

Study of Sexual Dimorphism by Bone Length, Width and Height Estimation in Left Talus

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Abstract

Introduction: Morphometric measurement of maximum anteroposterior length, maximum transverse width, talar height of talus are helpful for reconstruction and rehabilitation procedures, for identifying joint pathologies and help surgeons to plan preoperatively to design accurate talus bone prosthesis and talar implant. The morphometric data of talus can be used to prepare a database that can be used as landmarks for clinical exploration and research. Talus is an important bone for sex determination.

Methods: A cross sectional analytical study was carried out in the Department of Anatomy, Dhaka Medical College, Dhaka from January, 2018 to December, 2018. Maximum anteroposterior length, maximum transverse width, talar height were measured on 150 fully ossified dry human left talus by digital slide calipers.

Results: Mean (\pm SD) of maximum anteroposterior length (MAPL), maximum transverse width (MTW) and talar height (TH) was significantly higher ($p < 0.001$) in male than in female.

Conclusion: Significant morphometric difference exists between male and female tali. The maximum anteroposterior length, maximum transverse width and height of talus were significantly higher in male than in female.

Key words: Length of talus, Width of talus, Height of talus

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Introduction:

The talus is one of the seven tarsal bones in human body and it is the link between the foot and the leg through the ankle joint.¹ The talus has a body, a neck and a head. The superior surface or trochlea of talus is gripped by two malleoli and receives the weight of the body from tibia. It transmits weight in turn dividing the weight between calcaneus on which the talar body rests and the forefoot via an osseoligamentous 'hammock' (spring ligament) that receives the rounded and anteromedially directed talar head.²

Tibio-fibular mortice receives superior, medial and lateral articular surfaces of the body of talus. These articular surfaces have applications in designing ankle braces to ankle implants and in total ankle replacements.³

Accurate estimation and derivations of metric features can be obtained straight forwardly from talus, since this bone is compact and more durable. Even for designing and fabrication of prosthesis data of normal dimensions of talus is needed. Therefore the present study is taken up to have a baseline data regarding the dimensions of talus. As the talus is resisting degeneration for a long time unlike other bones the present study was undertaken to study talus for various morphological features.⁴

Talus is an important bone for sex determination. Peckmann et al⁵ described that nine parameters of talus were sexually dimorphic. They were talar length, breadth and height, trochlear length and breadth, head-neck length, head height, posterior articular surface length and breadth. The accuracies for sex determination using parameters of talus were 80% to 81.7% in White South Africans stated by Bidmos and Dayal⁶, 80% to 85.8% in Black South Africans by Bidmos and Dayal⁷ and 67.1% - 82.9% for Korean in Lee et al.⁸

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Methods:

One hundred and fifty (150) fully ossified dry human left talus of unknown sexes were collected from Dhaka Medical College, Dhaka and Northern Medical College, Dhaka. Broken or incomplete bone, congenitally deformed bone were excluded from the study. Digital slide caliper and digital camera were used for the measurements. Sexes of the collected tali were determined by stepwise discriminant function analysis technique and grouped into male and female. Maximum anteroposterior length (MAPL) was measured by the linear distance between the most anterior point on the head and the most posterior point on the body of the talus.⁸ Maximum transverse width (MTW) was measured by the linear distance between the most medial and the most lateral points on the body.⁸ Talar height (TH) was measured as the distance between horizontal plane with the bone base and the highest point on the superior surface of the trochlea.⁹ Maximum anteroposterior length of talus [MAPL], Maximum transverse width of talus [MTW] and Talar height [TH] were measured three times, then the average value of each variable was taken and recorded in millimeter.

The study was approved by the Ethical Review Committee of Dhaka Medical College, Dhaka.

Results:

The present study was conducted on 150 fully ossified human left talus. Out of 150 left tali, 83 were male and 67 were female. After collection of data, statistical analysis was done by the software SPSS (Statistical Package for Social Sciences) for Windows, Version 22.0.

