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MORPHOMETRIC STUDY OF SPUR FORMATION IN DRY ADULT HUMAN CALCANEAE

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ABSTRACT

The calcaneum is a key tarsal bone in the skeleton of the foot. When a person stands, the calcaneum forms a focal point for transmission of weight. Due to long standing hours and disorders like obesity and diabetes, there is an abnormal growth of bony spur on the inferior surface of the calcaneum either due to calcification or deposition of calcium salts on the fibrous tissue attached to the tubercles. Many studies have highlighted the radiological existence of the spur based on western population. This study is centered around the Morphometric analysis of the calcaneal spur. 218 calcaneae were analyzed. Spur formation in 122 bones was observed. The mean length was more in the right (0.95cm) than left side(0.87cm).The mean breadth was also more in the right (1.73cm) than left (1.71cm). Variations of shape of spur like triangular, circular and oblong shape were categorized. There is a significant difference between radiological appearance and naked eye examination. The findings will serve as a guideline to foot and ankle surgeons who deal with calcaneal spurs.

Keywords: Calcaneum, calcaneal spur, heel pain

INTRODUCTION

The calcaneum is the key bone and the largest¹ in skeleton of the foot which plays the most significant role in transmission of weight, weight bearing, posture and gait. Very rarely the calcaneum may also present itself with a set of accessory bones¹. Such accessory bones of the calcaneum presenting in the inferior or the plantar surface is the os sub calcis and os aponeurosis plantaris. Due in improvement in the quality of life, there is an increase of life expectancy. Increased life expectancy leads to an aging population and presents itself with diseases and conditions associated with it. Out the diseases associated with the formation of a calcaneal spur, obesity plays an important role². Although the mechanism of formation of calcaneal spur is not clearly understood it has been suggested that it could either due to longitudinal traction or due to

vertical compression and but are yet inconclusive regarding the formation of a spur. Most of the studies on calcaneal spurs have focused mainly on radiological appearance and in some cases the histological architecture and during observation during surgery. This study centers around the calcaneal spurs which are observed by naked eye examination. Whatever be the cause of origin of the calcaneal spur, it results in heel pain for the affected person and leads to an interferes activities of daily living. Persons whose profession involves standing for long hours are the most affected³. Usually the affected individuals are adults however there are reported cases of calcaneal spur occurring in young individuals also⁴. There also exists a higher frequency of calcaneal spur formation in individuals with abductor digiti minimi atrophy⁵.

MATERIALS AND METHODS

218 Dry Human calcaneae from the Department of Anatomy, Vinayaka Missions Kirupananda Variyar Medical College, Salem were obtained for the study. The calcaneae without spur formation were excluded from the study. Those calcaneae with spurs were measured using a vernier calipers and photographed using digital photographic equipment. A hand lens was used for close examination of the calcaneal spur.

The calcaneae with spurs were subjected to the following parameters.

- Length of the spur
- Breadth of the spur
- Thickness of the spur
- Any other bony variation

RESULTS

Out of the 218 calcaneae observed, only 122 calcaneae exhibited spur formation (n=122). The differences in the sides were also categorized (Table-1). The length of the calcaneal spur was measured in which the right sided spurs were longer than the left side (Table-2). There was only a marginal difference in the breadth of the spur of the right and the left sides and the right sided spurs were broader than the left (Table-3). Also the thickness of the spur were more on the right than the left (Table-4). The variations in the shape of the spur were categorized (Table-5). The resultant measurements were statistically analyzed (Table-6).

DISCUSSION

In the present study it is observed that there was no spur formation from the lateral tubercle of calcaneum and the calcaneal spurs originated from the medial tubercle predominantly and in a miniscule percentage the spur took origin from both the tubercles. This extended presence could be due to the muscles of the first layer of sole and the plantar aponeurosis conjoin to form a single origin at the medial calcaneal tubercle as reported

by Simon Smith⁶ et al. (2007). All the calcaneal spurs were visualized as a hook like projection when viewed from the side whereas in true sense it had a broad margin. The formation of the spurs were due to compression force exerted on the calcaneum during weight bearing. This could be due to an increased load and calcaneal spurs were a resultant feature from obesity⁷ as reported by Jakob C Thorud et al.

