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## Bilateral absence of the musculocutaneous nerve: implications for humerus fracture and atypical median nerve palsy

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**Abstract:** The absence of the musculocutaneous nerve represents a failure of the nerve to depart from the median nerve during early development. During a routine dissection of a 66-year-old white female cadaver, a bilateral absence of the musculocutaneous nerve was observed in the upper limbs. Muscles of the anterior flexor compartments of the arms including biceps brachii and brachialis were supplied by branches of the median nerve. The lateral cutaneous nerve of the forearm also branched from the median nerve. In a clinical case of a particularly high median nerve injury, a variation of an absent musculocutaneous nerve may not only result in typical median nerve palsy of the forearm and hand, but palsy in the arm that would manifest as deficiencies in both shoulder and elbow flexion as well as cutaneous sensory loss from the lateral forearm.

**Keywords:** anatomy, anatomical variation, brachial plexus, musculocutaneous nerve, median nerve.

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### Introduction

The musculocutaneous nerve arises from the lateral cord of the brachial plexus; provides motor innervation to the coracobrachialis, biceps brachii, and brachialis muscles (anterior flexor compartment of arm); provides sensory innervation to the lateral forearm by way of the lateral cutaneous nerve of the forearm; and carries mixed motor and sensory fibers from C5, C6, and less commonly C4 and C7 spinal cord levels [1].

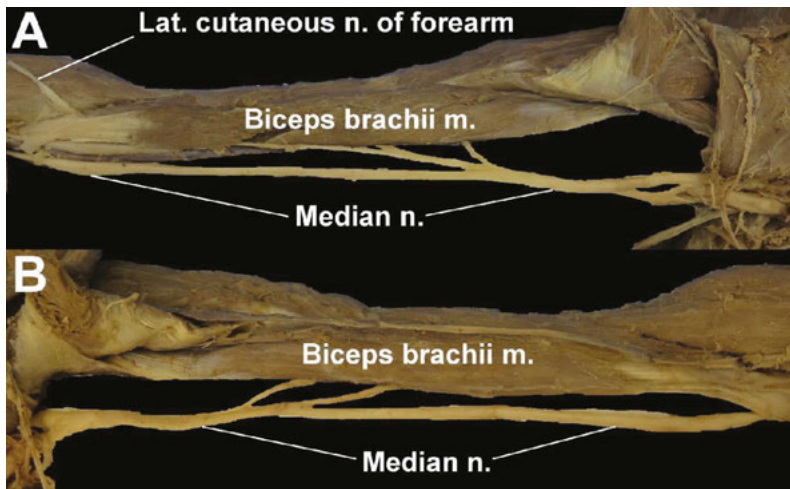
The median nerve arises from the lateral and medial cords of the brachial plexus; provides motor innervation to the pronator teres, palmaris longus, flexor carpi radialis, flexor digitorum superficialis, flexor pollicis longus, half of flexor digitorum profundus, and pronator quadratus muscles (anterior flexor compartment of forearm); provides motor innervation to thenar compartment and first two lumbricals of the hand; provides sensory innervation to lateral two-thirds of the palmar side of hand; and carries mixed motor and sensory fibers from C6-T1 and less commonly by C5 spinal cord levels [1].

The most common variation of the musculocutaneous nerve is that of a communicating branch joining the musculocutaneous nerve to the median nerve. A less common variation is the absence of the musculocutaneous nerve [1]. Because the absence of the musculocutaneous nerve is a relatively rare brachial plexus variation, it is particularly important to understand the salient anatomical detail regarding musculocutaneous nerve absence in order to eschew unforeseen clinical confusion.

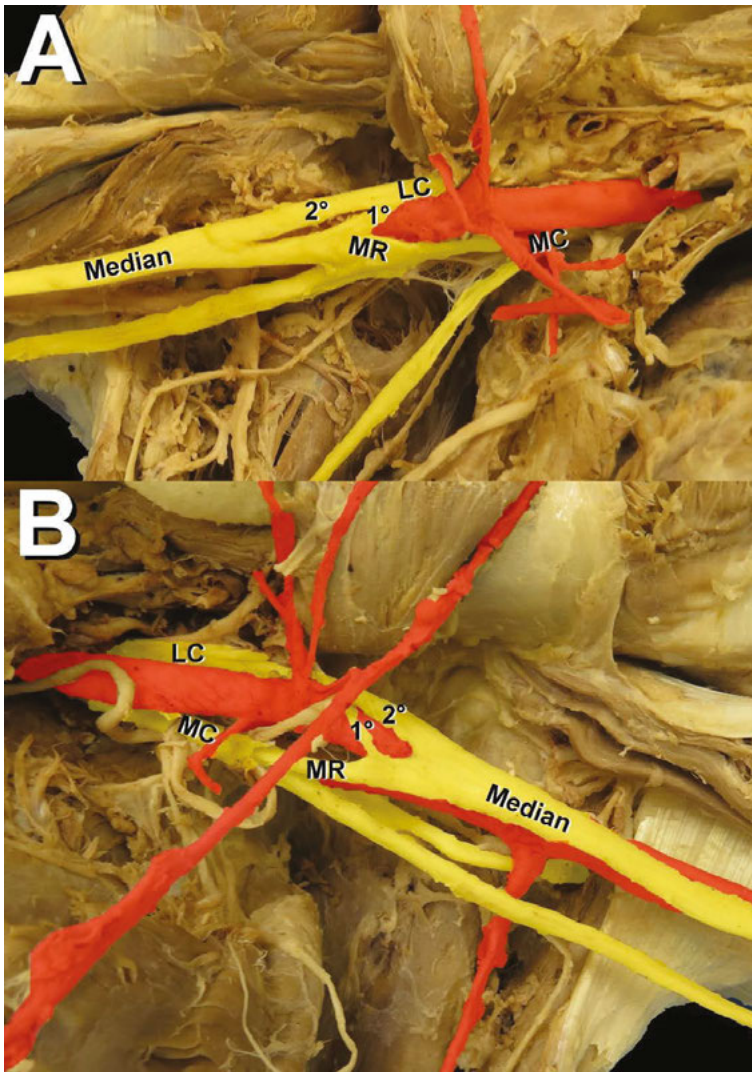
This report provides a cadaveric example detailing an uncommon bilateral absence of the musculocutaneous nerve.

