

A CADAVERIC STUDY OF ACCESSORY HEAD OF BICEPS BRACHII AND ITS INNERVATION

Anatomy

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ABSTRACT

Background The biceps brachii is one of the principal muscles of the anterior compartment of the arm and exhibits considerable anatomical variations. Among these, the presence of accessory or supernumerary heads is the most frequently encountered variation. Such variations are of considerable clinical importance because they may compress neurovascular structures, alter upper limb biomechanics, complicate surgical procedures and interfere with radiological interpretation. **Aim** To study the incidence, morphology and innervation of accessory heads of the biceps brachii muscle in adult human cadavers. **Materials and Methods** A descriptive cadaveric observational study was conducted in the Department of Anatomy, K.H.Patil Institute of Medical Sciences, Gadag, from January to July 2024. Forty upper limbs obtained from twenty formalin-fixed adult human cadavers were meticulously dissected following Cunningham's Manual of Practical Anatomy. The number of heads of the biceps brachii, their origin, insertion, laterality and nerve supply were observed and documented. **Results** Among the forty upper limbs examined, accessory heads of the biceps brachii were identified in three limbs belonging to two male cadavers, giving an incidence of 7.5% per limb and 10% per cadaver. One cadaver demonstrated bilateral accessory heads, whereas another exhibited a unilateral accessory head on the right side. All accessory heads were supplied by the musculocutaneous nerve and inserted along with the common tendon of the biceps brachii onto the radial tuberosity. **Conclusion** Accessory heads of the biceps brachii are not uncommon anatomical variations. Their recognition is important for Anatomists, Surgeons, Orthopaedic specialists, Radiologists and Neurologists because they may contribute to nerve entrapment syndromes, alter fracture displacement, complicate tendon transfer surgeries and influence surgical approaches to the arm.

KEYWORDS

Accessory head, Biceps brachii, Musculocutaneous nerve, Cadaveric study, Anatomical variation, Upper limb.

INTRODUCTION

The biceps brachii is one of the most important muscles of the anterior compartment of the arm and plays a vital role in upper limb movements. Anatomically, it is classically described as a two-headed muscle comprising the long head, which originates from the supraglenoid tubercle of the scapula and the short head, arising from the apex of the coracoid process. Distally, both heads unite to form a common tendon that inserts into the posterior aspect of the radial tuberosity and gives rise to the bicipital aponeurosis, which blends with the deep fascia of the forearm. The muscle is supplied by the musculocutaneous nerve (C5–C7) and receives its vascular supply primarily from the brachial artery. Functionally, the biceps brachii is a powerful supinator of the forearm, particularly when the elbow is flexed and also acts as an important flexor of the elbow joint while assisting in stabilization of the glenohumeral joint during upper limb movements. [1,2]

Among all the muscles of the upper limb, the biceps brachii exhibits one of the highest frequencies of anatomical variations. Variations may involve the number of heads, origin, insertion, morphology, course and nerve supply. The most frequently encountered variation is the presence of one or more accessory (supernumerary) heads, resulting in a three-headed, four-headed or even seven-headed biceps brachii. These accessory heads most commonly originate from the humeral shaft, coracoid process, pectoralis major tendon, brachialis muscle, shoulder joint capsule or intermuscular septa before joining the common tendon of insertion. Although these variations are generally asymptomatic, they are of considerable anatomical and clinical interest because of their close relationship with adjacent neurovascular structures [1,3]

The reported prevalence of accessory heads varies considerably among different ethnic and geographical populations. Rodríguez-Niedenführ et al. reported that supernumerary humeral heads are among the commonest muscular variations of the upper limb and described their diverse morphological patterns.[1] Studies from Japanese, Turkish, Sri Lankan, South Indian, Nepalese and African populations have documented prevalence rates ranging from approximately 3% to 20%, while exceptionally higher incidences have also been reported in certain populations.[4–9] Such variability suggests that racial, developmental and genetic factors may influence the occurrence of these anatomical variations.

