

Bifid median nerve associated with superficial ulnar artery: case report

Abstract

The median nerve constitutes one of the six terminal branches of the brachial plexus. It descends through the inner part of the arm, and in the forearm through the midline. Once it reaches the wrist, it travels the carpal tunnel and divides into its terminal branches. Different variations have been described regarding its most distal portion in relation to carpal tunnel syndrome, the most frequent neuropathy in the upper limb.

We report an anatomical variation in the median nerve and the ulnar artery found in the upper left limb of a female cadaver. The median nerve, in the distal third of the forearm, splits leaving a muscular fascicle interposed between the two branches. The ulnar artery has a superficial course along the entire forearm.

In 1977 Lanz grouped the different variations in the median nerve in four sections. Type III (median bifid nerve) was sub classified years later into six subtypes. The present case corresponds to type III of Lanz subtype V (bifid median nerve with abnormal muscular fascicle interposed). Although this nerve variation has been described, the coexistence of a superficial ulnar artery had not been previously reported.

Thorough knowledge of median nerve anatomy is of utmost importance to diagnose and treat injuries and entrapment neuropathies affecting this nerve and its major branches in the upper extremity. Furthermore, knowledge of its anatomical variations such as bifurcation of the median nerve or superficial ulnar artery could prevent surgical complications.

Keywords: anatomical variation, median nerve, ulnar artery, carpal tunnel syndrome

Volume 7 Issue 3 - 2020

Vega Pose Juan Cruz, Frydman Judith, Pfund Guillermo

Department of Anatomy, School of Kinesiology and Physiatry, Argentina

Correspondence: Juan Cruz Vega Pose, Department of Anatomy, School of Kinesiology and Physiatry, School of Medicine, University of Buenos Aires (UBA) Buenos Aires, Argentina, Tel +549 2944212860, Email juancruzvega@gmail.com

Received: June 12, 2020 | **Published:** June 26, 2020

Introduction

The median nerve, formed by the union of the lateral cord and the medial cord of the brachial plexus, constitutes one of its six terminal branches. It travels distally in the arm and then runs through the cubital fossa to reach the forearm. Here the nerve runs between the two fascicles of the pronator teres and the flexor digitorum superficialis. Once it reaches the wrist it passes through the carpal tunnel along with the tendons of the flexor carpi radialis, flexor digitorum superficialis, flexor digitorum profundus and flexor pollicis longus. The median nerve emerges from the carpal tunnel and divides into its terminal branches. It provides the thenar motor branches which supply the thenar muscles of the hand, and the common palmar digital branches for the thumb, index finger, middle finger, and the radial half of the ring finger.¹

Regarding the ulnar artery, it represents the medial bifurcation branch of the brachial artery. It travels distally from the elbow to the wrist, beneath the flexor digitorum superficialis, it crosses through the Guyon's canal together with the ulnar nerve and ends in the palm forming the superficial palmar arch.²

Both segments have been objects of analysis due to multiple variations found, mainly those of the median nerve because of its close relationship with the carpal tunnel syndrome, the most frequent compression neuropathy.³

In our study we report a case of multiple anatomical variations found in the same limb of a female cadaver during routine dissection. We describe anatomical variations found in the median nerve and the

ulnar artery. The current literature regarding the anomalies is reviewed and surgically relevant aspects are discussed.

Case report

Multiple variations were observed in the left upper limb of a female cadaver during a routine dissection in the Department of Anatomy at the School of Kinesiology and Physiatry of the University of Buenos Aires (UBA). These variations were not observed in the contralateral upper limb.

To perform the dissection of the superficial structures, all the subcutaneous tissue and superficial fascia were removed. The deep fascia was then removed, where the ulnar vessels were recognized. Subsequently, the remaining muscle compartments were separated and the deeper vascular and nervous systems were dissected.

Variation in the median nerve

The median nerve bifurcated in the distal third of the forearm into two branches of similar caliber. Both branches crossed down and out deep to the flexor digitorum superficialis and then surrounded the external edge of the muscle. Finally, both branches ended in front of the muscle. At this point, a muscular fascicle was interposed between both branches of the median nerve. This fascicle had its origin in the anterior edge of the radius and distally, it joined to the flexor digitorum superficialis tendon of the index finger. Both branches of the nerve passed through the carpal tunnel in front of the flexor digitorum superficialis. Already in the palm, the lateral branch supplied the muscles of the thenar eminence and it supplied the first three proper

palmar digital branches. The medial branch is divided into the second and third common palmar digital nerves (Figure 1).

