



ANATOMICAL AND MORPHOLOGICAL STUDY ON RADIAL HEAD AND ITS CLINICAL IMPLICATION

Dr. Moumita Saha

Demonstrator, Associate Profesor, Dept. of Anatomy, Mahara Jitendra Narayan Medical College, Coochbehar-736101.

Dr. Santanu Bhattacharya*

Associate Professor, Dept. of Anatomy, Mahara Jitendra Narayan Medical College, Coochbehar-736101. *Corresponding Author

ABSTRACT

Introduction: The lateral forearm bone, Radius is a fundamental element for the physiological or prosthetic stability of the elbow and superior radio-ulnar joints. It also participates in elbow flexion, supination & pronation. The knowledge of shape and size of the radius will be useful for the radial head prosthesis. The morphometric data may help orthopedic surgeons for reconstructive surgery.

Aims & Objectives: To determine the morphometric parameters of proximal end of radius and to assess its clinical significance.

Methodology: A cross sectional morphometric study was conducted on sixty-six undamaged adult dry human Radii of unknown age and sex, in the Department of Anatomy, MJNMCH, by using a digital vernier caliper of accuracy of 0.01mm. Anteroposterior diameter, transverse diameter, medial height and lateral height and depth of superior articular facet were measured.

Result: In the present study mean values (\pm standard deviation) of anteroposterior diameter, transverse diameter, medial height, lateral height of radial head and depth of superior articular surface were 16.86 \pm 2.92mm, 16.22 \pm 2.91mm, 8 \pm 1.7mm, 5.8 \pm 1.29mm and 1.1 \pm 0.3mm for the right side and 18.71 \pm 2.05mm, 18.14 \pm 2.1mm, 8.5 \pm 1.33mm, 6.15 \pm 0.9mm and 1.21 \pm 0.3mm for the left side respectively. The average values of anteroposterior and transverse diameter of radial head show significant difference between right side and left side of radius.

Conclusion: The knowledge of size and shape of radial head is necessary for creation of radial head prosthesis that should be automatically and biochemically correct so that the open be safely applied. The study was conducted to find out some additional and relevant information on the morphometric parameters of radial head so that it can help in creation of radial head prosthesis.

KEYWORDS : Radial head, Radial Morphometry, Radial prosthesis.**INTRODUCTION:**

Radius is the thicker and shorter of the two bones in the human forearm. It is the preaxial / lateral bone of the forearm. It is the long bone comprising of proximal end, shaft and distal end. Radius articulates with humeral capitulum. Its smooth articular periphery is vertically deepest medially, where it contacts the ulnar radial notch. Proximal articular surface of the radial head and its circumference are covered by hyaline cartilage. The proximal end of radius is very important clinically because Humero-radial joint permits flexion and extension movements at elbow joint and superior radio-ulnar joint permits supination and pronation movement of forearm. Fractures of proximal end of radius are approximately 1.7% - 5.4% of all the fractures² and about 1/5th of all the fractures at the elbow joint i.e. about 20%.³

Numerous pathologies may affect the proximal end of the radius and its head. These may include dislocations, fractures, degenerative diseases, osteochondroma, heterotopic ossification, subluxation that may alter the joint mechanics.^{4,5,6} These conditions may require prosthetic implantation or some corrective surgeries.

Radial head dislocation may lead to osteoarthritis, posterior interosseous nerve palsy & cubitus valgus deformity among children as age advanced. Radial head prosthesis is considered as a valuable option in patients with radial head & neck fractures, who require radial head replacement. Radial head prosthesis first proposed by Speed in 1941. He used a ferule cup over the neck of radius.⁷ Since then the use of silicon rubber, acrylic & other metallic prosthesis has been there. If orthopaedicians are performing hemiarthroplasty, the main goal is restoring the normal anatomy as much as possible. Radial head prosthesis must restore maximum function of radial head within the elbow joint.^{8,9}

This objective of the present study is to determine the morphometry of head of radius to help in the standardization of the radial head prosthesis available in the Indian market.

