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Variations in the origin of the third head of biceps brachii in North Coastal Andhra Pradesh: A cross-sectional cadaveric study.

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Abstract

Background
The biceps brachii muscle is classically described as having two heads: long and short. However, anatomical variations such as a third (accessory) head are not uncommon and may have clinical implications during surgical, orthopedic, or radiological procedures involving the arm. This study aimed to evaluate the prevalence and morphological characteristics of the third head of biceps brachii in cadavers from North Coastal Andhra Pradesh.

Materials and methods
A total of 100 upper limbs from 50 formalin-fixed adult cadavers (35 males, 15 females) were dissected during routine anatomical teaching sessions. The origin and laterality of the third head of biceps brachii were documented, and observations were categorized by sex and site of origin.

Results
A third head of the biceps brachii was identified in 10% of dissected upper limbs. It was more commonly observed in males (11.4%) than in females (6.8%). The third head originated from the insertion site of the deltoid muscle in 7 limbs (7%) and from the insertion of the coracobrachialis in 3 limbs (3%). Bilateral occurrence was noted in 6 limbs, 4 from the deltoid and 2 from the coracobrachialis origins in males, and 2 bilateral deltoid-origin cases in females. No additional accessory heads were noted. The origins of the long and short heads remained constant in all specimens.

Conclusion
The third head of the biceps brachii is a notable anatomical variation, especially in males, with deltoid insertion being the more frequent site of origin. Awareness of such variations is essential for surgeons, radiologists, and clinicians to avoid diagnostic confusion and complications during upper limb procedures.

Recommendations
Further anatomical studies across diverse regions are recommended to support surgical planning and prevent complications related to muscular variations.

Keywords: *Biceps brachii, Third head, Anatomical variation, Deltoid, Coracobrachialis, Cadaveric study, North Coastal Andhra Pradesh*
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Introduction

The biceps brachii is a prominent muscle of the anterior compartment of the arm, typically described as a two-headed muscle originating from the supraglenoid

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tubercle (long head) and the coracoid process (short head) of the scapula. It plays a crucial role in forearm supination and elbow flexion, and is of substantial clinical significance in orthopedic, radiological, and surgical contexts [1].

However, anatomical studies have consistently documented the presence of a third (accessory) head of the biceps brachii, making it one of the most common muscular variations in the upper limb [2,3]. The prevalence of this variation varies widely, reported between 10% and 30% in different populations [1,4]. The site of origin of the third head is variable and may include the humeral shaft, medial intermuscular septum, or regions near the insertion of the coracobrachialis or deltoid muscle [2,5].

These supernumerary heads are not merely of academic interest -they have important clinical implications. The presence of an accessory head may affect the course of the musculocutaneous nerve, increasing the risk of nerve entrapment syndromes and complicating surgical procedures such as neurovascular decompression, tendon repair, and fracture fixation [3,5].

Despite a wealth of international literature, there is a paucity of region-specific data on variations in the biceps brachii in the North Coastal Andhra Pradesh population. Documenting these anatomical variants is essential for improving surgical precision, reducing the risk of iatrogenic injuries, and enhancing clinical outcomes in procedures involving the upper limb.

This study was conducted to assess the prevalence, gender-wise distribution, and anatomical origin of the third head of the biceps brachii in cadaveric specimens from North Coastal Andhra Pradesh, aiming to enhance regional anatomical knowledge and support its clinical relevance in surgical and diagnostic practices.

Materials and methods

Study design and setting

This was a descriptive, cross-sectional cadaveric study conducted in the Department of Anatomy, Great Eastern Medical School (GEMS), Srikakulam, Andhra Pradesh, India. The study period extended over twelve months, from January 2024 to December 2024.

Sample size and selection criteria

A total of 50 formalin-fixed adult human cadavers were included in the study, consisting of 35 males and 15 females. Both upper limbs of each cadaver were dissected, yielding 100 upper limbs for analysis.

Inclusion criteria

All well-preserved adult cadavers were available in the department during the study period.

Exclusion criteria

Cadavers showing evidence of upper limb trauma, surgical scars, congenital deformities, or gross anatomical anomalies were excluded to avoid confounding factors.

The study included 50 cadavers (100 upper limbs), which represented the entire available and eligible sample from the anatomy department over the study period of twelve months. No formal sample size calculation was performed as this was a descriptive cadaveric study aimed at documenting anatomical variation; instead, a total enumeration method was adopted to include all suitable specimens to maximize data reliability within the given timeframe.

