

SQUATTING FACETS ON THE TALUS AND TIBIA IN INDIANS

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The presence of so-called squatting facets on the upper surface of the neck of the talus, and on the corresponding part of the anterior margin of the lower end of the tibia, was first described by Thomson (1889). These facets have subsequently been studied by a number of workers. Several distinct facets have been described and, as Barnett (1954) has pointed out, lack of an agreed terminology has resulted in considerable confusion. Further, some workers have studied only tali, and others only tibiae. That results thus obtained are not strictly comparable is shown below. Finally, though there are several reports on adult bones, only one series of foetal tali has been reported (Barnett).

The present paper analyses critically the facets described by various authors, and classifies them (as far as possible) according to the terminology presented by Barnett. The results of a study of a series of adult and foetal Indian tali and tibiae are reported. The theory that the presence of the facets both in the foetus and the adult represents an example of the transmission of an acquired character to the offspring (Charles, 1894; Wood Jones, 1949) is discussed in the light of the findings.

MATERIAL

The material used for this study is as follows:

	Tibiae	Tali
Adult: dry bones	200	200
wet, cartilage-covered specimens	92	100
Foetal	66	66

In the case of the dry bones, while it was not possible to assign individual tali and tibiae to one another, they presumably belonged, in large part, to the same group of cadavers. The wet specimens were either freshly dissected or preserved museum specimens. In eight of these specimens the talus alone was available. The foetal specimens were from preserved foetuses varying from 112 to 234 mm. c.r. length. Specimens from the younger foetuses were examined under a stereoscopic microscope.

OBSERVATIONS

A. Forward prolongation and displacement of the medial articular surface of the talus

The medial articular surface of the talus is prolonged forwards beyond the level of the anterior margin of the trochlear surface in 188 out of 200 dry tali, in all the 100 wet tali, and in all the 66 foetal tali studied. The degree of forward prolongation in the dry tali is analysed in Table 6.

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Forward prolongation of the anterior end of the medial surface is usually accompanied, both in the adult and in the foetus, by a corresponding anterior displacement of the posterior end (Table 1).

The medial articular surface of the talus is frequently curved medially at its anterior end, in both foetal and adult specimens. The degree of curvature is very variable (Table 2).

Medial curvature and forward prolongation of the medial articular surface frequently coexist, but may be present independently (Table 3).

Table 1. *Forward displacement of the medial articular surface of the talus*

	Adult	Foetal
Forward displacement of both anterior and posterior ends	272	66
Forward displacement of anterior end only	16	—
Forward displacement of posterior end only	12	—
Total number examined	300	66



Fig. 1. Talus showing marked forward displacement and medial curvature of the anterior part of the medial articular surface.

Table 2. *Curvature medially of the anterior part of the medial articular surface of the talus*

Degree of curvature	Adult	Foetal
No curvature	88	12
Perceptible	59	10
Distinct	112	42
Marked	41	2
Total number examined	300	66

Table 3. *Relationship of medial curvature to forward prolongation of the medial articular surface of the talus*

	Adult	Foetal
Forward prolongation and medial curvature	204	54
Forward prolongation alone	84	12
Medial curvature alone	8	0
Neither present	4	0
Total number examined	300	66

Examination of dissected specimens shows that the anterior part of the medial articular surface, and the corresponding part of the malleolar facet are in perfect apposition only when the joint is strongly dorsiflexed.

B. *Medial extension of the trochlear surface of the talus*

The medial part of the trochlear surface is often prolonged anteriorly on to the neck of the talus. This area varies in size and shape (Figs. 2, 4 and 7). In some cases it is partially cut off from the trochlear surface by a notch and appears to be an almost distinct facet (Fig. 7). However, it always continues the antero-posterior curve of the trochlear surface. It comes into contact, in marked dorsiflexion of the ankle, with the undersurface of the lower end of the tibia and not with its anterior margin. A medial extension is seen in 165 out of 300 adult tali (55%), and in 34 out of 66 foetal tali (51.5%) examined.

