SHORT REPORT

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The squatting facets on the tibia of Byzantine (13th) skeletons

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SUMMARY

Squatting is a resting postural complex that involves hyper-flexion at the hip and knee joints, and hyper-dorsiflexion at the ankle and subtalar joints. The effects of squatting stress may induce bone remodeling. Different incidences of these modifications reflect the life style of a population. Stress-induced bone remodeling may be the result of physical and sports performance, especially that of women.

We investigated 125 tibia from adult male skeletons from the late Byzantine period (13th century) to see if they had squatting facets or not. Thirty-one tali pairing tibia were also investigated concerning their relationship with the squatting facets of these bones.

There were 64 right (51.2%) and 61 left (48.8%) tibia and squatting facets were observed on 30 right (46.9%) and 30 left (49.2%) tibia. Among the 25 paired tibia investigated, squatting facets were seen on 9 (36%) pairs and there was no evidence of side predilection. On the right side, squatting facets occurred on 3 (20%) tibia-tali; on the left side they were present on 7 (43.7%) tibia-tali, and only one tibia had the squatting facet and tali had none.

The occurrence of squatting facets in this Byzantine population was greater than that reported for modern Europeans, but less than for Australians and Indians. Therefore, different factors can play a role in the modifications of the distal tibia surface, articulating with the talus.

Key words: Squatting facets – Talus – Tibia – Byzantium

INTRODUCTION

Squatting is a resting postural complex that involves hyper-flexion at the hip and knee joints, and hyper-dorsiflexion at the ankle and subtalar joints. During locomotion, this position of the foot is rarely achieved.

The mechanical stress induced by the squatting habit is known to elicit various types of remodeling of bones of the lower extremity (Thomson, 1889, 1890). Squatting facets have been described 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. These facets have been studied by a number of investigators, sometimes only on tali or tibia. Thus, modifications at the neck of talus and the distal tibia indicating habitual contact between the two elements have been taken as evidence of the extreme dorsi-flexion of the ankle that occurs in squatting (Thomson, 1889, 1890; Charles, 1893; Aitken, 1905; Sewell, 1905; Barnett, 1954; Das, 1959; Singh, 1959; Rao, 1966; Satinoff, 1972; Pandey and Singh, 1990; Oygucu, 1998). The anterior extensions of the trochlear and the malleolar surfaces of the talus may be associated with modifications of the anterior margin of the distal tibia. Here, we investigated the presence of squatting facets on the tibia and their relationships with the talus in a group of Byzantine male skeletons.

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Materials and Methods

A total of 125 tibia (64 right, 61 left; 25 of them paired) without any apparent pathology or physical damage were investigated. They were from adult male skeletons (sexed by pelvic and cranial morphology) with healthy teeth, excavated from a Byzantine (13th century) burial site near Iznik (Nicaea), Turkey; Nicaea is the town where the first council of Christians was held in 325, under the supervision of Emperor Konstantin of Rome.

The mean age of the skeletons at death was calculated (Ozbek, 1984) to be approximately 35 years using the morphology of the symphysial surface of the pubis and the degree of closure of the cranial sutures (Vandervael, 1964).The evidence of traumatic injury shortly before death (Ozbek, 1984) was the sign of a battle. The classification of Singh (1959) was used to determine the occurrence of squatting facets on the tibia (Fig. 1). In addition, the squatting facets on 31 paired tibia and tali of the same side were examined. We also compared the squatting facets on the right and left tibia of the same skeleton to observe whether there was a side predilection due to life style. Squatting facets on the tibia and talus of the same side were compared using the Mc Nemar (χ^2) test.

Results

Squatting facets occur on the anterior border of the tibia in contact with the dorsum of the neck of talus. The inferior articular surface of the tibia continues as a squatting facet on the lateral anterior border of the tibia (Fig. 1). These facets were present on 60 (48%) (30 right 46.9%, and 30 left 49.2%) tibia (Table 1).

Only one tibia had three squatting facets while the others had only one. There was an adaptation between the total of 31 tibia and tali on the same side. We observed that there were squatting facets on three (20%) right tibia-tali, and seven (43.7%) left tibia-tali of these groups and one left tibia had a squatting facet where its left talus had none (Table 2).

Of the 25 paired tibia, nine pairs (36%) had squatting facets and three pairs were different from the others. These three pairs exhibited side asymmetry. In one of them, there was a squatting facet on the right tibia but the left tibia had none. On the other two pairs, the left tibia had a squatting facet and the right tibia had none (Table 3).

There was no side preference of squatting facets on the tibia of the same skeleton ($p>0.05$).

These findings are in agreement with the reports by Finnegan (1978) and Panteado et al. (1986) to the effect that nonmetric traits of the infracranial skeleton do not show side dimorphism.

Squatting facet	Right (%)	Left (%)	Total (%)
+	30 (24.0)	30 (24.0)	60 (48.0)
-	34 (27.2)	31 (24.8)	65 (52.0)
Total	64 (51.2)	61 (48.8)	125 (100.0)

Table 1.– The squatting facets on the right and left tibia.

Squatting facet	Right	Left	Total
Tibia+ Talus +	3	7	10
Tibia+ Talus -	--	1	1
Tibia - Talus +	--	--	--
Tibia - Talus -	12	8	20
Total	15	16	31

Table 2.– The presence of squatting facets on 31 paired tibia and tali were evaluated by χ^2 analysis. No significant relationship was found ($p>0.05$).

