Original article

Bilateral incidence and severity of acetabular dysplasia of the hip

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Abstract

**Background.** Most Japanese patients have secondary osteoarthritis, mainly due to developmental dislocation of the hip (DDH) or acetabular dysplasia (AD). However, the precise pathomechanism of AD remains unknown. The purpose of this study was to investigate the frequency of bilateral AD and determine the correlation of the severity of AD between the right and left hips.

**Methods.** A total of 206 patients with prearthrosis or early-stage osteoarthritis caused by AD were examined radiographically, and their history of treatment for DDH during infancy was reviewed. There were 187 women and 19 men included in the study, and the mean age at examination was 37.6 years (range 20–49 years).

**Results.** A total of 174 patients (84%) had bilateral AD. In all, 72 (35%) of the 206 patients had a history of treatment for DDH (DDH group), and the remaining 134 (65%) had no history of DDH (non-DDH group). Bilateral AD was observed in 55 patients (76%) in the DDH group and 119 patients (89%) in the non-DDH group; the difference was significant. The center-edge angle, acetabular head index, acetabular angle, and acetabular roof angle showed positive correlations between the right and left sides in the non-DDH group. There was no correlation of the acetabular roof angle between the two sides in the DDH group.

**Conclusions.** A high rate of bilateral AD and a positive correlation of the severity of AD between the right and left hips were observed, especially in patients with no history of DDH. Our data suggest that in many patients AD occurred as a result of bone malformation involving bilateral hip joints. More research from a genetic standpoint is needed to elucidate the pathomechanism of this disease.

Introduction

Primary osteoarthritis is a rare condition in Japan. Most Japanese patients have secondary osteoarthritis, mainly due to developmental dislocation of the hip (DDH) or acetabular dysplasia (AD). More Japanese people with osteoarthritis were reported to have dysplasia than did American or British subjects.

The precise pathomechanism of AD remains unknown. Patients with AD have been reported to exhibit abnormal morphology of the pelvis, and AD was considered to be associated with pathological transverse growth of the pelvis.

The purpose of this study was to investigate the frequency of bilateral AD and the correlation of the severity of AD between the right and left hips. This retrospective diagnostic study received permission for publication from the institutional review board of Nagasaki University.

Material and methods

We selected patients with AD of the hip with prearthrosis or early-stage osteoarthritis. Those with advanced or end-stage osteoarthritis were excluded so we could evaluate AD more accurately by excluding osteophyte formation. Patients ≤19 years of age were excluded to avoid premature hip joints, as were those >50 years because of the difficulty of confirming a history of treatment for DDH. Other patients who were excluded if they had a history of hip osteotomy, hip dislocation into the gluteal muscles, or secondary posttraumatic osteoarthritis, inflammatory rheumatic disease, osteonecrosis, or an infectious disease.

All patients visited our hospital for consultation about hip joint pain between 1996 and 2006. A total of 206 patients were examined radiographically and for any history of treatment for DDH during infancy. There were 187 women and 19 men, and the mean age at examination was 37.6 years (range 20–49 years).

Parameters evaluated were the center-edge (CE) angle, acetabular head index (AHI), acetabular angle,
and acetabular roof angle (Fig. 1). AD was defined as a CE angle <20°, AHI <75%, acetabular angle >45°, or acetabular roof angle >15° on anteroposterior radiographs.10

Severity of osteoarthritis was graded using Japanese Orthopaedic Association (JOA) criteria.11 Osteoarthritis of the hip was classified into the following four stages: prearthritic stage, with no osteoarthritic change; early stage, with slight narrowing of the joint space associated with sclerosis of the subchondral bone; advanced stage, with narrowing of the joint space with cystic radiolucenties and small osteophytes; and end stage, with almost total disappearance of the joint space and marked osteophyte formation.

Clinical symptoms were evaluated using Merle d’Aubigne and Postel’s12 hip joint scoring system, in which a maximum of six points in each case is assigned according to the following three criteria: pain, mobility, and walking ability.

All radiographs were obtained in the supine position. Anteroposterior radiographs were taken with a source-to-film distance of 110 cm. The patient’s feet were internally rotated with the toes at 15° ± 5° to ensure that the X-ray beam was centered on the superior aspect of the pubic symphysis.

To test the reproducibility of the radiographic measurements, three authors (K.O., M.T., N.O.) measured the CE angle, AHI, acetabular angle, and acetabular roof angle in five randomly selected hips. Each hip was measured three times, with an interval of 1 week between measurements, and the values were then averaged. The data were analyzed for intra- and interobserver variances, and the coefficient of variation was calculated to be less than 5%. Therefore, the reproducibility of the measurements was considered reasonable.

Differences between two means were tested using the Wilcoxon rank test. The correlations of X-ray parameters between the right and left sides were evaluated using Pearson’s correlation coefficient (StatView software; Abacus Concepts, Berkeley, CA, USA). The significance level of the hypothesis test was $P < 0.05$.

### Results

The mean total hip score on examination was 13.8 (range 8–17). The mean scores of pain, mobility, and ability to walk were 3.9 (range 1–5), 5.7 (range 5–6), and 4.2 (range 1–6), respectively. Almost none of the patients showed any limitation in the range of motion of the hip, and none had severe pain; however, they did have slight walking disturbances. In total, 22 patients with fatigue or dull pain in the contralateral hip consulted us. In these cases, the side with fatigue or dull pain was analyzed and considered as the side without pain. A total of 104 patients (51%) had hip joint pain on the right side at examination and 102 patients (49%) on the left side.

The CE angle and AHI were significantly smaller and the acetabular angle and acetabular roof obliquity significantly greater on the side with pain than on the side without pain; however, the differences between the right and left sides were not significant (Table 1). In all, 174 patients (84%) had bilateral AD. The CE angle, AHI, acetabular angle, and acetabular roof angle

### Table 1. Measures of acetabular dysplasia on the right and left sides and on the sides with and without pain

<table>
<thead>
<tr>
<th>Measure</th>
<th>Right hip (n = 206)</th>
<th>Left hip (n = 206)</th>
<th>Hip with pain (n = 206)</th>
<th>Hip without pain (n = 206)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE angle</td>
<td>12.7 ± 12.9 (–13 to 38)</td>
<td>13.1 ± 12.9 (–21 to 50)</td>
<td>8.4 ± 9.2 (–21 to 25)*</td>
<td>17.4 ± 9.0 (–3 to 50)</td>
</tr>
<tr>
<td>AHI</td>
<td>63.8 ± 11.3 (35–90)</td>
<td>64.8 ± 10.5 (36–90)</td>
<td>60.0 ± 10.6 (35–90)*</td>
<td>68.6 ± 9.8 (49–90)</td>
</tr>
<tr>
<td>Acetabular angle</td>
<td>48.3 ± 3.5 (37–57)</td>
<td>48.5 ± 4.0 (39–60)</td>
<td>49.7 ± 3.8 (43–60)*</td>
<td>46.9 ± 3.2 (37–55)</td>
</tr>
<tr>
<td>Acetabular roof angle</td>
<td>21.2 ± 8.3 (5–41)</td>
<td>20.2 ± 8.4 (3–45)</td>
<td>23.7 ± 7.9 (5–45)*</td>
<td>17.6 ± 7.6 (3–40)</td>
</tr>
</tbody>
</table>

CE, center-edge; AHI, acetabular head index

All values are the mean ± SD, with the range in parentheses

* $P < 0.001$, for pain vs. without pain side