CASE REPORT

Supernumerary Head of the Biceps Brachii Muscle: An Anatomic Variant With Clinical Implications

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ABSTRACT

Objective: The purpose of this anatomic case report is to describe a variation of the biceps brachii muscle identified in an adult male cadaveric specimen and its potential clinical relevance.
Methods: A cadaveric specimen with a left supernumerary biceps brachii muscle was dissected. Adjacent neurovascular structures were isolated, and their pathways were observed for possible areas of compression.
Results: A tricipital supernumerary head of the biceps brachii muscle was noted on the left upper extremity in an embalmed human cadaveric specimen. The median nerve and brachial artery maintained their common neurovascular path. The musculocutaneous nerve passed deep to the third head of the anatomic variant before distributing its cutaneous branches as the lateral antebrachial cutaneous nerve.
Conclusion: The presence of a supernumerary biceps brachii muscle may cause neurovascular compression of the median nerve, musculocutaneous nerve, or brachial artery, resulting in peripheral nerve deficits. When patient conditions are refractory to care, they may warrant careful evaluation of the anterior compartment of the arm for potential anomalous muscle variations. (J Chiropr Med 2021;20;37-42)
Key Indexing Terms: *Anatomic Variation; Forearm; Musculocutaneous Nerve; Median Nerve*

INTRODUCTION

Clinical assessment of the musculoskeletal system relies on a thorough knowledge and understanding of normal human anatomy. Morphologic variations are frequently encountered that could affect diagnosis and subsequent treatment. The presence of a supernumerary head of the biceps brachii muscle has the potential to compromise adjacent neurovascular structures, leading to motor and sensory deficits.[1-3]

Anatomic variations in the upper extremity are a common finding and affect both muscle and neurovascular structures.[4,5] The biceps brachii is 1 of the most frequently affected muscles.[6] A third, or supernumerary, head of the biceps brachii muscle has occasionally been reported.[1,6] This so called "tricipital biceps muscle" may generate additional power, as well as cause peripheral nerve compression.[7,8] Variations in the distribution of the musculocutaneous nerve have been reported in people with supernumerary heads of the biceps brachii.[9,10] There have also been cases reported where the musculocutaneous nerve passes between the biceps brachii and triceps muscles, resulting in a potential site of nerve compression.[1,11] The path of the brachial artery and median nerve, which course together adjacent to the tendons of the biceps brachii muscle and the brachialis muscle, may also be at risk for neurovascular compromise.[8,12,13]

Nerve entrapments of the upper extremity are a common incidental finding, especially in athletes.[2,7,8,14] Compression of peripheral nerves may present with varying degrees of complications, resulting in paresthesia, muscle weakness, and atrophy.[3,7,8,13] Peripheral nerve compression may result in sensory deficits leading to a decrease in proprioception, joint control, and stabilization, all of which are predisposing factors for injury.[8] The etiology of these compartment syndromes varies, from muscular or fascial adhesions to inflammatory compression of nerve or neurovascular bundles to anatomic variations of muscles or nerves.[3,15] Variant muscle patterns may be considered when assessing patients with nerve entrapment symptoms, those with unusual clinical presentations, or those who do not respond favorably to care.[16]

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Paper submitted September 19, 2020; in revised form December 18, 2020; accepted February 3, 2021.
1556-3707

https://doi.org/10.1016/j.jcm.2021.02.001

This study investigates anatomic variations of the biceps brachii muscle and discusses potential neurovascular compromise and clinical implications.

Case Presentation

The presence of an unusual unilateral supernumerary head of the biceps brachii muscle was observed during a routine upper-extremity dissection of an embalmed adult white male cadaver in the Logan University Department of Anatomy. Before the gift of body donation, a written and signed Logan University anatomic donor consent form was obtained from the deceased, stating that the body donated can be used for scientific, educational, or such related uses as the authorized personnel of the university, in their sole discretion, deem proper. All personal data were de-identified. The handling of anatomic specimens was in accordance with the Logan University ethical policy for body donation for anatomic study and scientific purposes.

