

# Variation in the Branching Pattern of the Radial Nerve Observed during Fixation of the Humerus Shaft: A Case Report

DHANANJAY D DESHMUKH



## ABSTRACT

The posterior cord of the brachial plexus typically maintains a consistent branching pattern, and deviations from this norm are exceedingly rare. Even more infrequently encountered are variations in the branching pattern of the radial nerve. The current case report of a 45-year-old male patient presents a unique clinical scenario involving a middle third and distal third humerus shaft fracture, manifesting as the chief complaint of pain during movement, coupled with localised swelling. A posterior approach was employed for surgical intervention due to the expansile nature of the fracture within the middle and distal thirds. During the surgical exploration, an anomalous branching pattern of the radial nerve was observed when transitioning from the posterior to the anterior compartment. This atypical radial nerve branching consisted of a branch extending into the anterior compartment and an accompanying posteroinferior branch, which notably supplied the medial and long heads of the triceps muscle. The present case underscores the imperative role of the orthopaedic surgeon in considering the radial nerve's intricate anatomy while exposing and stabilising segmental humerus fractures. It is of paramount importance to exercise vigilance, as the conventional practice of splitting the triceps muscle should be abstained from until an unusual branching or splitting of the radial nerve is definitively ruled out. The present case report elucidates the significance of meticulous anatomical awareness and surgical technique when addressing such complex humeral fractures, offering insights into the management of these uncommon clinical presentations.

**Keywords:** Humerus surgery, Neurological variation, Orthopaedic surgery, Posterior approach

## CASE REPORT

A 45-year-old man had an accident and presented to the Emergency Department (ED) himself 12 hours after the trauma with a chief complaint of pain during movement, accompanied by localised swelling. Diagnosis of left middle-third humerus shaft fracture was made. Neurologically, he was not affected. The author chose to use a posterior approach and perform an open reduction with plate fixation. A posterior midline incision was made under the interscalene block in which skin subcutaneous tissue incision was taken and retracted laterally. Triceps was reflected and brachial was split. The medial and long head interval was negotiated proximally and the muscles were retracted. A radial nerve was visible when exposing the fracture's proximal and distal ends, in which one equal branch goes inferiorly while the other branch exits posteriorly to the antero-lateral septum. On dissecting the posterior inferior branch, it was found that the radial nerve was further extending inferiorly up to the lateral condyle [Table/Fig-1]. The posterior divisions were giving branches to the medial head, long head, and lateral head intermittently. Anaesthetic stimulation of 0.2 mA at 0.1 ms was used to reduce the muscular reaction. The muscle movements were seen in the triceps medial head and extension of the elbow. The eliciting muscle response on stimulating the exiting nerve branch resulted in forearm extensor muscle response. The author managed to fix the fracture with a 12-hole titanium plate without damaging the radial nerve iatrogenically.

## DISCUSSION

Brachial plexus abnormal branching is an uncommon occurrence, typically in the brachial plexus's lateral and medial cords but less often seen in the posterior cord [1]. Similarly, the study conducted by Chaudhary P et al., discovered the various radial nerve branching patterns that connect to the triceps brachii muscles. Type A1, B1 (first pattern), B2 (second pattern), and Type C3 branching were noted in their investigation, of which C3 type was most common i.e., 78.6% [2]. In 89.3% of cases, long-head single innervation was



**[Table/Fig-1]:** Two yellow arrows on the right-side indicate abnormal branching of radial nerve, the white arrow indicates normal course, and the branch of radial nerve enters from posterior to anterior compartment.

seen along with 10.7% and 7.1% of cases having medial heads and lateral heads dual innervations, respectively [3].

A study done by Oluyemi K et al., revealed a brachial plexus having cords i.e., medial and lateral and three abnormal communications [4]. Muthoka JM et al., examined the branching structure of the posterior cords in the Kenya population. However, just 10% of cases exhibited classical branching patterns and radial nerve development from posterior cords and the radial nerve itself couldn't show any modifications [5].

In the current investigation, the radial nerve showed variations in branching patterns in posterior cords, from which one branch

Author	Place	Year	Cords	Variations
Ramasamy P and Kalaivanan M [1]	Tamil Nadu, India	2021		The radial nerve was observed in proximity to the distal fragment but was separated from the triceps muscle by a few muscle fibres
Bhat KMR and Girijavallabhan V [6]	Manipal, India	2008	Posterior cord	Divided into two roots, enclosing the subscapular artery and two roots fused to give radial nerve
Kuwar RB and Bilodi AKS [7]	Kathmandu, Nepal	2007	Posterior cord	Two roots were radial and two roots were clasping the subscapular artery
Bertha A et al., [8]	India	2009	Posterior cord	Cords had two parts: upper and lower upper: Continued as the axillary nerve and gave the upper root of radial nerve lower: continued as lower root of the radial nerve and joined with the upper root to form the radial nerve
Aktan ZA et al., [9]	Ege University, Bornova	2001	Posterior cord	The radial nerve was formed by the fusion of posterior divisions from the inferior and middle trunks, without any involvement of the superior trunk
Honma S et al., [10]	Africa	2011	Posterior cord	The axillary artery was penetrating the radial nerve from deep to superficial

**[Table/Fig-2]:** Anatomical variations of radial nerve and cords in previously conducted research studies [1,6-10].

continued inferiorly and one entered the anterior compartment as usual. Some of the comparable variations in radial nerve, differing slightly in a certain manner are listed below in [Table/Fig-2] [1,6-10].

