

# Anatomical Localisation and Morphometric Study of Lister's Tubercle of Radius: A Cross-sectional Study

SANGEETA JITENDRA RAJANI<sup>1</sup>, HINA BHULABHAI RAJPUT<sup>2</sup>, AAYUSHI JITENDRA RAJANI<sup>3</sup>, VASANT H VANIYA<sup>4</sup>

## ABSTRACT

**Introduction:** Fractures of the distal radius are one of the most common injuries and it accounts for 8-15% of all fractures of the upper limb. Lister's Tubercle (LT) is an important anatomical, surgical landmark during various orthopaedic and other surgical procedures on the distal radius.

**Aim:** To determine the anatomical localisation of LT in relation to radial styloid process and ulnar notch and to measure the morphometric parameters of LT on dry radii.

**Materials and Methods:** The present cross-sectional study was done on 180 radii, 90 right-sided and 90 left-sided obtained from the Department of Anatomy, Medical College Baroda, Vadodara, Gujarat, India, from December 2021 to August 2022. Localisation and length, width and height of the lister tubercle were measured with the help of a vernier calliper. Mean and range of each parameter was calculated. All measurements were made by two observers to avoid bias interpretation. The data were entered in Microsoft Excel window 10.

**Results:** On right-side the LT was nearer to the styloid process in 04 radii (ratio was less than 1) while it was nearer to the ulnar

notch in 86 radii (ratio was more than 1). Highest ratio of two distance was 1.768 (LT nearer to ulnar notch) while the lowest distance was 0.8706 (LT nearer to styloid process). On left-side LT was nearer to styloid process in 28 radii (ratio was less than 1) while it was nearer to ulnar notch in 62 radii (ratio was more than 1). Highest ratio of two distance was 1.42 (LT nearer to ulnar notch) while the lowest distance was 0.79 (LT nearer to styloid process). The mean length of LT on right-side was  $12.30 \pm 1.46$  mm, breadth  $4.66 \pm 0.98$  mm, while height was  $2.87 \pm 0.57$  mm and the mean length of LT on the left-side was  $13.19 \pm 1.511$  mm, width  $4.89 \pm 1.17$  mm, while the height was  $2.96 \pm 0.692$  mm.

**Conclusion:** The present study shows that in majority of cases, LT was nearer to the ulnar notch and the distance between LT and radial styloid process was more. The anatomical localisation and morphometric data of LT will be is useful in various surgical procedures like screw fixation in volar plating and micro nail techniques.

**Keywords:** Dorsal tubercle, Micro nail, Radial nerve, Volar plate fixation

## INTRODUCTION

The posterior surface of distal end of radius displays a palpable dorsal tubercle or LT which is in line with the cleft between the index and middle fingers. LT receives a slip from the extensor retinaculum and is grooved medially by the Extensor Pollicis Longus (EPL) tendon. LT acts as bony fulcrum around which EPL changes its line of pull from the forearm to the thumb. As a consequence of the obliquity of its tendon, EPL adducts the extended thumb and rotates it laterally [1]. The vascularity of distal radius has importance in the new surgical approach of the distal radius and new techniques of osteosynthesis like K-wire placement and micro nail technique for distal radius fractures. The dorsal epiphyseal vessels of the lower end radius enter through the LT and palmer interosseous vessels enter the bone at the level of LT [2-4].

Fractures of the distal radius are one of the most common injuries and it accounts for 8-15% among all the fractures of the upper limb. Thus, the morphometric evaluation of distal radius is important for evaluation and treatment of the injuries around the wrist [5,6]. The LT is used as an anatomical landmark for localising the anatomical variants like the 1<sup>st</sup> dorsal extensor compartment, Posterior interosseous nerve, superficial branch of radial nerve, dorsal radio-triquetral ligament [7-10]. Further, LT is also used as a surgical landmark in wrist arthrography injections and arthroscopy, dorsal wrist capsulotomy, hand microsurgery, radio scapholunate arthrodesis, Kirschner wire placement and internal fixation of Colle's fracture and the insertion of square and elastic intramedullary nails for fixation of diaphyseal fracture of radius [2,9,11,12].

The EPL tendon ruptures are common complication of distal radius fractures. A spontaneous rupture of the EPL tendon is associated with rheumatoid arthritis, fractures of the wrist, systemic or local steroids and repetitive and excessive abnormal motion of the wrist joint like in kick boxers and tailors [13,14]. The EPL tendon can rupture without severe trauma or inflammatory diseases as there is poor vasculature around the LT. The EPL has proximal and distal blood supply with a relatively avascular zone around the LT [15]. The spontaneous rupture without trauma, could occur due to attrition of the EPL tendon around LT [16,17]. The LT is an important anatomical and surgical landmark during various orthopaedic procedures. To identify nearby anatomical structures, the localisation of LT is required.

