

## ORIGINAL PAPER

# A cadaveric study in the Indian population of the brachialis muscle innervation by the radial nerve

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### Abstract

Radial nerve innervation to the brachialis muscle has been studied previously by different authors in Caucasian, Chinese, and Thai population. Present study was aimed to describe the radial nerve and musculocutaneous nerve contribution to the brachialis muscle and to elucidate racial differences between Indian and other populations. Hundred-forty superior extremities of 70 embalmed cadavers including 29 female and 41 male cadavers were dissected to study the innervation of brachialis muscle by musculocutaneous nerve and branch from the radial nerve. All the specimens were studied for site of penetration, level of distribution and nature of course and pathway of the branch of the radial nerve to the brachialis muscle. The musculocutaneous nerve innervated the brachialis muscle in 100% specimens, whereas the radial nerve in 72.14% specimens. The radial nerve branch to brachialis pierced the muscle in the lower one third of the humerus in 65.71% specimens; on the other hand in the middle one third in 34.29% specimens. The radial nerve branch to brachialis in 50.71% specimens had relatively straighter course before penetration into the muscle, whereas in 49.29% specimens the nerve had relatively curved course and pathway. Aforementioned results regarding brachialis innervation by radial nerve in Indian population is different from studies reported in other populations. These anatomical facts are important for humeral surgery including both the anterior and posterior approaches especially for orthopedic interventions on the Indian population.

**Keywords:** radial nerve, brachialis, cadaver, humerus.

### Introduction

Radial nerve anatomy around humerus in the arm has been studied repeatedly by various authors [1–7]. Brachialis muscle innervation by radial nerve and the course of the radial nerve and origin of its branches is important for humeral surgery including both the anterior and posterior approaches. Radial nerve motor branch to brachialis muscle has been reported previously by different authors in Caucasian, Chinese and Thai population.

Chou PH *et al.* [8] reported anatomic distribution of the radial nerve in the upper arms in embalmed adult Chinese cadavers.

Blackburn SC *et al.* [9] studied and described the radial nerve contribution to the brachialis muscle of the Caucasian population in the United Kingdom.

Mahakkanukrauh P and Somsarp V [10] reported the brachialis innervation by radial nerve in East Asian Thai population.

Carlan D *et al.* [11] explored the course of the radial nerve in the brachium in both embalmed cadavers and fresh frozen specimens in United States of America and identified practical anatomic landmarks that can be used to avoid iatrogenic injury during humerus fracture fixation.

Leonello DT *et al.* [12] carried out cadaveric study in Australian population to clarify brachialis muscle anatomy in order to refine surgical techniques around the elbow.

Guse TR and Ostrum RF [13] dissected cadaveric arms in United States of America to determine the position of radial nerve on the posterior aspect of the humerus and provided landmarks as guidelines to avoid the radial nerve during operative intervention on the humerus.

Frazer EA *et al.* [14] reported the distribution of the radial and musculocutaneous nerves in the brachialis muscle in Scotland, United Kingdom.

No study has been carried out in Indian population, which nearly forms one-fifth of world population. Present work was under taken to study on cadavers the radial nerve and musculocutaneous nerve contribution to the brachialis muscle in the anatomy department and to elucidate racial differences between Indian and other populations.

### Material and Methods

Seventy embalmed cadavers (140 superior extremities) including 29 females and 41 males were dissected on both the right and left sides.

Brachialis muscle was exposed to study its innervation. Radial nerve course and branches including branch to the brachialis muscle was explored. Course and branches of the musculocutaneous nerve was also dissected in both arms of the cadavers.

