

## Morphometric study of the angle of inclination and angle of torsion of the humerus using digital imaging techniques

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The angle of inclination (AI) and humeral torsion angle (HTA) are critical morphometric parameters. AI determines glenohumeral joint alignment, while HTA affects the rotational orientation of the humeral head. These angles are essential for understanding upper limb function, asymmetry, and have significant clinical implications in prosthetic design, fracture fixation, and surgical planning. This study aimed to evaluate AI and HTA in adult human humeri using digital imaging techniques and assess the correlation between them. A total of 36 dry humeri (16 right-sided, 20 left-sided) from the National Institute of Ayurveda (NIA) osteological collection were analyzed without sex differentiation. Angles were measured using image analysis software. AI was defined as the angle between the humeral head and shaft axes, while HTA was the angle between the humeral head axis and bicondylar plane. The mean AI was  $130.56^\circ \pm 3.46^\circ$  (range:  $125^\circ$ – $136^\circ$ ) in right humeri and  $125.85^\circ \pm 4.09^\circ$  (range:  $119^\circ$ – $133^\circ$ ) in left humeri. The mean HTA was  $64.06^\circ \pm 9.50^\circ$  (range:  $50^\circ$ – $80^\circ$ ) in right humeri and  $64.10^\circ \pm 9.26^\circ$  (range:  $49^\circ$ – $82^\circ$ ) in left humeri. A statistically significant moderate negative correlation was found between AI and HTA in right humeri ( $r = -0.61$ ,  $p = 0.011$ ), while a weak, non-significant positive correlation was observed in left humeri ( $r = 0.09$ ,  $p = 0.704$ ). These results suggest potential functional or anatomical interdependence between the two angles in right-sided bones in an India -Rajasthan sample and reveals a statistically significant inverse relationship between the two angles on the right side, possibly linked to dominant limb usage, while asymmetry may reflect population-specific anatomical variation. Also, findings suggest a functional interdependence between AI and HTA in the dominant limb and highlight the need for further regional, sex-specific studies to enhance clinical and anatomical understanding.

**Keywords:** *Morphometric study, Angle of inclination, Angle of torsion, Humerus*