Original articles

Unusual facets on the acetabulum in dry adult human coxal bones A morphological and radiological study

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Abstract

Abstract A smooth facet was found antero-inferior to lunate surface of 48 acetabula, in a study conducted on 315 dry adult coxal bones, 26 of which (13 pairs) were of articulated pelves. Three different shapes of the facet were oval (56.3%), piriform (22.9%) and elongated (20.8%). The prevalence of the oval facet was higher in both sexes. In 37.5% bones it extended to superior ramus of pubis and in 62.5% it was limited within the acetabular margin. They were either discrete (58.3%) or continuous with the lunate surface (41.7%). The surface configuration was flat (29.2%), concave (43.7%) or grooved (27.1%). One male articulated pelvis showed a bilateral presentation. Measured along the long axis the size varied between 11 to 17 mm. The radiographs showed notching, antero-inferior to acetabular margin in grooved facets whereas concave and flat facets were seen as areas of rarefaction. It is postulated that this facet could be a consequence of a particular posture which results in traction of the ligaments attached to this area. This unusual feature has not been reported earlier.

It is acknowledged that the magnitude and direction of functional forces produce bone remodelling effects during life and are reflected on them. The bone adapts itself to the mechanical needs by atrophy or hypertrophy [2] in the form of grooves, ridges, spines, facets and other such features. These have fascinated the anatomists, anthropologists and research workers in allied fields for centuries and has inspired them to document such findings. Such features are known as non-metrical variants. The incidence of their presence has been used as anthropological markers [1].

Examination of coxal bones revealed one such variation in the form of a facet on the non-articular part of pubic component of acetabulum just inferior to the anterior end of the lunate surface. Awareness of such a facet is important to differentiate variants from pathological conditions while performing hip arthroscopy [8] and imaging procedures. The frequency of this feature and paucity of reports in literature warrants this study.

Material and methods

The study for the facet present inferior to the anterior end of the lunate surface was conducted on 315 dry adult coxal bones of Indian origin, collected from the Department of Anatomy, Lady Hardinge Medical College. Of these, 26 bones (13 pairs) belonged to articulated pelves for the remaining pairing was not possible. Sexing of bones was done, using Schulter Ellis Index 1 [9], which is the ratio of acetabular diameter (horizontal distance between the margin of acetabulum passing through its midpoint) to acetabular length (distance between the most superior aspect of pubic symphysis to nearest point on the rim of acetabulum), multiplied by 100 [9]. Each facet was studied for its shape, extent, surface configuration and continuity to lunate surface. The size was measured along the long axis with the help of a divider and scale. The facets continuous with the lunate surface were measured from the indentation which marked their separation. The bony pelvis and three bones, one of each type, according to the configuration, were radiographed. The prevalence of these parameters was determined and evaluated.

Results

Of the 315 coxal bones, 167 (76 right, 91 left) belonged to males and 95 (45 right, 50 left) to females (including 8 male and 5 female articulated pelves). 53 bones (25 right, 28 left) could not be sexed accurately. The presence of a smooth facet on the non-articular part of acetabulum inferior to the anterior end of the lunate surface was observed in 48 (15.2%) coxal bones, out of these 29 (60.4%) belonged to male, 12 (25%) to female and 7 (14.6%) were unsexed (Table 1). Thirty-four (70.8%) bones of the left and fourteen (29.2%) of the right side displayed this feature. It showed a predilection for the left side in both male (21 out of 29) and female (9 out of 12) coxal bones. The unsexed bones had 4 facets on the left side and 3 on the right side. The size of the facets measured along the long axis varied between 11 to 17 mm.

