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Original Research Article

A STUDY OF MORPHOMETRY OF DISTAL END OF RADIUS IN THE TRIBAL POPULATION OF MANIPUR

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ABSTRACT

Background: Fractures of distal end of radius are very common and form 8-15% of upper limb trauma.[1] It is important to have knowledge of the morphometry of distal radius to treat the fracture of radius and to improve the design of distal radius plates. However the measurements used for evaluation currently are based on western figures. The aim of this study is to report the morphometry of the distal radius in the tribal population of Manipur and also compare it to similar studies of other races and populaion.

Materials and Methods: The study was conducted on 142 participants 71 each male and female from August 2020 to November 2022. True anteroposterior and lateral wrist xrays were taken. The radial inclination, radial height, palmer tilt and ulnar variance were measured in the console. Radiographs with no distal radial structural deformities and fused physis were included in the study.

Results: The mean value of radial inclination is 22.41 ± 4.81^0, range 10.1 - 34.2^0. The mean radial height of all the participants is 10.87 ± 1.73 mm. The palmer tilt averaged to 10.42 ± 1.28^0. The mean ulnar variance of the participants is +0.55 ± 1.27 mm (range: -2.2 to + 3.2mm).

Conclusion: The distal radius morphometry varies with different races and ethnicity. This study provided a deep insight into the various distal radius parameters which can be used as reference values for treating distal radius injuries among the tribals of Manipur.

Keywords: Distal radius, morphometry, radial inclination, radial height, palmer tilt, ulnar variance.

INTRODUCTION

Fractures of distal end of radius are very common and form 8-15% of upper limb trauma.[1] It is important to have the knowledge of the morphometry of distal radius to treat the fracture of radius and to improve the design of distal radius plates. Distal radius morphomery and wrist biomechanics are closely intertwined with eachother. Radial inclination, radial height palmer tilt and ulnar variance are the four crucial parameters that dictates the biomechanics of the wrist joint. Cadaveric experiments conducted by Short WH et al in 1987 have emphasized the importance of anatomic correction of palmer tilt.[2] A decrease in the palmer tilt results in the increased load burden on the ulna. This further affects the force distribution across the wrist joint. With increasing dorsal angulation the load pressure distribution is more concentrated on radial and ulnar joint surface. The maximum load sharing across wrist joint occurs through radiocarpal joint (82%) especially through the lunate fossa transmitted via lunate. But when there is negative ulnar variance the force distribution is further increased in radiocarpal joint thereby predisposing for kienbock's disease. The kinesiology and the grip strength of wrist joint is strongly influenced by the loss of radial height and altered palmer tilt.[3,4]

Most orthopaedicians follow western data of radiographic anatomy of distal radius as a reference for evaluation of acceptable value of post reduction distal radius morphometry. Data on morphometric parameters of distal end of radius is limited, especially in this part of the country.

The purpose of the study is to analyse the distal radius morphometry of the local tribal population of Manipur, to compare the morphometry of the sampled population between male and female subjects and also with the existing reference values. Hence, this study will provide a database for further research and experimental studies and the result may also provide reference values for evaluation and treatment of distal radius fractures and injury among the tribal population of Manipur.

MATERIALS AND METHODS

With the approval of the REB (Research Ethics Board), RIMS all the tribal subjects above 18 years of age attending Orthopaedic OPD between January 2021 to June 2022 with due consent were subjected to true anteroposterior (AP) and lateral radiographs of wrist joint. Participants with radiologically confirmed ossified bone with no structural abnormalities and pathological conditions of DER (Distal end of Radius) were included in the study. The radiographs were taken alternatively first starting with the right side.

The radiographs were adjusted for the magnification on the radiology computer console. This is a computer workstation in which we can draw lines and angles on the radiographs and the system immediately gives the length in millimetres or centimetres and angles in degrees. We measured the radial inclination, radial height, palmer tilt and ulnar variance. This data was recorded in tables and grouped between male and female gender.

Standard statistical analysis was done and data were analysed by Independent t test to compare the means of radial inclination, radial height, palmer tilt and ulnar variance between male and female gender. $P<0.05$ was taken as significant in this study. Data entry and analysis is done using SPSS Version 21.0 (IBM.Inc.Armonk.NY, USA).

