

## A Morphometric Study of Bicipital Groove in Humerus and its Clinical Importance

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### Abstract

**Introduction:** The Bicipital groove (BG) remains controversial regarding its morphology. The primary objective of this study was to elucidate the detailed gross morphology of BG in an adult Indian population.

**Method:** 124 unpaired dry humeri (58 right side and 66 left) were studied and measured for various parameter such as length, width and depth of the bicipital using digital vernier caliper in anatomy laboratory of our institution. The data were expressed in mean  $\pm$  SD and statistically compared between right and left sides of bicipital groove.

**Results:** The mean length, width and depth of the bicipital groove were  $85.50 \pm 4.84$  mm,  $7.5 \pm 2.0$  mm and  $4.6 \pm 1.8$  mm, respectively. There was no statistically significant difference in these parameters between the left and right sides. A supratubercular ridge of Meyer was seen in 27% of the humeri.

**Conclusion:** Morphometric knowledge of BG is significant in functional and clinical setup for better understanding of wide range of movements in upper extremities and it's predispose dislocation of tendon of biceps.

**Keywords:** Bicipital groove; Intertubercular sulcus; Morphometry; Supratubercular ridge.

### Introduction

Bicipital groove (BG) is an indentation on the

anterior aspect of proximal part of humerus between the lesser and greater tubercles which allows tendon of long head of biceps brachii muscle enveloped in synovial sheath and ascending branch of anterior circumflex humeral artery to pass through it.<sup>1</sup> The BG is converted into a canal by the fibrous band called transverse humeral ligament which extends between lesser and greater tubercle of the humerus. The transverse humeral ligament provides stability and effective functioning of long head of biceps muscle and prevents subluxation of the tendon.<sup>2</sup> The supratubercular ridge is a bony prominence that is continuous with the lesser tubercle and it allows gradual change in the direction of tendon of long head of biceps by elevating and forcing it laterally.<sup>3</sup> Related to the functional significance of structures in BG, it is an important landmark for replacement of prosthesis of shoulder and the knowledge of its morphometry is essential for the selection of prosthetic design, size and position.<sup>4</sup> Any alteration in the morphometry of bicipital groove can affect the functions of neighboring structures leading to several pathological conditions.<sup>5</sup> In the present study, the morphometry of BG was examined in relation to its length, width, depth, length of the medial and lateral walls of the BG and the presence of supratubercular ridge in south Indian population.

## Materials and Methods

The study was carried out in 124 adult humeri (58 right and 66 left) from the Department of Anatomy, Kannur Medical College, Kannur, between May 2018 and September 2019. Bones with external deformities were excluded from the study. The length, width, depth were accurately measured by using digital vernier caliper. All the parameters were measured by two observers to ensure accuracy and the average was taken. Data were presented in Mean  $\pm$  SD. Statistical significance is performed using independent *t*-test. Data were analysed using SPSS 15.0 Programme (SPSS Inc, Chicago, Illinois, USA).

The following parameters were measured in this study.

1. The length of the BG was measured from the point between the tubercles to the end of the medial lip of the BG.
2. The depth of the BG was measured between the greater and lesser tubercles. The width of

the BG was measured between the midpoint of the medial and lateral lips.

3. The length of the medial and lateral walls was measured from the tubercles to the respective lips of the BG. Supratubercular ridge is a bony prominence extending from the lesser tubercle. and is found in few humeri in the present study (Table1 and Fig. 1).

## Results

The mean length, width and depth of the BG were  $85.50 \pm 4.84$  mm,  $7.5 \pm 2.0$  mm and  $4.6 \pm 1.8$  mm respectively. Data were analyzed between the sides and the detailed values are presented in Table 1. The mean length of the Lateral lip of BG was longer than the medial lip ( $p = 0.04$ ). Other than this, no parameters showed statistically significant differences ( $p > 0.05$ ) between the right and left sides. A supratubercular ridge of Meyer (Fig. 1) was identified in 27%.

