ISSN 2563-7142

CASE REPORT

Bilateral Long Head of the Triceps Brachii Muscle Innervation via Axillary Nerve: A Case Report

William M Scogin[1], Alexandra R Vinson[1], Cristina B Pfister[1], Kathryn M Johnson[1], Jamie N Holmes[1], Hannah E Capps[1], Cassidy R Romans[1], R Mark Caulkins[1], Kathleen E McKeon[2,3], Nicholas B Washmuth[1*]

Scogin WM, Vinson AR, Washmuth NB, et al. Bilateral Long Head of the Triceps Brachii Muscle Innervation via Axillary Nerve: A Case Report. Int J Cadaver Stud Ant Var. 2023;4(1):22-26.

Abstract

The radial nerve has traditionally been considered the innervation of the long head of the triceps brachii muscle. However, cadaveric studies have discovered long head of the triceps brachii muscle innervation via the axillary nerve in roughly 6-15% of shoulders. A cadaver with exclusive axillary nerve innervation to the long head of the triceps brachii muscle bilaterally was discovered during cadaveric dissection in a graduate course at Samford University. This anatomical variation may have clinical implications for surgeries, shoulder dislocations, and quadrilateral space syndrome. Axillary nerve injuries may additionally present with shoulder extension and elbow extension weakness if this variation is present.

Key Words: *Axillary nerve; Triceps brachii long head; Anatomical variation; Clinical significance*

Introduction

Traditional anatomy textbooks consider the radial nerve (C5, C6, C7, C8, and T1) to be the exclusive innervation of the triceps brachii while the axillary nerve (C5,C6) is responsible for innervating the deltoid and teres minor muscles [1]. However, cadaveric dissections have reported variability in the long head of the triceps brachii muscle (LHT) innervation [2,3]. Pure radial, pure axillary, and dual innervation of the LHT have all been reported [2]. Erhardt & Futterman (2020) studied 22 cadaveric shoulders and found that isolated axillary nerve innervation of the LHT was present in only 3 shoulders, thus roughly estimating the prevalence of this variation at 15% [3]. Mehta et al. (2020) reported isolated axillary nerve innervation to the LHT in only 2 out of 30 shoulders [4].

[1]Samford University, 800 Lakeshore Drive, Birmingham, Alabama 35229, USA
[2]Andrews Sports Medicine & Orthopaedic Centers, 805 St. Vincents Drive, Birmingham, Alabama 35205, USA
[3]American Sports Medicine Institute, Birmingham, Alabama

[*]Corresponding author: Nicholas B Washmuth, Associate Professor, Department of Physical Therapy, Samford University, 800 Lakeshore Drive, Birmingham, AL 35229, USA, Phone: 314-229-8043; E-mail: nwashmut@samford.edu

Received: April 10, 2023, Accepted: April 21, 2023, 2023, Published: May 12, 2023

Additionally, in Erhardt & Fetterman's (2020) study, dual radial and axillary innervation of the LHT was found to be present in 50% of the cadavers [3]. We present here a case of bilateral axillary nerve innervation of the LHT, as well as potential clinical implications of this anomaly.

The axillary and radial nerves emerge from the posterior chord of the brachial plexus [5]. Along with deltoid and teres minor innervation, the axillary nerve also supplies sensory innervation to the superolateral arm [1]. The radial nerve and its branches supply sensory innervation to the posterolateral arm, posterior forearm, and dorsum of the hand [6]. In addition to the triceps brachii, the radial nerve also supplies motor innervation to the brachioradialis, anconeus, and extensor carpi radialis longus muscles [6]. The posterior interosseous nerve branches from the radial nerve to supply the remaining wrist extensors and the finger extensors. The LHT originates on the infraglenoid tubercle of the scapula and inserts at the olecranon via the common triceps tendon [1]. The triceps brachii muscle acts to extend the humerus at the shoulder in addition to extending the forearm at the elbow.

Case Report

An 89-year-old White male cadaver was obtained by Samford University for cadaveric dissection during the spring 2023 semester in Birmingham, Alabama. The cadaver exhibited no significant surgical history and presented with unremarkable height and weight upon postmortem examination. The cause of death was diabetic chronic renal disease. It is unknown if these anomalies were known to the subject, or if there were any symptoms associated with them. There was no evidence of scars or trauma in either shoulder region.