	Male n = 29 (60.4%)		Female n = 12 (25%)		Unsexed n = 7 (14.6%)	
Shape	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**
Oval n = 27 (56.3%)	5	13	2	4	1	2
Piriform n = 11 (22.9%)	1	6	0	3	1	0
Elongated n = 10 (20.8%)	2	2	1	2	1	2
Total	**8**	**21**	**3**	**9**	**3**	**4**

Table 1. Prevalence of different shapes of facets on the acetabulum

Shape of the facet

The facet was oval, piriform or elongated in shape (Figs. 1, 2, 4, 5). In 27 (56.3%) bones it was oval, in 11 (22.9%) piriform and in 10 (20.8%) elongated. Oval facet was found in 18 male, 6 female and 3 unsexed bones. In males on the left side, the presence of oval and piriform facets were significantly higher, 13 and 6 respectively, as compared to 5 and 1 on the right side. In female and unsexed bones the difference was not marked (Table 1).

Fig. 1 Right (female) coxal bone showing an oval, flat, discrete facet limited to acetabular margin (*arrow*)

Fig. 2 Left (male) coxal bone showing a piriform, concave, continuous facet, extending on the superior ramus of pubis (*arrow*)

Fig. 4 Left (male) coxal bone showing elongated, concave continuous facet, limited to acetabular margin (*arrow*)

