Volume : 3 | Issue : 6 | June 2014 • ISSN No 2277 - 8179

Research Paper

Morphometry of Intertubercular Sulcus of Humerus and its Variations

Medical science

KEYWORDS : : Intertubercular sulcus, morphometry, humerus, variations.

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ABSTRACT

The morphological features of interubercular sulcus (ITS) of humerus were studied in 164 intact dry paired humeri in Western regions of India. The length, width, depth, angle between medial and lateral wall of ITS with its floor was measured and the incidence of supratubercular ridge of Meyer was noted. The data were tabulated as mean ± SD and statistically compared between the right and left side. There was no statistically difference in these parameters between the left and right side (P>0.05). The supratubercular ridge was seen in 85 (51.82%) humeri. This study shows that the variations in ITS of humerus are common in western Indian population. We believe that this study will be an important reference for scientific research, and the details are also important for anthropologists and clinical anatomists.

Introduction: The bicipital groove of the proximal humerus is formed by the medial and lateral tuberosities and serves to retain the long biceps tendon in its proper place as the arm moves. Bicipital root and proximal tendon disorders are becoming increasingly recognized as an important symptom generator in the shoulder (Ward, Hamarneh, Schweitzer 2008). From a functional point of view, the most important region of the bicipital groove is the intertubercular sulcus (ITS), which is bounded by the lesser tuberosity medially, the greater tuberosity laterally, and the transverse humeral ligament superiorly (Cone, Danzig, Resnick, Goidman, 1983). According to Williams et al. (1989) the ITS continues distally as bicipital groove which has prominent medial and lateral margins which function as sites for muscle insertion. The transverse humeral ligament is a broad band passing from the lesser to the greater tubercles, converting the ITS into a canal for tendon of the long head of biceps brachii muscle, for which it functions as a retinaculum. The tendon of the long head of the biceps plays an important role in maintaining the alignment of the head of the humerus within the glenoid cavity of the scapula in movements involving use of the arm and forearm. The humerus moves on the tendon of the long head of the biceps in all movements of the upper extremity (Vettivel et al. 1992). Literature search revealed that the variable morphology of bicipital groove is related to biceps tendon dislocation and this prompted us to undertake this study.

Materials and Methods

The study was carried out on 164 paired dry human humeri (Right-82 and Left-82).Out of these 50 pairs were obtained from collection of anatomy museum of Rural Medical College, Loni and remaining procured from the unclaimed cadavers of the department. The age of the donors was between 30-50 years. The humeri with gross evidence of disease were excluded from the study. The intertubercular sulcus of each bone was studied carefully and following parameters were evaluated. The length of medial and lateral wall of bicipital groove; length, width, depth of intertubercular sulcus; angle of medial and lateral wall of intertubercular sulcus. (Figure 1 B)

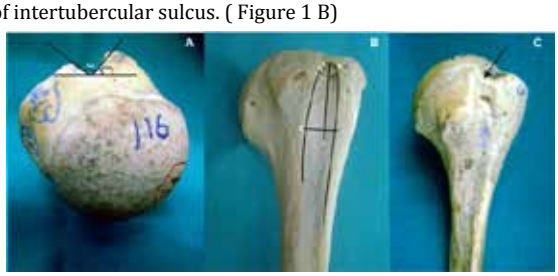


Figure 1: A- showing measurement of angles of ITS of Left humerus. Alw-angle of lateral wall, Amw- angle of medial wall. B- showing measurement of parameters of ITS. C- Arrow shows supratubercular ridge.

1. Length of medial wall (Line A in fig.1 B): Maximum length of prominent medial margin of bicipital groove.
2. Length of lateral wall (Line B): Maximum length of prominent lateral margin of bicipital groove.
3. Length of intertubercular sulcus (Line C): Maximum vertical distance between the greater and lesser tubercle.
4. Width: Width is measured at two locations on bicipital groove.
   Top width (Line D) - the distance between medial and lateral lips of intertubercular sulcus at the top.
   Middle width (Line E) - Maximum width at the middle of the intertubercular sulcus.
5. Depth (Line F): Maximum distance between the floor and margins of ITS.

All these measurements were taken with help of vernier caliper.

For the measurement of angle photographs of upper end of humerus were taken. Then the outlines of upper end including the greater and lesser tubercle were drawn on paper. A horizontal line parallel to the floor and two oblique lines along the planes of greater and lesser tubercles were drawn on the paper (Figure 1 A).

The angle of medial wall (Amw): the angle between the medial wall and the floor of ITS.

The angle of lateral wall (Alw): the angle between the lateral wall and the floor of ITS.

All measurements were recorded separately for left and right humeri. Means, S.D. and S.E.M. were calculated for each measurement. Unpaired 't' test was used to determine if there were any significant difference in the mean values of these dimensions. The presence of supratubercular ridge was noted and its incidence on both the sides was calculated.

Results

Morphometric measurements of the ITS of humerus were done on 164 humeri (82 right, 82 left). The mean, range, SD, SE of measurements of the length, width, depth, angle between the medial and lateral wall of ITS with the floor are shown in table 1 and table 2.

