

OSTEOMETRIC ANALYSIS OF SINUS TARSII AND ITS CLINICAL IMPLICATIONSwati Saxena¹, Rajesh Kumar Maurya¹, Puneet Chaudhary², Mahendra Kumar Pant³¹Assistant Professor, Department of Anatomy, Government Doon Medical College, Dehradun, Uttarakhand²Junior Resident, Department of Anatomy, Government Doon Medical College, Dehradun, Uttarakhand³Professor and head, Department of Anatomy, Government Doon Medical College, Dehradun, Uttarakhand**Corresponding Author****Rajesh Kumar Maurya***Assistant Professor, Department of Anatomy, Government Doon Medical College, Dehradun, UK*

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ABSTRACT

The Subtalar joint is located within the rearfoot and is the articulation between talus and calcaneum. The TSC (tarsal sinus canal) lies between the posterior and anterior facets of the subtalar joint and is formed by the talar and calcaneal sulci. Fracture of the Subtalar joint which is present between talus and calcaneum bones is more common in active people in productive age. Present study data serve as a reference and model for predicting the size of sinus implants thereby minimizing the risk of oversizing, extrusion, bone erosion, and postoperative discomfort in the sinus tarsi. Study can also be used as a guide for osteotomies for hind foot deformities and foot rehabilitation procedures as well as will add to knowledge basis of Calcaneum and talus morphometry.

Keywords: Sinus tarsi, Subtalar joint, fracture, foot rehabilitation, osteotomy**INTRODUCTION**

The Subtalar joint is located within the rearfoot and is the articulation between talus and calcaneum. This joint is well utilized during walking and running, especially on uneven terrain. The subtalar joint articulates the talus, calcaneus, and navicular bones of the foot. The functional subtalar joint is anatomically separated into the talocalcaneal joint and talonavicular joint with the sinus tarsi and tarsal tunnel surrounding the subtalar joint laterally and medially.^[1] The talocalcaneonavicular joint is a ball-and-socket joint. The neck of talus and calcaneus make the superior and inferior surfaces of the sinus tarsi, respectively.^[2] Fracture of the Subtalar joint which is present between talus and calcaneum bones is more common in active people in productive age. The Talus is one of the peculiar tarsal bone because it transmits the weight of entire body to calcaneum bone. It is devoid of any muscle attachment. It is the keystone in maintaining the medial longitudinal arch of the foot, when it is abnormal may lead to flat foot. Fractures of the calcaneum are reported most commonly in the tarsal region. The TSC (tarsal sinus canal) lies between the posterior and anterior facets of the subtalar joint and is formed by the talar and calcaneal sulci. The sinus on the lateral side is conical and posteromedial side as a funnel-shaped canal that opens medially posterior of the sustentaculum tali (Cahill, 1965; Sarrafian, 1993). The space contains blood vessels, nerves, fat, and ligaments.^[3] Sinus tarsi syndrome is caused due to subtalar joint synovitis and the infiltration of fibrotic tissue into the sinus tarsi.^[4] It develops due to excessive motions of the subtalar joint, commonly presented as anterolateral ankle discomfort in the athletes.^[5] Arthroereisis is a technique for treating flatfoot by means of inserting a prosthesis into the sinus tarsi. It is a Greek word which means joint raising up. It helps to create a positive therapeutic change in the functioning of foot especially during weightbearing activities by reducing its pronation range.^[6] Chamber described the bonegraft in the floor of sinus tarsi anterior to lateral process of the talus thereby blocking excessive STJ pronation in pathological flatfoot deformities.^[7] Various other sinus tarsi implants have been described in the literature for example in 1974 Subotnick described inert silicone elastomer block as an implant.^[8] Smith et al detailed about ultra-high molecular weight polyethylene plug, called the "STA-peg" as an implant.^[9] In 1987, Valenti described the first "screw in" cylindrical-shaped STJ arthroereisis implant, which utilized external screw threads to allow easier implantation into the sinus tarsi.^[10] Valenti's threaded polyethylene threaded implant was followed in 1997 by a similarly designed, cylindrical threaded titanium Maxwell-Brancheau arthroereisis (MBA) implant.^[11] Other current STJ arthroereisis implants include the HyproCure (GraMedica), the Futura Conical

Subtalar Implant (Tornier) and Bioarch (Wright Medical). The bioBLOCK implant (Integra) is a cylindrical threaded implant that is made of poly-L-lactic acid and is resorbable. Therefore, all STJ arthroereisis implants, regardless of design, material and size, are “axis-altering” devices since all arthroereisis implants alter the postoperative spatial location of the STJ axis during weightbearing activities.^[12]

The study aimed to analyze the morphometric variations in the Calcaneum and talus bones and sinus tarsi which can be used as a guide for osteotomies for hind foot deformities and foot rehabilitation procedures as well as will add to knowledge basis of Calcaneum and talus morphometry including sinus tarsi.

