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MORPHOMETRIC ANALYSIS OF THE HUMAN TALUS

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ABSTRACT

Due to the very unique disposition of the articular surfaces associated with the talus, the bone and its constituent components (body and the head) are oriented in specialised spatial orientation. Thus, the force subjected to the talus in load bearing not only dictates the resultant shapes and dimensions of the articular surfaces acquired by the bone, stress on the talus also probably decides the outcome of the angular orientation of the bone in conjunction with configuring the overall architecture of the bone. Different parameters for morphometry were recorded in 100 dry tali. Among these, the neck-body angle had a mean of 153.6° on the right side and 155.2° on the left side with a 't' value of 2.024 and a 'p' value of 0.046 which was significant. Statistical analysis revealed that the correlation between the parameters studied in morphometry was found to be positive and statistically highly significant. Data analysed in this study would aid to understand the morphology of the talus, its load bearing patterns and it may also help in foot prosthesis, screw placements in fractures at related areas of foot.

Key Words: Tali, Morphometry, Foot Prosthesis

INTRODUCTION

The talus is one of the seven tarsal bones. It is the link between the foot and leg, through the ankle joint. Talus is the key bone of the longitudinal arch. It is responsible for receiving the body weight and transmitting it to the plantar arch below. It is the only bone which has no muscular and tendinous attachment. The talus has three articulating surfaces.

They are : 1) Large oval surface on its most posterior aspect, articulating with sustentaculum tali of calcaneum 2) a flat surface on its anterolateral surface articulating with upper surface of calcaneum on its anteromedial surface 3) medial to the above two facets is the third facet articulating with spring ligament which is covered by articular cartilage. It is observed that the talus exhibits variations in the calcaneal articular surfaces.

A study done by Ilknur Ari and Ilker Mustafa Kafa (2009) showed that significant side differences do exist in atleast two parameters for the talus. A total of 14 bony markers were selected for the measurements.

Data were subjected to statistical analysis in order to assess the bilateral differences in the bony markers. Length of the sulcus tali and width of the sulcus tali parameters for talus bones showed statistically significant differences ($p < 0.01$). This study showed that significant side differences do exist in at least two parameters for talus and that the right sides of these bones are larger than the left sides for several parameters (the length of the sulcus tali and width of the sulcus tali parameters for tali).

The long axis of the talus is inclined anteromedially and inferiorly, its distally directed head is medial to the calcaneus and at a higher level. The long axis of the neck, inclined downwards, distally and medially, makes an angle of approximately 150° with that of the body.

The medial articular facet of the talar body and part of the trochlear surface may extend onto the neck. Koshy *et al.*, (2002) did a study on the bony parameters of talus bone from South India. In his study he found that the maximum length of the talus regressed significantly with maximum transverse width, length and width of the lateral articular surface, the length of the medial articular surface, the vertical and transverse diameters of the head, and the depth of the sulcus tali.

The present study is taken up to understand these changes further, so as to help in surgical interventions and treatments of congenital abnormalities and trauma to the talus.

Research Article

MATERIALS AND METHODS

The present study was done on dry human ossified tali of unknown sexes. 100(50 right and 50 left) tali were collected from the department of Anatomy of KVG Medical College, Sullia, K S Hegde Medical Academy, Mangalore, A J Shetty Institute of Medical Sciences, Mangalore, Father Muller's Medical College, Mangalore, Yenepoya Medical College, Mangalore and from the bone sets from medical students of MBBS phase I (2011-2012) of KVG Medical College, Sullia. Human talus which is apparently normal, free from any congenital or acquired deformity was included in the study. Deformed and unossified tali were excluded from the study. All dimensions of articular surfaces were recorded using vernier calipers. Neck-body angle was measured using a goniometer. The following parameters were recorded for the present 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. Trochlear length (TL): It is the distance between the most anterior and most posterior point over the trochlear surface.
4. Circumference of the facies articularis calcanea posterior (CFACP): It was recorded by measuring the sides of the facet using a thread, and then by measuring the length of the thread in cms.
5. Length of the sulcus tali (LST): It is the maximum distance between the two ends of the sulcus tali.
6. Width of the sulcus tali (WST): It is the distance between the edges of the sulcus tali at its maximum width.
7. Neck- body angle: It is the angle between the longitudinal axis of the neck and longitudinal axis of the body. The longitudinal axis of the neck divides the neck and is parallel with the lateral edge of the neck. The longitudinal axis of the body divides the body and is parallel with the medial border of the trochlear surface. It is measured by using two straight sticks kept parallel to the longitudinal axis of the neck and the longitudinal axis of the body, and then by measuring the angle between them using a goniometer

RESULTS AND DISCUSSION

In the present study, the following metrical variations are noted:

- a. The MAPL ranged from 4.3 cms to 6.2 cms and had a mean of 5.26 cms. Mean on the right side was 5.23 and 5.29 on the left side.
- b. The MTW ranged from 3.1 cms to 4.6 cms and had a mean of 3.74 cms. Mean on the right side was 3.79 and 3.68 on the left side.
- c. The TL ranged from 2.3 cms to 3.6 cms and had a mean of 3.05 cms. Mean on the right side was 3.06 and 3.04 on the left side.
- d. The CFACP ranged from 7.2 cms to 10.6 cms and had a mean of 8.67 cms. Mean on the right side was 8.67 and 8.67 on the left side.
- e. The LST ranged from 1.2 cms to 2.7 cms and had a mean of 2.01 cms. Mean on the right side was 2.01 and 2.04 on the left side.
- f. The WST ranged from 0.3 cms to 1.5 cms and had a mean of 0.68 cms. Mean on the right side was 0.69 and 0.68 on the left side.

