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Squatting Facet: A Case Study Dilkaya and Van-Kalesi Populations in Eastern Turkey

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A B S T R A C T

Anomalies of the skeleton provide information on living conditions, cultural structure and health problems in ancient societies. Squatting facet is a kind of anomaly that forms on the surfaces where the tibia and talus articulate is the squatting facet states the daily activities and living style of the society. The aim of this study is to learn the daily activities of the medieval societies in the Van region through studying of squatting facets. In this study, adult skeletons from Dilkaya and Van Kalesi-Eski Van Şehri societies dating to the Medieval Age were investigated (65 tibia and 82 tali from Dilkaya, 61 tibia and 52 tali from Van Kalesi-Eski Van Şehri). The lateral squatting facet had high ratios in both societies. The tibia lateral squatting facet found on females and males of Dilkaya was 97.2% and 96.9%, respectively, and on females and males of Van kalesi Eski Van Şehri was 87.5% and 89.2 %, respectively. The talus lateral squatting facet found on females and males of Dilkaya was 72.1% and 51.3%, respectively, and on females and males of Van kalesi Eski Van Şehri was 91.2% and 83.7%, respectively. The results provide an opportunity to study the relationship between past and modern population, and also describe the daily activity of life and cultural structure.

Key words: *squatting facet, Dilkaya and Van Kalesi-Eski Van Şehri, Anatolia*

Introduction

Squatting facet is a type of extra joint on the bone surface where the tibia and talus articulate[1–3]. As the name suggests, a squatting facet is formed by prolonged squatting[3–6]. Squatting is described as the hyperflexion of the hip and the knee and the movement of hyperdorsiflexion between the leg and the ankle[7].

The bones that form the ankle joint can show different types of modification when exposed to different types of stress. While the ankle joint is in extreme dorsiflexion the anterior of the tibia hangs on the border of facies articularis navicularis over the column of the talus. As a result of this kind of movement, squatting facets are produced on the distal tibia and neck of the talus. Reasons for squatting facet include physical stress, genetic factors and mechanical effects. Researchers[1,2,4,5,8–10] think that mechanical effects, in particular, are directly related to this syndrome. In studying heredity, squatting facet is seen on the bones of the tibia and talus during the fetal stage and childhood[11]. As age increases, squatting is no longer part of the daily movement routine so the facet disappears. In summary, the main reason for the facet is the frequent squatting motion[1,2,4,5,8–10].

Thomson, who first defined squatting facet, characterized them as extra facets at the articulation of distal tibia and neck of talus surfaces[1,2]. Barnet[4], in addition, found two facets on the medial and lateral neck of the talus. He also found lateral and medial extension on the neck of the talus, which continue the line of curvature of the trochlea of the talus and which makes contact with the undersurface of the tibia during dorsiflexion. Satinoff[10] divided the facets into individual groups, such as facet that occur when the lateral and medial are in contact with each other, and facets seen in separate lateral and medial facets.

By examining the frequencies, shapes and types of facets on the tibia and talus, the habitual feet movements and postures, lifestyles and typical activities can be interpreted[7,9, 11,12,13]. The squatting facet is often studied in defining modern and past population's daily activi-

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ties; for Neanderthals[7,14], Europeans[1,4,15], Indians[3,5,8], Aborigines[16], Japanese[17], Egyptians[10], American Indians and North Africans[7], population of Early Byzantines Iznik[9,13], South Asians, Americans and Australians[18], I, II, IV-VIII, X-XII, XIV-XVI, XVIII centuries and Hamman-Todd series[11,12], late Stone age South Africans, Iron age XVIII century and modern cadavers[6].

The purpose of this study is to learn about the daily activities of the medieval societies in the Van region though a study of squatting facets. In this way we can get some information about the cultures and structures previous populations of Eastern Anatolia.

