Original Research Paper

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THE RELATION OF BIFURCATION OF RADIAL NERVE TO LATERAL EPICONDYLE OF HUMERUS – A MORPHOLOGICAL AND MORPHOMETRIC STUDY.

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ABSTRACT **Introduction:** Radial nerve is one of the major nerves in the upper extremity which is often involved in nerve damage. Knowledge on the variations of this nerve and its relation to nearby structures during its course help to prevent iatrogenic injuries in clinical practice. **Objective:** To find out the level of bifurcation of radial nerve into superficial and deep branches with respect to lateral epicondyle of humerus. **Methods:** Conducted a cross-sectional study on 74 cadaveric upper limbs in Department of Anatomy, Government Medical College, Kozhikode. Radial nerve was traced from mid arm to its bifurcation into superficial branch of radial nerve and deep branch of radial nerve. **Result:**The division of radial nerve into superficial and deep branches was below the level of lateral epicondyle in 63 specimens (85.14%), above the lateral epicondyle in 8 specimens (10.81%), and at the level of lateral epicondyle in 3 specimens (4.05%).Radial nerve divided into superficial and deep branches at a distance of 0.92±0.74 cm distal to the lateral epicondyle. **Conclusion:** The Lesions of the radial nerve can present with significant functional limitations that negatively affect the quality of life of the person. The findings of this study would help the clinicians in the diagnosis of radial nerve pathology and thus the execution of safe surgical procedures.

KEYWORDS : radial nerve, superficial branch of radial nerve, deep branch of radial nerve, lateral epicondyle.

INTRODUCTION

A detailed understanding of normal anatomy, relations, and variations of nerves is very much important in clinical practice to prevent the risk of nerve injuries. The radial nerve is one of the major nerves in the upper extremity which is continuously involved in nerve damage. Knowledge on the variations of the radial nerve and how it is related to some clinically relevant nearby structures during its course aids the medical practice and adds to the literature for the future scholars.

The radial nerve originates from the posterior cord of the brachial plexus. The root value of the radial nerve is C5, C6, C7, C8, and T 1. The nerve descends behind the third part of the axillary artery and proximal part of the brachial artery, and in front of the subscapularis, latissimus dorsi, and teres major in the posterior wall of the axilla. Accompanied by the arteria profunda brachii, the nerve inclines dorsally through the lower triangular space that is bounded superiorly by the teres major, medially by the long head of the triceps, and laterally by the shaft of the humerus.

It leaves the axilla through the lower border of the teres major to enter the spiral groove at the posterior aspect of the humerus. Then it emerges from the spiral groove by piercing the lateral intermuscular septum to enter the anterior compartment of the brachium.[1] In the anterior compartment, it is seen lateral to the brachialis and medial to brachioradialis and extensor carpi radialis longus. In the cubital fossa, the radial nerve ends anterior to the lateral epicondyle by dividing into superficial and deep terminal branches.

The superficial terminal branch is essentially sensory and runs downward along the lateral aspect of the front of the forearm. The deep terminal branch winds around the lateral side of the radius between the superficial and deep strata of the supinator and then descends in the back of the forearm between superficial and deep groups of extensor muscles as the posterior interosseous nerve.[2]

Nerves and related structures may be damaged and displaced by fracture, dislocation, or hematoma. The ensuing fibrosis distorts normal anatomical relations; this increases the risk of intraoperative damage when nerves and accompanying vessels are not formally exposed. The incidence of such iatrogenic injuries is increasing and even higher for nerves around the elbow.

AIMS AND OBJECTIVES

The present study aims at the morphological relationship and morphometric variation of bifurcation of radial nerve into its superficial and deep branches with respect to the lateral epicondyle of humerus.

MATERIAL AND METHODS

A cross-sectional cadaveric study was conducted on 74 upper limb at Dissection Hall - Department of Anatomy, Government Medical College Kozhikode from December 2020 to December2022 after obtaining clearance from the institutional research committee and ethics committee.Inclusion criteria:All cadavers available for the undergraduate dissection were used. Exclusion criteria: Upper limb specimens with disfigurement precluding the performance of dissection was excluded from the study. The radial nerve was traced from distal arm to its bifurcation. Morphological and morphometric data were collected, analysed, and expressed in terms of frequency, percentage, mean and standard deviation. Quantitative data was collected using a vernier calliper, measuring tape and flexible scale. The measurements were recorded in centimetres. The measurements were taken after reflecting the skin and removing subcutaneous fat. This minimized the confounding effect of varied thickness of the subcutaneous fat. Each measurement was repeated on two separate occasions and an average of these measurements was then used for further analysis. Structures with variant anatomy were coloured using acrylic yellow paint and photographed using a digital camera.

