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Original Article

Study of calcaneal spurs and lateral tubercular bar in Indian population

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ABSTRACT

Introduction: A spur or an enthesophyte is a bony outgrowth at the site of attachment of a ligament or tendon into a bone. Calcaneal spurs are more common, usually associated with the attachment of plantar fascia to the calcaneus. The aim of this study is to analyse the incidence of calcaneal spurs and correlate it with the pattern of talar facets of calcanei in Indian population.

Materials and method: 300 dry human calcanei were classified on the basis of talar articular facets present on its superior surface. The presence of plantar and tendoachilles spurs was looked for and their incidence was calculated.

Results: Type I calcaneus was predominant (78.7%) in the Indian population with least incidence being type IV (1.3%). Of the 300 calcanei, 39.33% presented with spurs [plantar (15%); tendoachilles (12.33%); both (11%); sustentaculum tali (1%)]. Calcaneal spurs were more frequent in type I calcanei. In addition to that the presence of a lateral tubercle bar enclosing a foramen was noted in 8.66%.

Discussion: The presence of sustentaculum tali spurs and lateral tubercle bar is reported for the first time in this study. The morphological patterns of talar articular facets of the calcaneus contribute to the stability of the talocalcaneal articulation. Anatomical knowledge of the structures on the plantar aspect of hind foot is crucial for distinct localisation of a calcaneal spur which may affect the choice of therapy.

1. Introduction

The calcaneus is the strongest of the tarsal bones and forms the prominence of the heel. It serves as the junction between the lower extremity and the foot and acts as a calf muscle lever.[1] Its architecture and articulations ensure stress conduction for weight bearing and to maintain normal function of hind foot. It is an irregular-shaped bone with 6 surfaces: dorsal (superior), plantar (inferior), posterior, anterior, medial and lateral surfaces. The posterior part of the plantar surface presents the calcaneal tuberosity which has medial and lateral tubercles. The medial tubercle is broader and contacts the ground during standing.[2] The superior surface of the calcaneus bears articular facets for the inferior surface of the body of the talus namely the anterior, middle and posterior talar facets. Four types of calcanei are described on the basis of talar articular facets – type I: one continuous anterior and middle facet; type II: separate anterior and middle facet; type III: single facet present limited to sustentaculum tali and no anterior facet; type IV: posterior, middle and anterior facets confluent[3] (Fig. 1). The calcaneus is composed of trabecular bone in which the traction trabeculae radiate from the inferior portion of the calcaneus and compression trabeculae converge to support the posterior and anterior talar articular facets.[4] The integrity of calcaneal anatomic morphology is vital to maintain normal function of hindfoot, supporting modality of arch and to ensure stress conduction for weight bearing.[5]

A spur or an enthesophyte is defined as a bony outgrowth at the site of attachment of a ligament or tendon into a bone and grows further in the direction of natural pull of that ligament or tendon.[6] The development of bony spur in the body is well recognised. The supracondylar spur on the medial side of humerus was first described by Robert Knox in 1841.[7] Calcaneal spurs are more common, usually associated with the attachment of plantar fascia to the calcaneus. They are of two types: plantar/inferior spurs and tendoachilles/posterior spurs.[8]

The morphological patterns of the talar articular facets of the calcaneus contribute to the stability of the talocalcaneal articulation. Anatomical knowledge of the talar facet configuration might be useful when performing calcaneal lengthening osteotomy.[9] The purpose of the present study is to analyse the incidence of calcaneal spurs and correlate it with the pattern of talar facets of calcanei in Indian population.

