

## Squatting Facets and Trochlear Extensions on the Neck of Talus in Modern North-Eastern Nigerian

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### ABSTRACT

The occurrence of tallar modifications was investigated in a population of 119 late adult Nigerians in the year 2000. Lateral squatting facets occurred most frequently (46.2%) and medial facets (15.9%) but the combined facets (0.8%) were also observed. Lateral (29.4), medial (17.6%). Combined (lateral and medial) (6.9%) and continuous lateral/central/medial extensions (10.0%) of the trochlear surface were all present in the late Nigerian population. The result obtained from the present study was also compared with those obtained from previous study in different populations around the world.

Therefore, it is unlikely that precisely the same factor determines the expression of squatting faces and trochlear extensions.

**Keywords:** Squatting Facet; Trochlear Extension; Talus; North-Eastern; Nigerians

## Introduction

The talus is unique weight bearing and weight transmitting bone in the body. It receives the weight on its trochlear surface and transmits same in two different directions that is downwards to the calcaneus and forward to the navicular bone. During walking, the talus is subjected to changing stresses due to the rolling of the tibia on the trochlear surface and with change in position of the talus itself. The articular morphology of the human skeleton could be subjected to modifications by imposed mechanical stresses [1] mechanical stress of habitual squatting has been recognized to induce varied remodeling of the skeletal morphology of the lower limb [2].

Squatting is a resting, postural complex involving hyperflexion at the hip and knee as well as hyper-dorsiflexion at the ankle and subtalar joint. During locomotion, the foot is rarely dorsiflexed sufficiently to bring the anterior border of the inferior extremity of the tibia into contact with the dorsum of the neck of the talus and the distal tibia indicating their habitual contact have been taken as evidence of extreme dorsiflexion of the ankle that occurs in habitual squatting [3, 4, 5, 6, 7, 8]. Thus, mechanical stress as a result of habitual squatting would affect not only the neck of the talus but also its articular facets.

Due to dearth of data on this Nigerian population, the present study was undertaken to observe the neck of the talus among North-Eastern Nigerians. The squatting position is said to be the most frequently assumed posture during most sociocultural activities in this region of Nigeria.

## Materials and Methods

A total sample of 119 dry tali of unknown sex was used in this research. The bones were without apparent pathology or physical damage. Out of the total sample size, 62 belonged to the right foot while 57 were of the left. The tali were derived from adult skeletal collections of the medical colleges located in the study region (North-eastern Nigeria). Vernier calipers were used in taking various measurements.

The occurrence of squatting facets on the neck of the talus and extensions of the trochlear surface of the talus was determined using the classifications established by [8]. Trochlear extensions are defined as prolongations of the trochlear surface anterior to a transverse, base-line drawn at the anterior margin of the trochlear surface perpendicular to the long axis of the foot (figure A). The super anterior end of the lateral Malleolar surface is the lateral limit of the above base-line while the medial limit is a cross-point on the medial Malleolar surface. Extension can be lateral (Figure B), medial (figure C), combined as well as continuous (Figure D). Similarly, the squatting facets as seen in the sketches presented in Figures E, F and G respectively.

## Results

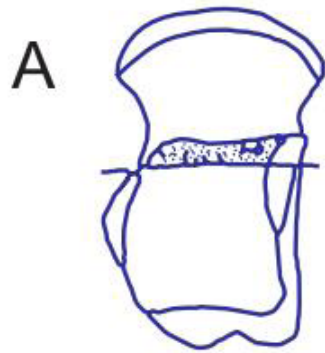
In the remodeling of the neck of the talus in response to squatting or mechanical stress, various types of modifications of the neck of the talus can occur. In the present study the following modifications were observed (Table 1 and 2).

### i. Squatting Facets

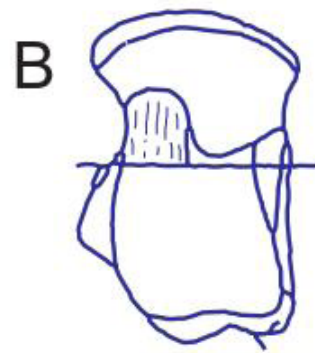
Lateral squatting facet on the dorsum of the neck of the talus was present on 55 tali, out of which 50.0% were on the right tali while 42.1% were on the left tali. Medial squatting facet was located on the dorsomedial aspect of the neck of the talus. It was not continuous with the trochlear surface. The medial squatting facet was found on 15.9% of the 119 tali investigated. A combined squatting facet which comprised of both lateral and medial facets on a single talus recorded 0.8% talus from the left feet.