The mean length of ITS was 3.15 cm on the right and 3.55 cm on the left sides respectively. The lateral margin of ITS is extended more lower down than the medial margin. The mean length of the lateral margin of ITS was found to be 8.5 cm on the right and 8.77 cm on the left. The mean length of the medial margin was 6.52 cm on the right and 6.43 cm on the left sides. The width of

Volume : 3 | Issue : 6 | June 2014 • ISSN No 2277 - 8179

the ITS is measured at the two sites. The mean width at upper end of ITS was 5.93 mm on right and 5.86 mm on left sides respectively whereas the width

Table:1 showing results of Right side

Parameter	Range	Mean	S.D.	S.E.	P value
L of Medial Wall (cm)	2.7-9	6.52	1.52	0.16	p>0.05 (0.70)
L of lateral wall (cm)	5.4-10.9	8.50	1.15	0.12	p>0.05 (0.14)
L of ITS (cm)	2.3-6	3.15	0.58	0.06	p>0.05 (0.68)
Top width (mm)	4-10	5.93	1.27	0.14	p>0.05 (0.74)
Middle width (mm)	13-15	9.26	1.83	0.20	p>0.05 (0.19)
Depth (mm)	2-8	4.95	1.19	0.13	p>0.05 (0.14)
Angle of Medial wall (^{0})	20-90	51.26	16.21	1.79	p>0.05 (0.39)
Angle of Lateral wall (^{0})	105-164	140.58	12.78	1.41	p>0.05 (0.10)

at the middle of ITS is the maximum width of ITS. It was 9.26 mm on right and 9.69 mm on the left respectively. The angle between the medial wall of ITS with the floor had a wider range (20-80) on both sides. The means were closely similar (51.26^0 on the right and 53.23^0 on the left). The mean angle of the lateral wall was more on the left side (140.58^0 right, 137.42^0 left). The supratubecular ridge of Meyer was present in 59.75 % from the right and 43.90 % from the left humeri. No significant difference was found between left and right sides of specimens in all parameters. In the present study the ITS showed variable morphology. It may be narrow, normal and shallow as seen in figure 2.

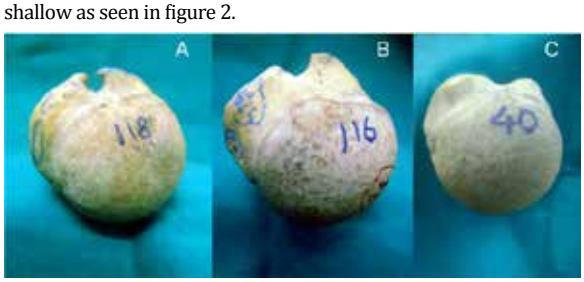


Figure 2: A-Narrow, B-Normal, C-Shallow ITS.

Table:2 showing results of Left side

Parameter	Range	Mean	S.D.	S.E.	P value
L of Medial Wall (cm)	2.2-9.4	6.43	1.46	0.15	p>0.05 (0.70)
L of lateral wall (cm)	5.8-12.3	8.77	1.18	0.12	p>0.05 (0.14)
L of ITS (cm)	2.4-4.8	3.55	0.46	0.05	p>0.05 (0.68)
Top width (mm)	4-11	5.86	1.44	0.15	p>0.05 (0.74)
Middle width (mm)	12-14	9.69	2.33	0.25	p>0.05 (0.19)
Depth (mm)	3-11	5.23	1.32	0.14	p>0.05 (0.14)
Angle of Medial wall (^{0})	24-88	53.23	13.35	1.44	p>0.05 (0.39)
Angle of Lateral wall (^{0})	105-164	137.42	12.48	1.35	p>0.05 (0.10)

Discussion: Rockwood and Masten (1990) mentioned that humans are unique among the primates in presenting marked variations in the configuration of the bicipital groove and the angle formed between its medial wall and floor. Multiple authors have debated the contribution of intertubercular groove morphology to biceps tendon pathology. The intertubercular groove depth and width are important factors in the retention of the long biceps tendon. 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 (Rockwood & Masten 1990). The supratubercular bony ridge first described by Meyer is a projection proximal to the medial wall of ITS superior to the lesser tubercle (Cone et al 1983).

The morphometric data of present study has been compared with other studies and shown in table 3.

The measurement of mean length of medial and lateral wall of ITS was done by Singh et al and it was 22 mm on right and 23 mm on left side. These values in present study are higher as we measured the length upto the lowest limit of bicipital groove.

Table:3 Comparison of width, depth and angle of ITS

Author	Width	Depth	AMW	ALW
Cone et al	8.8	4.3	56	-
Levinsohn	7	5	59	-
Vettival	10.23	3.7	60	135
Joseph et al	-	5.1	47	81
Muralimanju	8.5	4.4	-	-
Singh et al	8	6	48.91	82.20
Present study	5.8 Top	5.09	52.24	139
	9.4 Middle			

The width of the ITS in other studies is found to be measured at one end of the ITS. In present study width is measured at two locations on ITS as the ITS is narrow at the upper end and wider at the middle part.

The depth of ITS in present study is comparable to Joseph et al and Levisohn et al. The medial wall angle (Amw) in present study is higher than Joseph et al and Singh et al and lower than Cone et al, Levinsohn et al and Vettivel et al. The lateral wall angle (Alw) in present study is comparable with that of Vettivel et al and higher than Joseph et al and Singh et al. The supratubercular ridge in present study is found in 59% in right and 43% in left humeri. Thus the total incidence of supratubercular ridge in present study is 51%. We believe that the incidence of supratubercular ridge is higher on right side to prevent medial displacement of tendon of long head of biceps brachii.

Conclusion: The morphometry of intertubercular sulcus (ITS) of humerus have been studied in Western regions of India. We believe that the variations in the morphology of ITS is due to the thrust exerted by tendon of biceps altering the width, depth and angles of ITS. This study forms an important reference for scientific research, and the details are also important for anthropologists and clinical anatomists.

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