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ORIGINAL RESEARCH

Reassessing the morphometry of the bicipital groove: a radiographic investigation

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ABSTRACT

Background: An increase in the prevalence of the proximal humeral fractures which provides an accurate assessment of the various measurements of the bicipital groove and for assessing the gender differences on the same side of bicipital groove along with the difference between various sites on the same gender is vital. **Aim:** The present study aimed to reassess the morphometry of the bicipital groove using the radiographic method. **Methods:** The present study assessed 620 MRI (magnetic resonance imaging) scans that were done at the Institute within the defined study period. These MRI scans were from 310 males and 310 female subjects. Also, 380 scans were from the right side and 240 MRI scans were from the left side. The data gathered were assessed statistically for formulation of the results. **Results:** The study results showed a statistically significant difference in the genders concerning the width and depth of the bicipital groove and distance between lesser and greater tubercles. Additively, a significant difference was seen on different sides concerning the distance between tubercles and depth of the intertubercular groove. **Conclusions:** The present study concludes that from the variations in the different population, attaining an accurate morphometry of the proximal humerus is now vital to simulate the anatomy of the proximal humerus. Also, the difference between the intertubercular grooves in the two genders can be helpful in forensic cases.

Keywords: Bicipital groove, intertubercular groove, greater tubercle, lesser tubercle, proximal humerus

INTRODUCTION

The intertubercular or bicipital groove is one of the vital components of the proximal end of the humerus. It is a slit located on the anterior surface of the proximal humerus and is limited by lesser and greater tubercles medially and laterally respectively. The bicipital groove has been divided into three zones that are demarcated based on pectoralis major and subscapularis tendons. Various structures pass via the bicipital groove namely the ascending branch from the anterior circumflex humeral artery and the long head of the biceps brachii tendon.[1]

Teres major muscle insert at the lesser tubercle crest on the medial lip of intertubercular groove having a mean area of 187±87mm^2, width of 7.4±2.3, and length of 49.6±7.7 mm. Latissimus dorsi attach to the bicipital groove directly below the long head of the biceps brachii tendon with a dimension of 94mm. The attachment site of pectoralis major was at the crest of the greater tubercle at the lateral lip of the intertubercular groove.[2]

The transverse ligament of the humerus is not seen as a separate structure in all the subjects, it is mainly seen as subscapularis muscle fibers which are covered by fibrous expansion blended with capsule of the glenohumeral joint and it overlays the long head of the biceps brachii tendon and originate from posterior lamina of the tendon of pectoralis major muscle. It has also been reported that a few fibers from the coracohumeral ligament and supraspinatus muscle also participate in the formation of the transverse ligament of the humerus.[3]

Concerning the blood supply in the bicipital groove, on computed tomography angiography and gross anatomical and histological sections, it was seen that the bicipital groove and its content including the long

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head of biceps brachii tendon are supplied by ascending branches of an anterior circumflex humeral artery or recurrent branch of the brachial artery. Normal anatomy replication is vital for the fabrication of the best possible prosthetic design. It can be different owing to various sides of bicipital grooves concerning width and width on various studies and also differences based on genders have been reported.[4]

Existing literature data suggest a difference in female and male osteometry of the intertubercular groove where few studies reported the mean width and depth of the bicipital groove as 9.18 ± 1.45 mm and 7.43 ± 1.29 mm respectively. In females, mean width and depth were found to be 9.05 ± 1.31 mm and 7.53 ± 1.24 mm respectively. Various previous studies have reported a relationship between the anatomy of biceps brachii tendon disease and bicipital groove anatomy. However, it was also seen that there is no significant correlation between the morphology of the bicipital groove and the long head of biceps brachii tendon instability instead of its association with subscapularis rupture as it is part of the biceps pulley.[5]

Also, no significant relationship is seen between bicipital groove depth and pathology of the long head of the biceps brachii tendon. In the bicipital groove, mean depth was assessed on MRI (magnetic resonance imaging) in the range of 2.8 to 6.9 mm. Existing literature data is scarce concerning the distance between greater and lesser tubercles which is vital for replication of proximal humerus fractures.[6] The present study aimed to reassess the morphometry of the bicipital groove including width, depth, and distance between lesser and greater tubercles using the radiographic method.

MATERIALS AND METHODS

The present retrospective study was aimed to reassess the morphometry of the bicipital groove using the radiographic method. The study assessed subjects with the chief complaint of trauma or pain in the shoulder. The inclusion criteria for the study were Adult Indian cases from Vidarbha region and the exclusion criteria for the study were subjects with tumors, pathological osseous changes, and/or fractures.

The study assessed 620 MRI scans for the left and right shoulders from the existing medical records and data of the Institute. The included images were from 310 males and 310 females. Among assessed MRI, 380 images were from right side and 240 images were from left side. MRI was done using the system from the Institute.

Statistical analysis of the gathered data was done using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY, USA) for assessment of descriptive measures, Student t-test, ANOVA (analysis of variance), Pearson correlation coefficient, and Chi-square test. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered.

RESULTS

The present retrospective study was aimed to reassess the morphometry of the bicipital groove using the radiographic method. The present study assessed 620 MRI (magnetic resonance imaging) scans that were done at the Institute within the defined study period. These MRI scans were from 310 males and 310 female subjects. 380 scans were from the right side and 240 MRI scans were from the left side.

The study results showed that for assessment of various parameters of the bicipital groove in study subjects, inter-tubercle distance in males on the right and left side was 12.84±0.21 and 13.94±0.19 mm and was11.94±0.21 and 13.10±0.22 mm respectively in females. Bicipital groove width in males on the right and left side was 7.63±0.16 and 7.91±0.14 mm and in females was 7.16±0.16 and 7.21±0.14 mm respectively. For the bicipital groove, the mean depth in males on the right and left side was 5.42±0.09 and 6.19±0.09 mm respectively, and was 5.10±0.08 and 5.64±0.10 mm in females on the right and left side respectively (Table 1).