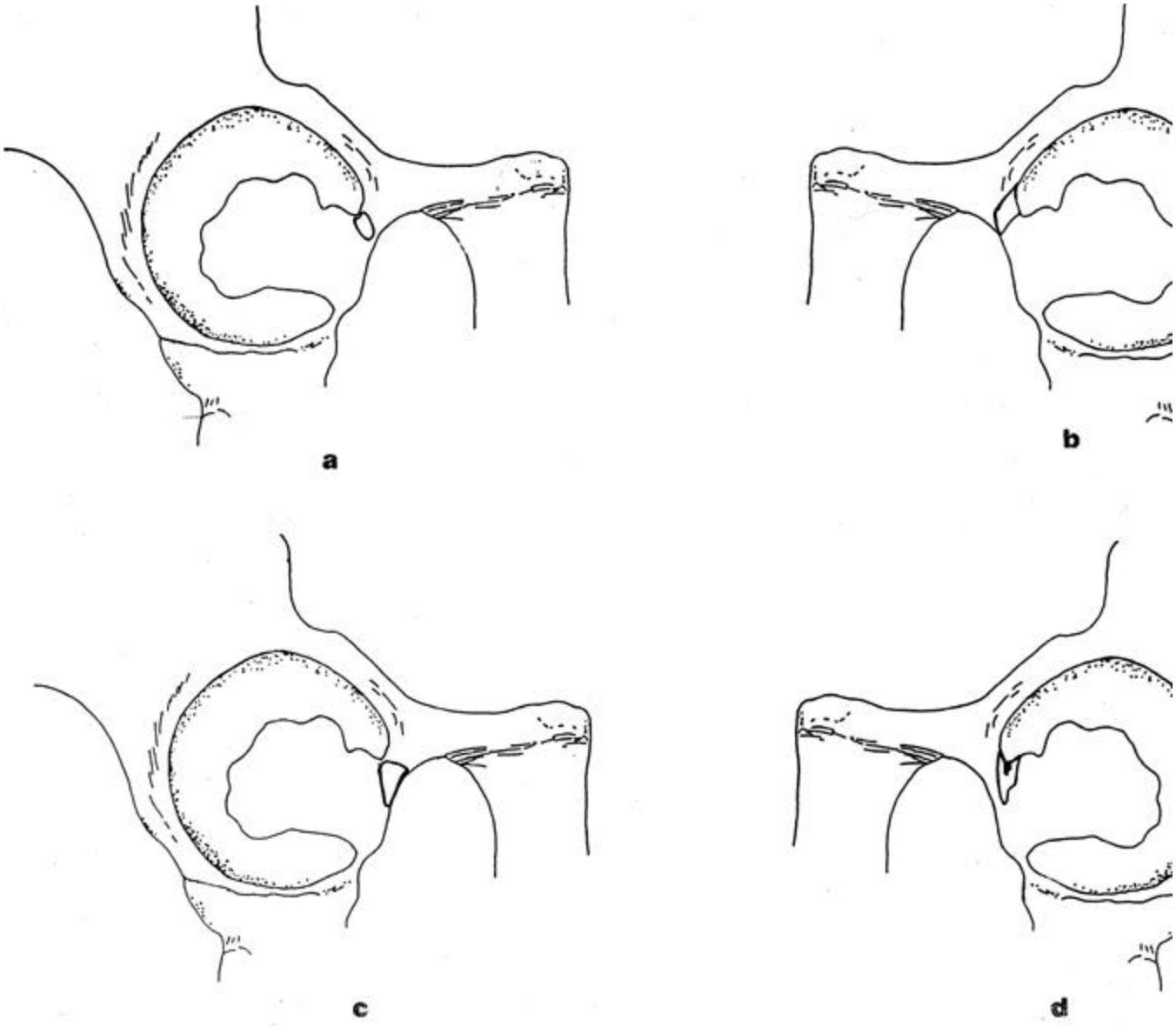

Fig. 5a-d Diagrams of acetabulum showing various types of facets. **a,** oval, flat, discrete facet limited to acetabular margin; **b,** piriform, concave, continuous facet extending to superior ramus; **c,** piriform, grooved, discrete facet extending to superior ramus; **d,** elongated, concave, continuous facet limited to acetabular margin

Extent of facet

In 18 (37.5%) coxal bones, the facet extended beyond acetabular margin to superior ramus of the pubis (Figs. 2, 3a-b, 5), while in 30 (62.5%) coxal bones it was confined to acetabulum (Figs. 1, 4, 5). Those extending to pubic ramus had piriform (10) and elongated (8) shapes.

