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Morphometric Study of Bicipital Groove from Dry Adult Humerus

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ABSTRACT

Background: Bicipital groove, the narrow sulcus present between the greater and lesser tubercles of proximal humerus, is an important anatomic landmark during prosthetic replacement of humeral head. Bicipital groove variations are associated with diseases of biceps tendon causing painful shoulder. The study aims to outline the morphometry of bicipital groove and create some baseline data which may be useful in arthroplasties and interpretation of radiologic anatomy of the shoulder.

Methods: A quantitative cross-sectional observational study was conducted on 100 dry humerus bones from convenience sampling of dry bones available at the Department of Anatomy, Maharajgunj Medical Campus. The length of bone was measured with osteometric board. Side of bone was determined. The length, width and depth of bicipital groove was measured with Vernier calipers. Data was analyzed in SPSS version 17 and frequencies, descriptive statistics were calculated along with bivariate analysis using independent samples T-test and Pearson's correlation.

Results: Out of the total 100 humeri studied, the mean length was 296.7 mm (22.04 SD). Mean length, width and depth of bicipital groove were 69.6 mm (6.6 SD), 6.34 mm (1.64 SD), and 5.75 mm(1.5 SD) respectively. The length and width of bicipital groove were positively correlated with length of bone.

Conclusions: The study investigated the morphometry of bicipital groove and its relation with length of humerus. The findings will have potential implications in clinical and surgical practice including shoulder prosthesis and arthroplasty.

Keywords: Bone morphometry; humerus; upper extremity.

INTRODUCTION

The bicipital groove (BG) is a sulcus present between the greater and lesser tubercles of humerus. It lodges the tendon of long head of biceps brachii muscle, its synovial sheath and an ascending branch of anterior circumflex humeral artery.[1]

Various studies[2,3] conclude that a shallow bicipital groove increases the chances of subluxation and medial dislocation of biceps tendon producing shoulder pain and weakness. A shallow acute angled BG has been linked with biceps tendinitis in patients with anterior shoulder pain.[4] A deep and narrow groove restrains and causes lesions of the long biceps tendon.[5] Knowledge of BG morphology aids in understanding these clinical conditions and also in selecting and positioning of humeral head prosthesis.[6,7]

Morphometric study of bicipital groove in our population is lacking. Thus, the present study was done to obtain a baseline data involving the length, width and depth of the bicipital groove.

METHODS

This study was a cross-sectional, descriptive, quantitative investigation conducted over a six-month period at the Anatomy Department of Maharajgunj Medical Campus. Ethical approval was obtained from the Institutional Review Committee of the Institute of Medicine (IOM) prior to data collection. The study included dry humerus bones from adult cadavers that were intact and without broken pieces. Bones showing visible deformities or breakage, as well as those from the paediatric population, were excluded. Total enumeration method was used to sample 100 humeri out of the available 109, after excluding nine that had

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visible deformities or damages.

Data was collected from direct measurement of the bones. The bones were segregated in right and left groups, photographed and numbered. Each bone was placed longitudinally at the center of the osteometric board with the anterior aspect of bone facing superiorly. The length of each humerus was measured using an osteometric board. The proximal end of humerus was studied with respect to length, width and depth of the bicipital groove. The measurements were taken by using Vernier calipers. Length (Fig 1), width (Fig 2), and depth of the bicipital groove were obtained. The depth was measured using the technique of Vettivel et al[8] as the difference between the diameters of the proximal end of humerus at two levels: on the lateral margin of lesser tubercle and on the floor of the BG (Fig 3). All the measurements were taken by a single investigator to exclude observational bias.

Figure 1. Measurement of length of bicipital groove using Vernier calipers.

Figure 2. Measurement of width of bicipital groove using Vernier calipers.