Material and Methods

The material used in this study comes from two settlements in Eastern Anatolia: Van Kalesi-Eski Van Sehri (EVS) and Dilkaya (DK). The tumulus of EVS is located 70 km north of Van Castle, and is oriented in an east-west direction parallel to the base of a cliff. This tumulus was dated to the 11–13th centuries A.D. based on ceramics from the burials[19]. The DK tumulus is located 24 km southwest of the Van city center, in the area of Edremit west of Dilkaya village. It was dated to the 10–11th century A.D. based on the archeological materials recovered from the cemetery[20].

This study analyses the talus and tibia bones belonging to adult skeletal remains found in the two archeological sites mentioned above. In total, the study sample from DK includes 65 tibias and 82 talus and the EVS sample includes 61 tibias and 52 talus (Table 1). While the facet was being evaluated, the sexes and ages of the people were recorded, but the pathological individual's were not evaluated[21,22]. For place, formation and description of squatting facet, the definitions were used by Barnett[4], Singh[5] and Trinkaus[7]. χ^2-tests were carried out on the frequencies of squatting facet.

Results

A high proportion of the tibias from both archaeological sites were observed to have the lateral squatting facet (Table 2 and Figure 1). In the DK samples, lateral squatting facet occurs on 97.2% (100% right side, 94.4% left side) of females, and 96.9% (93.8% right side, 100% left side) of males. In the EVS samples, the percentages for the lateral squatting facet are 87.5% (91.7% right side, 83.3% left side) for female and 89.2% (78.3% right side, 100% left side) for male. In the DK and EVS samples no instances of the medial squatting facet were observed. χ^2-test of the EVS and DK samples shows no significant difference between males and females ($p>0.001$).

TABLE 1
DISTRIBUTION OF DK AND EVS INDIVIDUAL

			Talus (N)	Tibia (N)
Dilkaya	Female	right	21	18
		left	22	18
	Male	right	20	16
		left	19	13
Van Kalesi	Female	right	13	12
		left	10	12
	Male	right	16	23
		left	13	14

TABLE 2
THE PERCENTAGE OF THE SQUATTING FACET ON TIBIAS

	Dilkaya		Van Kalesi	
	Females	Males	Females	Males
Right Tibia	N	N	N	N
Lateral	18 (100%)	15 (93.8%)	11 (91.7%)	18 (78.3%)
Medial	–	–	–	–
Total	18	16	12	23
Left Tibia				
Lateral	17 (94.4%)	13 (100%)	10 (83.3%)	14 (100%)
Medial	–	–	–	–
Total	18	13	12	14

($p>0.001$)

The percentage of the lateral squatting facet on the talus is very high for both sites (Table 3, Figure 1). In the DK samples, the percentage of the lateral squatting facet is 72.1% (71.4% right, 72.7% left) for male, and 51.3 (50% right, 52.6% left) for male. In the EVS samples, the lat-

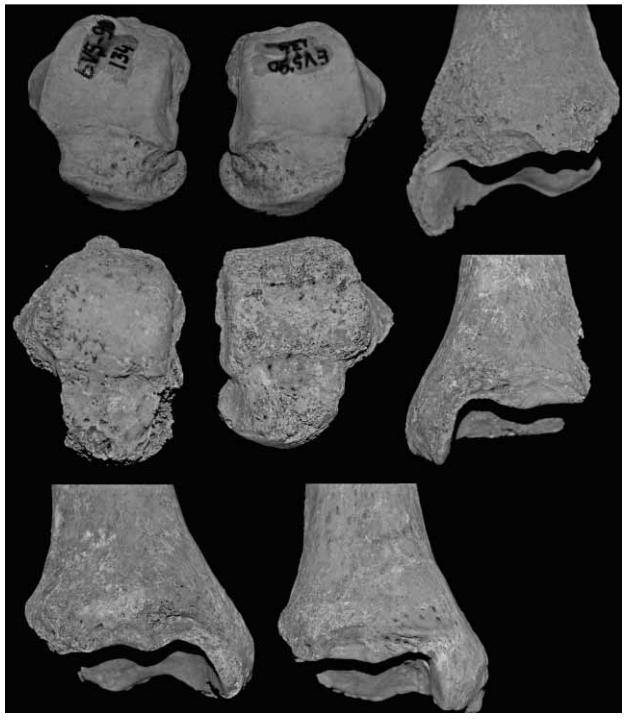

Fig. 1. Lateral Squatting Facet on Tibias and Talus from DK and EVS.