MATERIALS AND METHODS:

An observational study with cross sectional design of data collection was conducted in the Department of Anatomy, Maharaja Jitendra Narayan Medical College & Hospital (MJNMCH), Coochbehar for a period of six months. Only undamaged, dry, human cadaveric bones were included in the study and the final sample size was sixty-six. Among the total number of bones, fifty percent was of right side and

the rest was of left. Different morphometric measurements were taken for the head of radius by using a digital Vernier Caliper. The details of the parameters and the procedure of measurements are described below:

- i. **Antero-posterior diameter of radial head:** distance from most anterior point on radial head to most posterior point. (Fig-1)
- ii. **Transverse diameter:** distance from medial point on radial head to most lateral point. (Fig-2)
- iii. **Medial height of Radial head:** distance between radial lip & head & neck junction on medial side. (Fig-3)
- iv. **Lateral height of Radial head:** distance between radial lip & head & neck junction on lateral side. (Fig-4)
- v. **Depth of Superior Articular Facet:** scale put over the radial head touching most prominent anterior and posterior rim of radial head and depth in the centre measured by the Vernier caliper. (Fig-5)

**Fig-1:** Measurement Of Antero-posterior Diameter Of Radial Head.**Fig-2:** Measurement Of Transverse Diameter.



Fig-3: Measurement Of Medial Height Of Radial Head



Fig-4: Measurement Of Lateral Height Of Radial Head

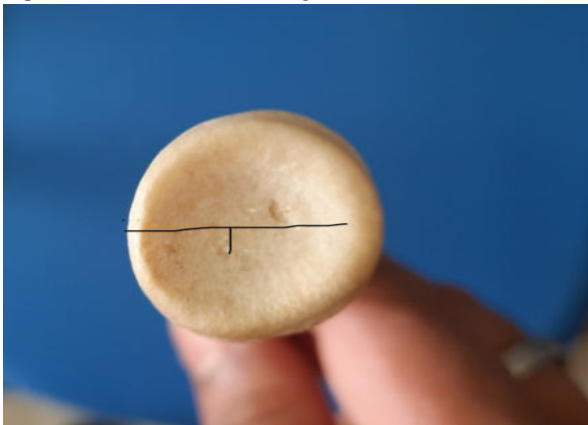


Fig-5: Measurement Of Depth Of Superior Articular Facet

RESULT AND ANALYSIS:

The average values of different morphometric parameters were determined from sixty-six radii. Among the total collected specimens fifty percent radii were of right side and the rest were of left side.

In present study the mean Anteroposterior diameter (APD) and Transverse diameter (TD) were 16.865mm & 16.221mm with standard deviation of 2.93mm & 2.919mm respectively. The average Medial height and Lateral height of radial head were 8.006mm and 5.83mm with standard deviation of 1.751mm and 1.296mm respectively. The mean depth of Superior Articular Surface was 1.107mm with standard deviation of 0.328mm. The average values with standard deviation, range of different morphometric parameters are depicted in **Table-1** according to the sides of the radii.

Table-1: Mean With Standard Deviation, Range Of Different Parameters According To Side Of Radius (n=66)

Parameters	Side	Mean (mm)	Standard Deviation (mm)	Range (mm)	Test of significance
Antero-posterior diameter of radial head	Right (n=33)	16.865	2.929	10.3-22.01	T Statistic = 2.9723 P-value = 0.0042*
	Left (n=33)	18.716	2.053	12.22-24.05	

Transverse diameter of radial head	Right (n=33)	16.221	2.919	10.28-21.73	T Statistic = 3.0638 P-value = 0.0032*
	Left (n=33)	18.142	2.109	11.85-23.35	
Medial height of Radial head	Right (n=33)	8.006	1.751	4.19-11.3	T Statistic = 1.3201 P-value = 0.1915*
	Left (n=33)	8.512	1.338	5.1-10.93	
Lateral height of Radial head	Right (n=33)	5.83	1.296	3.97-8.8	T Statistic = 1.1667 P-value = 0.2476
	Left (n=33)	6.159	0.966	3.79-8.08	
Depth of Superior articular facet	Right (n=33)	1.107	0.328	0.22-2.01	T Statistic = 1.3972 P-value = 0.1672
	Left (n=33)	1.216	0.302	0.96-1.95	

*Significant

Impression:

Average values of antero-posterior and transverse diameter of radial head show significant difference between right side and left side of radius.

