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*Case Report*

# Variant Flexor Carpi Ulnaris Muscle with High Origin of Dorsal Branch of the Ulnar Nerve

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## ABSTRACT

During routine dissection, of the right upper limb of a 70 years old donated embalmed male cadaver in the Department of Anatomy, K.J. Somaiya Medical College, Sion, Mumbai, India, we observed a separate humeral and ulnar heads of flexor carpi ulnaris muscle and high origin of dorsal branch of the ulnar nerve. To recognise anatomical variations it is necessary to know the normal anatomy. Normally the flexor carpi ulnaris muscle arises by two heads, humeral and ulnar, connected by a tendinous arch. The humeral head arises from the medial epicondyle via the common flexor tendon. The ulnar head arises from the medial margin of the olecranon process and an aponeurosis attached to the posterior sub cutaneous border of the ulna. The tendon of flexor carpi ulnaris inserted into the hamate and the fifth metacarpal bone through pisohamate and pisometacarpal ligaments. In the present case the ulnar head of flexor carpi ulnaris muscle was more bulky. It separated ulnar nerve and artery. The humeral and ulnar heads were separated from each other by ulnar nerve. These two heads fused with each other just before their insertion, where the ulnar artery came in contact wih ulnar nerve. The knowledge of such unusual ulnar head separating ulnar artery and nerve with high origin of dorsal branch of the ulnar nerve may be clinically important for plastic surgeons doing flap surgeries and for the surgeon dealing with cubital tunnel syndrome.

***Keywords:*** Flexor carpi ulnaris, Ulnar artery, Ulnar Head, Ulnar nerve, Humeral head, plastic surgeons, cubital tunnel syndrome.

## INTRODUCTION

Flexor carpi ulnaris muscle is the medial most muscle of the superficial flexor group. It arises by two heads, humeral and ulnar, connected by a tendinous arch. The small humeral head arises from the medial epicondyle via the common flexor tendon. The ulnar head has an extensive origin from

the medial margin of the olecranon process and proximal two-thirds of the posterior border of the ulna, an aponeurosis (along with flexor digitorum profundus and extensor carpi ulnaris) and from the intermuscular septum between it and flexor digitorum superficialis. A thick tendon forms along its anterolateral border in its distal half. The tendon is attached to the pisiform, and thence prolonged to the hamate and the fifth metacarpal bone by pisohamate and pisometacarpal ligaments (pisiform is the sesamoid bone developing in the tendon of flexor carpi ulnaris). Acting with the flexor carpi radialis, it flexes the wrist and acting with the extensor carpi ulnaris it adducts the wrist. [(1)] Flexor carpi ulnaris muscle is innervated by the ulnar nerve $C_{7,8}T_1$. The line between the medial humeral epicondyle and the pisiform, along the anterior palmar margin of the muscle, is used as a reference point for locating the ulnar neurovascular bundle. The ulnar artery reaches the muscle in its middle third, whereas the ulnar nerve is covered by the muscle throughout its entire course running under the tendon in the wrist region. The ulnar artery, the larger of the two terminal branches of the brachial, begins a little below the bend of the elbow, and, passing obliquely downward, reaches the ulnar side of the forearm at a point about midway between the elbow and the wrist. It then runs along the ulnar border to the wrist, crosses the transverse carpal ligament on the radial side of the pisiform bone, and immediately beyond this bone divides into two branches, which enter into the formation of the superficial and deep palmar arches. The ulnar nerve is a nerve which runs near the ulna bone. The ulnar collateral ligament of elbow joint is in relation with the ulnar nerve. The ulnar nerve is the largest unprotected nerve in the human body (meaning unprotected by muscle or bone), so injury is common. This nerve is directly connected to the little finger, and the adjacent half of the ring finger, supplying the palmar side of these fingers, including both front and back of the tips, perhaps as far back as the fingernail beds. It enters the anterior (flexor) compartment of the forearm through the two heads of flexor carpi ulnaris and runs alongside the ulna. There it supplies one and a half muscles (flexor carpi ulnaris and the medial half of flexor digitorum profundus). It soon joins with the ulnar artery, and the two travel inferiorly together, deep to the flexor carpi ulnaris muscle. In the forearm it gives off three branches: 1. Muscular branches of ulnar nerve, 2. Palmar branch of ulnar nerve, 3. Dorsal branch of ulnar nerve. The dorsal branch of ulnar nerve arises about 5 cm. proximal to the wrist; it passes backward beneath the Flexor carpi ulnaris, perforates the deep fascia, and, running along the ulnar side of the back of the wrist and hand, divides into two dorsal digital branches; one supplies the ulnar side of the little finger; the other, the adjacent sides of the little and ring fingers. It also sends a twig to join that given by the superficial branch of the radial nerve for the adjoining sides of the middle and ring fingers, and assists in supplying them. A branch is distributed to the metacarpal region of the hand, communicating with a twig of the superficial branch of the radial nerve. [(1)]

## MATERIALS AND METHODS

The right upper limb of a donated embalmed 70 years old male cadaver was dissected during routine dissection in the department of Anatomy at K.J. Somaiya Medical College, Sion, Mumbai. All the superficial flexor muscles were exposed. The humeral and ulnar heads of flexor carpi ulnaris muscle was dissected carefully to observe the arrangement of ulnar artery, ulnar head, ulnar nerve and humeral head.

