



STUDY OF VARIANT HEADS OF TRICEPS MUSCLE WITH ITS DEVELOPMENTAL BASIS.

Sharadkumar Pralhad Sawant

Department of Anatomy, K. J. Somaiya Medical College, Somaiya Ayurvihar, Eastern Express Highway, Sion, Mumbai-400 022. E-mail: drspsawant@gmail.com

ABSTRACT

Materials & Methods: The study on variant heads of triceps muscle was performed on 100 (200 specimens of superior extremities) embalmed donated cadavers (90 males & 10 females) in the department of Anatomy of K.J.Somaiya Medical College, Sion, Mumbai, India. The dissection of the arm and forearm was done meticulously to expose the triceps muscle. The variant heads of triceps muscle was observed. The neuro vascular pattern of the upper limb were also observed. The photographs of the variant heads of triceps muscle were taken for proper documentation.

Observations: Out of 200 specimens of superior extremities the variant heads of triceps muscle were observed in 4 specimens. In all the 4 specimens, the fourth head of the triceps brachii muscle was originated from the postero-medial aspect of the shaft of the humerus just below the surgical neck. The variant fourth head of the triceps brachii muscle was supplied by the radial nerve. The fourth head passed directly over the neurovascular bundle containing the radial nerve and profunda brachii artery. The long, lateral and fourth heads of the triceps brachii muscle converged to form a superficial tendon which was inserted into the posterior part of the superior surface of the olecranon process of the ulna. The medial head of triceps muscle was partly inserted into the superficial tendon and partly into the posterior part of the superior surface of the olecranon process of the ulna. The associated altered anatomy of the nerves and vessels were not observed. All the variations were unilateral.

Conclusion: The role of additional muscles in compression syndrome is a well known phenomenon. The knowledge of such type of variation is clinically important for Anatomists, Neurologists, Radiologists, Surgeons, Plastic surgeons and Orthopedicians.

Key words: Triceps Brachii, Fourth Head, Radial Nerve, Profunda Brachii Artery, Shaft of Humerus, Olecranon Process of Ulna, Radiologists, Orthopedicians.

INTRODUCTION

The triceps brachii muscle is the large muscle on the back of the arm of many vertebrates. It is the muscle principally responsible for extension of the elbow joint. The plural form of triceps was tricipites, a form not in general use today; instead, triceps is both singular and plural. The triceps also make up approximately 2/3 of the muscle mass in the arm [1]. The long head arises from the infraglenoid tubercle of the scapula. It extends distally anterior to the teres minor and posterior to the teres major. The medial head arises distally from the groove of the radial nerve; from the dorsal (back) surface of the humerus; from the medial intermuscular septum; and its distal part also arises from the lateral intermuscular septum. The medial head is mostly covered by the lateral and long heads, and is only visible distally on the humerus. The lateral head arises from the posterior surface of the humerus, lateral and proximal to the radial groove, from the greater tubercle down to the region of the lateral intermuscular septum [2]. Each of the three fascicles has its own motorneuron subnucleus in the motor column in the spinal cord. The medial head is formed predominantly by small type I fibers and motor units, the lateral head of large type II b fibers and motor units and the long head of a mixture of fiber types and motor units. It has been suggested that each fascicle "may be considered an independent muscle with specific functional roles [3]. All three heads of the triceps brachii are classically believed to be innervated by the radial nerve [4]. However, the long head may be innervated by a branch of the axillary nerve [5].

The long and lateral heads of the triceps brachii muscle converged to form a superficial tendon which get inserted into the posterior part of the superior surface of the olecranon process of the ulna. The medial head of triceps muscle get partly inserted into the superficial tendon and partly into the posterior part of the superior surface of the olecranon process of the ulna. The triceps is an extensor muscle of the elbow joint and an antagonist of the biceps and brachialis muscles. It can also fixate the elbow joint when the forearm and hand are used for fine movements, e.g., when writing. It has been suggested that the long head fascicle is employed when sustained force generation is demanded, or when there is a need for a synergistic control of the shoulder and elbow or both. The lateral head is used for movements requiring occasional high-intensity force, while the medial fascicle enables more precise, low-force movements (3). With its origin on the scapula, the long head also acts on the shoulder joint and is also involved in retroversion and adduction of the arm (2). In the horse, 84%, 15% and 3% of the total muscle weight correspond to the long, lateral and medial heads, respectively (6). In humans, the Anconeus is sometimes loosely called "the fourth head of the triceps brachii."

MATERIALS AND METHODS

The study on variant heads of triceps muscle was performed on 100 (200 specimens of superior extremities) embalmed donated cadavers (90 males & 10 females) in the department of Anatomy of K.J.Somaiya Medical College, Sion, Mumbai, India. The dissection of the arm and forearm was done meticulously to expose the triceps muscle. The variant heads of triceps muscle was observed. The neuro vascular pattern of the upper limb were also observed. The photographs of the variant heads of triceps muscle were taken for proper documentation.