The innervation of the LHT via the axillary nerve was discovered during posterior arm and axilla dissection of the right upper extremity (Figure 1). With the cadaver positioned prone, the muscles of the posterior compartment of the arm were identified and separated from the brachial fascia. When identifying the quadrilateral space of the right posterior arm, the axillary nerve was found piercing the LHT with no innervation from the radial nerve (Figures 2 and 3). Blunt dissection was used to track the radial nerve from axilla to cubital fossa. The radial nerve continued distally into the arm with no branches piercing the LHT. The dissection process was repeated in the left arm, and the same variation was found (Figure 4).

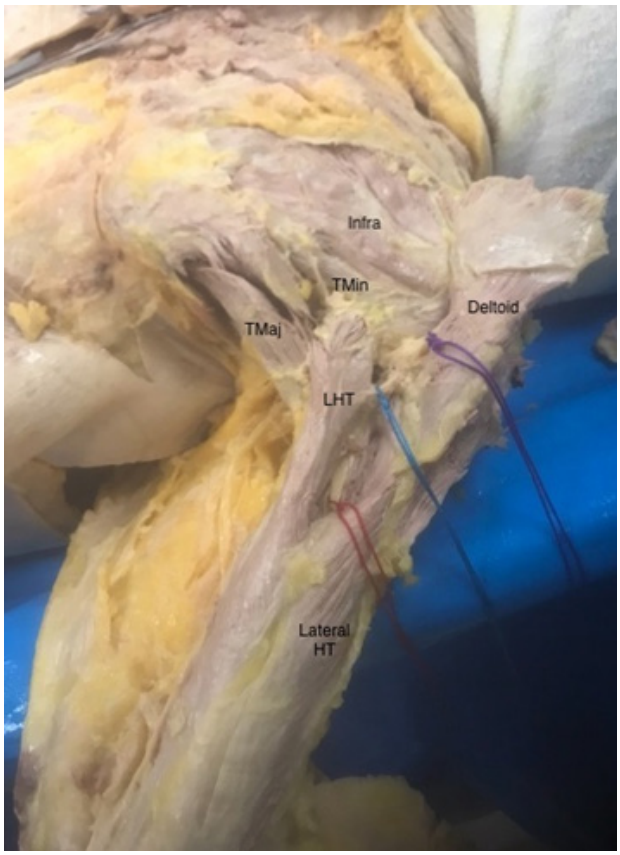

Figure 1) *Right shoulder showing radial nerve (red string), Axillary nerve (purple), and axillary nerve branch to LHT (blue).*

LHT-Long head of the triceps brachii; Lateral HT-Lateral head of the triceps brachii; Infra-Infraspinatus; TMaj–Teres Major; TMin-Teres Minor

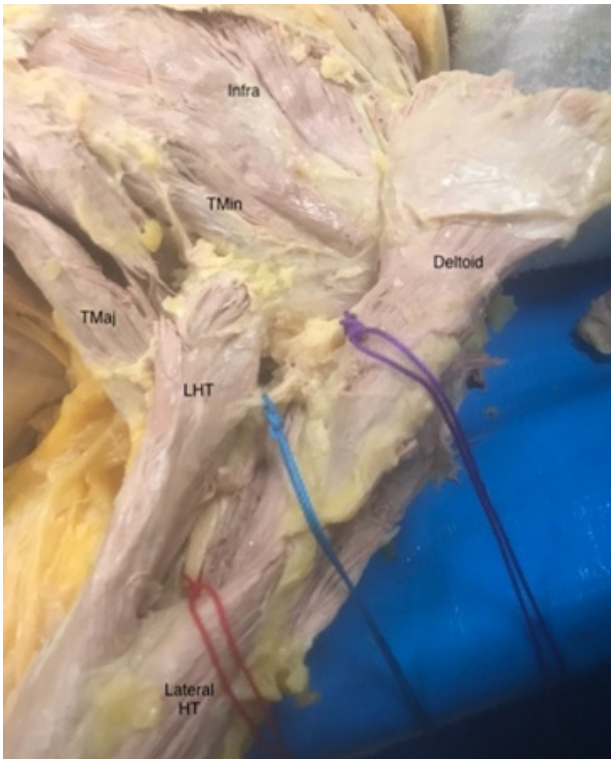

Figure 2) *Right shoulder showing radial nerve (red string), Axillary nerve (purple), and axillary nerve branch to LHT (blue).*

