IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 19, Issue 7 Ser.13 (July. 2020), PP 39-44
www.iosrjournals.org

Radiographic morphometry of the distal radius in Kashmiri population in North India

Mudasir Ahmad Bhat[1], Obaid Nisar[1], Faisal Khursheed[2], Aabid Ahmad Rather[2], Bilal Ahmad Lone[2]

[1]*Senior Resident, postgraduate department of Orthopedics, SKIMS MCH Bemina, jammu and Kashmir, India*
[2]*Postgraduate students, postgraduate department of Orthopedics, SKIMS MCH Bemina, jammu and Kashmir, India*
Corresponding author: Obaid Nisar

Abstract
Background:*Distal radius fractures are the most common fractures encountered by the treating orthopedic surgeon. Reduction of this fractureis important to restore the normal biomechanics of the wrist joint . The aim of this study is to report the morphometry of the distal radius in Kashmiri population in North India and give a comparison to similar studies of other races and populations.*
Methods*: This is retrospective, unicentric, observational, analytic study. We studied 212 normal wrist posteroanterior and lateral radiographs from our hospital radiology data, and calculated these 4 morphometric measurements namely radial height, radial inclination, ulnar variance and palmar tilt. Radiographs that were not centered on the wrist joint or rotated were excluded from the study. Only radiographs of the distal radius with fused physis were considered in this study.*
Results*: The average radial height is 12.1mm (± 1.52mm) with range from 9.1mm to 16.7mm, radial inclination is 25.77 degree(± 2.91 degree) range from 21degree to 33degree, ulnar variance -1.16 mm (±1.48mm) range from -4.9 mm to 2.1 mm is and palmar tilt is 11.58 degree (±2.37degree) range from 4 degree to 17 degree.*
Conclusion: *The morphometry of the distal radius varies with race, ethnicity, and build of the patient. Thorough knowledge of the morphometry of the distal radius of the local population becomes critical for the treating surgeon. We have set the normal values in true PA and lateral wrist radiographs and these can be used as a reference values in North Indian population.*
Key words: *Distal radius, radiological morphometry, radial tilt, ulnar variance, radial height, radial inclination.*

Date of Submission: 13-07-2020 Date of Acceptance: 27-07-2020

I. Introduction

The distal radius morphometry is extremely critical for understanding normal wrist biomechanics, which has been studied and reported before. Radial height, radial inclination, palmar tilt and ulnar variance are the four important parameters which describe the distal radius morphometry[1]. Short WH et al., in their cadaveric study described the importance of reduction in the palmar tilt parameter, leading to increased dorsal angulation which results in increased loading of the distal radioulnar joint due to increased contact pressure on the articular surface between the sigmoid notch and ulnar head[2]. Negative ulnar variance leads to predisposition of the individual to avascular necrosis of the lunate bone due to increased loading on the capitate-lunate-radius axis[3]. In 1984, Palmer and Verner studied the bio-mechanics of wrist joint and concluded that the radiocarpal joint bears about 82% of the axial force to the wrist joint and 18% load by the ulnocarpal joint[4]. A positive ulnar variance of 2.5 mm results in increased loading of the ulnocarpal joint up to 42% while as negative ulnar variance decreases compression load borne by the ulnocarpal joints up to 4.3%[2-5]. Hence,understanding the normal distal radius morphometry is essential for better treatment of the distal radius fractures[6]. Most orthopedic surgeons in our country follow the western data of the radiographic anatomy of the distal radius. The aim of this study to determine the morphometric parameters of distal radius in our population is to makes these measurements more surgeon friendly as these can be compared intra-operatively to achieve acceptable distal radius alignment[7,8]and postoperatively to assess the reduction in acceptable limits.

