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Patterns Of Talar And Calcaneal Facets In South Indian Population With Clinical Implications.

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ABSTRACT

Calcaneal and talar facets are subject to racial and morphological variations. The knowledge of these variations would aid the clinicians and physiotherapists to understand the underlying pathological cause of various ankle disorders and also for orthopaedic surgeons during treatment procedures on ankle joints. The present study was conducted on 130 dry calcaneum and 72 dry human tali of unknown sex and race obtained from MVJ Medical College and Research Hospital, Bangalore. Pattern of talar and calcaneal facets were studied and statistically analyzed. Out of 130 calcaneum, on both side, type 1 was most common and type 3 was the least observed. Out of 72 dry tali, overall type 2 was most common followed by type 1. Type 5A was seen in11 (15.2%) bones, Type 3 and type 4 are seen in 7(9.7%) bones each. On the right side out of 36 bones, type 1 was most common and type 5A was least common. On the left side, type 2 was most common and type 4 was least. Knowledge of variation of calcaneal facets can be used as an anthropological marker for racial and regional differentiation of unidentified bones. Detailed anatomical information will act as a baseline for advanced treatment procedure.

Keywords: Talus, Subtalar joints, calcaneal articular facets, anthropological marker, ankle joint.

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INTRODUCTION

Calcaneum or the heel bone is the largest tarsal bone. Its superior surface is divided into three areas of which the middle area bears the post talar facet which is oval and convex anterosuperiorly. The sustentaculum tali arising from the anteromedial aspect of the calcaneum bears the anterior and middle talar facets. The talar articular facets are subject to variation, with the post facet having the least variation and anterior and middle facets showing much of variation differing amongst races [1]. These variations are of academic and clinical interest as they may affect the stability of the subtalar joint [2-4].

Spurs are a common entity observed in response to skeletal stress in the calcaneum. They are commonly observed in back of heel (Dorsal spurs) or on the plantar aspect (Plantar heel spur).

Talus is the second largest bone of the foot forming the link between bones of leg and foot and involved in ankle joint, subtalar joints and talocalcaneonavicular joints [5]. Talus is the only tarsal bone which does not give attachment to any muscles or tendons. The inferior surface of talus shows three articular facets - anterior, middle and posterior which articulates with superior facets of calcaneum. The anterior facet lies below the head whereas middle and posterior facets in front and behind the sulcus tali. The locations and number of these facets shows wide range of variations and these variations are attributed mainly by the difference in gait ,built and due to racial difference .Hence in medico legal cases the morphological variations of calcaneal facets can be used as anthropological markers to identify the racial and regional origin of unidentified skeletal remains [6]. The knowledge of these variations are important in identifying the underlying pathological condition as well as in planning accurate treatment options. The thorough examination of subtalar articular facets is important as it gives idea regarding foot dynamics following postoperative fixations and artificial joint production [7].

Even though previous literature shows numerous studies on calcaneum and talar articular facets separately very few studies are available on both the bones. Hence the present study is an attempt to study the facets of talus and calcaneum and to compare the results of current study with that of previous literature.

Objective of the study: To study the pattern of talar facets in dry calcaneum and classify them.

- To study the incidence of calcaneal spurs (Dorsal and plantar) in the calcaneum bone
- To analyze if any association exists between Type of calcaneum and presence of spur.
- To determine the incidence of morphological variations of calcaneal articular facets of human tali on both the sides and to correlate the results of present study with previous literature.

MATERIAL AND METHODS

The present study was conducted on 130 dry calcaneum (56right and 74 left) and 72 dry tali (36 right and 36 left) of unknown sex and race obtained from the department of anatomy and bone sets from MBBS phase 1 students of 2019 -20 batch. Damaged and deformed calcaneum and talus were excluded from the study. Side of the calcaneum was determined. Presence of Plantar and Dorsal spur were noted.

The calcaneum were classified into five different types based on the pattern of facets

Type 1-Anterior and medial facet fused Post facet separate.
Type 2-All the facets are separate
Type 3-Anterior facet absent, middle and posterior facet separate.
Type 4-Anterior facet absent middle and posterior facet fused.
Type 5- All the facets are fused.

All the above data were entered in an excel sheet and results inferred.

