Int. J. Morphol.,
38(6):1729-1734, 2020.

Morphometric Analysis of Calcaneal (Heel) Spurs in Ancient and Modern Anatolian Populations

Análisis Morfométrico de los Espolones Calcáneos en Poblaciones de Anatolia Antiguas y Modernas

Ahmet Kürsad Açıkgöz[1]; Raciha Sinem Balci[2]; Ahmet Cem Erkman[2]; Pınar Göker[1]; & M. Gülhal Bozkir[1]

AÇıKGÖZ, A. K.; BALCI, R. S.; ERKMAN, A. C.; GÖKER, P.; & BOZKIR, M. G. Morphometric analysis of calcaneal (heel) spurs in ancient and modern anatolian populations. *Int. J. Morphol., 38(6)*:1729-1734, 2020.

SUMMARY: Heel spurs are the bony protrusion seen especially on the dorsal and plantar face of the calcaneus bone at the attachment site of the muscles. It was aimed herein to obtain data about the life styles, daily lives, and especially the socioeconomic structures of modern and ancient Anatolian populations by evaluating the prevalence, location, age, and gender differences of heel spurs on the calcaneus and comparing these findings between the populations. Herein, the 251 calcaneus bones of 137 skeletons, which had been previously analyzed paleodemographically and dated to the Middle Ages, and 68 calcaneus bones belonging to a modern population, whose gender was unknown but lived in Anatolia, were examined in terms of heel spurs. In the current study, the presence of dorsal, plantar, or both dorsal/plantar heel spurs on these in 251 calcaneus bones was 43.9 %, 11.1 %, and 10.3 %, respectively. The presence of dorsal, plantar, or both dorsal/plantar heel spurs was determined as 22 %, 3 %, and 1.5 %, respectively, among the 68 calcaneus bones belonging to the modern population. When a comparison was made of the current study with studies in the literature on modern and prehistoric populations, a higher prevalence of heel spurs was found in prehistoric samples than in modern populations. It is our belief that this situation may have derived from the heavy labor force, environmental, or sociocultural differences in ancient Anatolian populations, insufficiency of vital materials due to inadequate industrial conditions, and the solution of anatomical disruption. In addition, the findings determined herein will guide the development of future and industrial studies on the foot and foot structure.

KEY WORDS: Heel spur; Calcaneus; Dorsal spur; Plantar spur.

INTRODUCTION

Anatolia has hosted many societies during the historical process and many different cultures have coexisted in this context. Paleoanthropological materials provide us with very important insight toward understanding the stresses, living conditions, socioeconomic structures, and health conditions that past societies were exposed to. In particular, the calcaneus bone, one of the best indicators of physiological stress, provides important information about life in the past.

The first ossified calcaneus bone is the largest, strongest, longest bone of the tarsal bones and forms the shape of the heel protrusion, supports body weight, and acts as a lever arm of the calf muscle (Snell, 1993; Kullar *et al*., 2014). The bony protrusion on the plantar side of the foot was first described by Plettner, a German physician, in 1900, and was named Kalkaneussporn (Micke *et al*., 2004; Kullar *et al*.). Moreover, the bone spurs, which are located on the insertions of the muscles, were named enthesophytes (Weiss, 2012). These structures are a bone growth that extends from the skeleton to the soft tissue, and appears like a spinal protrusion that splits off from the bone and adheres to the surface (Rogers *et al*., 1997; Benjamin, 2006). The most common bone spurs are observed as the dorsal spurs of the tendo calcaneus and bone spurs of the plantar fascia (Weiss) (Fig. 1). Heel spurs are a bony outgrowth that is greater than 2 mm in size that originated from the medial tubercule of the calcaneus, which is located on the plantar fascia at the level of the junction of calcaneus. The pain and sensitivity of the medial tubercule of the calcaneus on the anterior side is a characteristic symptom of heel spur syndrome (Kose *et al*., 2004).

