Outcome of Chiari pelvic osteotomy in adults

90 hips with 2–15 years' follow-up

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We studied retrospectively 90 Chiari osteotomies in 83 adults with pain, hip dysplasia and arthrosis. At follow-up after 6 (2–15) years, 35 hips were pain-free, 38 had rare or slight pain, and 17 had moderate or severe pain. The dysplastic acetabulum was corrected in all but 5 cases. There was diminution of arthrosis in 36 hips, no change in 38, and worsening in 16 hips. Functional outcome was best when surgery was performed before the age of 40, and in hips with the greatest degree of dysplasia. However, two thirds of the patients aged over 40 years at surgery had a good result.

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The Chiari osteotomy described in 1955 has been widely used in the treatment of adult acetabular dysplasia (Hogh and MacNicol 1987, Lack et al. 1991, Matsuno et al. 1992). Although favorable long-term results have been reported (Lack et al. 1991, Windhager et al. 1991), acetabular reorientation surgery seems to be favored now (Tönnis 1987, Ganz et al. 1988).

Prognostic factors for the outcome of Chiari osteotomy are controversial. Lack et al. (1991) stated that the young patient has a better prognosis, but Hogh and MacNicol (1987) and Nishina et al. (1990) did not observe such a relationship. Lack et al. (1991) and Reynolds (1986), contrary to Hogh and MacNicol (1987), found it important to adhere strictly to the original Chiari technique to obtain a good result. We have attempted to identify prognostic factors in a retrospective study of 90 Chiari osteotomies performed in treating arthrosis secondary to hip dysplasia.

Patients and methods

Between 1976 and 1989, 92 Chiari osteotomies were performed by the same surgeon (AD) or under his supervision. We reviewed the results of these osteotomies in 1991. 2 patients were excluded from the study: 1 had severe cerebral palsy, and 1 was lost to follow-up. The 90 osteotomies were performed on 83 patients (66 women with 7 bilateral operated hips and 17 men) aged 34 (16–59) years. The series consisted of 38 hips with sequelae of congenital dislocation of the hip (CDH) treated during childhood, and 52 dysplastic hips discovered in adulthood.

Preoperative function was evaluated according to Merle d'Aubigné (1970) (Table 1). Pain was required for surgery and two thirds of the hips were painful, even for a short walking distance (pain score ≤ 3). Duration of pain was 3 (0.3–14) years. Two thirds of the patients limped before surgery. All the hips had a preoperative flexion greater than 70°. The Body Mass Index (BMI, weight in kg/height in m^2) was calculated for each patient.

All the hips had a dysplastic acetabulum. The acetabulum-head index of Heyman and Herndon (1950) (Figure 1) was always less than 70 percent and the CE angle (Wiberg 1939) less than 20° (Table 2). All

Table 1. Number of hips according to the rating of Merle d'Aubigné (1970)

	Pain		Walking		Mobility	
Grade	Preop	F-u	Preop	F-u	Preop	F-u
VI	0	35	3	40	72	63
V	6	38	27	41	8	15
IV	22	6	48	7	6	9
III	21	4	11	2	3	2
II	9	4	0	0	1	1
I	9	1	1	0	0	0
0	23	2	0	0	0	0

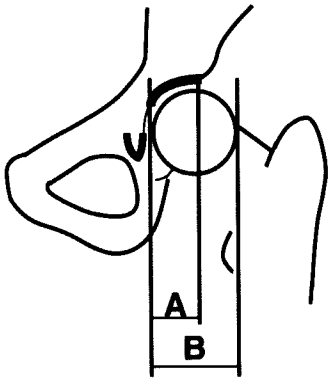


Figure 1. The acetabulum-head index (A/B × 100) of Heyman and Herndon (1950) expresses the coverage of the femoral head. Distance A is measured from the medial tangent of the femoral head to Perkins' line and distance B is the transversal diameter of the head.

Table 2. Radiography in 90 hips. Mean *SD*, (range) or n

Radiography	Preoperatively	Follow-up
CE angle (°)	0.3 *10* (–28–19)	40 *11* (15–60)
AH-index[a] (%)	53 *10* (20–68)	91 *12* (60–118)
Arthrosis[b] (n)		
Grade 0	0	13
Grade I	0	0
Grade II	19	23
Grade III	60	36
Grade IV	11	18

[a] Actebular-head index, see Figure 1.
[b] de Mourgues and Patte (1978) rating of arthrosis modified according to Courpied and Ricard (1991):
Grade 0 no radiographic signs of acetabular dysplasia nor of arthrosis;
I hip dysplasia without arthrosis;
II bone sclerosis and/or bone cyst, without narrowing of the joint space;
III narrowing of the joint space less than half, or more than half, but segmental;
IV narrowing of the joint space more than half.

the hips showed radiographic signs of arthrosis (Table 2), which was severe in four fifths of the hips, using the de Mourgues and Patte classification (1978).

