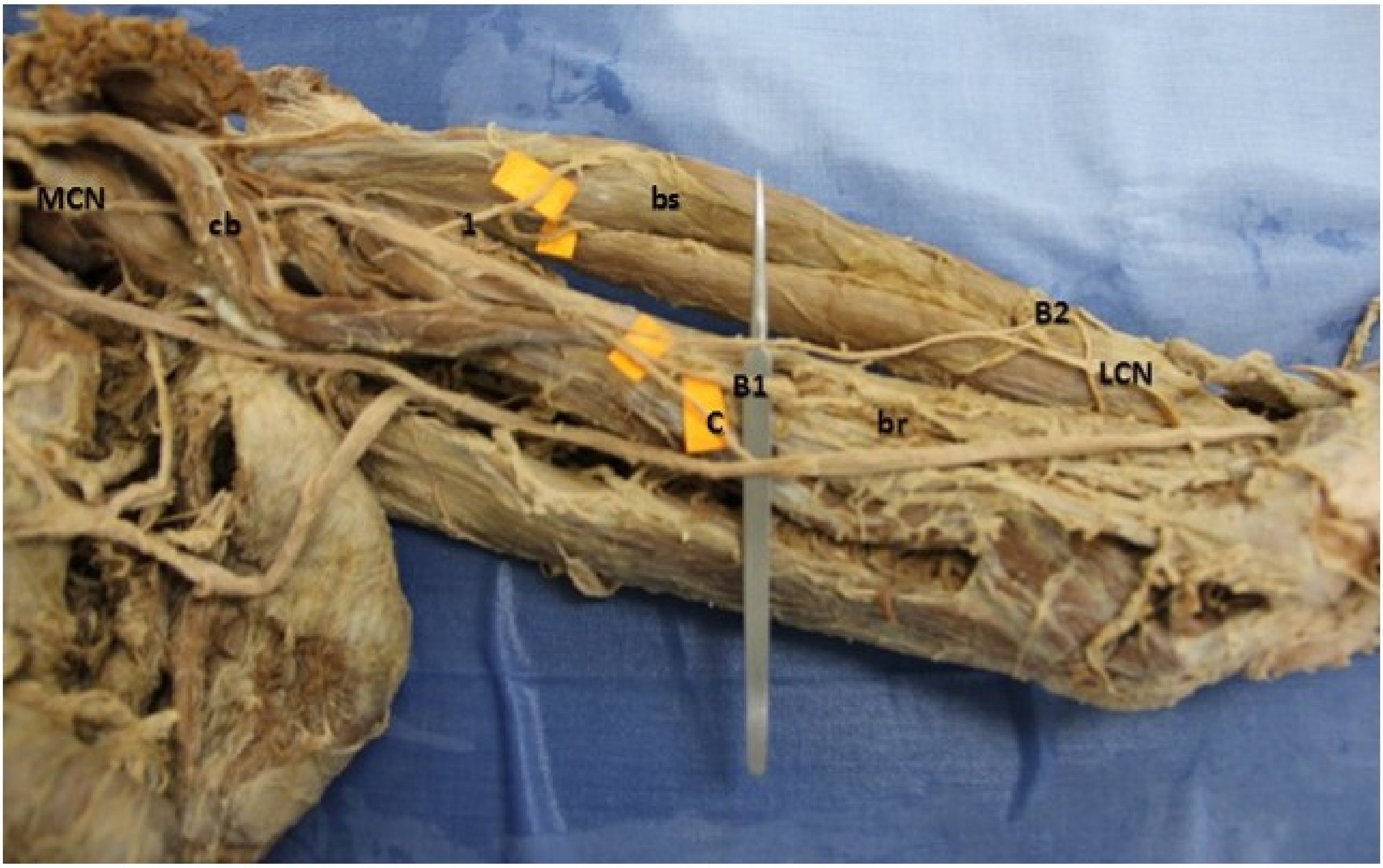
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