Original article

Assessment of Morphometry of Bicipital Groove of Human Adult Dry Humerus

Nasima Hoque,[1] Selina Anwar,[2] Rakshana Afruz,[3] Naheeda Nasrin Nahar Akand,[4] Farhana Afroz Snigdha,[5] Fatema Ferdousi Barna[6]

1. Associate Professor
   Department of Anatomy
   Rangpur Medical College
2. Professor
   Department of Anatomy
   Rangpur Community Dental College
3. Lecturer
   Department of Anatomy
   Rangpur Medical College
4. Lecturer
   Department of Anatomy
   Rangpur Medical College
5. Assistant Professor
   Department of Anatomy
   Rangpur Medical College
6. Medical Officer
   Department of Anatomy
   Rangpur Medical College

Correspondence to:
Nasima Hoque
Associate Professor, Department of Anatomy
Rangpur Medical College
E-mail: nasimazaman@gmail.com

Submission Date : 22 Apil 2024
Accepted Date : 24 August 2024
Published Date : 30 September 2024
DOI: https://doi.org/10.3329/jrpmc.v9i2.77369

Abstract

Background:
Bicipital groove is a shallow sulcus at its head-shaft junction of the humerus which has significance in post-mortem anthropology, archaeology and in clinical practice for orthopaedic surgeons.

Objective:
To determine length, width and depth of bicipital groove of adult human dry humerus.

Methods:
This cross-sectional study was conducted in the Department of Anatomy, Rangpur Medical College between the periods of July 2020 to June 2021. Two hundred dry adult humerus bones were collected purposively from 1st and 2nd year MBBS and BDS students of Department of Anatomy, Rangpur Medical College, Rangpur. Among the 200 humerus, 106 were right and 94 were left sided humerus including 41 paired bone. The length, width and depth of bicipital groove were measured. From the measurements mean and standard deviation was calculated for each variable.The student's't' testwas done for comparison of these variables and correlation test was done to find out the correlation with the total length of humerus withbicipital groove length (BGL)by using SPSS version 16.

Results:
In the present study, it was observed that the values of the length of bicipital groove was higher in the left side but the value of width of the groove was significantly higher on the right side of the total humerus but in paired bones, all the variables were higher in right side. Significant positive correlation found between the length of BG to total length of humerus.

Conclusions:
In the present study width of BG was significantly higher on the right side indicating robustness of right biceps brachii and thus right handedness. The positive correlation of BG with total length of humerus would help in determination of length of humerus in forensic investigation.

Keywords: Humeral bicipital groove (BG), Length (BGL), Width (BGW) and depth (BGD)

Citation: Hoque N, Anwar S,Afruz R, Akand NNN,Snigdha FA,Barna FF.Assessment of Morphometry of Bicipital Groove of Human Adult Dry Humerus.J Rang Med Col. 2024 Sep;9(2):84-88.doi: https://doi.org/10.3329/jrpmc.v9i2.77369

Introduction:

The bicipital groove also called intertubercular sulcus[1] is an elongated depression between the greater and lesser tubercles in the proximal part humerus.[2] It got its name as it contains the tendon of long head of biceps brachii with its synovial sheath and an ascending branch of anterior circumflex humeral artery. The upper part of the margins of the groove gives attachment to the transverse humeral ligament converting it into a canal, through which the tendon enters the sulcus. Shallowness of the groove or any inflammation of the ligament may cause irritation of the tendon as it is intracapsular, which is a common problem in shoulder disability especially in elderly. Again, wider groove may cause sublaxation of the tendon during multidirectional biomechanical movements of the arms.[3] Some researchers suggest that handedness could be determined by width of the BG which is due to more muscular biceps tendon. Moreover, length of BG is proportional to length of total humerus; which would be useful for determination of length of humerus in a fragmented bone.[4]

With the advancement of medical science, there is use of advanced orthopedic technique of prosthesis, the exact mormhometry of bicipital groove is necessary. Though various studiesare

found in foreign studies regarding this, there is unavailability of data of our own country specially in Northern part of Bangladesh. So, the anatomist, orthopedicians, clinicians and forensic surgeons have to depend on foreign data. The aim of the present study was to conduct the morphometric measurements of bicipital groove to establish a data bank regarding this BG that would help the Orthopedicians, Anatomists etc of our country.