Although the existence, shape, location, and differences between genders, and right-left sides of heel spurs have been investigated in the literature previously,

[1] Department of Anatomy, Faculty of Medicine, Çukurova University, Adana, Turkey.
[2] Department of Anthropology, Faculty of Science and Literature, Ahi Evran University, Kırsehir, Turkey.

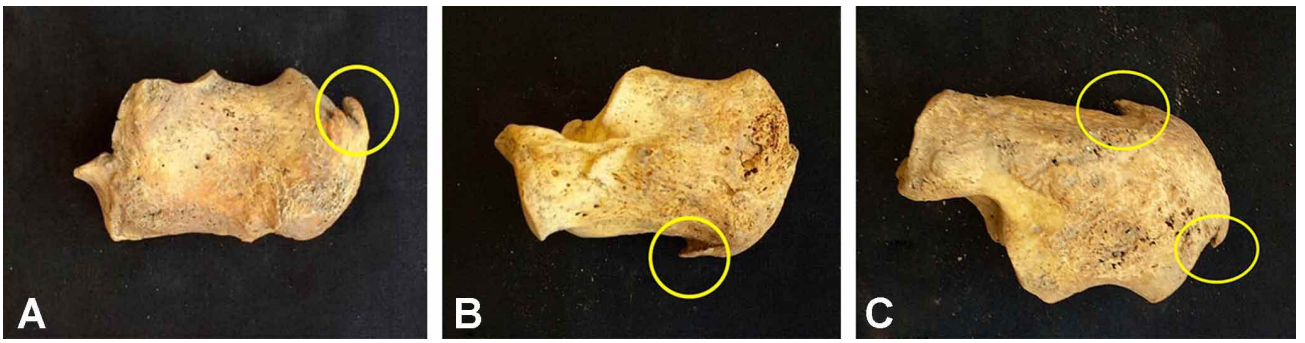

Fig. 1. (A) Dorsal heel spur, (B) Plantar heel spur, and (C) Both.

insufficient studies exist that have examined, evaluated, and compared heel spurs in modern and ancient populations in detail. Therefore, it was aimed herein to obtain data about the life styles, daily lives, and especially the socioeconomic structures of modern and ancient Anatolian populations by evaluating the prevalence, location, age, and gender differences of heel spurs on the calcaneus and comparing these findings between the populations.

MATERIAL AND METHOD

In this study, 137 skeleton samples (80 males, 57 females) that dated to the Middle Ages, which were obtained from the excavation sites of Höyüktepe, Attepe, Dereköy, Tokul (Aegean region), and Van Castle Mound (eastern Anatolian region), and their 251 calcaneus bones, in addition to 68 calcaneus bones belonging to a modern population, whose gender was unknown, were examined for the presence of heel spurs at the Anatomy Laboratory of Çukurova University Faculty of Medicine. Calcaneus bones that were deformed or exhibited pathological changes were excluded from the study.

The skeleton samples from the Middle Ages consisted of 114 bilateral and 23 unilateral calcaneus bones. The skeletons were analyzed paleodemographically by Kırsehir Ahi Evran University and are currently preserved in the Anthropology Department of Ahi Evran University. In the age determination of the adult individuals, tooth wear, auricular surface morphology with symphysis pubis in coxae, body cross-section of the clavicle, degree of closure of the sutures in the skull, changes in the sternal ends of the costae, proximal sections of the femur and humerus bones, and complex aging methods were taken into consideration and had previously been described in the literature (Çırak *et al*., 2015). The skeletons were evaluated in three categories according to age, as 18–29.9, 30–44.9, and >45.

There were no fractures or deterioration in the calcaneus that would have prevented them from being studied with regards to heel spurs. SPSS 22.0 software was (IBM Corp., Armonk, NY, USA) was used for the statistical analyses. The prevalence of heel spurs according to age and sex distribution in the populations was obtained using descriptive statistical methods.

RESULTS

The distribution of the presence of heel spurs according to location in the 251 calcaneus bones from the Middle Ages is shown in Table I.