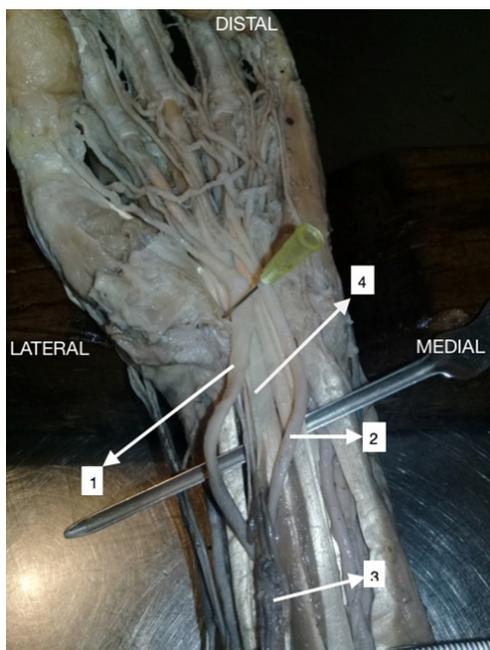


Figure 1 Bifid median nerve with lateral branch (1), medial branch (2) and muscular fascicle interposed (3). Flexor digitorum superficialis tendon of the index finger (4).

Variation in the ulnar artery

The ulnar artery arose from the brachial artery at the level of the cubital fossa. From here, it descended downward and inward, superficially crossing the pronator teres and flexor carpi radialis. It then ran beneath the palmaris longus to meet the ulnar nerve and continued its normal course (Figure 2). The ulnar artery did not emit any collateral branches during its length. Both the common interosseous and the recurrent ulnar arteries arose from a voluminous interosseous trunk that originated from the radial artery.

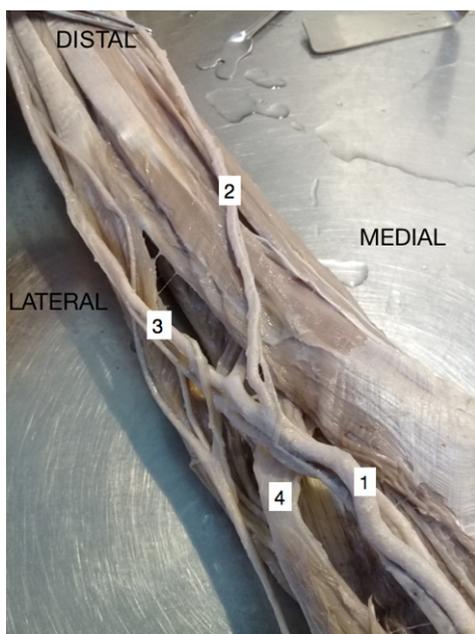


Figure 2 Brachial artery (1), superficial ulnar artery (2) and radial artery (3). Biceps brachii tendon.

Discussion

The relationship between variations in the median nerve at the level of the wrist joint and the carpal tunnel syndrome promoted the early dissemination of different reports. Kessler⁴ described the finding of a bifid median nerve. Later Schultz et al.⁵ found an accessory lumbrical muscle between the bifurcation branches of the median nerve. Finally, Lanz⁶ grouped the different variations found in the distal third of the median nerve into 4 sections (Table 1).

Table 1 Classification of the different variations found in the distal third of the median nerve⁶

Group I	Variations of the course of the thenar branch.
Group II	Accessory branches of the median nerve at the distal carpal tunnel.
Group III	High division of the median nerve (Bifid nerve)
Group IV	Accessory branches proximal to the carpal tunnel.