LHT-Long head of the triceps brachii; Lateral HT-Lateral head of the triceps brachii; Infra–Infraspinatus; TMaj–Teres Major; TMin–Teres Minor

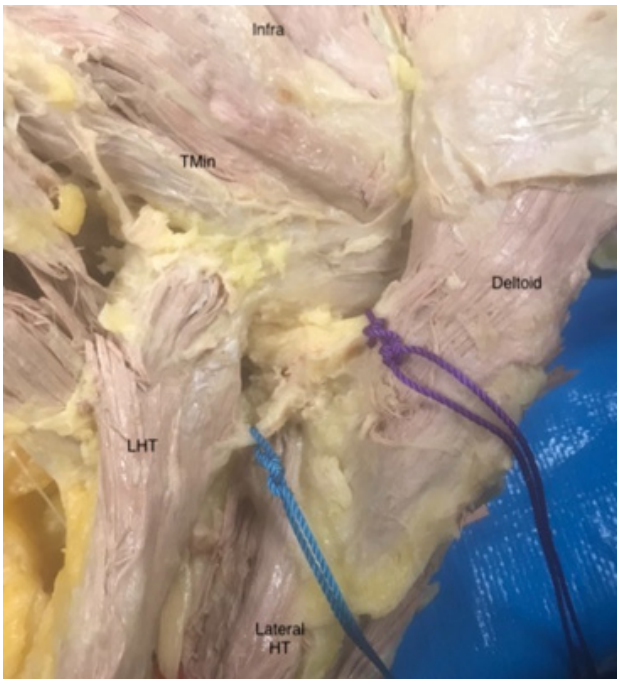

Figure 3) *Right shoulder showing radial nerve (red string), AxilRight shoulder showing Axillary nerve (purple), and axillary nerve branch to LHT (blue).*

LHT-Long head of the triceps brachii; Lateral HT-Lateral head of the triceps brachii; Infra-Infraspinatus; TMaj-Teres Major; TMin-Teres Minor

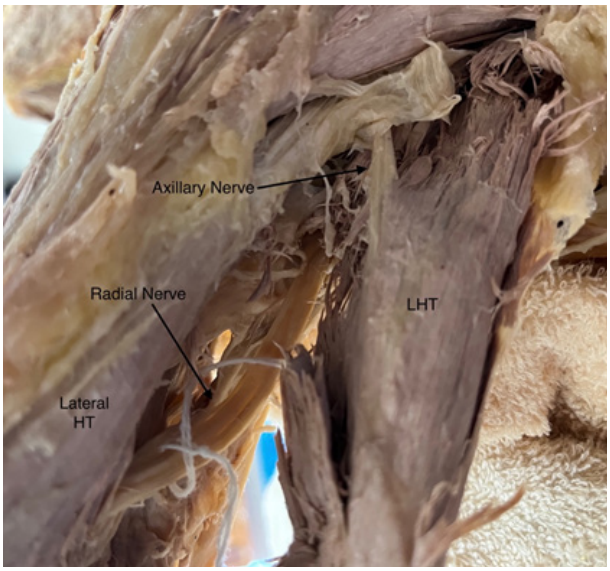

Figure 4) *Left shoulder showing radial nerve (white string) and axillary nerve piercing the LHT.*

LHT–Long head of the triceps brachii; Lateral HT–Lateral head of the triceps brachii.

Discussion

There are several surgical and clinical implications to consider with this anatomical variation. Axillary nerve injury has been reported during acromioclavicular joint reconstruction [7], total shoulder arthroplasty and reverse shoulder arthroplasty [8], and anterior shoulder reconstruction [9]. Additionally, axillary nerve injury due to quadrilateral space compression or shoulder dislocation is well documented.

The quadrilateral space is defined as the space between the teres minor muscle, teres major muscle, LHT, and the lateral head of the triceps brachii muscle. The posterior circumflex humeral artery and axillary nerve pass through the quadrilateral space, the latter of which has consistent bifurcation within the space [10]. Quadrilateral space syndrome can occur when the axillary nerve becomes impinged within this space. Paresthesia, motor loss, and pain are common clinical symptoms for those suffering from axillary nerve compression in

the quadrilateral space [11]. Strength deficits in the deltoid and teres minor muscles may lead these patients to demonstrate weakness in glenohumeral abduction and external rotation.