When the 251 calcaneus bones of the skeletons in the current study were examined, it was found that the presence of only dorsal, only plantar, or both dorsal/plantar heel spores, and the total presence of heel spurs was found as 37.2 %, 0 %, 10.3 %, and 47.6 % in the males and 28.3 %, 1.9 %, 10.4 %, and 40.6 % in the females, respectively. The presence of heel spurs in all of the skeletons was 33.5 %, 0.8 %, 10.3 %, and 44.6 %, respectively (Table I).

The distribution of the presence of heel spurs according to location in the 68 calcaneus bones of the modern population is shown in Table II.

In the modern population, the calcaneal spurs were observed as only dorsal, only plantar, or both dorsal/plantar heel spurs in 20.5 %, 1.5 %, and 1.5 % of the calcaneus bones, respectively. Moreover, the total presence of heel spurs was determined as 23.5 %.

The distribution of the presence of heel spurs according to location in the 114 skeletons from the Middle Ages is shown in Table III.

Table I. Incidence of calcaneal spurs according to the calcaneal type in the population from the Middle Ages. N = 251 (n = 106 females, 145 males)

Type	Calcaneal spurs		
	Females	Males	Total
Only dorsal spurs	30 (28.3 %)	54 (37.2 %)	84 (33.5 %)
Only plantar spurs	2 (1.9 %)	0 (0 %)	2 (0.8 %)
Both dorsal /plantar spurs	11 (10.4 %)	15 (10.3 %)	26 (10.3 %)
Total	43 (40.6 %)	69 (47.6 %)	112 (44.6 %)

Table II. Incidence of calcaneal spurs according to the calcaneal type in the modern population. N = 68

Type	Calcaneal spurs
Only dorsal spurs	14 (20.5 %)
Only plantar spurs	1 (1.5 %)
Both dorsal /plantar spurs	1 (1.5 %)
Total	16 (23.5 %)

Table IV. Distribution of heel spurs according to age. N = 106

Age group	Calcaneal spurs
18 to 29.9 years	1 (5 %)
30 to 44.9 years	24 (52.1 %)
> 45 years	23 (57.5 %)

Table III. Incidence of calcaneal spurs according to the calcaneal type in the skeletons from the Middle Ages. N = 114 (n = 51 females, 63 males).

Type	Calcaneal spurs		
	Females	Males	Total
Only dorsal spurs	14 (27.4 %)	23 (36.5 %)	37 (32.4 %)
Only plantar spurs	2 (3.9 %)	0 (0 %)	2 (1.8 %)
Both dorsal/plantar spurs	6 (11.8 %)	8 (12.7 %)	14 (12.3 %)
Total	22 (43.1 %)	31 (49.2 %)	53 (46.5 %)

The distribution of heel spurs according to age, in the 106 skeletons whose age was known, is shown in Table IV.

When the presence of heel spurs in the 114 skeletons from the Middle Ages was examined, the presence of only dorsal, only plantar, both dorsal/plantar spurs, and the total presence of heel spurs was 36.5 %, 0 %, 12.7 %, and 49.2 % in males and 27.4 %, 3.9 %, 11.8 %, and 43.1 % in females, respectively. The presence of heel spurs in all of the skeletons was 32.4 %, 1.8 %, 12.3 %, and 46.5 %, respectively (Table III). In addition, the presence of heel spurs in the 106 skeletons with a known age was 5 % in the 18–29.9 year age group, 52.1 % in the 30–44.9 year age group, and 57.5 % in the >45 year age group (Table IV).

Table V. Comparison of the presence of heel spurs in the calcaneus bones of the modern and medieval populations.

Type	Calcaneal spurs	
	Medieval	Modern
Only dorsal spurs	84 (33.5 %)	14 (20.5 %)
Only plantar spurs	2 (0.8 %)	1 (1.5 %)
Both dorsal/plantar spurs	26 (10.3 %)	1 (1.5 %)
Total	112 (44.6 %)	16 (23.5 %)

The comparison of the presence of heel spurs in the calcaneus bones of the modern and medieval populations is shown in Table V.