Different reports have associated a variation in the median nerve with the existence of a vascular alteration such as the persistent median artery (PMA) or an abnormal muscle. Skie et al.⁷ described the finding of a median nerve crossed by an abnormal muscular fascicle of the flexor digitorum superficialis. Antoni et al.⁸ found an abnormal muscle that divided the median nerve in the proximal third of the forearm. The existence of an abnormal lumbrical muscle in relation to an undamaged median nerve in the wrist of a patient with carpal tunnel syndrome has also been reported.⁹

The great variety of cases within group III of Lanz motivated Al-Qattan et al.¹⁰ to sub-classify it, taking into account the presence of associated variations and their symptomatology (Table 2). This report corresponds to group III of Lanz (bifid median nerve) subtype V of Al-Qattan et al.¹⁰ (An anomalous muscle present between the two divisions of the nerve).

Bifid median nerve is a well described but rare abnormality with a reported incidence of 2.8%.⁶ It is frequently found in patients with carpal tunnel syndrome, since it is considered a risk factor for the increased cross-sectional area compared to a not bifid median nerve.¹¹ The risk would increase even more if it is associated with a vascular variation such as PMA. Furthermore, greater weakness was observed in the muscles of the thenar eminence in patients with bifid median nerve.^{11,12}

Nuclear magnetic resonance and ultrasound are the most widely used methods for the diagnosis of carpal tunnel syndrome as well as for the detection of anatomical variations. Implementing these complementary studies would allow better preparation for decompression surgeries, thus avoiding possible injuries or unforeseen events.¹¹

The variation described in the ulnar artery is called Superficial Ulnar Artery, with a reported incidence of 0.7 - 9.38%. It owes its course and situation to the fact of having a higher or proximal origin.² The superficial ulnar artery, with its anomalous location, makes the ulnar artery more susceptible to cut injuries and vascular damages.¹³ Due to its superficial location, it can be mistaken as a vein and intravenous medications can be administered in it.¹⁴ On the other hand, knowledge of the variations in the arterial system is essential for the judicious planning of various reconstructive procedures in oncological, orthopedic and reconstructive surgeries.¹⁵ The increase in surgical interventions on the forearm, due to the use of radial artery as a coronary bypass conduit, emphasizes the importance of a thorough knowledge of variations in this segment.

Table 2 Classification of the bifid median nerve according to its associated abnormalities¹⁰

Group	Description	Prevalence	Presentation
I	Bifid median nerve without persistent median vessels or any other	Very rare	Asymptomatic
II	Bifid median nerve with persistent median vessels without a pathology	Common	Asymptomatic
III	Bifid median nerve with a pathology in the persistent median vessels:	Very rare	
	a) Arteriovenous malformation		Mass/ CTS
	b) Aneurysm		Mass/ CTS
	c) Thrombosis		Acute CTS or digital ischaemia
	d) Venous malformation		Mass
IV	A bifid median nerve with each division passing through a separate carpal tunnel	Very rare	Usually asymptomatic
V	An anomalous muscle present between the two divisions of the nerve	Very rare	STC
VI	An anomalous muscle present between the two divisions of the nerve	Common	The aberrant branches themselves are asymptomatic

When analyzing the vascular and nervous development in the upper extremity of an embryo after 5 weeks of gestation, it was observed that the growth of the motor axons is guided by the different molecules, generating attraction or repulsion. The growth of an axon and an angioblast often responds in the same way to certain ligands in the environment, thus relating the development of the vascular system with the peripheral nervous system.¹⁶ The great variety of molecules that guide the development of the limb can be modified at some point and lead to vascular and nervous variations. This information can explain the variation of the median nerve and its association with the anatomical variation of the ulnar artery in this report. Such finding has not been reported in the same limb to date. Regarding the associated variations in the upper limb, Hizzay et al.¹⁷ reported the presence of a median nerve that divides into its proximal third to make way for an ulnar artery that it passes through.

Conclusion

Numerous variations in the course of the median nerve in the carpal tunnel, as well as variations in its branches in the wrist and in the hand, have been reported. Additionally, the superficial ulnar artery has already been described by the classical anatomical literature as well as in numerous case reports. The importance of this report lies in the association of both anatomical variations in the same limb, a finding that has not been mentioned in the literature thus far. The clinical significance of these variations and the information provided in the present work would improve detection and prevent inadvertent damage in surgical interventions as well as in many procedures.

Acknowledgments

None.

Conflicts of interest

The authors declare that there are no conflicts of interest

Funding

None.

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