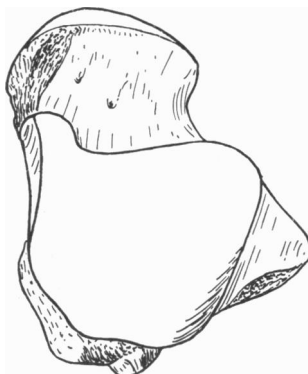


Fig. 2. Talus showing a medial extension of the trochlear surface. See also Figs. 4 and 7.

Table 4. *Relationship of forward prolongation of the medial articular surface of the talus to medial extension of the trochlear surface*

	Adult	Foetal
Forward prolongation and medial extension	165	34
Forward prolongation alone	123	32
Neither	12	0
Total number examined	300	66

Medial extension of the trochlear surface is always accompanied by forward prolongation of the medial articular surface of the talus. However, the reverse is not invariably true (Table 4).

C. *Lateral extension of the trochlear surface of the talus*

The anterior margin of the trochlear surface is not straight but shows a convexity forwards. The forward convexity usually involves the lateral half to two-thirds of the trochlear surface, and its apex is often more central than lateral. In some of those specimens in which a medial extension is absent, the entire width of the trochlear surface shows a convexity forwards (Figs. 3, 4, 6 and 7). A lateral extension is present in 164 out of 300 adult tali (54.6%), and in 43 out of 66 foetal tali (65%) studied.

Examination of dissected specimens shows that both medial and lateral extensions of the trochlear surface are accompanied by corresponding changes in the shape of the articular surface of the tibia. However, articulation with the tibia occurred only at the extreme limit of dorsiflexion.

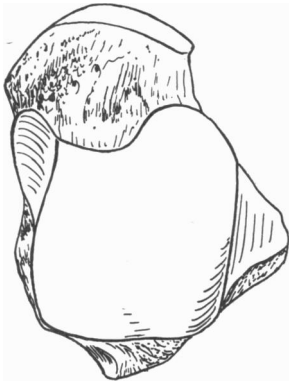


Fig. 3

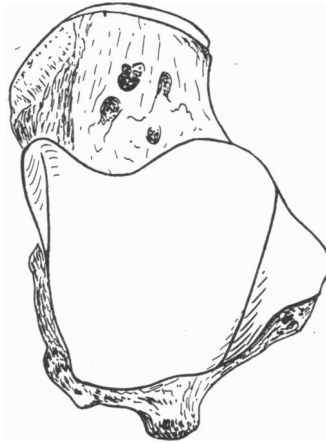


Fig. 4

Fig. 3. Talus showing lateral extension of the trochlear surface. See also Figs. 4, 6 and 7.

Fig. 4. Talus showing both medial and lateral extensions of the trochlear surface.

D. *Lateral squatting facet*

This facet lies on the upper surface of the neck of the talus, usually towards the lateral side. However, it is sometimes on the centre of the neck, specially in foetal specimens (Fig. 8). It varies in size and shape (Figs. 5–7). It may be directly continuous with the trochlear surface or may be separated from it by a definite margin. Rarely, a non-articular strip separates it from the trochlear surface.

A lateral facet is distinguishable from a lateral extension by the fact that, whereas the lateral extension continues the antero-posterior curve of the trochlea the lateral facet does not. Thus while a lateral extension faces upwards and slightly forwards, a lateral facet faces upwards and, occasionally, slightly backwards. The antero-posterior diameter of a lateral extension is convex upwards, but that of a lateral facet is usually concave. These differences are obviously associated with the fact that it is only the true lateral facet that articulates with the anterior margin of the tibia, the extension articulating only with the undersurface of that bone. Lateral squatting facets are present in 86 out of 300 adult tali (28.6%) and in 8 out of 66 foetal tali (12%) examined.

A facet on the anterior margin of the tibia is not always accompanied by a facet on the talus. The facet is seen in 142 out of 200 dry tibiae examined, but is present in only 48 out of 200 dry tali. Further, in 92 dissections the facet is present on the tibia alone in 46 cases, and on both talus and tibia in 38 cases. While the tibial facet is less marked in the former group, it is nevertheless distinct. The facet on the talus is often smaller than that on the tibia, coming in contact with only part of the latter (Fig. 9).

