

# Bilateral Tricipital Origin of Biceps Brachii

Pulipati Anil Kumar<sup>1</sup>, Eluru Ravitheja<sup>2</sup>

## ABSTRACT

**Introduction:** Normally the biceps brachii arises by two heads. The anatomical variations of number of heads of biceps brachii which may be innervated by either musculocutaneous nerve or median nerve or both are most common. The knowledge of these anatomical variations is important for general surgeons, traumatologists, neurovascular surgeons and radiologists to avoid complications. The aim of the study was to see the variations in the number of heads of biceps brachii.

**Material and Methods:** 80 upper limbs from 40 adult embalmed cadavers were studied in the dissection hall, department of the Anatomy, Great Eastern Medical School and Hospital, Ragolu, Srikakulam District, Andhra Pradesh, India. The anatomical variations in the number of heads of biceps brachii and their innervations with musculocutaneous nerve or/and median nerve were observed.

**Results:** Out of 40 adult cadavers, 3 heads of biceps brachii bilaterally in 3 adult cadavers, and 4 heads in right arm and 3 heads in left arm in one cadaver (4<sup>th</sup> cadaver) innervated by musculocutaneous nerve were reported.

**Conclusion:** The awareness of these anatomical variations in the number of heads of biceps brachii guides the surgeons and radiologists to avoid complications during diagnostic and therapeutic procedures.

**Keywords:** Biceps brachii, Brachialis, Coracobrachialis, Median nerve, Musculocutaneous nerve.

## INTRODUCTION

The biceps brachii, being one of the muscles of anterior compartment of upper arm crossing two joints (shoulder joint and elbow joint) normally arises by two heads namely long head and short head. The long head takes origin as a tendon from supraglenoid tubercle of scapula, becomes intracapsular but extrasynovial in the shoulder joint, comes out of the joint cavity by passing through the opening in the capsule above bicapital sulcus, runs downwards deep to the transverse humeral ligament within the bicapital sulcus whereas short head of biceps brachii along with upper two heads of coracobrachialis takes origin from the tip of coracoid process of scapula. The bellies of both heads of biceps brachii run side by side to join to form a single belly 7cm above the elbow joint. The belly ends as a tendon which after entering into cubital fossa rotates laterally so that the anterior surface of the tendon becomes lateral surface where as posterior surface becomes medial surface, the medial border the tendon becomes anterior border and vice versa in case of lateral border. The posterior part of lateral surface of the tendon is inserted into posterior part of radial tuberosity. A bursa intervenes between anterior part of lateral surface of tendon of biceps brachii and anterior part of radial tuberosity.<sup>1-2</sup>

Musculocutaneous nerve (MCN) which is a branch of lateral cord of brachial plexus, after piercing and supplying the coracobrachialis passes downwards and laterally between

biceps brachii and brachialis where it gives branches to these two muscles. Later it emerges from the lateral border of biceps brachii 5cm above the elbow bent, runs downwards in the lower part of anterior compartment of arm, pierces the deep fascia to become continued as lateral cutaneous nerve of forearm.<sup>1-2</sup>

Median nerve (MN) formed by the medial and lateral roots of median from medial and lateral cords of brachial plexus respectively, runs lateral to the 3<sup>rd</sup> part of axillary artery and upper part of brachial artery, then crosses from lateral to medial and superficial to brachial artery to run downwards along the medial aspect of brachial artery in the lower part of anterior compartment of arm and cubital fossa. Nerve communications are more common between median nerve and musculocutaneous nerve in the axilla and in the anterior compartment of arm.<sup>1-2</sup> Current study aimed to see the variations in the number of heads of biceps brachii.

## MATERIAL AND METHODS

On routine dissection of pectoral, axillary and arm regions of 40 adult embalmed cadavers in the dissection hall, department of the Anatomy, Great Eastern Medical School, Ragolu, Srikakulam District, Andhra Pradesh, India during 2015 – 2017, 3 heads of biceps brachii bilaterally in 3 adult cadavers, 4 heads in 1 right arms and 3 heads in 1 left arms in two cadavers (4<sup>th</sup> cadaver), and their innervation either with musculocutaneous nerve or median nerve or both were observed and photographed.

## STATISTICAL ANALYSIS

Microsoft office 2007 was used for the statistical analysis. Descriptive statistics like mean and percentages were used to interpret the results obtained.