MATERIAL AND METHODS

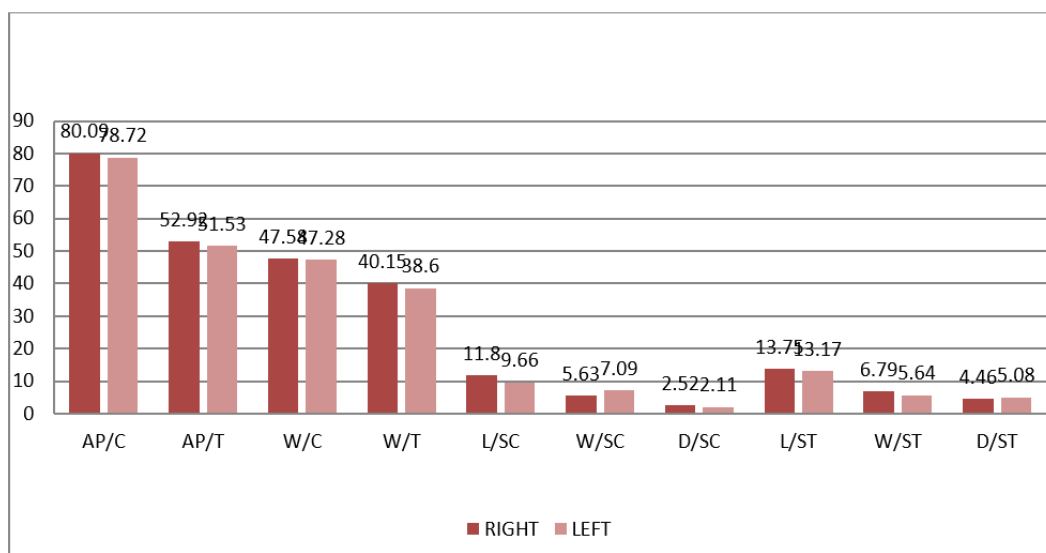
A total of 100 (right 50 and left 50) dry paired calcanei and Tali of known gender were used for this study. The bones were obtained from the bone collection room of the Department of Anatomy, Government Doon Medical College, Dehradun, UK. Various morphometric parameters like anteroposterior length and transverse width of calcaneum and Talus as well as length, width and depth of sulcus calcanei and sulcus tali were measured with the help of Digital vernier caliper. Dimensions of Sinus Tarsi were calculated by adding the respective dimension of sulcus calcanei and sulcus tali. All parameters were measured with .01 mm accuracy. The bones with any structural variations and damage were excluded from the study. Statistical analysis (Student Paired T test) was done using SPSS version 22 statistical analysis software was done. The values were represented by Mean \pm SD.

RESULTS

The Anteroposterior length of the right calcaneum (80.09 ± 10.27 mm) was found greater than left calcaneum (78.72 ± 9.13 mm) with **p value 0.50**, while their transverse width were found to be in consensus (**p value 0.81**). Length of right sulcus calcanei (11.8 ± 2.114 mm) and width of left sulcus calcanei (7.098 ± 4.06 mm) were found to be marginally more than their counterparts. However the depth of both right and left sulcus calcanei were accorded (**p value 0.0017**). Results of Sulcus Calcanei dimensions were found to be statistically significant. (refer to graph 1)