RESULTS

Morphological analysis- The radial nerve is divided into superficial and deep branches around the lateral epicondyle. The division was below the level of lateral epicondyle in 63 specimens (85.14%)[Figure 3], above the lateral epicondyle in 8 specimens (10.81%) [Figure 1], and at the level of lateral epicondyle in 3 specimens (4.05%) [Figure 2].

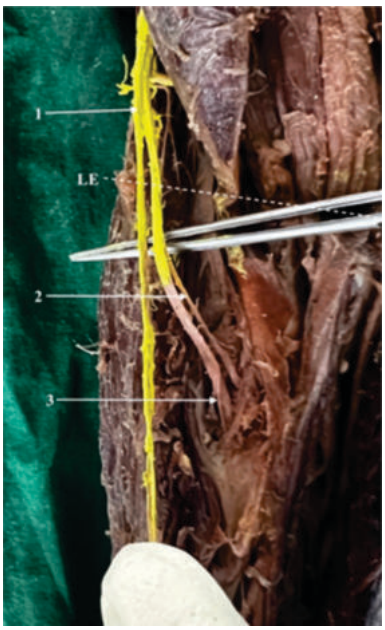

Figure 1: Bifurcation Of The Radial Nerve Into Superficial And Deep Branches Above The Level Of Lateral Epicondyle.

1- Bifurcation of radial nerve.
2- Nerve to extensor carpi radialis brevis (ECRB) from deep branch of the radial nerve(DBRN)
3- Nerve to supinator from the deep branch of the radial nerve.

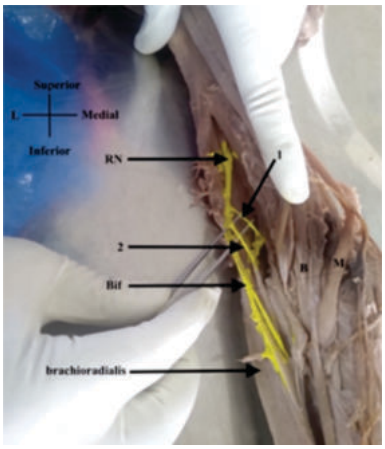

Figure 2: Bifurcation Of The Radial Nerve Into Superficial And Deep Branches At The Level Of Lateral Epicondyle.

RN- Radial nerve, 1-Branch to brachialis, 2-Branch to brachioradialis, Bif- Bifurcation of radial nerve into superficial and deep branches.B-Biceps tendon,M- Median nerve

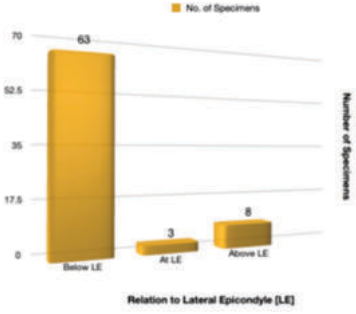

Chart 1: 3d Bar Chart Showing The Relationship Of Lateral Epicondyle To The Division Of Radial Nerve Into Superficial And Deep Branches.

Morphometric analysis[Chart 2]- The radial nerve is divided into superficial and deep branches at a distance of 0.92±0.74 cm distal to the lateral epicondyle. [Figure 3].

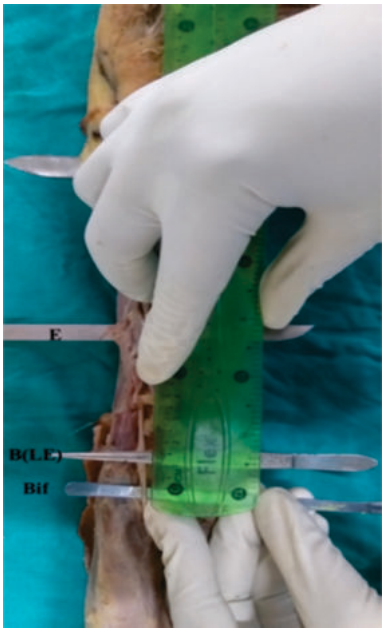

Figure 3: Measuring The Distance From The Most Prominent Part Of The Lateral Epicondyle[B(LE)] To The Bifurcation(bif) Of The Radial Nerve Into A Superficial And Deep Branch.