Inferior surface of each talus was examined for number and type and the facets were classified using Arora's classification [8] which include five different types. The percentage of each type of facets on both the sides were calculated.

Type 1: Anterior and middle facets fused and posterior facet separate.

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Type 2: Anterior and middle facets separated by ridge and posterior facet separate.
Type 3: Anterior and middle facets separated by ridge and groove with separate posterior facet.
Type 4- Anterior and middle and posterior facets separately present
Type 5 is divided into type5A and Type 5B
Type 5A: Anterior, middle and posterior facets are fused.
Type 5B : Middle and posterior facets are fused.

RESULTS

Out of the 130 dry calcaneum studied, 74 were left sided and 56 were right sided. The calcaneum was classified into five different types based on the pattern of articular facets and percentage of each Type of calcaneum calculated from both right and left side calcaneum (Table1)(figure1).

Table1: Showing classification of calcaneum based on the pattern of talar facets

Type of calcaneum	Right sided calcaneum (Total-56)		Left sided calcaneum (Total-74)		Total-130	
	No	Percentage	No	Percentage	No	Percentage
Type 1	36	64.3%	47	63.5%	83	63.8%
Type 2	15	26.8%	23	31.1%	38	29.2%
Type 3	2	3.6%	3	4.1%	5	3.8%
Type 4	0	0.0%	0	0%	0	0.00%
Type 5	2	3.6%	0	0%	2	1.53%
Variant type 1 A	-	-	1	1.4%	2	1.53%
Variant type 4 A	1	1.8%	-	-	-	-

Figure 1: Showing different types of talar articular facets of calcaneum. (Type 1-Anterior and middle facet fused, posterior facet separate. Type 1 a-Anterior and middle facet fused and posterior facet separate, accessory facet present. Type 2-All the three facets anterior, middle and posterior facet separate. Type 3-Anterior facet absent middle and posterior facet separate. Type 4a: Anterior facet present middle and posterior facet fused.Type 5:all facets fused)

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It was observed that Type 1 calcaneum was most common pattern observed in our study followed by Type 2. Only 2 (3.6%) calcaneum out of 130 calcaneum studied showed Type 3 and Type 5 pattern. We also encountered a variant of Type 1, which we named as Type 1 a, where anterior and middle facet were fused with posterior facet separate, but accessory anterior facet was seen (1 out of 130 calcaneum). One of the calcaneum also showed a type 4 variant wherein Anterior facet was present but middle and posterior facets were fused.

92 out of 130 calcaneum showed the presence of spurs (60 Dorsal and 32 plantar spurs). There was no association between sidedness or Type of calcaneum with the incidence of spurs. (figure 2)

Figure 2: Calcaneum showing dorsal spur (DS) and plantar spur(PS)

Percentage of various types of calcaneal facets were noted on dry tali and classified as per Arora's classification. (Table 2).

Table 2: Showing the classification of talus based on the pattern of calcaneal facets

Type of talus	Right sided talus (Total-36)		Left sided talus (Total -36)		Total-72	
	No	Percentage	No	Percentage	No	Percentage
Type 1	14	**38.3**	9	25	23	31.9
Type 2	11	30.5	13	**36.1**	24	**33.3**
Type 3	3	8.3	4	11.1	7	**9.7**
Type 4	5	13.8	2	5.5	7	**9.7**
Type 5A	3	8.3	8	22.2	11	15.2

In the present study, out of 72 dry tali ,24 showed type 2, followed by type 1 seen in 23 tali. Type 3 and type 4 were present in 7 bones each constituting about 9.7%. In the current study we have not observed type 5B (figure 3).

