Morphometric analysis of acetabulum and its clinical correlation in south Indian population

K Yugesh and S Senthil Kumar

Abstract

Introduction: In modern world Orthopedic Surgeons and Biomedical Engineers are trying to make the best possible prostheses for planning the total hip management. Body proportions and absolute dimensions vary widely in respect to age, sex and racial groups. While partially due to variability in musculature and adiposity, such variations are chiefly in skeletal.

Materials and Methods: The study was conducted in the Department of Anatomy. Sixty hip bones of both sexes were used. The osteometric parameters such as Side, Sex, and Diameter of acetabulum, Depth of acetabulum, Notch Width and Lunate surface endings were measured using Vernier caliper, scale and thread. The data were analyzed statistically using SPSS software. In this study we included only healthy bones, deformed and eroded bones were excluded from the study.

Observation: The depth of acetabulum was found to be more in males (30±0.223 mm) than in females (21.45±0.22 mm). Diameter was found to be more in the males than in females (P<0.005). Notch width was found to be more in females than in the males. There is no significant difference between the right and left sides of acetabulum.

Conclusion: Morphometric measurements of acetabulum is essential for clinical correlation and it also helps the orthopedic surgeons to identify the accurate diameter of the acetabulum.

Keywords: Hip bone, Osteometric parameters, Acetabulum
The posterior acetabular wall has been proposed to be hypo-plastic, for acetabular retroversion. Pre-operative planning has always been an integral part of total hip replacement [8]. For many years, human hip joint has been an object of investigation for morphologists and biomechanics etc. Load is transferred to the hip bone through sacroiliac joint and from the pelvis to the lower extremities through hip joint [4]. It is important to understand ethnic differences in the general morphology of hip joint that may contribute to the onset of osteoarthritis. Assessment of acetabular depth ratio to study the acetabular morphology helps the surgeons to diagnose the hip dysplasia [9]. Knowledge of the anatomical parameters in this area is very much essential, for better learning the complexity and etiopathogenesis of diseases like primary osteoarthritis of the hip joint etc.

2. Materials and Methods
Sixty hip bones of both sex were used. The osteometric parameters such as Side, Sex, Diameter, Depth, Notch Width and Lunate surface endings were measured using Vernier caliper, scale and analyzed statistically using SPSS software. In this study we included only healthy bones, eroded and deformed were excluded from the study. Diameter were measured from anterior to posterior part of the rim of the acetabulum, depth was measured by a line joining the aforesaid rim perpendicular to it in non-articular part is measured Fig. 1.1.

3. Results
3.1 The mean value of depth, diameter and notch width on male and female hip bone
Depth of the acetabulum was greater in males (30.00±0.223 mm) compared with females (21.45±0.22 mm). While diameter of acetabulum was greater in males (48.66±0.33 mm) and less in females (46.18±0.24 mm) where both the sexes showed statistically significant. Notch width was greater in females (31.77±0.39 mm) when compared with males (30.47±0.70 mm) which was not significant statistically. (Table –I).

<table>
<thead>
<tr>
<th>Acetabulum</th>
<th>Sex</th>
<th>Mean (SD) in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>Male</td>
<td>30.00±0.223</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>21.45±0.22</td>
</tr>
<tr>
<td>Diameter</td>
<td>Male</td>
<td>48.66±0.33*</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>46.18±0.24*</td>
</tr>
<tr>
<td>Notch Width</td>
<td>Male</td>
<td>30.47±0.70</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>31.77±0.39</td>
</tr>
</tbody>
</table>

*p<0.005

3.2 Ends of acetabular labrum
In majority of the bones (93.3%), the anterior end was pointed and the posterior end was lunate shaped (Fig. 3. A). While in 5% anterior and posterior end lunate in shape (Fig.3.B). In 1.7% cases the anterior and posterior ends were pointed (Fig. 3. C).

3.3 The mean depth, diameter and notch width of acetabular fossa on right and left side of hip bone
Depth of the acetabulum compared with both sides (Right - 29.9±0.21 mm & Left - 29.7±0.23 mm) were more or less same. Diameter of the acetabulum is same with small variation (Right side – 47.4±0.27 mm and Left side – 48.0±0.37 mm). Notch width of both right and left side (Right side - 30.8±0.42 mm; Left side – 31.1±0.72 mm) was more or less same but none were statistically significant TABLE - II.

