

## Morphometric Study of Angle of Inclination of the Human Humerus

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The angle of inclination of the humerus is the angle between the long axis of the shaft and the central axis of the head of the humerus in the frontal plane. It is about 130° to 150°. Orthopedic surgeons performing reconstruction of the shoulder during prosthetic replacement should consider the size and placement of the head of the humerus. Prosthetic systems with a wide range of modular head sizes, eccentric tapers, and adjustable inclination angles and versions help orthopedic surgeons better to adapt prosthesis to a patient's bone anatomy. The present study aimed to establish the morphometry of the angle of inclination of the humerus in the Bangladeshi population and to correlate with the previous studies. The present prospective study was carried out with 100 (43 right-sided + 57 left-sided) dried humeri of unknown sex and age. In the present study, the mean±SD angle of inclination of the right humeri was 128.89±3.987 degree and the left humeri were 129.19±3.335 degree. In this article, we review the effects of this anatomical parameter on prosthetic design.

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**Key words:** Morphometry, Angle, Inclination, Humerus, Human

### Introduction

The angle between the long axis of the shaft and the central axis of the head of the humerus is called the angle of inclination of the humerus<sup>1</sup>. It is about 130° to 150°. It is expressed by  $\Theta^2$ . This angle is used to determine the coronal displacement of the proximal humerus. This angle may be used not only to plan arthroplasty and osteotomy but also to assess the effects of osteosynthesis. A prosthetic design with a fixed angle of inclination allows for the reproduction of the humeral center of rotation with a simple and more economical prosthetic solution. Orthopedic surgeons, who used to do shoulder arthroplasty should have a comprehensive understanding of shoulder joint anatomy. As the angulations vary with populations, different populations need different kinds of implants<sup>3</sup>. The present study aimed to make baseline data on the angle of inclination of the humerus in the Bangladeshi population.

### Method

The study was conducted from July 2021 to June 2022 at the Department of Anatomy, Mymensingh Medical College, Bangladesh. Samples were collected from the Department of Anatomy, Mymensingh Medical College, Bangladesh. The Institutional Review Board (IRB) of Mymensingh Medical College, Bangladesh approved the protocol of the study (Memo no. MMC/IRB/2022/442 Date: 10/04/2022). One hundred (100) fully ossified dry human humerus were collected for the study. The study was cross-sectional descriptive type. A non-random purposive

sampling technique was used for sample selection. The sample was excluded if the bones were un-ossified, developmentally abnormal and broken. Measurement of one parameter was taken from this study. A line was drawn along the long axis of the shaft of the humerus and another line was drawn along the central axis of the head of the humerus with a pencil. The angle between them was measured by a goniometer and was expressed in degree.

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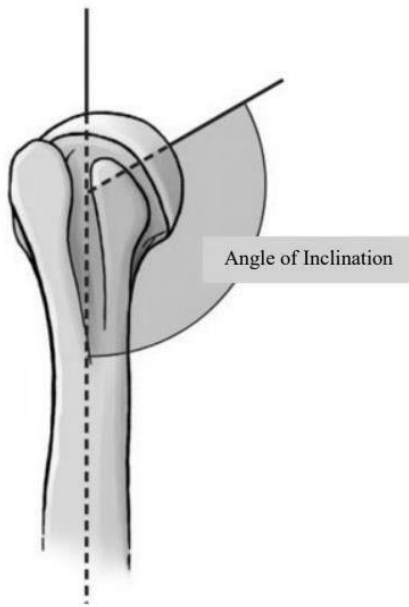


Figure 1: Angle of inclination of humerus<sup>4</sup>

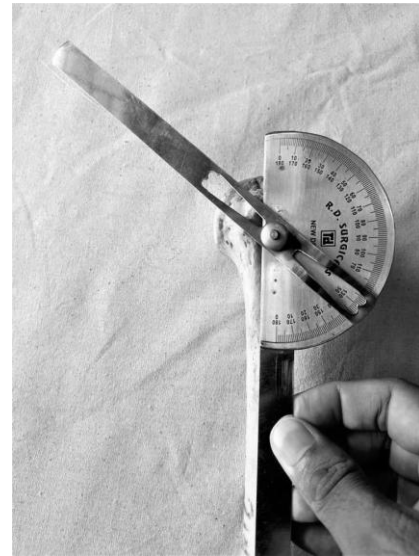


Figure 2: Photograph showing the procedure of measurement of the angle of inclination of the humerus

**Results**

The angle of inclination of 43 right humeri ranged from 120° to 135°. More than 72.0% of samples were measured within the range of 124.50° to 134°. The angle of inclination of 57 left humeri ranged from 120° to 135°. More than 70% of samples were measured within the range of 125.50° to 132.50°.