When the bones from modern population and that from the Middle Ages were examined with regards to the presence of heel spurs, it was observed that the prevalence was higher in the medieval population.

The comparison of the presence of heel spurs in studies conducted on modern and prehistoric populations is shown in Table VI.

Table VI. Comparison of heel spurs in different studies.

Researchers	Region/ population	Period	Study group	N	Calcaneal spurs (%)			
					Plantar	Dorsal	Both	Total
Resnick *et al.* (1977)	America	20th century	Normal control patients	75	16	11	4	22
Prichasuk & Subhadrabandhu (1994)	Thailand	20th century	Normal subjects	400	-	-	-	15.5
			Patients with plantar heel pain	82	-	-	-	65.9
Galera & Garralda (1993)	Spain	Early Middle Ages	Skeletal sample	70	-	15.71	-	-
Riepert *et al.* (1995)	Caucasian	20th century	Normal patients	1027	11.2	9.3	-	15.7
Kullar *et al.* (2014)	India	21st century	Dry human calcaneus	200	6.5	15.5	4.5	26.5
Marker (2016)	Nubian population/Kulubnarti	Medieval	Skeletal sample	98	51	35.7	-	-
Cermak & Kirchengast (2015)	Africa	19th century	Skeletal sample	54	-	-	-	13
Menz *et al.* (2008)	Australia	21st century	Between 62–94 years of age	216	55	48	-	-
Bassiouni (1965)	Egypt	20th century	Rheumatoid arthritis	282	-	-	-	21.6
			Osteoarthrosis	168	-	-	-	81
			Controls	80	-	-	-	16.2
Weiss (2012)	America	Dated 2180 to 250 BP	Skeletal sample	117	-	-	-	34.2
Chundru *et al.* (2008)	America	21st century	With atrophy of the abductor digiti minimi muscle	100	-	-	-	48
			Without atrophy of the abductor digiti minimi muscle	100	-	-	-	7
Perumal & Anand (2013)	India	21st century	Dry human calcaneus	218	-	-	-	56
Kose *et al.* (2004)	Turkey	Between 1994–1997	Without plantar heel pain	120	-	-	-	8.3
			With plantar heel pain	73	-	-	-	60.2
Present study (2020)	Anatolia	Medieval	Skeletal sample	114	1.8	32.4	12.3	46.5
			Dry human calcaneus	251	0.8	33.5	10.3	44.6
		20th century	Dry human calcaneus	68	1.5	20.5	1.5	23.5

DISCUSSION

Heel spurs are a common problem and even though there are several studies about heel spurs in the literature, they remain poorly understood. The present study focused on analyzing the presence, location, age, and gender differences of heel spurs, evaluating data on the lifestyles, daily lives, and socioeconomic structures of ancient and modern Anatolian populations, and comparing these data with modern and ancient populations.

When focus was aimed at previous studies conducted on ancient populations, it was demonstrated that spur formation increased with age. In prehistoric hunter-gatherer populations, the presence of heel spurs was found as 34.2 % in the 117 skeletons in America (Weiss). In a study conducted on the San and Khoi skeleton collection, examinations were performed on 54 skeletons and the presence of heel spurs was found as 13 % (Cermak & Kirchengast, 2015). Furthermore, a study of enthesopathies in a medieval Spanish population revealed a dorsal plantar spur prevalence of 15.71 %. In other study, the presence of plantar and dorsal spurs was observed as 51 % and 35.7 %, respectively, in a medieval Nubian population (Marker, 2016). In the skeleton samples examined herein, the presence of heel spurs in the 114 skeletons of the ancient population who lived in Anatolia was observed as 46.5 % in the skeletons and 44.6 % in the calcaneus bones. All of these prevalences were lower than those determined in the current study. These differences may have derived from racial factors and the different living periods and conditions of the populations.