The dissection began by removing skin and adipose tissue from the right and left upper extremities. Neurovascular tissue was identified and preserved in order to appreciate its anatomic distribution. The proximal and distal attachments of the muscles of the anterior brachial region were identified, and each muscle was separated and isolated along its fascial planes. Adjacent neurovascular structures were traced along their anatomic pathways in order to identify any areas of possible compression by the variant musculature (Fig 1).

Dissection revealed a unilateral 3-headed biceps brachii muscle in the left upper extremity and a normal biceps brachii muscle on the right side. The common proximal and distal attachments of the brachialis and biceps brachii muscle were noted. The third head of the biceps brachii muscle originated on the lateral portion of the proximal third of the humerus, merged with the common tendon of the short and long heads of the muscle along the distal third of the brachium, and inserted into the radial tuberosity.

The musculocutaneous nerve with its lateral antebrachial branches and median nerve were identified in their in situ arrangement. The median nerve conformed to its typical path within the cubital fossa, without any variation in its course. The musculocutaneous nerve passed deep to the 3 heads of the biceps brachii muscle, while remaining superficial to the brachialis muscle, and terminated as the lateral antebrachial cutaneous nerve. Notably, the musculocutaneous nerve traversed deep to the tendon of the supernumerary biceps muscle at the most distal region of the left brachium (Fig 2). This configuration may be a site of compression. In the right upper extremity, the musculocutaneous nerve terminated as the