Research Article

g. The neck-body angle had a mean of 153.6° on the right side and 155.2° on the left side with a 't' value of 2.024 and a 'p' value of 0.046.

Table 1: Showing comparison between the right and left tali along with standard deviation 't' and 'p' values

	Side	Number	Mean	Std.deviation	p	t
MAPL	Right	50	5.232	0.399	0.496	0.683
	Left	50	5.290	0.448	ns	
MTW	Right	50	3.794	0.352	0.091	1.705
	Left	50	3.680	0.315	ns	
TL	Right	50	3.062	0.237	0.72	0.360
	Left	50	3.044	0.263	ns	
CFACP	Right	50	8.668	0.739	1.0	0.000
	Left	50	8.668	0.775	ns	
LST	Right	50	2.012	0.298	0.598	0.529
	Left	50	2.044	0.307	ns	
WST	Right	50	0.688	0.177	0.74	0.333
	Left	50	0.676	0.184	ns	
ANGLE	Right	50	53.56	4.052	0.046	2.024
	Left	50	55.20	4.051	sig	

In the present study, the mean values of MAPL were 5.23 cms on right side and 5.29 cms on the left side. According to Ilknur Ali and Ilker Mustafa Kafa (2009), the mean values were 5.72 for right side and 5.64 for left side, which were slightly higher when compared to our study. According to Niladri Kumar Mahato (2011), it was 5.57 cms on right side and 5.58 on left side. In the present study, the mean values of MTW were 3.79 cms on right side and 3.68 cms on the left side. According to Ilknur Ali and Ilker Mustafa Kafa, the mean values were 4.91 for right side and 4.69 for left side. According to Niladri Kumar Mahato (2011), it was 2.99 cms on right side and 3.03 on left side which was almost similar to our study. According to Ilknur Ali and Ilker Mustafa Kafa (2009), the mean values for TL were 3.15 for right side and 3.08 for left side, whereas, in our study it was 3.06 for right side and 3.04 for left side which is similar. In the present study, the mean values of CFACP were 8.67 cms on both right and left side. According to Ilknur Ali and Ilker Mustafa Kafa (2009), the mean values were 10.13 for right side and 9.85 for left side which is slightly higher. In the present study, the mean values of LST were 2.01 cms on right side and 2.04 cms on the left side. According to Ilknur Ali and Ilker Mustafa Kafa (2009), the mean values were 1.76 for right side and 2.10 for left side. According to Niladri Kumar Mahato (2011), it was 2.46 and 2.42 cms for right and left side respectively. In the present study, the mean values of WST were 0.69 cms on right side and 0.68 cms on the left side. According to Ilknur Ali and Ilker Mustafa Kafa (2009), the mean values were 0.38 for right side and 0.48 for left side. According to Niladri Kumar Mahato (2011), it was 1.5 and 1.44 cms for right and left side respectively. According to Ilknur Ali and Ilker Mustafa Kafa (2009), the LST and WST parameters showed significance for side differences. According to study done by Niladri Kumar Mahato (2011), no significance was found for any of the parameters. The present study showed no significant side differences. These variations could be due to

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differences in gait or otherwise be influenced by habit. When the above parameters were correlated with each other, it showed significant inter relationship between almost all variables measured in the study. According to Ilknur Ali and Ilker Mustafa Kafa (2009), the MAPL significantly correlated with MTW, TL, and CFACP. In the present study, the neck-body angle showed a mean of 153.56° on the right side and 155.20° on the left side. It showed a p value of 0.046 which is significant. According to the study done by Niladri Kumar Mahato (2011), the superior articulating surface correlates with the neck-body angle which means that the compressive load experienced at the top of the talus tends to increase the angle.

Table 2: Showing the comparison of mean values of the parameters of right and left side with other studies

Authors	MAPL		MTW		TL		CFACP		LST		WST	
	R	L	R	L	R	L	R	L	R	L	R	L
Ilknur Ali and Ilker Mustafa Kafa	5.72	5.64	4.91	4.69	3.15	3.08	10.1	9.85	1.76	2.1	0.38	0.48
Niladri Kumar Mahato	5.57	5.58	2.9	3.03	–	–	–	–	–	–	–	–
Niladri Kumar Mahato	–	–	–	–	–	–	–	–	2.46	2.62	1.5	1.44
Present study	5.23	5.29	3.79	3.68	3.06	3.04	8.66	8.66	2.01	2.04	0.68	0.67

Conclusion

In the present study, the parameters used in morphometry showed differences in measurements when compared to the previous studies. Among these parameters, only the neck-body angle showed significant side differences. All the parameters showed inter-relationship among all variables. These variations could be due to differences in gait or be influenced by habit. From the above, it can be concluded that data analysed in this study would aid to understand the morphology of the talus, its load-bearing patterns, and it may also help in foot prosthesis, screw placements in fractures at related areas of foot.

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Research Article

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