Figure 1: Radial Inclination

Figure 2: Radial height

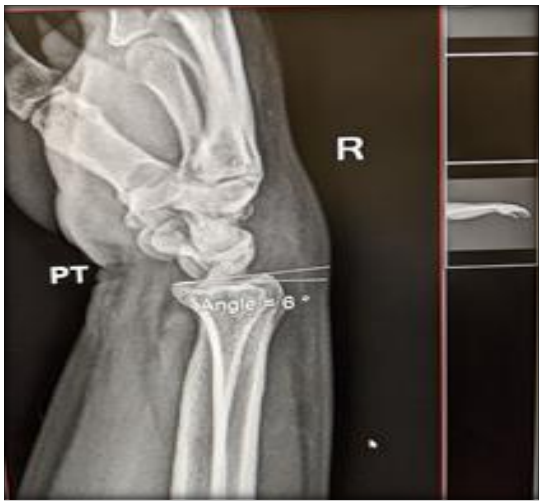

Figure 3: Palmer tilt

Figure 4: Ulnar variance

RESULTS

142 participants were enrolled in the study with 71 each male and female and 50% comprised of right and left side each. The mean age of all the

participants irrespective of sex was 39.80 ± 15.41 years. [Table1]

The mean radial inclination of all the participants is 22.41 ± 4.81^0 (range 10.1 - 34.2 ^{0}). The mean radial inclination with respect to sex was 22.64 ± 4.95^0 (Male) and 22.18 ± 4.68^0 (Female). [Table 2]

The mean radial height of all the participants is 10.87 ± 1.73 mm (range: 7.3 - 18.3 mm). The mean radial height with respect to sex and side is shown in Table 3. [Table 3]

The mean palmer tilt of all the participants is 10.42 ± 1.28^0 (range: 7.8 - 16.2^0). The mean palmer tilt with respect to side and sex is shown in Table 4. [Table 4]

The mean ulnar variance of the participants is +0.55 ± 1.27 mm (range: -2.2 to + 3.2mm). There is no significant difference in ulnar variance between male and female subjects and with respect to side. [Table 5]

There is no significant difference in the radial inclination, radial height, palmer tilt and ulnar variance of distal radius in the different age groups. [Table 6]

Table 1:

Parameters	Male	Female
Mean Age (years)	39.99 ± 15.78	39.68 ± 15.14

Table 2:

Parameter	Radial Inclination (0)	P value
Male	22.64 ± 4.95	0.577
Female	22.18 ± 4.68	
Right side	22.59 ± 4.81	0.654
Left side	22.23 ± 4.83	

Table 3:

Parameter	Radial Height(mm)	P value
Male	11.46 ± 1.84	0.00
Female	10.28 ± 1.39	
Right side	10.78 ± 1.80	0.526
Left side	10.24 ± 1.66	

Table 4:

Parameter	Palmer tilt (0)	P value
Male	10.57± 1.47	0.168
Female	10.28 ± 1.04	
Right side	10.61 ± 1.48	0.084
Left side	10.24 ± 1.03	

Table 5:

Parameter	Ulnar variance (mm)	P value
Male	0.37± 1.26	0.095
Female	0.73± 1.25	
Right side	0.41 ± 1.43	0.190
Left side	0.69 ± 1.07	

Table 6:

Parameters	< 30years	31-60 years	>60 years	P value
Radial Inclination (^{0})	21.89 ± 5.14	22.69 ± 4.80	22.78 ± 3.84	0.626
Radial Height (mm)	11.10 ± 1.71	10.81 ± 1.83	10.84 ± 1.33	0.401
Palmer Tilt (^{0})	10.42 ± 1.28	10.39 ± 1.19	10.63 ± 1.71	0.785
Ulnar Variance (mm)	+0.34 ± 1.16	+0.69 ± 1.3	+0.58 ± 1.39	0.309

DISCUSSION

Distal radius fractures are one of the most common types of fractures which accounts for around 25% of the fractures in the pediatric population and reaching upto 18% of all fractures in elderly age group.[5] Orthopaedic surgeons all around the world classically use the Gartland and Werley reference values as a guideline to treat these injuries and achieve an acceptable reduction.[6] However the available literature sheds light on the fact that distal radius morphometry varies from country to country, between races and ethnic background. However due to the unavailability of the data of local population, orthopaedists tends to refer to the western reference values to treat DER injuries which may not hold true for that population.