## RESULTS

We observed the following variations in the number of heads of biceps brachii in 4 cases and their innervation by either musculocutaneous nerve or median nerve or both out of 40 adult embalmed cadavers in the dissection hall in the department of Anatomy, Great Eastern Medical School and Hospital, Ragolu, Srikakulam district, Andhra Pradesh, India.

In both arms of upper limbs of 3 adult embalmed cadavers and left arms of 4<sup>th</sup> cadaver (Figures 1 and 2), biceps brachii was seen originating by 3 heads. The long head of biceps brachii was seen originating from supraglenoid tubercle and the short head

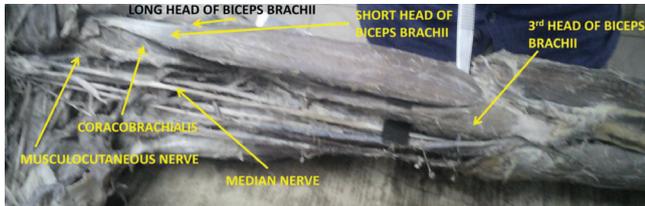
<sup>1</sup>Associate Professor, <sup>2</sup>Assistant Professor, Department of Anatomy, Dr. N.T.R.U.H.S., Vijayawada, A.P., India

**Corresponding author:** Dr. Pulipati Anil Kumar, M.D., D.O., Associate Professor of Anatomy, Department of Anatomy, Great Eastern Medical School and Hospital, Ragolu- 532484, Srikakulam District, Andhra Pradesh, India

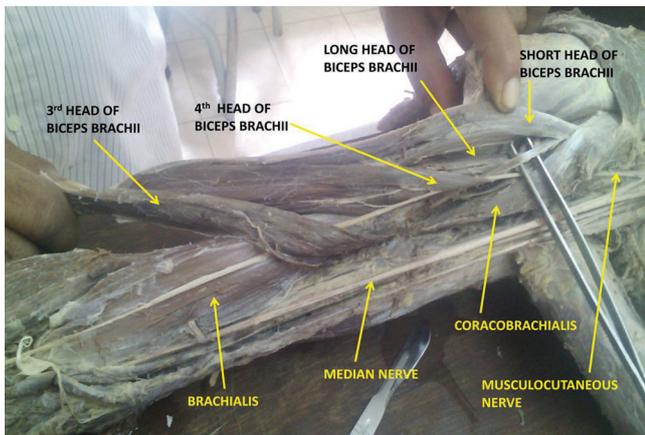
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**Figure-1:** Three headed biceps brachii in right arm



**Figure-2:** Three headed biceps brachii in left arm



**Figure-3:** Four headed biceps brachii in right arm (Its tendon was cut and lifted)

of biceps brachii was found originating from the tip of coracoid process of scapula in common with the origin of coracobrachialis normally. The 2 heads were joined to form a belly which ended into a tendon in the lower part of front of arm. A 3<sup>rd</sup> head was seen originating from the junction between the insertion of coracobrachialis and origin of brachialis from the anteromedial surface of shaft of humerus. The 3<sup>rd</sup> head descended downwards and laterally behind the belly and ended in a tendon to join with the above tendon formed by both long and short heads of biceps brachii to insert into posterior part of radial tuberosity. The MCN originating from lateral cord of brachial plexus, after piercing and supplying the coracobrachialis was seen passing between biceps brachii and brachialis where it gave the muscular branches to all 3 heads of biceps brachii and brachialis. Then it was continued downwards as lateral cutaneous nerve of forearm. MN was found normal in its level of formation, course, relations, branches and distribution. No communications were observed between MN and MCN.

In the right arm of upper limb of 4<sup>th</sup> cadaver (Figure-3), biceps brachii arising by 4 heads was observed. The long head of biceps brachii was seen originating from supraglenoid tubercle of scapula. The short head along with coracobrachialis and 4<sup>th</sup> head of biceps brachii were found originated from the tip of coracoid process of scapula. The 4<sup>th</sup> head joined with the back of short head of biceps brachii. Then both long and short heads were joined to form a belly which ended into a tendon in the

lower part of front of arm to insert into posterior part of radial tuberosity. A 3<sup>rd</sup> head was seen originating from the junction between the insertion of coracobrachialis and the origin of brachialis. The 3<sup>rd</sup> head descended downwards and laterally behind the belly and ended in a tendon to join with the above tendon formed by both long and short heads of biceps brachii. The MCN after piercing and supplying the coracobrachialis was found to pass downwards and laterally first between short and 4<sup>th</sup> heads of biceps brachii, later between short and 3<sup>rd</sup> heads of biceps brachii, and finally between short head and brachialis to emerge lateral to biceps brachii to continue as lateral cutaneous nerve of forearm. The level of formation, course, relations, branches and distribution of median nerve were observed normal. No communications were observed between MN and MCN.