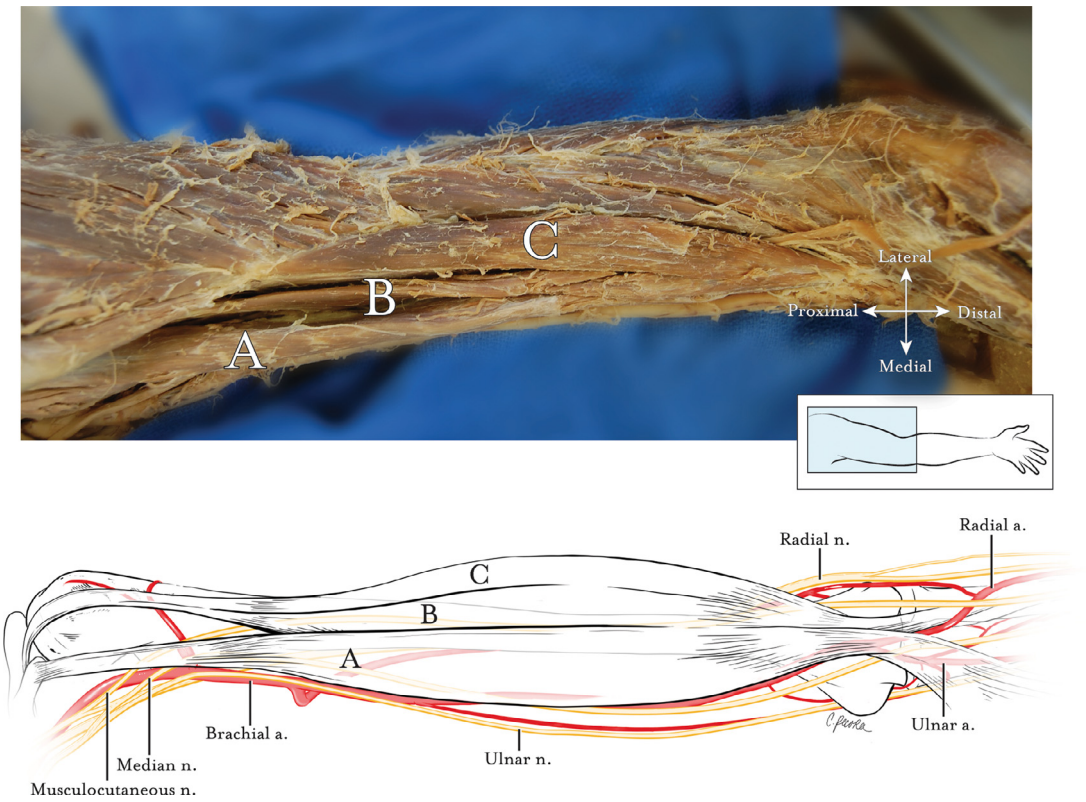

Fig 1. *Photo and illustration of dissection demonstrating the long head (A), short head (B), and supernumerary head (C) of the biceps brachii muscle. Illustration by Christina Pecora.*

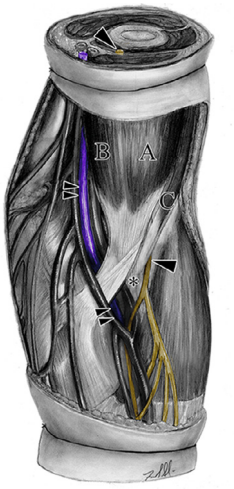

Fig 2. *Illustration of a 3-headed biceps brachii muscle demonstrating the long head (A), short head (B), and supernumerary head (C). The musculocutaneous nerve (yellow), with its lateral antebrachial branches of the forearm, and the median nerve (purple) are common sites for neurovascular compromise. The single black arrowhead signifies where the musculocutaneous nerve passed deep to the tendon of the supernumerary biceps tendon. This may be a site of compression, as typically this nerve passes in the middle to distal third of the brachium. The common insertion point of the brachialis and biceps brachii is shown at the asterisk (*). Illustration by Frank Scali; used with permission.*

lateral antebrachial cutaneous nerve at the middle third of the right brachium, passing between the muscle bellies of the brachialis and biceps brachii.

Discussion

The biceps brachii is a long fusiform muscle of the upper extremity responsible for flexion and supination of the forearm and flexion of the shoulder.[2,17,18] The proximal biceps brachii muscle normally originates as 2 separate heads which converge into a single tendon inserting distally into the radial tuberosity.[17,18] The proximal tendon of the long head attaches to the supraglenoid tubercle of the scapula, becoming intracapsular as it traverses the glenohumeral joint.[17,19] The proximal short head attaches on the coracoid process of the scapula and travels extracapsular to the glenohumeral capsule. Along with the brachialis and coracobrachialis, it receives innervation from the musculocutaneous nerve and its arterial supply from the brachial artery.[2,17] The brachial artery, which courses together with the median nerve between the biceps brachii and the brachialis muscles, may undergo compression in individuals with variations of the biceps brachii muscle.[8,12] The specimen in this study did not reveal a definitive or obvious neurovascular entrapment, but the musculocutaneous nerve may have been at risk for compression at the distal aspect of the supernumerary biceps brachii muscle. The presence of an extra belly of the biceps brachii muscle may cause muscular compressive forces to shift laterally over the area where the musculocutaneous nerve terminates into the lateral antebrachial cutaneous nerve.

This unusual variant of normal anatomy may be clinically significant in cases of neurovascular compromise with unknown etiology. Although this is a rare finding, this study highlights the need for clinicians to recognize potential variations in anatomy, which may present unilaterally, bilaterally, or in combination with other anatomic variants. Additional examinations or focused diagnostic testing, including imaging or electrodiagnostic testing, may improve diagnoses and treatment outcomes.

