AN OSSEOUS STUDY OF NON-METRIC VARIATION OF THE NECK OF THE FEMUR

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INTRODUCTION
Femoroacetabular impingement is a condition of repeated contact between the acetabular rim and the femoral head-neck junction. Impingement arises as a result of abnormal morphological features involving the proximal femur (cam type) or the acetabulum (pincer type). Repetitive microtrauma from impingement of the femoral neck against the acetabular rim is the cause of many cases of idiopathic osteoarthritis of the hip. Femoroacetabular impingement is often associated with an osseous bump deformity on the femoral head-neck junction. With having this knowledge in background, present study was taken to find out non-metric variations of neck of femur which may cause femoroacetabular impingement (cam type).

MATERIALS AND METHODS: All available, intact 182 femora (84 belonged to the right side and 98 belonged to the left side) of unknown age and sex from the bony collection of the Department of Anatomy, Medical College, Baroda, Gujarat (India), were examined for the non-metric variations of the neck of the femur like Cervical fossa of Allen (depression on anterosuperior part), Poirier’s facet (extension of articular facet anterosuperiorly), Plaque formation (overgrowth or bony scar) and Posterior cervical imprint (extension of articular facet on posterior part). RESULTS: Cervical fossa of Allen was found in 25(13.74%) femora, Poirier’s facet was in 55(30.22%), Plaque formation was in 81(44.51%) and Posterior cervical imprint was in 15(8.24%) femora. CONCLUSION: Present study will be helpful to orthopaedic surgeons, radiologists, anthropologists, anatomists and physical therapists to understand and manage the mechanics of hip joint, cam type of femoroacetabular impingement and osteoarthritis of hip joint.

Key Words: Femoroacetabular impingement, fossa, facet, plaque, posterior imprint.

INTRODUCTION
Femoroacetabular impingement is a condition of repeated contact between the acetabular rim and the femoral head-neck junction. Impingement arises as a result of abnormal morphological features involving the proximal femur (cam type) or the acetabulum (pincer type). Repetitive microtrauma from impingement of the femoral neck against the acetabular rim is the cause of many cases of idiopathic osteoarthritis of the hip.

For patients suspected of having impingement of the rim, anatomical variation in the proximal femur should be considered as a possible cause. Variations of the proximal part of femur specially its head and neck region have attracted anthropologists and anatomist for a long time. Several non-metric traits have been distinguished so far. The variations are like the cervical fossa of Allen, Poirier’s facet, Plaque formation and Posterior cervical imprint. The cervical fossa of Allen is a depression with exposed trabeculae near the anterosuperior part. Poirier’s facet is a smooth bulging of the articular surface of the femoral head towards the anterior portion of the femoral neck. Plaque formation is an overgrowth or bony scar onto the femoral neck. All of the above variants may be defined on a single femur. Posterior cervical imprint resembles Poirier’s facet which is located on the posterior aspect of femoral neck. There is no general consensus about possible cause of these variations. As far as our knowledge goes, no such data is available from India. With having this knowledge in background, present study was taken to find out non-metric variations of neck of femur which may cause femoroacetabular impingement (cam type) or osteoarthritis of the hip joint.

MATERIALS AND METHODS
All available, intact 182 femora (84 belonged to the right side and 98 belonged to the left side) of unknown age and sex from the bony collection of the Department of Anatomy, Medical College, Baroda, Gujarat (India), were examined for the non-metric variations of the neck of the femur like Cervical fossa of Allen, Poirier’s facet, Plaque formation and Posterior cervical imprint. Damaged femora were excluded from the study. The following variations were systemically observed and noted. a) The Cervical fossa (depression) of Allen, when present, is usually located near the anterior superior margin of the femoral neck close to the border of the head. It can vary from a small depression to a large eroded area. To be scored as present, the underlying trabeculae must be seen. b) Poirier’s facet is scored present when there is a noticeable, however slight, bulging of the articular surface of the femoral head towards the anterior portion of the femoral neck. This facet is necessarily smooth. c) Plaque formation is scored as present when an overgrowth or bony scar extending from the area of Poirier’s facet on the femoral head down onto the femoral neck. All of the above variants may be defined on a single femur. d) Posterior cervical imprint resembles Poirier’s facet which is located on the posterior aspect of femoral neck. Statistical methods: The data so obtained was checked for its completeness, quality and internal consistency. Data entry and analysis was done using epi-info version 6.04d software.

RESULTS
The numbers and percentage of non-metric variations of the neck of the femur like Cervical fossa of Allen (Figure 1.A), Poirier’s facet (Figure 1.B), Plaque formation (Figure 2.A) and Posterior cervical imprint (Figure 2.B) were systemically observed and noted from all available, intact 182 femora (84 belonged to the right side and 98 belonged to the left side) of
Figure 3: Osseous bony bump

(A) Osseous bony bump seen from front. (right side)

(B) Osseous bony bump seen from inferior aspect. (right side)

unknown age and sex and are shown in Table 1. Out of total 182 femora observed, 148 (81.31%) femora showed variations of one or of other kind. The commonest variation was Plaque formation found in 81 (44.51%) femora followed by Poirier’s facet in 55 (30.22%), cervical fossa of Allen in 25 (13.74%) and Posterior cervical imprint in 15 (8.24%) femora. One right sided femur (1.19%) showed all four types of variations. Four right sided (4.76%) and one left sided femora (1.02%) showed combined fossa, facet and Plaque formation. 132 (72.52%) femora showed fossa, facet or Plaque formation, either alone or in combination. In present study, two femora demonstrated osseous bump

