MORPHOMETRIC AND MORPHOLOGICAL STUDY OF DISTAL END OF ULNAE OF SOUTH INDIAN POPULATION

Sainu Susan Oommen
Assistant Professor, Department of Anatomy,
Fr. Muller Medical College, Mangalore, Karnataka, India
E-mail: sainu1712@gmail.com

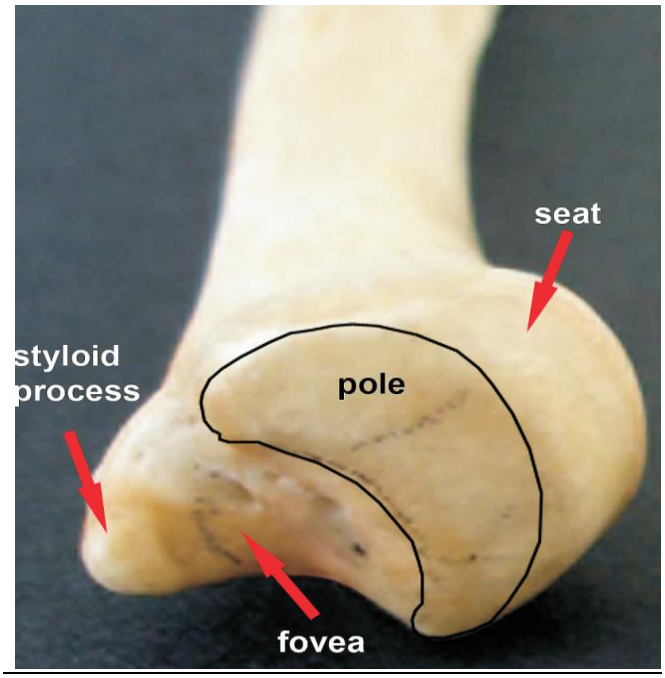
ABSTRACT

Introduction: *The wrist is a complex joint that serves as the link between the forearm and hand and is critical for many upper extremity movements. An understanding of distal end of ulna anatomy allows for appreciation of the biomechanics of wrist movement, which helps the clinician to understand injury patterns, perform an efficient history and physical examination, and improve diagnostic accuracy and treatment decisions. Keeping this in mind, anatomy of distal end of ulna is studied on south Indian population.*
Methods: *The distal end of 100 ulnae (50 of each sides) of unknown sex from the Anatomy department of Fr. muller medical college, Mangalore were studied for natural variation in the shape and width of pole, height of the seat, width of fovea and shape and size of styloid process.*
Results: *The average width of pole was 5.13mm.84% of pole showed kidney shape. The average maximum height of seat was 6.5mm and 65% showed sloping. The average width of fovea was 4.32mm and 36% showed absence of vascular foramina. The length of styloid process recorded was 5.6mm and 4% of left ulnae showed absence of styloid process. Also noted that 18% absence in groove of ECU.*
Conclusion: *Careful observation of the lower end of ulna shows that it is made up of four main parts, viz, seat, pole, fovea and styloid process. These parts play an important role in anatomy and physiology of DRUJ and wrist. Any alterations in the morphometric and morphology can produce various clinical conditions like perforation of TFCC, ulnar impaction syndrome, ulnar styloid triquetral impaction syndrome.*

Keywords: *distal end of ulna, head of ulna, seat, styloid process*

INTRODUCTION

The whole upper extremity works as a jointed lever. The lower extremity of the ulna is small, presents two eminences; the lateral, larger, round articular-head of the ulna; the medial, narrower, non-articular, the styloid process. The head presents an articular surface(POLE) of an oval or semilunar form, articulates with the triangular fibro cartilaginous complex (TFCC) which separates it from the wrist joint; the remaining portion, is narrow, convex and received into the ulnar (Sigmoid) notch of the radius—SEAT. The styloid process attaches to the ulnar collateral ligament of the wrist joint. The head is separated from the styloid process by a depression (FOVEA) for the attachment of the apex (ligamentum subcruetum) of the TFCC sometimes contains vascular foramina, and behind by a shallow groove for the tendon of the extensor carpi ulnaris. The ulnar head is not only the fixed point of the distal forearm and wrist, around which the Forearm and the carpus with the hand rotates, it is also an integral part of the ulnocarpal wrist joint and important for load transfer from the hand to the forearm. Traumatic derangements around the ulnar head usually affects both joint compartments, the distal radio ulnar joint (DRUJ) and the ulnocarpal joint. Untreated most major injuries to the bony or stabilizing ligamentous structures lead to the development of arthrosis of the DRUJ. The significance of the distal ulnar fractures is often not appreciated and results in inadequate treatment in comparison with radius. Radius rotates through a 150^{o} arc; further lateral movement of the radius of around 30^{o} in the direction of rotation. Galeazzi-fracture dislocations can also be associated with fracture of the ulnar shaft and styloid process in high energy trauma. Studies on ulnar variance (difference in lengths of radius and ulna) is described abnormal when the difference is >1mm in lengths of radius and ulna at their distal articular surfaces (oatis, 2003).