Out of the 46 specimens showing facets on the tibia alone, 22 show a smooth area, not covered with cartilage, on the neck of the talus. This area comes into contact with the tibial facet in extreme dorsiflexion. In some of the remaining cases, the capsule of the ankle joint is attached fairly close to the margin of the trochlear surface and the tibial facet comes into contact with its lowermost part. In extreme dorsiflexion this part of the capsule is caught between the anterior margin of the tibia and the extra-articular part of the neck of the talus.

Out of 66 foetal specimens examined, 8 show facets on both bones, and 29 show a facet on the tibia alone.

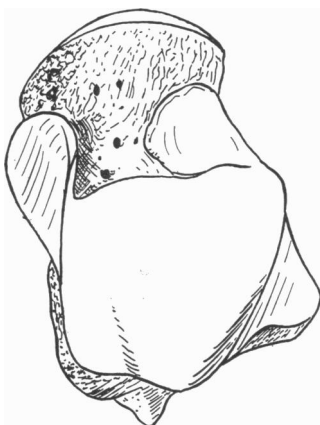


Fig. 5

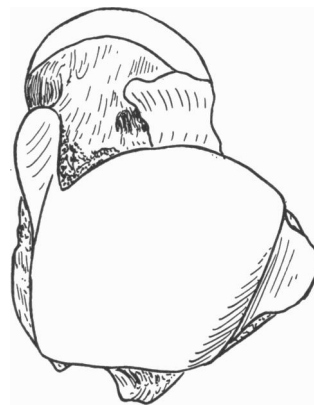


Fig. 6

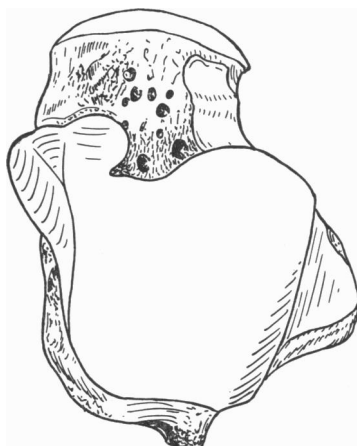


Fig. 7

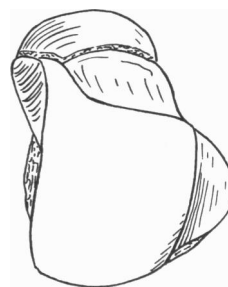


Fig. 8

Fig. 5. Talus showing a lateral squatting facet.

Fig. 6. Talus showing a lateral squatting facet and lateral extension of the trochlear surface.

Fig. 7. Talus showing a lateral squatting facet, and medial and lateral extensions of the trochlear surface.

Fig. 8. Talus of a foetus (175 mm. c.r. length) showing a large squatting facet covering almost the entire upper surface of the neck. A medial extension of the trochlear surface is also seen.