TABLE 3
THE PERCENTAGE OF SQUATTING FACET ON TALUS

	Dilkaya				Van Kalesi			
	Females		Males		Females		Males	
	Right	Left	Right	Left	Right	Left	Right	Left
Lateral	15 (71.4%)	16 (72.7%)	10 (50%)	10 (52.6%)	12 (92.3%)	9 (90%)	12 (75%)	12 (92.3%)
Medial	–	–	1 (5%)	–	–	–	–	–
Total	21	22	20	19	13	10	16	13

($p>0.001$)

eral squatting facet occurs on 91.2% (92.3% right, 90% left) of female, and 83.7%(75% right, 92.5% left) of male. In the DK samples, the medial squatting facet is found on only one male individual right talus (5%). The chi-square test of the EVS and DK samples shows no significant difference between males and females ($p>0.001$).

Discussion and Conclusions

The present study shows that the percentage of lateral squatting facet in tibias and talus are very high in both DK and EVS samples. In both site samples, the medial squatting facet is not found on the talus and tibias with the exception of one male individual right talus in the DK samples. The DK and EVS samples show an asymmetry in the manifestation of the lateral squatting facet, due to an unequal distribution of the body weight. These samples show that all of the body weight was placed on the lateral side.

The Eastern Anatolian Region of Turkey is surrounded by mountains, to the north are the East Black Sea Mountains and to the southeast are the Taurus Mountains. Tectonic activity produced these high mountain ranges, whose peaks average more then 3,000 meters in elevation. Many of the peaks are extinct volcanoes, some with lava flows dating to the fairly recent past. This mountainous region was unproductive for plant agriculture. The regional economy, consequently, was orientated around livestock. Approximately, ten percent of the land is used for agriculture in the area. The basin of Van (including both the city and the lake) is particularly high in elevation and are therefore subject to a very long winter. This short growing season, along with the high rate of erosion due to a lack of forest cover and the high relief of the area, has led to the lessened productivity of the region. In addition, the lake is high in salinity and therefore cannot be used for agriculture[23]. This sort of situation leads to hard physical activity, which has a direct effect on the human body and often leads to deformation. The high percentage of squatting facets in the populations living in this region could therefore be seen as a direct result of the environmental conditions of Eastern Anatolia.

In order to better understand ancient human activities, it is useful to examine modern human behavior. The women living in the region were cooking food, baking bread, resting, milking their animals, preparing dung, knitting rugs or working in the fields meaning that crouching was a part of daily activities. These routine activities are thought of as important factors contributing to squatting facets. The formation of squatting facets is also caused by the daily life activities of the men in the region such as plowing, animal husbandry, and especially the habit of resting by crouching. Although the archaeological data is not evaluated completely, we can understand from evidence such as spindle whorls and grinding stones that weaving and grinding the grains were a part of daily life activities. These kinds of activities might be the other reasons for the formation of squatting facets.

Similar results were found from two articles focusing on the same region. Baykara and Yılmaz[24] investigated the city of Van in Eastern Anatolia and they found that in all three archaeological samples (Dilkaya, Karagündüz, and Van Kalesi-Eski Van Şehri) there is a high degree of symmetry in pressure facets on the talus and tibia. Overall, the lateral pressure facet occurs with very high frequency whereas medial facets are very rare. The reasons for the high frequencies of lateral pressure facets are life conditions, habitual activities and postures, production economies and generally hard working conditions. Medieval society's economies depended on agriculture and husbandry activities as well as textile and ceramic production. Consistencies in pressure facets among the samples reflect the inheritance of occupations from fathers to sons and from mothers to daughter in medieval societies. The wider variety of facet types on males may reflect a wider range of occupations and activities. Another studying of the same region is os trigonum syndrome[25]. The frequency of this syndrome in medieval populations from the Van area shows that there is a correlation between lifestyles of societies and the os trigonum syndrome. Results is that these populations performed difficult or stressful motions of the feet which indicates that they were farmers, or spent a long time in a kneeling position while making ceramics by hand, grinding grain, or conducting other activities. The results of these two studies are similar to the present study. Therefore, it appears that the harsh environment of the region had a direct effect on the human body.