OBJECTIVE

The aim of the study is to find statistically based information about the natural variation in the shape and width (mm) of the pole, height of the seat (mm), width of fovea (mm), shape and size of styloid process (mm) of 100 ulnae of South Indian origin. The height and slope of the seat may be of great clinical significance in understanding any dysfunction of the site, as far as assessing the stability of the DRUJ is concerned.

MATERIALS AND METHODS

In order to perform the work, dry human ulnae obtained from Department of Anatomy, Fr. Muller Medical College, Manglaore, India were used. Best 50 ulnae of each sides of unknown sexes were selected. Only bones in regular shape, without obvious evidence of dystrophy, deformities and/or trauma were selected. The distances were measured from the nearest of selected parts to avoid overestimated values. Each measurements was performed three times and averaged. Anatomical measurements were taken using vernier calliper (accurate to 0.1mm) sensitivity. Frequencies of the data were tabulated and separated according to the side. Statistical package include SPSS (13) software was used for the analysis. The mean and standard deviation (SD) of measurements were assessed and expressed as mean M±SD. Also noted were the presence or absence of vascular foramina in the fovea, the presence or absence of styloid process, the shape and length (base to apex) of the styloid process and the presence or absence of grooves for extensor carpi ulnaris (ECU).

Table 1: Comparison of Measurements of Various Parameters of Right and Left Distal End of Ulnae

PARAMETERS IN mm	RIGHT		LEFT		AVERAGE
	MEAN	SD	MEAN	SD	
MAX WIDTH OF POLE	5.04	1.45	5.0	1.43	5.02
MAX HEIGHT OF SEAT	6.51	0.08	6.42	0.05	6.46
MAX WIDTH OF FOVEA	4.14	1.63	4.50	1.37	4.32
LENGTH OF STYLOID PROCESS	5.80	1.24	5.50	1.28	5.65

SD---STANDARD DEVIATION

Fig. 2: showing the various shapes of pole: A-semilunar, B -semicircular, C-kidney shaped and D- comma shaped.

RESULTS

All quantitative measurements of the pole, seat, fovea and styloid process of the 50 right and 50 left left sided ulnae were taken and tabulated. The mean and standard deviation of each parameter was calculated (table 1), and the various shapes of the poles and styloid process were noted. The ulna seat (sloping and non-sloping surfaces), the presence or absence of vascular foramina of the fovea and that of ECU groove were also observed and their percentages tabulated (TABLE 2).

Table 2: Measurements of Various Parts of Distal End of Ulna

COMPONENT		RIGHT NO. (n)%	LEFT NO. (n)%
(1).Shapes of the pole	Kidney	25(50)	17(34)
	semilunar	08(16)	16(32)
	semicircular	12(24)	11(22)
	comma	05(10)	06(12)
(2).Seat	Sloping	33(66)	32(64)
	Non sloping	17(34)	18(36)
(3).Styloid process	Present Absent	50(100) NIL	48(96) 02(04)
A) *Overall shape*	Curved	11(22)	14(28)
	Straight	39(78)	20(40)
	Absent	NIL	34(68)
B) *Shape of the tip*	Blunt	24(48)	20(40)
	Pointed	26(52)	28(56)
(4).Fovea with vascular foramina	Present absent	43(86) 07(14)	39(78) 11(22)
(5).Extensor carpi ulnaris groove	Present Absent	48(96) 02(04)	43(86) 07(14)

