



Original Article

Morphometric Analysis of Talus Bone in Indian Adults: A Radiological Cross – sectional study

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ABSTRACT

Background:

The talus is an important bone of the ankle joint that plays a crucial role in weight transmission and ankle biomechanics. Knowledge of its morphometric dimensions is important for understanding anatomical variations and may have clinical relevance in the assessment and management of ankle disorders and in the planning of reconstructive and orthopedic procedures. Computed tomography (CT) provides accurate radiological visualization of the talus and allows reliable assessment of its dimensions.

Aim:

To analyze and record the morphometric dimensions of the talus using computed tomography (CT) imaging

Materials and Methods:

A cross-sectional observational study was conducted among 84 Indian adults aged 20–60 years, comprising 42 males and 42 females. Participants with normal or mild osteoarthritis of the ankle who were willing to undergo CT examination and provide informed consent were included. Individuals younger than 20 years or older than 60 years and those with severe ankle disorders, pregnancy, metal implants, previous ankle surgery, or severe medical conditions were excluded. CT scans were used to assess the morphometric dimensions of the talus. The parameters included talus length, measured from the posterior to anterior aspect; talus width, measured from the medial to lateral aspect; and talus height, measured from the superior to inferior aspect. These measurements were compared according to sex.

Results

A total of 84 participants (42 males and 42 females) were included in the study. The mean talar length, width, and height were greater in males than in females on both the right and left sides. Mean talar length was 54.08 mm and 54.04 mm in males compared with 51.02 mm and 52.06 mm in females on the right and left sides, respectively. Mean talar width was 43.01 mm and 41.05 mm in males compared with 37.08 mm and 36.98 mm in females, while mean talar height was 25.79 mm and 25.88 mm in males compared with 24.55 mm and 24.85 mm on the right and left sides, respectively.

Conclusion

The findings indicate that talar morphometric dimensions were greater in males than in females on both sides. These findings suggest that sex may influence talar dimensions and that CT-based talar morphometry may be useful for understanding anatomical variation in Indian adults.

Keywords: Morphometry; Reconstructive; Orthopedic; Radiological

INTRODUCTION

The talus is a tarsal bone that forms an important mechanical link between the leg and the foot. It articulates superiorly with the tibia and fibula to contribute to the ankle joint, inferiorly with the calcaneus, and anteriorly with the navicular, thereby participating in the formation of the talocrural, subtalar, and talonavicular joints. The morphology of the talus has an important influence on foot biomechanics and locomotion. Approximately 70% of the surface of the talus is covered by articular cartilage with no direct muscular or tendinous attachments. So, assessment of its morphology is important in the evaluation and management of talar fractures, dislocations, degenerative changes, and other disorders of the ankle and hindfoot. [1,2]

Morphometric assessment of the talus provides quantitative information regarding its size and structural characteristics. Commonly evaluated dimensions include talar length, width, and height, together with measurements of the trochlea, talar head, neck, and articular surfaces.

Such measurements have been used to describe population-specific anatomical variation and to investigate differences related to sex and other biological characteristics.

Sexual dimorphism is an important characteristic of human skeletal morphology. Previous morphometric studies have demonstrated that talar dimensions are generally greater in males than in females, although the magnitude and pattern of sexual dimorphism may vary among populations [3-6]. The population-specific data are important because skeletal dimensions and the accuracy of sex-estimation equations may vary between populations.

Although traditional osteometric studies based on dry bones and cadaveric studies have provided valuable information, but the measurements obtained cannot always be directly generalized to living populations. Consequently, radiological methods provide an opportunity to investigate skeletal morphology in living subjects and to obtain standardized measurements without requiring skeletal dissection. Computed tomography (CT) has multiplanar images which allow visualization of the complex three-dimensional anatomy of the bone. CT datasets can also be reconstructed into three-dimensional models, allowing quantitative assessment of talar dimensions and articular morphology. Compared with conventional radiographs, CT-based three-dimensional reconstruction reduces the influence of projection and positioning and provides more detailed information regarding the spatial morphology of the talus. [1,2]

Three-dimensional geometric morphometric analysis has further demonstrated that talar morphology varies according to sex and age [2]. Such findings indicate that talar morphology is not uniform across individuals and support the need to investigate variation in relation to biological and anthropometric characteristics.

Despite the growing application of radiological and three-dimensional techniques, there is limited CT-based information on simple linear dimensions of the talus-specifically length, width, and height-in contemporary Indian adults, together with assessment of their relationships with age, body height and body weight. Establishing such population-specific data may improve understanding of normal talar variation and provide reference values for anatomical, radiological, orthopaedic, and anthropological applications.

