**ORIGINAL RESEARCH**

# The morphological diversity of the brachialis tendon insertion and its connections to the neurovascular systems of the arm

[1]Dr. Raveena Singh, [2]Dr. Vipin Kumar

[1]Assistant Professor, Department of Anatomy, ASMC, Fatehpur, Uttar Pradesh, India
[2]Assistant Professor, Department of Anatomy ASMC, Pratapgarh, Uttar Pradesh, India

**Corresponding Author**
Dr. Vipin Kumar
Assistant Professor, Department of Anatomy ASMC, Pratapgarh, Uttar Pradesh, India

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**ABSTRACT**

**Aim:** The morphological diversity of the brachialis tendon insertion and its connections to the neurovascular systems of the arm. **Materials and Methods:** The research was carried out on fifty upper limbs taken from preserved human cadavers stored in the Department of Anatomy. An incision was made along the length of the anterior surface of the brachial fascia, beginning at the level of the pectoralis major muscle and ending at the elbow. The limbs were dissected as part of standard procedure in order to study the insertion of the brachialis muscle and its relationship to the neurovascular systems in the arm. Observations were made on the path taken by the median nerve and the brachial artery. **Results:** The brachialis muscle is inserted into the anterior side of the coronoid process and the tuberosity of the ulna in 48 out of 50 specimens (96%) of the study's participants. Both the median nerve and the brachial artery go superficially via the brachialis muscles, and the interaction between the two structures was normal. In two of the specimens, or 4% of the total, brachialis muscles in the bottom third of the right upper limbs formed a tunnel. It was estimated that the length of the tunnel was about 2.6 centimetres. It was only present in one arm of the corpse, but the other arm, which was the left one, seemed normal. In this particular instance, entrapment of the brachial artery as well as the median was found inside the tunnel formed by the brachialis. **Conclusion:** As a result, having information about these kinds of uncommon mutations is essential for surgeons in order to prevent providing incorrect diagnoses and treatments.

**Keywords:** Brachialis, tendon insertion, Neurovascular



## INTRODUCTION

One of the three muscles that make up the anterior compartment of the arm is the brachialis muscle, which is also referred to as the "work-horse".[1] of the elbow. In comparison to the biceps brachii muscle, which is also engaged in supination of the radio-ulnar joints, it is predominantly involved in the flexion at the elbow joint. This is in contrast to the fact that the biceps brachii muscle flexes the elbow joint. After deriving its origin from the anterolateral and anteromedial surfaces of the shaft of the humerus, as well as the anterior border and adjoining medial and lateral intermuscular septa below the insertion of the coracobrachialis and deltoid muscles, it is found deep within the biceps brachii muscle.[2] It is also known as the long head of the biceps brachii. After this, all of the fibres come together below to create an extended and wide tendon, which ultimately serves as the floor of the cubital fossa. After this, the tendon is placed into the front surface of the coronoid process and the ulnar tuberosity of the ulna.[2,3] A portion of its fibres combine with the capsule that surrounds the elbow joint, which is also referred to as Portal's muscle.[3] The Median Nerve (MN), the Brachial Artery, the Biceps Tendon, and the Radial Nerve (RN) all reside anterior to the muscle in the cubital fossa, whereas the Capsule of the Elbow Joint sits posterior to the muscle. Due to the fact that it is a hybrid or composite muscle, it receives nerve impulses from two sources. Both the Musculocutaneous Nerve (MCN) and the Radial Nerve (RN) feed the tiny lateral component of the muscle.[4] The MCN provides the majority of the muscle. When the elbow is in any position, this muscle is the most strong flexor of the elbow joint Unfortunately, throughout history, it has been given very little attention, and as a consequence, there is a paucity of published material that describes its anatomy in comparison to that of other muscles. Determining the morphology of the muscle is of considerable clinical significance because infrequent mention of pathologies such as a tear, ruptures, tendinopathies, and so on, coupled with conflicting reports of its morphology, can often lead to inaccurate diagnosis of clinical conditions that are related to it. This is why determining the morphology of the muscle is so important.[2,5] The anatomical variations of the brachialis have their imprints in the prenatal life, when at about the fifth week of development a complex interaction between several components, such as the growth factors and pre-adhesion molecules, facilitate the migration of the myoblast to the limb buds, followed by their orderly and synchronised distribution.[6,7] This interaction takes place when the myoblast migrates to the limb buds at about the fifth week of development. This is mirrored in the dual nerve supply that the muscle receives since it originates from two fused muscular primordia, namely the ventral/flexor and the dorsal/extensor pre-muscle masses. There is an alternative school of thought that holds the belief that the muscle only develops from the ventral one, and that the nerves that supply it originate from the ventral division of the brachial plexus, and that they reach the muscle through the RN in order to supply it.[8] Knowledge of anatomical variations in the muscular structure and its related neurovascular entrapment is important surgically for orthopaedic surgeons, plastic surgeons, and also physiotherapists clinically. Because of this, the present study was done to observe the insertion of brachialis as well as the course of the Median nerve and the Brachial artery related to it.

## MATERIALS AND METHODS

The research was carried out on fifty upper limbs taken from preserved human cadavers stored in the Department of Anatomy. An incision was made along the length of the anterior surface of the brachial fascia, beginning at the level of the pectoralis major muscle and ending at the elbow. The limbs were dissected as part of standard procedure in order to study the insertion of the brachialis muscle and its relationship to the neurovascular systems in the arm. Observations were made on the path taken by the median nerve and the brachial artery.