From an embryological perspective, the development of accessory heads is believed to result from incomplete fusion of the primitive muscle masses or persistence of muscle primordia during the differentiation of the upper limb musculature. Failure of programmed regression of embryonic muscle segments or abnormal differentiation of mesenchymal tissue may give rise to accessory muscular slips. These developmental alterations explain the diversity in origin, insertion and innervation reported in different anatomical studies. [2,6] Knowledge of these anatomical variations has significant clinical relevance. Accessory heads may compress the musculocutaneous nerve, median nerve or brachial artery resulting in neurovascular entrapment syndromes, unexplained pain, weakness or altered sensory symptoms. They may also modify the displacement of fracture fragments, interfere with tendon transfer procedures, complicate orthopaedic and reconstructive surgeries and produce unexpected findings during radiological imaging. Awareness of these variations is therefore essential for Anatomists, Orthopaedic surgeons, Plastic surgeons, Vascular surgeons, Radiologists, Anesthesiologists and clinicians involved in the diagnosis and management of upper limb disorders. [1,3,7]

Considering the anatomical and clinical importance of these variations and the limited data available from North Karnataka, the present cadaveric study was undertaken to determine the incidence, morphology, laterality and innervation of accessory heads of the biceps brachii muscle in adult cadavers and to compare the findings with those reported in previous anatomical studies.

Materials and Methods

This descriptive observational cadaveric study was conducted in the Department of Anatomy, K.H.Patil Institute of Medical Sciences (GIMS), Gadag, Karnataka, from January to July 2024. The study was performed on formalin-fixed adult human cadavers available in the Department of Anatomy for undergraduate and postgraduate teaching purposes.

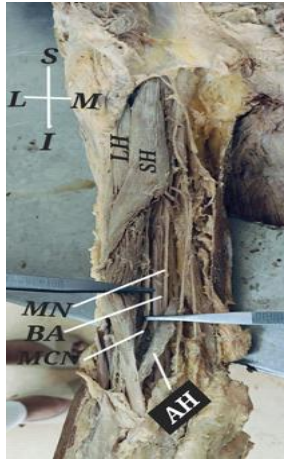
A **convenience sampling technique (non-probability sampling)** was employed, wherein all available cadavers meeting the study criteria during the study period were included. A total of **20 adult cadavers**, providing **40 upper limbs**, constituted the study sample. Cadavers with intact upper limbs and preserved anatomical structures

were included, whereas cadavers with congenital deformities, traumatic injuries, previous upper limb surgeries or damaged upper extremities that could interfere with anatomical assessment were excluded from the study.

Each upper limb was dissected systematically according to **Cunningham's Manual of Practical Anatomy**. After reflecting the skin, superficial fascia and deep fascia, the biceps brachii muscle was carefully exposed. The number of muscular heads, their origin, insertion, laterality, and relationship with adjacent neurovascular structures were meticulously observed. Whenever an accessory head was identified, its morphology and nerve supply were confirmed by tracing the musculocutaneous nerve and its branches. Digital photographs were taken to document all anatomical variations.

The collected data were entered into Microsoft Excel and analyzed using descriptive statistics. The frequency and percentage of accessory heads were calculated and compared with findings reported in previous anatomical studies.

CADAVER I RIGHT UPPER LIMB



LEFT UPPER LIMB



CADAVER II RIGHT UPPER LIMB



RESULTS

A total of 20 formalin-fixed adult cadavers, comprising 40 upper limbs, were examined for variations in the biceps brachii muscle. Accessory heads of the biceps brachii were identified in 2 cadavers (10%), involving 3 upper limbs (7.5%). One cadaver exhibited bilateral accessory heads, whereas the second cadaver showed a unilateral accessory head on the right side. No accessory head was observed in the remaining 18 cadavers. All accessory heads were supplied by the musculocutaneous nerve and inserted into the common tendon of the biceps brachii.

Table 1. Incidence of accessory head of biceps brachii in the present study

Observation	Number (n)	Percentage (%)
Total cadavers examined	20	100
Cadavers with normal anatomy	18	90.0
Cadavers with accessory head	2	10.0
Total upper limbs examined	40	100
Upper limbs with normal anatomy	37	92.5
Upper limbs with accessory head	3	7.5

Accessory heads of the biceps brachii were observed in 2 of the 20 cadavers, corresponding to an incidence of 10% per cadaver and 7.5% per upper limb.

Table 2. Distribution of accessory heads according to side

Side	Upper limbs examined	Limbs with accessory head	Percentage (%)
Right	20	2	10.0
Left	20	1	5.0
Total	40	3	7.5

Accessory heads were more frequently observed on the right side (two limbs) than on the left side (one limb).

Table 3. Pattern of occurrence of accessory heads

Pattern of occurrence	Number of cadavers	Percentage (%)
Bilateral accessory head	1	5.0
Unilateral right-sided accessory head	1	5.0
Unilateral left-sided accessory head	0	0
No variation	18	90.0
Total	20	100

of the two cadavers exhibiting variations, one showed bilateral accessory heads, while the other demonstrated a unilateral accessory head on the right side.