Tables 4 and 5 present the percentage of the squatting facets in talus and tibias to compare both studied sites and other archaeological-modern population sam-

TABLE 4
THE PERCENTAGE OF THE SQUATTING FACET ON TIBIAS

Researcher	Population	Sex	Part	Lateral Squatting Facet %	Medial Squatting Facet %	Squatting Facet %
Donlon (2000)	Chinese	Female	Left	31	8	–
Donlon (2000)	Chinese	Female	Right	54	–	–
Donlon (2000)	Chinese	Male	Left	33	–	–
Donlon (2000)	Chinese	Male	Right	42	–	–
Donlon (2000)	Hawaii	Female	Left	86	–	–
Donlon (2000)	Hawaii	Female	Right	92	–	–
Donlon (2000)	Hawaii	Male	Left	66	3	–
Donlon (2000)	Hawaii	Male	Right	81	3	–
Donlon (2000)	American's Black	Female	Left	50	–	–
Donlon (2000)	American's Black	Female	Right	48	–	–
Donlon (2000)	American's Black	Male	Left	34	–	–
Donlon (2000)	American's Black	Male	Right	33	–	–
Donlon (2000)	American's white	Female	Left	24	–	–
Donlon (2000)	American's White	Female	Right	33	–	–
Donlon (2000)	American's White	Male	Left	26	–	–
Donlon (2000)	American's White	Male	Right	33	–	–
Donlon (2000)	Aborigine	Female	Left	86	3	–
Donlon (2000)	Aborigine	Female	Right	83	21	–
Donlon (2000)	Aborigine	Male	Left	96	32	–
Donlon (2000)	Aborigine	Male	Right	88	32	–
Donlon (2000)	Aborigine	Female	Left	96	–	–
Donlon (2000)	Aborigine	Female	Right	95	–	–
Donlon (2000)	Aborigine	Male	Left	90	–	–
Donlon (2000)	Aborigine	Male	Right	95	–	–
Ari et al. (2003)	Ýznik (Late Byzantine)	Male	Left	–	–	24
Ari et al. (2003)	Ýznik (Late Byzantine)	Male	Right	–	–	24
Ari et al. (2003	Ýznik (Late Byzantine)	Male	General	–	–	48
Satinoff (1972)	Egypt	–	General	96	–	–
Thomson (1890)	European	–	General	6.6	–	–
Wood (1920)	European	–	General	17	1.7	–
Thomson (1890)	Aborigine	–	General	78.5	–	–
Wood (1920)	Aborigine	–	General	80.5	2.1	–
Charles (1893)	Indian	–	General	86.5	19.2	–
Singh (1959)	Indian	–	General	77.4	1.7	–
Morimoto (1960)	Japanese	–	General	51.4		–
Ullinger et al. (2007)	Stephen (Byzantine)	–	Left	55.9	3.6	–
Ullinger et al. (2007)	Stephen (Byzantine)	–	Right	53.4	8.8	–
Ullinger et al. (2007)	Umm el-Jimmal (Byzantine)	–	Left	77.8	–	–
Ullinger et al. (2007)	Umm el-Jimmal (Byzantine)	–	Right	70	–	–
Present study	DK	Female	Left	94.4	–	–
	DK	Female	Right	100	–	–
	DK	Male	Left	100	–	–
	DK	Male	Right	93.8	–	–
	EVS	Female	Left	83.3	–	–
	EVS	Female	Right	91.7	–	–
	EVS	Male	Left	100	–	–
	EVS	Male	Right	78.3	–	–