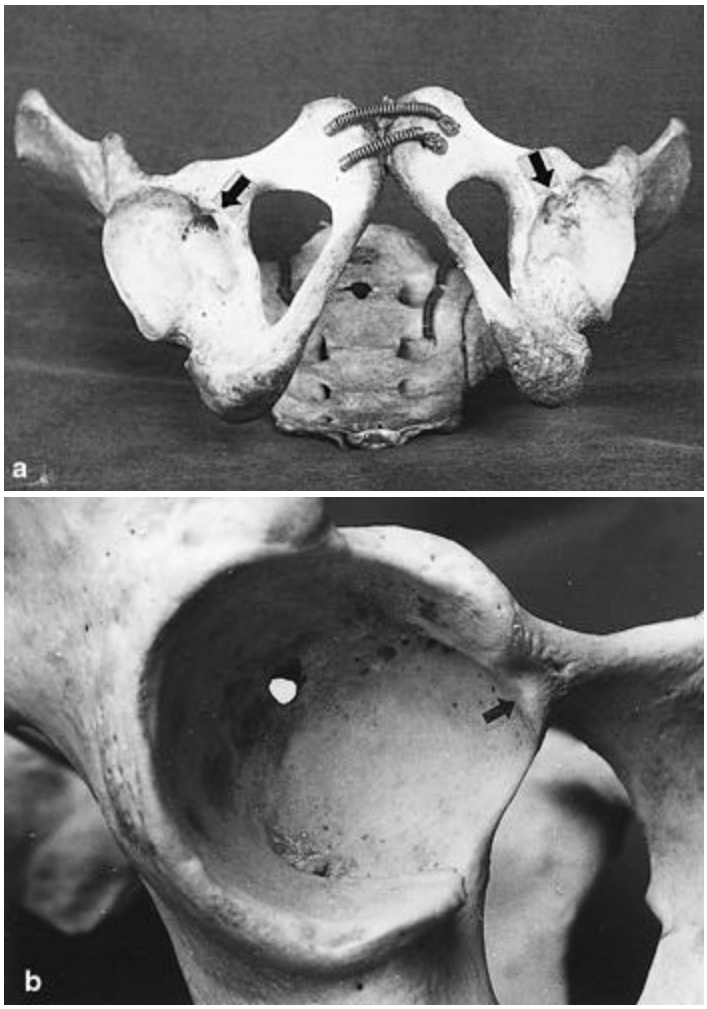

Fig. 3a, b a. Male pelvis showing bilateral piriform, grooved, discrete facets (*arrows*) notching the acetabular margin. **b.** Right (male) coxal bone (articulated pelvis) showing a piriform, grooved, discrete facet, extending on the superior ramus of pubis (*arrow*)

Surface configuration

Subjective assessment revealed smooth facets which were level with the adjoining area or slightly depressed or deeply grooved, designated as flat, concave or grooved respectively (Table 2, Figs. 1, 2, 3a-b). The flat facet was present in 14 (29.2%), (8 male, 5 female, 1 unsexed) bones. The concave facet was in 21 (43.7%), (13 male, 4 female, 4 unsexed) bones having predominance over the others. The grooved facet was present in 13 (27.1%) coxal bones (8 male, 3 female and 2 unsexed). Out of the 13 articulated pelves only one male pelvis had deeply grooved facets present bilaterally (Fig. 3a). In males the three surface configurations had a higher prevalence on the left side (5 flat, 9 concave and 7 grooved) as compared to the right one (3 flat, 4 concave and 1 grooved). In females only the concave had a significantly, higher distribution on left side (Table 2).

Surface Configuration	Male		Female		Unsexed	
	Right	Left	Right	Left	Right	Le
Flat n = 14 (29.2%)	3	5	2	3	0	1
Concave n = 21 (43.7%)	4	9	0	4	2	2
Grooved n = 13 (27.1%)	1	7	1	2	1	1

Table 2. Prevalence of surface configuration of the facets

Continuity to lunate surface

The facet exhibited a varying relation to the lunate surface, being either discrete or continuous. The former was well circumscribed with a gap separating it from the lunate surface (Figs. 1, 3a-b, 5) and was seen in 28 (58.3%) coxal bones (17 male, 5 female and 6 unsexed). The remaining 20 (41.7%) coxal bones (12 male, 7 female and 1 unsexed) had a facet in continuity with the lunate surface (Table 3, Figs. 2, 4, 5).

Proximity to lunate surface	Male		Female		Unsexed	
	Right	Left	Right	Left	Right	Le
Discrete n = 28 (58.3%)	5	12	2	3	2	4
Continuous n = 20 (41.7%)	3	9	1	6	1	0

Table 3. Prevalence of discrete and continuous facets in male, female and the unsexed coxal bones

Radiological findings

The grooved facet showed notching (Fig. 6) at the anterior-inferior end of acetabular margin while the concave and the flat ones appeared as less dense areas.

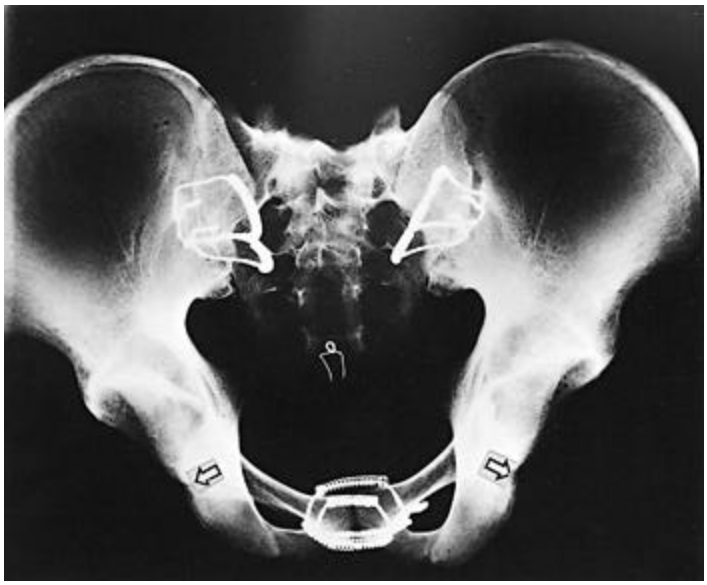

Fig. 6 Radiograph of a male pelvis (grooved facets) showing bilateral notching at antero-inferior end of acetabulum (*arrows*)

