

Exploring the Bilateral Comparisons of Articular Surfaces of Talus: An Observational Study at Tertiary Health Care Center in Pune City

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ABSTRACT

Background: The existing conclusive data show variations in the subtalar joint regarding its morphological features and articulation of bones. Inadequate studies exist on the morphometry of articular surfaces of the talus which may help in surgical interventions and development of implants and prostheses in diverse populations.

Purpose: The current study was undertaken to conduct a bilateral comparison of parameters of articulating surfaces of talus.

Material and Methods: An observational study design was carried out at one of the private medical colleges in the Pune district of Maharashtra. A total of 100 (fifty-one from right side and forty-nine left-sided tali) dry human talar bones were collected and various dimensions of articular surfaces of bones were measured by Digital Vernier Caliper and Ruler. The data analysis was performed and results were tabulated and presented graphically.

Results: There was a statistically significant difference ($p < 0.05$) in bilateral measurements of lateral articular surface height (LASH) of talar bones. The difference was not significant ($p > 0.05$) for all other parameters.

Conclusions: The study inferences can be applied as a guide and baseline information for surgical measures, inflammatory disease management, and forensic anthropologists.

KEYWORDS: Articular Surface, Bilateral, Talus, Trochlear Length.

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INTRODUCTION

The talus performs a vital role in transmitting load in weight-bearing actions, as it is the key functional connector between the leg and the foot [1]. Due to its unique and complex shape as well as its wide articular surface, it

regulates ambulation in an appropriate manner [1].

The talus is the axis of the ankle movements and a good indicator of the way of locomotion [2]. The existing literature reports variations in the subtalar joint about its

morphological features and articulation of bones [3]. The differences in the structures of the articular facets in the talus and calcaneus in the subtalar joint may impact the range of joint movements and can cause instability, laxity of ligaments, and arthritis.

The talus has seven articular surfaces and is divided into the head, neck and body, and two processes, the posterior process and the lateral process [4]. The body of talus shows a curved smooth trochlear surface and is roofed with hyaline cartilage. The dorsal surface is covered by a trochlear surface articulating with the distal end of the tibia. The triangular lateral surface is smooth and vertically concave for articulation with the lateral malleolus. Superiorly, it is continuous with the trochlear surface; inferiorly its apex is a lateral process.

Limited studies are available on morphometry of articular surfaces of talus which would assist in surgical interventions and manufacturing of implants and prosthesis in different population. The current study described the morphology of the talus in terms of its articular surfaces. It highlighted the bilateral comparison of parameters of articulating surfaces of talus. The emerging results of the study will be useful as an essential tool for reconstruction surgeries of foot deformities as well as foot rehabilitation procedures.

MATERIALS AND METHODS

Ethics procedures: The study protocol was approved by Institutional Ethics Committee (IEC) of the respective institute.

Study design and material: In the current study, total 100 (fifty-one from right side and forty-nine left sided tali) dry human talus bones of unknown gender and without any gross deformity were collected from the Department of Anatomy of one of the private medical colleges in Pune District for evaluation. With the help of Digital Vernier Caliper and Ruler, following dimensions of articular surfaces of bones were measured. The data retrieved were analyzed, tabulated, and embodied graphically.

Dimensions of articular surfaces

Trochlear anterior posterior length (TAPL): It

is the distance between the most anterior and the most posterior point of the trochlear articular surface. This was measured at three planes - i) at medial border ii) at lateral border and iii) in the midline of the trochlear articular surface.

Trochlear transverse width (TtW): It is the distance between the most medial and the most lateral point of the trochlear surface. It was measured at three planes as i) anterior width ii) width at the midpoint of anterior and posterior border and iii) posterior width over the trochlear articular surface.

Medial articular surface height (MASH):

It is the maximum height of the central region of the medial articular surface.

Lateral articular surface height (LASH):

It is maximum height of anterior side, central height and posterior side height of lateral articular surface.

Length of Inferior anterior articular surface:

It is the maximum distance along the long axis of the articular surface.

Width of Inferior anterior articular surface:

It is the maximum transverse distance perpendicular to that of length of inferior anterior articular surface.

Length of Inferior posterior articular surface:

It is the distance between most anterior and the most posterior point, measured at three planes - medial side, lateral side and middle length over the articular surface.

Width of Inferior posterior articular surface:

It is the distance the between most medial and the most lateral point. It was measured at three different planes - anterior width, central width and posterior width over the articular surface.

Height of anterior articular surface of head:

It is the maximum distance between the most medial point and most lateral point of the articular surface of the head.

Width of anterior articular surface of head:

It is the distance between the most superior point and the most inferior point of the articular surface of the head.

RESULTS

Table 1: Bilateral Comparison of Antero-Posterior Length of Trochlear Surface of Tali.

TAPL	Right (n= 49)			Left (n=51)			P-value
	Range	Mean	SD	Range	Mean	SD	
Medial	2.3-3.7	2.95	0.33	2.3-3.7	3.01	0.33	0.316
Middle	2.3-3.7	2.95	0.3	2.3-3.6	3.03	0.29	0.23
Lateral	2.3-3.7	2.93	0.32	2.5-3.7	3.03	0.27	0.091

TAPL- Trochlear antero-posterior length, SD- Standard Deviation, P<0.05- Statistically significant