The course of ulnar artery and ulnar nerve were also dissected.
The photographs of the variations were taken for proper documentation.

## RESULTS

The variation was observed in the forearm of right upper limb. However, the left upper limb was normal. The forearm and palm was exposed and the fascia was carefully removed. The right forearm showed separate ulnar and humeral heads of flexor carpi ulnaris muscle. The ulnar head of flexor carpi ulnaris muscle separated ulnar artery and nerve. The humeral and ulnar heads were separated from each other by ulnar nerve. The tendons of both the heads of flexor carpi ulnaris fused with each other just before their insertion. The ulnar artery comes in contact wih ulnar nerve in the lower part of the forearm near the wrist where the two heads of flexor carpi ulnaris fused with each other. The ulnar artery in the hand takes part in the formation of superficial and deep palmar arches. After the reflection of the flexor carpi ulnaris medially and removal of the flexor retniaculum, the main trunk of the Ulnar nerve was identified. The dorsal branch of ulnar nerve (dorsal ulnar nerve) originated from the ulnar nerve trunk at the level of the elbow near the cubital fossa approximately at the junction of upper one fourth and the lower three fourth. It descended down initially under and then along the medial border of the flexor carpi ulnaris in the forearm. After emerging out from the flexor carpi ulnaris muscle and before turning on to the dorsal part of the forearm, the dorsal branch, divided into three branches, one medial and two lateral. The medial most branch emerged about 4 cm proximal to the styloid process of the ulna and gave off few thin branches along its course on the hypothenar eminence to the abductor digiti minimi muscle and to the skin around it. Then this medial branch merged with the communicating branch from the superficial palmar branch of the ulnar nerve and continued as the medial proper digital nerve to the little finger. The lateral two divisions of the dorsal branch of the ulnar nerve became cutaneous and were supplying the medial half of the dorsum of hand along the medial three digits i.e. radial and ulnar side of little, ring and middle finger. After its course in the forearm, the ulnar nerve entered the Guyon's canal in the hand and divided into superficial (sensory) and deep (motor) branches.

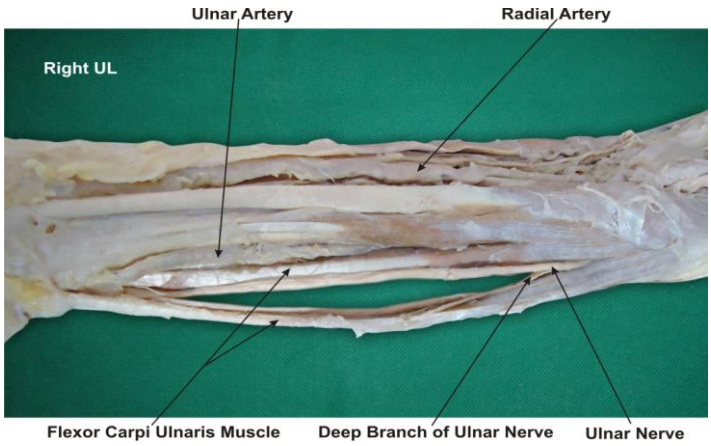


Figure 1: Photographic representation of the ulnar artery and nerve separated by the ulnar head of flexor carpi ulnaris muscle and the humeral and the ulnar heads of flexor carpi ulnaris muscle were separated from each other by the ulnar nerve with high origin of the dorsal branch of the ulnar nerve.