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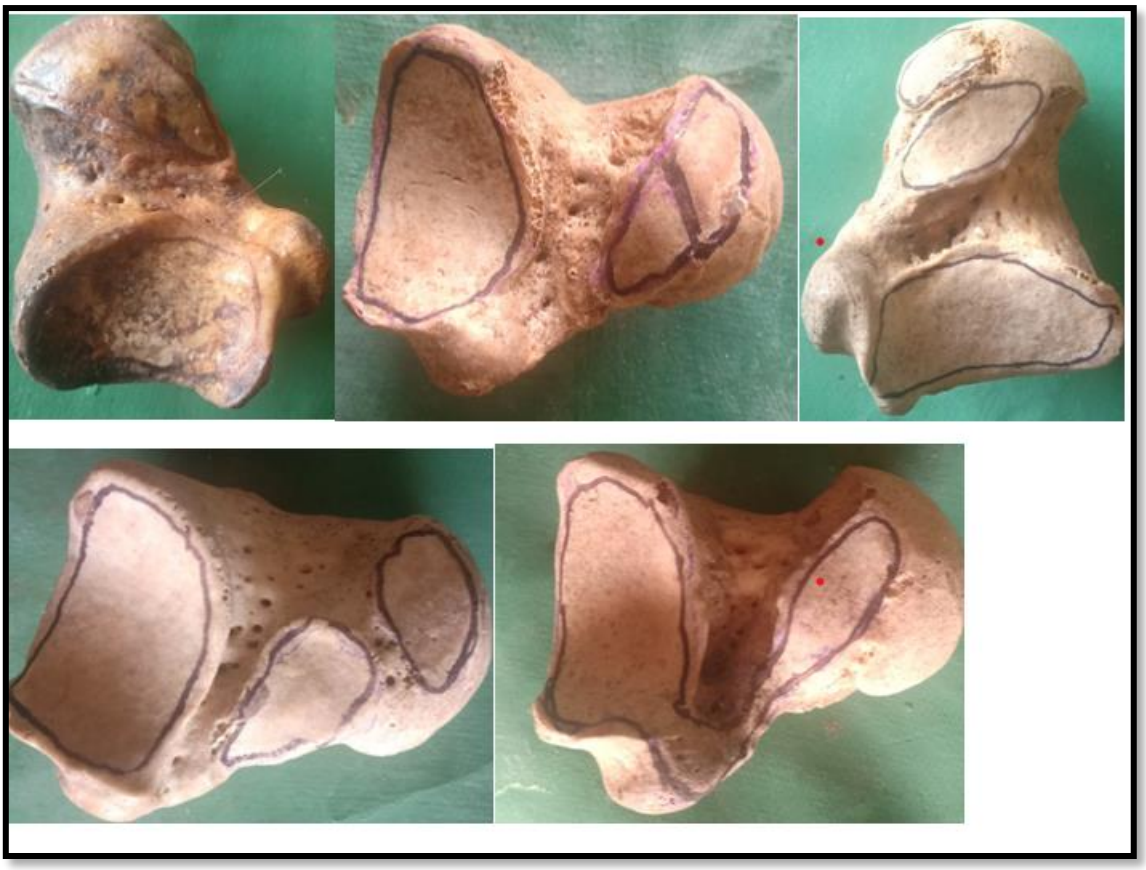

Figure 3: Showing different types of calcaneal articular facets of talus. (Type 1: Anterior and middle facets fused and posterior facet separate. Type 2: Anterior and middle facets separated by ridge and posterior facet separate. Type 3: Anterior and middle facets separated by ridge and groove with separate posterior facet. Type 4- Anterior and middle and posterior facets separately present Type 5A: Anterior, middle and posterior facets are fused)

DISCUSSION

Bunning and Barnett (1963) classified the calcaneum into three different types. Type A with three independent facets, Type B with fused anterior and middle facet or with a notch between them and Type C with one facet due to fusion of all the facets [9]. In our study Type B was the most commonly encountered variant followed by Type A and C as per their classification. In present study we observed Type 1 as the most common variant which corresponded to Type B of the above classification followed by Type 2 variant corresponding to Type A in their study.

Anbumani et al studied the calcaneum based on the above classification and reported the maximum incidence of type B calcaneum followed by A and C [10]. Our study also confirmed the same. They further classified the Type B calcaneum into B1-B4. B1 and B2 with fused anterior and middle facet without notch and with notch respectively, B3 with anterior facet absent. B4 with middle and post facet fused. Frequency of B1 and B2 put together was 69% which is comparable to our study.

Nagar et al examined 529 calcaneum and classified them into 5 types (A to E), A with three separate facets, B with fused anterior and middle facet, C with all facets fused, D with anterior facet absent, E with anterior facet absent along with fused middle and posterior facet fused. Highest incidence of Type B facet was reported in their study followed by Type A similar to our study [11].

