Evaluation of variations in the human Calcaneal Articular Facets on head of Tali in Indian population and associated clinical implications

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Abstract

Introduction: Morphological examination and classification of talus bone based on Calcaneal Articular Facets (CAFs) in Indian population groups, mainly in the western and central peninsular region, have been sparingly known. **Aim and Objectives**: The current cross-sectional study was done to evaluate the variations in Calcaneal Articular Facets on collected dry head of talus bones. **Material and Methods:** Hundred adult human dry tali of unknown age and gender were retrieved from the Department of Anatomy, of a private Medical College. They were inspected for the presence of several patterns of CAFs on the head of the talus. All the articular facets were observed and classified into V types according to the classification suggested by Arora et al. **Results:** The proportion of Type I was highest (49%), followed by Type II (24%), Type V(A) (16%), and Type III (11%). However, the study did not observe Type IV and Type V(B). **Conclusions:** The CAFs of the human talar head indicate a wide variety of variations and are acquainted, which can assist in dealing with the recurrently occurring joint instability problems as well as arthritic changes in and around the talus bone.

Keywords: Calcaneal Articular Facets, clinical implications, Indian population, talus

Introduction

The Talocalcaneal joint (TC) is a key synovial subtalar joint that is functionally significant for smooth and frictionless ankle movements and inversion and eversion of the foot at this joint especially walking on uneven surfaces. The talocalcaneal articulation is formed by superior facets of calcaneus bone with Calcaneal Articular Facets (CAFs) of the talus[(1)].

The talus bone forms the ankle joint with the tibia and fibula and forms the tibiofibular mortice, which is necessary for the stabilization of the ankle. The tibial inferior articular surface articulates with a trochlear surface of the talus at the ankle. Dorsolateral extension of trochlear surface so called 'squatting facet' on the talus neck commonly present in those who habitually adopt this position. Evaluation of talus morphology with relation to mechanics and locomotion is important as the external surface is mostly covered by articular facets[(2)]. Many authors have noted that minor changes in the morphology of these articular surfaces directly affect the possible range of motion at the joint[(3,4)]. Several studies reported the incidence and disparities in types of TC joint facets in diverse populations[(5-7)]. Talus and other tarsal bones have been found useful for age and gender determination in forensic research areas[(8,9)].

In addition, prior to ankle joint surgeries, the patterns and variant morphometries of CAFs on the talus are considered.

The published literature mentioned multiple classifications of the calcaneal articular facets. Kaur et al.[(5)] and Jung et al.[(7)] categorized CAFs into 5 to 6 subtypes. Some race-specific differences were also noted in the types of subtalar joint facets. Morphological analysis and classification of talus bone based on calcaneal facets in the Indian population, particularly in the western and central peninsular region, have been sparsely documented.

The present cross-sectional study was conducted to assess the variations in CAFs on the head of collected dry tali bones. The emerging data would be advantageous to surgeons, anatomists, and anthropologists for the management of talus and related bone diseases.

Material and Methods

A cross-sectional study was carried out at the Department of Anatomy from a private Medical College, Pune; during June 2015 to March 2017. Ethical approval was obtained from Institutional Ethics Committee.

Inclusion/exclusion criteria

The age and sex of the talus bones were not known. Fully ossified talus bones were included in the present study. These bones were free of any physical or external pathological changes or anomalies. The tali that were damaged, un-ossified, or having any pathological changes were not considered for the study.

Sample size estimation and sampling method

We did not calculate the sample size using statistical formula; however, the sample size was decided depending on the availability of the bones in the Department of Anatomy. The identified 100 (right – 49 and left – 51) dried adult human tali from the bone bank of the Department of Anatomy were examined for variant types of calcaneal articular facets.

Procedure

The complete calcaneal bone facets of the talus head were observed and classified according to the classification suggested by Bilodi et al.[8] and Arora et al.[9] as follows;

Classification of Inferior Calcaneal Articular Surface

Type I: Single calcaneal facet on the plantar surface of the head of the talus

Type II: Single calcaneal facet on the plantar surface of the head of the talus divided by a ridge into two parts

Type III: Two calcaneal facets on the plantar surface of the head of a talus separated partly by a ridge and partly by a groove

Type IV: Two calcaneal facets on the plantar surface of the head of the talus separated by a non-articular groove

Type V: Two subtypes: -

V(A) - Single calcaneal facet continuous with posterior calcaneal facet

V(B) - Two calcaneal facets, one of them continuing with posterior calcaneal facet

Data analysis

The data were entered into Microsoft Office Excel Sheet and analyzed for descriptive statistics using Statistical Package for Social Sciences (SPSS) Version 25.

