

A Morphometric Study of Bilateral Symmetry of the Human Talus

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Abstract: ***Introduction:** The Talus is the second largest tarsal bone and has a unique structure designed to channel and distribute body weight. Morphometric data of the human tali will be helpful to surgeons for surgical interventions during the treatment of talar neck fractures caused by trauma, in designing talar body prostheses, and in aligning the bones in the treatment of congenital talipes equinovarus (CTEV) or club foot. **Materials and Method:** The study conducted on 250 (125 right, 125 left) dry human tali of unknown sex and race. Morphometric analysis of talus included Talar Length, Talar Height, Talar Width measured with digital vernier callipers. Range, Mean, standard Deviation, p values were calculated. **Results:** In this present p values of all parameters do not showing any significant side difference and hypothesized that the left and right talus bones would be symmetrical to a high degree.*

Keywords: Talus, morphometry, talar length, talar height, talar width

1. Introduction

The human foot is a highly developed biomechanically complex structure that serves to bear the weight of the body. The Talus is the second largest tarsal bone and has a unique structure designed to channel and distribute body weight. Talus is the link between the foot and the leg through ankle joint and keystone of the medial longitudinal arch of foot.² The word talus is derived from the Latin word **Taxillus** which refers to ankle bone of a horse. These bones were used as playing dice by Roman soldiers.³ Approximately 60% of its surface is covered by articular cartilage and there are no muscular or tendinous attachments to this bone. Variations in talar anatomy can be of help for reconstruction and rehabilitation of foot. The talus is a good example of plasticity exhibited by bones in response to mechanical requirements of new functions, which are imposed on it, as the talus encounters several differential forces during locomotion. The stress patterns across the talus influence its overall dimensions and articular surface areas.¹ Bilateral symmetry is an ubiquitous concept, frequently used in morphometric studies of biological structures. Left-right symmetry analysis of bones is important for implant design, mechanical testing, and for using the contralateral bone as a control.⁴ The adequate knowledge of anatomy of talus is significant not only to anatomists but also to the operating surgeons as fractures of the talus are quite common and lead to avascular necrosis, arthritis and when unrecognized to chronic pain and non union. In spite of being such an important bone to anatomist, orthopedic surgeon and to the anthropologist scanty literature is available on its dimension and morphological features.

2. Materials and Method

For this study 250 dry human tali were collected from Osmania medical college, Deccan Institute of medical sciences, Kamineni institute of medical sciences in Hyderabad. Only undamaged, fully ossified, adult tali of unknown sex, race and age were taken. Tali separated into right and left. Each tali labelled and all measurements were recorded using digital vernier calipers.

The following parameters of each talus taken for study:

- 1) Maximum AnteroPosterior Length (MAPL): It is the linear distance between the most anterior point on the head and most posterior point on the body of the talus.
- 2) Maximum Transverse Width (MTW): It is the linear distance between the most medial and most lateral points on the body of the talus
- 3) Maximum Vertical Height (MVH): It is the maximum distance between the most superior and inferior points on the body of the talus

3. Observations and Results

In this present study range of MAPL of right side is 4.35 cm. to 6.31 cm. and left side is 4.35 cm to 6.52 cm. Mean value of MAPL of right side is 5.346 cm. And left side is 5.336 cm. Median of MAPL of right side is 5.34cm. And left side is 5.27 cm. Standard Deviation of right side is 0.4180 cm. And left side is 0.4811 cm. t value is 0.0701 and p value is 0.9441 which is not significant. According to above values, this study showing that there is no significant difference between MAPL of right and left tali.

In this present study range of MTW of right side is 2.81 cm. to 4.88 cm and left side is 2.93 cm to 4.58 cm. Mean value of MTW of right side is 3.836 cm. And left side is 3.807 cm. Median of MTW of right side is 3.836cm. And left side is 3.782cm. Standard Deviation of right side is 0.3668cm. And left side is 0.3398 cm. t value is 0.6551 and p value is 0.5130 which is not significant. According to above values, this study showing that there is no significant difference between MTW of right and left tali.