Therefore, the present study was undertaken to evaluate the morphometric dimensions of the right and left talus using computed tomography in Indian adults and to compare talar length, width, and height between males and females. The study also aimed to assess the relationship of these talar dimensions with age, body height and body weight.

MATERIALS AND METHODS STUDY DESIGN

A cross-sectional radiological study

Study Setting

The study was conducted in the Department of Anatomy, Faculty of Allied Health Sciences, Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India. Images were recruited from the department of Orthopedic and Radiology in Santosh Hospital

Study Sample

The study included 84 radiological images of talus bone of Indian adults out of which 42 were males and 42 were females

Inclusion Criteria

Participants were included if they meet all of the following:

1. Adults aged 20–60 years.
2. Both male and female participants.
3. Individuals undergoing CT examination in whom the talus is adequately visualized bilaterally.
4. CT images of sufficient quality to permit accurate measurement of talar length, width, and height.
5. Participants willing to provide relevant anthropometric information, including age, height, and weight.

6. Participants who provide informed consent for inclusion in the study, where required by the study protocol.

Exclusion Criteria

Excluded participants with:

1. Previous fracture, deformity, or major trauma involving either talus.
2. Previous surgery involving the ankle, hindfoot, or talus.
3. Congenital or developmental abnormalities of the talus or ankle.
4. Radiological evidence of significant pathology or structural destruction of the talus.
5. Severe osteoarthritis or other conditions causing substantial alteration of normal talar morphology.
6. CT images with poor image quality, artifacts, or inadequate visualization of the talus.
7. Individuals outside the predefined age range of 20–60 years.
8. Participants for whom required anthropometric information is unavailable

Variables measured independent variables

1. Sex of individual (Male/Female)

Dependent variables

1. Talus Length, measured from the posterior to anterior aspect
2. Talus width, measured from the medial to lateral aspect
3. Talus height, measured from the superior to inferior aspect

Methodology

A cross-sectional observational study was conducted among 84 adults aged 20–60 years, comprising 42 males and 42 females. Eligible participants were selected according to the predefined inclusion and exclusion criteria.

CT images of the ankle/foot region were obtained from eligible participants. The CT datasets were reviewed for adequate visualization of the right and left talus. (Figure 1). The CT images were analyzed to obtain morphometric measurements of the right and left talus. The measurements included maximum talar length (Figure 2), maximum talar width, and maximum talar height (Figure 3), expressed in millimeters (mm). Measurements were obtained using the CT image dataset/appropriate measurement software according to standardized anatomical landmarks.

The measurements were recorded separately for the right and left talus. The obtained morphometric measurements were subsequently compared between male and female participants.

