CHIARI’S OSTEOTOMY IN THE TREATMENT OF PERTHES’ DISEASE

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Seventeen patients, with an average age of nine years 11 months, underwent 18 Chiari osteotomies for the treatment of painful subluxation of the hips following Perthes’ disease. The average follow-up period was four years three months.

The 13 patients reviewed clinically all did well and none complained of pain or instability. The radiographs were examined in all 17 cases. The average centre-edge angle and percentage femoral head cover were definitely improved by the operation. No significant medial displacement of the femoral head was achieved. The clinical success may result from improved femoral head coverage and diminished eccentricity.

Chiari’s osteotomy is recommended for adolescent patients with painful subluxation of the hip as a consequence of Perthes’ disease.

Perthes’ disease, if it is diagnosed late or in the older patient, presents deformities which are too severe to be treated by the conventional methods of containment and motion. Though many adolescents have few symptoms despite severe deformity, those that have persistent pain with subluxation require treatment.

The medial displacement innominate osteotomy of Chiari (1955, 1974) is a method of treatment for lateral subluxation of the femoral head. The procedure was first proposed for a variety of conditions including congenital and paralytic dislocation of the hips, Perthes’ disease and the hip dysplasias of cerebral palsy (Hoffman, Simmons and Barrington 1974; Canale et al 1975; Handelsman 1980; Bailey and Hall 1985; Klisić et al 1985). Improvement in function and diminution of pain were thought to result from medialisation of the femoral head which, in theory, reduces the force on the femoral head and increases the surface area over which the force is distributed (Chiari 1955; Colton 1972).

We have reviewed a selected group of patients with painful incongruent subluxed hips, resulting from Perthes’ disease, treated by Chiari’s osteotomy.

Fig. 1
Age distribution at the time of operation.

MATERIALS AND METHODS

Between November 1982 and August 1986, 18 Chiari osteotomies were performed on 17 patients at the Children’s Hospital in New Orleans, Louisiana. There were 16 males and one female, 10 patients had the operation on the left hip, six on the right and one bilaterally. Previous surgical procedures included one upper femoral osteotomy and trochanteric advancement, one adductor tenotomy and one cheilectomy. The patients’ average age at diagnosis was six years eight months (range two years to 10 years eight months) and at the time of operation was nine years 11 months. The average interval between the onset of disease and operation was three years eight months (range five months to 11 years eight months). The age distribution at the time of operation is shown in Figure 1. Follow-up averaged four years three months (range two to eight
years). For the purpose of this report, 13 patients were examined clinically 24 to 65 months postoperatively.

The indications for surgery included severe deformity and pain. Radiographically all cases fell into Catterall groups III or IV and Waldenstrom stage II or more, with progressive subluxation. Treatment by containment in ambulatory orthoses had been tried and had failed in them all. Loss of abduction range usually accompanied the painful subluxation and when this became apparent, the hip was investigated further to determine if concentric reduction was possible by any means. Arthrography confirmed incongruency in 16 of the 17 patients (Fig. 2) and in the other case it was obvious from the plain radiographs (Gallagher, Weiner and Cook 1983).

Clinical results were rated according to the classification of Robinson et al (1988). If the hip caused no symptoms and had a full range of motion the clinical result was rated good. A fair result was one in which the hip caused no symptoms but had limited movements. A poor result was one in which limitation of hip movement was associated with pain at rest or on activity (Stulberg, Cooperman and Wallenstein 1981).

![Fig. 2](image)
The arthrogram demonstrates that containment of the femoral head in the acetabulum is no longer possible by conventional means.

Standing anteroposterior radiographs were obtained pre-operatively, immediately postoperatively, one year later and at the time of most recent follow-up. We measured, as shown in Figure 3, the acetabular index (AI), the centre-edge angle of Wiberg (CE), the centre to midline distance (D) (a measure of medial displacement), and the percentage cover of the femoral head (A/B × 100). On the immediate postoperative film the angle of the osteotomy, the angle of the acetabular roof, and the percentage medial displacement of the femoral head were measured (Fig. 3).

In addition, computer generated digitisation of the femoral head and acetabulum, pre- and postoperatively, was performed on 10 randomly selected hips as described by Herring et al (personal communication, 1987). The epiphyseal height and the thickness of the cartilage between the ossific nucleus of the head of the femur and the subchondral plate of the acetabular dome (the joint space) were measured.

The index of eccentricity, as described by Harry and Gross (1987), was determined by constructing a best-fit-circle for the acetabular shape (radius Ra in Fig. 3), and a best-fit-circle for the femoral head shape (radius Rf in Fig. 3). The radii and the centres were computed and the eccentricity was recorded as the distance between the centres of the circles. Increasing eccentricity implies more extrusion or subluxation of the head.

The joint space was measured at many points around the femoral head from the digitised radiographs. It was recorded as an average thickness, with standard deviation, and maximum and minimum measurements. These numbers were used to compare the discrepancies between the shapes of the femoral head and the acetabulum.

**RESULTS**

**Radiographic evaluation.** The average angle of the osteotomy was 20.1°; the roof angle averaged 5.2° and the displacement averaged 31.2% (Table I). Ideally, these numbers should be: 10° to 15°, 5° to 10° and 50% to 100% respectively (Chiari 1955).