II. Methods

Total of 212 posteroanterior (PA) and lateral radiographs of adults (mature skeleton) were selected from Department Of Radiology of our Hospital database. This is a retrospective, unicentric, observational study

where most of the radiographs were from the month of May 2019 to october 2019 at SKIMS Bemina, Srinagar, Kashmir. Radiographs of normal wrist with fused epiphysis were included in the study and the radiographs showing any structural deformity,fracture,arthritisor any lesion were excluded from the study. The radiographs were taken using standard radiographic protocol. True AP and lateral view x rays were considered in the study and the film with rotation were discarded. The morphometric parameters like radial inclination, radial height and ulnar variance were measured on AP view and palmer tilt was measured on lateral view. **Radial height**(Fig.1) is the distance between two parallel lines perpendicular to the long axis of radius at the level of radial styloid and the other at the level of lunate fossa. **Radial inclinaton**(Fig.2) is defined as an angle made by the tangent line connecting the radial styloid to the medial edge of distal radius and the horizontal line perpendicular to the axis of radius at the level of lunate fossa. **Palmer tilt**(Fig.3) is the angle formed by the meeting point of two lines; one line tangential connecting the dorsal and palmer edge of the articular surface of distal end of radius and second line drawn from the palmar edge of articular surface perpendicular to the long axis of radius at the level of radial styloid. **Ulnar variance**(Fig.4) is the distance measured between the two horizontal lines, one line drawn perpendicular to the axis of ulna at the distal cortical margin and the second line perpendicular to the axis of radius at the distal cortical margin.

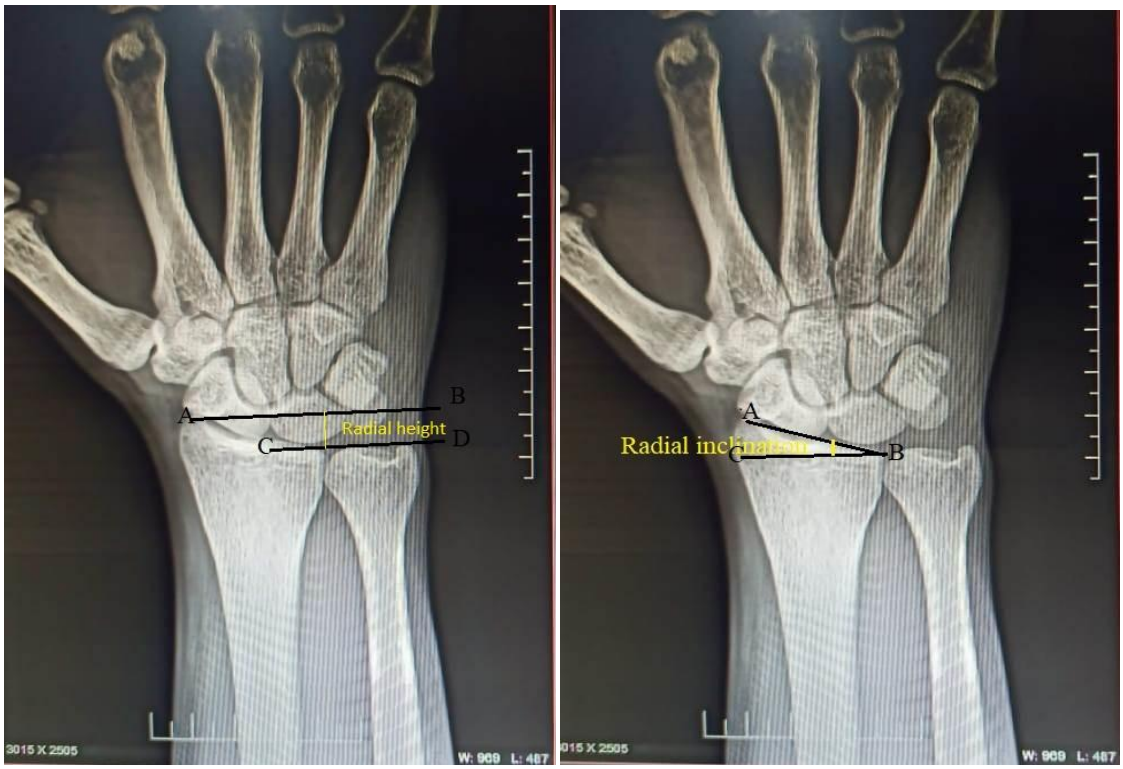

Fig.1Fig. 2

Fig.3

Fig.4

All radiographs were corrected for magnification and reviewed by the same team of authors so as to negate interobserver differences. The data was analyzed using SPSS Statistical software version 20 for Windows. One way ANNOVA test was used for comparing the means of the parameters between the two genders and the two sides within the population and the level of significance set for the P< 0.05.

III. Results

A total of 212 plain radiographs of the wrist joint were analyzed in this study. There were 167 males (78.8%) and 45 female patients (21.2%) (table 1) of which 139 were labelled right and 73 labelled as left(table 2).