The aim of the present study was to determine the anatomical localisation of LT in relation to the radial styloid process and the ulnar notch and to measure the morphometric parameters of the LT on dry radii.

## MATERIALS AND METHODS

A cross-sectional observational study was conducted in the Department of Anatomy, Medical College Baroda, Vadodara, Gujarat, India, from the December 2021 to August 2022. A total of 210 adult human radii of unknown age and sex were obtained from the bone store and out of 210 radii, after satisfying inclusion and exclusion criteria, only 180 radii (90 of each side) were used for the present study.

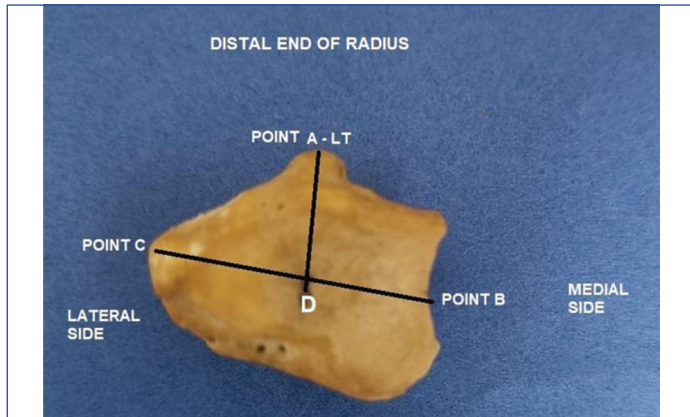
**Inclusion criteria:** Dry, clean and anatomically normal adult radii, were included in the study.

**Exclusion criteria:** Radii with any structural deformity, previous radial trauma, and any other pathological irregularities such as arthritis and any gross breakage, were excluded from the study.

**Study Procedure**

At the distal end of radius bone, the LT was identified and localisation and length, width and height of LT were measured with the help of vernier calliper.

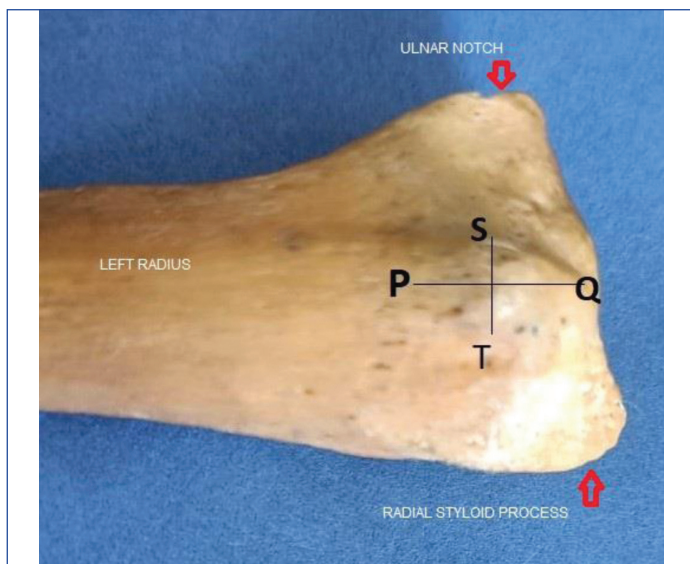
**Localisation of Lister's Tubercle (LT) [11,18]:** Three anatomical landmarks were identified on each radius [Table/Fig-1].