DISCUSSION

While the ulna is the major contributor to the elbow joint, the radius primarily contributes to the wrist joint. The radius is named so because the radius (bone) acts like the radius of a circle. The ulna acts as the centre point to the circle because when the arm is rotated the ulna does not move. Head of the radius fundamental element for the physiological or prosthetic stability of the elbow.^{10,11,12,13}

Various works had been done regarding the measurement of radial head either by morphometrically or by radiologically due to increasing trend of using radial head prosthesis. Singh et al. (2015)¹⁵ done their study to measure the morphometry of radial head as well as they calculate a correlation between depth vs surface area, depth vs volume and surface area vs volume of radial head which are also measured by Al-Imam et al. (2016)¹⁶. Beredjiklian et al. (1999)¹⁷ measured various parameters of radial head by using magnetic resonant techniques and stated that currently available radial head prosthetic stem designs overestimated the intramedullary dimensions of radial head.

Singh et al. (2015)¹⁵, found the mean APD of radial head 20.44 cm in right side & 20.59 in left side, whereas Puchwein et al. (2013)¹⁸, found the mean APD of radial head at its widest part 2.3cm & Capiter et al. (2002)¹⁹ reported 2.16cm at widest part. While in our present study we see the mean APD in right side 16.86 mm & in left side 18.15 cm with a SD of 2.93 in right & 2.05 in left.

In the present study we get the TD (mean±Standard Deviation) of right side was 16.226 ± 2.9mm & of left side was 18.14 ± 2.1mm. In their study, Singh et al. (2015)¹⁵ found the TD was 19.43±2.39 mm in right side & was 19.66±/- 2.08 mm in left side.

According to the study of Puchwein et al. (2013)¹⁸ height of circumference of radial head of medial and lateral sides were 11.7mm & 11.8mm respectively and the values were higher than the findings of Gupta et al. (2015)²⁰ (9mm & 7.5mm respectively) and Shastry et al. (2018)²¹ (8.65 mm & 6.28 mm respectively).

In our study the medial height of right is 8.0mm & of left 8.5mm & lateral height of right is 5.83mm & left is 6.15mm. This is probably Puchwein et al. (2013)¹⁸. measured values by CT scan while other authors measured it in dry bones including us. In the present study the depth of the superior articular surface in right sided radius 1.107mm & in left sided radius 1.215mm, whereas Singh et al. (2015)¹⁵ reported 1.96 mm which is greater than the present study.

According to the study done by Akshaya et al. (2020)²² there was no significant difference between right and left dimensions among all the selected parameters. In contrast the present study shows a significant difference in average values of antero-posterior and transverse diameter right sided and left sided of radial head.

Swieszkowski et al. (2001)²³ performed a morphologic study of the radial head where they measured the maximum diameter, height of radial height & depth of articular surface. They concluded that there were no significant differences on the right & left sided radius.

Koslowsky et al. (2007)²⁴ conducted a study with the help of optosil imprint and reported the similar findings except the complexity of the shape of the radial head. They also measured radial neck length & neck shaft angle by using x-rays and optosil imprint.

Some authors like Smith et al. (1996)²⁵ did the cadaveric study of the radial head and neck to determine the limits for safe placement of internal fixation the surface of radial head or neck. They concluded the safe zone is nearly 1/3rd of radial head circumference and can be reliably determined with the method of intraoperative marking as outlined.

Giannicola et al. (2012)²⁶ found that there were extensive morphologic dissimilarities were present at the outline of the proximal radius. These should be considered when operating on the fractures of the proximal radius. They also, opined that osteosynthesis of radial head and neck fractures should be done in safe zone, where a plate can be securely applied without risking the proximal radio-ulnar joint.

CONCLUSION:

Morphometric parameters of proximal end of radius are useful in the designing of prosthesis. The knowledge of the size of the head of radius plays a major role in influencing radial head replacement. So, the present study was conducted to supplement the existing data on the morphometry of radial head. However, smaller sample size, unknown region of origin of bones, not supplemented by any other techniques like skiagrams/MRI scan/CT scan are some limitations of the present study.

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