INTRODUCTION

Femoroacetabular impingement (FAI) may cause the progression of degenerative changes in both the labrum and the articular cartilage and it is regarded as the cause of primary or idiopathic osteoarthritis (1). The likelihood of FAI is dependent on the anatomical deformity of the acetabular rim or femoral head neck junction (2). The difference of individual hip anatomy also affects to it.

To differentiate these anatomical abnormalities from a normal variation, normal hip joint anatomy of the acetabulum and proximal femur need to be investigated more in detail. In addition, anatomical differences between male and female have routinely been seen (3, 4).

The purpose of this study was to investigate the gender difference in anatomy of the Japanese normal hips.

MATERIALS AND METHODS

Computer tomography (CT) images of 136 hip joints (45 males; 91 females) of 94 elderly people (28 males; 66 females) were analyzed. The data of bilateral hip joints of 42 adults (17 males; 25 females) without hip symptoms were from our image database of healthy volunteers. The remaining data of 52 hips were obtained from the contralateral normal side of the hip of adults (11 males; 41 females) with a hip fracture. The average age of the subjects was 74.0±6.8 (range; 57 to 96) years old for male and 73.4±7.8 (range; 57 to 97) years old for female. Using three-dimensional (3D) viewer software (3D template; Japan Medical Materials), multiple planar reconstruction (MPR) views were generated.

To reconstruct standardized MPR views, the coronal plane and the transverse plane were adjusted to include the bilateral anterior superior iliac spines (ASIS). Then, the coronal plane was tilted until the pubic tubercles were on the same plane using ASIS (Anatomical pelvic position). This sagittal rotation angle was defined as the tilt of the anterior pelvic plane (APP). Then, the orthogonal MPR views were moved to pass the center of the femoral head. In these views, acetabular anteverision and inclination were measured. The orthogonal MPR views were further moved to cancel the acetabular anteverision and then, the acetabular inclination was canceled so that the axial plane included three points of anterior, lateral, and posterior acetabular edges. On the planes perpendicular to the axial plane through the femoral head center, the acetabular edge angle between the acetabular center axis and a line through the femoral head center and each acetabular edge point was measured around the acetabular rim at 15 degrees of interval from the deepest acetabular notch.

In the femoral side, femoral head diameter, femoral anteverision and neck shaft angle were measured according to the previously reported method (3). To investigate the shape of the head neck junction at the impingement point to the acetabular rim, MPR views through the femoral neck axis were used. A radius of the head-neck junction from the femoral neck axis where a sphere fitted to the femoral head merged to the neck was measured. The ratio of the neck radius to the femoral head radius was calculated around the head neck junction at 15 degrees of interval from the most prominent point of the Adam’s arch.

RESULTS

The morphologic parameters of the acetabulum and femur were shown in Table 1. The gender differences were found in the acetabular anteverision, acetabular inclination, femoral head diameter, and femoral neck anteverision.

When the acetabular rim height was shown in a graph (Fig. 1), there were three valleys and three peaks. These peaks were seen at the points of 135 degrees anterior, 60 degrees anterior, and 45 degrees posterior from the deepest inferior notch in males and at the points of 135 degrees anterior, 45 degrees anterior, and 45 degrees posterior from the deepest inferior notch in females. The average acetabular rim height of males was significantly larger than that of females at the point of 15 degrees posterior from the deepest inferior notch.

The average shape of femoral head neck junction was shown in Fig. 2. The gender differences were found at the top corners of the femoral neck.

DISCUSSION

The male acetabulum has a smaller anteverision and a smaller inclination than the female acetabulum. The male femur was less antverted than the female femur. These were the same gender differences in hip anatomy as reported by others (3, 4). The height of acetabular rim was not different between males and females except at the corner of the ischium. The shape of head neck junction was more projected at the antero-superior corner in males.

These gender differences all contribute to more range of motion until bony impingement in flexion for females and in extension for males. The anatomical data in this study can serve as a reference to determine the area and amount of the acetabular rim or femoral neck resection for FAI syndromes and gender difference should be considered in diagnosis and treatment of FAI.

Table 1. Morphologic parameters of the acetabulum and femur

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetabular anteverision</td>
<td>20.2±7.4</td>
<td>17.8±6.5</td>
<td>21.3±7.6</td>
<td>*</td>
</tr>
<tr>
<td>Acetabular inclination</td>
<td>37.6±4.4</td>
<td>36.0±3.6</td>
<td>38.5±4.5</td>
<td>*</td>
</tr>
<tr>
<td>Tilt of APP</td>
<td>-4.5±7.4</td>
<td>-4.0±6.2</td>
<td>-4.8±7.9</td>
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</tr>
<tr>
<td>Femoral head diameter</td>
<td>44.9±3.5</td>
<td>48.6±2.3</td>
<td>43.0±2.4</td>
<td>*</td>
</tr>
<tr>
<td>Femoral neck anteverision</td>
<td>22.4±10.2</td>
<td>19.4±10.4</td>
<td>23.9±9.8</td>
<td>*</td>
</tr>
<tr>
<td>Femoral neck shaft angle</td>
<td>125.1±4.8</td>
<td>124.6±4.8</td>
<td>125.4±4.9</td>
<td>-</td>
</tr>
</tbody>
</table>

*: p<0.05

Fig. 1. The acetabular rim height was shown as a center edge angle in an interval of 15 degrees. (*: p<0.05)

Fig. 2. The head-neck ratios at the femoral head neck junctions (*: p<0.05)

References

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