**Table 1:** Comparison of Measurements of Right and Left Humeri ( $n = 124$ )

Parameter (mm)	Mean $\pm$ SD		<i>p</i> value
	Right side	Left side	
Length of BG	$84.79 \pm 5.84$ mm	$87.33 \pm 6.40$ mm	0.53
Width of BG	$6.84 \pm 1.01$ mm*	$7.74 \pm 1.96$ mm	0.48
Depth of BG	$4.21 \pm 0.58$ mm*	$5.01 \pm 1.05$ mm	0.45
Length of the medial wall	$24.22 \pm 1.02$ mm	$23.31 \pm 2.21$ mm	0.37
Length of the lateral wall	$32.05 \pm 2.21$ mm	$31.12 \pm 0.24$ mm	0.04*

Values are mean  $\pm$  SD, Statistical significance (independent *t*-test). \*:  $p < 0.05$



**Fig. 1:** Upper end of the humerus showing measurements of bicipital groove. (STR: supratubercular ridge of Meyer).

## Discussion

The tendon of the long head of the biceps plays an important role in maintaining integrity of the shoulder joint. Subluxation and dislocations of the biceps tendon are more common in people with a shallow bicipital groove.<sup>6</sup> A shallow bicipital groove associated supratubercular ridge of Meyer predisposes a patient to bicipital disease.<sup>7,8</sup> The variation in the morphology of the BG affects the biomechanics of the biceps tendon, and implicated in the development of bicipital tendinitis<sup>8</sup> Any Anatomic variations in the groove could give rise to sliding of the biceps brachii muscle tendon<sup>9</sup> is a subject clinical interest but still there is limited data available in it. In a morphometric study by Rajani S et al.<sup>8</sup> reported the length of the medial wall was  $23 \pm 4$  mm on the right side and  $24 \pm 5$  mm on the left side and the length of the lateral wall was  $31 \pm 6$  mm on the right side and  $31 \pm 5$  mm on the left side which is similar to the present study. According to reports the incidence of subluxation and dislocation of tendon of biceps is common when the BG is shallow.<sup>10</sup> The instability of biceps tendon may be also attributed to the lengths of medial and lateral walls, presence of supratubercular ridge.<sup>11</sup> The reports on length, width and depth of BG of several studies are presented in (Table 1 and Fig. 1).

In general most of the persons (approx. 90–95%) are right handed preference to do the work. Thereof, pressure of long head of the biceps tendon is higher on the right side than on the left, which may be subjected to morphometric changes in BG.<sup>12</sup> Vettivel et al. observed that the mean width of the BG was greater on the right humeri than the left and the mean depths of the BG on right and left sides were same on both sides.<sup>5</sup> But the present study showed no significant differences between the right and left humeri ( $p > 0.05$ ).

Wafae et al., reported the average length of the groove was 80.1 mm and mean width of 10.1 mm and depth was 4.0 mm which is higher than the other study population.<sup>13</sup> Similar study by Pfahler et al., and Robertson et al., reported sex differences in the morphometry of BG.<sup>14</sup> Studies on Indian population reported that in right side BG mean length ( $86 \pm 10.1$  mm) and width ( $8.3 \pm 2.4$  mm) whereas on left side ( $83.3 \pm 11.5$  mm) and ( $8.7 \pm 2.2$  mm) respectively.<sup>15</sup> Our finding was similar to the previous studies.

Cone et al., defined the supratubercular ridge as a bony ridge extending proximally from the lesser tubercle more than one-half of the distance

to the humeral head<sup>16</sup> and reported its prevalence to 48% of all specimens and 46% of all patients in their study. The authors through radiographic interpretations concluded that the supratubercular ridges are not pathologically significant. But contrarily Hitchcock and Bechtol demonstrated definite correlation between the supratubercular ridge and tendonitis.<sup>17</sup> Vettivel et al., found this ridge in 88% on the right side and 57% on the left side<sup>5</sup> and interpreted that higher incidence of supratubercular ridge on the right side will prevent medial displacement of biceps tendon. Sangeeta gupta et al., observed 42% incidence of supratubercular ridge in North Indian population but their findings were not statistically significant.<sup>18</sup> Murlimanju et al., reported supratubercular ridge in 38.1% of the humeri in their study.<sup>15</sup> In our study we found a lower incidence of 27% supratubercular ridge on the right side and 15% on the left side. This may probably be due to ethnic variation and it needs to be substantiated with comparison with different population.

## Conclusion

Our study reported the width of the BG and the incidence of supratubercular ridge is less when compared to other studies in western population. However it's on par with other Indian studies.

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