### ii. Trochlear Extensions

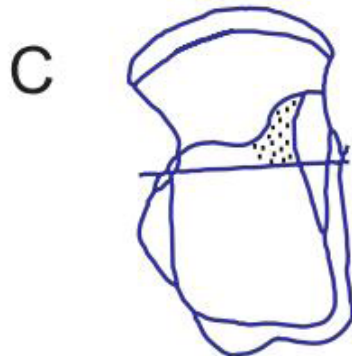
A lateral trochlear extension, is an extension of approximately one-third of the trochlear surface onto the dorsum of the neck of the talus. Out the 62 right tali investigated the lateral extension was found in 27.4% of the bones while 31.5% of the 57 left tali had the lateral extension.



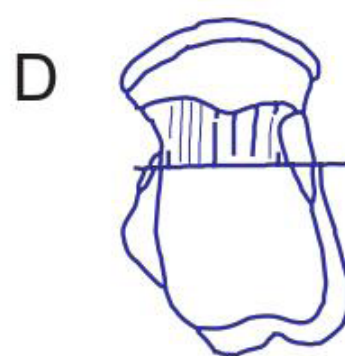
**A**  
NORMAL TALUS



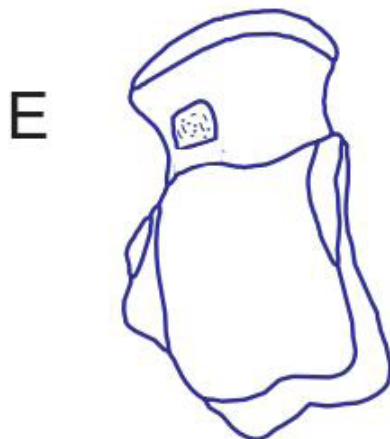
**B**  
LATERAL TROCHLEAR EXTENSION



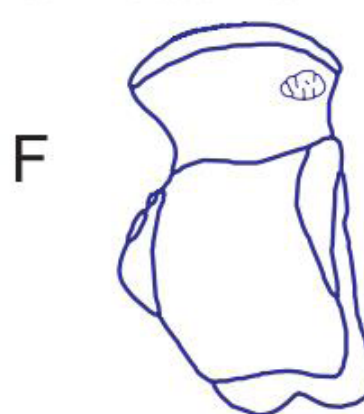
**C**  
MEDIAL TROCHLEAR EXTENSION



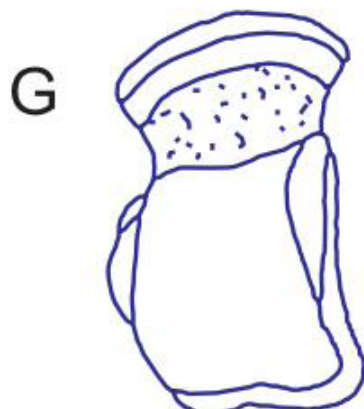
**D**  
CONTINUOUS TROCHLEAR EXTENSION



**E**  
LATERAL SQUATTING FACET



**F**  
MEDIAL SQUATTING FACET



**G**  
CONTINUOUS SQUATTING FACET

**Figure A-G:** Showing diagrams of tali with different anatomical landmarks. A: Normal talus, B: Lateral Trochlear extension, C: Medial Trochlear Extension, D: Continuous Trochlear Extension, E: Lateral Squatting Facet, F: Medial Squatting Facet and G: Continuous Squatting Facet.

No. of Tali Squatting facet	Right=62	Left=57	Total=119
Lateral	31 (50.0%)	24 (42.1%)	35 (46.2%)
Medial	11 (17.7%)	8 (14.7%)	19 (15.9%)
Combined		1 (1.9%)	1 (0.8%)
Trochlear Extension			
Lateral	17 (27.4%)	18 (31.5%)	35 (29.4%)
Medial	7 (11.2%)	14 (24.5%)	21 (10.5%)
Continuous	9 (14.5%)	3 (5.2%)	12 (10.0%)
Combined	5 (8.0%)	3 (5.2%)	8 (6.7%)
No Squatting facets	20 (32.2%)	23 (40.3%)	43 (36.1%)
No Trochlear Extension	23 (37.0%)	18 (31.5%)	14 (34.4%)
Normal (no facets or Extension)	8 (12.19%)	9 (15.9%)	17 (8.5%)

