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Original Research Article

Variations in the Bicipital Groove in North Indian Population: A Morphological and Morphometric Study and Review of Literature

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ABSTRACT

The morphology and morphometry of the bicipital grooves of the proximal end of humerus were studied in 100 intact dry humeri in the north Indian population. The parameters that were studied included the length, depth and width of the bicipital groove and the maximum length of the humeri. The incidence of supratrochlear ridge in the humeri were noted.The data was tabulated as mean ± SD and statistical comparison was made between the right and left side. No parameter was found to have a statistical significant difference between the two sides (p<.05). Supratrochlear ridge of humerus was found in 42% of the humeri. The present study is an attempt to determine the morphometry of the bicipital groove in the humeri of north Indian population. The data can be useful to anthropologists, orthopaedic surgeons and clinical anatomists.

Keywords: Bicipital groove, intertubercular sulcus, supratrochlear ridge of Meyer, long head of biceps tendon, shoulder arthroplasty.

INTRODUCTION

The intertubercular sulcus of the proximal humerus is situated between the greater and the lesser tuberosities but it continues distally for about 5 cm on the shaft as the bicipital groove. [1,2]

It contains the long head of the biceps brachii muscle, its synovial sheath and an ascending branch of the anterior circumflex humeral artery. Its lateral lip is marked by the bilaminar tendon of the pectoralis major, its floor by the tendon of the latissimus dorsi and its medial lip by the tendon of the teres major. The transverse humeral ligament is shaped like an abroad band passing between the tubercles and converting the sulcus into a canal and act as a retinaculum for the long tendon of the biceps brachii muscle for which it acts as a retinaculum. [3]

From a functional point of view, the most important region of the bicipital groove is the intertubercular sulcus. The coracohumeral ligament directly overlies the transverse humeral ligament and is continuous with the rotator cuff. [4]

This groove with transverse humeral ligament/ muscle fibers bridging it provides stability and smooth functioning of tendon of long head of biceps brachii muscle and prevents its subluxation during multidirectional biomechanical movements of arms. Apart from this, the greater function of biceps brachii muscle whose tendon is enshrined in bicipital groove is supination, flexion and screwing biomechanical movements. On motion of humerus, the proximal humerus moves in relation to fixed biceps tendon which is firmly held in place at the level of intertubercular sulcus by tuberosities and humeral transverse ligament. [4] With elevation of the arm, the humerus moves about 3.8cm on the fixed tendon. [6] In the motion from external rotation to internal rotation the tendon is forced medially against the lesser tuberosity and superiorly against the transverse humeral ligament. [7] Morphometry of BG may influence the functions of surrounding structures leading to various pathological conditions. [2,8]

Supratubercular ridge originally described by Meyer in 1928 [7] and later by Hitchcock and Bechtol in 1948 [5] consists of bony protuberance and is continuous with superior aspect of lesser tuberosity. The supratubercular ridge was defined by Cone as "a bony ridge extending proximally from the lesser tuberosity more than one half of the distance to the humeral head". [9]

Bicipital groove and proximal tendon disorders are becoming increasingly recognized as an important symptom generator in theshoulder. The spectrum of abnormalities includes tenosynovitis, pulley lesions, SLAP tears, bicepsdislocations, and proximal tears. The bicipital groove (BG) and the long head of the biceps tendon (LBT) are intimately related; the shape of the BG can have a great impact on the tendency for the LBT to be dislocated, subluxated, frayed, or torn. It is understood that a shallow, wide BG can promote subluxation and/or dislocation of the LBT, a deep narrow BG can cause LBT irritation and tenosynovitis, osseous spurs in the BG can cause LBT fraying and the presence of the supratubercular ridge of Meyer is suspected to promote dislocation. [7]

The data related to the bicipital groove in the Indian population is scarce.The knowledge of bicipital groove is highly useful in prosthetic sizing, positioning and designing. Bicipital groove also acts as an important landmark for placement of lateral fin of prosthesis in shoulder arthroplasty and humeral head replacement in fractures of upper end of humerus. [10] The bicipital groove shows a wide degree of variation and the present study is undertaken to determine the morphology and morphometry of the bicipital groove in the north Indian population.

MATERIALS AND METHODS

The study was carried out on 100 human humeri. The age and sex of the specimen was not determined. 53 among them were from the right side and 47 from the left side. All the humeri were obtained from the Postgraduate Department of Anatomy, GMC, Jammu. These bones were unpaired. Humeri with gross evidence of disease were excluded from the study. The maximum length of the humerus was measured using an osteometric board. The bicipital groove of each bone was thoroughly examined and parameters included length, width and depth .The length of the bicipital groove was measured as the maximum vertical distance between the greater and lesser tuberosity. The maximum width of the bicipital groove recorded at any point was considered its width .Depth was measured as the distance between the floor and the margins of the bicipital groove at the midpoint of the tubercles. A vernier caliper was used for all the measurements. The data was recorded separately for right and left humeri. Statistical analysis between the sides was performed using independent t-test. p-values <0.05 were considered significant. The data was presented as mean ±SD. The humeri were also analysed for the presence of ridge of Meyer.