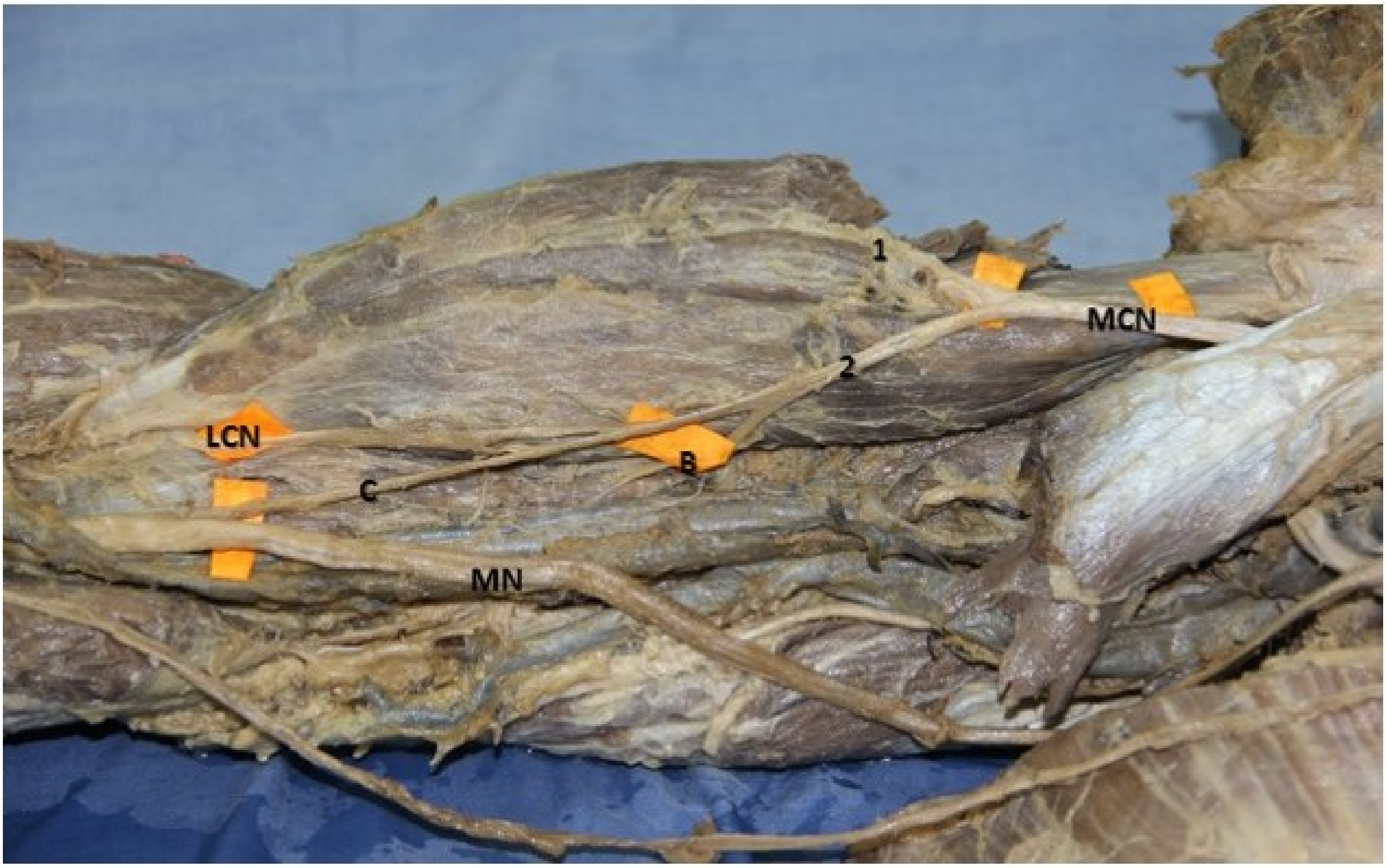
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