Muscular Variations

Anatomic variants in the upper extremity are a common incidental finding.[20,21] Numerous muscular variations have been reported in the upper extremity of cadavers, with the biceps brachii being 1 of the most common.[6,8,22] A supernumerary head of the biceps brachii is the most frequently occurring muscular variation in the upper limb and the most common biceps brachii muscle variant, with a prevalence[5,10] of between 7.5% and 18.3%. Anatomic variants from 4 to 7 heads of the biceps brachii muscle have also been reported.[12,23] Supernumerary heads of the biceps brachii muscle have been categorized by their proximal and distal attachments as superior, inferomedial, or inferolateral humeral heads.[24] One study documented the presence of a third head in 23 of 175 (13.1%) cadavers or in 27 of 350 (7.7%) upper extremities.[24] In 26 arms (7.4%), the third belly of the supernumerary biceps brachii muscle was an inferomedial humeral head, whereas 1 arm (0.3%) revealed an inferolateral humeral head. Another study reported that 10% of the time, the variant biceps brachii belly originates from the superomedial part of the brachialis and attaches to the bicipital aponeurosis as well as the tendon of the biceps brachii muscle.[2] The proximal attachment of the present report's unilateral variant at the superolateral portion of the biceps brachii identifies this configuration as a rare variation.

In addition to the number of heads comprising the biceps brachii muscle, there are variations in attachment sites for other muscles, such as the brachioradialis. These accessory muscle variations also commonly present with minor nerve variations, which may cause changes in sensory nerve distribution.[21,25]

The prevalence of anatomic variations of the biceps brachii muscle depends on a person's origin (Table 1).[1,2,4] The prevalence of bicipital supernumerary heads has been reported as 38% in Colombians, 21% in black South Africans, 18% in Japanese people, 15% in Turkish people, 12% in black Africans, 10% in white Europeans, 8% in Chinese people and white South Africans, 20% in white Brazilians, 9% in black Brazilians, and 2% in Indian

Table 1. *Prevalence of Bicipital Supernumerary Head in Various Populations*

Population	Prevalence, %	Reference
Colombian	38	Rincon et al[26]
Turkish	15	Kopuz et al[27]
Japanese	18	Bergman[28], Kosugi[29]
African black	12	Bergman et al[28]
South African black	20.5	Asvat et al[4]
South African white	8.3	Asvat et al[4]
European white	10	Khaledpour[30]
Brazilian white	20	Neto et al[31]
Brazilian black	9	Neto et al[31]
Chinese	8	Bergman et al[28]
Indian	2	Nayak et al[32]
Indian (North Karnataka)	3.75	Bagoji et al[33]
Sri Lankan	3.7	Ilayperuma[34]
Greek	1.6	Paraskevas et al[35]
Nepalese	6.25	Poudel and Bhattarai[36]
Spanish	15.4	Rodriguez-Niedenfuhr et al[24]
Thai	35	Techataweewan[37]
Saudi Arabian	10	Nasr et al[38]

people.[1,2,4] Most authors report that an accessory biceps brachii head tends to occur asymmetrically, more often on the right.[2,4] However, others report no preference as to side.[5,39] Although some authors report a higher incidence in males than females, there is no clear consensus as to the role of gender in biceps brachii variations.[4,5]

Nerve Variations

Variations of nerves in the upper extremity have been reported in conjunction with bicipital supernumerary heads.[12,18,40,41] The presence of a supernumerary head of the biceps brachii muscle has been associated with either a complete absence or a duplication of the musculocutaneous nerve in 1.7% to 15% of the population.[1,10] Kosugi et al describe variations of the musculocutaneous nerve and divide them into 5 categories depending on how they attach to the median nerve. Group I has no communication with the median nerve; group II has a communicating branch from the musculocutaneous nerve to the median nerve; group III has a branch from the median nerve to the musculocutaneous nerve; group IV has both group II and group III branches; and group V presents multiple variations.[1] Other studies have reported up to 13 distinct variations of the musculocutaneous nerve associated with a supernumerary bicipital head, affecting 6.25% of the population.[10,12,18] Some of these variations include an intramuscular course of the nerve between the long head and the third head.[10,12,18] This variant can cause compartment syndromes, producing pain, muscular weakness, or paresthesia of the lateral forearm.[12,18]