Discussion

The architecture of osseous tissue is influenced by the extrinsic and intrinsic factors which model it and determine if the resultant effect will be resorption or deposition. Whether the morphological features are prominent (tubercles, trochanters, condyles) or less conspicuous (faint ridges, imprints, depressions, facets) are attributed to factors such as the traction by muscle, ligament and fascia, or to pressure at articulation. The shape of mature bone is also affected by adoption of an unusual posture, e.g. squatting [4].

The smooth facet on the acetabulum, inferior to the anterior end of lunate surface, present in 15.2% bones in this study, has not been reported in literature. It was either discrete (58.3%) or continuous (41.7%), and was predominately seen on the left side (70.8%) as compared to the right (29.2%). The facet was oval, piriform or elongated in shape, the former had a higher prevalence (56.3%), in both male and female bones. The majority of the facets were concave (43.7%). All three surface configurations had a higher distribution on left side in males whereas in females only the concave facet showed a left dominance. The unsexed bones had no such predilection. In 37.5% it extended to the superior ramus of pubis, while in 62.5% it was limited by the margin of acetabulum.

The radiologic picture of coxal bones with unusual presentation of facet could not be compared in the absence of any reported study. Literature is available regarding the presence of facets on the neck of femur on its antero-inferior, antero-superior and posterior aspects [3, 5, 6]. The former imprint is commonly referred to as fossa of Allen or imprint of Berteaux and also ascribed to Poirier [7]. However no published report is available on the acetabular facets which would correspond to these femoral impressions. It can only be a conjecture, as this facet on the coxal bone approximates to the antero-inferior cervical imprint in flexion and adduction. The cervical femoral facets had erosion or ulcer like excavation [3] unlike the ones found on the acetabulum in the present work which in contrast were smooth surfaced.

The impression on the antero-inferior aspect of the neck of femur was due to the "spiral twist and full screw home of circular fibres of zona orbicularis during extension of the hip joint" and a higher frequency was seen in males than in females [6]. This sexual dimorphism was accounted for by the degree of capsular pressure sustained by males. Contrary to the above a higher incidence in females is also reported [3]. In the present study the facet on the coxal bone showed dominance in the males. It was opined [3] that the etiological factor is a local bone reaction by the pull of capsule in both extension (as in walking) and flexion (as in squatting) therefore an equal incidence was detected in squatters and non-squatters [3]. The presence of the lower cervical imprints were considered to be a consequence of atrophy by sustained pressure from the acetabular labrum due to long maintained posture such as lying on the side with lower extremity flexed [5]. It was concluded that the outer margin of this imprint was congruent with the bony acetabular rim though the precise area of its contact was not mentioned.

The part of the acetabular margin bearing the facet besides the capsular ligament gives attachment to acetabular labrum, medial origin of the lig. of head of femur and the upper attachment of transverse lig. It is postulated that any one or more of these ligaments when taut in any posture frequently adopted for long duration, this imprint may be a consequence. The relation of this facet to squatting is doubtful, otherwise most of our bones would have shown this feature, as squatting is

common in Indians, especially among the lower socio-economic status, whose bones make up the skeletal collection. During arthroscopic procedures on the hip joint, one encounters minor anatomical anomalies of acetabulum, femoral head shape and joint congruency.

Whether these variations are a consequence of degenerative changes or local pathology or conversely the variations are the causative factors of these conditions is controversial [10] and need to be investigated.

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