

## A MORPHOLOGICAL STUDY ON PATTERNS OF HUMAN CALCANEAL ARTICULAR FACETS FOR TALUS IN POPULATION OF BIHAR AND ITS CLINICAL IMPLICATIONS

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### ABSTRACT

#### BACKGROUND

The calcaneum is the largest and strongest bone of all tarsal bones. It articulates above with talus to form talocalcaneal joint. In the middle third of superior surface, there is an oval shaped posterior articular facet which articulates with the body of talus. In the anterior third of superior surface, there are anterior and middle facets for the articulation of head of talus.

Aim of the present study is to determine the variations of articular facets in population of Bihar and its clinical implications.

#### MATERIALS AND METHODS

This is a descriptive study which was conducted on human calcaneal articular facets in the Department of Anatomy from September 2016 to May 2017. 200 dry adults' human calcanei were obtained from Indira Gandhi Institute of Medical Science, Patna; Vardhman Institute of Medical Sciences, Pawapuri; Nalanda & Darbhanga Medical College, Laheriasarai; and also from undergraduate students.

#### RESULTS

In this study, we found the 3 major types based on the separation of articular facets on superior surface i.e. type A, B & C. In this study, type B was most common (54%) in which Type B1 was commonest with fused anterior and middle facets without constriction. Type C was rarest variety of pattern.

#### CONCLUSION

This study reveals that configuration of articular facets influences the stability of subtalar joint.

#### KEYWORDS

Calcaneum, Facets for the Talus, Pattern, Variation.

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#### BACKGROUND

The calcaneum is the largest and strongest of all the tarsal bones. It is the most proximal of all the tarsal bones and situated below the talus and extends behind it. It is directed upwards, forwards and laterally. It is somewhat irregular cuboid in shape. It is the weightbearing bone. The superior surface of calcaneum has two parts- non-articular and articular. The non-articular part extends posteriorly and is about one third of total superior surface. Anterior to this non-articular part is articular which articulates with talus bone to form talocalcaneal joint, where inversion and eversion of foot occurs.<sup>[1]</sup>

Normally there are three articular facets on the superior surface of calcaneum for the articulation of talus bone- anterior, middle and posterior facets. In the middle third of superior surface of calcaneum, there is an oval shaped posterior facet which articulates with the body of talus. In the anterior one third of superior surface of calcaneum there are two articular facets- anterior and middle for the articulation of head of talus.<sup>[2]</sup> The posterior calcaneal facet for talus does not show much variation.<sup>[3]</sup> But there are considerable variations in the patterns of anterior and middle articular facets in different races.<sup>[4]</sup> There are several studies on different population groups which also confirm the variations in the pattern of articular facets.<sup>[5-7]</sup> These facet patterns are present in foetal calcanei and not a developmental response to physical activities. These morphological variations of calcaneal facets may predispose to the development of arthritic changes in the subtalar joint.<sup>[8]</sup> Variations in the talar facets of calcanei are important because they influence subtalar joint stability. Knowledge about the variations in talar facets of calcanei is essential for orthopaedic surgeons while correcting foot deformities. Therefore, this study was carried out after finding a scarcity of data on the variations of the calcaneal facets for the talus in the population of Bihar.

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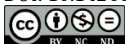
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Calcaneum is also a useful tool for determination of sex and is long being considered useful in stature estimation.<sup>[9,10,11,12]</sup> The objective of the present study was to identify the patterns of the talar facets of calcanei and their clinical implication. Data of this study compared with those of previous studies.

**MATERIALS AND METHODS**

This is a descriptive study which was conducted on human calcaneal articular facets in the Department of Anatomy from September 2016 to May 2017. 200 human calcaneum dried bones obtained from Department of Anatomy & Department of Forensic Medicine of Indira Gandhi Institute of Medical Science, Patna; Vardhman Institute of Medical Sciences, Pawapuri; Nalanda & Darbhanga Medical College, Laheriasarai; and also from undergraduate students. Adult bones irrespective of sex were included in my study. Calcaneal bones with prominent pathological changes or damaged bones were excluded. The patterns of articular facets on superior surface of calcaneum were observed with naked eye and by using hand lens. A sliding Vernier calliper of 0.1 mm accuracy was used for measuring distance between articular facets. Data obtained from bones were analysed for patterns of talar articulating facets and were compared with those of previous studies.

**3 types of patterns of talar facets in calcanei were considered-**

Type A- Anterior, middle and posterior articular facets separate with 4 subtypes (A1, A2, A3, A4).

A1- Distance between anterior and middle articular facets <2 mm.

A2- Distance between anterior and middle articular facets 2-5 mm.

A3- Distance between anterior and middle articular facets >5 mm

A4- There is only one joint facet named as anterior talar facet.

Type B- Anterior and middle facets fused with 2 subtypes (B1, B2).

B1- There was a constriction between anterior and middle facets.

B2- There was no constriction between anterior and middle facet.

Type C- Anterior, middle and posterior facets fused.