Methods:

This cross-sectional study was done in the Department of Anatomy, Rangpur Medical College, Rangpur from July 2020 to June 2021.The study was done on 200 humerus bones of unknown sex, collected from 1st year and 2nd year students of MBBS and BDS, Department of Anatomy, Rangpur Medical College, Rangpur. Among the total bones, 106 were of right sided and 94 of left sided including 41 paired humerus. Samples were collected by convenient sampling as per inclusion and exclusion criteria.Dried, completely ossified, grossly normal humerusbones were taken for the study.If a part of humerus is missing or incomplete humerusor humerus with any deformity, these were rejected. Prior to collecting information, permission was taken from authorities. The study protocol was approved by the Ethical Review Committee of Rangpur Medical College, Rangpur.

For the present study, Bicipital groove length (BGL), Bicipital groove width (BGW) and Bicipital groove depth (BGD) were measured carefully with a Digital vernier calipers in millimeters. All the measurements were done with sameinstruments by the researcher herself to avoid inter-observer variations. Statistical analysis was carried out using SPSS version 16.0.Comparison between right and left sides was done by Student's unpaired t test for unpaired bones and paired 't' test for 41 paired bones.

Bicipital groove length (BGL): The groove's upper end was marked in the midpoint of the bicipital groove's two lips and its distal end by the lower

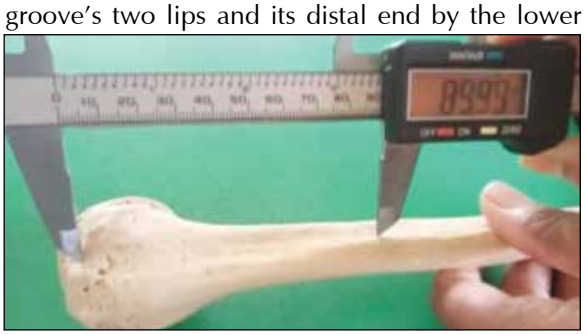

Figure-1: Photograph showing the measurement of bicipital groove length of humerus (BGL)

Bicipital groove width (BGW): Itwas measured at minimum and maximum wide part and an average

Figure-2: Photograph showing the measurement of bicipital groove width of humerus (BGW) by using digital vernier calipers.

Measurement of bicipital groove depth (BGD): was measured by using a wooden stick (Figure-3). At first the minimum and maximum depth was taken by inserting a wooden stick and then calculating the value by placing it over a measurable scale and the

Figure-3: Photograph showing the measurement of bicipital groove width of humerus (BGW) by using digital vernier calipers.

Results:

Table-I showed the results of BG length, width and depth of total humerus. It was observed that the length of BG was higher on the leftside, but width was significantly higher on right side. However, the depth of the groove was similar on both sides.

Table-I: Distribution of measurements of Bicipital groove of total humerus (N=200)

Variables	Right (n=106)		Left (n=94)		p-value
	Range	Mean±SD	Range	Mean±SD	
Total length (mm)	256-336	298.10±19.00	243-336	295.66±21.40	
BGL	65.00-110.00	86.08±8.08	63.00-111.00	86.70±9.03	0.612
BGW	4.81-10.59	7.88±1.30	4.30-10.70	7.37±1.24	0.005
BGD	3.00-9.00	4.55±.1.00	2.75-7.00	4.55±.73	0.998

Results are shown as ranges and mean±SDs.

Table II showed the results of BG length, width and depth of paired humerus. It was observed that length, width anddepth of BG was higher on the right side but the variation was statistically not significant.

Table-II: Comparisons of measurements of Bicipital groove of paired humerus (N=41 pairs)

Variables	Right (n=41) Mean±SD	Left (n=41) Mean±SD	p-value
BGL	65-110 83.69±7.70	63-106 83.46±8.34	0.701
BGW	4.81-10.59 7.81±1.44	5-10 7.64±1.28	0.257
BGD	2.75-7 4.48±1.01	2.75-7 4.31±.89	0.115

Results are shown as ranges and mean±SDs.

