ISSN 2515-8260 Volume 9, Issue 7, Summer 2022

ORIGINAL RESEARCH

Assessment of Bilateral Asymmetry in the Humerus of Human Skeletal Specimen: An observational study

[1]Sunanda Raina, [2]Nikita Kalra

[1]Professor, Department of Anatomy, Chintpurni Medical College Bungal, Pathankot, Punjab, India
[2]Associate Prof, Department of Biochemistry, Chintpurni Medical College, Bungal, Pathankot, Punjab, India

Correspondence:
Nikita Kalra
Associate Prof, Department of Biochemistry, Chintpurni Medical College Bungal, Pathankot, Punjab, India

ABSTRACT

Background: To evaluate the Bilateral Asymmetry in the Humerus of Human Skeletal Specimen.

Materials & methods: A total of 100 sets of skeletons, both female and male, of different ages and geographical origins were enrolled. Weight of humerus bone was assessed on a weighing balance. Humerus length was determined by using an osteometric board. Mid-Shaft Circumference was assessed using a millimeter graph paper at the level of the apex of the deltoid V. All the dimensions were recorded in Microsoft excel sheet and were quantified. All the results were recorded and analysed using SPSS software.

Results: Among the males, mean weight of left and right humerus was 118.3 grams and 117.2 grams. Mean length of left and right Humerus was 32.91 cm and 32.83 cm respectively.Mean mid-shaft circumference of left and right Humerus was 5.95 cm and 5.72 cm respectively. Among the females, mean weight of left and right humerus was 103.5 grams and 103.1 grams. Mean length of left and right Humerus was 31.12 cm and 30.99 cm respectively.Mean mid-shaft circumference of left and right Humerus was 5.62 cm and 5.49 cm respectively.

Conclusion: Bilateral asymmetries do exist in the humerus with more asymmetry observed in the male compared with the female.

Key words: Bilateral asymmetry, Human, Skeleton

INTRODUCTION

The humerus is the largest bone of the upper extremity and defines the human brachium (arm). It articulates proximally with the glenoid via the glenohumeral (GH) joint and distally with the radius and ulna at the elbow joint. The most proximal portion of the humerus is the head of the humerus, which forms a ball and socket joint with the glenoid cavity on the scapula. As one of the many long bones within the appendicular skeleton, the humerus develops via endochondral ossification. This process is characterized by the replacement of a cartilage template by bone.[1-3]

The proximal humerus has two necks. The anatomic neck is the old epiphyseal plate, and the surgical neck is the metaphyseal area below the humeral head. The blood supply is the anterior and posterior humeral circumflex artery with the axillary nerve as the major nerve of this region. The humeral shaft is a cylindrical bone that gradually becomes triangular

distally.[4- 6]Although the development of behavioral handedness has been observed, how it presents in the skeleton throughout growth is not well established. Previous work with the humerus in a living population also supports the hypothesis that dimensions of this element are reflective of both hand preference and activity.[5- 7]Hence; the present study was conducted for evaluating the Bilateral Asymmetry in the Humerus of Human Skeletal Specimen.

MATERIALS & METHODS

The present study was conducted for evaluating the Bilateral Asymmetry in the Humerus of Human Skeletal Specimen. A total of 100 sets of skeletons, both female and male, of different ages and geographical origins were enrolled. Weight of humerus bone was assessed on a weighing balance. Humerus length was determined by using an osteometric board. Mid-Shaft Circumference was assessed using a millimeter graph paper at the level of the apex of the deltoid V. All the dimensions were recorded in Microsoft excel sheet and were quantified. All the results were recorded and analysed using SPSS software.

RESULTS

Among the males, mean weight of left and right humerus was 118.3 grams and 117.2 grams. Mean length of left and right Humerus was 32.91 cm and 32.83 cm respectively.Mean mid-shaft circumference of left and right Humerus was 5.95 cm and 5.72 cm respectively. Among the females, mean weight of left and right humerus was 103.5 grams and 103.1 grams. Mean length of left and right Humerus was 31.12 cm and 30.99 cm respectively.Mean mid-shaft circumference of left and right Humerus was 5.62 cm and 5.49 cm respectively. Bilateral asymmetry was higher among males in comparison to females.

