

Variations in Talar Articular Facets of Calcaneum in UP Region and its Clinical Correlation



Anatomy

KEYWORDS: Calcaneum, Subtalar Joint, Variations, Articular facets.

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ABSTRACT

Introduction: On superior surface of calcaneum generally three articular facets are present, anterior middle and posterior. These facet shows variations in different geographical regions. Aim of this study: To find out prevalence of different types of talar articular facet configuration in UP region. **Material and Methods:** This study was conducted on 1000 calcanei (500 left, 500 rights) obtained from the osteology section of Department of Anatomy, KGMU, Lucknow. Calcanei were observed for different talar articular facets on superior surface. Bones were classified as type A if all three facets were separate; Type B if anterior and middle facet were fused; Type C if all three facets were fused and Type D if anterior facet was absent. **Results:** In present study the prevalence of Type A calcaneum was observed 21.7%, type B 74.5%, type C 0.6% and type D 3.2%. Bones were also studied for difference in morphological types on left and right side and we found that there was no significant difference in left vs. right (p value=0.558). **Conclusion:** This study shows that type B calcaneum (fused anterior and middle facet) is the most prevalent type of calcaneum in UP region. Many studies have shown that persons with type B calcaneum are prone to joint instability, ligamentous laxity and development of arthritic changes in subtalar joint.

INTRODUCTION

Human foot is a complex structure adapted to allow orthograde bipedal stance and locomotion. It has got two major functions: to support the body in standing and progression, and to lever it forwards and absorb shock in walking, running and jumping. When foot is on the ground, the superior talar articular surface takes the full thrust from tibia and passes it backward to calcaneus and forward to heads of metatarsals¹. Thus calcaneum receives main but variable part of body weight. The calcaneum projects posterior to tibia and fibula as a short lever and provides attachment to tendocalcaneum. As a result calcaneum is affected not only by compressive but also by strong tensile forces of Achilles tendon, ligaments and muscles of foot. All these forces result in changes in inner dynamic stress distribution in bone, resulting alteration in shape, dimensions and structure of bone. Therefore it can be stated that structure of calcaneum meets its function. This also affirms the importance of studying morphometric parameters of this bone in different ethnic groups living in different geographical regions².

AIM OF STUDY: On superior surface of calcaneum generally three articular facets are present, anterior middle and posterior. These facet shows variations in different geographical regions. Aim of this study was to find out prevalence of different types of talar articular facet configuration in UP region.

MATERIAL AND METHODS: This study was conducted on 1000 calcanei (500 left, 500 rights) obtained from the osteology section of Department of Anatomy, KGMU, Lucknow. Calcanei were observed for different talar articular facets on superior surface. Bones were classified as type A if all three facets were separate; Type B if anterior and middle facet were fused; Type C if all three facets were fused and Type D if anterior facet was absent.

RESULTS: In present study the prevalence of Type A calcaneum was observed 21.7%, type B 74.5%, type C 0.6% and type D 3.2%. Bones were also studied for difference in morphological types on left and right side and we found that there was no significant difference in left vs. right (p value=0.558).

Table 1: Prevalence of different Morphological types of Calcaneum based on Talar Articular Facets

SN	Type	Overall (n=1000)		Left (n=500)		Right (n=500)	
		No.	%	No.	%	No.	%
1	A	217	21.7	114	22.8	103	20.6
2	B	745	74.5	364	72.8	381	76.2
3	C	6	0.6	3	0.6	3	0.6
4.	D	32	3.2	19	3.8	13	2.6

Left vs. Right: $\chi^2=2.071$ (df=3); p=0.558 (NS)

DISCUSSION:

TABLE 2. Comparison of occurrence of various patterns of talar articular facets in different parts of India

S.N.	Study, year, region, sample size (n)	Type A(%)	Type B(%)	Type C(%)	Type D(%)
1	Gupta et al, 1976, UP (n=401) ³	26	67	2	5
2	Rangnath et al, 2006, South India, (n=71) ⁴	25.35	67.6	0	7.04
3	Muthukumaravel et al, 2011, South India, (n=237) ⁵	33.33	65.82	0.42	0
4	Patel et al, 2011, Western India, (n=205) ⁶	28.78	64.88	1.95	4.39
5	Seema et al, 2012, North India (n=300) ⁷	42	56	2	0
6	Nagar et al, 2012, Gujarat (n=529) ⁸	22.3	76.4	0	1.1
7	Anjaneyulu et al, 2014, North-East India (n=100) ⁹	31	62	2	5
8	Present study, 2016, UP (n=1000)	21.7	74.5	0.6	3.2