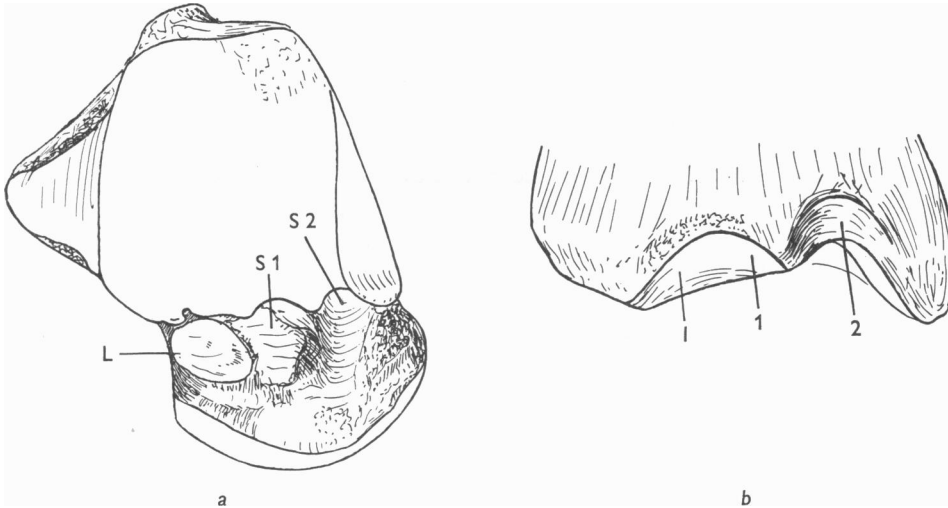


Fig. 9. (a) Upper surface of the talus showing a lateral cartilage-covered squatting facet (*L*) and two smooth areas, *S1* and *S2*. (b) Anterior margin of the tibia of the same specimen showing a large facet. Its lateral part (*l*) articulates with the facet on the talus; its medial part (*1*) with the area *S1* of the talus. More medially the tibia shows a smooth groove (*2*) which articulates with the smooth ridge *S2* on the talus.

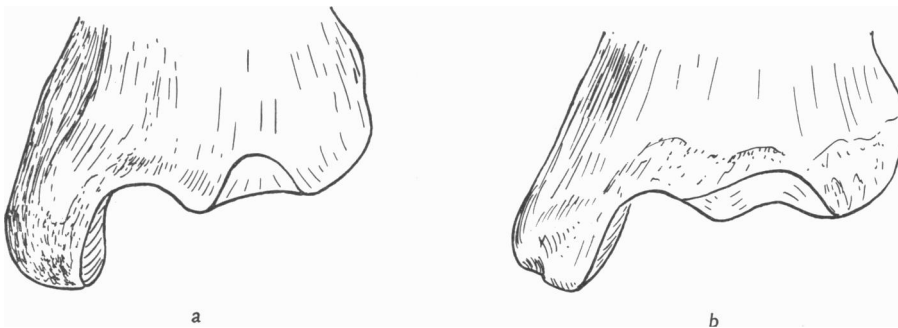


Fig. 10. Anterior surface of the lower end of the tibia showing two forms of the lateral squatting facet.

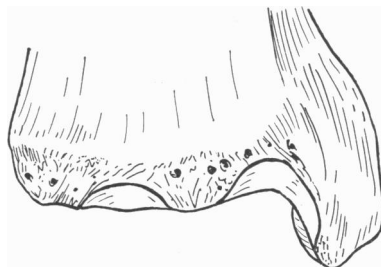


Fig. 11. Anterior surface of the lower end of the tibia showing distinct medial and lateral squatting facets.

E. *Medial squatting facet*

In the present investigation no distinct example of a facet on the medial part of the upper surface of the neck of the talus has been seen. In one dry specimen the medial extension of the trochlear surface does not continue the line of the trochlea but is concave upwards. Unfortunately, the tibia is not available for comparison, and hence it is not possible to say whether this area articulated with the anterior margin or with the undersurface of that bone. In five dry tibiae, a distinct facet is seen on the medial part of the anterior margin, separated from the lateral facet by a non-articular area.

F. *Relationship of the various modifications associated with squatting to one another*

A description of the modifications due to squatting would be incomplete without an analysis of the relationship that they bear to one another (Table 5).

Table 5. *Relationship of the various modifications of the talus, associated with squatting, to one another*

Modification present	Adult	Foetal
Medial extension alone	59	9
Lateral extension alone	40	18
Lateral facet alone	12	0
Medial and lateral extensions	65	19
Lateral extension and lateral facet	33	2
Medial extension and lateral facet	15	2
Medial and lateral extensions and lateral facet	26	4
No modification	50	12
Total number examined	300	66

DISCUSSION

A. *Forward prolongation and displacement of the medial articular surface of the talus*

A comparison of the findings in dry bones of the present series with those of Barnett (Table 6) shows that forward prolongation of the medial articular surface of the talus is much more pronounced in Indian bones than in those of Europeans.