Function

The biceps brachii muscle generates actions responsible for flexion of the humerus at the glenohumeral joint, supination of the forearm, and flexion at the elbow.[3] Depending on the size of the third head, the additional mass may provide a substantial contribution to strength in flexion and supination of the forearm.[4,18,23,42] This increased bicipital muscle size may also create compression of peripheral nerves.[7,18] Specifically, compression of the median nerve may be associated with an aberrant muscle attachment of a supernumerary head.[9,23] Additionally, compression of the musculocutaneous nerve may cause decreases in strength in the biceps brachii, coracobrachialis, or brachialis muscles, or neurosensory changes of the lateral forearm and anterior elbow joint capsule.[3,5,7]

Clinical Implications

Variations in nerves of the upper extremity have been reported in conjunction with bicipital supernumerary heads. These variations may contribute to changes in strength, sensation, and function, mimicking common peripheral neuropathies of the upper extremity. With the addition of the rare muscular variant discussed in this study, altered bicipital kinematics may be present, increasing flexion and supination of the elbow.[8] The wide variability in presentation of neurovascular structures associated with muscular variants predisposes individuals to entrapment syndromes. These compartment syndromes may complicate symptomatology usually associated with median or musculocutaneous nerve injuries, creating diagnostic challenges.

The upper limb tension test used as part of a standard provocative orthopedic evaluation for cervical radiculopathy or nerve entrapment syndromes of the upper extremity has a 50% sensitivity and 86% specificity for the diagnosis of nerve root impingement compared to needle electromyography and nerve conduction studies.[11,16,43] Positive tension tests are a common diagnostic indicator of cervical spine disc, nerve root lesion, or brachial plexus

injuries.[16,43] The presence of the anatomic variations discussed may cause false positives in orthopedic tests, especially nerve tension tests.[7,11,16,44] With the potential for neurovascular compromise in this relatively common anatomic variant, orthopedic or neurologic tests that seem to conflict with the patient presentation may be a clue to this condition. Suspected nerve root lesions that are refractory to conservative care may warrant additional imaging, such as diagnostic ultrasound, for evaluation of potential variations in anatomy. Anatomic variations of the biceps brachii muscle may be clinically important and require additional investigation to rule out their involvement.

Limitations

This case report describes a single anatomic finding of a tricipital supernumerary biceps brachii muscle in a human cadaver. While this variation in anatomy may be common within some populations, this single case discovered during a routine dissection cannot justify a discussion of provenance within the general population. Morphometric and histologic analysis of tissue samples were not included in this study.

Conclusion

Anatomic variations of the biceps brachii muscle and structures within the anterior brachial compartment are common. The presence of a supernumerary biceps brachii muscle may cause neurovascular compression of the median nerve, musculocutaneous nerve, or brachial artery, resulting in neurosensory and motor deficits. Patient conditions that are refractory to care may warrant careful evaluation of the anterior compartment of the arm for potential muscle variations.

Acknowledgments

The authors thank Christina Pecora, MSMI, for anatomic artwork and Sara Riegel, DC, for her assistance in the literature and manuscript review.

Funding Sources and Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): D.E., F.S.
Design (planned the methods to generate the results): D.E., F.S., K.S.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): D.E.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): D.E., F.S., R.K.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): D.E., F.S., R.K.
Literature search (performed the literature search): D.E., K.S., R.K.
Writing (responsible for writing a substantive part of the manuscript): D.E., F.S., K.S., R.K.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): D.E., F.S., K.S., R.K.
Other (list other specific novel contributions): Illustration and anatomic dissections: F.S.

Practical Applications

- Of the numerous muscular variations, the biceps brachii muscle is 1 of the most commonly affected, with a supernumerary head of the biceps brachii the most frequently occurring variation.
- The presence of a supernumerary head of the biceps brachii muscle may potentially compromise adjacent neurovascular structures, leading to motor and sensory deficits.
- Patient conditions that are refractory to care or indicate suspicion of nerve root lesions may warrant additional assessment of the anterior compartment of the arm, including diagnostic ultrasound, to identify potential variations in anatomy.

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