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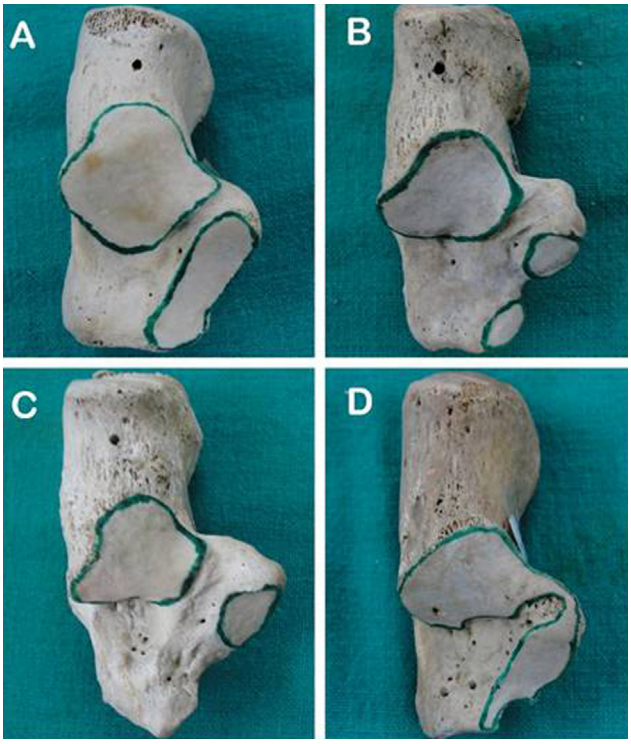

Fig. 1. Types of calcanei. (A) Type I: one continuous anterior and middle facet; (B) type II: separate anterior and middle facet; (C) type III: single facet present limited to sustentaculum tali and no anterior facet; (D) type IV: posterior, middle and anterior facets confluent (3).

2. Materials and methods

300 dry (142 right and 158 left) human calcanei of unknown sex from the Department of Anatomy, of our institution, were used for the present study. The calcanei were labelled from 1 to 300 with suffix R (right) or L (left). The calcanei were classified on the basis of talar articular facets present on the middle-third of superior surface. The presence of plantar and tendoachilles spurs was looked for and their incidence was calculated.

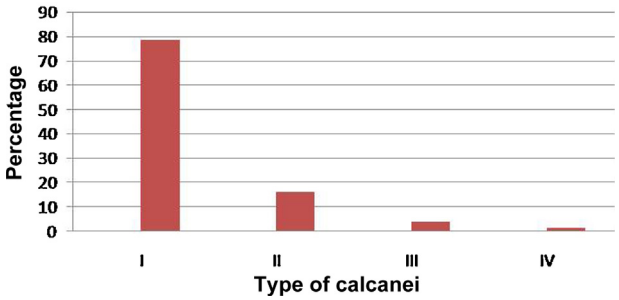

Fig. 2. Incidence of types of calcanei in Indian population.

3. Results

Detailed analysis of patterns of talar articular facets of calcaneus showed that the incidence of type I calcaneus was predominant (78.7%) in the Indian population with least incidence being type IV (1.3%) (Fig. 2).

Out of the 300 calcanei observed, 118 calcanei (39.33%) presented with either plantar (15%) or tendoachilles (12.33%) or both (11%) spurs and 3 (1%) of the calcanei showed spur in the posterior aspect of sustentaculum tali (Fig. 3).

The incidence of spurs in each type of the calcanei is given in Table 1.

In addition, the presence of a well-defined bony bar extending from the lateral tubercle of the calcaneal tuberosity to the inferolateral border of calcaneum, enclosing a foramen was noted in 26 calcanei (8.66%; right – 16; left – 10) (Fig. 4).

4. Discussion

Bony changes seen in adult skeletons include osteophytes and enthesophyte formation. Osteophytes can be defined as lateral outgrowths of bone at the margin of the articular surface of a