Moreover, many studies have been performed on modern population samples. In a study of radiographic images that focused on gross morphological and histological examinations to find the influencing effects of heel spurs, it was reported that the development of the heel spurs might be a response to stress (Li & Muehleman, 2007). A study conducted regarding related factors of calcaneal spurs emphasized that there were no differences between genders. However, it was reported that spurs were more common among older participants, obesity was related to calcaneal spurs, and heel spurs were more common in females than in males and in participants over the age of 40 (Bassiouni, 1965; Kose *et*

al.; Menz *et al*., 2008). As a result of the examinations conducted in the current study, it was found that heel spurs were more common among males.

When previous studies were analyzed with regards to the prevalence of dorsal/plantar spurs in different populations, the presence of heel spurs was determined as 26.5 % in an Indian population by Kullar *et al*. and 22 % by Resnick *et al*. (1977). The prevalence was determined as 15.5 % in 400 individuals by Prichasuk & Subhadrabandhu (1994) and similarly, as 15.7 % by Riepert *et al*. (1995) in a study of radiographic images obtained from a Caucasian population.

When focusing specifically on studies of plantar spurs, the prevalence was determined as 16 % by Resnick *et al*. and 11.2 % in a Caucasian population by Riepert *et al*. In contrast to these results, Kullar *et al*. determined the prevalence of plantar spurs as 6.5 %. On the other hand, Menz *et al*. determined the prevalence of plantar spurs as 55 % in an Australian population. In the current study, the prevalence was determined as 1.8 % in the skeleton samples and 0.8 % in the calcaneus bones. The results herein were lower than all of those reported in the abovementioned studies and resulted from differences in the age, race, era in which they lived, and living conditions of the populations. According to the literature findings, when the prevalence of dorsal spurs was analyzed, Resnick *et al*. reported a presence of 11 % and Riepert *et al*. reported it as 9.3 %. Similarly, it was reported as 15.5 % in an Indian population by Kullar *et al*. Dorsal spur prevalence was reported as 48 % in a study conducted on an Australian population by Menz *et al*. The prevalence was determined as 32.4 % in skeletons and 33.5 % in calcaneus bones. Hence, Menz *et al*. obtained highest prevalence results for dorsal and plantar spurs among all of the abovementioned studies. This difference mayhave derived from their study population, which comprised individuals between 64 and 92 years of age. It has been estimated that this remarkable difference may have been based on age differences. Some studies in the literature have focused on the relationship between heel spurs and some disorders. A study that was conducted on chronic plantar heel pain patients revealed a spur prevalence of 12.4 % and they were more common in women and older patients (Moroney *et al*., 2014). It was revealed that the incidence of calcaneal spurs in normal subjects was 8.3 %, while in plantar heel pain patients, it was 60.2 % (Kose *et al*.). Moreover, in a study of patients with rheumatoid arthritis and osteoarthrosis, it was determined that the prevalence of heel spurs was maximum in patients with osteoarthrosis (81 %), followed by patients with rheumatoid arthritis (21.6 %), and the controls (16.2 %) (Bassiouni). In an investigation focused on a comparison of calcaneal spurs in patients with and without abductor digiti minimi muscle atrophy, it was reported that patients with atrophy had significantly greater prevalence of calcaneal spurs. In addition, research performed on the radiographs of calcaneal spurs and plantar fasciitis aimed to improve the calcaneal spur grading system and compare the prevalence and size of calcaneal spurs between the plantar fasciitis and the control groups using an improved system. They reported that the prevalence of moderate or severe spurs was 60 % in the plantar fasciitis group, while it was 2.5 % among the controls (Wainwright *et al*., 1995).

In conclusion, when the results of the current study was compared with studies performed on modern and prehistoric populations, the presence of heel spurs was determined to be very high in the ancient populations. It is our belief that this situation may have derived from the heavy labor force, environmental, and sociocultural differences in ancient Anatolian populations, insufficiency of vital materials due to inadequate industrial conditions, and the solution of anatomical disruption.

In present day populations, the presence of heel spurs is low when compared to those in ancient populations, indicating the importance of the impact of industrial development on human health. We believe that the incidence of heel spurs will decrease due to the development of industrial designs. Furthermore, the findings presented herein will guide both future and industrial studies.

