Acetabular Retroversion: A Torsional Disorder of the Pelvis at the Level of the Acetabulum

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Introduction: Acetabular retroversion, defined as a posteriorly oriented acetabular opening with reference to the sagittal plane, is considered a risk factor for osteoarthritis of the hip.[1,2] Abnormal acetabular orientation adversely affects the load transmission across the hip, damaging the labrum and cartilage. It has been proposed retroversion is due to either a posterior wall deficiency, excessive anterior coverage, or both.[3] We hypothesized that acetabular retroversion is not only an abnormality of the acetabulum but involves the entire pelvis at the level of the acetabulum.

Materials and Methods: Thirty normal pelvic CT scans (15 male, 15 female) obtained from our trauma center radiology database were studied. All scans had been obtained as part of the standard trauma work-up, avoiding any additional x-ray exposure to patients. 3-D models were created using a commercially available software package (Mimics, Materialise, Ann Arbor, MI). A specialized acetabular analysis module was used to enter various anatomical points on the pelvises. A series of anatomical planes was constructed for each pelvis. The standard coronal plane (SCP) was defined as running through both ASIS points and the pubic symphysis. The pelvic axial plane was defined as running through both ASIS points and normal to the standard coronal plane. The sagittal plane is normal to the SCP and runs through the center of S1 vertebra and the pubic symphysis. A sphere with seven evenly spaced planes parallel to the pelvic axial plane and normal to standard coronal plane was overlaid on the inner surface of each acetabulum with its center being defined as the center of the acetabulum. Points were plotted where the planes intersected the acetabular rim anteriorly and posteriorly. The specific version at each level of the acetabulum was measured as the angle between two planes, the first plane runs between the anterior and posterior rim at each level and is normal to the pelvic axial plane and the second plane is the sagittal plane. The version measurements were determined for the planes from levels 1-4 in order to delineate the variability in acetabular anteversion from cranial to caudal. Data for acetabular size as defined by the sphere diameter, interASIS distance, interacetabular center distance, and interschisalspinous distances were expressed as mean ± standard deviation. A normalized index of ischial spine position was developed (ischial spine index or ISI) by dividing the ischial spine to sagittal plane distance by the interischialspinous distances.

Results: The prevalence of acetabular retroversion was 11.7% (7 of 60, in six pelvises bilaterally, in one unilaterally) at level 1, 5% (3 of 60, in one bilaterally, in one unilaterally) at level 2, and did not occur at levels 3 and 4. The mean results for male and female values of acetabular cup size, interASIS distance, interacetabular distance, interschisalspinous distance, and anteversion at levels 1-4 are shown. Table 1. Mean Values of Measurements for Males and Females

<table>
<thead>
<tr>
<th>Sex</th>
<th>Acetabular Cup Size (mm)</th>
<th>Inter-ASIS Distance (mm)</th>
<th>Inter-Acetabular Distance (mm)</th>
<th>Inter-Spine Distance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>32.0 (11.3)</td>
<td>101.8 (1.0)</td>
<td>98.4 (7.2)</td>
<td>6.2 (4.8)</td>
</tr>
<tr>
<td>Female</td>
<td>22.5 (1.2)</td>
<td>197.7 (1.2)</td>
<td>198.6 (6.5)</td>
<td>16.1 (4.3)</td>
</tr>
</tbody>
</table>

A moderate linear correlation was found between level 4 anteversion and the ISI (R=0.691) [FIGURE 1] and between level 1 and level 4 anteversion (R=0.791). A strong linear correlation was found between level 2 and level 4 anteversion (R=0.851) [FIGURE 2] and level 3 and level 4 anteversion (R=0.935).

Discussion: Acetabular retroversion is a common diagnosis associated with a number of underlying conditions.[2,4] Previously, retroversion of the acetabulum has been considered a combination of anterior overcoverage and posterior wall deficiency.[1] This study suggests that the retroversion does not simply involve the anterior and posterior walls but may reflect an associated torsional abnormality of the entire pelvis at the level of the acetabulum. Based on this information, the optimal hip preservation technique for acetabular retroversion may be an acetabular reorientation such as a “reverse” periacetabular osteotomy rather than alternative treatments such as hip arthroscopy and/or open anterior acetabular rim recontouring.