Table 6. *Forward prolongation of the medial articular surface of the talus*

Percentage of the antero-posterior diameter of the medial articular surface extending beyond the anterior margin of the trochlea	European tali (Barnett) (%)	Indian tali (present series) (%)
0-10	48	7
11-20	34	15.5
21-30	17	31
31-40	1	34
41-50	0	12
Above 50	0	0.5

Forward prolongation of the medial articular surface is, as shown above, usually accompanied by a forward displacement of the posterior end. Barnett observed this association in the European foetus, but not in the adult.

Although Barnett mentions the presence of medial curvature of the anterior part of the medial articular surface, he does not say how frequent and how marked it is. Comparison of his findings in the European with those of the present series is, therefore, not possible.

Charles (1893), who first described these features, attributed them not only to squatting, but also to the so-called sartorial position. According to him, in this position there is plantar flexion and marked adduction at the ankle. He claims that these modifications of the talar medial articular surface render the adoption of this posture easier. As shown above, however, the anterior parts of the medial articular surface and the corresponding part of the malleolar facet are in perfect apposition only when the joint is strongly dorsiflexed. This clearly shows that this modification is related to the marked dorsiflexion associated with squatting, and has no relation to the sartorial position. This is further confirmed by the fact that forward prolongation of the medial articular surface may be present even in people who possess marked mobility of the ankle joint (Wood Jones 1949), but who never adopt the sartorial posture.

B. Medial extension of the trochlear surface of the talus

The fact that a medial extension comes into contact, in marked dorsiflexion of the ankle, with the undersurface of the lower end of the tibia and not with its anterior margin, shows that it is not a true squatting facet. This agrees with the view expressed by Inkster (1927), and Barnett. The so-called medial facets described by Parker & Shattock (1884), Charles (1893), and Sewell (1904), are all found, on critical study of their texts and figures, to be merely extensions of the trochlear surface and

Table 7. *Medial extension of the trochlear surface of the talus*

	Author	Race	Total no. studied	Medial extension present	Percentage
Adult	Charles	Punjabi	53	25	47.2
	Sewell	Egyptian	1006	189	19
	Barnett	European	100	11	11
	Present series	Indian	300	165	55
Foetal	Barnett	European	56	44	78.5
	Present series	Indian	66	34	51.5

not true squatting facets. This is further confirmed by the fact that the incidence of the medial facet described by Charles in the Punjabi (47.2 %) corresponds fairly closely to incidence of medial extension of the trochlear surface (55 %) observed, in material collected from the same region, in the present series. The incidence of medial extension of the trochlear surface found in the present series is compared with findings of other workers in Table 7.

C. Lateral extension of the trochlear surface of the talus

The incidence of lateral extension of the trochlear surface in bones of the present series is compared with that in European bones (Barnett) in Table 8.

Table 8. *Lateral extension of the trochlear surface of the talus*

	Author	Race	Total no. studied	Lateral extension present	Percentage
Adult	Barnett	European	100	17	17
	Present series	Indian	300	164	54.6
Foetal	Barnett	European	56	Common	?
	Present series	Indian	66	43	65

D. *Lateral squatting facet*

Earlier workers (Thomson, Charles, Sewell) did not distinguish the lateral extension of the trochlear surface from the lateral squatting facet. It is possible that some of the instances of lateral facets described by them were in reality merely lateral extensions. It might be argued that the absence of a corresponding facet on the tibia would always enable a lateral extension to be correctly distinguished from a true facet. That this is not so is clear from the fact that, as shown above, facets are very often present on the tibia, unaccompanied by any definite facet on the talus. This fact was clearly brought out by Thomson, but seems to have been overlooked by subsequent workers. Thus a lateral extension is easily confused with a facet unless the criteria put forward above (p. 543) have been kept in mind. Considering that Charles studied material collected from the same region as in the present investigation, the much higher incidence of the lateral facet found by him supports this contention. The incidence of lateral facets on the talus and tibia in the present series is compared with that found by other workers in Tables 9 and 10 respectively.

