Original Research Article

Bony Impressions on Caput and Neck of Human Femora in Indian Population

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Abstract

Idiopathic osteoarthritis of the hip has been currently attributed by researchers to the repetitive microtrauma caused to the femoral neck by its impingement against the acetabular rim. This impingement occurs as a result of abnormal morphological traits like Allen's fossa, Poirier's Facet, and Posterior Cervical Imprint that appear on the proximal end of femur especially on the neck. Hence, this study was undertaken to investigate the incidence of these traits in the Indian population and to find a correlation between the occurrence of the trait and the side and sex of the bone. The study was conducted on 152 adult dried femora in the Department of Anatomy, Maulana Azad Medical College, New Delhi, India. The positive findings were photographed. The significance of the correlation was found out using Chi-square test. Allen's Fossa was found to occur in 71.1% of the total bones assessed Poirier's Facet in 31.6% and Posterior Cervical Imprint in 19.7%. Out of these, a significant side association was found for the Poirier's Facet with a predominance of the left side. All the traits were found to be more in males with a significant sex variation for Poirier's Facet. Each trait demonstrated a significant side and gender dimorphism.

Keywords: Femoro-acetabular impingement syndrome, Allen's Fossa, Poirier's Facet, femur neck, bony facets

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Date of submission: 28 Jul, 2013 Date of acceptance: 17 Mar, 2014

Introduction

Bony facets and imprints of the femur have been described by many workers with causative hypothesis revolving around evolution, micro evolutionary trends, posture, gait and muscular activities but no consensus has been reached to date as to ascribe them to a particular cause. Recently, these osseous non metric traits have been associated in several osteodegenerative disorders of the hip. One of such disorders which are associated is the femoro-acetabular impingement syndrome. It is a condition that occurs due to repeated contact between the acetabular rim and femoral head and neck junction (1). For current medical insights, it is very important to study the incidence of these osseous non-metric traits in Indian population as these have been studied in the Western population. The present study included the Allen's Fossa, Poirier's facet, and Posterior Cervical Imprint affecting the neck of the femur. Following is a description of these traits:

Allen's Fossa (Cervical fossa or depression; Anterior Cervical imprint; Imprint of Berteaux; Empreinte Iliaque) – It is found on the anterior aspect of the femoral neck adjacent to its junction with the articular surface. It can vary from a small depression to large eroded areas. The lateral edge is often clearly defined by a bony ridge (2,3,4,5).

Poirier's Facet – It is a noticeable extension of the articular surface of the femoral head toward the anterior portion of the femoral neck. It is a smooth facet (2,4).

Posterior Cervical Imprint – It is a facet resembling Poirier's, occurring on the posterior aspect of the neck

Figure 1: Allen's Fossa in right male femur in anterior view

Figure 2: Poirier's Facet in right male femur in anterior view

of femur. Its lateral limit may be formed by a tubercle, which is the medial limit for the groove for obturator externus (4).

Materials and Methods

The study was conducted on 152 adult dried femora collected from the Osteology Museum of the Department of Anatomy, Maulana Azad Medical College, New Delhi, India. The presence or absence of each of the three traits were assessed and photographed by Sony Digital Camera HX7 against a dark background. Each trait was analysed with the side and gender. The results were processed using SPSS version 17.0 for significance of the findings using Chi-square test.