DISCUSSION

Lower end of ulna is integral to normal function of forearm and hand. The anatomical relationships of the distal ulna with the distal radius and the ulnar carpus are precise. These relationships are important from the functional point of view, eg. minor modification in these lead to significant load changes and resultant pain syndromes(ulnar-carpal abutment, ulnar styloid triquetral impaction syndrome and ulna styloid impaction).Studies conducted by Berger et al, Joshi et al, and Sharma A et al have targeted the anatomy of bony configurations on dry bones forming wrist joint which can aid in surgical approach. Keeping this relevance in mind, we compared our findings with their observations. The size and shape of the pole may guide us in the direction of transmission of forces through the ulna. We recorded the maximum width and various shapes of the pole. The average maximum widths of the pole along transverse axis is 5.02mm (table 1).Berger reported a dimension of 8.2 (range5.1-13.2) mm, regardless of the side of ulna. In our study the width recorded showed closer to Joshi et al findings. It can be due to the change in the shapes of the pole which ranged from kidney, semilunar, semicircular and comma. The most common shape was kidney of 84% and the least was comma shape with 22%.In most studies semilunar shape was recorded the most common. The seat is the main determining factor for gliding articulation and complexity of movement at the DRUJ. In our study the average maximum height of the seat was 6.5mm.However studies had documented the maximum height of the seat as 9.3 (range 6.8—12.6) mm. Also 65% sloping of the seat were recorded. Kleimann demonstrated that in the neutral positioned forearm the seat of the ulna acts like fulcrum against the sigmoid fossa at the DRUJ. The maximum width of the fovea was recorded as 4.32mm.36% showed absence of vascular foramina in fovea. This suggests that a substantial amount of nutrition reaches the TFCC of the wrist from the synovial fluid of the DRUJ (on the superior surface) and the wrist joint (on the inferior surface) and blood supply to the ligament at the medial end of the disc by the vascular foramina. Joseph et al have stated that the disc is vascularised by branches from ulnar and posterior interosseous arteries.

The mean length of styloid process was 5.6mm. >6mm is reported as long styloid process. Garcia-Elias (1987) has developed a method of assessing the relative size of styloid process. Long styloid process can lead to ulnar impaction syndrome with ulnar side wrist pain (topper et al).4% of left ulnae showed natural absence of styloid process.73% straight and 25% curved overall shape was noted. The shape of the tip of the styloid process varied from 54% pointed and 44% blunt. Biyani et al (1990) have reported the variations in the shapes of styloid process. The groove for ECU tendons were absent in 18 % ulnae. Bruckner (1995) explained ECU being unique among the compartmentalized extensors being present in its own fibro-osseous tunnel. Its anatomical position is of great importance in the treatment of dislocation of theDRUJ. Fractures at the base of styloid process leads to instability or even dislocation of DRUJ depending on amount of TFCC pulled off from the central fovea of pole. The ulna styloid process can be fixed using Kirschner wires (K wires), tension band wiring or small screws. With wrist arthroscopy a more precise diagnosis of ulnar wrist pain is possible.

The ulnocarpal joint plays a critical role in hand and wrist function. It serves as part of forearm rotation and part of carpal kinematics. Traumatic disruptions and chronic inflammatory conditions are better diagnosed through CT, MRI or Arthroscopy. Instability of the distal ulna can be treated with tenodesis procedures, hemi-resection arthroplasty or sauve-kapandji procedure. Eventhough fractures of radius and ulna are complex and difficult to treat successfully. Most untreated injuries to the bony stabilizing ligamentous structures lead to arthrosis of the DRUJ.

CONCLUSION

Therefore, the aim must be to restore normal anatomy in an acute situation, whenever possible, rather than delaying it until only excision or arthrodesis remains the treatment of choice. In Galeazzi lesion implantation of prosthesis such as the Herbert ulnar head instead of arthrodesis as

commonly found in the literature. These metrical values of structural anatomy of the lower end of ulna are valuable for reconstruction of the DRUJ with prosthesis. Morphometrical analysis of the DRUJ is still evolving. This study aimed at morphomtric analysis of distal end of ulna which is less researched and neglected area in Indian population with respect to proximal end of ulna.

REFERENCES

1. Berger Ra, Weiss Apc, Hand Surgery, Vol 1,1st Edition Philadelphia Usa: William And Wilkins, Lippincott.
2. Joshi Sd, Joshi Ss, Athavale Sa,2009,294,Metrical And Non Metrical Study Of Lower End Of Ulna—J Anat Soc Ind(2009).
3. Tulley E, Sports Physiotherapy Applied Science and Pactice in the Wrist and Hand, 1st Edition, Churchill Livingstone, Melbourne 1995.
4. Oatis Ca, Kinesiology In Structure And Function Of The Bones And Joints Of The Wrist And Hand,2nd Edition Williams And Wilkins,Baltimore,Lipincott2003.
5. Sharma A, Kumar A, Singh P, Anatomical Study Of The Distal End Of Cadaveric Human Ulnae, A Clinical Consideration For The Management Of Distal Radioulnar Joint Injuries, Singapore Med Journal .
6. Kleimann-Williamb, Stability of Distal Radioulanar Joint Biomechanics, Patho Physiology, Physical Diaganosis and Restoration of Function.
7. Joseph Sy, Pauta A Habib Normal Mr Imaging Anatomy of the Wrist and Hand. Radiol Clinic—2006.
8. Garcias-Elias M, Dorsal Fractures Of The Triquetrium, Avulsion Or Compression Fractures?1987
9. Topper Sm, Wood Mb, Ulnar Styloid Impaction Syndrome.
10. Biyani A, Mehara A, Morphological Variation of the Ulnar Styloid Process.1990.