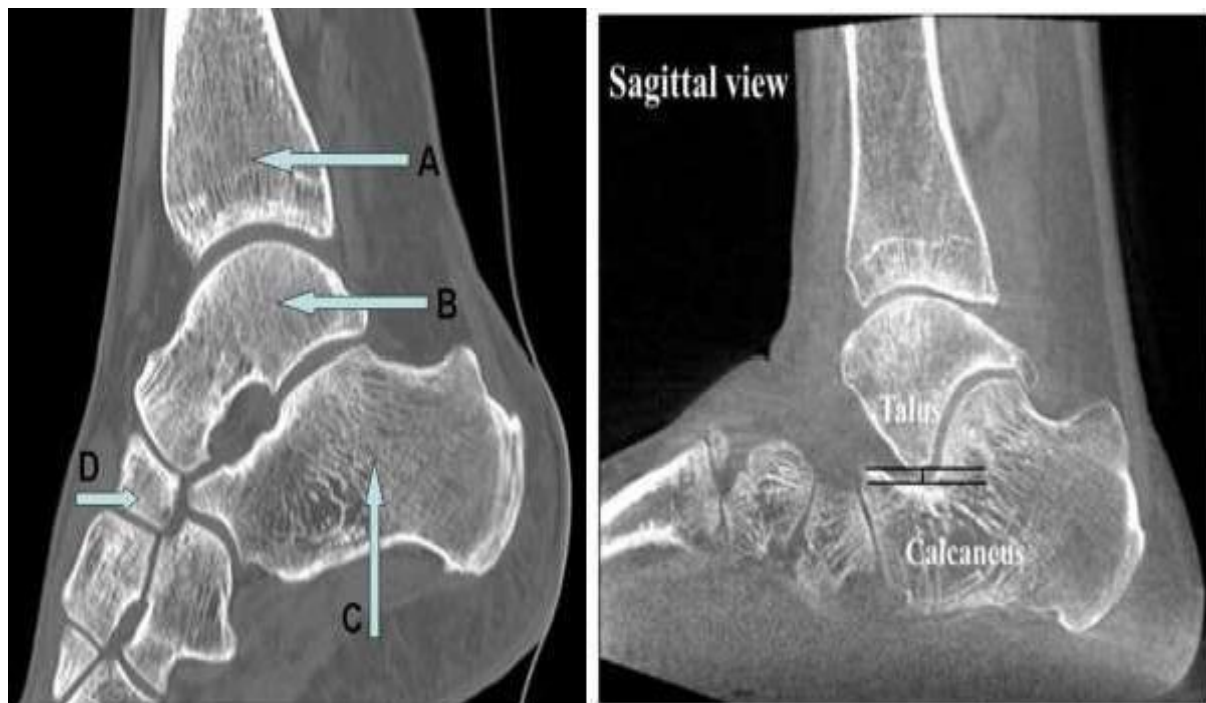


Figure 1,2. Sagittal Computed tomography image demonstrating the anatomical relationships of the tibia (A), talus (B), calcaneus (C), and navicular (D).



Figure 3. Computed tomography (CT) images demonstrating the talus in three- dimensional reconstruction (A), sagittal section (B1), coronal section (B2), and axial section (C).

Statistical Analysis

Continuous variables were expressed as mean values. The mean talar length, width, and height were compared between male and female participants. The data is expressed in the form of mean values and Bar graph

Ethical Considerations

The study was approved by the Institutional Ethics Committee of Santosh Deemed to be University before commencement of the research. The study involved analysis of CT images and relevant demographic and anthropometric data of eligible participants. Patient confidentiality and anonymity were maintained throughout the study, and all data were used solely for research purposes.

RESULT

The mean talar length, width, and height were greater in males than in females on both the right and left sides. Mean talar length was 54.08 mm and 54.04 mm in males compared with 51.02 mm and 52.06 mm in females on the right and left sides, respectively (Figure 4). Mean talar width was 43.01 mm and 41.05 mm in males compared with 37.08 mm and 36.98 mm in females (Figure 5), while mean talar height was 25.79 mm and 25.88 mm in males compared with 24.55 mm and 24.85 mm on the right and left sides, respectively. (Table 1) (Figure 6)

Table 1- Comparison of talus morphometric dimensions between males (n=42) and females (n=42)

Talus parameter	Male Right	Female Right	Male Left	Female Left
Length (mm)	54.08	51.02	54.04	52.06
Width (mm)	43.01	37.08	41.05	36.98
Height (mm)	25.79	24.55	25.88	24.85