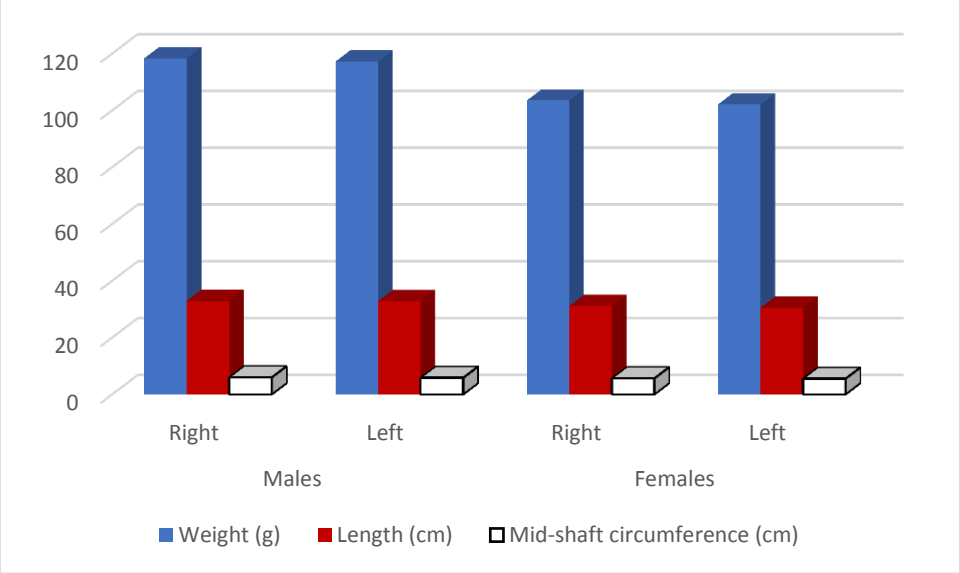
Table 1: Anthropometric data of humerus of males

Variable	Weight (g)	Length (cm)	Mid-shaft circumference (cm)
Right	118.3	32.91	5.95
Left	117.2	32.83	5.72

Table 1: Anthropometric data of humerus of males and females

Variable	Weight (g)	Length (cm)	Mid-shaft circumference (cm)
Right	103.5	31.12	5.62
Left	103.1	30.99	5.49

Graph 1: Anthropometric data of humerus of males and females



DISCUSSION

The shoulder is structurally and functionally complex as it is one of the most freely moveable areas in the human body due to the articulation at the glenohumeral joint. It contains the shoulder girdle, which connects the upper limb to the axial skeleton via the sternoclavicular joint. The high range of motion of the shoulder comes at the expense of decreased stability of the joint, and it is prone to dislocation and injury. The blood supply of the humeral head is complex and highly variable. The variations of the anterior circumflex humeral artery and its branches as well as its relationship to the long head of biceps tendon should be considered in pre- surgical planning. Humans demonstrate species-wide bilateral asymmetry in long bone dimensions. Previous studies have documented greater right-biases in upper limb bone dimensions--especially in length and diaphyseal breadth--as well as more asymmetry in the upper limb when compared with the lower limb.[8- 11]

Among the males, mean weight of left and right humerus was 118.3 grams and 117.2 grams. Mean length of left and right Humerus was 32.91 cm and 32.83 cm respectively.Mean mid-shaft circumference of left and right Humerus was 5.95 cm and 5.72 cm respectively. In a similar study conducted by Auerbach BM et al, authors re-examined geographically and temporally diverse sample of 780 Holocene adult humans. Fourteen bilateral measures were taken, including maximum lengths, articular and peri-articular breadths, and diaphyseal breadths of the femur, tibia, humerus, and radius. Dimensions were converted into percentage directional (%DA) and absolute (%AA) asymmetries. Results reveal that average diaphyseal breadths in both the upper and lower limbs have the greatest absolute and directional asymmetry among all populations, with lower asymmetry evident in maximum lengths or articular dimensions. Upper limb bones demonstrate a systematic right-bias in all dimensions, while lower limb elements have biases closer to zero %DA, but with slight left-bias in diaphyseal breadths and femoral length. Crossed symmetry exists within individuals between similar dimensions of the upper and lower limbs. Females have more asymmetric and right-biased upper limb maximum lengths, while males have greater humeral diaphyseal and head breadth %DAs.[11]