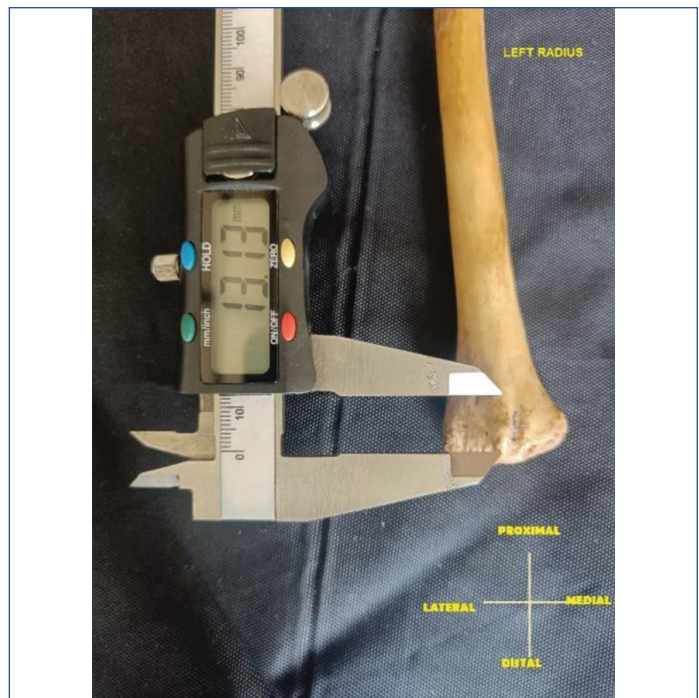
**[Table/Fig-1]:** Localisation of Lister's Tubercle (LT).  
 Point A: The midpoint of lister tubercle  
 Point B: Midpoint of volar and dorsal border of ulnar notch  
 Point C: Midpoint of radial styloid process.  
 Point D: Intersecting point

A line was drawn between point B and point C (Line BC). Another perpendicular line was drawn from point A to line BC. Intersecting point was labelled as point D.

Distance BD (D1)- Distance between the mid-point of ulnar notch to intersecting point was noted in mm. Distance CD (D2)- Distance between mid-point of radial styloid process to intersecting point was noted in mm. Maximum and minimum distances of LT were noted and their mean and standard deviation were calculated. The ratio of two measurements (D2/D1) was calculated to find out the location of LT in relation to the mid-point of the radial styloid process and the mid-point of the ulnar notch. If the ratio was more than 1 that indicates the LT is nearer to the ulnar notch, while if the ratio was less than one that indicates the LT is nearer to radial styloid process. Morphometry of LT [7,19,20]. Length, width and height of LT were also measured with the help of a digital vernier calliper [Table/Fig-2-5].



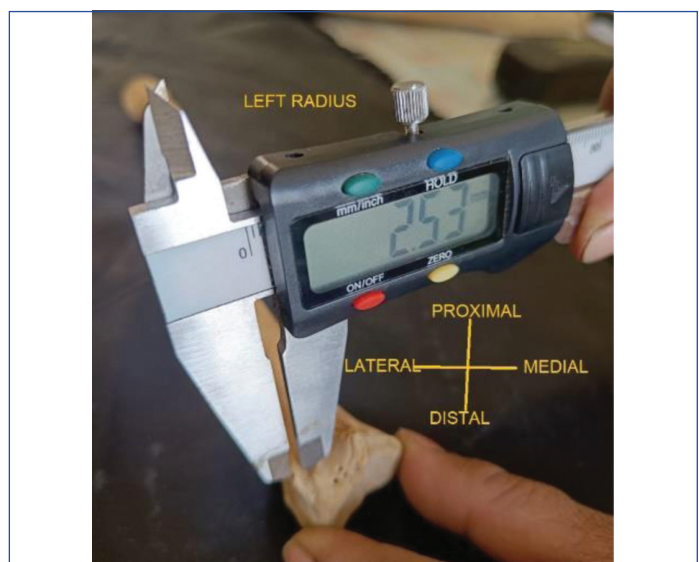
**[Table/Fig-2]:** Morphometry of LT of left radius.  
 Point P and point Q- Proximal and distal ends of the lister tubercle, respectively  
 Point S and point T- Medial and lateral ends at the maximum broadness of LT



**[Table/Fig-3]:** Measurement of length of LT.



**[Table/Fig-4]:** Measurement of width of LT.



**[Table/Fig-5]:** Measurement of height of LT.



Point R- Highest point on the LT, Point P and point Q- Proximal and distal ends of the LT, respectively.

Point S and point T- Medial and lateral ends at the maximum broadness of the LT

- Length (mm)- Distance between the point P and point Q.
- Width (mm)- Distance between the point S and point T.
- Height (mm)- Distance from point R to floor of EPL groove.

Mean and range of each parameter were calculated.

## STATISTICAL ANALYSIS

All measurements were made by two observers to avoid the bias interpretation. The data were entered in Microsoft Excel window 10 and descriptive statistics was used.

## RESULTS

All 180 radii showed the LT on its dorsal aspect. On the right-side, the distance from the LT to the styloid process ranged between 9.86 mm to 17.34 mm, while distance from the LT to the ulnar notch ranged from 7.75 mm to 15.25 mm. In the present study, the LT was nearer to the styloid process in 04 radii (ratio was less than 1) while it was nearer to the ulnar notch in 86 radii (ratio was more than 1). The highest ratio of the two distance was 1.768, while the lowest ratio was 0.8706.