Table 9. *Lateral squatting facet on the talus*

	Race	Author	Total no. studied	Lateral facet present	Percentage
Adult	European	Thomson	25	1	4
		Pfizzner	840	1	—
		Barnett	100	2	2
	Australian	Thomson	11	7	63.6
		Inkster	150	45	30
	Egyptian	Sewell	1006	86	8.6
		Indian	Charles	53	34
Present series	300		86	28.6	
Foetal	European	Barnett	56	13	23
	Indian	Present series	66	8	12

Table 10. *Squatting facet on the tibia*

Race	Author	Total no. studied	Lateral facet present	Medial facet present
European	Thomson	30	2 (6.6%)	—
	Wood	118	20 (17%)	2 (1.7%)
Australian	Thomson	14	11 (78.5%)	—
	Wood	236	190 (80.5%)	5 (2.1%)
Indian	Charles	52	45 (86.5%)	9 (19.2%)
	Present series	292	226 (77.4%)	5 (1.7%)

E. *Medial squatting facet*

The medial squatting facet described by Barnett as an area on the medial part of the upper surface of the neck of the talus, not continuous with the trochlear surface, and not articulating with the tibia, is a dubious entity. If it does not articulate with the tibia, there is no justification in including it among squatting facets. It has been shown above that most of the so-called medial facets described by Parker & Shattock, Charles, and Sewell, are really medial extensions of the trochlear surface. A medial facet on the anterior margin of the lower end of the tibia has been described by Charles and by Wood (1920), and has also been seen in the present series. Charles claims to have seen specimens in which this facet articulates with a facet on the neck of the talus, but does not say how often this was seen. A true medial facet on the talus, if present, must indeed be rare considering that no other worker describes it. None is seen in the present series. That facets on the tibia are not necessarily accompanied by facets on the talus is clear from what has been said about the lateral squatting facet.

F. *Inheritance of acquired characters*

The fact that modifications in bones attributed to squatting are to be seen not only in the adult, but also in the foetus, led Charles (1894) to believe that these modifications, acquired by the individual, had in course of time become an inherited characteristic of the Punjabi. However, the presence of these features in the European foetus (Sewell, Barnett) can hardly be explained on this hypothesis. A consideration of Table 11, comparing the findings of Barnett in the European adult and foetus with those of the present series, clearly shows that the modifications associated with squatting are, on the whole, more frequent:

- (i) in the Indian adult as compared to the European;
- (ii) in the European foetus as compared to the adult;
- (iii) in the Indian adult as compared to the foetus; and
- (iv) in the European foetus as compared to the Indian.

Table 11. *Percentage squatting facets in European and Indian tali*

	Adult		Foetal	
	European	Indian	European	Indian
Medial extension	11	55	78.5	51.5
Lateral extension	17	54.6	Common	65
Lateral facet	2	28.6	23	12

From the above the following conclusions are obvious:

(a) That the Indian inherits no greater tendency to the development of squatting facets than does the European.

(b) That these features present in the European foetus tend to disappear in the adult. This lends strong support to the view expressed by Sewell that the presence of these features in the foetus is simply due to the fact that 'during intra-uterine life the lower extremities of the foetus are in the position most favourable for the formation of such articular surfaces, viz., one of extreme dorsiflexion and inversion'.

(c) The fact that these features persist in, and even undergo further development in, the Indian adult can accordingly be attributed to the fact that in squatting he continues to maintain the dorsiflexed position for considerable periods.

(d) That the presence of 'squatting' facets both in the foetus and adult in Indians is a mere coincidence and is not indicative of the fact that these features have been inherited.

SUMMARY

1. The so-called squatting facets described in the literature have been critically analysed.

2. The incidence of these facets in a series of 300 adult and 66 foetal tali, and in 292 adult and 66 foetal tibiae, is described.

3. Modifications produced by squatting are more frequent in (a) the Indian adult than in the European, (b) the European foetus than in the Indian, (c) the Indian adult than in the foetus, and (d) the European foetus than in the adult.

4. It is concluded that these facets in the Indian adult are purely acquired and are not inherited.

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