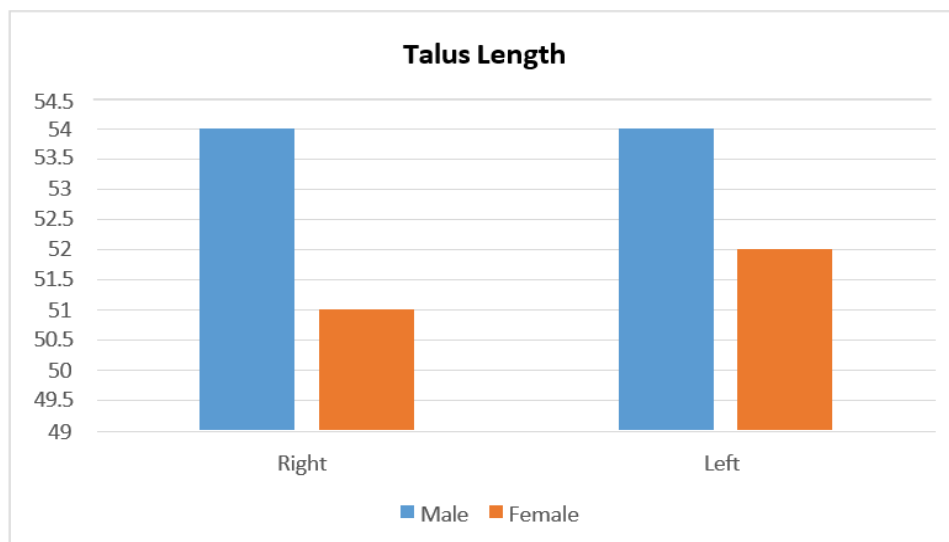


Figure 4- Comparison of mean talar length between males and females

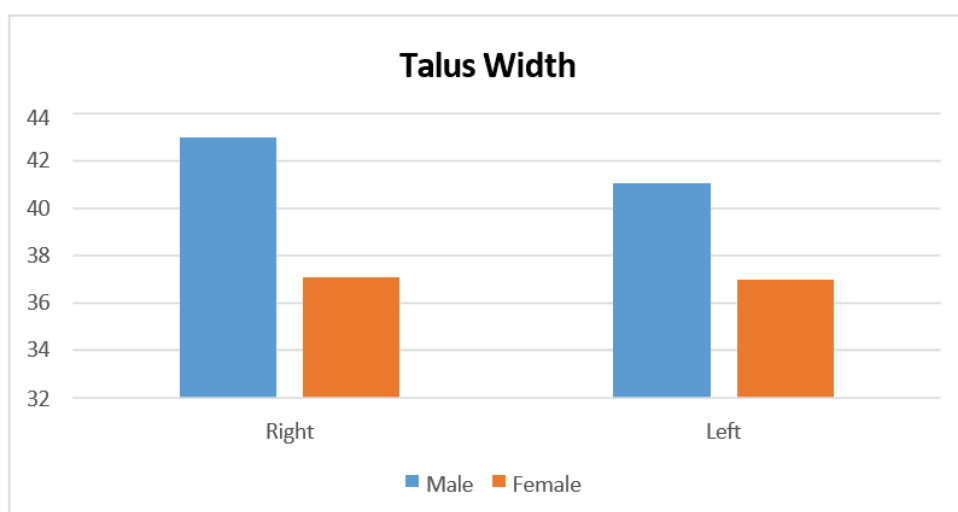


Figure 5- Comparison of mean talar width between males and females

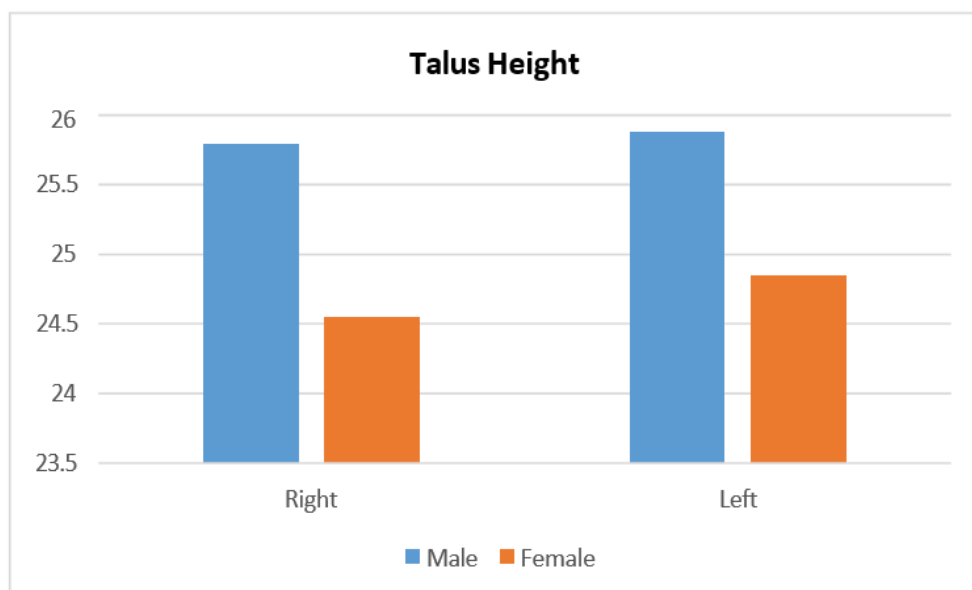


Figure 6- Comparison of mean talar height between males and females

DISCUSSION

The present study evaluated the morphometric dimensions of the talus using computed tomography in 84 adult participants,

comprising 42 males and 42 females. The principal finding was that the mean talar dimensions—length, width, and height—were greater in males than in females on both the right and left sides. This overall pattern is consistent with previous morphometric investigations demonstrating sexual dimorphism in talar size. He et al., using three-dimensional CT-based models in healthy Chinese volunteers, reported significantly larger talar dimensions in males than females, including measurements of talar length, width, and height [1]. Similarly, Sadanandam and Gangam, in an Indian population, reported higher mean values for talar length, width, and height in males compared with females on both sides [7].