On the left-side, the distance from the LT to the styloid process ranged between 10.15 mm to 16.74 mm, while distance from the LT to the ulnar notch ranged 9.76 mm to 14.81 mm. The LT was nearer to the styloid process in 28 radii (ratio was less than 1), while it was nearer to the ulnar notch in 62 radii (ratio was more than 1). Highest ratio of two distance was 1.42, while the lowest ratio was 0.79.

The range and the mean values for the localisation, length, width and height of LT is given in [Table/Fig-6].

Parameters		Right-side	Left-side	Remarks
Distance BD (D1) (mm)	Maximum	15.25	14.81	Distance from Ulnar notch to LT was more on left-side
	Minimum	7.75	9.76	
	Mean±SD	11.17±1.45	12.12±1.14	
Distance CD (D2) (mm)	Maximum	17.34	16.74	Distance from radial styloid process to LT was more on right-side/distance from ulnar notch to LT was less on left-side
	Minimum	9.86	10.15	
	Mean±SD	14.16±1.45	12.73±1.32	
Length (mm)	Maximum	16.81	16.75	Mean length of Left LT was more than right-side
	Minimum	9.18	9.94	
	Mean±SD	12.30±1.46	13.19±1.51	
Width (mm)	Maximum	7.6	9.9	Mean width of LT was more on left-side
	Minimum	3.03	2.45	
	Mean±SD	4.66±0.98	4.89±1.17	
Height (mm)	Maximum	4.61	5.94	Mean height was more on left-side
	Minimum	1.75	1.46	
	Mean±SD	2.87±0.57	2.96±0.69	

[Table/Fig-6]: Range and mean values for localisation and length, width and height of LT.

## DISCUSSION

The LT is an important clinical and anatomical landmark. Its location and morphometric study are useful in various procedures. This data will be helpful in performing accurate procedures and avoiding injury to nearby structures. The comparison of localisation of the LT with the past studies is shown in [Table/Fig-7] [8,11,18]. Kumar P and Sharma A studied 50 radii [8]. They found the LT was near to the radial styloid process in 13 radii, while it was nearer to the ulnar notch in 37 radii. Ojha P and Ojha AK found that out of 52 radii, the LT was nearer to the radial styloid process in 39 (75%) radii while in 13 (25%) radii it was nearer to the ulnar notch [11]. Agir I et al., studied 20 radii and found that in 11 radii the LT was nearer to the

styloid process, while in nine subjects, it was near or to the ulnar notch [18]. In the present study, out of 90 right radii, the LT was nearer to the radial styloid process in 04 (4.5%) radii while it was nearer to the ulnar notch in 86 (95.5%) radii, while on the left-side out of 90 radii, the LT was nearer to the styloid process in 28 (31%) radii while it was nearer to the ulnar notch in 62 (69%) radii. The present study revealed that in majority of cases (82.22%) LT lies nearer to the ulnar notch. Kumar P and Sharma A also found same results, while study of Ojha P and Ojha AK and Agir I et al., showed that LT was nearer to the radial styloid process [8,11,18].

Parameters	Ojha P and Ojha A K [11] 52 radii (R 22, L 30)	Agir I et al., [18] 20 radii (R 8, L 12)	Kumar P and Sharma A [8] 50 radii (R 23, L 27)	Present study 180 radii (R 90, L 90)
Place and year of study	Udaipur, 2020	Turkey, 2014	Chandigarh, 2021	Vadodara, Gujarat, December 2021 to August 2022.
Distance from Ulnar notch to mid-point of LT-D1 (mm)	10.88-17.10	11.3-16.9	11-17.10	(R) 7.75-15.25 (L) 10.15-16.74
Distance from radial styloid process to mid-point of LT-D2 (mm)	9.76-18.22	12.2-18.6	9-16	(R) 9.86-17.34 (L) 10.15-16.74
Highest ratio	1.46	1.40	1.30	(Rt) 1.76 (Lt) 1.42
Lowest ratio	0.66	0.78	0.52	(Rt) 0.87 (Lt) 0.79

[Table/Fig-7]: Comparison of distance from ulnar notch and radial styloid process to LT and their ratios with the past studies [8,11,18].