All osteotomies were performed by the technique of Chiari (1955, 1979), but with the following modifications: guidance of chisels by pins positioned under image intensification and screw osteosynthesis. The latter modification was used by Chiari's colleagues (Lack et al. 1991). Additional surgery was performed on 9 hips: 4 intertrochanteric femoral osteotomies (2 varus and 2 valgus osteotomies), 2 complementary anterior bone-shelf arthroplasties, and 3 resections of intracapsular calcifications. Except for the first 4 cases, the patients were not immobilized by a plaster cast, but were rehabilitated for 6 weeks in bed. Weight bearing was usually permitted at the end of the second postoperative month.

There were 5 nonunions which healed after reoperation (1 change of the screw, 4 bone grafts with plate osteosynthesis). 2 of these have later been changed for total hip arthroplasty (THA). 2 patients had peroneal palsy with complete recovery before the sixth postoperative month, and 2 others had transient pain related to the sacro-iliac joint.

Evaluation at follow-up

At 6 (2–15) years of follow-up, all patients except 3 were reviewed by the same examiner who did not participate in the surgery (HM). The remaining 3 patients who died of unrelated causes were included in the series because their clinical and radiographic outcomes were known at the time of death. 11 osteotomies changed for THA were included with their last hip rating, just before THA.

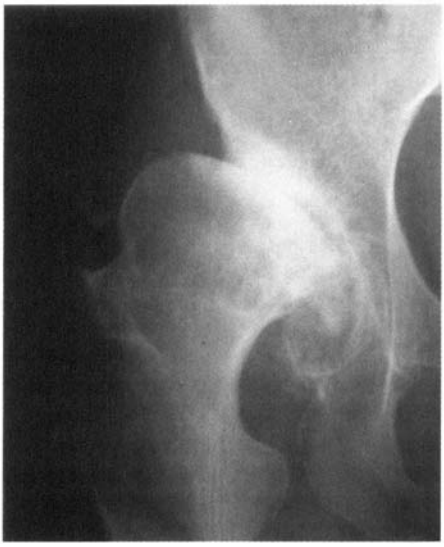
Clinical examination was performed by means of Merle d'Aubigné hip rating (1970) and the Trendelenburg sign, according to Hardcastle and Nade (1985). On the radiographs, the same parameters were measured as on the preoperative radiographs (Table 2). On the postoperative radiographs, we also measured the angle of osteotomy (osteotomy/horizontal line).

The data were evaluated by the statistical package Statview 512+™ (Brain Power Inc, Calabasas, California). Qualitative values were compared by means of the Chi-square test. Quantitative values were compared by means of regression analysis, and the Anova test. When the samples were small, non-parametric tests were used (Kruskal-Wallis test or Mann-Whitney test). $P < 0.05$ was considered significant.

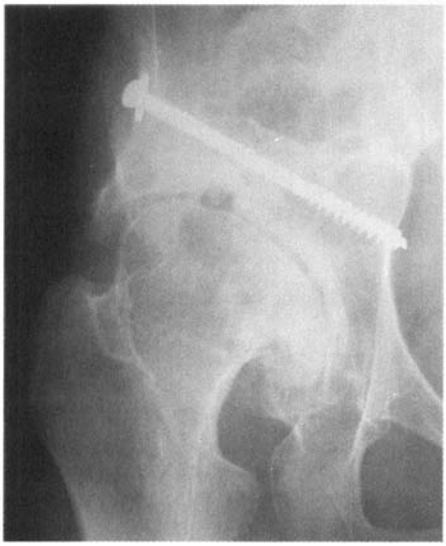
Results

The mean improvement in pain rating was 2.6 ± 2.1. 35 hips were painless and 38 hips were slightly and occasionally painful. The improvement in walking score, mean 1.1, was less significant (Table 1). 90 percent of the hips had no limp or slight limp. We observed a positive Trendelenburg sign in one third of the cases. Mobility analysis revealed a reduction in range of motion, especially involving flexion (mean 8°, SD 4). Using the Merle d'Aubigné functional score (sum of 3 parameters: pain, walking,

Figure 2. Right hip of a 48-year-old woman.



Preoperative severe dysplasia with grade IV arthrosis. Merle d'Aubigné hip rating was 12.



At 12 years follow-up, there is full lateral coverage and improvement of arthrosis features. The hip rating was 17.

mobility), the results were excellent in 19 hips (score 18), very good in 25 hips (score 17), good in 27 (score 15–16), satisfactory in 11 (score 13–15), poor in 4 (score 9–12) and bad in 4 (score less than 9).

