Long-term results of Chiari pelvic osteotomy in patients with developmental dysplasia of the hip: indications for Chiari pelvic osteotomy according to disease stage and femoral head shape

SHIGERU YANAGIMOTO1, HIRAKU HOTTA1, RYOUICHI IZUMIDA1, and TOYONORI SAKAMAKI2

1Department of Orthopedic Surgery, School of Medicine, Keio University, 35 Shinanomachi, Shinjuku-ku, Tokyo 160-8582, Japan
2Department of Orthopedic Surgery, Hakone National Hospital, Odawara, Japan

Background. We evaluated the long-term results of Chiari pelvic osteotomy for developmental dysplasia of the hip (DDH) after follow-up of 10 years or more. The indications for Chiari osteotomy were assessed based on the results.

Methods. We evaluated 74 hips in 69 patients treated for DDH with Chiari osteotomy. The average postoperative follow-up period was 13 years. The mean age at the time of surgery was 32 years (range 6–64 years). The disease was classified into two stages based on joint space measurements on radiographs: an early stage (36 hips) in which the mean age at surgery was 21 years (range 6–48 years) and an advanced stage (38 hips) in which the mean age at surgery was 41 years (range 18–64 years). Femoral head shape was classified into two types based on measurements of the sphericity of the femoral head: spherical (33 hips) or flat (41 hips). Clinical manifestations were evaluated according to Japanese Orthopaedic Association (JOA) hip scores. The joint space was measured on radiographs as an index of the progression of osteoarthritis. We attempted to identify factors that affected the long-term results of Chiari osteotomy, especially in regard to disease stage and femoral head shape.

Results. The mean total JOA score was 72 preoperatively and 87 at final follow-up. It had improved in 66 hips and was worse in 7 hips. All of the worse cases were at the advanced stage at the time of surgery, and in 6 of the worse cases the femoral head was spherical. Hips with advanced DDH and a spherical femoral head had poor outcomes and exhibited joint space narrowing postoperatively.

Conclusions. Early DDH is considered a good indication for Chiari pelvic osteotomy because of the good results at 10 years or more. Even with advanced DDH, a flat femoral head predicts a good surgical outcome, but patients with a spherical femoral head may experience early progression to osteoarthritis.
according to Japanese Orthopaedic Association (JOA) hip scores. Osteotomy height, osteotomy angle, and the displacement ratio on plain radiographs were used as surgical variables. Differences in the center-edge (CE) angle (Wiberg) after the operation were also measured. The joint space was measured before and immediately after surgery and at the final follow-up examination. The Chiari osteotomy provided new, additional acetabular coverage with adequate changes. The joint space before and after surgery was another indicator of the patient’s condition. The joint space immediately after surgery indicates the osteotomy height; adaptation of the new joint surface then occurs gradually. Slight narrowing of the joint space parallel to the femoral head shape is soon seen on radiographs. This is the postoperative remodeling process of the joint. After several years, as the osteoarthritis progresses, joint space narrowing may be seen on the radiographs. We measured joint space on radiographs with slide calipers that have a precision of 0.1 mm. Measurements were made twice.

We attempted to identify factors that affected the long-term results, especially in regard to disease stage and femoral head deformity. The disease was divided into two stages: an early stage, in which the joint space was normal on radiographs, and an advanced stage, in which the joint space had become narrow. Femoral head shape was analyzed on plain anteroposterior (AP) radiographs by calculating two parameters: the aspect ratio of the femoral head (defined as the ratio of the maximum major diameter to the minimum minor diameter) (Fig. 1) and the spherical index according to Okano et al.1 to evaluate the position of the top of the femoral head (Fig. 2). Based on the results, femoral head shape was classified as spherical (defined as having an aspect ratio of less than 1.2 and a spherical index of less than 65%) and flat (defined as everything else). All patients were classified into four groups according to disease stage and femoral head shape, and the long-term outcomes for the four groups were compared. Factors that affected long-term outcome were identified based on the results.

**Results**

Classification by disease stage and femoral head shape

All cases were classified according the disease stage based on the preoperative joint space measurements on radiographs. There were 36 early-stage hips and 38 advanced-stage hips. The mean age at the time of surgery was 20.6 years (6–48 years) in the early-stage group and 40.8 years (18–64 years) in the advanced-stage group. Table 1 shows the patient distribution according age at the time of surgery for each group. These two mean years in each groups were statistically different (Student’s t-test; \( P < 0.01 \)). The femoral head was spherical in 33 cases and flat in 41. All hips were divided

![Fig. 1. Aspect ratio of the femoral head](image1)

![Fig. 2. Spherical index of the femoral head (according to Okano et al.1)](image2)

**Table 1.** Age distribution at time of Chiari operation

<table>
<thead>
<tr>
<th>Stage</th>
<th>No. of patients, by age (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–9</td>
</tr>
<tr>
<td>Early (36 hips)</td>
<td>3</td>
</tr>
<tr>
<td>Advanced (38 hips)</td>
<td>0</td>
</tr>
</tbody>
</table>