Observations

Out of 200 specimens of superior extremities the variant heads of triceps muscle were observed in 4 specimens. In all the 4 specimens, the fourth head of the triceps brachii muscle was originated from the postero-medial aspect of the shaft of the humerus just below the surgical neck. The variant fourth head of the triceps brachii muscle was supplied by the radial nerve. The fourth head passed directly over the neurovascular bundle containing the radial nerve and profunda brachii artery. The long, lateral and fourth heads of the triceps brachii muscle converged to form a superficial tendon which was inserted into the posterior part of the superior surface of the olecranon process of the ulna. The medial head of triceps muscle was partly inserted into the superficial tendon and partly into the posterior part of the superior surface of the olecranon process of the ulna. The associated altered anatomy of the nerves and vessels were not observed. All the variations were unilateral.

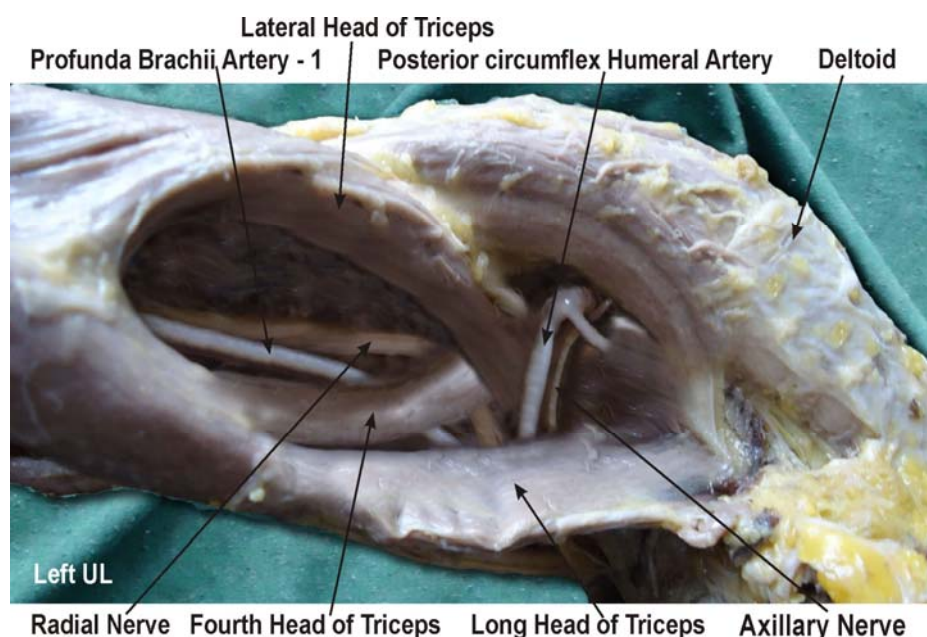


Figure 1 showing the photographic presentation of the variant fourth head of triceps brachii muscle arising from the postero-medial aspect of the shaft of the humerus just below the surgical neck.

DISCUSSION

The triceps brachii muscle is normally composed of three heads. The long head originates from the infraglenoid tubercle, the lateral head from the humerus superior to the radial groove and lateral intermuscular septum and the medial head from the humerus inferior to the radial groove and medial intermuscular septum. This entire muscle inserts onto the olecranon process and contributes to the extension of forearm. It is supplied by a branch from the radial nerve and deep brachial artery [1]. In the present case, the fourth head of the triceps brachii muscle was originated from the postero-medial aspect of the shaft of the humerus just below the surgical neck. The similar proximal attachment of the fourth head of the triceps brachii was observed by Fabrizio and Clemente [7]. The variant fourth head of the triceps brachii muscle was supplied by the radial nerve. The long, lateral and fourth heads of the triceps brachii muscle converged to form a superficial tendon which was inserted into the posterior part of the superior surface of the olecranon process of the ulna. The medial head of triceps muscle was partly inserted into the superficial tendon and partly into the posterior part of the superior surface of the olecranon process of the ulna. This type of distal attachment of the fourth head of the triceps brachii to the long head of triceps has been mentioned earlier by Macalister [8]. The variations of triceps brachii muscle are not common, but yet they have been reported by some authors [7]. The long head of triceps may split with one tendon attached to the capsule of the shoulder joint; the common tendon of insertion may be attached to the anconeus; there may be fusion between the lateral head of triceps and the extensor carpi ulnaris; a duplicated lateral head of triceps may be present and a slip from the tendon of the latissimus dorsi may be attached to triceps brachii; a slip from the long head of triceps may attach to the coracoid process of the scapula; slips may be found attaching to the triceps from the subscapularis [8,9,10]. A muscular slip from the tendon of latissimus dorsi to the long head of triceps called as 'latissimocondyloideus' was found in literature [11]. According to Macalister there are three types of variations of triceps brachii muscle, the additional fourth head arising from the medial part of humerus, the slips arising from the tendon of latissimus dorsi or teres major and the splitting of long head with one part attached to capsule and other to tricipital spine or axillary border [8]. A fourth head of triceps may arise from various points on the humerus, scapula, shoulder joint capsule or the coracoid process [10]. In the present study the fourth head passed directly over the neurovascular bundle containing the radial nerve and profunda brachii artery. Clinicians diagnosing or treating patients with weakness or pain of posterior arm should consider variations of this compartment that may result in neurovascular compression [12].