## DISCUSSION

Several authors [Abdullah G. Al- Kushi (2013)<sup>3</sup>, Amar Jayanthi A and Elezy MA (2012)<sup>4</sup>, Asvat R et al.(1993)<sup>5</sup>, Chitra PS and Kalaiyarari S (2016)<sup>6</sup>, El- Naggar MM and Zhir FI (2001)<sup>7</sup>, Hitendra Kumar et al.(2008)<sup>8</sup>, Kosugi K et al.(1992)<sup>9</sup>, Lokanadham S and Subhadra Devi V(2011)<sup>10</sup>, Parthasarathy BM and Sowmya S (2016)<sup>11</sup>, Nakatani T et al.(1998)<sup>12</sup>, Probhjot Cheema and Rajan Singla (2011)<sup>13</sup>, Rai R et al.(2007)<sup>14</sup>, Ramakrishna Avadhani and Chakravarthi KK (2012)<sup>15</sup>, Rodriguez et al(2003)<sup>16</sup>, Sreedevi et al.(2013)<sup>17</sup>, Subhalakshmi W et al.(2015)<sup>18</sup>, Sunitha V and Narasingarao B (2011)<sup>19</sup>, Swieter MG and Carmichael SW (1980)<sup>20</sup>, Vaishaly KB et al. (2015)<sup>21</sup>] reported the presence of supernumerary heads of biceps brachii. Gray's Anatomy<sup>22</sup> reported the incidence of this variation to be as many as 10%. A not uncommon anomaly of the biceps is for it to present a third head, a muscular slip that usually arises in the region of insertion of coracobrachialis (Wolf – Heidegger).<sup>23</sup> In the present study, 3 heads of biceps brachii bilaterally in 3 adult cadavers, 4 heads in right arm and 3 heads in left arm in one cadaver (4<sup>th</sup>) were observed.

Unilateral 3 headed biceps brachii was the commonest anatomical variation to occur but bilateral 3 headed biceps brachii was also reported in 9 male cadavers out of 85 cadavers (Asvat R et al.<sup>5</sup>), 1 cadaver out of 120 cadavers (Amar Jayanthi A And Elezy MA<sup>4</sup>), 1 male cadaver out of 48 cadavers (Hitendra kumar et al.<sup>8</sup>), 1 male cadaver out of 25 cadavers (Parthasarathy BM and Sowmya S<sup>11</sup>), 1 male cadaver (Sunitha V and Narsingarao B<sup>19</sup>), 1 male cadaver (Swieter MG and Carmichael SW<sup>20</sup>), and in 1 female cadaver (Vaishaly KB et al.<sup>21</sup>). According to these authors, this bilateral anatomical variation was found more in males than females. In the present study, bilateral tricipital origin of biceps brachii was observed in 3 male cadavers out of 40 cadavers (7.5%) and male preponderance was noted. This study coincides with the studies of the above authors (Table 1). El-Naggar MM and Zahir FI<sup>7</sup> described that the two bellies of coracobrachialis muscle associated with the third head of biceps brachii although the coracobrachialis was found to have a normal origin, short head of biceps brachii muscle had separate bellies. In the present study, the 4<sup>th</sup> head was seen originating along with 2 bellies of coracobrachialis from the tip of coracoid process of scapula in the right arm of 4<sup>th</sup> cadaver. This study coincides with the study of above authors.