At the present time, the use of inappropriate shoes, such as high-heeled shoes, is one of the reasons for the increase in the presence of heel spurs in women. In addition, being active in business life, for women as well as men, can be considered as another factor that increases in the presence of heel spurs.

ACKNOWLEDGEMENTS

This project was supported by the Unit of Scientific Research Projects of Cukurova University. An early version of this manuscript was presented at the 1st International Congress on Sports, Anthropology, Nutrition, Anatomy and Radiology (SANAR 2018)

AÇıKGÖZ, A. K.; BALCI, R. S.; ERKMAN, A. C.; GÖKER, P. & BOZKIR, M. G. Análisis morfométrico de los espolones del calcáneo (espuelas del talón) en poblaciones de anatolia antiguas y modernas. *Int. J. Morphol., 38(6)*:1729-1734, 2020.

RESUMEN: Los espolones del talón son la protuberancia ósea que se ve especialmente en la cara dorsal y plantar del hueso calcáneo en el sitio de inserción de los músculos. El objetivo de este trabajo consistió en obtener datos sobre los estilos de vida, la

vida cotidiana y, especialmente, las características socioeconómicas de las poblaciones anatolias modernas y antiguas mediante la evaluación de la prevalencia, la ubicación, la edad y las diferencias de sexo de los espolones calcáneos y comparar estos hallazgos entre los poblaciones. La muestra consistió en 251 calcáneos correspondientes a 137 esqueletos, que habían sido previamente analizados paleodemográficamente y fechados en la Edad Media; también se incluyeron 68 calcáneos pertenecientes a una población moderna de Anatolia, sin distinción de sexo. De la muestra de 251 calcáneos, se encontraron espolones calcáneos dorsales, plantares y dorsales/plantares, en el 43,9 %, 11,1 % y 10,3 %, respectivamente. La presencia de espolones calcáneos dorsales, plantares y dorsales/plantares se determinó en el 22%, 3% y 1,5%, respectivamente, entre los 68 calcáneos pertenecientes a la población moderna. Cuando se realizó una comparación del estudio actual con la literatura sobre poblaciones modernas y prehistóricas, se encontró una mayor prevalencia de espolones calcáneos en muestras prehistóricas que en poblaciones modernas. Creemos que esta situación puede haberse derivado a la gran fuerza de trabajo, y las diferencias ambientales o socioculturales en las antiguas poblaciones de Anatolia, la insuficiencia de materiales vitales debido a las condiciones industriales inadecuadas produjo la alteración anatómica. Además, los hallazgos aquí determinados guiarán el desarrollo de estudios futuros e industriales sobre la estructura del pie.

PALABRAS CLAVE: Espolón calcáneo; Espolón dorsal.

REFERENCES

Bassiouni, M. Incidence of calcaneal spurs in osteo-arthrosis and rheumatoid arthritis, and in control patients. Ann. Rheum. Dis., 24(5):490-3, 1965.

Benjamin, M.; Toumi, H.; Ralphs, J. R.; Bydder, G.; Best, T. M. & Milz, S. Where tendons and ligaments meet bone: attachment sites ('entheses') in relation to exercise and/or mechanical load. *J. Anat., 208(4)*:471-90, 2006.

Cermak, C. & Kirchengast, S. Calcaneal spurs among San and Khoi skeletons. *Anthropol. Anz., 72(1)*:107-15, 2015.

Chundru, U.; Liebeskind, A.; Seidelmann, F.; Fogel, J.; Franklin, P. & Beltran, J. Plantar fasciitis and calcaneal spur formation are associated with abductor digiti minimi atrophy on MRI of the foot. *Skeletal Radiol., 37(6)*:505-10, 2008.

Çırak, A.; Karaöz, S. A.; Erkman, A. C. & Acar, E. Khalkeritis ve Tokul S¸apel I˙skeletlerinin Travma Analizi. *HÜSBED, 8(2)*:493-504, 2015.