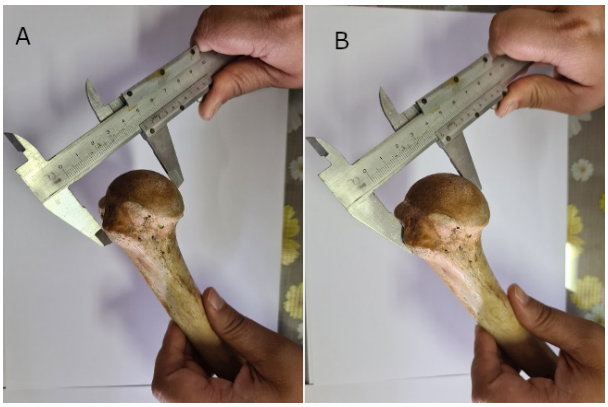


Figure 3. Measurement of depth of bicipital groove by obtaining a difference between two measurements. A: At the margin of medial wall and B: At the floor of the groove.

Data was entered in proforma sheet and computerized in Epidata version 3.1. Data was exported to Microsoft excel and further analyzed using SPSS version 17. Descriptive statistics was calculated for bone length, length of BG, width of BG and depth of BG. Frequency table was constructed for side of bone.

Comparisons of mean measurements of right and left sides was done by using independent samples t-test. Correlation between bone length and other measurements was analyzed using Pearson's correlation coefficient and presented as scatterplot.

RESULTS

Out of the total 109 bones available, 100 humeri (44 right and 56 left) were selected for this study. Mean length of the studied humeri was 296.72 mm (22.03 SD). Mean values of the measured parameters of BG in right and left humeri are summarized in table 1.

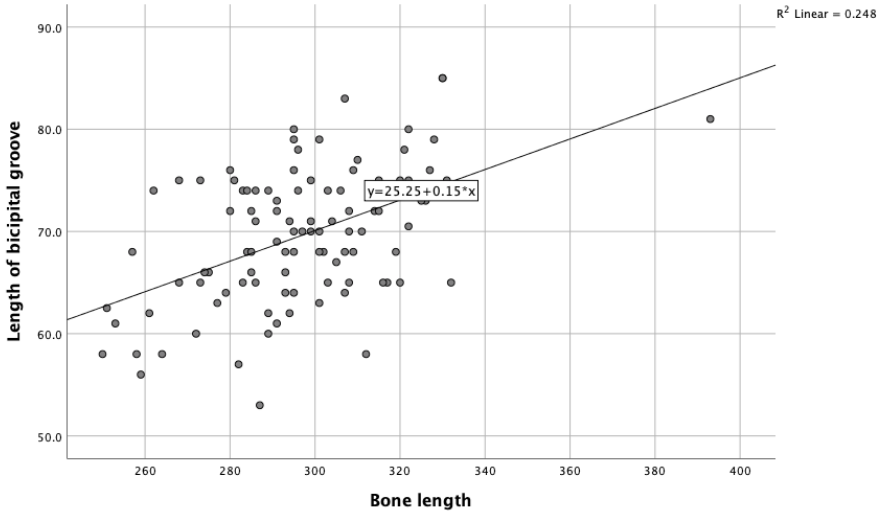
Table 1. Mean values with standard deviation of the measured parameters in the present study.

	Bone length (mm)	Length of BG (mm)	Width of BG (mm)	Depth of BG (mm)
Right (44)	296.31±21.7	69.67±6.9	6.53±1.9	5.09±1.1
Left (56)	297.03±22.44	69.53±6.4	6.18±1.3	6.26±1.5
Both (100)	296.72±22.03	69.59±6.6	6.34±1.6	5.75±1.4
p-value*	-	0.92	0.319	<0.001

*Independent samples t-test used

Length of BG (r=0.498, p-value<0.001) and width of BG (r=0.299, p-value=0.003) were significantly correlated with bone length (Fig 4 and 5).

Figure 4. Scatter plot showing correlation of bone length with length of BG.