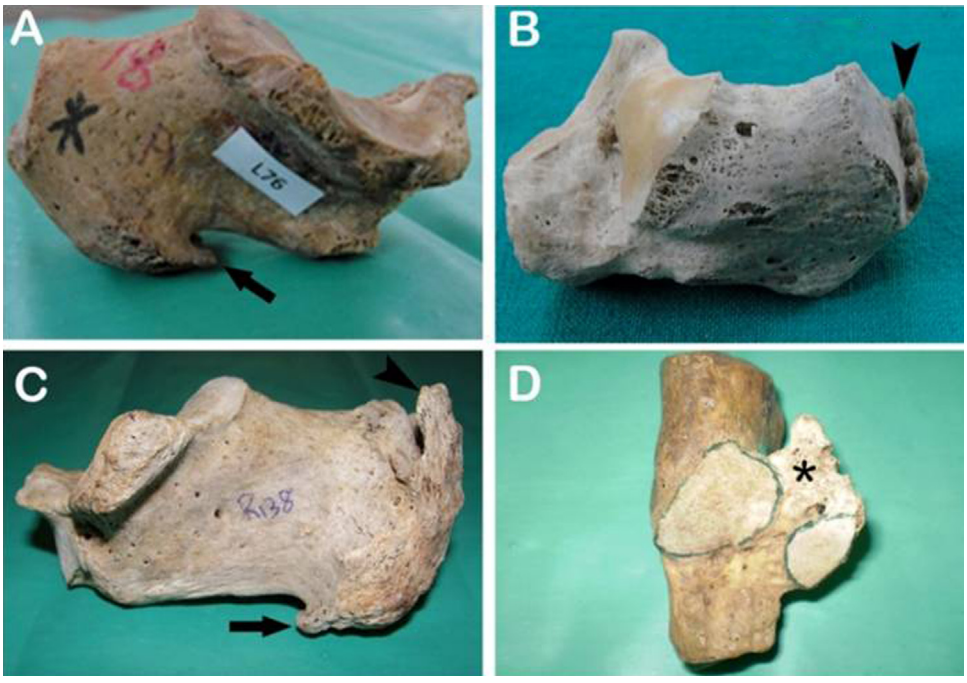

Fig. 3. Spur types. (A) Plantar spur; (B) tendoachilles spur; (C) plantar spur (bold arrow) and tendoachilles spur (double arrow); (D) sustentaculum tali spur (asterisk).

Table 1
Incidence of spurs in each calcaneal type.

Spur type	Total number	%	Percentage of calcaneal type			
			Type I	Type II	Type III	Type IV
Plantar spur ($n=45$)	45	15	13	1.3	0.3	0.3
Tendoachilles spur ($n=37$)	37	12.33	8.3	3	0.6	0.3
Plantar + tendoachilles spur (33)	33	11	8	2.3	0.6	0
Sustentaculum tali spur	3	1	0.3	0.3	0.3	0

synovial joint. An enthesophyte is a bony spur forming at a ligament or tendon insertion into bone, growing in the direction of the natural pull.[6] Both osteophyte and enthesophyte can be regarded as skeletal responses to stress. Spur formation on the plantar aspect of the calcaneus was first reported by the German physician Plettner in 1900.[10] The incidence of calcaneal spurs is variable in different populations, 55% in Australian population,[10] 22% in Asian population,[11] 15.5% in Thailand population[12] and 15.7% in Caucasian.[13] While Perumal and Anand (2013) reported spurs in 56% of the South Indian population[14] and Kullar et al. reported 26.5% in Punjab, India,[15] the present study shows the incidence of calcaneal spurs as 39.3% in the South Indian population.

In the present study, the incidence of plantar spurs was more than that of tendoachilles spurs which is in accordance with Menz et al.,[10] Resnick et al.[11] and Riepert et al.[13] But Kullar et al. reported lower incidence of plantar spurs in Punjabis.[15] Menz et al. observed that plantar spurs were more likely associated with tendoachilles spurs.[10] In this study, the combination of both plantar and tendoachilles spurs were found in 11% calcanei.

Calcaneal spurs were more commonly found in type I calcanei (plantar – 13%; tendoachilles – 8% and both in 8% calcanei). Kullar et al. reported that they found no spurs in type III calcanei.[15] In the current study, calcaneal spurs were present in all types of calcanei with lowest incidence in type IV (0.3%). For the first time, we report the presence of spurs in the posterior aspect of sustentaculum tali.

The cause for formation of a calcaneal spurs is multifactorial. Calcaneal spurs are associated with obesity which can hasten the degenerative changes occurring in the plantar heel region.[9] They are also found in higher frequency in individuals with abductor digiti minimi atrophy.[16] Plantar calcaneal spurs are also associated with osteoarthritis. Though plantar calcaneal spurs are more prevalent in elderly, calcaneal spurs have been reported in younger age group also.[17] In the present study, the plantar calcaneal spurs originated from the medial tubercle which could be due to the conjoined origin of the muscles of the first layer of the sole and the plantar aponeurosis from the medial tubercle of calcaneus.[18] The plantar spurs were always directed anteriorly. This could be due to the traction of plantar fascia. Controversy exists in the pathophysiology of plantar spurs. Plantar spur develops as a result of tensile forces due to traction of the structures attached to calcaneus.[19] But Kumai and Benjamin proposed that plantar spurs develop from vertical compression and not due to traction.[20] because plantar spurs do not develop within the plantar fascia itself. In addition, studies have shown that in plantar spurs the bony trabeculae are vertically oriented in the direction of stress on the calcaneus during walking and standing and not in the direction of soft tissue traction.[21] The tendoachilles spurs were always directed superiorly due to the pull of tendocalcaneus. Spur formation in the tendocalcaneus and the plantar fascia could possibly be related to the transfer of mechanical stress from site to site.[19] Weiss et al. recently observed that tendoachilles spurs are due to the sustained activities but plantar spurs are related to long periods of standing and excess weight.[22]