### Case Report

Routine dissection of a 66-year-old white female revealed the bilateral absence of the musculocutaneous nerve (Fig. 1). Bilaterally, the lateral root of the median nerve was duplicated (Fig. 2). On the right side, the median nerve was formed by primary and



**Fig. 1.** Photographs of the right (A) and left (B) anterior compartments of the arms demonstrating branches off the median nerve; rather than the musculocutaneous nerve to supply innervation to the biceps brachii and brachialis muscles. In addition, the lateral cutaneous nerve of the forearm is shown as a continuation of a median branch on the right forearm (A).



**Fig. 2.** Photographs of the right (A) and left (B) axillary regions demonstrating the absence of the musculocutaneous nerve off of the brachial plexus (1°: primary lateral root of the median nerve; 2°: secondary lateral root of the median nerve; LC: lateral cord; MC: medial cord; Median: median nerve; MR: medial root of the median nerve).

secondary lateral roots (primary root: length = 18 mm, width = 3.1 mm; secondary root: length = 53 mm, width = 5.4 mm). The median nerve traveled 35 mm from the primary root to the anastomosis of the secondary root. The aforementioned segment of the median nerve was 4.0 mm in width. From the anastomosis of the secondary root, the median nerve traveled another 41 mm (width = 7.4 mm) before branching to

supply motor branches to the biceps brachii, brachialis, and sensory branches to the lateral cutaneous nerve of the forearm. The branch was located where the proximal third of the arm met the distal two-thirds of the arm. On the left side, the motor branches were likewise given by the median nerve. Also, bilaterally, the nerve supply to the coracobrachialis muscles was not discernable. The primary root of the median nerve was 13 mm in length and 1.5 mm in width. The secondary root was 30 mm in length and 2.6 mm in width. The median nerve spanned 18 mm (width = 3.4 mm) from the primary root to the secondary root. From the secondary root, the median nerve traveled 60 mm (width = 3.4 mm) before giving a muscular branch to the biceps and brachialis at the junction between the proximal third and distal two-thirds of the arm. The median nerve traveled another 24.1 mm before giving a second branch between the proximal and distal halves of the arm.

## Discussion

Absence of the musculocutaneous nerve in humans has been posited as an ontological remnant from embryogenesis. The musculocutaneous nerve is absent in lower vertebrates, amphibians, reptiles, and birds [1]. In the aforementioned lower vertebrates, the flexor muscles, comparable to those of the anterior compartment of the arm in humans are, instead, innervated by the median nerve [1].

Anatomical studies of embryos also suggest that the musculocutaneous nerve is derived from the median nerve [1]. Therefore, it is likely that the absence of the musculocutaneous nerve represents a failure of the nerve to depart from the median nerve during early development.

According to Tountas and Bergman [2] the musculocutaneous nerve usually arises from the lateral cord (90.5% of upper extremities); however, less commonly, the nerve may arise from the lateral and posterior cord (4%), the median nerve (2%), the posterior cord (1.4%), or as two separate bundles emerging from medial and lateral cords (1.4%). Also, musculocutaneous nerve variations have been reported to occur both unilaterally and bilaterally [3, 4]. Indeed, there have been enough variations of the musculocutaneous nerve reported in the literature that several classification systems have been proposed [5].

According to the classification algorithm posited by Guerri-Guttenberg and Ingolotti [5] this case would classify as a Type 0 (absent musculocutaneous nerve). The aforementioned algorithm includes subcategories of Type 0-1 (branches for the coracobrachialis, biceps brachii, brachialis, and the lateral cutaneous nerve of the forearm originate from a common trunk of the median nerve) and Type 0-2 (branches for the coracobrachialis, biceps brachii, brachialis, and lateral cutaneous nerve originate from the median nerve). This case fits neither Type 0-1 nor Type 0-2. Therefore, we suggest including an additional subcategory to the categorization system presented by Guerri-

Guttenberg and Ingolotti — Type 0-3 [5]. With regard to a Type 0-3 musculocutaneous nerve, branches for the coracobrachialis, biceps brachii, brachialis, and lateral cutaneous nerve of the forearm may arise from any combination of the trunk, root of the median nerve, or the median nerve.

The absence of the musculocutaneous nerve has clinical implications, particularly with regard to the management of humeral fractures. The anterolateral surgical approach to the humerus is widely utilized for fracture fixation [6, 7]. The medial approach to the humerus has been determined to have equal merits in fracture fixation [8]. In both of the aforementioned procedures, the median and musculocutaneous nerve need to be identified during the procedure. In the setting of an absent musculocutaneous nerve, surgical confusion might occur during fracture fixation. Further, a fractured humerus might cause median nerve damage [9–11]. If the median nerve injury is quite high (i.e., proximal arm), the injury can masquerade as an injury to both the musculocutaneous and median nerve by demonstrating typical median nerve palsy with concomitant paralysis of the anterior compartment of the arm and cutaneous sensory loss in the lateral forearm.

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### **Conflict of interest**

None declared.

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