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A study of morphological pattern of the talar articular facets in dry human calcanei and its clinical implications

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***Abstract*---**Background: The calcaneum is longest and largest of all the tarsal bone. Morphology of the talar articular facets of calcanei is important for anatomy with respect to diagnosis and treatment of the injuries related to foot. Aims: This study was done to understand the variation in the morphology of talar articular facets on the superior surface of human calcanei and to study various shapes of these facets . Methods: 138 of adult dry calcanei 86 of right side and 52 of left side of unknown gender were taken from the museum of Department of Anatomy of Rohilkhand Medical College and Hospital, Bareilly and LBKMCH,Saharsa and evaluated one by one. Result: PatternI was 69.5% of the studied bones, Pattern II and Pattern III were 4.3% each, Pattern IV was 21.7%, Pattern V was not found. The anterior and middle articular facets were mostly oval in shape and that of posterior articular facet was oval and convex. The calcaneal length was recorded with the mean and SD of 6.9 ± 0. 65cms (left side) and 6.9 ± 0. 9cm (right side). The width was 4.0 ± 0.38 cm (left) ,4.1 ± 0.3 cm

(right) . Conclusion: Detailed study of the different patterns of talar articular facets of the calcaneum and its shapes help in diagnosis and treatment of various deformities and injuries of foot to the orthopaedic surgeons.

***Keywords*---**talar articular facets, patterns, calcanei.

Introduction

Calcaneum the biggest tarsal bone that articulates with talus bone to form Talo-calcaneal joint. Talo-calcaneal joint and talo-calcaneo-navicular joint together forms subtalar joint[1]. At this joint inversion & eversion movements of foot occurs.Talus articulates with calcaneum by anterior, middle and posterior facets [2]. Most anteriorly lies the anterior talar articular facet. There is medially projecting bone known as sustentacular tali where lies the middle talar articular facet[3]. Posterior articular facet of calcaneum is present on the middle of its upper surface. Morphological variability of calcaneal facets could also result from differences in gait or the other habits influencing these articular areas postnatally or could be indicative of genetically determined variation.

Detailed morphological assessment of calcaneum is important for the diagnosis, treatment & rehabilitation [4].Tonoanatomists are very much interested in morphology of articular facets of calcaneum. Knowledge of this can guide orthopedic surgeons in diagnosis and treatment of deformities and injuries of foot [5,6,7]. As reported earlier the relative distribution of facets pattern varies with race and sex. Study of calcaneal articular facets variation is important because it influence subtalar joint stability and knowledge of facets is essential while correcting foot deformities and for placing the screw in fracture fixation by orthopaedic surgeons. The purpose of this study was to identify the dominance of the pattern of facets.

Material and Methods

138 adult dry human origin calcanei with gender not known, obtained from Anatomy department of Rohilkhand Medical College & LBKMCH were studied. .Dry calcaneum bones from department of anatomy were studied hence no ethical committee clearance was required.

Inclusion Criteria

Calcanei were considered on following basis:

1. Calcanei of adults were taken belonging to both sex.
2. Intact, non- pathological not having osteolytic lesions or tumors, without any fracture, calcanei were taken.

Exclusion Criteria

- Broken calcanei.

Method of data collection

Study was done on Posterior, middle and anterior small facets with respect to their patterns & shapes. Classification of calcaneum carried out according to the pattern of talar articular facets.
The classification of talar articular facets present on calcaneum:-
Patterns were observed and classified as per the grouping methods author Anjaneyulu [8]).
Pattern I :- Anterior & middle articular facets fused together with separate posterior facet[Figure 2] Pattern I has two subtypes:
I (A)- With constricted fused facet
I (B)- Without constricted fused facet
Pattern II :- Three facets on the superior surface of calcaneum, anterior and middle facets were incompletely separated from each other as shown in Fig(2).
Pattern III :- Absent anterior facet as shown in Fig.(2)[11,12]
Pattern IV :-Three articular facets are separated from each other by inter-facetal space present as shown in Figure(2)
Talar articular facets shapes were observed
Anterior facet shapes observed were – Oval, Triangular, Round, Elongated, Irregular.
Middle facets shapes observed were –Oval, Pear, Round, Elongated.
Posterior facets shapes observed were –Convex and Oval, Convex and Irregular.
Calcaneal length, width of both sides were measured by Digital Vernier caliper to the maximum accuracy upto 0.02cm.