The cause for formation of a calcaneal spur is multifactorial but it is evident from the present study that the spur is of various sizes and shapes. There is a preponderance towards a bigger right sided spur than the left which could be due to biomechanical reasons. In all the bones studied the spurs appeared to be an extension from the medial tubercle of the calcaneum rather than a new bone formation and in some of the bones the presence of vascular foramina points out that it had incorporated into and had become an integral part of the medial tubercle of calcaneum. Calcification of the structures attached to the medial tubercle was not observed in any of the bones.

The presence of a calcaneal spur affects the normal alignment of structures attached to the medial tubercle of calcaneum thereby causing instability which results in heel pain. The spur is akin to that of an osteophyte or a new bone formation. Repeated traction could result in breakage of the osteophyte resulting in pain and in some instances these micro fractures may not be visible in spite of using sophisticated investigations.

CONCLUSION

Based on the present study, it can be inferred that spur formation predominantly occurs in the medial tubercle of calcaneum. The differences in the shape and size of the spurs is multifactorial like compression forces and biomechanical reasons. Calcaneal spur formation will result in heel pain and difficulties in posture and walking style of an affected individual. However more

elaborate studies have to conducted to exactly pinpoint the cause of formation of a spur in the calcaneum.

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Fig. 1 Hook like appearance on lateral view



Fig. 2 Spur originating from medial tubercle

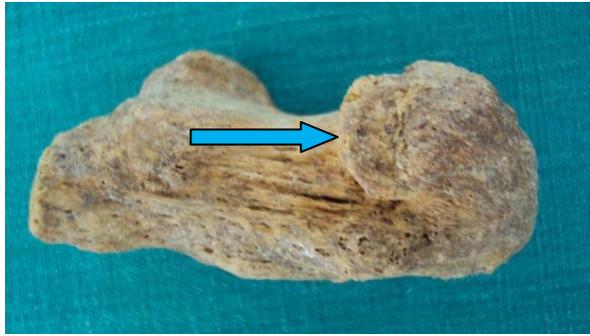


Fig: 3 Circular shaped spur

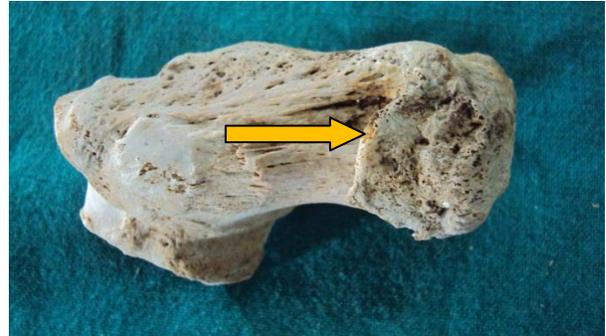


Fig: 6 Spur originating from both tubercles



Fig: 4 Triangular shaped spur



Fig: 5 Oblong shaped spur

Table - 1 Total number of calcaneae and specific side

Total number of calcaneae	Right side	Left side
122 (56%)	62 (62.5%)	60 (55%)

Table - 2 Length of the calcaneal spur

Total number of calcaneae	Right side Mean length	Left side Mean length
122	0.95 cm (36.58%)	0.87 cm (31.2%)

Table - 3 Breadth of the calcaneal spur

Total number of calcaneae	Right side Mean breadth	Left side Mean breadth
122	1.73 cm (66.34%)	1.71 cm (61.8%)

Table - 4 Thickness of the calcaneal spur

Total number of calcaneae	Right side Mean thickness	Left side Mean thickness
122	0.26 cm (3.72%)	0.23 cm (7.08%)

Table - 5 Variations observed

Variations in shape (Basal view)	Right side (62)	Left side (60)
<i>Triangular with sharp edge (Fig – 4)</i>	14	13
<i>Circular (Fig – 3)</i>	43	47
<i>Oblong (Fig – 5)</i>	05	nil
Variations in shape (Side view)		
<i>Hook like (Fig – 1)</i>	62	60
Position of origin of spur		
From lateral tubercle	nil	nil
<i>From medial tubercle (Fig–2)</i>	51	54
<i>From both tubercles (Fig–6)</i>	11	06
Presence of foramina in the spur		
<i>Single</i>	03	03
<i>Multiple</i>	05	06

Table – 6 Standard deviation

Length		Breadth		Thickness	
Right side	Left side	Right side	Left side	Right side	Left side
0.471083	0.401856	0.498105	0.450864	0.059232	0.124997