All the 140 specimens were studied for following three criteria:

- The level of penetration and distribution of radial nerve branch and musculocutaneous nerve to brachialis muscle was measured superiorly from the tip of the acromian process of the humerus and inferiorly from the medial and lateral epicondyles of the humerus was recorded. Accordingly the humerus and the arm was divided into three parts namely upper one third, middle one third, lower one third. The site of penetration of the radial nerve branch to

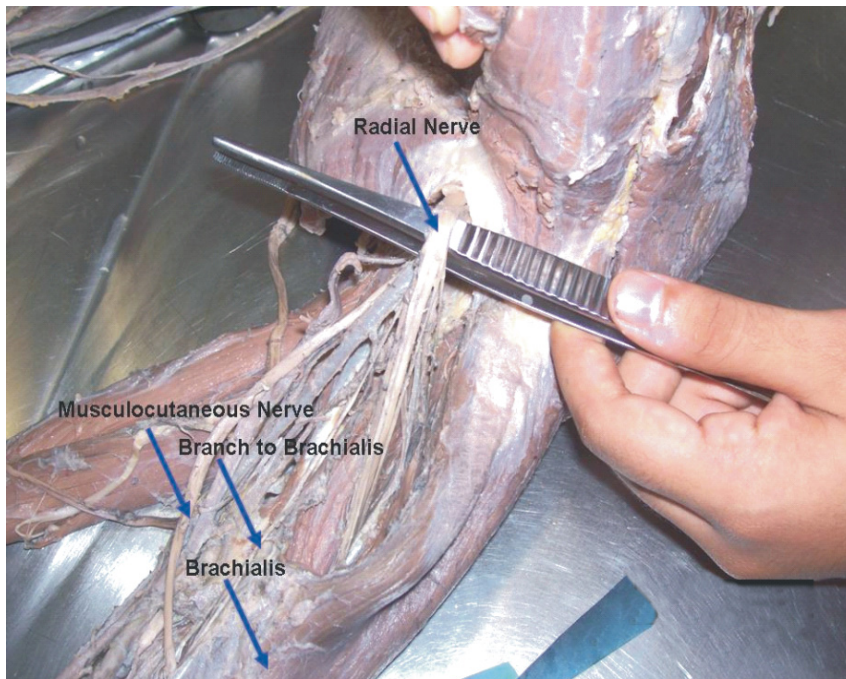
the brachialis muscle was studied and recorded in relation to the three parts of the humerus.

- Whether the radial nerve branch to brachialis muscle penetrated the muscle at the same site with musculocutaneous nerve or it pierced the muscle at different sites separately.

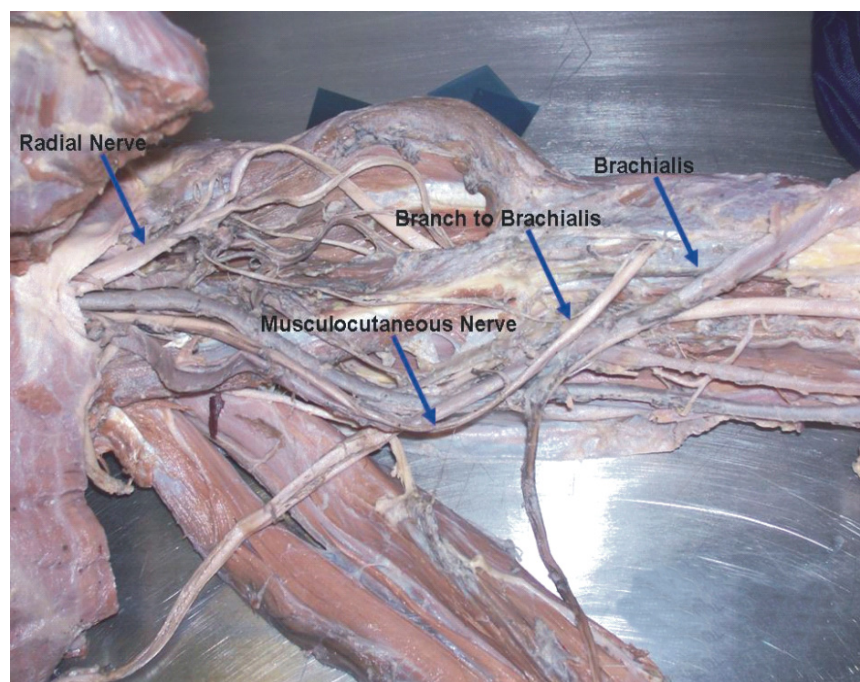
- Whether the radial nerve innervation to the brachialis muscle had relatively straighter course or its pathway was relatively curved or zigzag course.