Measurement of length of calcaneum: Calcaneal length taken from anterior most point of calcaneum to posterior bony part of articular facet, where the Tendoachillis attaches with help of digital vernier caliper in centimeter (cm) as shown in Fig (1). Measurement of width of calcaneum : Calcaneum width was measured from lateral to medial calcaneal tuberosity by digital vernier caliper in centimeter as shown in Fig (1).

Statistical analysis

By using (SPSS) Version 20.0. IBM, Oxford University, 2010. Mean and standard deviation of length and width of calcaneum were calculated and t test(independent) to assess the variability in measurements of length, width of both sided calcaneum with p value ($p>0.05$) was derived.

Results

Table 1 shows the dominance of pattern 1 in both right (62.8%) and left (80.8%), followed by pattern IV in right 27.9% and left 11.5%. Table 2 shows subtypes of pattern I on left and right side, from this it is evident that pattern I subtype A is dominant on left (57.2) and pattern I subtype B is dominant on right 37%. Table 3 shows mean calcaneal length on left side 6.9 ± 0.65cms, on right side 6.9 ± 0.9cms.mean calcaneal width 4.0±0.38cms and on right side 4.1±0.3cms. Among talar articular facet oval shape was most common of middle articular facet in 30 adult calcaneum (71.4%) , the least frequent shape found to be elongated(9.52%).

Most frequent shape of posterior articular facet was oval and convex in 80 calcanei (57.97%), least frequent shape was convex and irregular (42%) in 58 calcanei. Oval shaped anterior facet was present in 55.5% and less commonly found was irregular present in 5.56%. Independent sample t test results depicted in table 4 showed ($p>0.05$) which was not statistically significant between both sides

Discussion

The calcaneal facets which articulates with talus shows both racial and individual differences. These differences should be taken into account for orthopedic, forensic and anthropological purposes. In this study various patterns of calcaneal facets were analysed and the various shapes of calcaneal facets were observed. Most prominent pattern in the present research is pattern I (Table 2). These findings are consistent with those of Bunning and Barnett 9,10, Sadeeh et al1, Gindha2015 16), Jagdev2015 7; Pakistani (Wajid et al,2010), Turkish (Uygur et al. 2009) 2, Spanish (Campos and Pellico. 1989) 13, Southern Nigeria (Ukoha U,2017) 17 race studies. Pattern II was observed at a low incidence of 4.34% (6 cases) in the present study however Pattern II not visualised in previous studies done by (Rohin et al.,2013 5;Chavan et al.,2014 6; Bunning and Barnett,1965; Jagdev et al.,2015). Our findings are similar to the findings of Ukoha U et al as they also observed Pattern II to be least common with an incidence of 7.7% in their study. Pattern III was found in 4.34% i.e (6 cases), similar to the study of Schweta et al 15 however many authors reported it at higher frequency as mentioned in table 2.. In this study Pattern IV was present in 21.7% however Sadeeh et al(2000) reported it in 30.3% reported Pattern IV with an incidence of 30.3% and Barnett(1965) reported it in 36% i. in the present study pattern IV was found was found to be the second most common pattern similar to the findings of various other authors as mentioned in table 3. Racial, genetic factors may be responsible for the variability in morphology of calcanei.