Ontogeny

Embryologically, the intrinsic muscles of the upper limb differentiate in situ, opposite the lower six cervical and upper two thoracic segments, from the limb bud mesenchyme of the lateral plate mesoderm. The formation of muscular elements in the limbs takes place shortly after the skeletal elements begin to take shape. At a certain stage of development, the muscle primordia within the different layers of the arm fuse to form a single muscle mass [13]. Langman stated, however, that some muscle primordia disappear through cell death despite the fact that cells within them have differentiated to the point of containing myofilaments [14]. During fifth week of development, mesoderm invades the upper limb bud to further condense into ventral and dorsal muscle masses [15]. The triceps muscle is derived from dorsal muscle mass of upper limb bud and it could be during this period that accessory muscles may have formed. The failure of muscle primordia to disappear during embryologic development may account for the presence of the accessory muscular bands reported in this case.

Phylogeny

Studies of comparative anatomy have observed the existence of such fourth head, the accessory head in many mammals, such as dogs, cows and pigs. It lies between the lateral and medial heads (3). Considering the fourth head of the triceps brachii muscle as a remnant from the phylogenetic or comparative anatomical point of view and the ontogeny recapitulates the phylogeny.

Clinical Significance

The variant triceps muscle is clinically important for surgeons dealing with entrapment or compressive neuropathies, orthopaedicians operating on the fractures of the humerus, anaesthetist performing pain management therapies on the upper limb, the radiologists while doing radiodiagnostic procedures e.g. CT scan, MRI of the arm and angiographic studies and physiotherapist doing electromyography for evaluating and recording the electrical activity produced by skeletal muscles.

CONCLUSION

The variant triceps muscle is a rare occurrence. The knowledge of such variation is important for plastic surgeons performing 'free functional muscle transfer'.

ACKNOWLEDGEMENT

Author is thankful to Dean Dr. Geeta Niyogi Madam for her support and encouragement. Author is also thankful to Mr. M. Murugan, Mr. Sanjay, Mr. Sankush, Mr. Pandu, Mr. Kishor and Mr. Raju for their help. Author also acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The author is also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

REFERENCES

- [1] Williams P. L., Warwick R., Dyson M., Bannister L. H., Gray's Anatomy, 39th Ed., New York, Churchill Livingstone, 2005, 615–616.
- [2] Platzer, Werner. Color Atlas of Human Anatomy, Vol. 1: Locomotor System, 5th ed., Thieme. 2004, ISBN 3-13-533305-1.
- [3] Lucas-Osma, AM; Collazos-Castro, JE. "Compartmentalization in the triceps brachii motoneuron nucleus and its relation to muscle architecture". J Comp Neurol 2009, 516 (3), 226–39.
- [4] Bekler H, Wolfe VM, Rosenwasser MP "A Cadaveric Study of Ulnar Nerve Innervation of the Medial Head of Triceps Brachii". Clinical Orthopaedic Related Research, 2009, 467 (1), 235–238.
- [5] de Se`ze MP, Rezzouk J, de Se`ze M, Uzel M, Lavignolle B, Midy D, Durandeau A . "Does the motor branch of the long head of the triceps brachii arise from the radial nerve?" Surgical Radiological Anatomy 2004, 26 (6), 459–461.
- [6] Watson, JC; Wilson, AM. "Muscle architecture of biceps brachii, triceps brachii and supraspinatus in the horse". Journal of Anatomy, 2007, 210 (1), 32–40.
- [7] Fabrizio P. A., Clemente F. R. Variation in the triceps brachii muscle: a fourth muscular head. Clinical Anatomy, 1997, 10, 259–263.
- [8] Nayak S. R., Krishnamurthy A., Kumar M., Prabhu L. V., Saralaya V., Thomas M. M. Four headed biceps and triceps brachii muscles with neurovascular variation. Anat. Sci. Int., 2008, 83, 107–111.
- [9] Wood J. On human muscular variations in their relation to comparative anatomy. Journal of Anatomy & Physiology, 1867, 31, 44–59.
- [10] Anson B. J. Morris' Human Anatomy. 12th Ed., New York, McGraw-Hill, 1996, 482–484.
- [11] Bergman R. A., Afifi A. K., Miyauchi R. Anatomy Atlases: Illustrated Encyclopedia of Human Anatomic Variation. 2009,
- [12] Tubbs R. S., Salter E. G., Oakes W. J. Triceps brachii muscle demonstrating a fourth head, Clinical Anatomy 2006, 19, 657–660.
- [13] Arey L. B. Developmental Anatomy, In: A Textbook and Laboratory Manual of Embryology, 6th Ed., Philadelphia, WB Saunders company, 1960, 434–435.
- [14] Langman J. Medical Embryology. 2nd Ed., Baltimore, Williams and Wilkins, 1969, 143–146.
- [15] Schoenwolf G. C., Bleyl S. B., Brauer P. R., Francis-West P. H. Larsen's Human Embryology. 4th Ed., Philadelphia, Churchill Livingstone, 2009, 241–242.