**DISCUSSION**

Non-metric variations of the neck of the femur were observed and noted (table 1) in total all available 182 femora (84 belonged to the right side and 98 belonged to the left side). Percentage of Poirier’s facet was much higher on the left side and this difference is statistically significant. Percentage of Plaque formation and posterior cervical imprint was slightly higher on right side. There is no significant difference in the percentage of cervical fossa of Allen between the right and the left side. The findings of the present study were compared with other studies. Authors have proposed different reasons for the presence of this kind of non-metric variations of the neck of the femur. Angel considered anterosuperior part of femoral neck as a ‘sensitive reaction area’ which may appear either as fossa or as a plaque close to the rim of the femoral head which (rim) extend outward to form the extra area of joint surface called Poirier’s facet. Angel found the reaction area in 83% of males and 74% of females (N=294). In the present study 132 (72.52%) femora showed reaction area. As the sex of the femora was unknown, separate findings of male and female could not be conducted. Allen’s cervical fossa, marks in about 2/5 of a series of ancient Greeks (N=430) and Angel believed that this fossa was induced by the passage of the iliofemoral ligament when the thigh was hyper-extended as in running downhill. Percentage of the cervical fossa of Allen in the present study was 13.74%. Poirier’s facet associated with the passage of the tendon for the muscle iliopsoas during habitual flexion and abduction of the thigh. Kostick studied total 738 femora into two series. In series A total 564 femoral studied from specially prepared skeletons and in series I.D.H. (Infectious Disease Hospital) total 174 femoral studied from exhumed skeletons of cemetery of I.D.H. Ibadan. In his series A, poirier’s facet were present in 56% of male femora(n=418) and 38% of female femora(n=146). In series I.D.H., Poirier’s facet were present in 72% of male femoral(n=144) and 52% of (n=30). Percentage of Poirier’s facet in Angel’s study was 71% while in the present study it was 30.22%. Difference between the findings of the present study and other studies may be because of racial and regional variations of study materials. Jager M et al reported osseous bump at the anterolateral head-neck junction in 17 out of 22 patients on radiographs and typical signs of femoroacetabular impingement on clinical examination. There was a significant improvement in internal rotation and pain relief in patients who underwent surgical resection of the osseous bump. In present study, two femora demonstrated osseous bump (Figure 3). Pitt et al. Studied the dry and cadaveric specimens showing reaction area radiographically and suggested the term ‘herniation pit ’ that it is formed by herniation of soft tissues through erosions or perforations of the reaction area surface, which result from abrasive action of the overlying hip capsule. This pit accounts for the radiolucency of the neck. This is composed of collagenous tissue, neocartilage, and reactive new bone. He postulated that excessive hyperextension of the hip was the major contributing factor and considered it as a vulnerable area, as synovial proliferative diseases such as rheumatoid arthritis show predilection for involving this site. It may weaken the superior
### Table 1: Non-metric variations of the neck of the femur

<table>
<thead>
<tr>
<th>Type of variations</th>
<th>Right side No. (%)</th>
<th>Left side No. (%)</th>
<th>Total No. (%)</th>
<th>(X^2) and P value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical fossa of Allen</td>
<td>12 (14.29)</td>
<td>13 (13.27)</td>
<td>25 (13.74)</td>
<td>(X^2 = 0.039) P&gt;0.05 Non-significant</td>
</tr>
<tr>
<td>Poirier’s facet</td>
<td>19 (22.61)</td>
<td>36 (36.73)</td>
<td>55 (30.22)</td>
<td>(X^2 = 4.27) P&lt;0.05 Significant</td>
</tr>
<tr>
<td>Plaque formation</td>
<td>41 (48.81)</td>
<td>40 (40.82)</td>
<td>81 (44.51)</td>
<td>(X^2 = 1.17) P&gt;0.05 Non-significant</td>
</tr>
<tr>
<td>Posterior cervical imprint</td>
<td>09 (10.71)</td>
<td>06 (6.12)</td>
<td>15 (8.24)</td>
<td>(X^2 = 1.26) P&gt;0.05 Non-significant</td>
</tr>
</tbody>
</table>

cortex of the femoral neck, contributing to fractures of the hip in aged⁷. Leunig et al, in their radiological study, fibrocystic changes were identified on the AP radiographs of the 39 (33%) of the 117 FAI( Femoroacetabular Impingement)-affected hips and on none of the radiographs of the 132 DD (developmental dysplasia) affected hips and they hypothesize that these alterations at the anterosuperior femoral head-neck junction are not incidental. They proposed that they are instead caused by repetitive mechanical contact between the femoral head-neck and the acetabular rim⁸. Villotte et al suggested that reliable occupational stress markers could be described and defined in this way⁹.

**CONCLUSION**

Present study will be helpful to anatomists, anthropologists, orthopaedic surgeons, radiologists and physical therapist to better understand reaction area of the neck of the Femur for better management of pathologies like Cam type of femoroacetabular impingement and osteoarthritis of hip joint. Since this study performed on limited number of dry femora of unknown age,sex and profession, further cadaveric, radiological and clinical studies are indicated.

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**REFERENCES**