RESULTS

Morphometric measurements of the bicipital groove were carried out on 100 humeri .The mean maximum length of the humerus was 30.592±2.39cm.The mean length of the bicipital groove was 2.97±0.34cm .The mean width was 0.717±0.16cm and the mean depth was 0.423±0.1cm. Table 1 shows the data analysed between the sides .No parameter showed statistically significant difference (p-value>0.05) between the right and left sides. A supratubercular ridge of Meyer was identified in 42 of the 100 humeri (42%).Of these 30 were present on the right side.

TABLE 1: Morphometric measurements of bicipital groove and maximum humeral length

Parameter (cm)	Right side	Left side	p value
Length of the bicipital groove.	2.96±0.36	2.98±0.32	0.48
Width of the bicipital groove	0.74±0.166	0.68±0.16	0.54
Depth of the bicipital groove	0.43±0.11	0.41±0.08	0.07
Maximum length of the humeri	30.83±2.33	30.31±2.46	0.78

Values are as mean±SD, p<0.05

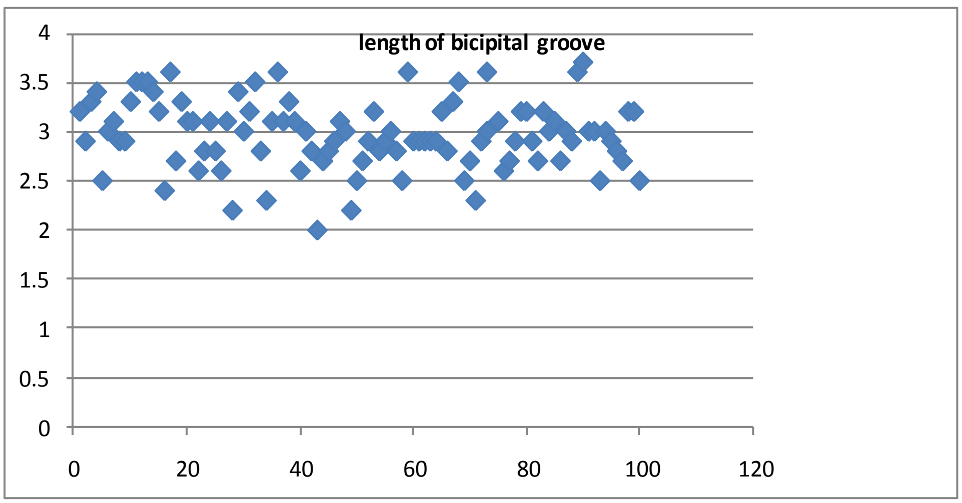

Fig 1: Distribution of length of bicipital groove

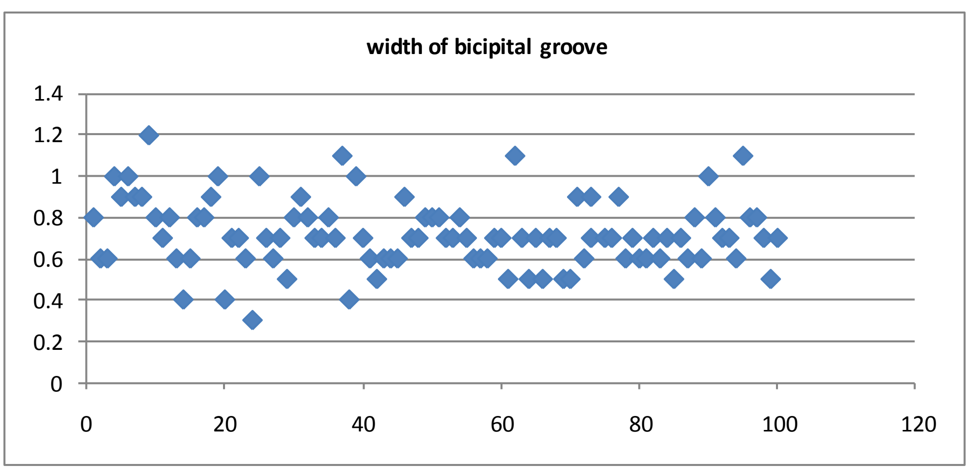

Fig 2: Distribution of width of bicipital groove

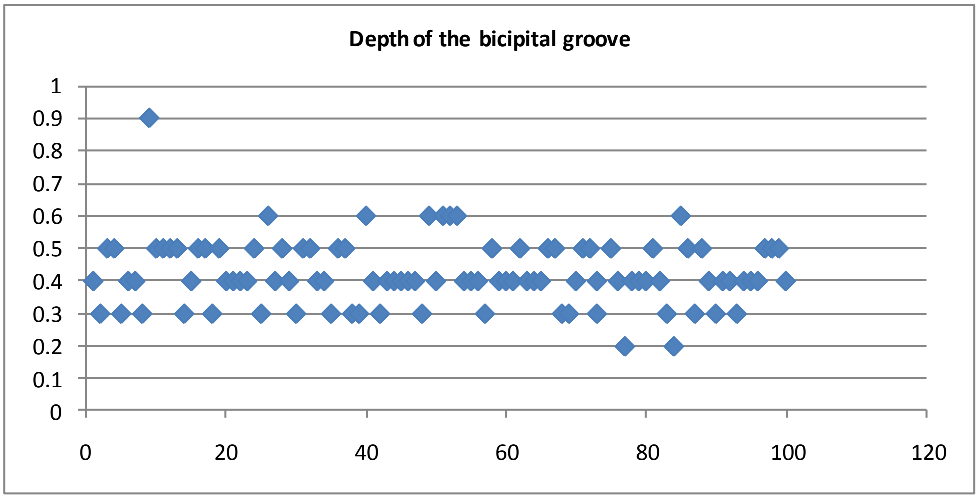

Fig 3: Distribution of depth of the bicipital groove

Fig 4: Bicipital groove

Fig 5: Supracondylar ridge of Meyer

DISCUSSION

Rockwood and Matsen mentioned that humans are unique among primates in presenting marked variation in the configuration of the bicipital groove **.**The bicipital groove depth and width are important factors in preventing subluxation and dislocation of tendons. A thick tendon in a wide, shallow groove will have a tendency to dislocate. At the other extreme, a deep, narrow groove is likely to constrict the tendon and cause impingement syndrome. **[19,20]**

Pathology in the long head of the biceps tendon can be responsible for marked shoulder pain and disability. The long head of the biceps tendon (LHBT) travels through the glenohumeral joint space from its origin and turns anteriorly to enter the bicipital groove at an angle of 35^0.The LHBT is intra articular and intracapsular but extrasynovial. The intertubercular groove provides the bony constrain for the LHBT pulley system. **[10]**

Primary bicipital tenosynovitis is a condition limited to the tendon without evidence of associated shoulder pathology. Individuals who participate in sports that require repeated overhead motions are at risk. Narrowing of the bicipital groove, which can occur when the bony anatomy is altered after fracture, glenohumeral joint arthritis and groove anomalies can all exacerbate biceps tenosynovitis. [11] Anatomic variations in the bicipital groove could give rise to sliding of the biceps brachii tendon. [17]

The medial displacement or slipping of the long head of the biceps tendon is prevented by the supracondylar ridge of Meyer. [7]

In the present study STR was seen in 42% of the humeri of which 71% were of the right side and 29% on the left.

TABLE 2: Comparison of width and depth of bicipital groove (mean)

AUTHOR	WIDTH (mm)	DEPTH(mm)
Cone et al [9]	8.8	4.3
Levinsohn [12]	7	5
Vettival et al [2]	10.23	3.7