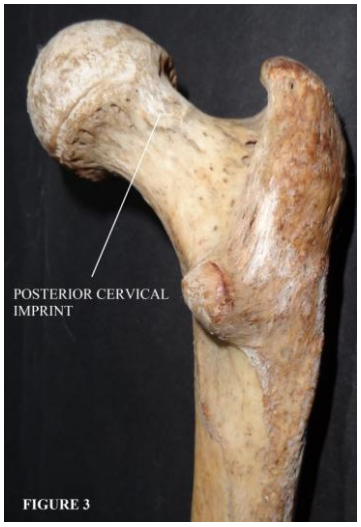

Figure 3: Posterior cervical imprint in right female femur in posterior view

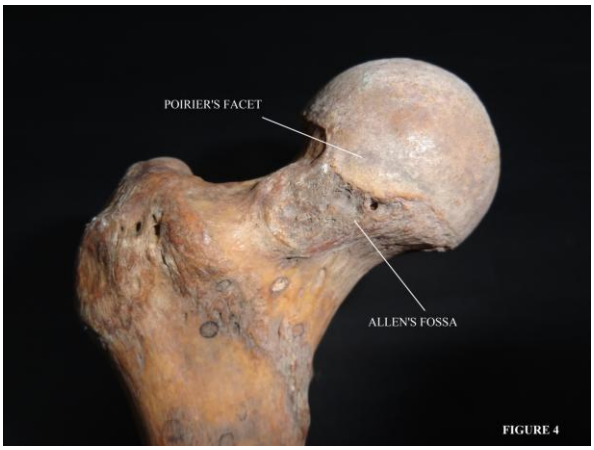

Figure 4: Both Allen's Fossa and Poirier's Facet in right male femur in anterior view

Results

Figure 1-4 showed the selected photographs of the traits. In few bones simultaneous occurrence of Allen's Fossa and Poirier's Facet were observed. Table 1 summarised the percentage incidence of each trait according to the side of the bone. The occurrence of Allen's Fossa was 71.1% with a higher predisposition on the right side. Regarding Poirier's Facet an incidence of 31.6% was found with the occurrence more on the left side. Posterior cervical imprint with a slight predisposition on the right was found to occur in 19.7% of the bones analysed. Hence, it was found that all the imprints were more common on the right side but facet was more common on the left side. Table 2 showed the Chi square test results and the p value. It was evident that the side variation

Table 1: Percentage incidence of each trait with the side of the bone

Osseous Non-Metric Traits of Proximal End of Femur				
Osseous Non-Metric Traits		Side of Bone		Total (152)
		Left (76)	Right (76)	
Allen's Fossa	Absolute number	52	56	108
	Incidence	68.4%	73.7%	71.1%
Poirier's Facet	Absolute number	30	18	48
	% of Total	39.5%	23.7%	31.6%
Posterior Cervical	Absolute number	14	16	30
Imprint	% of Total	18.4%	21.1%	19.7%

Table 2: Chi-square test and significance of the side of the bone and trait

Proximal End-Side_of_Bone -Trait				
Trait	**Side_of_Bone**		**Chi-square**	**Significance**
	Left	**Right**		
Allen's Fossa	52	56	0.512	0.474
Poirier's Facet	30	18	4.385	0.036*
Posterior Cervical Imprint	14	16	0.166	0.684

* Significant at 5% level of significance

Table 3: Percentage incidence of the traits in male and female femora

Osseous Non-Metric Traits of Proximal End of Femur				
Osseous Non-Metric Traits		Sex of Bone		Total (152)
		Male (76)	Female (76)	
Allen's Fossa	Absolute number	60	48	108
	Incidence	78.9%	63.2%	71.1%
Poirier's Facet	Absolute number	27	21	48
	% of Total	35.5%	27.6%	31.6%
Posterior Cervical	Absolute number	17	13	30
Imprint	% of Total	22.4%	17.1%	19.7%

Table 4: Chi-square test and significance of the gender of the bone and trait

Proximal End –Sex of Bone -Trait				
Trait	**Sex of Bone**		**Chi-square**	**Significance**
	Male	**Female**		
Allen's Fossa	60	48	4.606	0.032*
Poirier's Facet	27	21	1.219	0.27
Posterior Cervical Imprint	17	13	0.664	0.415

* Significant at 5% level of significance

was significant up to 5% for the Poirier's Facet being more commonly occurring on the left side. Table 3 showed the percentage occurrence of the trait in male and female femora; their Chi square test and

significance (p value) was tabulated in Table 4. The incidence of these traits was found to be more in male femora with the difference significant up to 5% only in Allen's Fossa.