Mean radial height is 12.1mm (± 1.5mm), mean Radial inclination is 25.77 degree (± 2.91 degree), mean ulnar variance is -1.17 mm (± 1.49mm), mean palmar tilt is 11.59degree (± 2.38degree).

The mean Radial height in males is 12.4mm (±1.5mm) which was statistically more than that in females 11.03mm (±1.09mm) (P value <0.001). Mean Radial height in right wrist is 12.3mm (±1.6mm) which wasstatistically more than that in left wrist 11.7mm (±1.62mm) (P value=0.01).

Mean Radial inclination angle in male is $26.02^{o}(\pm 3.02^{0})$ which is statisticallymore than that in females 24.87^{o} $(\pm 2.21^{o})$ (P value=0.005). Mean Radial inclination angle in right wrist is 26.09^{0} $(\pm 2.9^{o})$ which is statistically more than that in left wrist 25.16^{o} $(\pm 2.8^{o})$ (P value=0.027).

Mean palmar tilt angle in male is $11.3^{o}(\pm 2.15^{o})$ which is statistically less than that in females $12.67^{o}(\pm 2.87^{o})$ (P value=0.001). Mean palmar tilt angle in left wrist is $11.07^{o}(\pm 2.19^{o})$ which is statistically less than that in right wrist 11.86^{o} $(\pm 2.43^{o})$ (P value=0.02).

Mean ulnar variance in male is -1.33mm (±1.43mm) which was statistically low (P value=0.004) than that in females -0.56mm (±1.58mm).While mean ulnar variance does not vary significantly on right or left side. 46 radiographs have neutral ulnar variance.

Spearman's correlation test shows that radial height is positively correlated to radial inclination (p value = 0.000) but is negatively correlated to ulnar variance (p value = 0.005) and palmar tilt (p value=0.162).

Table 1.Results of our study; the mean values of all the 4 morphometric Parameters.

n=212 Radiographs	Mean(± SD)	Male(n=167)	Female(n=45)	P value
Radial height(mm)	12.1(± 1.5)	12.4(± 1.5)	11.03(± 1.09)	<0.001
Radial inclination(degree)	25.77(± 2.91)	26.02(± 3.02)	24.87(± 2.21)	=0.005
Palmar tilt(Degree)	11.59(± 2.38)	11.3(± 2.15)	12.67(± 2.87)	=0.001
Ulnar variance(mm)	-1.17(± 1.49)	-1.33(± 1.43)	0.56(±1.58)	=0.004

Table 2: Values of parameters for right and left side

Parameters	Right (139)	Left (73)	P value
Radial height(mm)	12.3(± 1.6)	11.7(± 1.62)	=0.01
Radial inclination(degree)	26.09(± 2.9)	25.16(± 2.8)	=0.027
Palmar tilt(Degree)	11.86(± 2.43)	11.07(± 2.19)	=0.02
Ulnar variance(mm)	-----	------	-----

IV. Discussion

Reduction of distal radius fracture depends on anatomically restoring the morphometric measurements of distal radius[9].The orthopedic surgeons treating distal radius fractures classically use the guidelines given by Gartland and Werley as a standard while treating these injuries [10].The authors, however, feel that these parameters vary from country to country, race, ethnic background and build of the patient. Chan et al. found thesemorphometric parameters varied significantlybetween Chinese and Malaysian population[1]. Mishra PK[11] studied parameters in PA and lateral radiographs and didn't find any statistical difference between measurements in Indian and Western population.

In our study we included the radiographs purely on true PA and true Lateral view criteria. Table 3 and 4compares the results ofour study with the western studies and within the Indian population,respectively.In our study 46 radiographs have neutral ulnar variance which is OTA references value but mean Ulnar variance is negative (-1.17mm).While Mishra PK[11]had positive ulnar variance of 0.66mm±2.46mm in Indian population. In our study there was a statistically significant difference of mean values in all four morphometric measurements with respect to males and females(Table1); while in Mishra PK[11] study, the statistical difference was found in radial height parameter onlywith respect to gender. In our study bilateral variability in mean values of morphometric measurements was found which is statistically significant except ulnar variance; while in Mishra PK[11] study, no significant difference was found in any of the 4 morphometric parameters.