The mean \pm SD of maximum anteroposterior length was 54.9 ± 2.2 mm with the range of 51.2 to 62.6 mm in male and 49.0 ± 2.5 mm with the range of 43.5 to 53.8 mm in female. Mean maximum anteroposterior length was significantly higher ($p < 0.001$) in male than female (Table I). The mean \pm SD of maximum transverse width was 39.8 ± 1.2 mm with the range of 36.8 to 44.2 mm in male and 35.5 ± 1.9 mm with the range of 30.9 to 38.5 mm in female. Mean maximum transverse width was significantly higher ($p < 0.001$) in male than female (Table I). The mean \pm SD of maximum talar height was 30.9 ± 1.5 mm with the range of 28.1 to 36.9 mm in male and 27.4 ± 2.3 mm with the range of 22.4 to 32.4 mm in female. Mean maximum talar height was significantly higher ($p < 0.001$) in male than female (Table I).

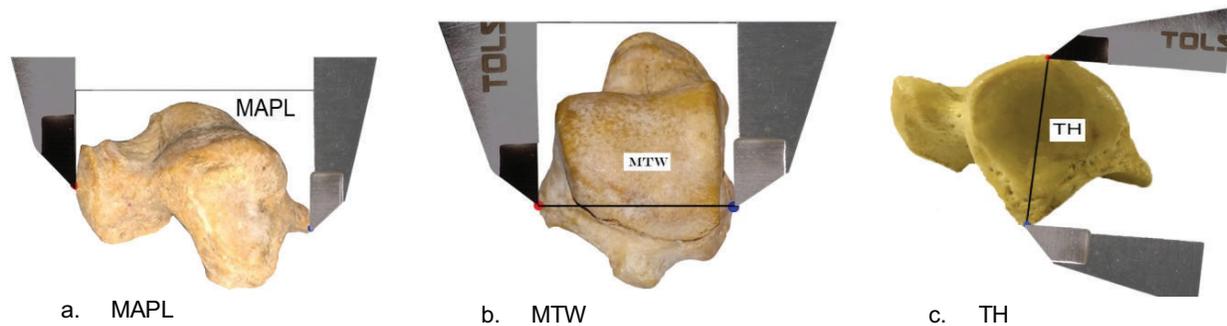


Fig.- 1: a) measurement of maximum anteroposterior length of talus b) measurement of maximum transverse width of talus c) measurement of talar height

Table I

Maximum anteroposterior length, maximum transverse width and talar height in male and female

| Variables | Male (n=83) | Female (n=67) | p value |
|--|---------------------------------|---------------------------------|-----------|
| | Mean \pm SD | Mean \pm SD | |
| Maximum anteroposterior length of talus (mm) | 54.9 ± 2.2 (51.2 - 62.6) | 49.0 ± 2.5 (43.5 - 53.8) | <0.001*** |
| Maximum transverse width of talus (mm) | 39.8 ± 1.2 (36.8 - 44.2) | 35.5 ± 1.9 (30.9 - 38.5) | <0.001*** |
| Talar height (mm) | 30.9 ± 1.5 (28.1 - 36.9) | 27.4 ± 2.3 (22.4 - 32.4) | <0.001*** |

Figures in parentheses indicate range. SD = Standard Deviation.

Comparison of values between male and female was done by Unpaired Student's 't' test

***= significant at $p < 0.001$ n= sample size

Discussion:

Findings of the present study were significantly higher ($p < 0.001$) in male than in female. This might be due to stronger and bigger male bones than that of female bones. Men are usually involved in most physical activities and exercises that improve and maintain the growth of bone. Other factors that affect bone growth are: genetic and environmental factors such as dietary pattern and occupation together with hormonal factors like growth hormones, testosterone for male and estrogens for female.¹⁰

In the present study the mean (\pm SD) of maximum anteroposterior length, maximum transverse width and talar height of left talus were similar ($p < 0.001$) with the findings of Peckmann, et al⁵ who carried out a study on Spanish population, Bidmos and Dayal on South African White⁶ & Black population⁷, Lee, et al⁸ on Korean people, Abd-elaleem, et al¹¹ on Egyptian population, Gualdi-Russo¹² on Italian people, Javia, et al¹³ on Indian population. They all found higher values in male than in female ($p < 0.001$).

Conclusion:

The present study was an attempt to construct data on different dimensions of fully ossified dry human left talus. Significant morphometric differences exist between male and female tali. The maximum anteroposterior length, maximum transverse width and talar height were found significantly higher in male than female ($p < 0.001$). This may contribute to the understanding of the relative status of male and female talus in the context of morphometric variations around the world.

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