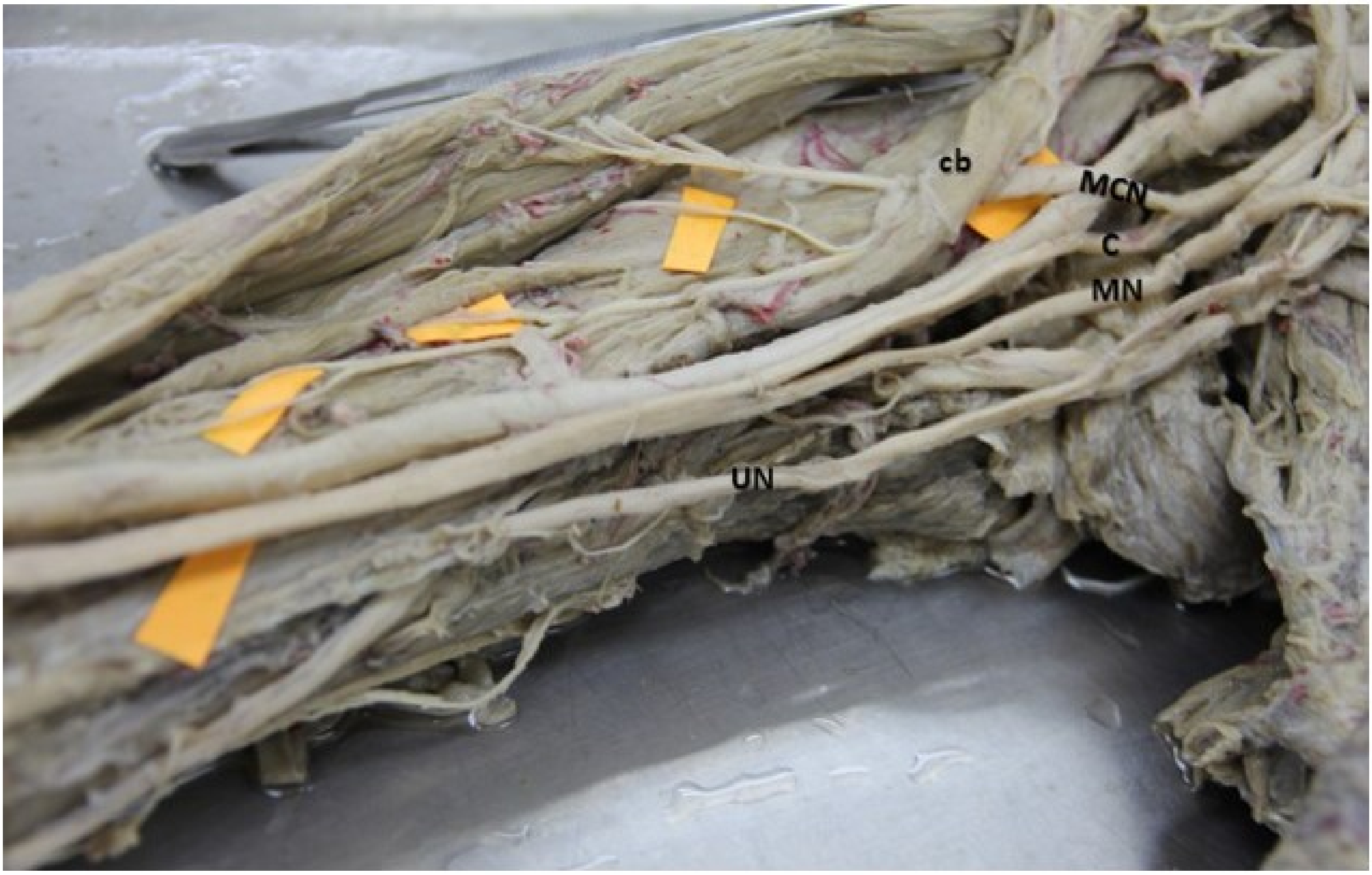
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