The length, height and width of LT of the present study is compared with the past studies [Table/Fig-8] [7,19,20]. The comparison showed that in the present study the length of LT was more than the length measured by Shanthi KC [20]; while it was less as compared to studies of the Harini P and Mohanraj KG and Clement H et al., [7,19]. In present study, height of LT was less as compared to study of Clement H et al., [19], while width of LT was also less as compared to study of Harini P and Mohanraj KG [7]. This data variation could be due to difference in numbers of sample. Ali AM et al., had dissected 16 embalmed forearms to identify a safe surgical zone to avoid injury of Superficial Radial Nerve (SRN) during Kirschner wire fixation in treatment of distal radial fractures [21]. They found mean distance between the LT and the closest branch of the SRN was 2.7 cm (SD=0.52).

Parameters		Harini P and Mohanraj KG [7] Chennai, Tamil Nadu, 2020 (33 radii)	Clement H et al., [19] Graz, Austria, 2008 (100 radii)	Shanthi KC [20] Salem, Tamil Nadu, 2015 (100 radii)	Present study Vadodara, Gujarat, December 2021 to August 2022 (180 radii)
Length	Mean±SD (mm)	(L) 14.79±0.12 (R) 16.05±0.48	18.3	(L) 7.6 (R) 11.8	(L) 13.19±1.51 (R) 12.30±1.46
	Range (mm)	-	6-26 mm	-	(L) 9.94-16.75 (R) 9.18-16.81
Height	Mean±SD (mm)	-	3.6	-	(L) 2.96±0.69 (R) 2.87±0.57
	Range (mm)	-	2-6±0.8	-	(L) 1.46-5.94 (R) 1.57-4.61
Width	Mean±SD (mm)	(L) 8.41±0.274 (R) 9.08±0.462	-	-	(L) 4.89±1.17 (R) 4.66±0.98
	Range (mm)	-	-	-	(L) 2.45-9.9 (R) 3.03-7.6

[Table/Fig-8]: Comparison of length, height and width of LT with the past studies [7,19,20].

Samarakoon LB et al., studied relation of LT and sensory branches of Radial nerve in 25 forearm and wrist in cadaver, they found that the mean distance to the point where the most medial and the most lateral superficial sensory branches of the radial nerve cross the wrist joint were 2.51 cm (SD=0.5) and 3.90 cm (SD=0.64) from the LT, respectively [10]. He suggested to avoid transverse incision in the snuff box region between 2.5 cm and 3.9 cm from the LT as the risk of damaging the branches of the nerve is very high.

Triphonydis M et al., studied the distance of the SRN branches from the LT, the ulnar styloid and the radial styloid processes [22]. They found that the distance of a nerve branch to the LT is greater. They recommended to consider this findings while planning to do percutaneous pinning of distal radial fractures and when possible, the LT may be utilised as an entry point instead of the radial styloid.

### Limitation(s)

The present study could not comment on gender differences of LT, but these deprived data can be fulfilled by cadaveric or radiological study.

### CONCLUSION(S)

The present study concludes that in majority of cases, anatomical localisation of LT was nearer to the ulnar notch and the distance between the LT and the radial styloid process was greater. This knowledge can be utilised in the management of distal radius fractures. The length, width and height of the LT is variable and these data should be considered, while operating on distal radius like screw fixation in volar plating and micro nail techniques.

### REFERENCES

- [1] Standring S. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 41<sup>st</sup> ed. Spain Churchill Livingstone; 2016. 839-840, 854.
- [2] Yammine K, Rafi SM, Furhad S. Tendon and neurovascular injuries of the distal radius after pinning with Kirschner wires: A meta-analysis of cadaveric studies. Clin Anat N Y N. 2015;28(4):545-50.
- [3] Geerts RW, Toonen HG, van Unen JM, van Vugt R, Werre AJ. A new technique in the treatment of distal radius fractures: the Micronail®. Acta Orthop Traumatol Turc. 2011;45(2):85-93.
- [4] Lamas C, Llusà M, Méndez A, Proubasta I, Carrera A, Forcada P. Intraosseous vascularity of the distal radius: Anatomy and clinical implications in distal radius fractures. Hand N Y N. 2009;4(4):418-23.