## DISCUSSION

The variations of flexor carpi ulnaris muscle have been reported previously by many authors. These variations include: (i) an additional slip of flexor carpi Ulnaris. [2] (ii) variations in musculotendinous junction of the flexor carpi ulnaris muscle, [3] (iii) variant flexor carpi ulnaris causing ulnar nerve compression. [4] In the present case the two heads of flexor carpi ulnaris muscle remain separate. The ulnar head separated ulnar artery and nerve. The ulnar nerve runs in between the two heads of the flexor carpi ulnaris muscle in the forearm. Such variation is not yet reported in literature. The flexor carpi ulnaris muscle acts as an anatomical guideline for finding the neurovascular bundle (ulnar nerve, ulnar artery and accompanying venae comitantes), it can be easily palpated in its distal course if the wrist is flexed and adducted. The present variation need to be taken into account when interpreting ultrasound and MR images, as well as during dissection of the ulnar neurovascular bundle when using flexor carpi ulnaris as a guideline. The flexor carpi ulnaris is a useful local muscle flap in the forearm and elbow. It is, however, an important palmar flexor and ulnar deviator of the wrist, and functional loss may arise from the use of this muscle in its entirety. The flexor carpi ulnaris is made up of two distinct neuromuscular compartments. This arrangement allows for splitting of the muscle and the potential use of the larger ulnar compartment as a local muscle flap while maintaining the humeral compartment as an ulnar deviator and palmar flexor of the wrist. [5] After multiple efforts to heal an infected nonunion of the proximal ulna, a flexor carpi ulnaris muscle pedicle flap was used to improve blood supply and softtissue coverage at the nonunion site. It was observed that it promoted bone healing and restoration of useful elbow function. [6] The course and distribution of ulnar nerve and ulnar artery can assist the surgeon in the diagnosis and effective management of the more common pain syndromes conditions associated with the ulnar aspect of the hand. [7] As the two heads of flexor carpi ulnaris muscles were separate the tendinous arch between them was absent. The possibility of entrapment of ulnar nerve in cubital tunnel in such cases is rare. The variations of the sensory innervations of the hand are not common. [8] The dorsal branch supply the dorsal aspect of the forearm and hand but many cases have been reported in the past to show its innervations even to the ventral aspect of the forearm and hand including hypothenar muscles. In the present case there is a higher origin of the dorsal branch of ulnar nerve in the forearm and its termination by uniting with a communicating branch from the superficial branch of ulnar nerve and its subsequent continuation as medial proper digital branch of little finger is rare. Bergman et al [9] and Bozkurt et al [10] have described the medial proper digital nerve to the little finger arising from the dorsal branch of the ulnar nerve and the higher origin of the dorsal branch of the ulnar nerve. The entire little finger is shown to supplied by the digital branches from the dorsal branch of the ulnar nerve. [11] In 2005, Paul et al [12] observed a higher origin of the dorsal branch of the ulnar nerve in the forearm and its connection with the deep branch of the ulnar nerve. Kaplan [13] in 1963 descried a nerve branch that arose from the dorsal cutaneous branch of the ulnar nerve and finally merged with the superficial ramus of the ulnar nerve, this type of communication has been termed as "Kaplan's anastomosis". Hoogbergen and Kauer [14] found a significant case of Kaplan anastomosis, the dorsal cutaneous branch emerged approximately 2.5 cm proximal to the ulnar styloid process gave off three branches and eventually merged with the deep ramus on ulnar nerve. Georgis et al [15]

reported a case where the dorsal cutaneous nerve was united with the trunk of the ulnar nerve before its bifurcation into superior and deep ramus. The innervations of the hypothenar muscles of the palm are usually by the deep terminal branches of ulnar nerve in the palm. [1] In the present study we detected a branch from the dorsal branch to the hypothenar muscles. However, similar innervations were reported rarely. [12, 16] The variant digital branches from the ulnar nerve to the ulnar half of the index, ulnar half of the middle, and radial half of the ring finger without any communication between these digital branches and that of the median nerve has also been reported. [17] This finding is important as in case of any injury to the deep terminal ramus of the ulnar nerve as the extra supply from dorsal branch may spare the muscles in the hypothenar eminence. Knowing the existence of the abnormal communication between the dorsal branch and the superficial terminal branch is very essential, as it may be damaged during surgery, in trauma in these area and in the condition which involve Guyon's canal. [15] It has also been indicated that the congenital abnormal course of the ulnar nerve branches in the forearm may involved in compressive ulnar neuropathy and can be corrected with surgical intervention. [18] As the dorsal branch of the ulnar nerve passes close to the 6 Radial portal used in wrist arthroscopy, the knowledge about the possible variations in the course of this nerve is helpful in avoiding the iatrogenic injury to the nerve during arthroscopy. [19] Finally, the knowledge of the variations in the dorsal branch of ulnar nerve is important in electrodiagnosis [20] and may be significant while using forearm flap, nerve block, carpel tunnel release, reconstruction of ulnar bone and other surgical interventions of the forearm and the hand and may help the hand surgeons to interpret discrepancies in sensory loss after either dorsal or palmar injuries.

## CONCLUSION

The knowledge of such unusual variations of flexor carpi ulnaris is a must before any operative procedures of the forearm and hand. The ulnar head of flexor carpi ulnaris separating ulnar artery and ulnar nerve seen in present case is important for Anatomists. It may be clinically important for plastic surgeons doing flap surgeries and for the surgeons dealing with cubital tunnel syndrome. Orthopaedicians have used this muscle flap for treating non union of proximal ulna and hence knowledge of this variable head is important.

The knowledge of the variations in the dorsal branch of ulnar nerve is helpful in avoiding the iatrogenic injury to the nerve during arthroscopy, electrodiagnosis, forearm flap, nerve block, carpel tunnel release, reconstruction of ulnar bone and other surgical interventions of the forearm and the hand and may help the hand surgeons to interpret discrepancies in sensory loss after either dorsal or palmar injuries.

**Competing Interests:**

The authors declare that they have no competing interest.

**Authors' contributions:**

SPS wrote the case report, performed the literature review & obtained the photograph for the study. RMM performed the literature search and assisted with writing the paper. STS conceived the study and helped to draft the manuscript. All authors have read and approved the final version manuscript.

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