In 42 bones middle facet was present. In 6 bones anterior facet not found. In 69% middle & anterior facet were fused together. In 4.3% the anterior & middle facet not fully separated .Oval shape most frequently seen in middle facet among all patterns of articular facets i.e 71.4%, (52.4%) on right side i.e (22/30), 19% left i.e 8 out of 30.Middle facet pear shaped in 14.2% (4.76% on left, 9.52% on right side).Round in 4.76% (4.76% on right, 0% cases on left).Elongated in 9.52% (9.52% on right , 0% on left side) .Findings are consistent with work of Jagdev etal.2015 who observed mostly oval shape among middle articular facets i.e19.5% and Ukoha U etal 2017 who also found oval form middle articular facets in 64.39% . Posterior facet found oval and convex in 57.96% (27.53% on right, 30.43% on left). This is inconsistent with the work of Jagdevetal (2015) where irregular and convex was the most common shape. Anterior facet was present separately in 26.1% (4.4% pattern II and 21.7% pattern IV).

Anterior facet oval in 55.5% (33.3% right, 22.2% left). The anterior facet triangular in 11.11%, round 22.22% and elongated in 11.11%and the least frequent shape of anterior articular facet as per this study was irregular in 5.56% on right calcanei only. These findings correlated with Jagdev etal, 2015 as they also found most frequently oval shape of anterior facet in 20.5% cases. We found

irregular shape with respect to anterior articular facet in 5.56% on right side calcanei. Ukoha U etal also found irregular shape to be the least common. Jagdevetal found pear and triangular to be least common.

Conclusion

Pattern I was most common pattern observed, Pattern IV was the second most common pattern in this study. Various shapes of the talar articular facets were observed and their frequency studied. These facts obtained from our study will be helpful as an important tool for reconstruction surgeries of hind foot deformities and foot rehabilitation procedures.

Conflict of Interest-not found with the authors

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List of Tables

Table 1: Shows the various morphological patterns of calcaneal facets of either side, where n is the total percentage of different patterns

Pattern	Left side N (%)	Right side N (%)	Total
I	42(80.8)	54(62.8)	96
II	2 (3.9)	4 (4.65)	6
III	2 (3.9)	4 (4.65)	6
IV	6 (11.5)	24 (27.9)	30
Total	52	86	138

Table 2- Subtypes of the pattern I (left and right), N: Total %

Pattern I	Sub-type	Left N (%)	Right N (%)	Total number
I	A	24 (57.2)	20(37)	44
I	B	18 (42.8)	34(63)	52
Total		42(100)	54(100)	96

Table 3: Calcaneal measurements (in cms) Mean & SD of length, width with p value

Measurement	Left side	Right side	P-Value
Length (cms)	6.9 ± 0.65	6.9 ± 0.9	0.925
Width (cms)	4.0 ± 0.38	4.1± 0.3	0.389

Table 4: Comparison with other studies. n –total number of calcanei

Study	Year	Country	N	PATTERN (%)				
				I	II	III	IV	V
Burning &Barnett[9]	1965	Britain	194	33	0	0	67	0
Campos & Pellico[13]	1989	Spain	176	53.41	0	6.82	39.77	0
Barbaix[14]	2000	Belgium	134	25	0	11	64	0
Uygur [2]	2009	Turkey	221	58.4	0	5.0	34.4	2.2
Schweta[15]	2013	India	205	64.9	0	4.4	28.8	1.9
Anjaneyulu[8]	2014	India	100	62	0	5	31	2
Jagdev[7]	2015	India	200	72.5	0	1.5	30	0.5
Gindha[16]	2015	India	325	69.5	0	0.3	29.8	0.6
Ukoha U[17]	2017	Nigeria	220	55.4	7.7	12.1	24.0	0
Present study	2020	India	138	69.6	4.35	4.35	21.7	0