<table>
<thead>
<tr>
<th>Acetabulum</th>
<th>Side</th>
<th>MEAN (SD) in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>Right</td>
<td>29.9±0.21</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>29.7±0.23</td>
</tr>
<tr>
<td>Diameter</td>
<td>Right</td>
<td>47.4±0.27</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>48.0±0.37</td>
</tr>
<tr>
<td>Notch Width</td>
<td>Right</td>
<td>30.8±0.42</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>31.1±0.72</td>
</tr>
</tbody>
</table>
4. Discussion

Hip joint is one of the major joint of the body described as ball and socket variety of synovial joint Williams et al. [10]. Menschik [11]. Various parameters of the acetabulum viz., diameter of acetabulum and depth of acetabulum were carried out by Murray [12] Lane et al. [13] and Gonzale [14] essentially to assist Orthopedic Surgeons, Biomedical Engineers to make suitable hip joint prostheses, detection of disputed sex by Forensic Experts and to understand the etiopathogenesis of diseases like the primary osteoarthritis. Bavormitt et al. [15] stated that it is necessary to evaluate the diameter of the acetabulum as a part of preoperative planning in order to estimate the size of the acetabular cup in surgical procedures of acetabulum especially in total hip arthroplasty. Stulberg and Harris [9] reported the pattern of damage to the acetabular cartilage and the labrum depends upon the shape of the hip. In the normal hip the labrum merges with the acetabular cartilage through a transitional zone without any gap.

Chauhan et al. [9] reported in North Indian population, the average diameter on the right and left side of males showed no significant differences but, in case of females, the right side was found to be less when compared to left side. Loder et al. [16] reported the acetabular depth has been regarded by many authors as an important measurement to define acetabular dysplasia. An acetabular depth of less than 0.9 cm is considered to be dysplastic. Sharp and Hull[17] reported that shallow acetabulum is more prone to develop congenital subluxation. Werner Kohlein et al. [17] reported width of the acetabular notch was 51±6 mm, which was wider in females than in males in Switzerland population. Jibgibi and Kwatampora [18] reported the gender differences in the depth of the articular surface were characterized by the size of the fossa and width of the notch rather than by outer rim profile. The significant differences observed in the acetabular depth and angle may be due to the wider pelvis of women.

In present study, sex comparison which revealed depth of the acetabulum was greater in males (30.60±0.223 mm) than in females (21.45±0.22 mm). Diameter of acetabulum was greater in males (46.66±0.33 mm) and less in females (46.18±0.33 mm) but, statistically significant in both sexes. Notch width was greater in females (31.77±0.39 mm) when compared with males (30.47±0.7 mm) without any significance. When comparing with both sides depth of the acetabulum in both sides (Right & Left) were more or less same. Diameter of the acetabulum is same with small variation. Notch width of both right and left side was more or less same but none were statistically significant.

Werner Kohlein et al. [17] reported the width of the acetabular notch was 51±6 mm, which was wider in females than in males in Switzerland population. In present study notch width revealed 30.8±0.42 mm on the right side, 31.1±0.72 mm on the left side of acetabulum showed no difference between the two sides. In case of males, the notch width was found to be 30.47±0.70 mm and in females 31.77±0.39 mm which is not statistically significant.

The gender differences in the depth of the articular surface were characterized by the size of the fossa and width of the notch rather than by outer rim profile.

5. Conclusion

A thorough knowledge of dimensions of acetabulum and femoral head in both sexes will assist the Biomedical Engineers to construct suitable prostheses. This gives the average values of various parameters to near normal situations as encountered in patients at the operation table. Knowledge of the anatomical parameters of bony components of the hip joint are also very much essential to get a better understanding of the etiopathogenesis of primary osteoarthritis and will help in early detection of disputed sex by Forensic experts.

The various parameters of acetabulum observed in the present study can be used for Total Hip Replacement. It is necessary to evaluate the diameter of the acetabulum as a part of preoperative planning in order to estimate the size of the acetabular cup in surgical procedures which will help the orthopedic surgeons to identify the accurate diameter of the acetabulum.

6. References