The functional outcome was better when osteotomy was performed before the age of 40 (P 0.01); the fraction of these patients who had a Merle d'Aubigné score equal to or greater than 16 was 0.81, compared to 0.68 in patients older than 40 years at surgery. We observed no influence on the final outcome for the BMI values, past history of hip problems (CDH or dysplasia detected in adulthood), and pain duration.

We obtained a normalization of the acetabulum-head index (index greater or equal to 70 percent) in all but 5 cases (Table 2). Using de Mourgues grading, we observed an improvement in the radiographic features of arthrosis in 36 hips (Figure 2), no change in 38 hips, and worsening in 16 hips. The hips which were most dysplastic in the frontal plane (less CE angle) before surgery, had a better functional outcome (P 0.02). The hips with the most pronounced grades of arthrosis preoperatively had a worse final functional outcome (P 0.0005).

The mean angle of osteotomy was 18 ± 5 (4–34)°. The larger the angle of osteotomy (ascending medially), the greater was the postoperative acetabulum-head index (P 0.02). The greater the improvement in the acetabulum-head index, the better was the functional outcome (P 0.006). On the other hand, the level of osteotomy (mean 5 [2–12] mm) had no influence on function.

At follow-up in 1991, 11 osteotomies had been changed for THA. According to Merle d'Aubigné, the functional status of these 11 hips before revision was 4 bad results, 4 poor results, and 3 satisfactory results but with severe pain. 9 patients were revised before the fourth postoperative year and 2 cases after 12 and 13 years. Compared to the rest of the group, the 9 early cases were older (mean age 43 years), had more often severe arthrosis (6 grade III, 3 grade IV), less dysplastic acetabulum (mean preoperative acetabulum-head index 58 percent). All revisions were easily performed, without the need for acetabular bone grafting.

Discussion

Our findings confirmed the favorable outcome of surgery at young age, as observed by Lack et al. (1991) and Calvert et al. (1987). However, age over 40 years is not a contraindication; two thirds of these patients had a good result. The maximum age for this procedure varies considerably (17–55 years) in other studies (Kerschbaumer and Bauer 1979, Reynolds 1986). We believe that a Chiari osteotomy can be proposed after age 40, if favorable factors are present: very dysplastic hip, moderate arthrosis.

No influence of the severity of preoperative dys-

plasia on the result of Chiari osteotomy was found by Hogh and MacNicol (1987), Calvert et al. (1987), and Nishina et al. (1990), whereas Matsuno et al. (1992) reported worse results in very dysplastic hips. We observed better results in very dysplastic hips and therefore think that Chiari osteotomy is best indicated in such circumstances.

Long-term studies have confirmed the unfavorable influence of preoperative arthrosis on the results (Calvert et al. 1987, Lack et al. 1991). In our study, severe arthrosis was associated with significantly worse results. Subluxation of the femoral head is not a contraindication for us, so long as the osteotomy line is ascending and does not reach the sacro-iliac joint (Gougeon et al. 1984). Like Tönnis (1987), we did not systematically correct a coxa valga. Delp et al. (1990) have demonstrated on a model that the combination of a Chiari osteotomy and varus femoral osteotomy increased the risk of a permanent limp.

Our findings stress the importance of a surgical technique respecting the principles described by Chiari. Like Hogh and MacNicol (1987) and Schreiber (1988), we believe that the Chiari osteotomy acts essentially by producing a stable fulcrum for the femoral head. Our observations underline the importance of an ascending osteotomy line in order to achieve a sufficient displacement and medialization (Gougeon et al. 1984). More complete covering and recentering of the femoral head guarantee a good result, in our experience.

The rate of nonunion in the literature varies from 0 percent (Calvert et al. 1987) to 4 percent (Zlatik et al. 1988). Our nonunion rate was 6 percent. Two factors may explain this: the pronounced displacement in the osteotomy required to obtain total covering of the femoral head, and the osteosynthesis which may maintain an interfragmentary gap (Reynolds 1986). But we believe that osteosynthesis, allowing early active mobilization, avoids the thromboembolic complications observed with immobilization by traction or a plaster cast (Kempf and Persoons 1985, Lack et al. 1991).

At 6 years follow-up after osteotomy, 11 patients were reoperated with a THA. Despite this high frequency of reintervention, we believe that the Chiari osteotomy remains a good procedure, if the indications are confined to moderate arthrosis in severe hip dysplasia. In our experience, the Chiari osteotomy delays the need for THA and improves technical conditions for this procedure, which has an uncertain outcome in the young patient (Solomon et al. 1992), and in cases of deficient acetabular bone stock (Jasty and Harris 1990).

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