It was seen that for comparison of various parameters of right and left sides in the study of male and female participants, inter-tubercle distance was statistically significant in males and females on the right and left side with p=0.004 and 0.01 in males and 0.001 and 0.001 in females on right and left side respectively. Bicipital groove width was significant on the left side in males with p=0.003 and non-significant in females. Bicipital groove depth in males on the right and left side was 0.02 and 0.001 respectively and in females was 0.000 and 0.001 in females on the right and left side respectively (Table 2).

On assessing the distance, width, and depth of BG in greater and lesser tubercles in males and females, inter-tubercle distance was significantly higher in females with 13.27mm compared to males with 12.39mm with p=0.000. Bicipital groove width was also significantly higher in females with 7.74 compared to males with 7.18mm with p=0.002. The depth of the bicipital groove was alsosignificantly higher in females at 5.72 compared to males at 5.31mm with p=0.00 (Table 3).

There was seen a marked variation in the anatomy of the bicipital groove which was evident on retrospective assessment of the data from study subjects. However, in the present study, morphology was not assessed in all 620 subjects and the percentage of each variation of bicipital groove was not assessed in all the subjects.

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Table 1: Assessment of various parameters of bicipital groove in study subjects

S. No	Parameters	Males		Females	
		Right	Left	Right	Left
1.	Intertubercle distance	12.84±0.21	13.94±0.19	11.94±0.21	13.10±0.22
2.	BG width	7.63±0.16	7.91±0.14	7.16±0.16	7.21±0.14
3.	BG depth	5.42±0.09	6.19±0.09	5.10±0.08	5.64±0.10

Table 2: Comparison of various parameters of right and life sides in the study of male and female participants

S. No	Parameters	Males		Females	
		Right	Left	Right	Left
1.	Intertubercle distance	**0.004**	**0.01**	**0.001**	**0.001**
2.	BG width	0.07	**0.003**	0.244	0.846
3.	BG depth	**0.02**	**0.001**	**0.000**	**0.001**

Table 3: Distance, width, and depth of BG in greater and lesser tubercles in males and females

S. No	Parameters	Males (mean)	Females (mean)	p-value
1.	Intertubercle distance	12.39	13.27	**0.00**
2.	BG width	7.18	7.74	**0.002**
3.	BG depth	5.31	5.72	**0.00**

DISCUSSION

The present study assessed 620 MRI (magnetic resonance imaging) scans that were done at the Institute within the defined study period. These MRI scans were from 310 male and 310 female subjects. Also, 380 scans were from the right side and 240 MRI scans were from the left side. The study results showed that for assessment of various parameters of the bicipital groove in study subjects, inter-tubercle distance in males on the right and left side was 12.84±0.21 and 13.94±0.19 mm and was11.94±0.21 and 13.10±0.22 mm respectively in females. Bicipital groove width in males on the right and left side was 7.63±0.16 and 7.91±0.14 mm and in females was 7.16±0.16 and 7.21±0.14 mm respectively. For the bicipital groove, the mean depth in males on the right and left side was 5.42±0.09 and 6.19±0.09 mm respectively, and was 5.10±0.08 and 5.64±0.10 mm in females on the right and left side respectively. These results were in agreement with the findings of Wafae N et al[7] in 2010 and Ward AD et al[8] in 2006 where results comparable to the present study were also reported by the authors in their respective studies.

The study results showed that for comparison of various parameters of right and left sides in the study of male and female participants, inter-tubercle distance was statistically significant in males and females on the right and left side with p=0.004 and 0.01 in males and 0.001 and 0.001 in females on right and left side respectively. Bicipital groove width was significant on the left side in males with p=0.003 and non-significant in females. Bicipital groove depth in males on the right and left side was 0.02 and 0.001 respectively and in females was 0.000 and 0.001 in females on the right and left sides respectively. These findings were consistent with the results of Kishve P et al[9] in 2012 and Kaur M et al[10] in 2015 where the comparison of various parameters of right and left sides in study males and females reported by the authors in their studies was comparable to the results of the present study.

It was seen that on assessing the distance, width, and depth of BG in greater and lesser tubercles in males and females, inter-tubercle distance was significantly higher in females with 13.27mm compared to males with 12.39mm with p=0.000. Bicipital groove width was also significantly higher in females with 7.74 compared to males with 7.18mm with p=0.002. The depth of the bicipital groove was also significantly higher in females at 5.72 compared to males at 5.31mm with p=0.00. These results were in line with the findings of Ghalawat N et al[11] in 2020 and Arunkumar KR et al[12] in 2016 where distance, width, and depth of BG in greater and lesser tubercles in males and females were comparable to the present study were also reported by the authors in their respective studies.

The study results also showed that there was a marked variation in the anatomy of the bicipital groove which was evident on retrospective assessment of the data from study subjects. However, in the present study, morphology was not assessed in all 620 subjects and the percentage of each variation of bicipital groove was not assessed in all the subjects. These findings

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correlated with the results of Karmali NK et al[13] in 2019 and Ashwini NS et al[14] in 2017 where these results were also confirmed by the authors.

CONCLUSION

Within its limitations, the present study concludes that resulting from the variations in the different population, attaining an accurate morphometry of the proximal humerus is now vital to simulate the anatomy of the proximal humerus. Also, the difference between the intertubercular grooves in the two genders can be helpful in forensic cases.

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