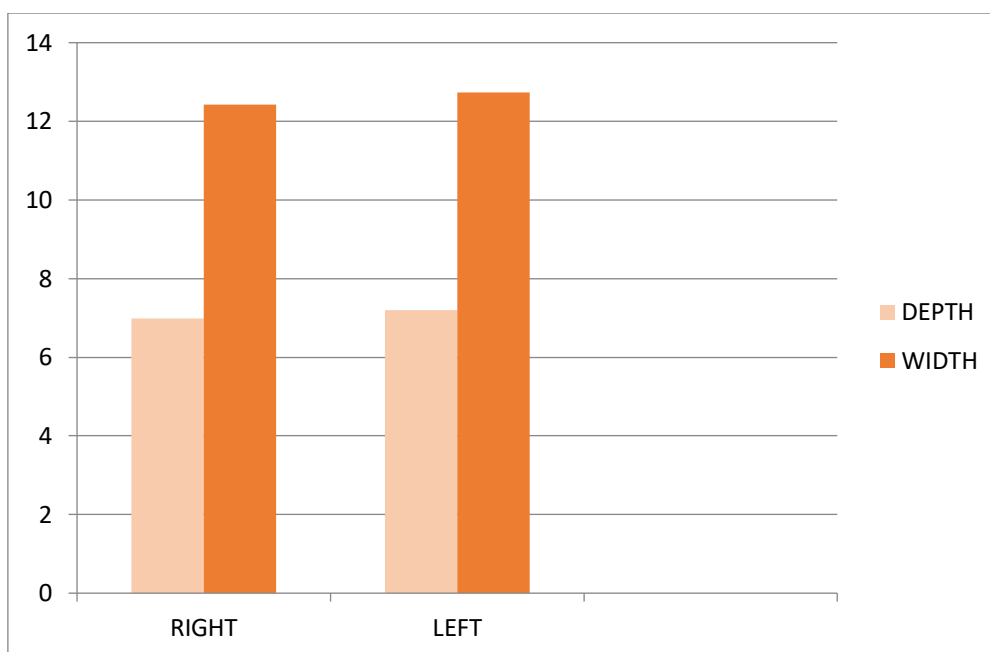
The Anteroposterior length (52.92 ± 4.95 mm) and the transverse width (40.15 ± 6.12 mm) of Right talus were found to be marginally more than left talus with **P value-0.233 and 0.03 respectively**. Width of right sulcus tali (**p value-0.017**) and depth of left sulcus tali (**p value -0.002**) were found to be marginally more than their counterparts. However the length of both right and left sulcus tali were found to be in unison with **P value-0.44**. (refer to graph 1)

Width or Anterio posterior length of sinus tarsi on right side was found to be 12.42 ± 2.54 mm and on left side was found to be 12.734 ± 3.74 mm respectively with **p value- 0.593**. While supero-inferior length of sinus tarsi was found to be 6.98 ± 1.65 mm on right side and 7.19 ± 2.45 mm on left side respectively with **p value-0.228**. However, Results were not found to be significant. (refer to graph 2 and graph 3)



Graph -1 Measurement of various parameters in mm on Y axis

[Abbreviations -- AP-Anteroposterior length W-Transverse width D- Depth R-Right L- Left C-Calcaneum SC-Sulcus calcaneum T-Talus ST- Sulcus Tali]



Graph-2 Mean value of supero-inferior (depth) and antero-posterior (width) diameter of sinus tarsi in mm unit.

DISCUSSION

Measurements obtained in the present study were on par with most of the studies (refer to table 1 and table 2). The individual and racial differences of the anatomic construction of calcaneal and talar articular facets influence the static and kinetic dynamics of foot. Factors like wearing shoes, squatting habits, genetic, occupational and racial differences could be the most probable reasons for the variations in the measurements of facets on the calcanei and tali among different studies done in Indians.

<u>Authors</u>	<u>Population</u>	<u>Antero-posterior length (mm) of Calcaneum</u>	<u>Transverse width (mm) of calcaneum</u>	<u>Width of sulcus calcanei(mm)</u>	<u>Length of sulcus calcanei (mm)</u>	<u>Depth(mm) of sulcus calcanei</u>
Koshy et al ^[13]	Indians (n=110)	73.6±5.7	40.8±4.6	21.1±2.4	31.9±3.5	3.4±0.9
Uygur et al ^[14]	Turkish (n=221)	77.7±5.65	47.5±4.2	6.15±2.7	30.4±3.1	2.55±0.7
Jung et al ^[15]	Korean (n=118)			5.16±1.16		
Boyan et al ^[16]	Turkish (n=57)	75.88±6.1	44.8±4.09	5.98±1.09	32.33±2.9	4.21±0.9
Prasad A et al ^[17]	Indian (n=92)	75.27±11.24	41.56±8.7	5.66±3.51	11.30±4.1	1.91±0.6
Laxmi V et al ^[18]	Indian (n=50)	68.94± 1.89	38.70± 2.6			
PRESENT STUDY	Indian (n=100)	R 80.09±10.2 L 78.72±9.13 P value 0.48	R 47.58±5.57 L 47.28±7.12 P value 0.81	R 5.63± 2.37 L 7.09± 2.01 P Value 0.0003	R 11.80±2.11 L 9.65±1.78 P value 0.001	R 2.52± 0.78 L 2.11± 0.79 P value 0.001