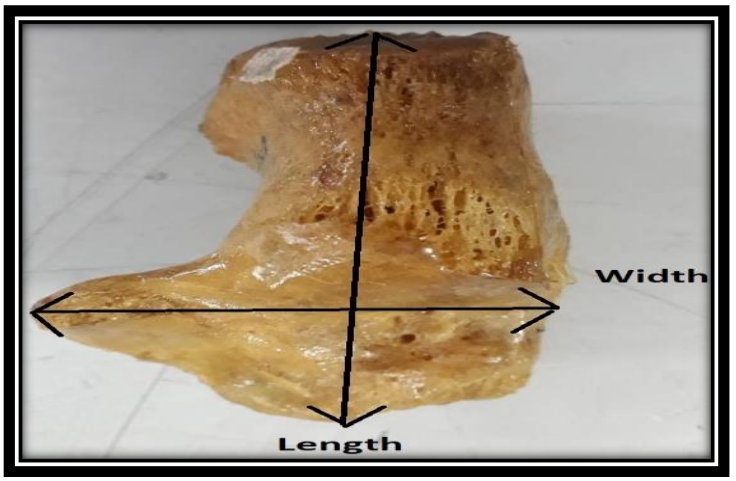

Figure 1 : Showing measurements of length and width of Left side calcaneum

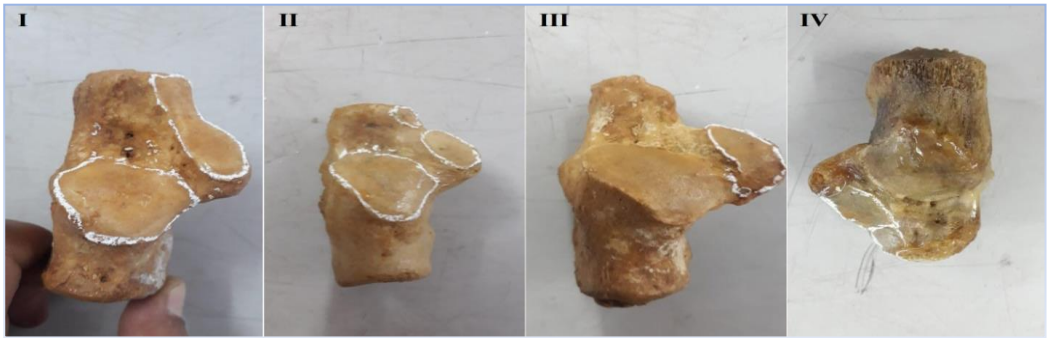

Figure 2- Showing classification of talar articular facets of calcaneum

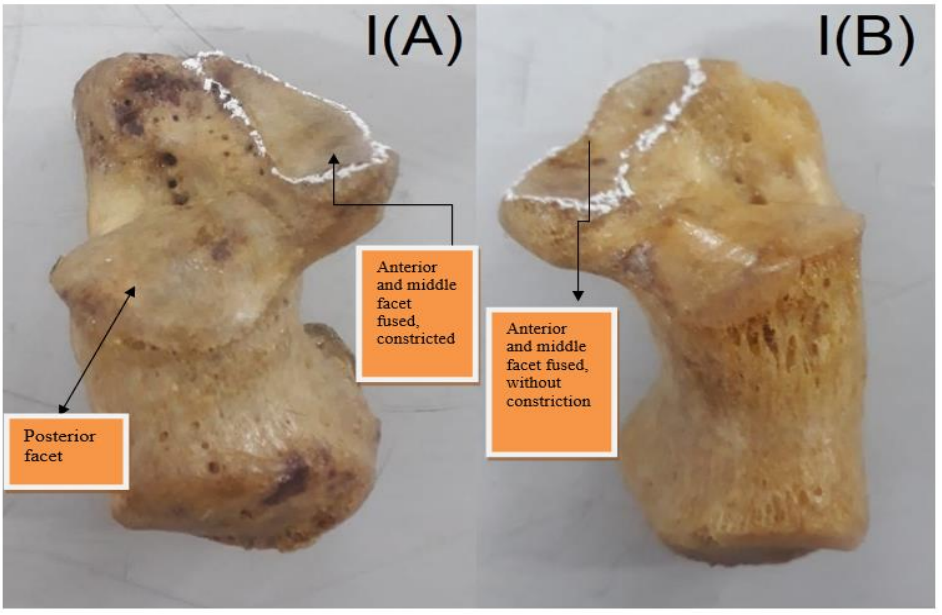

Figure 3 - Showing subtypes of pattern IA (Left side) and IB (Right side)