Discussion

Osseous non metric variations of the femoral head and neck junction have been the subject of anatomical and anthropological studies for many years. In the present study, the incidence of Allen's Fossa is 71.1% with 68.4% on left and 73.7% on the right. The side variation was not significant. The incidence found in males was 78.9% and in females was 63.2% with a significance of up to 5%. It is curious that though it is so often present, it seldom finds mention in text-books. In an earlier study by Odgers on African, Australasian, and Asiatic skeletons the frequency was found to be 92 % in males and 67.5% in females (3). In another study done by Kostick on Western Nigerian population, the incidence was 33% in specially prepared skeletons from undissected cadavers and 56% from exhumed skeletons without any significant side variation (4). In a study done by Parsons, incidences of 62.5% in European females and 79% in males were found which are comparable to the present study. The authors describe facet or depression is as often present in modern bones as in medieval or prehistoric, and that it is an indicator to the habit of squatting, since, in order to get the facet in contact with the margin of the acetabulum it is necessary to flex strongly and internally rotate the thigh (5). Schofield found the incidence to be 70% in New Zealand Maori females and 75% in males, which is almost comparable with our study (6). Study done by Kate on Indian femora, observed the incidence in male and female for Cervical Fossa to be 41.6% and 25%, respectively (7).

In the present study Poirier's Facet was found to occur in 31.6% of the total number of bones out of which a 5% significance of side variation was found with 39.5% on left and 23.7% on right. It was found in 35.5% and 27.6% in males and females but no significance to the difference. This left sided femoral predominance of Poirier's Facet has not been accounted for in the previous studies. Study done by Finnegan and Penteado on the Terry Collection, housed at the Smithsonian Institution, best representing American Whites and American Blacks did not find the side variation significant for this trait (2,8). Kostick's study on Western Nigerian population found the incidence to be 51% in specially prepared skeletons from undissected cadavers and 70% from exhumed skeletons (4).

Posterior Cervical Imprint was found in 19.7% of the total number of bones assessed of which 18.4% in left and 21.1% in right. In males an incidence of 22.4% and in females 17.1% was found in our study. No significant side or sex variation was seen for this trait in our study.

The aetiology for the production of these impressions has been discussed by various authors, but no accord could be reached so far. Charles' study on Panjabi bones hypothesized the occurrence of these features on the neck of the femur due to the squatting posture assumed by the Orientals whether in field labour, or engaged in culinary operations, or pursuing the avocations of an artisan, suggesting a possible hypothesis of occupational stress markers (1,9) but, this theory was questioned by Odgers and Kostick who found a simultaneous occurrence of these features in non squatters. They defended a capsular pressure hypothesis stating that the pull of the capsule presumably produces a local bone reaction in the neck. The spiral twist and full screw home of the circular fibres of zona orbicularis and tension in the ilio-femoral ligament occurring on the extension of the hip joint suggests to the development of Allen's Fossa and Poirier's Facet, respectively (3,4,7,10). Angel opined that the fossa, identified in a high frequency in ancient Greeks was induced by the passage of the iliofemoral ligament when the thigh was hyper-extended as in running downhill (11). A major cause of hip pain in adults and a possible precursor of osteoarthritis is the Femoroacetabular impingement which arises as a result of abnormal morphological configurations of the proximal femur (cam type) and/or the acetabulum (pincer type). Cam impingement is caused by a non-spherical femoral head with an increased radius that enters the acetabulum during forceful movement, especially during flexion (12,13,14). As stated earlier, the impingement syndrome is postulated to occur due to osseous non metric traits present in the femoral head and neck region which acts as a pressure reaction area for induction of Idiopathic osteoarthritis. The findings of the present study with regard to the incidence of non metric osseous traits on the upper end of femur may serve as a baseline reference for not only Indian population but also for comparative anthropological studies with other races. These osseous traits were not present since the fetal life.

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