Results of correlation coefficient test between total length of humerus with length of BG showed that length of BG was significantly positively correlated with length of total humerus in unpaired bones (r^2=.449, p<.000 in right side and r^2=.395, p<.000 in left side) (Figure-4 & 5).

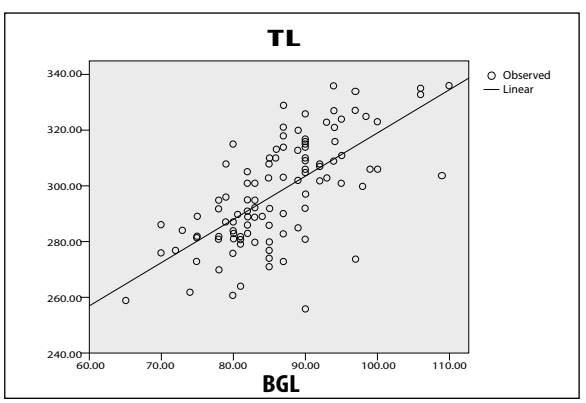

Figure-4: A Significant positive correlation between BGL and length of total humerus of right side (N=106)

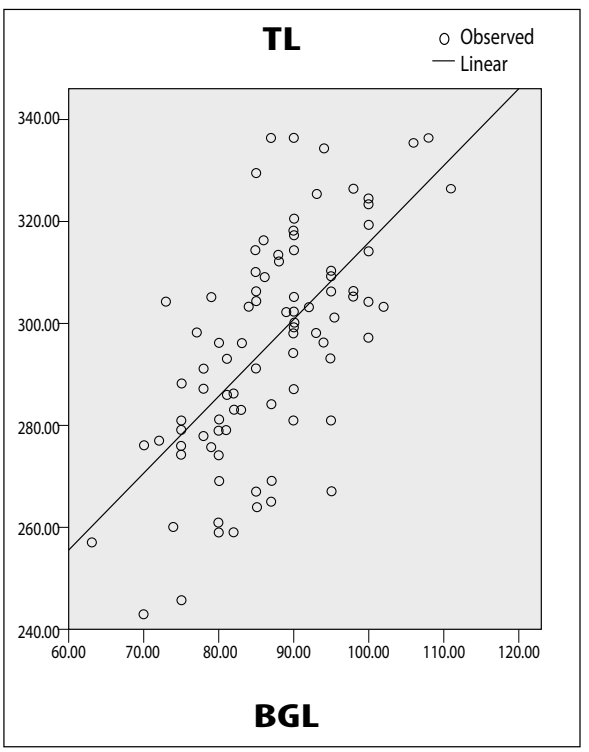

Figure-5: Significant positive correlation between BGL and length of total humerus of left side (N=94).

Discussions:

Human body variations which could be developmental or acquired give argument to abnormal functions of the body system. BG of humerus also shows variations in their morphology and morphometry.In the present study, the mean±SD of BGL of total humerus was lower on the right side than the left side, BGW of total humerus was significantly higher in the right side; however, the BGD was similar in both sides. But in paired humerus, all values were higher on the right side. However, no values vary significantly in paired bones.

Table-III: Comparison of different variables of Bicipital Groove of humerus (mm) with the findings of other studies

Researcher		Bicipital groove length (mm)	Bicipital groove width (mm)	Bicipital groove depth (mm)
Murlimanju et al[4]	Right	86±10.1	8.3±2.4	4.7±0.20
	Left	83.3±11.5	8.7±2.2	4.2±0.16
Rajani and Man[3]	Right	85±0.60	9.0±2.1	5.00±1.0
	Left	83±0.10	8.90±1.1	6.00±1.0
Goshu[5]	Right	74.6±0.9	7.96±0.1	4.84±0.08
	Left	74.5±0.9	8.12±0.08	4.43±0.07
Kabacki et al[6]	Right	75.59±6.05	8.06±1.16	4.89±1.38
	Left	77.20±6.83	8.01±0.92	4.48±0.99
Raghavendra et al[8]	Right	Not studied	9.34±1.62	5.86±1.32
	Left	Not studied	9.02±1.51	5.35±0.91
Rajan and Kumar[7]	Right	84.79±5.84	6.84±1.01	Not studied
	Left	87.33±6.40	7.74±1.96	Not studied
Vettival et al[9]	Right	Not studied	10.23	3.72
	Left	Not studied	9.8	3.70
In present study 2021	Right	83.69±7.70	7.81±1.44	4.48±1.01
	Left	83.46±8.34	7.64±1.28	4.31±0.89