Joseph et al [13]		5.1
Muralimanju et al [14]	8.5	4.4
Singh et al [15]	8	6
Prajakta Kishve et al [16]	5.5(top) 9.4(middle)	5.09
Wafae et al [17]	10.1	4
Present study	7.17	4.23

The width of bicipital groove in the present study is comparable to studies of Levinsohn et al and Singh et al where as it are less than the other studies. The depth is comparable to Cone et al and Muralimanju et al. The depth of the bicipital groove in the present study is comparable to Cone et al and Muralimanju et al and Wafae et al, more than Vettival et al and less than the rest of the studies in table 2.

It has been reported that 90-95% of people are right-handed. [18] In the manual workers, the pressure of the tendon of the long head of the biceps is higher on the right side than on the left, which may be expected to change the morphometry of the bicipital groove. Vettivel et al. observed that the mean width of the groove was greater on the right than the left humeri and the mean depth of the groove on right and left sides were similar. [2] The biceps is a muscle for heavy work and it is hypertrophied in manual labourers, with a resultant increase in the size of its long tendon. So the right tendon is larger than the left in the right-handed people and vice versa. But the present study showed no significant differences between the right and left humeri (p > 0.05).However while evaluating the pathologies of the biceps tendon and the groove clinically, particular attention should be paid to the bilaterality in that the opposite shoulder should also be evaluated for any underlying pathology.

According to Vettivel et al. the mean length of the right humeri was 30.2 ±0.2 cm and the left was 30.1 ±0.2 cms with no statistically significant difference. In the study of Muralimanju et al these lengths were 31 ±1.8 and30 ±2.5 cm, respectively. The only statistically significant difference in this study was that the right humerus was longer than the left. In the present study no parameter showed statistically significant difference between the right and left side with maximum length of humerus on right side being 30.83±2.33 and that on the left 30.31±2.46 .Cone et al. did not believe that direct measurements of the width of the groove are of value in evaluating the bicipital groove. [9]

The present study was limited in that the age and sex of the bones were not known and the bones were not matched pairs .Besides the occupation and built of the person could also not be determined which may have an effect on the morphology of the groove.

CONCLUSION

The present study is an attempt to determine the morphometry of the bicipital groove in the humeri of north Indian population. The data is an attempt to add to the scarce knowledge of the bicipital groove in the north Indian population which can be useful in planning of orthopaedic surgeries around the proximal humeri as well as some of the pathological conditions of the tendons and other structures around the groove. The data can also be useful for the anthropologists and clinical anatomists.

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