



Original Research Article

Morphometric Measurements of Lower End of Ulna - A Cross Sectional Study

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ABSTRACT

Background: The anatomy of the distal end of ulna is important in reconstructive surgeries. The distal end has head, styloid process and fovea. Ulnar head has two parts such as pole and seat. A fracture of distal end of radius is related with severe form of fracture of ulna due to non-union of distal ulnar metaphysis that act like Baldwin's operation which aims to create pseudo arthrosis in the lower end of ulna by extra periosteal resection of a segment of metaphysis of ulna.

Materials and Methods: This study was done on fully ossified 100 dry adult ulnae (50 right & 50 left) irrespective of age, sex & race. All the measurements were taken by using digital Vernier calliper.

Results: The average maximum width of pole on both sides was 4.13 mm. The average maximum height of seat on both sides was 3.86 mm. The average maximum width of fovea on both sides was 3.86 mm. The average maximum length of styloid process on both sides was 6.175 mm.

Conclusion: Clinically this study plays an important role for anatomists, forensic experts, orthopaedic surgeons, prosthetists for research, medico legal investigations, to construct suitable prostheses and operating patients with fractures at the lower end of ulna.

Keywords: Lower end of ulna, pole, seat, fovea, styloid process

INTRODUCTION

The anatomy of the distal end of ulna is important in reconstructive surgeries. The distal end has head, styloid process and fovea. Ulnar head has two parts such as pole and seat. The pole is separated from the triquetral bone by fibro cartilaginous complex which is triangular in shape. The fovea sits on the apex of triangular fibro cartilaginous complex. The seat articulates with the ulnar notch of radius that forms inferior radioulnar joint. Rheumatoid arthritis, traumatic arthritis, arthrosis, tenosynovitis of extensor carpi ulnaris,

injury to triangular fibrocartilage complex and Colles' fracture required the replacement of head of ulna with prosthetic material. The seat covers two third of the perimeter of head of ulna which is covered by an articular cartilage. The distal end of ulna is stable and is considered as reference for rotation of forearm. Galeazzi fracture dislocation can occur in relation with the fracture of styloid process of ulna. The morphometric values of distal end of ulna are helpful in prosthetic replacement as well as for the treatment of distal radio-ulnar injury. ^[1,2] The distal end of ulna is

expanded to form head and styloid process. The head is seen from the posteromedial carpal aspect during pronation of the forearm and it can be gripped when the hand in supination is flexed. Its lateral surface is convex that articulate with radial notch of ulna. Its distal surface is smooth which is separated by an articular disc from the carpus. The apex is attached between the styloid process and its articular surface. The distal end of ulna is palpable 1cm above the styloid process of radius. Between the head and styloid process of ulna there is presence of vertical groove on the posterior aspect. The ulnar collateral ligament is attached to the apex of styloid process of ulna. [3] Ulnar styloid triquetral impaction is a pathological condition that causes pain on the ulnar side with radiographic and clinical features, different from the impaction of head of ulna against the ulnocarpal impaction.

The pain is in ulnar side of the wrist and tenderness is over the styloid process of ulna opposite to proximal end of lunate. The concept of styloid process of ulna is introduced and anatomical variations of length of styloid process of ulna were demonstrated. The supination-pronation axis is fixed in relation to the ulna on which distal part of radius rotates by 150° arc and lateral movements of radius by 30° that enables this movement to rotate by 180° for rotation of hand. During sports activities, powerful impact on the thenar side of hand causes the wrist to be in hyperextension, intercarpal supination as well as ulnar deviation. Fracture, dislocation of head of ulna had been treated by implantation of Herbert ulnar head prosthesis. Traumatic derangements surrounding head of ulna affects joints like ulnocarpal joints and distal radioulnar joints. Major injury to ulna if untreated leads to development of arthrosis of distal radioulnar joint. [4-6]

This study may help the orthopaedic surgeons, prosthetists in the management of fracture of the lower end of ulna with triquetrum.

MATERIALS AND METHODS

This study was done on fully ossified 100 dry adult ulnae (50 right & 50 left) irrespective of age, sex & race. All the measurements were taken by using digital Vernier calliper.

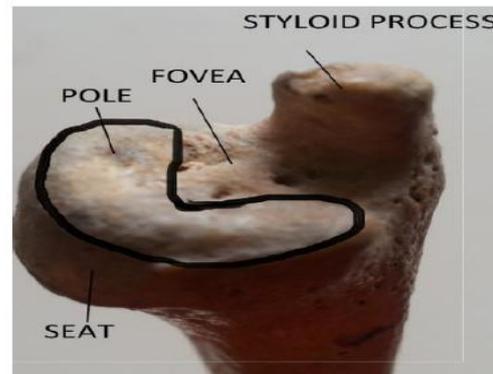


Figure 1: Photograph showing the various parts of lower end of ulna

The following parameters were studied:

The pole is the distal end of ulna which articulates with the triangular fibrocartilaginous complex of the wrist. It was measured along the transverse axis as the distance between the points where the transverse axis meets the margins of the pole. The maximum width of the pole observed in distal end of ulna was recorded by using Digital Vernier caliper.



Figure 2: Maximum width of pole (PW),

More than two-third of the convex lateral articular surface of the distal part of the head of ulna is known as the seat. It was measured as the distance between lateral most points in the upper margin to the lateral most point in the lower margin of the seat. The maximum height of seat observed in distal end of ulna was recorded by using Digital Vernier Calliper.