Galera, V. & Garralda, M. D. Enthesopathies in a spanish medieval population: Anthropological, epidemiological, and ethnohistorical aspects. *Int. J. Anthropol., 8(4)*:247-58, 1993.

Kose, N.; Gokturk, E.; Turgut, A.; Seber, S. & Hazer, B. The relationship between pes planus and calcaneal spur to plantar heel pain. *Acta Orthop. Traumatol. Turc., 32(4)*:322-4, 2004.

Kullar, J. S.; Randhawa, G. K. & Kullar, K. K. A study of calcaneal enthesophytes (spurs) in Indian population. *Int. J. Appl. Basic Med. Res., 4(Suppl. 1)*:S13-6, 2014.

Li, J. & Muehleman, C. Anatomic relationship of heel spur to surrounding soft tissues: greater variability than previously reported. *Clin. Anat., 20(8)*:950-5, 2007.

Marker, L. *Bioarchaeological Implications of Calcaneal Spurs in the Medieval Nubian Population of Kulubnarti*. Undergraduate Honors Thesis. Boulder, University of Colorado Boulder, 2016.

Menz, H. B.; Zammit, G. V.; Landorf, K. B. & Munteanu, S. E. Plantar calcaneal spurs in older people: longitudinal traction or vertical compression? *J. Foot Ankle Res., 1(1)*:7, 2008.

Micke, O.; Seegenschmiedt, M. H. & German Cooperative Group on Radiotherapy for Benign Diseases. Radiotherapy in painful heel spurs (plantar fasciitis)--results of a national patterns of care study. *Int. J. Radiat. Oncol. Biol. Phys., 58(3)*:828-43, 2004.

Moroney, P. J.; O'Neill, B. J.; Khan-Bhambro, K.; O'Flanagan, S. J.; Keogh, P. & Kenny, P. J. The conundrum of calcaneal spurs: do they matter? *Foot Ankle Spec., 7(2)*:95-101, 2014.

Perumal, A. & Anand, A. Morphometric study of spur formation in dry adult human calcaneae. *Int. J. Curr. Res. Rev., 5(7)*:93-7, 2013.

Prichasuk, S. & Subhadrabandhu, T. The relationship of pes planus and calcaneal spur to plantar heel pain. *Clin. Orthop. Relat. Res., (306)*:192-6, 1994.

Resnick, D.; Feingold, M. L.; Curd, J.; Niwayama, G. & Goergen, T. G. Calcaneal abnormalities in articular disorders. Rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, and Reiter syndrome. *Radiology, 125(2)*:355-66, 1977.

Riepert, T.; Drechsler, T.; Urban, R.; Schild, H. & Mattern, R. The incidence, age dependence and sex distribution of the calcaneal spur. An analysis of its x-ray morphology in 1027 patients of the central European population. *Rofo, 162(6)*:502-5, 1995.

Rogers, J.; Shepstone, L. & Dieppe, P. Bone formers: osteophyte and enthesophyte formation are positively associated. *Ann. Rheum. Dis., 56(2)*:85-90, 1997.

Snell, R. S. *Bones of the Foot.* In: Clinical Anatomy for Medical Students. 6th ed. Philadelphia, Lippincott, Williams & Wilkins, 1993. pp.551-2.

Wainwright, A. M.; Kelly, A. J. & Winson, I. G. Calcaneal spurs and plantar fasciitis. *Foot, 5(3)*:123-6, 1995.

Weiss, E. Calcaneal spurs: examining etiology using prehistoric skeletal remains to understand present day heel pain. *Foot (Edinb.), 22(3)*:125-9, 2012.

Corresponding author:
Dr. Ahmet Kürsad Açikgöz, Ph.D.
Faculty of Medicine, Department of Anatomy
Çukurova University, 01330
Adana
TURKEY

Email:akacikgoz@cu.edu.tr
ahmetkursadacikgoz@gmail.com

Received: 06-05-2020
Accepted: 10-08-2020