## ☞ Results

Brachialis muscle received innervations from the musculocutaneous nerve and branch of radial nerve (Figures 1 and 2).



**Figure 1 – Musculocutaneous nerve and radial nerve branches including branch to the brachialis muscle.**



**Figure 2 – Brachialis muscle innervated by musculocutaneous nerve and branch from the radial nerve.**

The musculocutaneous nerve innervated the brachialis muscles in 100% (140 superior extremities) and the radial nerve supplied the brachialis muscles in 72.14% (101 superior extremities). The upper limbs of the cadavers, which received innervations by a branch from the radial nerve, showed following results regarding aforementioned criteria of brachialis nerve supply from radial nerve:

- In 65.71% cases (92 out of 140 specimens) the radial nerve branch to brachialis muscle penetrated the muscle in the lower one third of the humerus in the arm. Whereas in 34.29% cases (48 out of 140 specimens) the radial nerve branch penetrated the muscle in the middle third of the humerus in the arm.

- In 16.43% cases (23 out of 140 specimens) the branch from the radial nerve and the musculocutaneous nerve pierce the brachialis muscle simultaneously at the same site. While in 83.57% cases (117 out of 140 specimens) aforementioned nerves pierced separately.

- In 50.71 cases (71 out of 140 specimens) the radial nerve branch to brachialis muscle had relatively straighter course before piercing the brachialis muscle. While in 49.29% (69 out of 140 specimens), the nerve had zigzag relatively curved course and pathway.

## Discussion

Embryological basis for double innervation of the brachialis muscle by musculocutaneous nerve and branch from radial nerve can be explained by union of ventral (flexor) and dorsal (extensor) muscle masses derived from two different embryonic muscular primordial [10].

Mahakkanukrauh P and Somsarp V [10] in their cadaveric study in East Asian Thai population reported that 81.61% specimens of brachialis muscle were also innervated by a branch from the radial nerve.

Blackburn SC *et al.* [9] studied and described the radial nerve contribution to the brachialis muscle in 67% of specimens of the Caucasian population.

Frazer EA *et al.* [14] in Scotland reported the distribution of the radial nerve in the brachialis muscle as 67%. Whereas our study on the Indian population, showed 72.14% radial nerve innervations to the brachialis muscle. Racial differences may be attributed to various aforementioned results.

Blackburn SC *et al.* [9] described that 61% of the radial nerve branches went straight into the brachialis muscle, 13% descended and 26% recurred.

Mahakkanukrauh P and Somsarp V [10] described two different patterns of branching from the radial nerve to the brachialis: the branch to the brachialis had a descending course (58%) in one pattern whereas in the other pattern the nerve ascended or recurred (42%) to innervate the muscle. On the other hand, our result demonstrated that the radial nerve branch to brachialis muscle had relatively straighter course before piercing the brachialis muscle in 50.71% specimens. Concomitantly the nerve had zigzag and relatively curved course and pathway in 49.29% specimens.

Mahakkanukrauh P and Somsarp V [10] reported in 83% of cases the radial nerve branch penetrated the inferolateral part of the brachialis muscle and in 17% of cases, it pierced the middle third of the brachialis muscle.

Frazer EA *et al.* [14] examined the right brachialis muscle of six cadavers and reported that in four cases the radial nerve branch supplied the inferolateral region of the muscle. On the other hand, in our study the radial nerve branch to the brachialis muscle penetrated the muscle in 65.71% cases in the lower one third of the humerus in the arm. Whereas the radial nerve branch pierced the muscle in 34.29% of cases in the middle third of the humerus in the arm.

These anatomical facts are useful for surgeons performing surgery through either the anterior or the posterior approach on the humerus in the arm especially for orthopedic interventions on the Indian population.

## Conclusions

Before planning orthopedic interventions and humeral surgery, the variations regarding prevalence of brachialis innervation by radial nerve in different racial populations should be considered for better outcome. Further studies on anatomical variations in this direction are suggested to ensure best results for surgeon.

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