Approximately, 3% of all adult fractures are humeral shaft fractures which can be treated or managed conservatively or surgically [3]. Radial nerve palsy is directly related to humeral shaft fractures which explain reported incidences ranging from 11.8% to 25.4%, respectively. This information demonstrates the most frequent peripheral nerve damage associated with bone fractures [1]. Plating or nail fixation techniques are the most preferred techniques for humeral shaft fractures. A retrospective investigation on 70 individuals with humeral shaft fracture was done by Yeh KL et al., in which patients were found to recover radial nerve palsy, both primary and secondary by opting for the closed Type-I surgical method for fixing nails without probing the radial nerve [11]. There are many situations in which radial nerve injury while performing a fixation surgery of the humerus fracture shaft, may lead to permanent palsy.

Recognising variations in nerve anatomy, especially in surgeries like humerus fracture fixation, is crucial to prevent nerve injuries. This case highlights an uncommon variant of the radial nerve branch. Understanding these variations ensures safer surgeries and better patient outcomes [12].

## CONCLUSION(S)

It is a fact of life that there are always exceptions and one example would be the anomalous branching structure of the brachial plexus' of radial nerve. However, an understanding of such variations is an emergence. While doing shaft humerus surgery by the posterior

approach, thorough identification and isolation of the radial nerve and its branches is important before dissection and fracture fixation.

## REFERENCES

- [1] Ramasamy P, Kalaivanan M. Abnormal division of radial nerve encountered during fixation of fracture of shaft of humerus through anterior approach. *TNOA J Orth Joint Surg.* 2021;3(2):80-81.
- [2] Chaudhary P, Singla R, Arora K, Kalsey G. Formation and branching pattern of cords of brachial plexus- A cadaveric study in north Indian population. *Int J Anat Res.* 2014;2(1):225-33.
- [3] Sarmiento A, Kinman PB, Galvin EG, Schmitt RH, Phillips JG. Functional bracing of fractures of the shaft of the humerus. *J Bone Joint Surg Am.* 1977;59(5):596-601.
- [4] Oluyemi K, Adesanya O, Ofusori D, Okwuonu C, Ukwanya V, Om'iniabohs F, et al. Abnormal pattern of brachial plexus formation: An original case report. *Internet J Neurosurg.* 2006;4(2):01-05.
- [5] Muthoka JM, Sinkeet SR, Shahbal SH, Matakwa LC, Ogeng'o JA. Variations in branching of the posterior cord of brachial plexus in a Kenyan population. *J Brachial Plex Peripher Nerve Inj.* 2011;6:1.
- [6] Bhat KMR, Girijavallabhan V. Variation in the branching pattern of posterior cord of brachial plexus. *Neuroanatomy.* 2008;7:10-11.
- [7] Kuwar RB, Bilodi AKS. Clasping of subscapular artery by radial nerve. *Kathmandu Univ Med J (KUMJ).* 2007;5(2):253-55.
- [8] Bertha A, Kulkarni NV, Maria A, Justin O, Joseph K. Entrapment of deep axillary arch by two roots of radial nerve – An anatomical variation. *J Anat Soc India.* 2009;58(1):40-43.
- [9] Aktan ZA, Ozturk L, Bilge O, Ozer MA, Pinar YA. A cadaveric study of the anatomic variations of the brachial plexus nerves in the axillar region and arm. *Turk J Med Sci.* 2001;31(2):147-50.
- [10] Honma S, Kawai K, Koizumi M, Kodama K. The superficial brachial artery passing superficially to the pectoral ansa, the highest superficial brachial artery (Arteria brachialis superficialis suprema). *Anat Sci Int.* 2011;86(2):108-15.
- [11] Yeh KL, Liaw CK, Wu TY, Chen CP. Radial nerve recovery following closed nailing of humeral shaft fractures without radial nerve exploration: A retrospective study. *World J Clin Cases.* 2021;9(27):8044-50.
- [12] Sun L, Park BK, Gupta S, Capo JT, Yoon RS, Liporace FA. Anatomic variant of the inferior lateral cutaneous branch of the radial nerve during the posterior approach to the humerus: A case report. *Patient Saf Surg.* 2015;9:16.

### PARTICULARS OF CONTRIBUTORS:

1. Senior Consultant, Department of Orthopaedics, Sunshine Superspeciality Hospital, Amravati, Maharashtra, India.

### NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Dhananjay D Deshmukh,  
Senior Consultant, Department of Orthopaedics, Sunshine Superspeciality Hospital,  
Amravati-444606, Maharashtra, India.  
E-mail: ddeshmukhwi2023@gmail.com

### AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

### PLAGIARISM CHECKING METHODS: [Jan H et al.]

- Plagiarism X-checker: Jul 24, 2023
- Manual Googling: Oct 18, 2023
- iThenticate Software: Dec 06, 2023 (9%)

### ETYMOLOGY: Author Origin

EMENDATIONS: 7

Date of Submission: **Jul 15, 2023**  
Date of Peer Review: **Sep 19, 2023**  
Date of Acceptance: **Dec 08, 2023**  
Date of Publishing: **Feb 01, 2024**