The average acetabular index was not significantly changed (p > 0.5); it was 11.3° pre-operatively and 10.2° postoperatively. The index changed no more than 9° in any patient. The centre-edge angle improved an average of 22.8° from 22.1° before operation to 44.9° at final...
follow-up (p < 0.00005) and the percentage coverage of the femoral head (Fig. 4) improved from 69.6% to 96.3% at follow-up (p < 0.00005). There was no significant change (p < 0.2) noted in the centre to midline distance which measured an average 8.1 cm before operation and 8.5 cm after, diminishing in seven and increasing in 11 hips (Table II). Eccentricity diminished (improved) by an average 16% (p < 0.25). The joint space, a measurement of cartilage thickness, was greater on the involved side both pre- and postoperatively (p < 0.0075). With increasing maturity, the cartilage thickness diminished by an average 11% in the normal hips and 16% in the operated hips (p < 0.2). The epiphysial height increased by an average 13% (p < 0.2).

**Clinical evaluation.** Thirteen patients (76%) were available for clinical evaluation. Four patients (31%) had a mild limp and nine walked normally. Leg length discrepancy was present in six patients (46%, average 2.4 cm). Trendelenburg's sign was positive in two patients (15%).

No patient reported pain during normal physical activity, and ranges of motion averaged 105° flexion, 33° abduction, 5° internal rotation and 10° external rotation.

Complications included one case of transient parasthesia in the distribution of the lateral femoral cutaneous nerve.

No further surgical procedures are planned in the immediate future for any of these patients, but one patient had a cheilectomy one year after the Chiari osteotomy.

Using the Mitchell (1974) clinical classification there were no good results, with 12 fair and one poor (the patient who required the cheilectomy). Using the radiographic criteria of Mose (1980), there were no good results (i.e., hips with less than 2 mm spherical deviation). However, the centre-edge angle and the percentage femoral head cover were restored to near normal (CE > 30, percentage cover > 90%) in 14 of the 18 hips.

**DISCUSSION**

Chiari's osteotomy has been shown to be useful in the treatment of painful subluxed hips with incongruency (Stulberg et al 1981). Our study confirms that the operation improves the radiographic appearances, particularly the centre-edge angle and the percentage cover of the femoral head.

Medialisation of the femoral head was not achieved in our cases. This may be due to deficient technique, the ilium being displaced laterally rather than the acetabulum moving medially (Salvati and Wilson 1974); or it may be due, at least in part, to the presence of coxa magna which results in the centre of the head moving away from midline. There have been similar findings in other studies in which the Chiari osteotomy was used to treat congenitally dislocated hips (Betz et al 1988).

Eccentricity is a measure of the relative displacement of the centres of rotation of the femoral head and the acetabulum and may be a more accurate indicator of lateral subluxation. Unfortunately, this is a three-dimensional problem that to date has been analysed in only two dimensions.

The Salter innominate osteotomy is said to be contra-indicated in hips which are incongruent (Salter 1973; Stevens, Williams and Menelaus 1981). However, Robinson et al (1988) reported good results in seven patients with deformed femoral heads (greater than 3 mm deviation from sphericity), all but one of whom responded satisfactorily to innominate osteotomy. Most of these patients were less than six years old and such good results would not be expected in older patients. In fact, Canale

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**Table I.** Radiographic measurements after Chiari's osteotomy on 18 hips

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Average</th>
<th>Range</th>
<th>Ideal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of osteotomy (degrees)</td>
<td>20.1</td>
<td>7 to 30</td>
<td>10 to 15</td>
</tr>
<tr>
<td>Roof angle (degrees)</td>
<td>5.2</td>
<td>15 to 16</td>
<td>5 to 10</td>
</tr>
<tr>
<td>Displacement (per cent)</td>
<td>31.2</td>
<td>24 to 50</td>
<td>50 to 100</td>
</tr>
</tbody>
</table>

**Table II.** Radiographic measurements of the Chiari's osteotomy on 18 hips

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Before</th>
<th>After</th>
<th>Change</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetabular index (degrees)</td>
<td>11.3</td>
<td>10.1</td>
<td>1.2</td>
<td>p &lt; 0.5</td>
</tr>
<tr>
<td>CE angle (degrees)</td>
<td>22.1</td>
<td>44.9</td>
<td>22.8</td>
<td>p &lt; 0.00005</td>
</tr>
<tr>
<td>Percentage cover</td>
<td>69.6</td>
<td>96.3</td>
<td>26.7</td>
<td>p &lt; 0.00005</td>
</tr>
<tr>
<td>Centre to midline (cm)</td>
<td>8.1</td>
<td>8.5</td>
<td>0.4</td>
<td>p &lt; 0.2</td>
</tr>
</tbody>
</table>

Fig. 4

Same case as Figure 2. Containment has been achieved with Chiari's osteotomy.
et al (1972) concluded that Salter’s osteotomy was contraindicated in late stage III Perthes’ disease. Lowering the acetalabral rim risks increasing the pressure on the anterolateral margin of the femoral epiphysis; subsequent crushing and distortion may result (Klisić; Blažević and Seferović 1980).

In our patients, the average age at surgery was nearly 10 years. After the age of nine, the potential for remodelling of the acetabulum declines (Bellyei and Mike 1988), and since the shape of the acetabulum has a major effect on the end result in Perthes’ disease, a very narrow window exists for the use of innominate osteotomy when spherical congruency is the goal (Bellyei and Mike 1988). After the age of nine years, an operation designed to increase the volume of the acetabulum may be more suitable than one that depends upon acetalabral remodelling (Stevens et al 1981; Maxted and Jackson 1985; Bellyei and Mike 1988). When arthrography confirms aspherical incongruency in the presence of subluxation, the Chiari osteotomy is to be preferred.

Many adolescents, even if they have severe deformity of the hips from Perthes’ disease, are almost asymptomatic. Chiari’s osteotomy is indicated for those few patients in whom the subluxed hip causes pain. Our results did not deteriorate in the short term and, radiographically, the hips appeared to improve with time. However, such joints must be predisposed to degenerative osteoarthritis in the long term (McAndrew and Weinstein 1984).

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REFERENCES