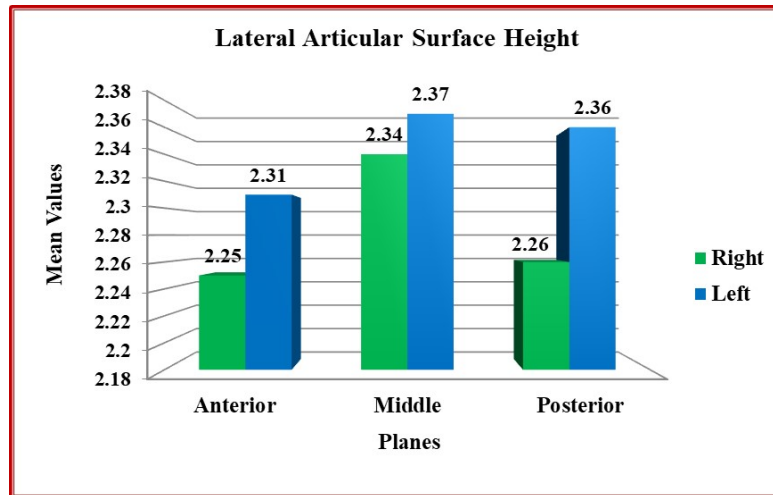


Fig. 1: Bilateral Comparison of Height of Lateral Articular Surface of Talus.

The study results demonstrated that except lateral articular surface height (LASH) [Figure 1], the values of all parameters of right and left sides were comparable and could not reveal any statistically significant differences between their means. The height of lateral articular surface (LASH) was measured at three different planes. On the right side, the mean height in the middle (2.34 ± 0.22 cm) was more as compared to anterior height (2.25 ± 0.21 cm) and posterior height (2.26 ± 2.22 cm). While, on the left side tali, mean height in the middle (2.37 ± 0.21 cm) and posterior (2.36 ± 0.22 cm) was almost same while the anterior height (2.31 ± 0.21 cm) was less. After comparing these three heights bilaterally, the posterior height (Right= 2.26 ± 0.24 cm) and (Left= 2.36 ± 0.22 cm) showed statistically significant difference (p-value=0.043) while the difference was not significant for the anterior height (p-value=0.150) and for the middle height (p-value=0.548).

Table 1 summarizes that the bilateral difference between all three parameters of TAPL was not statistically significant (p>0.05). The mean width of inferior anterior articular surface on the right side was 1.72 ± 0.62 cm and on the left side 1.46 ± 0.25 cm and this

difference was not statistically significant (p value = 0.21). The length of the inferior posterior articular surface was ranging from 1.5 cm-3 cm with a mean of 1.98 ± 0.18 cm on the right side and 2.02 ± 0.23 cm on left side. This bilateral difference was not statistically significant (p-value = 0.334). While, the mean width of inferior posterior articular surface on the right side was 3 ± 0.31 cm and on the left side 3.05 ± 0.23 cm. This parameter also did not indicate statistically significant difference (p-value=0.361).

The length of anterior articular surface of head (Right= 2.75 ± 0.41 cm and Left= 2.80 ± 0.36 cm) could not reveal statistically significant bilateral difference (p-value = 0.505). Similarly, the differences were not significant for the width of anterior articular surface of head (Right= 2 ± 0.38 cm and Left= 2.05 ± 0.33 cm) of tali.

DISCUSSION

The talus bone constitutes the most vital osseous element in the skeleton of the foot whereas the whole weight of the body is received and subsequently distributed towards the rest of the components of bones of foot. In the present study, the articular

surfaces of the talus were studied, and the baseline data was created to assist anatomists, surgeons and anthropologists to utilize this knowledge for betterment of community. The mean TAPL observed by Kumar S et al. [5], Otag and Cimen [6] and Ari and Kafa [7] were slightly higher than the observation of the present study (Right=2.94 cm and Left=3.04 cm). However, it was nearly similar to the observations by Motagi et al.[8] (Right=2.94 cm and Left=3 cm). The findings about trochlear transverse width (Right=2.55 cm and Left=2.40 cm) in the present study corroborated with the observations of Kumar S et al.[5] in which reported values were 2.53 cm on the right side and 2.57 cm on the left side. In our study, the mean value of length of inferior anterior articular surface was 2.8 cm on the right side and 1.72 cm on the left side. While, the mean value of width of inferior anterior articular surface was 2.7 cm on the right side and 1.42 cm on the left side. However, we have not come across any other studies to compare this parameter.

The length of anterior articular surface of head was observed in the present study was 2.75 cm on the right side and 2.80 cm on the left side. Ari and Kafa [7] detected slightly higher values. However, the disparities were noted for width of anterior articular surface of head between the study of Ari and Kafa (3.14 cm on the right side and 3.13 cm on the left side) and the present study (Right side =2 cm and Left side =2.05 cm).

In this study, the mean value of medial articular surface height (MASH) was 1.25 cm on the right side and 1.27 cm on the left side. Greater measurements (1.30 cm on both sides) were documented in the study conducted by Kumar S et al.[5] However, LASH values in their study [5] (2.30 cm and 2.33 cm on right and left side respectively) almost matched with the present study findings.

The inter-relationship between various parameters of articular surfaces of the talus needs to be evaluated in detail as it might be applicable to design talar and calcaneal screw placement procedures, manufacturing of prosthesis as well as biochemical studies. Flat-foot abnormality is linked with morphological

changes of talar and navicular articular surfaces which may cause medial arch collapse and forefoot abduction [9-17]. Therefore, a comprehensive knowledge of the articular surfaces of these bones is required to manage such health problems.

CONCLUSION

In the present study, except lateral articular surface height, all other parameters of articular surfaces of the talus could not indicate any significant bilateral differences. The study inferences can be utilized as a potential guide for surgical procedures, and inflammatory disease management as well as it may be useful resource data for forensic anthropologists.

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Balu G Londhe: Analysis and interpretation of data, drafting and revising the manuscript critically for important content.

Shilpa N Gosavi: Conception and design of the work and acquisition of data.

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