TABLE 5
THE PERCENTAGE OF THE SQUATTING FACET ON TALUS

Researcher	Populations	Sex	Part	Lateral Squatting Facet %	Medial Squatting Facet %
Boulle (2001a)	Favorite (France)	–	–	45.2	–
Boulle (2001a)	Michelet (France)	–	–	39	–
Boulle (2001a)	Larina (France)	–	–	38.8	–
Boulle (2001a)	Montalieu (France)	–	–	38	–
Boulle (2001a)	Macon I (France)	–	–	26.6	–
Boulle (2001a)	Macon II (France)	–	–	18.1	–
Boulle (2001a)	L'Observance (France)	–	–	20.2	–
Oygucu et al. (1998)	Ýznik (Late Byzantine)	Male	Left	41.1	–
Oygucu et al. (1998)	Ýznik (Late Byzantine)	Male	Right	34.1	1.2
Oygucu et al. (1998)	Ýznik (Late Byzantine)	Male	General	37.7	0.6
Barnett (1954)	European	–	General	2	–
Singh (1963)	Indian	–	General	28.6	–
Thomson (1890)	European	–	General	4	–
Thomson (1889)	Australians	–	General	63.6	–
Sewell (1904)	Egypt	–	General	8.6	–
Charles (1893)	Indian	–	General	64	–
Morimoto (1960)	Japanese	–	General	95.3	–
Jeyasing et al (1979	Indian (Agra)	–	General	43.5	8.6
Ullinger et al. (2004)	Stephen (Byzantine)	–	Left	50.9	8.7
Ullinger et al. (2004)	Stephen (Byzantine)	–	Right	59.6	5.9
Ullinger et al. (2004)	Umm el-Jimmal (Byzantine)	–	Left	53.3	14.3
Ullinger et al. (2004)	Umm el-Jimmal (Byzantine)	–	Right	53.8	7.1
Present Study	DK	Female	Left	72.7	–
	DK	Female	Right	71.4	–
	DK	Male	Left	52.6	–
	DK	Male	Right	50	5
	EVS	Female	Left	90	–
	EVS	Female	Right	92.3	–
	EVS	Male	Left	92.3	–
	EVS	Male	Right	75	–

ples. The Study of Eastern populations has shown that the ratio of the lateral squatting facet is higher than the medial squatting facet[2–6,10–12,16–18]. In Western sites, however, as age increases squatting facet are not seen due to decrease of squatting[4,6]. The lateral squatting facet indicators show a parallel situation between the sites in this study and other the Eastern populations.

In summary, one of the ways to reconstruct the activities of past human life is studying the squatting facet, which offers an opportunity to study the relationship between past and modern population, and also describe the daily activity of life and cultural structure.

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FACETA SAVINUTOG ZGLOBA: STUDIJA SLUČAJA POPULACIJA DILKAYA I VAN-KALESI U ISTOČNOJ TURSKOJ

SAŽETAK

Anomalije na kosturu daju informacije o životnim uvjetima, kulturalnoj strukturi i zdravstvenim problemaima u antičkim društvima. Faceta savinutog zgloba (»squatting facet«) je vrsta anomalije koja se formira na površini gdje se dodiruju goljenična kost i gležanjska kost i koja može poslužiti kao indikator dnevnih aktivnosti i životnog stila jednog društva. Cilj ove studije je otkriti dnevne aktivnosti u srednjovjekovnom društvu u području Van proučavajući facetu savinutog zgloba. Istraženi su kosturi odraslih osoba iz društava Dikaya i Van Kalesi-Eski Van Şehri koje datiraju u srednjem vijeku (65 goljeničnih i 82 gležanjske kosti iz Dilkaye, 61 goljenična i 52 gležanjske kosti iz Van Kalesi-Eski Van Şehri). Lateralna faceta imala je visok udio u oba društva. Goljenična lateralna faceta pronađena je među 97,2% žena i 96,9% muškaraca u Dilkayi, a u Van Kalesi-Eski Van Şehri 87,5% kod žena i 89,2% kod muškaraca. Gležanjska lateralna faceta pronađena je među 82,1% žena i 51,3% muškaraca u Dilkayi, a u Van Kalesi-Eski Van Şehri među 91,2% žena i 83,7% muškaraca. Rezultati daju mogućnost za istraživanje odnosa između prošlih i sadašnjih populacija te također za opisivanje svakodnevnih aktivnosti i kulturalne strukture.