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MORPHOLOGICAL AND MORPHOMETRIC STUDY OF ADULT HUMAN RADIUS IN JAMMU REGION

Anatomy

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ABSTRACT

INTRODUCTION: Radius is one of the most important bony structures of our skeletal system. Anatomical knowledge of radius bone helps in advancement of surgeries. Anatomy of radius is practically important for orthopedic and plastic surgeons.

AIM: Very few studies on radius are available in Indian population, especially North Indians. The present study is therefore designed on dry human radius for morphological and morphometric analysis. The outcome of present study highlights the need for imaging the contralateral bones to get optimal, beneficial results in various surgical and corrective procedures.

MATERIALS AND METHODS: The material for the present study comprised of 100 dried human adult radii randomly obtained from the Department of Anatomy, Government Medical College, Jammu. All the radii obtained were without any gross abnormality. Each radius was labeled from 1 to 100 with suffix 'R' for right and 'L' for the left. Various parameters of the proximal and distal ends of radius were studied.

RESULTS AND CONCLUSION: The data obtained from current trial can be used as baseline data for future studies in the department of Anatomy, Radiology, Forensic Medicine and Orthopedics.

KEYWORDS

Human Radius, Head, Neck, Prosthesis

INTRODUCTION:

- Anatomy of human body has always fascinated men from time immemorial. This quest for acquiring knowledge of anatomical details of the body became the fundamentals of the present day advance surgery. Anatomy of radius is practically important for orthopedic and plastic surgeons like in case of construction of radial head prosthesis. Measurements of bicipital tuberosity and its angular relationship with radial head is important in the reconstruction of biceps tendon. Word 'Radius' is a Latin word meaning 'Spoke" or 'Ray'. The radius is the weight bearing bone of the forearm **(Singh V, 2014).** The radius is the lateral bone of the forearm and its shaft has expanded ends. The proximal end includes head, neck and tuberosity. The shaft is triangular in section. Lower end projects distally as styloid process **(Gray H, 2008).**The role of the radial head in the functional anatomy and kinematics of the elbow and forearm continues to be defined. The importance of the radial head has stimulated a greater degree of interest in the fixation and reconstruction of traumatic injuries to the radial head and/or neck, whether simple or complex. The majority of simple fractures of the radial head are stable, even when displaced 2mm (**Ruchelsman DE et al, 2013).** Knowledge of size and shape of radial head is also necessary for creation of radial head prosthesis that is anatomically and biomechanically correct. **(Captier G et al, 2002).** Radial head and neck fractures constitute 1.7% to 5.4% of all fractures. Radial head fracture alone constitute one third of all elbow fractures and approximately 20% of all elbow trauma cases **(Koslowsky TC et al, 2007).** Stature estimation provides an idea about the size of the person. Due to allometric relationship of the body parts with one another, the stature can be estimated from almost all the bones of the skeleton (**Kanchan T & Krishan K, 2013).**

MATERIALS AND METHODS

The material for the present study comprised of 100 dried adult radii randomly obtained from the Department of Anatomy, Government Medical College, Jammu. Each radius was labeled from 1 to 100 with suffix 'R' for right and 'L' for the left. All the bones selected for the study were complete in all respects and without any gross abnormality so as to give correct measures of all the parameters under study.

Instruments used for the study were:

1) Osteometric board for measuring length of bones.
2) Vernier Caliper to measure different diameters and lengths with least errors.
3) Electronic weighing balance for measuring weight of individual bones.
4) Cotton thread and measuring tape for measuring circumferences of bones.
5) Goniometer for measuring angles.
6) Digital camera.
7) Black marker pen.

Each bone was examined for morphometric and morphological features. Following morphological and morphometric features of radius were observed and measured-

- Side of Radius was labelled as 'R' for right and 'L' for left
- Length of Radius bone was measured between the tip of radial styloid process and most lateral portion of radial head in mm.
- Weight of Radius was recorded with electrical weighing machine and was taken in grams.
- Articular surface of head was examined to notice its shape whether round/circular or oval/ellipsoid.
- Antero-posterior and Transverse diameter of head was measured in mm with vernier caliper.
- Length of neck was measured as distance between the head-neck border and superior border of bicipital tuberosity in mm.
- Proximal neck diameter was taken at head-neck border in mm with vernier caliper.
- Distal neck diameter: was taken at distal end of neck just above the radial tuberosity in mm with vernier caliper.
- Length of radial tuberosity was taken in mm with vernier caliper. .
- Width of radial tuberosity was taken in mm between two farthest points in transverse axis with vernier caliper in mm.
- Mid-shaft diameters transverse and antero-posterior diameters were taken with vernier caliper in mm.
- Circumference of shaft at the upper end, mid-shaft and lower end of the shaft with thread and then thread was measured on a tape in mm.
- Length of the styloid process: It was measured with vernier caliper.
- Length of the ulnar notch measured with vernier caliper.
- Distance of dorsal tubercle from tip of styloid process and ulnar notch was measured with vernier caliper.
- Angle of radial inclination: It was measured as the angle between, a line joining the tip of radial styloid process and the medial edge of the distal radius, and a line perpendicular to the long of the radius at the level of medial edge of the radius with goniometers.