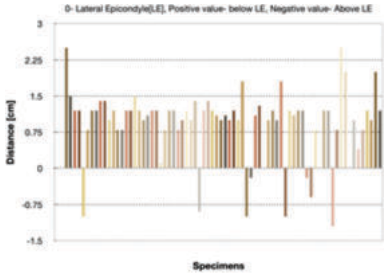

Chart 2: Bar Chart Showing The Bifurcation Of Radial Nerve With Respect To The Lateral Epicondyle.

DISCUSSION

Knowledge on the order of nerve branches from the main trunk is of clinical importance when evaluating motor and sensory deficits, treating nerve entrapment, and predicting the timing of recovery after nerve injury.[3]Variations are found among different authors regarding the level of division of the radial nerve into the superficial and deep branches. So studies assessing this parameter would add to the literature and help clinicians during various surgical procedures around the elbow. Radial nerve entrapments, such as radial tunnel and posterior interosseous nerve syndromes, are common and result in reduced quality of life and the ability to carry out activities of daily living.[4]Numerous sites of radial nerve entrapment have been identified in the literature for the deep branch of the radial nerve and its successor posterior interosseous nerve, each resulting in a unique clinical presentation specific to the nerve's motor branching pattern.[5]Clinicians must have a thorough knowledge on the course of the radial nerve and its branches to provide an accurate and timely diagnosis.

The calculated bifurcation level of the superficial and deep radial branch in 20 specimen by Abrams et al[6]was a mean of 10.3 mm above the lateral epicondyle of humerus[LE] (range, 25.9 mm above to 5.1 mm below the LE). According to Lusweti et al[7], 3/59 cases the nerve gave its terminal branches proximal to the lateral epicondyle while in 7/59 cases, it terminated distal to the lateral humeral epicondyle. Cho et al[8]conducted study on 40 specimen and found that the radial nerve divided into the superficial and deep branches at 5.7 mm proximal to the transepicondylar line on average (standard deviation [S.D.] =14.3). The division was above the transepicondylar line in 26 elbows (65.0%), at the line in one elbow (2.5%), or below the line in 13 elbows(32.5%).

According to Cox et al[9](sample size =17)the division of the radial nerve into the superficial and deep branch occurred at an average of 1.0 cm (range, 11.4 to 3.5 cm) distal to the LE. Abrams et al[10] in 1992 done study on 20 specimen and found that the radial nerve bifurcated in superficial and deep branches at the level of LE in 6.67% of specimen, above LE in 40% and below LE in 53.33% of specimen.

In the present study, the division of radial nerve into superficial and deep branch was below the level of lateral epicondyle in 63 specimens (85.14%), above the lateral epicondyle in 8 specimens (10.81%), and at the level of lateral epicondyle in 3 specimens (4.05%)[Chart 1]. Also the calculated bifurcation level of the radial nerve into SBRN and DBRN was an average of 0.9cm below the lateral epicondyle of the humerus which showed variation from the previous studies Abrams[6], Lusweti[7], Cho[8] and Niral[11] et albut in line with Cox[9] and Abram1992[10] et al.[Table 1]

Table 1: Comparison Of The Relation Of Lateral Epicondyle [LE] To The Bifurcation Of Radial Nerve With The Previous Studies. In Square Brackets- Average Measurement From LE.

study	At LE	Above LE	Below LE
Abram et al ,1992[10]	6.67%	40%	53.33%
Abram et al, 1997[6]	-	[1.3cm]	-
Cox et al, 2010[9]	-	-	[1cm]
Cho et al,2013[8]	2.5%	65%[0.57cm]	32.5%
Lusweti et al, 2019[7]	83.05%	5.09%	11.86%
Niralichavda(8)	53.33%	20%	26.66%
Present study	4.05%	10.81%	85.14%[0.9cm]

CONCLUSION

The present cadaveric study on 74 specimen shows that the division of radial nerve into superficial and deep branchwas below the level of lateral epicondyle in 63 specimens (85.14%), above the lateral epicondyle in 8 specimens (10.81%), and at the level of lateral epicondyle in 3 specimens (4.05%). Morphometric analysis shows that the radial nerve is divided into superficial and deep branches at a distance of 0.92±0.74 cm distal to the lateral epicondyle.

This information might be used with caution to avoid iatrogenic radial nerve injury in clinical scenario associated with elbow injuries/ fractures of the lower end of humerus. A disease or injury to the radial nerve can result significant functional limitations that negatively affect the quality of life of an individual. The morphological and morphometric findings of this study would help the clinicians in the diagnosis of radial nerve pathology and thus the execution of safe surgical procedures.

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