Results

In the present study, an analysis of hundred dry tali showed that the incidence of type I was highest (49%), followed by type II (24%), Type V(A) (16%), and type III (11%). However, the study did not observe type IV and type V(B) (Table 1 and Figure 1).

Table 1: Classification of Calcaneal Articular Facets on the head of Tali

Types	Total (n = 100)		Right (n = 49)		Left (n = 51)	
	n	%	n	%	n	%
Type-I	49	49	24	49	25	49
Type-II	24	24	13	26	11	22
Type-III	11	11	4	8	7	14
Type-V(A)	16	16	8	16	8	16
Type-V(B)	0	0	0	0	0	0

Type I

Type II

Type III

Type IV(A)

Figure 1 : Categorization of Calcaneal Articular Facets on head of Talus

Discussion

Due to ligamentous structures and bone morphology, the subtalar region of various populations is a usual site of anatomical variation[10]. Such variations pertaining to the subtalar joint are clinically considered in multiple types of ankle surgeries. An analysis of these variations may be helpful in accounting for the frequently encountered joint instability and arthritic changes in the vicinity of the talus[11,12]. The current study reported that the CAFs on the head of human dried tali in the Indian population might be categorized into five types, as depicted in Table 1. The most commonly observed pattern in the present study was Type I (49%), followed by Type II (24%). This inference corroborated with the other study result as presented in Table 2. Kaur et al.[5] revealed similar patterns (Type I = 45% and Type II = 24%). However, contrasting findings were noted in the studies conducted by Arora et al.[9] and Garg et al.[6], showing Type II as the most predominant pattern, followed by Type I (Refer Table 2). Present study and study by Kaur et al.[5] have almost similar proportion of type V(A). Highest proportion of Type V(A) was observed by study by Bilodi[13]. Nevertheless, in present and Bilodi's study[13] Type IV was not seen.

Garg et al.[6] observed 1% of tali in Type V(B). To the best of our knowledge, this pattern was not detected by any other study, including the present study. The differences in the incidence of calcaneal articular facets on the head of tali might be acceptable as the populations studied were diverse. The changes in the gait, built, heredity, and type of work also can affect these patterns[6-8].

Table 2: Showing comparison of Calcaneal Articular Facets on head of tali

Types	Present Study (N = 100) (%)	Arora et al.[9] (N = 500) (%)	Bilodi[13] (N = 50) (%)	Kaur et al.[5] (N = 100) (%)	Garg et al.[6] (N = 100) (%)
Type-I	49	16	10	45	39
Type-II	24	78	14	24	44
Type-III	11	1	20	9	6
Type-IV	-	3	-	5	5
Type-V(A)	16	2	56	17	5
Type-V(B)	-	-	-	-	1

In view of nationality-specific differences, a study done in the Thai population by Phunchago et al.[1] identified the highest incidence of Type II in the classification, and this finding differed from the present study. Moreover, it could be attributed to the fact that the study of the Thai population emphasized morphometric measurements on superior and inferior talar facets. Our study attempted to focus mainly on inferior articular facets on the head of the tali.

A classification system seems to be the primary prerequisite to differentiate several configuration types. In the current study, the classification provided by Arora et al.[9] was utilized to classify calcaneal articular facets on tali. It is imperative to note that all other authors did not use this classification which may create a biased distribution of various configurations, particularly for fused types. This may pose certain challenges in comparing the results. It reiterates the need to have a standard and uniform classification in future studies.

The current study had a few limitations. The study concentrated on calcaneal facets on the head of the talus; so other parameters like length and width of navicular articular surface of head and trochlear surface of body of talus were not considered. Gender differences and remaining articular surfaces on the head of the talus were not considered. Further studies including these factors can be executed to generate more valuable data.

In the modern era, there have been revolutionary technological changes and multiple developments of ankle prostheses and implants used during foot surgeries. The extracted results from the present study may act as baseline data that can be utilized for advanced surgical interventions. Multicentric studies on diverse population groups and with adequate sample size should be encouraged to make comparative studies more meaningful and generalizable.

Conclusion

The calcaneal articular facets on the head of a talus presented multiple variations which can be ascribed to the material or population group differences. This knowledge would be helpful in performing ankle surgeries, manufacturing prostheses and implants, and management of arthritic changes in the vicinity of the talus bone. For several reasons, the talus is particularly relevant for studying relationships between morphology, mechanics, and locomotor mode.

Externally, it is composed almost entirely of articular surfaces. In conclusion, it appeared that, even though surface areas of articular facets are significantly correlated with body mass, their scaling patterns do not follow simple theoretical predictions.

Conflict of Interest: Nil

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