**Table 1:** Showing incidence of Squatting Facets and Trochlear Extensions on the Tali

	SIDE R = Right L = Left	Mean	Standard Deviation	Chi-square ( $\geq 0.05$ ) Right vs left
squatting facets	R = 31 L = 24	27.50	4.95	>0.05
Lateral				
Medial	R = 11 L = 8	9.50	2.12	>0.05
Trochlear extension	R = 17 L = 18	17.50	0.70	>0.05
Lateral				
Medial	R = 7 L = 14	10.50	4.95	>0.05
Continuous	R = 9 L = 3	6.00	4.21	>0.05
Combined	R = 5 L = 3	4.00	1.41	>0.05
No squatting facets	R = 20 L = 23	21.50	2.12	
No Trochlear extension	R = 23 L = 18	20.50	3.54	
Normal (No facets on extension)	R = 8 L = 9	8.500	0.70	

**Table 2:** Showing the occurrence of Squatting Facets and Trochlear Extensions in Right and Left Tali

Population	Barnett (1954) Europeans (UK)	Singh (1959) Indians	Das (1959) Indians; Uttar Pradesh	Pandey and Singh (1990). Indian: E. Uttar Pradesh and N. Bihar	Oygucu et al (1997) Late Byzantine	Current study Nigerians.
No of tali	100	100	200	262	175	119
Squatting facets	2 (2.0%)	86 (28.6%)	40.5 (41.5%)	218 (83.2%)	66 (37.7%)	55 (46.2%)
Lateral						
Medial	0	0	8 (4.0%)	46 (17.6%)	1 (0.6%)	19 (15.9%)
Combined	-	-	3.0%	31 (11.8%)	1 (0.6%)	1 (0.8%)
Continuous	-	-	13.0%	28 (10.7%)	1 (0.6%)	-
Trochlear Extension						
Lateral	17 (17.0%)	73 (24.3%)	49 (24.5%)	238 (90.8%)	14 (8.0%)	35 (29.4%)
Medial	11 (11.0%)	74 (24.6%)	51 (25.5%)	158 (60.3%)	19 (10.9%)	21 (17.6%)
Continuous	-	91 (30.3%)	45 (22.5%)	152 (58.0%)	8 (4.6%)	12 (10.0%)
Combined	-	-	-	-	-	-

**Table 3:** Comparative incidence of squatting facets and Trochlear extensions in different population

A medial trochlear extension was a prolongation of the medial trochlear surface onto the dorsum of the neck of talus. Such an extension was recorded on 10.5% of the tali (7 right and 14 left). Continuous (lateral/central/medial) trochlear extension of the trochlear surface onto the dorsum of the neck of the talus was present on 10.0% of the bones. Combined (lateral and medial) trochlear extension of the trochlear surface onto the neck of talus was found on eight tali, that is a frequency of 8.0 and 5.2 of the right and left tali, respectively.

The incidence of the lateral squatting facet was  $27.5 \pm 4.95$ , the medial squatting facet  $9.5 \pm 2.12$ , for both the right and left tali. For the trochlear extensions the incidence of the lateral extension was  $17.5 \pm 0.7$ , medial extension  $10.5 \pm 4.95$  while the continuous extension was  $6.0 \pm 4.24$ . The incidence of the combined trochlear extension was on the average  $4.0 \pm 1.41$ . Chi-square test was applied to determine the statistical significance in the occurrence of the squatting facets and the trochlear extension between the right and left tali. It was found that for all the parameters considered, the incidence of the facets or extensions were not significantly different ( $p > 0.05$ ) between the right and left tali.

The length of the lateral squatting facet ranged from 0.9cm to 1.2cm, while the length of the medial squatting facet ranged between 0.2 and 0.3cm. The lateral and medial trochlear extensions measured in length from 0.6 to 1.5cm while the continuous was on the average of 0.5cm in length.

## Discussion

A modification of the talus as indicative of habitual squatting has been reported to occur in hominids since the Pleistocene era [9]. However, few previous studies have produced data detailed enough to allow accurate comparison of different population. Studies on a sample such as the one in this instance have scientific limitations. In that it is obtained from unclaimed bodies with unknown nutritional state of the 119 tali investigated in the current study, 62 were of the right side and 57 from the left side from different skeletons.