Among the females, mean weight of left and right humerus was 103.5 grams and 103.1 grams. Mean length of left and right Humerus was 31.12 cm and 30.99 cm respectively.Mean mid-shaft circumference of left and right Humerus was 5.62 cm and 5.49 cm respectively. Bilateral asymmetry was higher among males in comparison to females. Ruff et al observed (in the Denver Growth Sample) that rapid changes in femoral/humeral diaphyseal strength occurred shortly after walking commenced. Conversely, length proportions did not change with the initiation of walking. Therefore, changes in asymmetry throughout growth suggest that while this trait may be based to some extent on biomechanical modifications, the relationship between mechanical stimuli and asymmetry is not straightforward.[12] Lieverse et al reported an adult male skeleton with severe bilateral upper extremity asymmetry, designated Shamanka II 29.1, from the early Neolithic cemetery of Shamanka II on the south coast of Lake Baikal, Siberia, Russia. The most striking asymmetry was between the bilateral humerus, ranging from 11.7% to 89.5%.[13] Kubicka AM et al, in another study, assessed the level of directional asymmetry of humeral cross sections in Neandertals, recent Australian aborigines, and medieval farmers. Indices of directional and absolute asymmetry (%DA and %AA) of humeral cross-sectional properties were calculated. The medieval farmers were characterized by significant %DA and %AA for polar second moment of area (J), ratio of maximum to minimum second moments of area, and ratio of antero-posterior to medio-lateral bending strength. In Australian aborigines, only J in males shows significant %DA and %AA, while Neandertals exhibit no significant asymmetry of any cross-sectional properties. Differences in cross-sectional shape between sides of the body were established in all three

analyzed groups. High levels of directional asymmetry of cross-sectional shape and properties in medieval farmers may be caused by the performance of more physically demanding tasks using one side of the body from an early age in that population.[14]

CONCLUSION

Bilateral asymmetries do exist in the humerus with more asymmetry observed in the male compared with the female.

REFERENCES

1. Capo JT, Criner KT, Shamian B. Exposures of the humerus for fracture fixation. Hand Clin. 2014 Nov;30(4):401-14, v.
2. Paryavi E, Pensy RA, Higgins TF, Chia B, Eglseder WA. Salvage of upper extremities with humeral fracture and associated brachial artery injury. Injury. 2014 Dec;45(12):1870-5.
3. Samart S, Apivatgaroon A, Lakchayapakorn K, Chemchujit B. The correlation between acromion-axillary nerve distance and upper arm length; a cadaveric study. J Med Assoc Thai. 2014 Aug;97 Suppl 8:S27-33.
4. Martinez-Huedo MA, Jiménez-García R, Mora-Zamorano E, Hernández-Barrera V, Villanueva-Martinez M, Lopez-de-Andres A. Trends in incidence of proximal humerus fractures, surgical procedures and outcomes among elderly hospitalized patients with and without type 2 diabetes in Spain (2001-2013). BMC Musculoskelet Disord. 2017 Dec 11;18(1):522.
5. Schmidt CC, Jarrett CD, Brown BT. Management of rotator cuff tears. J Hand Surg Am. 2015 Feb;40(2):399-408.
6. Maruvada S, Madrazo-Ibarra A, Varacallo M. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Mar 31, 2022. Anatomy, Rotator Cuff.
7. Abrams R, Akbarnia H. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Jun 20, 2022. Shoulder Dislocations Overview.
8. Haeberle HS, Navarro SM, Power EJ, Schickendantz MS, Farrow LD, Ramkumar PN. Prevalence and Epidemiology of Injuries Among Elite Cyclists in the Tour de France. Orthop J Sports Med. 2018 Sep;6(9):2325967118793392.
9. Willeumier JJ, van de Sande MAJ, van der Wal RJP, Dijkstra PDS. Trends in the surgical treatment of pathological fractures of the long bones: based on a questionnaire among members of the Dutch Orthopaedic Society and the European Musculo-Skeletal Oncology Society (EMSOS). Bone Joint J. 2018 Oct;100-B(10):1392-1398.
10. Tashjian RZ. Epidemiology, natural history, and indications for treatment of rotator cuff tears. Clin Sports Med. 2012 Oct;31(4):589-604. [PubMed]
11. Auerbach BM, Ruff CB. Limb bone bilateral asymmetry: variability and commonality among modern humans. J Hum Evol. 2006 Feb;50(2):203-18.
12. Ruff CB. 2003. Ontogenetic adaptation to bipedalism: age changes in femoral to humeral length and strength proportions in humans, with a comparison to baboons. J Hum Evol 45:317–349
13. Lieverse A. R., Metcalf M. A., Bazaliiskii V. I., Weber A. W. Pronounced bilateral asymmetry of the complete upper extremity: a case from the early Neolithic Baikal, Siberia. International Journal of Osteoarchaeology . 2008;18(3):219–239.
14. Kubicka AM, Nowaczewska W, Balzeau A, Piontek J. Bilateral asymmetry of the humerus in Neandertals, Australian aborigines and medieval humans. Am J Phys Anthropol. 2018 Sep;167(1):46-60.