In this present study range of MVH of right side is 2.19 cm. to 4.08 cm. and left side is 2.34 cm to 3.85 cm. Mean value of MVH of right side is 2.881 cm. And left side is 2.887 cm. Median of MVH of right side is 2.852 cm. And left side is 2.845 cm. Standard Deviation of right side is 0.3175 cm. And left side is 0.3087 cm. t value is 0.1640 and p value is 0.8698 which is not significant. According to above values,

this study showing that there is no significant difference between MVH of right and left tali.

4. Discussion

According to **Ilknur Ali and Ilker Mustafa Kafa (2009)**⁵, the mean value of MAPL was 5.72cm for right side and 5.64 cm for left side, the mean value of MTW was 4.91 cm on right side and 4.69 cm on left side. According to **Ilhan Otag et al (2013)**⁶ study, the mean value of MAPL was 5.59 cm on right side and 5.65 cm on the left side. Standard deviation was 0.307 on right side and 0.365 on the left side and p value was less than 0.01 which was not significant, the mean value of MTW was 4.07cm on right side and 4.33 cm on the left side. Standard deviation was 0.474 on right side and 0.287 on the left side and p value was not less than 0.05 which was significant, the mean value of MVH was 3.14 cm on right side and 3.21 cm on the left side. Standard deviation was 0.208 on right side and 0.234 on the left side and p value was less than 0.05 which was not significant. According to **Saif Omar et al (2015)**¹ the mean value of MAPL was 5.31 cm on right side and 5.31cm on the left side. Standard deviation was 0.37 on right side and 0.34 on the left side, the mean value of MTW was 4.02 cm on right side and 4.02cm on the left side. Standard deviation was 0.24 on right side and 0.26 on the left side, the mean value of MVH was 2.93 cm on right side and 2.93 cm on the left side. Standard deviation was 0.22 on right side and 0.24 on the left side, According to **Gaurav Agnihotri et al (2016)**⁷, the mean value of MAPL was 5.76 cm on right side and 5.71 cm on the left side, and p value was 0.346 which was not significant, , the mean value of MTW was 4.06 cm on right side and 4.14 cm on the left side, and p value was 0.639 which was not significant, the mean value of MVH was 3.24 cm on right side and 3.23 cm on the left side, and p value was 0.855 which was not significant. According to **Bhanu Sudha Parimala Namburu et al (2017)**⁸, the mean value of MAPL was 5.37 cm on right side and 5.34 cm on the left side, the mean value of MTW was 3.79 cm on right side and 3.81cm on the left side, the mean value of MVH was 2.51 cm on right side and 3.0 cm on the left side.

5. Conclusion

The present study results coincided with majority of studies in other regions and it contributes to the available literature. This study concluded that p values of all parameters do not showing any significant side difference and hypothesized that the left and right talus bones would be symmetrical to a high degree.



Figure 1: Showing the method of measurement of Maximum Anteroposterior Length



Figure 2: Showing the method of measurement of Maximum transverse width



Figure 3: Showing the method of measurement of Maximum vertical height

Table 1: Measurements of Talus bone

| | SIDE | MEAN | MEDIAN | SD | P value |
|------|-------|------|--------|-------|---------|
| MAPL | RIGHT | 5.34 | 5.34 | 0.41 | 0.070 |
| | LEFT | 5.33 | 5.27 | 0.48 | |
| MTW | RIGHT | 3.83 | 3.83 | 0.366 | 0.513 |
| | LEFT | 3.83 | 3.78 | 0.339 | |
| MVH | RIGHT | 2.88 | 2.88 | 0.317 | 0.869 |
| | LEFT | 2.88 | 2.88 | 0.308 | |

Table 2: Comparison of mean values of parameters with other related studies

| | MAPL | | MTW | | MVH | |
|-------------------------|-------|------|-------|------|-------|------|
| | Right | Left | Right | Left | Right | Left |
| Ilhan Otag et al (2013) | 5.59 | 5.65 | 4.07 | 4.33 | 3.14 | 3.21 |
| Saif Omar et al(2015) | 5.31 | 5.31 | 4.02 | 4.02 | 2.93 | 2.93 |
| Gaurav Agnihotri(2016) | 5.76 | 5.71 | 4.06 | 4.14 | 3.24 | 3.24 |
| Bhanu Sudha et al(2017) | 5.37 | 5.34 | 3.79 | 3.81 | 2.51 | 3.0 |
| Present study(2018) | 5.34 | 5.34 | 3.83 | 3.83 | 2.88 | 2.88 |

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