Table-III summarized the finding of length, width and depth of bicipital groove by different authors along with the present study. It was observed that there was a variation in the findings of the different authors in the measurements of the bicipital groove. Regarding length of BG, it was found higher on the right in the study of Rajani and Man[3], Murlimanju et al[4], Goshu[5]; but it was found higher left side in study of Kabacki et al[6], Rajan and Kumar[7]and in the present study. Again, BG width was found higher on the right by Kabacki et al[6], Raghavendra et al[8], Vettival et al[9] and in the present study but it was higher on the left in the study of Murlimanju et al, Goshu and Rajan and Kumar.[3] Moreover, bicipital groove depth was higher on the right in the study of Murlimanju et al[4], Goshu[5], Kabacki et al[6], Raghavendra et al[8] and Vettival et al[9] but on left side it was higher in the study of Rajani and Man[3].However, in the present study, the value of BGD was similar. So, the values of the present are similar with the study of Kabacki et al[6], Raghavendra et al[8] and Vettival et al.[9]In the present study, BGL was significantly correlated with the total length of humerus. So, it could be stated that BGL is a good indicator and predictor of humeral length. So, it is useful in estimating humeral length, even when only a fragment of the BG is available, and stature of the subject could be estimated from its length. So, it has utmost importance in forensic medicine. Since BG and biceps tendon are intimately related, it is understood that variation of BG may influence the function of biceps tendon and consequently play an important role in causing tendon instability and attritional damage. Therefore, morphometry of BG allowing space for the passage of biceps tendon can be determined by various dimensions of the groove in the form of its length, width and depth along with their correlation with respective dimensions of humeri. The depth and width of BG have been caught up to be the most important contributing factors for retention of tendon of long head of biceps brachii muscle in

position. Studies suggested that a wide groove of more than 1.7 cm is often shallow which together may predispose subluxation or dislocation of the tendon.[7] Shallow BG may lead to chronic trauma or impingement by the overlying acromion, rotator cuff and coracoacromial arch while deep groove is more likely to cause constriction of the tendon DePalma[10] whereas a deep and narrow groove which on the other hand can cause irritation and tenosynovitis.[5] In this study, significantly higher width of BG of total humerus on right side as compared to left side can be explained on the basis that the higher pressure exerted by long tendon on the right side in manual workers may consequently alter the morphometry of BG on the respective side in terms of increase in its width. It indicates right handedness of most of the subjects. The length of BG may be related to height and build of the individuals. Thus, a more detailed analysis could be done in this respect. It would have been very useful if additional information regarding occupation and functional correlation pattern of upper limbs usage of the individuals could be known. Morphometric assessment of BG could propose useful information for wellbeing of patients with a view to undertake better shoulder reconstruction surgery. It could be considered that discrepancies attributed to various factors like ethnicity, age, sex, race, culture etc., along with environmental influence affecting bone growth such as nutrition, physical development and genetic factors.

Knowledge of present study highlighting anatomical variant of BG seemed to be relevant and clinically worth mentioning that would help in planning of surgical intervention by orthopedicians. This present study was a descriptive study for the specific population group of northern part of Bangladesh which creates perspectives not only to forensic and anthropological investigations, but the estimate could also be extended to living height of individuals and to archaeological studies.

Conclusions:

The values groove width of total humerus was significantly higher on right side than left but the length of the groove was higher on left side. However, in paired humerus, values were higher on the right side than left side though no significant differences were found. This present study was a descriptive study for the specific population group of northern part of Bangladesh which creates perspectives not only to forensic and anthropological investigations, but the estimate could also be extended to living height of individuals, handedness and help in the planning of surgical intervention by orthopedicians.

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