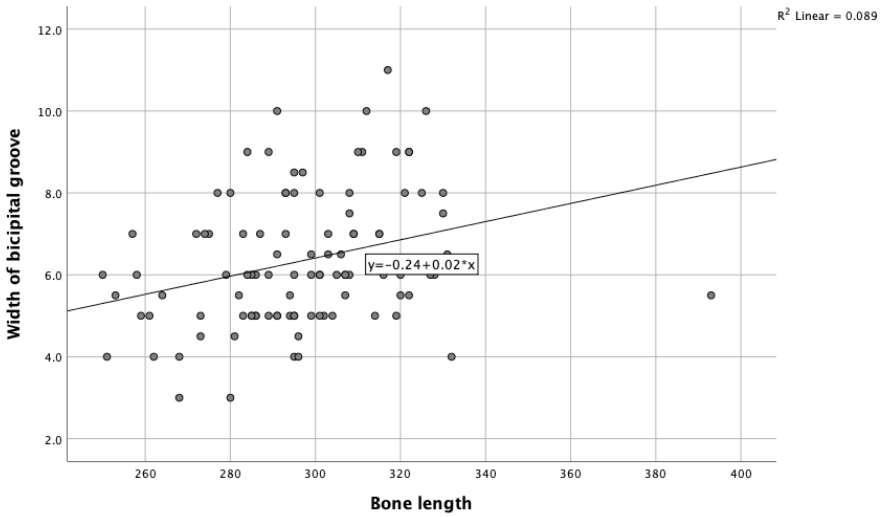


Figure 5. Scatter plot showing correlation of bone length with width of BG.

DISCUSSION

This is a descriptive quantitative study involving 100 dry unpaired humeri. The proximal end of each humerus was studied with respect to the length, width and depth of bicipital groove.

The mean length of BG on both sides was 69.59 mm in the present study which was similar to that of Srimani et al.[9] It was less than that of majority of other studies [10-14] while more than that of Ueberham and Le Floch-Prigent[15], Kaur et al[16] and Itamura et al.[7] These studies [15,16] measured the length of BG from proximal depression to the distal extremity of lesser tubercle. However, the present study found that the bicipital groove continues more distal than the lower limit of lesser tubercle. Hence the dissimilarity in the results can be explained.

Itamura et al[7] measured the length of BG by calculations based on the number of slices in CT scan. The variability in methodology is likely to impose variability in the results too.

Bicipital groove and intertubercular sulcus (ITS) are used synonymously in anatomy textbooks. However, review of the literature shows that there is a variability between the length of BG and the length of ITS, the former being longer than the latter. Vettivel et al[8] has concluded that BG is the distal extension of ITS.

The mean width of BG of both sides in present study was 6.34 mm which is similar to that of Ueberham and Le Floch-Prigent.[15] However, it was lesser as compared to all other literature available.[8-14,16,17-20] In most of the available studies, the width is measured at the widest part of the groove. But since the biceps tendon is restricted by the upper part of the walls of the BG, the measurement of width of BG at the upper part between the two tubercles, as done in the present study, seems more relevant.

For measuring the depth of BG, the methodology of Vettivel et al[8] was followed. Despite the same methodology, the mean depth of BG in the present study was found to be greater than that of Vettivel et al, Kaur et al[16] and Wafae et al.[20] It was slightly less than that of Ashwini et al[12] However, the mean depth of BG was similar to that of Singh and Singh[11], Arunkumar et al[18] and Gupta et al.[14] Singh and Singh have concluded in their study that rather than taking bony morphometry of BG alone as the predisposing factor for tendon pathologies or instability, the size of long tendon of biceps should also be taken into consideration, which further defines the relative narrowness or shallowness of BG. The significantly deeper BG on the left humeri corroborates with the findings of Singh et al[11] and may indicate differences in tendon morphology. However, the current study was done on dry humeri and couldn't compare morphometries with that of biceps tendon.

This study does not take into consideration the other soft tissue component which may equally contribute to the pathologies of the biceps tendon as described above.

The present study was conducted on a relatively small sample (N=100). Further studies can be done in a large number of humeri with random sampling, or with matched pair of bones from same individual and known gender, and with radiological correlation that includes the study of soft tissue component around bicipital groove.

CONCLUSIONS

The present study examined the bony parameters of bicipital groove of humerus and their correlation with length of humerus. It also threw some light on whether the bony parameters were similar on both right and left sides. Our study revealed that the mean depth of BG was significantly higher on left side than on right. However, it should be noted that the bones were not matched pairs. The study also showed a strong correlation of length and width of BG with bone length.

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