**RESULTS**

In this study, we found 3 major types based on the separation of articular facets on superior surface i.e. type A, B & C. Type B1 with fused anterior and middle facets without constriction was the most common pattern of articular facet.

In the present study, type A was found in 90 calcanei (45%) out of which A1 was in 10 calcanei (5%) (5 right and 5 left), A2 was in 30 calcanei (15%) (14 right and 16 left), A3 was seen in 40 calcanei (20%) (22 right and 18 left); A4 were seen in 10 calcanei (5%) (5 right and 5 left).

Type B was found in 108 calcanei (54%), out of which B1 was found in 44 calcanei (22%) (21 right and 23 left); B2 was found in 64 calcanei (32%) (32 right and 32 left). In type C, all the 3 facets were fused.

Type C found in 2 calcanei (1%) (1 right and 1 left).

Sl. No.	Type	Sub Type	Right (%)	Left (%)	Total (%)
1	A	A1	5 (2.5%)	5 (2.5%)	10 (5%)
		A2	14 (7%)	16 (8%)	30 (15%)
		A3	22 (11%)	18 (9%)	40 (20%)
		A4	5 (2.5%)	5 (2.5%)	10 (5%)
2	B	B1	21 (10.5%)	23 (11.5%)	44 (22%)
		B2	32 (16%)	32 (16%)	64 (32%)
3	C	1 (0.5%)	1 (0.5%)	2 (1%)	
<b>Total</b>			<b>100 (50%)</b>	<b>100 (50%)</b>	<b>200 (100%)</b>

*Table 1. Incidence and Percentages of Different Types and Subtypes of Calcanei according to Articular Facets*



**Figure 1. All Three Facets are Separated**  
[1- Anterior Facet, 2- Middle Facet, 3- Posterior Facet]



**Figure 2. Anterior and Middle Facets Fused (constricted)**  
[4- Fused and Constricted Anterior and Middle Facets]



**Figure 3. Anterior and Middle Facets Fused (Uniform) [5- Fused and Uniform Anterior and Middle Facets]**



**Figure 4. Middle and Posterior Facets Fused [6-Fused Middle and Posterior Facets]**



**Figure 5. All Three Facets Fused to Form Single Facet**

**DISCUSSION**

From the table no. 2, it is evident that the result of this study is very close to other Indian<sup>[9,13,14]</sup> and African studies.<sup>[7,15]</sup> In this study, I found that type B (54%) is the most common pattern of talar facets of calcanei. Type A pattern [45%] next common and type C [1%] is very rare pattern of talar articular facet of calcanei. Among the type B pattern, B2 subtype (32%) is commonest. High incidence of type A was found in one study in Africans.<sup>[16]</sup> Type A is more common than type B in American population.<sup>[10]</sup> El-Eishi found subtype A4 to a greater extent in Egyptians which suggests that the facets are genetically determined as mentioned by Brunning and Barnett.<sup>[8,17]</sup>

Type A pattern of facet forms more stable joint than type B.<sup>[10,18]</sup> Less medial rotation of talar head occurs in type B facet pattern leading to unstable subtalar joint and causes osteoarthritis.<sup>[10]</sup>

The interval between anterior and middle facets are important in osteotomy and interposition bone grafting to correct the deformities of pes planus. In this procedure, the identification of the interval between the anterior and middle facets is important for the exact placement of retractor because the line of osteotomy passes through this interval.<sup>[19,20]</sup> This technique is suitable for Europeans who predominantly have calcanei with type A pattern (with separate anterior and middle facets). So awareness about the variations in talar facets of calcanei is important during surgical management of foot deformities. In Indian population, type B (fused anterior and middle facets) was common, so orthopaedic surgeons should be careful or a suitable modification of technique is required.

Knowledge of variations in the morphology on articular facets of calcaneum is very important in triple arthrodesis procedure for flat foot deformities.

Sl. No.	Study, Year	T	A	A1	A2	A3	A4	B	B1	B2	C
1	Brunning and Barnett (1963) Indian	78	22					56			
2	Jha and Singh (1972) Indian	800	294					504			2
3	Gupta et al (1977) Indian	401	31	9	4	13	5	67	28	39	2
4	Boonruangsri et al, (1992) Northeastern Thai	230	40	11	19	8	2	59	19	40	0.43
5	Uygur et al (2009) Turkish race		39.3	4	13	17	5	58	25	33	22
6	Present study (2017) Indian	200	45 %	5 %	15 %	20 %	5 %	54 %	22 %	32 %	1 %

**Table 2. Comparisons of Results of Present Study with those of Previous Studies**

**CONCLUSION**

In the present study, the data collected from 200 normal dry calcaneal bones from Bihar in the northern part of India were analysed and compared with those of previous studies of different races. In this study, type B facet configuration is most common and type A configuration next common. These racial differences in patterns of talar articular facets for calcanei were probably genetically determined and not a developmental response to physical activities. This knowledge on the racial differences is very important for orthopaedic surgeons in India while correcting foot deformity. Less medial rotation of talar head occurs in type B pattern of articular facet leading to unstable subtalar joint and causes osteoarthritis.

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