

# Anthropometric Study of the Radiocapitellar Joint

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**Purpose** There is scant knowledge about the relationship between the size of the radial head and the size of the capitellum. Also, no data exist comparing the size of the capitellum between the left and the right elbow.

**Methods** Eight pairs of elbows and 12 single elbows from fresh-frozen cadavers were obtained for this study. The vertical height and anterior width of the capitellum were measured with digital calipers. Four different measurements were performed at the radial head: longest outer diameter, shortest outer diameter, the long dish diameter, and short dish diameter. The Pearson intrarater intraclass correlation coefficients were obtained for all measurements.

**Results** For the paired elbows, the correlations ranged between 0.95 and 0.96 for the capitellar dimensions and 0.77 and 0.98 for the radial head dimensions. The correlations between the long outer diameter of the radial head with the vertical height and the anterior width of the capitellum were 0.8 and 0.9, respectively.

**Conclusions** There is a high correlation between the long outer diameter of the radial head and the vertical height of the capitellum as well its anterior width. There is also a high correlation between the left and the right elbow.

**Clinical relevance** These findings are relevant to radiocapitellar arthroplasty and may be useful for radiocapitellar prosthetic design as well as in the preoperative planning of cases in which the radial head and/or the capitellum is destroyed. (*J Hand Surg Am.* 2018;■(■):1.e1-e6. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

**Key words** Elbow, radiocapitellar joint, biomechanics, human cadaver, anthropometric study.



PROPERLY SIZED RADIAL HEAD replacements have proven to be effective in restoring elbow kinematics and stability in severely comminuted radial head fractures,<sup>1–7</sup> and radiocapitellar prosthetic arthroplasty has shown promising results.<sup>8–11</sup>

The radiocapitellar joint morphology is complex, and several studies have already examined the anatomical dimensions of the radial head or the capitellum individually. However, there is scant knowledge about the relationship between the size of the radial head and the size of the capitellum. Leclerc et al,<sup>12</sup> in a computer tomography (CT)–based study, found that certain capitellar dimensions could help to accurately predict the native radial head diameter. They suggested that a study correlating direct intraoperative dimensions of the capitellum and radial head would be useful. Also, no data exist regarding the relationship comparing the size of the capitellum between the left and the right elbow.

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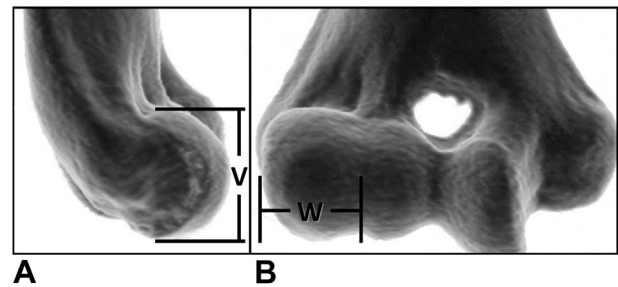
These data could be relevant for further development of radiocapitellar arthroplasties, and the correlation between the dimensions of the radial head and the capitellum could also be helpful in several other clinical settings. When insertion of a radial head implant is indicated because of a fracture, the preoperative measurements of the capitellum could help to decide which radial head implant size would be most appropriate. Also, if a radiocapitellar arthroplasty is needed because of isolated lateral elbow osteoarthritis, radiographic measurements (preferably CT scan) of the contralateral, intact side could help in preoperative planning.

The purpose of this study is to investigate the correlation between the size of the capitellum and that of the radial head and to investigate the correlation between the capitellum in the left and the right elbow of the same subject.

## MATERIAL AND METHODS

Eight pairs of elbows (8 right, 8 left), including 2 men and 6 women (average age, 79 years; range, 59–92 years), and 12 single (unpaired) elbows, including 6 men and 6 women (average age, 78 years; range, 60–89 years), from fresh-frozen cadavers were obtained for this study. The single, unpaired elbows were added to increase the sample size for radiocapitellar correlation to 20 subjects. The numbers included in this study were based on the availability of specimens. All specimens were white Americans, and subjects with degeneration of the cartilage of the capitellum or the radial head were excluded from the study. Measurements were done using a Mitutoyo Mycal 6" Digimatic Caliper (Mitutoyo America Corp, 965 Corporate Blvd., Aurora, IL). Each of the 2 observers (M.V. and D.R.S.) made 3 measurements of each dimension, and the mean was used. The vertical height (V) of the capitellum was determined in the sagittal plane, parallel with the long axis of the humerus. We defined the anterior width (W) as a transverse line parallel to the elbow's axis of motion, from the lateral trochlear ridge to the lateral border of the cartilage of the capitellum (anteriorly) (Fig. 1).

Four different measurements were performed at the radial head. The longest outer diameter (L-O) (from cortex to cortex along the major axis of the oval shape) and the shortest outer diameter (S-O) along the minor axis were measured. The corresponding 2 diameters of the articular dish, referred to as the long dish diameter (L-I) along the major axis and short dish diameter (S-I) along the minor axis



**FIGURE 1:** **A** Lateral view shows the vertical height of the capitellum: V. **B** Anteroposterior view shows the anterior width of the capitellum: W.

were measured along the same lines as the outer diameters (Fig. 2).

The Pearson correlation coefficient (r) and inter-rater intraclass correlation coefficient (ICC) were obtained for all measurements. Intrarater ICC and intrarater typical error values were calculated using consecutive pairwise analysis of trials for reliability.<sup>13</sup>

## RESULTS

The reliability (ie, repeatability) of the measurements themselves was based on the 3 measurements of each dimension made by each observer. The intrarater ICC was never less than 0.99 (95% confidence interval, 0.98–0.99) and the intrarater typical error was never greater than 0.24 mm (95% confidence interval, 0.20–0.31 mm). The average measurements, including SD and range, of the 2 dimensions of the capitellum and the 4 dimensions of the radial head are included in Table 1.

All the radiocapitellar correlations, with linear regression line equations, are shown in Figure 3. The capitellum vertical height (V) was correlated in the range between 0.75 and 0.80 with all the radial head dimensions (Table 2). The best correlation was found between the capitellum anterior width (W) and the radial head long outer diameter ( $r = 0.9$ ;  $P < .0001$ ).

The paired elbows correlated in the excellent range for the capitellar dimensions (range, 0.95–0.96), and in the high to excellent range for the radial head dimensions (range, 0.77–0.98) (Table 3).

Table 4 shows the inter-rater ICC, ranging between 0.91 and 0.99 for all capitellar and radial head dimension measurements.

## DISCUSSION

Previously, 3 articles studying the morphology of the capitellum have been published. Sabo et al<sup>14</sup> and

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