Rahman classified calcaneum into three categories based on their talar facets into Pattern 1 with three facets, Pattern 2 with two facets and Pattern 3 with a single facet. The highest incidence reported was that of Pattern 2, which is the commonest pattern seen in Indians unlike Pattern 1 which is usually seen in Europeans [12]. Our study also confirms to the same finding as the commonest pattern we encountered was anterior and middle facet fused and posterior facet separate.

Vijay Lakshmi et al in their study reported four patterns of talar facet, Type 1 with fused anterior and middle facet, Type 2 with separate middle and anterior facet, Type 3 with absent anterior facet, Type 4 with all facets seen but anterior and middle incompletely separated from each other. Highest incidence of Type 1 was reported in their study consistent with our study [13].

Chowdhury et al classified the talar facets on the calcaneum into five patterns and compared his results with different authors [14]. (Table 1).

Pattern 1-Anterior and middle facet fused post separate, Pattern 2 all separate facets, Pattern 3 anterior facet absent middle and posterior facet separate, Pattern 4 all facets fused, Pattern 5 showing single continuous facet on the sustentaculum tali continuous with cuboid facet. Maximum incidence of Pattern 1 followed by Pattern 2 was observed in this study. Maximum incidence of Pattern 1 was reported in Indians and African race whereas Pattern 2 was commonly observed in British, Egyptians and Veddahs (Table 3).

Table 3: Comparison of incidence of talar facets of calcaneum with previous studies

Study	El Eishi [15]	Bunning &Barnett [9]	Bunning &Barnett [9]	Bunning &Barnett [9]	Chowdhury A [14]
Origin	Egyptians	Veddahs	British	Africans	Indians
Number	200	10	194	492	380
Pattern 1	49%	-	33%	63%	73%
Pattern 2	80%	60%	67%	36%	18%
Pattern 3	11%	40%	-	-	2%
Pattern 4	-	-	1%	1%	1%
Pattern 5	-	-	-	-	6%

Talus forms the main link between leg and foot. Relationship between the talus and calcaneal articular configuration plays an important role in internal and external fixation of various pathological conditions of the foot like talocalcaneal arthritis, intraarticular fractures, valgus varus deformities, flat foot. Comparison of various types of calcaneal articular facets among different Indian authors shows that results of our study correlates with that of Arora [8], Garg [16] and Azra [5] et al (Table 4).

Table 4: Comparison of incidence of calcaneal facets of talus with previous studies

Study	Type1	Type2	Type3	Type4	Type 5A	Type 5B
Arora et al [8]	16	78	1	3	2	-
Azra et al [5]	17.6	44	32.8	1.6	1.6	2.4
Garg et al [16]	39	43.7	6	5.3	5	1
Kaur et al [17]	45	24	9	5	8	9
Bhanu Sudha et al [18]	52	32	1	3.6	10.7	-
Present Study	31.9	33.3	9.7	9.7	15.2	-

Buckner etal suggested that number of calcaneal facets on the inferior surface of talus decides the stability of subtalar joint. Increased surface area enables more joint mobility. In three facet arrangement talus (type 4) rests on the stable articular tripod and comes in contact with the calcaneum at three different points. Hence the mobility and surface area of the joint is reduced. The mobility is comparatively more in two facets arrangement (type 1) but single facet arrangement (type5A) shows highest mobility as it provides maximum gliding area [19]. Buckner concept was strengthened by Verhagen etal, suggested that arthritic limping was less in three separate facet configuration (type 4) than others and also noted that people with single facet (type 5A) are at high risk of developing joint instability [20]. Hence the prior knowledge of anatomical variations plays an integral role in delineation of underlying pathologies and also in finalizing treatment options [5].

CONCLUSION

This study would add value to surgeons performing calcaneal osteotomy in terms of better management of patients. Pattern of talar and calcaneal facets has a strong impact on the dynamics of foot, shows a racial variation as is apparent from literature owing to the lifestyle, built and gait. An insight into the Subtalar joint stability and predisposition to arthritic changes is influenced by talar facet morphology. Type 4 and 5 facet pattern predispose to ligament laxity and arthritic changes. Since Indian population have the maximum incidence of type 5 facet pattern they may be prone for unstable subtalar joint

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