The present results also demonstrate relatively similar measurements between the right and left sides, although small numerical differences were observed. For example, male talar length was 54.08 mm on the right and 54.04 mm on the left, while female talar length was 51.02 mm and 52.06 mm, respectively. Similar bilateral comparisons have been investigated in previous studies. Angthong et al., using matched cadaveric tali and three-dimensional scanning, reported significant side-to-side differences for some specific talar features, including talar dome height and certain trochlear width [8]. These findings suggest that bilateral symmetry may vary according to the particular talar dimension and measurement technique used.

The findings also have potential forensic and clinical relevance. The talus is a relatively well-preserved bone and has been investigated for sex estimation and biological identification. CT-based three-dimensional assessment allows multiple dimensions to be obtained without physically manipulating the bone and can provide reproducible anatomical reference measurements. Liu et al. demonstrated that three-dimensional talar measurements could be used in discriminant analyses for sex determination, with length-related variables showing particularly useful discriminatory performance [9]. In addition, CT morphometry has been investigated for forensic identification using talar volume and density-related parameters [10]. However, the study has limitations. The sample size was small, and the study population may not represent the entire Indian population. In addition, only three basic morphometric parameters—length, width, and height—were assessed. Other potentially informative variables, such as talar neck dimensions, trochlear measurements, articular surface dimensions, and talar volume, were not included. Future studies involving larger Indian populations and additional three-dimensional parameters could provide more comprehensive population-specific reference values.

CONCLUSION

The present CT-based study demonstrated differences in talar morphometry between males and females. Mean talar length, width, and height were greater in males than in females on both the right and left sides. The findings support the presence of sexual size dimorphism in the talus. CT-based assessment of talar dimensions may have potential applications in anatomical reference development, forensic sex estimation, and clinical planning involving the talus. However, the findings should be interpreted within the context of the study population and measurement methodology, and larger studies involving diverse Indian populations are warranted to establish robust population-specific reference standards.

REFERENCES

1. He JQ, Ma XL, Zhang X, Xin JY, Li N. Three-dimensional computer-assisted modeling of talus morphology in Chinese patients. *Orthop Surg.* 2016;8(3):383-392. Doi:10.1111/os.12258
2. Nozaki S, Watanabe K, Kamiya T, Katayose M, Ogiwara N. Morphological variations of the human talus investigated using three-dimensional geometric morphometrics. *Clin Anat.* 2021;34(4):536-543. Doi:10.1002/ca.23588.
3. Agnihotri G, Kaur S. A quantitative perspective on dimorphic profile of talus in North Indians. *Int J Anat Res.* 2016;4(4):3105-3110. Doi:10.16965/ijar.2016.413.
4. Dagar T, Sharma L, Khanna K. Sexual dimorphism: metric measurements-based study in human talus bone. *Int J Res Med Sci.* 2019;7(8):3070-3076. Doi:10.18203/2320- 6012.ijrms20193397.
5. Javia MM, Patel MM, Kubavat DM, Dixit D, Singel TC. Morphometry of the talus on the basis of sexual dimorphism. *Indian J Res.* 2013;3(5):208-212.
6. Lee UY, Han SH, Park DK, Kim YS, Kim DI, Chung IH, et al. Sex determination from the talus of Koreans by discriminant function analysis. *J Forensic Sci.* 2012;57(1):166-171. Doi:10.1111/j.1556-4029.2011.01914.x.
7. Sadanandam SS, Gangam RR. Determination of sex from the talus of Indian population using morphometrical analysis. *Int J Pharm Bio Sci.* 2016;7(4):B732- B739.
8. Angthong C, Rajbhandari P, Veljkovic A, Piyaphanee A, Stufkens SAS, Wibowo R. Morphometric geometric differences between right and left human tali: a cadaveric study of fluctuating asymmetry via systematic measurement and three-dimensional scanning. *PLoS One.* 2020;15(4):e0232012. Doi:10.1371/journal.pone.0232012.
9. Liu Y, Han Q, Yin W, Wang C, Chen B, Wu N, et al. Sex determination from talus in Chinese population by three-dimensional measurement approach. *Leg Med (Tokyo).* 2020;44:101647. Doi:10.1016/j.legalmed.2019.101647.
10. Inamori-Kawamoto O, Ishikawa T, Michiue T, Mustafa AMH, Sogawa N, Kanou T, et al. Possible application of CT morphometry of the calcaneus and talus in forensic anthropological identification. *Int J Legal Med.* 2016;130(2):575-585. Doi:10.1007/s00414-015-1258-3.