Dissection procedure

Standard anatomical dissection techniques were employed. The upper limbs were carefully dissected to expose the biceps brachii muscle, following removal of the overlying skin, superficial fascia, and adjacent musculature. Detailed observations were made for the following:

Long head of the biceps brachii: identified arising from the supraglenoid tubercle of the scapula.

Short head: arising from the tip of the coracoid process.

Third (accessory) head: when present, its presence, site of origin, laterality (unilateral or bilateral), and sex distribution were recorded.

Observation parameters

The site of origin of the third head was specifically categorized as arising from either:

The insertion of the deltoid muscle on the humerus, or

The insertion of the coracobrachialis muscle.

Laterality (right, left, bilateral) and the number of limbs exhibiting each variation were documented. Observations were grouped by **sex** to assess distribution differences between male and female cadavers.

Bias

To minimize potential observational bias, all dissections were performed using standard dissection protocols by the same team of anatomists. Findings were independently cross-verified by two experienced faculty

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members to ensure accuracy and consistency in identifying the third head of the biceps brachii. Any ambiguous findings were jointly reviewed and resolved through consensus to avoid subjective interpretation.

Data analysis

All collected data were recorded in Microsoft Excel and analyzed using descriptive statistics. The frequency and percentage of each variation were calculated. The findings were tabulated and represented in a series of structured tables for ease of interpretation.

Ethical considerations

The study was approved by the Institutional Ethics Committee of GEMS, Srikakulam (Approval No. 161/IEC/GEMS&H/2023, dated 21/12/2023). All protocols adhered to ethical guidelines for cadaveric research.

Results

A total of 100 upper limbs from 50 embalmed cadavers were dissected as part of this study. Of these, 35 were male cadavers contributing 70 upper limbs, and 15 were female cadavers contributing 30 upper limbs (Table 1).

Table 1: Distribution of dissected upper limbs by sex

Sex	Number of Cadavers	Number of Upper Limbs Dissected
Male	35	70
Female	15	30
Total	**50**	**100**

The presence of a third head of the biceps brachii was observed in 10 upper limbs, corresponding to a prevalence of 10% in the study population.

Table 2: Prevalence of the third head of biceps brachii

Sex	Limbs with Third Head	Percentage (%)
Male	8	11.4%
Female	2	6.8%
Total	**10**	**10%**

Among these, 8 limbs (11.4%) were from male cadavers and 2 limbs (6.8%) were from female cadavers (Table 2). This suggests that the third head was more commonly found in males than in females.

Table 3: Site of origin of the third head by sex

Sex	Origin at Deltoid Insertion	%	Origin at Coracobrachialis Insertion	%
Male	5	7.2%	3	4.2%
Female	2	6.8%	0	0%
Total	**7**	**7%**	**3**	**3%**

Regarding the site of origin of the third head, 7 limbs (7%) had the accessory head originating from the insertion site of the deltoid muscle, while 3 limbs (3%) showed origin from the insertion of the coracobrachialis muscle. Among males, 5 third heads (7.2%) arose from the deltoid insertion and 3 (4.2%) from the coracobrachialis insertion. In females, both third heads (6.8%) originated exclusively from the deltoid insertion (Table 3).

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Figure 1:Dissection of the anterior compartment of the arm showing the third head of the biceps brachii originating near the insertion of the deltoid muscle. The forceps indicate the accessory head.

Further analysis of laterality and site-wise distribution revealed that:
In male cadavers, the third head arose bilaterally from the deltoid insertion in 4 limbs (5.7%), unilaterally from the deltoid in 1 limb (1.4%), bilaterally from the coracobrachialis in 2 limbs (2.8%), and unilaterally from the coracobrachialis in 1 limb (1.4%).

Figure 2:Closer view of the third head of the biceps brachii arising from the deltoid insertion. Note the musculocutaneous nerve traversing the accessory muscle fibers.

Table 4: Laterality and site-wise origin of the third head

Sex	Bilateral (Deltoid)	%	Unilateral (Deltoid)	%	Bilateral (Coracobrachialis)	%	Unilateral (Coracobrachialis)	%
Male	4	5.7%	1	1.4%	2	2.8%	1	1.4%
Female	2	6.8%	0	0%	0	0%		

In female cadavers, both third heads (6.8%) originated bilaterally from the deltoid insertion, and no cases were observed with coracobrachialis origin (Table 4).

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Figure 3: Measurement of the third head of the biceps brachii muscle using a scale. The length of the accessory head is shown to be approximately 13.5 cm.