Remodeling effects induced by squatting stress in the form of various types of facets (medial, lateral, and combined) and extensions (medial and lateral) on the neck of the talus have been reported [10, 3, 5, 8, 11]. The hereditary basis of these facets and extensions have also been proposed or reported in certain articles [12,13, 3]. The modifications of the talus observed in the current study were consistent with prolonged extreme dorsiflexion of the talus during squatting. This might be due to the socio-cultural and strong religions lifestyle of the late population. In the present study, the lateral squatting facet occurred most frequently (50.0%) on the right tali compared to that of the left tali (42.1%). The occurrence was also slightly higher on the right medial side (17.7%) compared to the left medial side (14.7%) though this was statistically found to be insignificant ( $P > 0.05$ ).

The combined squatting facet was found on only one talus (0.8%) from the left foot (Table 1). The length of these facets and extensions also varies. The medial squatting appeared shorter than the lateral facet, with medial facet ranging between 0.2 – 0.3cm in length while the lateral squatting facet measured between 0.9 – 1.2cm on both sides. The variation in length between lateral and medial squatting facets might be due to frequent contact of the tibia on the lateral side of the neck of the talus during squatting; sitting with legs folded underneath or folded to the side. In either case, it leads to frequent, prolonged contact of lateral side of tibia on the neck of the talus, hence creating longer facets. For the medial squatting facet, the shorter length might be due to lack of constant contact of tibia with the medial side of the talus during squatting or other activities and so making a very small impression on the neck of the talus. The same observations were made by [8]. The lateral and medial trochlear extensions have almost the same length, ranging between 0.6 – 1.5cm with longest on the left tali on the medial side (about 1.5cm). The length of the continuous trochlear extension of both right and left tali was 0.5cm. this implies that continuous sliding forward of the trochlear extension of the tibia on the trochlear surface of the talus is not always frequent and even if frequent is not always prolonged as on the lateral and medial sides.

Generally, the incidence of lateral squatting facet in the present study (46.2%) was greater than that reported for modern Europeans 2.0%. [3] and Indians 28.6% [5], similar to the population of Indians from the Uttar Pradesh region [4] and the Byzantine population [11]. But [8] obtained an incident of 83.2% from the combined population E. Uttar Pradesh and N. Bihar. The difference in the occurrence of squatting facet between apparently Indian population may reflect the sex ratio of the bones investigated [8]. They reported that the prevalence of squatting facet was significantly greater in female than in male. Also the central trochlear

extensiom and other extensions were significantly more in female. In their work, such sex bias may also affect comparism between different populations, but it should be noted that the reported increased incidence in females varies only between approximately 9 and 16%, depending on the type of squatting facet [8].

The distribution of the four type of trochlear extension in the current study was more balanced than the distribution of squatting facets. Lateral extensions were present in 29.4%; medial extension in 10.5%; continuous (lateral/medial/central) extension in 10.0% and combined trochlear extensions (lateral/medial) in 6.7% (Table 1). The frequency of occurrence of trochlear extension in this study was substantially less than that in the Indian population [8] similar to those of the Indians (Das, 1959; Singh, 1959), but more than the modern Europeans and the Byzantine populations [11] (Table III).

The disjunction in the appearance of squatting facet and trochlear extension between different population suggests that their presence is not determined by exactly the same factors [11]. Considering the influence of sex hormones on bone physiology [14] the remodeling effects of qualitatively or quantitatively different strain and stress, and the physic role of the individual influence the occurrence of squatting facets and trochlear extensions. The morphology of various facets and extensions did not differ. All the remodeling consequences had significantly higher incidence and extent in females [8]. The effect of stress on bone is amenable to correction by timely hormonal and nutritional supplementation [15, 16].

In view of the fact that squatting facets were present almost entirely on the lateral aspect of the neck of the talus, it is possible that pas valgus deformity was present in the bones investigated in the present study. The pas valgus deformity can be caused by prolonged standing, walking and squatting on a hard surface which results in outward deviation of the foot at the talocalcaneal joint. This would bring the lateral surface of the anterolateral margin of the talus inferior extremity of the tibia.

In conclusion, extreme dorsiflexion as well as squatting and walking in hard surface may br the major contributing factors for the modification of the upper surface and neck of the talus.

## Conclusion

Squatting facets and trochlear extensions on the neck of talus have shown to be population specific as the comparison between Nigerians and other world ethnic groups have shown significant variation in all the measured dimensions like lateral, medial and continuous facets respectively.

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