• OBSERVATIONS

The present study "Morphological and Morphometric study of adult human radius" is done on 100 dry radii of both sides (Right: 52, Left: 48). All the parameters are recorded as per anatomical basis. Various statistical results calculated are: Mean with standard deviation and Range. The results obtained are tabulated as under:

TABLE 1: Mean and range of all parameters of radius on the right and left sides

Parameters	Mean ±SD (mm)	RANGE (mm)
Length of radius		
Right	239.6 ± 14.3	206 -265
Left	238 ± 16.08	206 – 282
Weight of radius		
Right	34.7 ± 8.7	17-58
Left	33.8 ± 9.7	14-58

Anterio-posterior diameter of head		
Right	20.9 ± 1.9	16.2 – 26.4
Left	20.6 ± 1.6	17.2 – 24.5
Transverse diameter of head		
Right	20.3 ± 1.84	16 - 25.2
Left	19.9 ± 1.6	16 – 23.6
Length of neck of radius		
Right	12 ± 1.6	6.4 - 15.6
Left	11.8 ± 1.7	8.4 – 15
Proximal neck diameter		
Right	14.5 ± 1.2	11.5 – 17.6
Left	15.3 ± 1.6	11.9 – 19
Distal neck diameter		
Right	12.8 ± 1.3	10.6 -16.8
Left	13.3 ± 1.6	10.3 – 18
Length of radial tuberosity		
Right	22.3 ± 2.9	16.2 – 29
Left	21.7 ± 2.7	12.6 -28.5
Width of radial tuberosity		
Right	12.2 ± 1.3	9.1 -15.8
Left	12.1 ± 1.8	8.6 -18.2
Mid shaft transverse diameter		
Right	13.2 ± 1.1	10.2 – 16.3
Left	13.1 ±1.3	10.2 – 16
Mid shaft anterio posterior diameter		
Right	11.1 ± 0.94	9.1 – 13.9
Left	10.9 ± 1.2	8.4 – 15
Circumference of shaft at upper end		
Right	42.4 ± 0.3	35 -49
Left	42.4 ± 3.6	35 -50
Circumference of shaft at mid shaft		
Right	39.5 ± 2.6	33 – 46
Left	39.2 ± 3.7	31 – 48
Circumference of shaft at lower end		
Right	46.3 ± 3.7	40 – 55
Left	46.4 ± 4.8	35 – 59
Length of styloid process		
Right	9.9 ± 1.5	6 – 14
Left	8.6 ± 1.5	6.5 – 13.6
Length of ulnar notch		
Right	7.1 ± 1.2	5 -11
Left	6.7 ± 1.5	5 -11.6
Distance of dorsal tubercle from ulnar notch		
Right	18.5 ± 1.8	14.4 + 21.3
Left	18.8 ± 1.2	16.2 +22.4
Distance of dorsal tubercle from tip of styloid process		
Right	15.9 ± 1.5	11.8 – 19.7
Left	16.5 ± 1.3	12.6 -22.2
Angle of radial inclination		
Right	20.8 ± 1.7	18 -26
Left	22.3 ± 2.2	18 -28

DISCUSSION

Length of bone provides high accuracy in determination of sex and estimation of stature. Radius can be of use for this purpose amongst upper limb bones. Knowledge of size and shape of radial head is also necessary during orthopedic procedures for creation of radial head prosthesis that is anatomically and biomechanically correct. Distal radial morphometry is important in the management of distal radius fractures, in order to maintain anatomical alignment. In the present study, mean length of radius on right and left side was 239.6mm and 238mm respectively. Present study is in accordance with studies done by Gaytari et al, 2014 and Charisi D et al, 2011. Mean weight of bone is more on the right side than the left side radii.

In a study done by Gupta C et al, 2015 most common shape of radial head was circular in 64% cases which is in accordance with the present study.

In the present study mean antero- posterior diameters of total radii was 20.6mm and mean transverse diameter was 20.1mm which is in accordance with the study done by Captier G et al, 2002. Mean transverse diameter was found to be less than mean antero-posterior diameter.

Gupta C et al, 2015 found mean length of neck 11.8mm on right and 12mm on left side radii, we also got similar results in the present study. Mean proximal neck diameter is slightly more and mean distal neck diameter is slightly less than the study done by Gupta C et al, 2015. Mean length and width of radial tuberosity was found to be slightly more on right side radii.

Mean antero-posterior and transverse diameter of mid-shaft is in accordance with the study done by IN Mike et al, 2016. In the present study it was found that the mean diameter of the shaft was least at the middle of the shaft.

Dimensions of radial styloid process along with dimensions of radial tuberosity facilitates in various surgical procedures such as reconstruction of the distal biceps tendon, reduction of distal radius fractures. Gupta C et al, 2015 found mean length of styloid process on right and left side as 10mm and 9.7mm respectively, which is slightly more than the present study.

The mean distance of dorsal tubercle from tip of styloid process was less than the distance from ulnar notch. The study of literature failed to cite any study evaluating length of ulnar notch and distance of dorsal tubercle from tip of styloid process and ulnar notch.

In the present study, mean angle of radial inclination is found to be 20.8 degrees on right side and 22.3 degrees on left side radii, which is in accordance with study done by Pritish Kumar IJ et al.

The anatomy has always provided a sound knowledge in management of various clinical conditions. The results thus calculated provide important information about right and left asymmetry of human radius bones to the Forensic experts and Orthopaedic surgeons. Knowledge of various parameters of this bone will help the forensic experts in determining sex and height of an individual, whereas to the orthopaedician the knowledge will help in various treatment modalities in fractures and dislocations of the bone and also in surgical procedures such as implantation of prosthesis, so as to avoid complications and in order to maintain anatomical alignment. The outcome of present study highlights the need for imaging the contra-lateral bones to get the optimal, beneficial results in various surgical and corrective procedures.

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