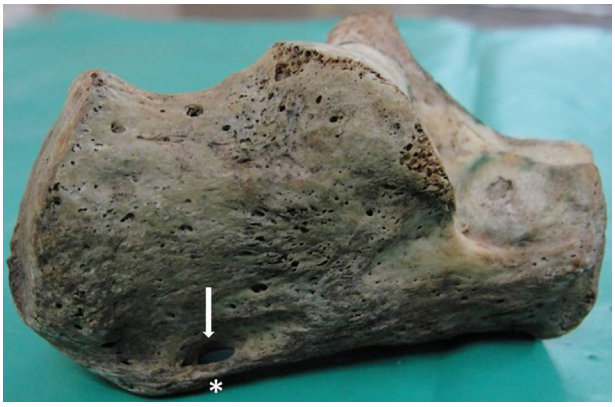

Fig. 4. Lateral tubercle foramen (white arrow), lateral tubercle bar (asterisk).

Usually calcaneal spurs are asymptomatic, but at times can cause heel pain. The possible explanations for a symptomatic calcaneal spur include large size spur, fracture of the spur, nerve entrapment and fat pad abnormalities resulting in increased shock transmission to the spur. Extrinsic causes such as occupational environment, level of physical activity and footwear may also a play a role in the development of symptomatic calcaneal spurs.[10] The potential methods for treatment of calcaneal spur include surgical resection with or without release of plantar fascia, extracorporeal shock wave treatment, endoscopic removal, osteotripsy and laser therapy.[20,23] Radiotherapy is one of the safest, cheapest and effective treatment modality for painful plantar heel.[24]

Plantar fasciitis due to calcaneal spur is one of the most common causes for inferior heel pain.[25] It is frequently diagnosed in sportsmen and professional athletes accounting for 10% total injuries. Recent studies have shown that cryoultrasound therapy has more beneficial effects in the treatment of chronic plantar fasciitis with heel spurs in comparison to cryotherapy alone.[26] Plantar fasciitis is caused by repetitive microtrauma at the point of its calcaneal insertion. A branch of the lateral plantar nerve passes between the plantar spur and deep surface of flexor digitorum brevis muscle. This structure has been implicated as a neurogenic cause for focal plantar pain.[27]

The bony bar extending from the lateral tubercle in the present study might probably be a spur extending from the lateral process of the calcaneal tuberosity within the plantar fascia. The plantar fascia is generally considered as the major structure in which the spurs develop.[20] The lateral part of the plantar fascia which covers the abductor digiti minimi is thin distally. But proximally, it is thick, and forms a strong band, sometimes containing muscle fibres, between the lateral tubercle of the calcaneal tuberosity and the base of the fifth metatarsal bone.[2] This could have undergone histological changes including connective tissue hyperplasia and bone formation. New bone formation is one of the main components of the response of musculoskeletal system to stress and injury.[6] This bony bar was found to enclose a well distinguished foramen which could probably conduct the neurovascular bundle present on the lateral aspect of the calcaneus, i.e. calcaneal branches of fibular artery and lateral calcaneal branches of sural nerve. The passage of blood vessels and nerves through this foramen makes it clinically important as it may lead to entrapment

neuropathy and necrosis. It should be kept in mind that the lateral approach to the calcaneus has been associated with skin necrosis.[21]

5. Conclusion

In conclusion, the present study shows that the calcaneal spurs are more frequent in type I calcanei of Indian population. Anatomical knowledge of the correlation between calcaneal spur and type of calcaneum may be of significant clinical interest to foot and ankle surgeons in clinical practice. In a significant number of human calcanei, lateral tubercle bar enclosing a foramen was noted, anatomical reports of which are not available in the literature. A cadaveric or a radiological study may provide better understanding of neurovascularisation of this foramen.

Conflicts of interest

The authors have none to declare.

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