TABLE 3. - Comparison of occurrence of various patterns of talar articular facet in different part of world

S.N.	Study, year	Country	Sample size	Type A (%)	Type B (%)	Type C (%)	Type D (%)
1	Bunning et al 1965 ¹⁰	Veddah	10	0	6	4	0

2	Bunning et al 1965 ¹⁰	British	194	67%	33%	0	0
3	Bunning et al 1965	Indian	78	22%	78%	0	0
4	Bunning et al 1965 ¹⁰	African	492	36%	63%	4	0
5	El-Eishi 1974 ¹¹	Egyptians	200	40%	49%	0	11%
6	Campos et al, 1989 ¹²	Spanish	176	46	53	0	0
7	Drayer-Verhagen et al 1993 ¹³	USA	191	26.7%	54.45%	0	18.85%
8	Saadeh et al, 2000 ¹⁴	Egypt	200	30.3	63	2	4.7
9	Hussain et al, 2010 ¹⁵	Pakistan	350	28.6	62.9	0	8.6
10	Present study 2016	India	1000	21%	74.5%	0.6%	3.2%

In the present study we have adopted the pattern of classification of **Bunning et al (1963)**, according to which type A, B and type C calcanei were classified. Type D calcanei, with absent anterior facet, is an addition in our study. The prevalence of Type D calcaneum is also reported by other researchers from different part of India which ranges from 0.0-7.04% (Table 7). In present study we have observed 3.2% prevalence of the same in UP region. **Drayer-Verhagen et al (1993)**¹³ have reported the maximum prevalence (18.85%) of this type in USA. Type C was the least prevailing type in every population that we analyzed. **Muthukumaravel et al (2011)**⁵, observed another pattern in South Indian population in which middle and posterior facet was found to be fused though its prevalence was very less (0.42%).

A comparison of the adult African, Indian and European calcanei by **Bunning et al (1965)**¹⁰ revealed clear cut racial differences, for which no functional explanation was offered. When these findings were compared with the study conducted on foetal calcaneal bones of African, Indian and European populations, the racial differences were observed in the foetal bones also. It is indirect evidence that these changes in articular facets are probably genetically determined and are not developed in response to physical activities. The studies establishing association between types of calcaneum and genetic or functional factors like squatting habits are still lacking. Next generation gene sequencing can offer some direct evidences for these variations in future.

Drayer-Verhagen et al (1993)¹³, in their study suggested that morphology of talar facet of calcaneum is an important factor in subtalar joint stability. Their finding was also consistent with the hypothesis of **Bruckner (1987)**¹⁶, who stated that subtalar joint formed by three facet configuration (type A) were comparatively more stable and had less chances of developing arthritis, because two separate anterior facets along with posterior facet provide an osseous tripod for the talus to sit on, thereby preventing excess motion of talar head. Another evidence regarding stability of subtalar joint was provided by study of **Postan et al (2011)**¹⁷, in which they found that type B calcanei had only two fascicles of spring ligament attached to sustentacular tali as compared to three fascicles in type A calcanei which makes type B calcanei less stable. They analyzed that third fascicle of the spring ligament was observed along with sustentaculum tali described as more stable and with less osteoarthritic changes therefore third fascicle may have special role in the stability of subtalar joint and the pathogenesis of acquired flat foot.

Knowledge of talar facet configuration is essential for the orthopaedic surgeons who perform lengthening-distraction wedge calcaneal osteotomy and interposition bone graft to correct the

deformities in Pes planus. In this surgery, the identification of the interval between the anterior and middle facets is important for exact placement of the retractor, since the line of osteotomy usually passes through the same interval (**Richardson E, 1998**)¹⁸. This technique is suitable for Europeans who predominantly have type A calcanei. Since Indians have predominantly type B calcanei, the surgeons need to suitably modify the procedure.

Conclusion: This study shows that type B calcaneum (fused anterior and middle facet) is the most prevalent type of calcaneum in UP region. Many studies have shown that persons with type B calcaneum are prone to joint instability, ligamentous laxity and development of arthritic changes in subtalar joint.

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