The accessory third head of biceps brachii mainly arose from

antero-medial surface of shaft of humerus just lateral to the insertion of coracobrachialis as was reported by Asvat et al.<sup>5</sup> and Rodriguez- Niefenfuhr et al.<sup>16</sup>, and between the bellies of biceps brachii and brachialis muscles and fused with the posterior aspect of common biceps tendon as described by Swieter and Carmichael.<sup>20</sup> According to Kopuz et al.<sup>24</sup>, the third head of biceps brachii frequently arose from the anterior surface of the humerus distal to the insertion of the coracobrachialis muscle. Kosugi et al.<sup>9</sup> observed that the supernumerary head of biceps arose from the humerus between the insertion of coracobrachialis and the upper part of the origin of brachialis and/or from the medial intermuscular septum. He also reported that in a few cases, the biceps brachii was seen to be arising from the tendon of the pectoralis major, the deltoid, the articular capsule, or the crest of the greater tubercle. In the present study, 3<sup>rd</sup> head took origin from the anteromedial surface of shaft of humerus between the insertion of coracobrachialis and the origin of brachialis and coincides with the studies of Asvat et al.<sup>5</sup>, Rodriguez- Niefenfuhr et al.<sup>16</sup> and Kosugi et al.<sup>9</sup>

Embryologically there are several different opinions or explanations regarding the occurrence of variations of muscle patterns. (a) Sannes et al. (2000)<sup>25</sup> stated that the guidance of the developing axons is regulated by expression of chemo-attractants and chemo-repulsants in a highly coordinated site specific fashion. Any alterations in signaling between mesenchymal cells of somites migrated into the developing limb buds and local mesenchyme and neuronal growth cones can lead to significant variations. (b) The accessory heads of biceps may be due to musculocutaneous nerve that pierces biceps and cause a longitudinal splitting of myotubules which get a covering of connective tissue and becomes a separate belly. Testut (1902)<sup>26</sup> described this variation of third head of biceps brachii as a portion of the brachialis muscle supplied by the musculocutaneous nerve in which its distal attachment (insertion) has been translocated from ulna to the radius. Lokanatham S and Subhadra Devi V (2011)<sup>10</sup> suggested that presence of

supernumerary heads was due to the musculocutaneous nerve piercing the brachialis muscle and producing a supernumerary separate head. (c) Some muscle primordia disappear through cell death despite the fact that cells within them have differentiated to the point of containing myofilaments. Failure of muscle primordia to disappear during development may result in the accessory muscles.<sup>6</sup> Several authors found a male preponderance of accessory head and the incidence was higher in the right arm, suspecting (d) functional adaptation in people who show excessive physical activity. Ramakrishna Avadhani and Chakravarthy KK (2012)<sup>15</sup> explained the presence of supernumerary heads due to (e) genetic origin (f) an inheritance carried over from ancient origins.

According to Swieter MG and Carmichael SW (1980)<sup>20</sup> the origin of biceps brachii from the humerus shaft may cause unusual bone displacement secondary to fracture. The biceps brachii is known for its powerful elbow flexion and supination of the forearm. It can be argued that the presence of supernumerary heads of biceps brachii muscle increase its kinematics. In addition to allowing the elbow flexion irrespective of the shoulder joint position, the third head of biceps brachii may enhance the strength of elbow flexion. Biceps brachii will be useful as a component of flap surgery Mas et al. (2006).<sup>27</sup>

## CONCLUSION

Anatomical variations in the number of heads of biceps brachii are most common. Compression of median nerve and brachial artery may occur when they pass among the supernumerary heads of biceps brachii. Entrapment of muscle fibres of accessory heads of biceps brachii at the site of fracture of humerus may result in non-union of the fracture. Hence the knowledge of these anatomical variations is essential for neurovascular surgeons and traumatologists clinically to prevent complications.

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S. No.	Name of the author	No. of arms/ cadavers studied	No. of cadavers with bilateral tricipital origin of biceps brachii	Percentage of occurrence of cadavers with bilateral tricipital origin of biceps brachii	Presence of total number of cadavers with bilateral tricipital origin of biceps brachii
					Male / Female
1.	Asvat R et al.	170 arms/ 85 cadavers	9	10.58%	9 males
2.	Amar Jayanthi A and Elezy MA	240 arms/ 120 cadavers	1	0.83%	-
3.	Hitendra kumar et al.	96 arms/ 48 cadavers	1	2.08%	1 male
4.	Parthasarathy BM and Sowmya S	50 arms/ 25 cadavers	1	4.00%	1 male
5.	Sunitha V and Narsinga rao B	2 arms/ 1 cadaver	1	100%	1 male
6.	Swieter MG and Carmichael SW	2 arms/ 1 cadaver	1	100%	1 male
7.	Vaishaly et al.	2 arms/ 1 cadaver	1	100%	1 female
8.	Present study	80 arms/ 40 cadavers	3	7.50%	3 males

**Table-1:** Total number of cadavers with bilateral tricipital origin of biceps brachii

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