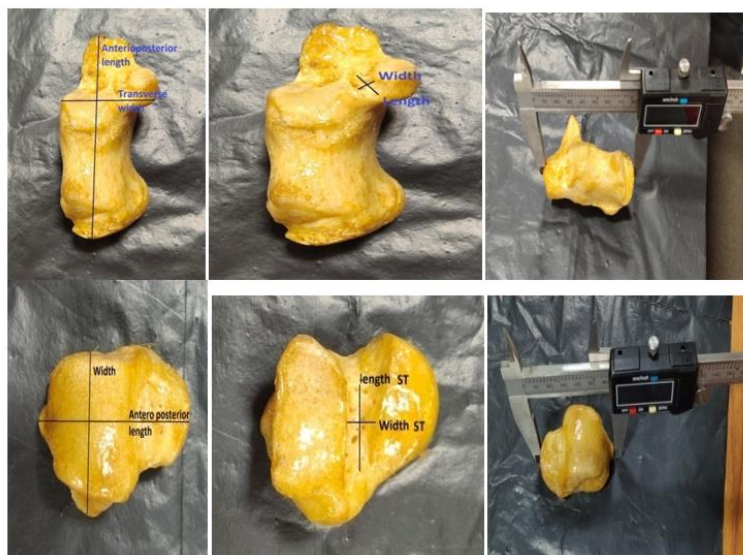
Table -1 Discussion table showing comparison of dimensions of calcaneum and sulcus calcanei.

<u>Authors</u>	<u>Population</u>	<u>Anterio posterior length(mm) of talus</u>	<u>Transverse width(mm) of talus</u>	<u>Width of sulcus tali(mm)</u>	<u>Length of sulcus tali(mm)</u>	<u>Depth of Sulcus tali(mm)</u>
Koshy et al [13]	Indians (n=70)	52.8±5.8	37.9±3.5	27.8±4.4	38±4.1	6.9±1.05
Lee et al [19]	Korean (n=140)	53.9±3.2	40.48±2.46	-	-	-
Boyan et al [16]	Turkish (n=57)	51.78±4.09	39.41±3.31	5.65±1.57	21.36±3.19	5.69±1.18
Prasad et al [17]	Indians (n=49)	51.02±8.06	36.61±5.65	5.44±2.79	11.41±5.78	4.00±2.18
Present study	Indians(n=100)	R 52.92 ± 4.9 L 51.52 ± 6.9 P value (0.23)	R 40.15 ± 6.1 L 38.6± 4.6 P value(0.03)	R 6.8± 1.9 L 5.6± 1.9 P value (0.017)	R 13.75 ± 4.5 L 13.2 ± 4.8 P value (0.45)	R 4.5± 1.2 L 5.1± 0.9 P value 0.02

Table -2 Discussion table showing comparison of dimensions of talus and sulcus tali

IMAGES

Measurement of Calcaneum and Talus bones



CONCLUSION

Morphometric parameters of Calcaneum and Talus bones will be helpful as an important tool for reconstruction surgeries of subtalar joint deformities and foot rehabilitation procedures.

Anterio posterior length of sinus tarsi is 12.42 ± 3.09 mm and 12.73 ± 2.5 mm on right and left side respectively. Supero-inferior length of sinus tarsi is 6.98 ± 1.09 mm and 7.19 ± 1.5 mm on right and left side respectively. These data serve as a reference and model for predicting the effect of sinus implants and understanding such clinical problems such as sinus tarsi syndrome. These data can serve as a reference to help the surgeon choose an implant when sizing and placing the stemmed implants and to provide information that could help minimize the risk of oversizing, extrusion, bone erosion, and postoperative discomfort.

CONFLICT OF INTEREST–NONE

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