Table 4. Morphological characteristics and innervation of accessory heads

Cadaver	Side	Number of accessory heads	Insertion	Innervation
Cadaver 1	Right	One	Common tendon to radial tuberosity	Musculocutaneous nerve
Cadaver 1	Left	One	Common tendon to radial tuberosity	Musculocutaneous nerve
Cadaver 2	Right	One	Common tendon to radial tuberosity	Musculocutaneous nerve

All identified accessory heads were inserted into the common tendon of the biceps brachii and were consistently supplied by the musculocutaneous nerve. No variation in the nerve supply was observed.

Overall, the present study demonstrated a relatively low incidence of accessory heads of the biceps brachii in the North Karnataka population. The observed variations were predominantly right-sided and the musculocutaneous nerve remained the sole source of innervation in all cases.

Findings

The present cadaveric study examined 40 upper limbs from 20 formalin-fixed adult cadavers to identify variations in the biceps brachii muscle. Accessory heads of the biceps brachii were observed in 2 cadavers (10%), involving 3 upper limbs (7.5%). One cadaver exhibited bilateral accessory heads, while the other showed a unilateral accessory head on the right side. In all cases, the accessory heads merged with the common tendon of the biceps brachii and were innervated by the musculocutaneous nerve. No variation in nerve supply was observed. These findings indicate that accessory heads are relatively uncommon but clinically significant anatomical variations in the North Karnataka population.

DISCUSSION

The biceps brachii is one of the most variable muscles of the upper limb, with accessory heads representing the most frequently encountered anatomical variation. These supernumerary heads differ in their origin, insertion and prevalence among various populations, making cadaveric studies essential for understanding their anatomical and clinical significance. In the present study, accessory heads of the biceps brachii were observed in **2 of 20 cadavers (10%)**, involving **3 of 40 upper limbs (7.5%)**. One cadaver exhibited bilateral accessory heads, while the other demonstrated a unilateral variation on the right

side. All accessory heads were supplied by the musculocutaneous nerve, which is consistent with the normal pattern of innervation.

The incidence observed in the present study closely corresponds with the findings of **Williams et al.**, who reported an incidence of approximately 10% in the Indian population. It is also comparable to the prevalence reported by **Kervancioglu et al.** (8.3%) in the Turkish population and **Kosugi et al.** (13.7%) among Japanese cadavers. However, lower incidences have been documented by **Ilayaperuma et al.** (3.7%) in the Sri Lankan population and **Lokanadham et al.** (5%) in South Indians, whereas **Poudel et al.** reported a remarkably higher prevalence of 90% in the Nepalese population. Such variations among studies may be attributed to differences in ethnicity, genetic factors, sample size and methodological approaches adopted during cadaveric dissection.

Embryologically, accessory heads are believed to develop due to incomplete fusion of the primitive muscle masses or persistence of muscle primordia during the differentiation of limb musculature. Failure of regression of embryonic muscle segments and abnormal differentiation of mesenchymal tissue may also contribute to the formation of these accessory muscular slips. These developmental variations explain the diversity in the origin and morphology of accessory heads reported in different populations.

The clinical importance of accessory heads of the biceps brachii should not be underestimated. Their close relationship with the musculocutaneous nerve, median nerve and brachial artery may predispose individuals to neurovascular compression syndromes, resulting in pain, sensory disturbances, or muscle weakness. Moreover, these variations may alter the displacement of humeral fracture fragments, complicate tendon transfer procedures, interfere with reconstructive surgeries, and lead to misinterpretation during radiological imaging. Therefore, detailed knowledge of these anatomical variations is essential for anatomists, Orthopaedic surgeons, Plastic surgeons, Vascular surgeons, Radiologists, and Anesthesiologists to ensure accurate diagnosis, effective surgical planning, and avoidance of inadvertent neurovascular injury. The findings of the present study contribute to the existing anatomical literature and provide valuable baseline data regarding the occurrence of accessory heads of the biceps brachii in the North Karnataka population.

CONCLUSION

The present cadaveric study demonstrated that accessory heads of the biceps brachii were present in **10% of cadavers** and **7.5% of upper limbs** examined. One cadaver exhibited bilateral accessory heads, while another showed a unilateral right-sided variation. All accessory heads were innervated by the musculocutaneous nerve, with no variation in nerve supply observed. Although uncommon, these anatomical variations have significant clinical implications because they may contribute to neurovascular compression and complicate surgical procedures involving the arm. Awareness of such variations is essential for anatomists, Orthopaedic surgeons, Plastic surgeons, Radiologists, and clinicians to facilitate accurate diagnosis, effective preoperative planning and safe surgical intervention.

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