Squatting facet	Number of tibia	%
Right + Left +	9	36
Right + Left -	1	4
Right - Left +	2	8
Right - Left -	13	52
Total	25	100

Table 3.– Evaluation of squatting facets on 25 paired tibia.

References	Population	Total number of bones	Squatting facets (%)
Present study	Byzantine	125	60 (48.0)
Thomson	European	30	2 (6.6)
Wood	European	118	20 (17.0)
Thomson	Australian	14	11 (78.5)
Wood	Australian	236	190 (80.5)
Singh	Indian	292	226 (77.4)
Charles	Indian	52	45 (86.5)

Table 4.– Comparison of squatting facets in different studies.

Fig. 1. The squatting facets on the tibia of late Byzantine period skeletons.

Discussion

The distal tibial surface, articulating with the talus, is wider in front, concave sagittally and transversely slightly convex (i.e. it is cellar). Medially, it continues into the malleolar articular surface. This articular surface may extend into the groove separating it from the shaft's anterior surface. Such extensions, medial or lateral or both, are squatting facets, articulating with reciprocal talar facets in extreme dorsiflexion (Williams et al., 1989). These facets of the tibia observed in the current study are consistent with prolonged extreme dorsiflexion of the tibia and talus during squatting, an activity compatible with the farming life style of the Byzantine people in Iznik (Ozbek, 1984). The occurrence of laterally located squatting facets in Byzantine males is greater than that reported for Europeans but less than for Australians (Thomson, 1889; Wood, 1920) and Indians (Charles, 1893, 1894; Singh, 1959). Comparative data are given in Table 4.

Pandey and Singh (1990) have reported that the prevalence of squatting facets is significantly greater in females. Such a gender bias may also affect comparisons among different populations. In addition, the presence of squatting facets is not determined by exactly the same factors. The results of the present study suggested us that the pes valgus deformity might have been present in the Byzantine population investigated; to some extent this can be caused by prolonged standing and walking on a hard surface and results in outward deviation of the foot at the talocalcaneal joint (Cotta, 1980), bringing the lateral surface of the neck of the talus into contact with the antero-lateral margin of the inferior extremity of the tibia. Thus, different factors can be invoked to explain the modification of the distal tibial surface, articulating with talus.

References

Aitken DM (1905). A note on the variation of the tibia and astragalus. *J Anat Physiol,* 39: 489-491.

Barnet CH (1954). Squatting facets on the European talus. *J Anat,* 88: 509-513.

Charles RH (1893). The influence of function, as exemplified in the morphology of the lower extremity of the Panjabi. *J Anat Physiol,* 28: 1-18.

Charles RH (1894). Morphological peculiarities in the Panjabi, and their bearing on the question of the transmission of acquired characters. *J Anat Physiol,* 28: 271-280.

Cotta H (1980). *Orthopaedics*. Georg Thieme, Stuttgart, pp. 302-309.

Das AC (1959). Squatting facets of the talus in U.P. subjects. *J Anat Soc India*, 8: 90-92.

Finnegan M (1978). Non metric variation of the infracranial skeleton. *J Anat*, 192: 23-37.

Oygucu IH, Kurt MA, Ikiz I, Erem T and Davies DC (1998). Squatting facets on the neck of the talus and extensions of the trochlear surface of the talus in Late Byzantine males. *J Anat,* 192: 287-291.

Ozbek M (1984). Roma acik hava tiyatrosundan (Iznik) cikartilan Bizans iskeletleri. *Hacettepe Universitesi Edebiyat Fakultesi Dergisi,* 2: 81-89.

Pandey SK and Singh S (1990). Study of squatting facet / extension of talus in both sexes. *Medical Science and the Law,* 30: 159-164.

Penteado CV, Duarte E, Meciano FI and Stabille SR (1986). Non-metric traits of the infracranial skeleton. *Anat Anz,* 162: 47-50.

Rao PDP (1966). Squatting facets on the talus and tibia in Australian aborigines. *Archeology and Physical Anthropology in Oceania,* 1: 51-56.

Satinoff MI (1972). Study of the squatting facets of the talus and tibia in ancient Egyptians. *J Human Evolution,* 1: 209-212.

Sewell RBS (1905). A study of the astralagus, part III. The collum tali. *J Anat Physiol,* 39: 74-88.

Singh I (1905). Squatting facets on the talus and tibia in ancient Egyptians. *J Anat*, 93: 540-550.

Thomson A (1889). The influence of posture on the form of the articular surfaces of the tibia and astralagus in the different races os man and the higher apes. *J Anat Physiol*, 23: 616-639.

Thomson A (1890). Additional note on the influence of posture on the form of the articular surfaces of the tibia and astralagus in the different races of man the higher apes. *J Anat Physiol*, 24: 210-217.

VANDERVAEL F (1964). *Biometrie Humaine*. Masson, Paris.

WILLIAMS PL, WARWICK R, DYSON M and BANNISTER LH (1989). *Gray's Anatomy*. 37th Edition. Churchill Livingstone, London, Edinburgh, Melbourne, New York, pp 445-450.

WOOD WQ (1920). The tibia of the Australian aborigine. *J Anat*, 54: 232-257.

WOOD JF (1949). *Structure and Function as seen in the foot*, 2nd Ed. Bailliére, Tindall and Cox, London.