## RESULTS

The brachialis muscle is inserted into the anterior side of the coronoid process and the tuberosity of the ulna in 48 out of 50 specimens (96%) of the study's participants. Both the median nerve and the brachial artery go superficially via the brachialis muscles, and the interaction between the two structures was normal. In two of the specimens, or 4% of the total, brachialis muscles in the bottom third of the right upper limbs formed a tunnel. It was estimated that the length of the tunnel was about 2.6 centimetres. It was only present in one arm of the corpse, but the other arm, which was the left one, seemed normal. In this particular instance, entrapment of the brachial artery as well as the median was found inside the tunnel formed by the brachialis.

**Table 1: Age and Gender**

| Gender | Number | % |
|---|---|---|
| Male | 24 | 48 |
| Female | 26 | 52 |
| Age | | |
| below 50 | 3 | 6 |
| 50-70 | 37 | 74 |
| Above 70 | 10 | 20 |

**Table 2: Brachialis muscle**

| | Number | Percentage |
|---|---|---|
| Brachialis muscle inserted into the anterior aspect of the coronoid process | 48 | 96 |
| Tunnel formed | 2 | 4 |

**Table 3: Length of the tunnel(cm)**

| | Mean |
|---|---|
| length of the tunnel(cm) | 2.61 |

## DISCUSSION

The morphological variations of the brachialis muscle are most commonly seen in the form of accessory slips arising from the adjacent structures and merging with the muscle or vice versa.[1] This was the case up until about a decade ago, when a reexamination of the anatomy of the muscle revealed that it consisted of two heads: the larger and bulkier SH and the fan-shaped DH. The SH is positioned laterally and contains fibres that run in a longitudinal direction, while the DH was located medially and included fibres that ran in an oblique direction.[2,4] Whereas the tendon that makes up the SH inserts at the ulnar tuberosity, the aponeurosis that makes up the DH attaches to the coronoid process of the ulna. According to a number of writers' accounts, the muscle fibres and slips of the brachialis have been seen as being superficial to the neurovascular bundle in the arm. According to a research that was published not too long ago, the brachialis muscle in the arm has an unusually long tunnel for the transit of neurovascular bundles, measuring 2.6 centimetres in length.[2–4]

Carpal tunnel syndrome, pronator teres syndrome, and anterior interosseous syndrome are the three well-defined entrapment syndromes that involve the median nerve and its branches. Carpal tunnel syndrome is the most common of these three. A small number of case reports that were discovered in the research suggested that the probable median nerve entrapment was caused by the third head of the biceps brachii.[5,6] Even though the anatomy literature only rarely mentions that the median nerve compression is due to bicipital aponeurosis, a few researchers say that it could be a case of high median nerve compression along with the brachial artery. This is despite the fact that bicipital aponeurosis is one of the most common causes of compression of the median nerve.[6]

There was only a rare sub-brachialis path of the median nerve and the brachial artery in the arm, according to certain kinds of study; nevertheless, the complete course of the median nerve and the brachial artery was deep to the brachialis muscle. But, once it approached the cubital fossa, it reverted to its typical path and presented itself as the most medically significant aspect of the cubital fossa.[7,8] When the median nerve and the brachial artery were discovered compressed beneath the musculo-fascial structure, which had a character that was unyielding, this variation has all the possibilities of entrapment neuropathy as a cause, as it has been pointed out. As a result, we reason that the clinical signs that may be shown in such an entrapment would be comparable to those that are displayed in pronator syndrome. Nevertheless, when the condition has progressed to a more advanced state, compression may cause endothelial damage and thrombotic blockage of the brachial artery. In clinical practise, tunnel syndromes of this sort will also generate symptoms in the forearm and the hand.[9]

In the current investigation, the tunnel was produced by the Brachialis muscle, which originated from the superficial fibre and had an aponeurosis that measured 2.6 centimetres in length. This aponeurosis extended downward, overlapping the median nerve and the brachial artery on its way to the medial intermuscular septum, where it was inserted. The slips of brachialis may have significant clinical consequences since they have the ability to cause the median nerve to get entrapped and the brachial artery to become compressed.

On the basis of the development of the muscles of the arm, it is possible that the Brachialis muscle that was described in this instance may be explained. The Brachialis muscle is formed during the development of the limb bud by the merging of two muscular primordials. This process takes place in the arm. The majority of it is created from the ventral or flexor pre muscular mass, which is supplied by the ventral rami of spinal neurons. The dorsal or extensor pre muscular mass contributes to the formation of a portion of it (which is supplied by the dorsal rami of spinal nerves). Some authors believe that the brachialis muscle only develops from the ventral premuscular mass, and that the branch of the radial nerve that supplies it is derived from the anterior division of the brachial plexus. This theory suggests that the brachialis muscle uses the radial nerve as its only route to the brachialis muscle due to unknown mechanisms. Having said that, this viewpoint is not supported by any credible evidence. There are three distinct components that make up the extensor premuscular mass found in the forearm.[10] After this, some of the muscle primordia will perish due to a process of cell death known as apoptosis. It's possible that the diversity seen in this research is attributable to the fact that muscle primordia didn't completely vanish throughout embryological development.[11]

## CONCLUSION

As a result, having information about these kinds of uncommon mutations is essential for surgeons in order to prevent providing incorrect diagnoses and treatments.

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