Figure 3: Maximum height of seat (SH),

The distal end of ulna consists of the depression, known as fovea. It was measured in transverse axis as the distance between points where transverse axis meets the lateral most point on the lateral margin of fovea and the lateral end of base of styloid process of ulna. The maximum width of fovea in distal end of ulna was observed and recorded by using Digital Vernier caliper.

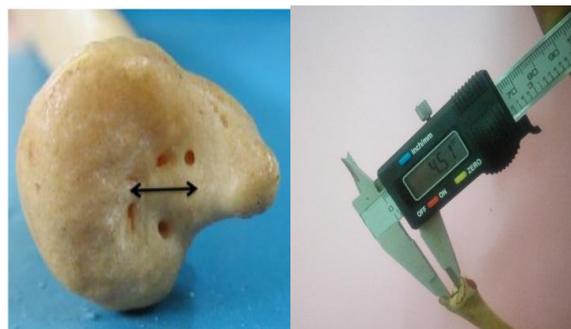


Figure 4: Maximum width of fovea (FW)

Styloid process is the bony projection from medial and posterior aspect of the lower end of ulna. It is measured as the distance

between tips of styloid process to the base of styloid process. The maximum length of the styloid process was observed and recorded by using Digital Vernier caliper.



Figure 5: Length of styloid process (SL)

RESULTS

It was observed that there was slight difference between the values of right and left side of lower end of ulna in all the 4 parameters because they did not belong to same individuals. The values of all the 4 parameters of lower end of ulna on both sides are statistically not significant. The average maximum width of pole on both sides was 4.13. The average maximum height of seat on both sides was 3.86. The average maximum width of fovea on both sides was 3.86 mm. The average maximum length of styloid process on both sides was 6.175 mm. The results of all the parameters of right and left ulnae are given in table no: 1.

Table No. 1: Results showing all the parameters of right and left ulna

| Parameters | Right ulna (Mean/S.D.) | Left ulna (Mean/S.D.) | t | D.F. | P value | 95% C.I. for mean difference |
|--|------------------------|-----------------------|-------|------|---------------------|------------------------------|
| Mean maximum width of pole | 4.19 ± 0.60 | 4.07 ± 0.52 | 1.069 | 49 | 0.291 ^{NS} | -0.11 to 0.35 |
| Mean maximum height of seat | 3.91 ± 0.55 | 3.81 ± 0.47 | 1.161 | 49 | 0.251 ^{NS} | -0.07 to 0.28 |
| Mean maximum width of fovea | 3.83 ± 0.44 | 3.89 ± 0.42 | 0.601 | 49 | 0.551 ^{NS} | -0.24 to 0.13 |
| Mean maximum length of styloid process | 6.26 ± 1.11 | 6.09 ± 1.06 | 0.789 | 49 | 0.434 ^{NS} | -0.26 to 0.6 |

DISCUSSION

The distal end of ulna represents the fixed point around which hand and radius of movements occur in daily living. The importance of the distal end of ulna is useful for the treatment as well as it helps in guidance investigation and management of complex injuries. [7] Comparative study of mean values of all parameters among

different authors and present study of right and left ulna is given in table no: 2.

In the present study, the mean maximum width of pole on right side was 4.19 ± 0.60 mm and 4.07 ± 0.52 mm on left side. The present study shows values similar to those obtained by Vijaykishan B et al (2016) from Bangalore, India. The values obtained from Sharma A (2011) in North

India were slightly greater than the values obtained from the South Indian and the present study. So it indicates that the values are different in different regions of India, which shows the regional variation. From

the above study it is also concluded that the mean maximum width of pole was more on right side than the left side because the ulna belonged to different individuals.

Table No.2: Comparative study of mean values of all parameters among different authors and present study of right and left ulna

| S.N. (mm) | Side | Present study | Vijaykishan B et al. [2] (2016) | Zarana AA et al. [3] (2014) | Sharma A et al. [5] (2011) | Oommen S S. [6] (2015) |
|-----------|------|---------------|---------------------------------|-----------------------------|----------------------------|------------------------|
| PW | R | 4.19 | 4.92 | 5.67 | 5.40 | 5.04 |
| | L | 4.07 | 4.93 | 5.72 | 6.10 | 5.0 |
| SH | R | 3.91 | 6.06 | 6.01 | 5.90 | 6.51 |
| | L | 3.81 | 5.75 | 6.46 | 6.90 | 6.42 |
| FW | R | 3.83 | 5.42 | 4.76 | 4.50 | 4.14 |
| | L | 3.89 | 5.17 | 4.10 | 4.90 | 4.50 |
| SL | R | 6.26 | 4.89 | 4.25 | 5.20 | 5.80 |
| | L | 6.09 | 4.5 | 5.28 | 5.00 | 5.50 |

The mean maximum height of seat on right side was 3.91 ± 0.55 mm and 3.81 ± 0.47 mm on left side. The present study shows values lesser than those obtained by Vijaykishan B et al, Zarana AA et al, Sharma A et al, Oommen SS and Joshi SD et al.

The mean maximum width of fovea on right side was 3.83 ± 0.44 mm and 3.89 ± 0.42 mm on left side. The present study shows values lesser than those obtained by Vijaykishan B et al, Zarana AA et al, Sharma A et al, Oommen SS and Joshi SD et al.

In the present study, the mean maximum length of styloid process on right side was 6.26 ± 1.11 mm and 6.09 ± 1.06 mm on left side. The present study shows values greater than those obtained by Vijaykishan B et al, Zarana AA et al, Sharma A et al and Oommen SS.

CONCLUSION

Clinically this study plays an important role for anatomists, forensic experts, orthopaedic surgeons, prosthetists for research, medico legal investigations, to construct suitable prostheses and operating

patients with fractures at the lower end of ulna.

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