In the case of LHT innervation via the axillary nerve, mild weakness may also be seen in shoulder and elbow extension. Severe weakness would be unlikely, as other muscles work in conjunction with the LHT to perform these actions. It is unknown whether peripheral cutaneous innervation was altered in this person. It is possible that this anomalous axillary nerve had sensory branches to supply cutaneous innervation more distally or posteriorly in the arm that expected.

Shoulder dislocation injuries commonly lead to peripheral nerve injuries, with the axillary nerve involvement reported in up to 60% of dislocations [12]. Shoulder dislocations can also lead to injury of terminal branches of the brachial plexus to varying degrees, depending on the injury location and severity. Risk factors for neurological complications with shoulder dislocation from simple fall include older age (greater than 50) and male sex, [12] both of which apply to this case. Often in shoulder dislocations, the mechanism of injury involves the axillary nerve being stretched during arm abduction and external rotation, resulting in a traction injury. The likelihood of axillary nerve traction during shoulder dislocation may increase in cases where the axillary nerve pierces the LHT.

Typical axillary nerve injuries would display symptoms such as shoulder instability, impaired movement, and loss of abduction [12]. The addition of LHT innervation would likely lead to additional weakness previously mentioned. Recovery of shoulder dislocation injury with this nerve anomaly may be prolonged or require nerve or tendon transfers as compared to spontaneous recovery.

Conclusion

The anatomical variation of bilateral axillary nerve innervation to the long head of the triceps brachii muscle is rare. This anomaly may have potential clinical implications for both surgeons and non-operative clinicians.

Acknowledgements

We would like to thank the donors and their families for their beneficial contribution. Without their generosity, this article would not have been possible. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors' contributions: RMC, NBW and WMS were responsible for idea conceptualization. WMS, ARV, CBP, KMJ, JNH, HEC, CRR, RMC, KEM, and NBW were responsible for writing and approving manuscript prior to submitting.

References

1. Moore KL, Agur AMR, Dalley AF. Essential Clinical Anatomy. (4thedn), Wolters Kluwer Health, Lippincott Williams & Wilkins, Philadelphia, Pennsylvania, USA. 2011.

2. Wade MD, McDowell AR, Ziermann JM. Innervation of the long head of the triceps brachii in humans-a fresh look. Anat Rec. 2018;301:473-83.

3. Erhardt AJ, Futterman B. Variations in the innervation of the long head of the triceps brachii: a cadaveric investigation. Clin Orthop Relat Res. 2017;475:247-50.

4. Mehta G, Rani BGG, Mokhasi V. Contribution of axillary nerve in the innervation of long head of triceps brachii: a cadaveric study. Int J Anat Res. 2020;8:7350-5.

5. Orebaugh SL, Williams BA. Brachial plexus anatomy: normal and variant. Scientific World Journal. 2009;9:300-12.

6. Węgiel A, Karauda P, Zielinska N, et al. Radial nerve compression: anatomical perspective and clinical consequences. Neurosurg Rev. 2023;46:53.

7. Parnes N, Ciani MJ, DeFranco MJ. Risk of iatrogenic axillary nerve injury during acromioclavicular joint reconstruction. Orthopedics. 2021;44:e68-72.

8. Ladermann A, Stimec BV, Denard PJ, et al. Injury to the axillary nerve after reverse shoulder arthroplasty: an anatomical study. Orthop Traumatol Surg Res. 2014;100:105-8.

9. McFarland EG, Caicedo JC, Kim TK, et al. Prevention of axillary nerve injury in anterior shoulder reconstructions: use of a subscapularis muscle-splitting technique and a review of the literature. Am J Sports Med. 2002;30:601-6.

10. Rastogi P, Stewart DA, Lawson RD, et al. Cadaveric dissection of the axillary nerve: an investigation of extra-muscular and intra-muscular branching patterns. J Hand Surg Asian Pac. 2018;23:533-8.

11. Zurkiya O. Quadrilateral space syndrome. Cardiovasc Diagn Ther. 2021;11:1112-7.

12. Gutkowska O, Martynkiewicz J, Urban M, et al. Brachial plexus injury after shoulder dislocation: a literature review. Neurosurg Rev. 2020;43:407-23.