- [5] Dahl J, Lee DJ, Efar JC. Anatomic relationships in distal radius bridge plating: A cadaveric study. Hand N Y N. 2015;10(4):657-62.
- [6] Mishra PK, Nagar M, Gaur SC, Gupta A. Morphometry of distal end radius in the Indian population: A radiological study. Indian J Orthop. 2016;50(6):610-15.
- [7] Harini P, Mohanraj KG. Analysis of lister's's tubercle of radius bone and its clinical implications-a morphometric study. PalArchs J Archaeol Egypt Egyptol. 2020;17(7):203-07.
- [8] Kumar P, Sharma A. A study of parameters of lower ends of radius and their significance. International Journal of Scientific Study. 2021;9(1):4.
- [9] Chan WY, Chong LR. Anatomical variants of Lister's's tubercle: A new morphological classification based on magnetic resonance imaging. Korean J Radiol. 2017;18(6):957-63.
- [10] Samarakoon LB, Lakmal KC, Thillainathan S, Bataduwaarachchi VR, Anthony DJ, Jayasekara RW. Anatomical relations of the superficial sensory branches of the radial nerve: A cadaveric study with clinical implications. Patient Safety in Surgery. 2011;5(1):28.
- [11] Ojha P, Ojha AK. Clinical and surgical significance of anatomical localization of Lister's's Tubercle. Int J Sci Res. 2020;9(7):57-58.
- [12] Verma S, Agrawal AC, Nayak B, Kar B, Sakale H, Yadav SK. Surgical anatomy of distal radius and surgical approaches for distal radius fractures. J Orthop Dis Traumatol. 2020;3(2):30.
- [13] Lloyd TW, Tyler MP, Roberts AH. Spontaneous rupture of extensor pollicis longus tendon in a kick boxer. Br J Sports Med. 1998;32(2):178-79.
- [14] Choi JC, Kim WS, Na HY, Lee YS, Song WS, Kim DH, et al. Spontaneous rupture of the extensor pollicis longus tendon in a tailor. Clin Orthop Surg. 2011;3(2):167-69.
- [15] Kim CH. Spontaneous rupture of the Extensor Pollicis Longus tendon. Arch Plast Surg. 2012;39(6):680-82.
- [16] Ferreres A, Llusà M, García-Eliás M, Lluch A. A possible mechanism of direct injury to the EPL tendon at Lister's's tubercle during falls with the wrist fully extended. J Hand Surg Eur. 2008;33(2):149-51.
- [17] Tas S, Balta S, Benlier E. Spontaneous rupture of the extensor pollicis longus tendon due to unusual etiology. Balk Med J. 2014;33(1):105-06.
- [18] Ağır I, Aytekin MN, Küçükdemir F, Gökhan S, ÇavuşUY. Anatomical localization of lister's's tubercle and its clinical and surgical importance. Open Orthop J. 2014;8:74-77.
- [19] Clement H, Pichler W, Nelson D, Hausleitner L, Tesch NP, Grechenig W. Morphometric analysis of Lister's's tubercle and its consequences on volar plate fixation of distal radius fractures. J Hand Surg. 2008;33(10):1716-19.
- [20] Shanthy KC. Morphometric analysis of extensor groove of lower end of radius. IJCRR. 2015;7(24):39-42.
- [21] Ali AM, El-Alfy B, Attia H. Is there a safe zone to avoid superficial radial nerve injury with Kirschner wire fixation in the treatment of distal radius? A cadaveric study. J Clin Orthop Trauma. 2014;5(4):240-44.
- [22] Tryfonidis M, Charalambous CP, Mills SP, Jass GK, Jacob S, Stanley JK, et al. Distal radial and ulnar landmarks used in percutaneous pin fixation: Anatomical relationship to the superficial radial and ulnar nerves. Hand Surg Int J Devoted Hand Up Limb Surg Relat Res J Asia-Pac Fed Soc Surg Hand. 2010;15(3):161-64.

#### PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Anatomy, Medical College Baroda, Vadodara, Gujarat, India.
2. Associate Professor, Department of Anatomy, Medical College Baroda, Vadodara, Gujarat, India.
3. Intern, Medical College Baroda, Vadodara, Gujarat, India.
4. Professor and Head, Department of Anatomy, Medical College Baroda, Vadodara, Gujarat, India.

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

Hina Bhulabhai Rajput,  
C-190, San Tropez, Madrid County, Opposite Ashapura Temple, Bhayli Station Road,  
Vadodara-391410, Gujarat, India.  
E-mail: drhinarajput81@gmail.com

#### AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? NA
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

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

- Plagiarism X-checker: Nov 24, 2022
- Manual Googling: Feb 08, 2023
- iThenticate Software: Mar 14, 2023 (20%)

#### ETYMOLOGY: Author Origin

Date of Submission: **Nov 19, 2022**  
Date of Peer Review: **Jan 06, 2023**  
Date of Acceptance: **Mar 25, 2023**  
Date of Publishing: **May 01, 2023**