No additional accessory heads beyond the third were identified in any specimen. The origin of the long head (supraglenoid tubercle) and short head (coracoid process) remained consistent across all limbs. Additionally, no associated neurovascular anomalies or deviations in the course of the musculocutaneous nerve were noted.

Discussion

The present study was conducted to determine the prevalence and morphological characteristics of the third head of the biceps brachii in a cadaveric population from North Coastal Andhra Pradesh. Although the biceps brachii muscle generally consists of two heads, numerous anatomical studies have documented the occurrence of a third head, making it one of the frequently encountered muscular anomalies in the upper limb. In the current study, the third head was found in 10% of dissected upper limbs, with a higher occurrence in males (11.4%) compared to females (6.8%).

The prevalence observed in this study is within the range reported in previous literature, which varies from 9% to over 30% depending on the population studied and methodology used [6,7,8]. Variations in prevalence are likely attributable to ethnic, genetic, and developmental factors, supporting the importance of region-specific anatomical data [9].

In the present study, the most frequent origin of the third head of the biceps brachii was found to be the insertion site of the deltoid muscle (7%), followed by the coracobrachialis insertion (3%). This anatomical variation was observed more commonly in males than in females and demonstrated both bilateral and unilateral patterns. The predominance of the deltoid insertion as the origin suggests a regional muscular adaptation or developmental variance specific to the population studied.

This finding is significant because the location of origin can influence the morphology and functional biomechanics of the upper arm musculature. An accessory head arising from the deltoid insertion might contribute additional muscular bulk or alter the course of neurovascular structures, especially the musculocutaneous nerve, increasing susceptibility to entrapment or diagnostic confusion during radiological evaluation.

These observations are consistent with previous reports that identified the deltoid insertion as a common site of origin for the third head, reinforcing the anatomical relevance and recurrence of this variation across diverse populations (10,11).

Bilateral occurrence of the third head was noted in 6 limbs, indicating that while symmetry is possible, unilateral presentation is more frequent. This aspect is important for surgeons, as unilateral anomalies are less likely to be anticipated during procedures involving only one upper limb.

Clinically, the third head may influence the path and branching pattern of the musculocutaneous nerve, potentially predisposing individuals to nerve entrapment syndromes or anatomical distortions that complicate nerve blocks and surgical dissection [6,8]. Its presence may also affect the outcomes of tendon repair, fracture fixation, and reconstructive surgeries of the anterior arm compartment. Additionally, radiologists should consider such muscular variations when evaluating unusual soft tissue masses or signal intensities on imaging studies to avoid misdiagnosis [6,7].

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Generalizability

The findings of this study may be generalizable to similar South Indian populations due to shared genetic and environmental factors. However, caution is warranted when extrapolating to other ethnic or geographic groups, as anatomical variations like the third biceps head may differ across populations. Broader multicentric studies are recommended.

Conclusion

This study highlights the presence of a third head of the biceps brachii muscle in 10% of dissected upper limbs, with a higher prevalence in males. The most common site of origin was the insertion of the deltoid muscle, followed by the coracobrachialis. Bilateral occurrence was more frequent in males, while no accessory heads beyond the third were observed. Understanding such anatomical variations is essential for anatomists, surgeons, radiologists, and clinicians, as these can impact surgical approaches, nerve entrapment assessments, and imaging interpretations. The findings add valuable region-specific data and underscore the need for careful anatomical consideration during upper limb procedures.

Limitations

The study was limited by a relatively small sample size and was confined to cadavers from a single geographic region. Only gross anatomical observations were made; histological or neurovascular assessments were not performed. Therefore, findings may not be fully generalizable to broader populations or living individuals.

Recommendations

Based on the findings of this study, it is recommended that anatomists, surgeons, and clinicians maintain heightened awareness of anatomical variations such as the third head of the biceps brachii during dissection, diagnosis, and surgical interventions. Preoperative imaging and intraoperative vigilance are advised to identify such muscular anomalies, particularly in procedures involving the anterior compartment of the arm. Educational institutions should emphasize these variations during anatomical training to improve future clinical outcomes. Furthermore, additional large-scale, multicentric cadaveric studies across different populations are recommended to better understand the prevalence, morphology, and clinical implications of supernumerary heads of the biceps brachii.

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List of abbreviations

BB – Biceps Brachii
LHB – Long Head of Biceps
SHB – Short Head of Biceps
THB – Third Head of Biceps
MCN – Musculocutaneous Nerve
IEC – Institutional Ethics Committee
GEMS – Great Eastern Medical School

Source of funding

The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

RKU-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. VE-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript. RMR-Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation. VDPM-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.

Data availability

Data is available upon request.

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