\Table I: Angular measurement of humerus (n=100)

Variable	Side	Range		
		Maximum	Minimum	Mean±SD
Angle of inclination (degree)	Right	135	120	128.89±3.987
	Left	135	120	129.19±3.335

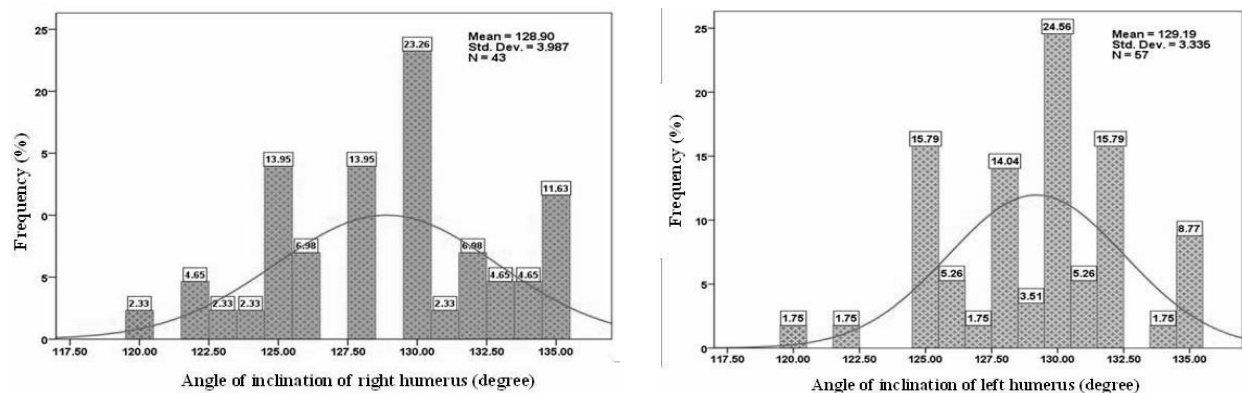


Figure 3: Histogram showing the frequency distribution of the angle of inclination on both-sided humerus

**Discussion**

According to the present study, the mean±SD angle of inclination of the right humeri was 128.89±3.987 degree and the left humeri were 129.19±3.335 degree. The range was 124.50° to 135° on the right side and 125.50° to 132.50° on the left side. Aroonjarattham et al.; Iannotti, Lippitt & Williams, Sahu et al., and Jia et al. also studied this variable. However, those studies did not mention the side of the humerus.

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Aroonjarattham et al. measured the mean±SD of the angle of inclination was 127.64±4.28 degree<sup>1</sup> for the 76 irrespective of side. Sahu et al. conducted a study on 50 humeri. According to their observation, the mean and standard deviation of the angle of inclination of the humerus was 133.8±6.4 degree<sup>5</sup>. Iannotti, Lippitt & Williams conducted a study and stated that the mean angle of inclination of the humerus was 135 to 140 degree<sup>6</sup>. Jia et al. conducted a study on 120 humeri and they stated the mean and standard deviation of the angle of inclination of the humerus as 132.1±4.4 degree<sup>7</sup>. In the present study, the mean value of the angle of inclination of humerus was nearly similar to the value described by Aroonjarattham et al. and lower than the value described by Sahu et al., Iannotti, Lippitt & Williams and Jia et al.

### **Conclusion**

The present study provides new data to the research literature on the angle of inclination of the humerus. It adds to the knowledge of population frequency and distribution while comparing to previously observed frequencies reported in studies. It is important for the orthopedic surgeon for preoperative planning in the reconstruction of the shoulder during prosthetic replacement.

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