Limits of our study are - wide range of age, pure radiographic criteria for selection and retrospective study while as the strength of the study is that the radiographic criteria was applied strictly to include only true PA and Lateral view radiographs[12]. Radial inclination parameter was found to be higher in our study as compared to the previous studies. Ulnar variance parameter was found to be on the negative side, while previous study shows it to be neutral, though these cannot be compared to previous studies statistically.

Table 3: Comparison of our study to western literature

	Our study.	Gartland and Werley, 1951[10].	Altissimi et al, 1986[13]	Schuind et al, 1992[14]
Radial inclination (degree)	25.77 (±2.91) [21-33]	23[13-30]	16-28	24[19-29]
Palmar tilt (degree)	11.59 (±2.38)[4-17]	11[1-21]	0-18	Not reported
Ulnar variance(mm)	-1.167 (±1.489)[-4.9-2.1]	Not reported	-2.5 to + 3.1	-4.2 to 2.3

Table 4: Comparison to Indian Literature and reference values currently followed in India.

Parameters	Our study	Mishra PK[11]	OTA reference value
Radial inclination (degree)	21-33	11.3-42.1	13-30
Radial height (mm)	9.1- 16.7	7.1-30.4	11-13
Ulnar variance (mm)	4.9 to 2.1	−2.4-4.1	Neutral
Palmer tilt(degree)	4-17	1-16.9	1-21

V. Conclusion

We have set the normal values in true PA and lateral wrist radiographs and these can be used as a reference values in North Indian population. In our study we conclude that ulnar variance is negative in most of the Kashmiri population in North India and shall be considered normal. Rest of the morphometric values like radial height, radial inclination angle and palmar tilt are comparable to western literature.

Conflict of interest.
The authors have no conflicts of interest to declare.

References

[1]. Chan CYW, Vivek AS, Leong WH, Rukmanikanthan S. Distal radius morphometry in the malaysian population. Malays Orthop J 2008;2:27–30.
[2]. Short WH, Palmer AK, Werner FW, Murphy DJ. A biomechanical study of distal radial fractures. J Hand Surg Am 1987;12:529–34.
[3]. De Smet L. Ulnar variance: facts and fiction review article. Acta Orthop Belg 1994;60:1–9.
[4]. Palmer AK, Werner FW. Biomechanics of the distal radioulnar joint. Clin Orthop Relat Res 1984;187:26–35.
[5]. Casagrande DJ, Morris RP, Carayannopoulos NL, Buford WL. Relationship between ulnar variance, cortical bone density, and load to failure in the distal radius at the typical site of fracture initiation. J Hand Surg Am 2016;41:461–8.
[6]. Jupiter JB, Masem M. Reconstruction of post-traumatic deformity of the distal radius and ulna. Hand Clin 1988;4:377–90.
[7]. Handoll HH, Madhok R. From evidence to best practice in the management of fractures of the distal radius in adults: working towards a research agenda. BMC Musculoskelet Disord 4;2003a:27.
[8]. Handoll HH, Madhok R. Surgical interventions for treating distal radial fractures in adults. Cochrane database.2003b. Syst Rev CD003209.
[9]. Hove LM, Fjeldsgaard K, Skjeie R, Solheim E. Anatomical and functional results five years after remanipulated Colles' fractures. Scand J Plast Reconstr Surg Hand Surg 29; 1995:349–55.
[10]. Gartland JJ, Werley CW. Evaluation of healed Colles' fractures. J Bone Joint Surg Am 1951;33A:895– 907.

[11]. Mishra PK, Nagar M, Gaur SC, Gupta A. Morphometry of distal end radius in the Indian population: A radiological study. Indian J Orthop 2016;50:610–5.
[12]. Sandjaja G. Overview The average value of the distal radius angle normal access to the visitors at the RSCM[Thesis]. Mount Pleasant, MI: Universitas Indonesia; 1993.
[13]. Altissimi M, Antenucci R, Fiacca C, Mancini GB. Long term results of conservative treatment of fractures of the distal radius. Clin Ortho Relat Res.1986; 206: 202-10.
[14]. SchuindFA, LinscheidRL, AnK, ChaoEYS. A normal data base of posteroanterior roentgenographic measurements of the wrist. J Bone Joint Surg.1992; 74A(9): 141829

Mudasir Ahmad Bhat, et. al. "Radiographic morphometry of the distal radius in Kashmiri population in North India."*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(7), 2020, pp. 39-44.