Results obtained from cadaveric studies previously done on distal radius morphometry puts up a reasonable amount of doubt since the subjects in the cadaveric study mostly comprises of older age which may not be truly representative of the population. Moreover there is always a higher chance to include pathologic or deformed bone as no previous clinical data is available for the subjects. However, it is critical to consider how cadaveric (osteometric)

morphometric values will be translated in clinical practice, where the perspective of acceptance and non-acceptance is purely radiological.

A total of 142 participants were included in this cross sectional study. In terms of age distribution most of the study populations were young age group with the mean age of males was 39.99 ± 15.78 years and the mean age of females was 39.68 ± 15.41 years which is comparable to a similar study conducted by Mishra PK et al.[7]

In our study the mean radial inclination was 22.41 ± 4.81^0 ranging from 10.1 - 34.21^0 which is comparable to the study done by Nekkanti S et al,[8] and Agarwala et al,[9] where the mean radial inclination was 21.58 ± 3.35^0 and 21.85± 2.76^0 (15 - 29.50^0) respectively. The study conducted by Chan et al,[10] also showed similar results.

The mean radial height observed in our study is 10.87 ± 1.73 mm ranging from 7.3 – 18.3 mm which is comparable to the studies done by Mishra PK et al[7] and Aggarwal V et al[9] and also comparable to the Orthopaedic Trauma Association (OTA) standard reference values.

The mean palmer tilt observed in our study is 10.42 ± 1.28^0. Mishra PK et al,[7] observed the average palmer tilt in the Indian population to be 11.31 ± 4.9^0 (7.1 – 30.4^0) which is comparable. Study done by Nekkanti S et al,[8] in Indian population showed mean palmer tilt to be 11.36 ± 3.16^0 which is also comparable. However OTA reference values showed significant deviation from our finding.

The mean ulnar variance observed in our study is +0.55 ± 1.27 mm. Though various studies have mentioned about negative ulnar variance but in our study we observed positive ulnar variance which is in accordance with the study done by Chan et al,[10] on the Indian race in Malaysia. Study done by Mishra PK et al,[7] and Aggarwal V et al[9] also showed that positive ulnar variance is more common in Indian population. Negative ulnar variance were mostly seen in whites as described in the study conducted by Gilberman et al,[11] and De Smet et al.[12]

In our study we also observed that there is no significant difference in the radial inclination (P = 0.577) palmer tilt (P= 0.168) and ulnar variance (P = 0.095) between male and female which is in accordance to the study done by Nekkanti S et al,[7] and Mishra PK et al,[7] However significant difference was observed in radial height (P<0.05) between male and female population in our study. Study done by Mishra PK et al,[7] and Nekkanti S et al,[7] also observed similar statistical difference in radial height between genders. But in a similar study conducted by Hadi SA et al,[13] they found significant difference in radial inclination, palmer tilt, radial height and ulnar variance between male and female groups.

In our study we did not observe any significant difference (P > 0.05) in radial inclination, radial height, palmer tilt and ulnar variance between right and left side. This finding is similar to the finding obtained in the study done by Mishra PK et al.[7] But in a similar study by Hadi SA et al,[13] they found significant difference in the parameters between right and left side. The mean radial inclination, radial height, palmer tilt, ulnar variance showed no significant statistical difference (P> 0.05) in different age groups which is corroborating with the study done by Nekkanti S et al.[8]

Even though this study has found that there is no significant difference in radial inclination, palmer tilt, and ulnar variance between male and female participants and also between right and left sides there are conflicting findings in other similar studies. Therefore, further study can be done involving higher sample size.

CONCLUSION

This study provides an invaluable inaugural insight about the morphometric data of the distal radius among the tribal population of Manipur. From the study we conclude that the distal radius morphometric parameters in the tribal population of Manipur are similar to the parameters found in the other Indian population as evident from the study by Mishra PK et al.[7] It is also evident that there were no significant differences in the parameters between left and right side wrists among the tribal population of Manipur. With the availability of this data the treating surgeon will be well versed with the variations of these parameters in the local population and hence can be more efficient in his clinical practice of treating DER injuries. These data can be further used as a rough guide to treat their DER injuries in the other parts of northeast India.

Conflict of Interest

Dr Debraj Bhaumik, Dr Prasenjit Debnath, Dr Sanjib Waikhom, Dr Ashutosh Sharma declare that they have no conflict of interest.

Informed Consent

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5). Informed consent was obtained from all patients for being included in the study.

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