Modified Chiari osteotomy for arthrosis after Perthes' disease

14 hips followed for 2–12 years

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Between 1983 and 1995, a modified Chiari pelvic osteotomy was performed for coxarthrosis after Perthes' disease in 13 patients (14 hips). The median age at operation was 33 (16–56) years. The median duration of follow-up was 6 (2–12) years.

The center-edge angle, Sharp's angle, acetabulum head index and acetabular edge angle improved substantially. The median hip score substantially improved from 76 (46–90) points to 91 (71–100) points at the most recent follow-up examination. We recommend this procedure for patients who have early arthrosis, acetabular dysplasia, pain and good range of motion.

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Most children with Perthes' disease have few, if any, symptoms as adults (Danielsson and Hernborg 1965, Ratliff 1967, Gower and Johnston 1971, Ratliff 1977, Stulberg and Cooperman 1981, McAndrew and Weinstein 1984, Saito et al. 1985). However, some develop painful coxarthrosis already as young adults.

We have performed a modified Chiari pelvic osteotomy in 14 cases of coxarthrosis secondary to Perthes' disease and report the clinical and radiographic outcome.

Patients and method

Between 1983 and 1995, a modified Chiari pelvic osteotomy was performed for coxarthrosis after Perthes' disease in 14 hips, involving 12 hips in 11 men and 2 hips in 2 women. 7 hips had initially been treated non-operatively, using a brace, cast or bed rest, 3 had been treated operatively and 4 were untreated. The median age at operation was 33 (16–56) years. The median duration of postoperative follow-up was 6 (2–12) years. According to the modified classification of the Japanese Orthopaedic Association, all hips were classified in 4 stages of arthrosis from anteroposterior radiographs: prearthrosis (acetabular dysplasia alone), early (slight joint space narrowing and subchondral sclerosis), advanced (marked joint space narrowing with or without cyst or sclerosis) or as terminal stage (obliteration of the joint space) (Higuchi and Inoue 1995). 6 hips were judged as prearthrosis, 5 as early, 2 as advanced and 1 as terminal stage. 8 hips were treated with a modified Chiari pelvic osteotomy only, 4 by a Chiari osteotomy combined with intertrochanteric osteotomy (3 valgus and 1 varus) and 2 by a Chiari osteotomy with femoral lengthening (Ninomiya and Tagawa 1976). In 1 of the hips treated with a Chiari osteotomy only, femoral lengthening was added 5 years after the initial operation and intertrochanteric valgus osteotomy 10 years after.

Clinical assessment was based on the scoring system of the Japanese Orthopaedic Association (Imura and Matsunaga 1990), which assesses the Japanese life-style of patients with a hip disorder. The best hip score is a total of 100 points, which is the sum of 4 independent scores—with a maximum of 40 points given for pain, and 20 points each for the range of motion, for gait ability and for the activity of daily life. The score of hip pain is divided into 5 grades: 40 points given for no pain, 30 points for slight pain, 20 points for moderate pain, 10 points for severe pain during walking and 0 points for severe pain at rest.

An anteroposterior radiograph of the pelvis was taken preoperatively, immediately postoperatively and at follow-up. Lateral radiographs were not taken in all patients and therefore were not analyzed. The center-edge (CE) angle (Wiberg 1939), Sharp's (1961) angle, acetabulum head index (Heyman and Herndon 1950), and acetabular edge angle (Saito et al. 1985) were measured preoperatively and at follow-up. The acetabular edge angle is the angle between the line parallel to the Hilgenreiner line and the

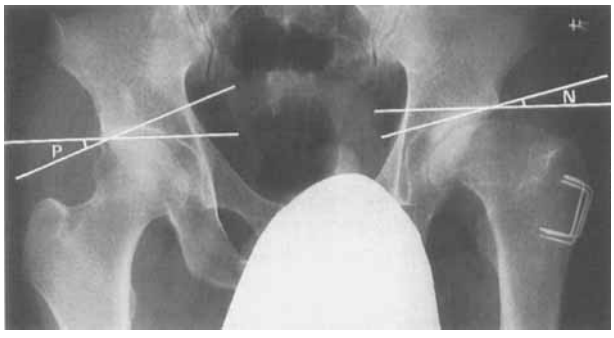

Figure 1. Acetabular edge angle. P positive, N negative.

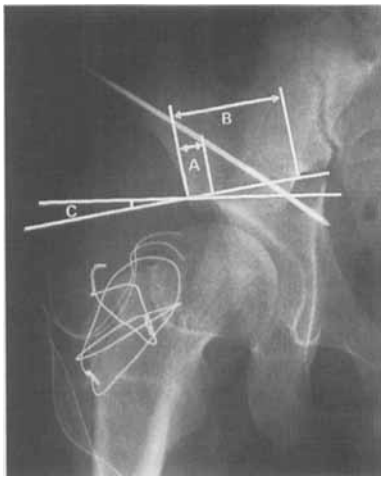

Figure 2. Osteotomy angle is between the line parallel to the Hilgenreiner line and the line along with the osteotomy (C). The percentage displacement is calculated by the formula (A/B) × 100.

tangent to the acetabular roof at the lateral edge. The acetabular edge angle is positive in a case with a laterally descending inclination of this tangent, and is negative in a case with a laterally ascending inclination (Figure 1).

In addition, on the radiograph taken immediately postoperatively, the angle of osteotomy and the percentage of displacement for the width of the ilium at the level of osteotomy were measured (Figure 2).

Wilcoxon's signed rank-sum test was used to evaluate differences between the preoperative data and those at follow-up.

Surgical technique

Details of the procedure of the osteotomy that we usually perform have been published (Inoue et al. 1990). Briefly, the patient is placed in the true lateral position. After a longitudinal skin incision, the fascia lata is divided. The proximal two-thirds of the greater trochanter is osteotomized and reflected with the gluteal muscles. The lateral wall of the pelvis is then exposed from the anterior inferior iliac spine to the sciatic notch. A dome-shaped pelvic osteotomy is performed using a bone saw. The thigh is then gradually abducted with gentle inward pressure against the acetabulum to displace it medially. When femoral varus or valgus osteotomy is necessary, a closed wedge osteotomy is performed in the intertrochanteric portion of the femur. The femoral osteotomy is fixed by 2 cannulated cancellous hip screws. The greater trochanter is reattached and fixed by wires about one-third more distally than its original position to achieve lateralization and improve mechanical function. When a femoral osteotomy is also performed, the harvested bone wedge is put between the osteotomized aspect of the greater trochanter and the distal fragment before reattachment of the greater trochanter. After wound closure, and after the desired displacement is achieved by manipulation under image-amplified control, percutaneous extra-articular fixation is done using a 2.4 mm Kirschner wire. If the desired displacement is not achieved, the

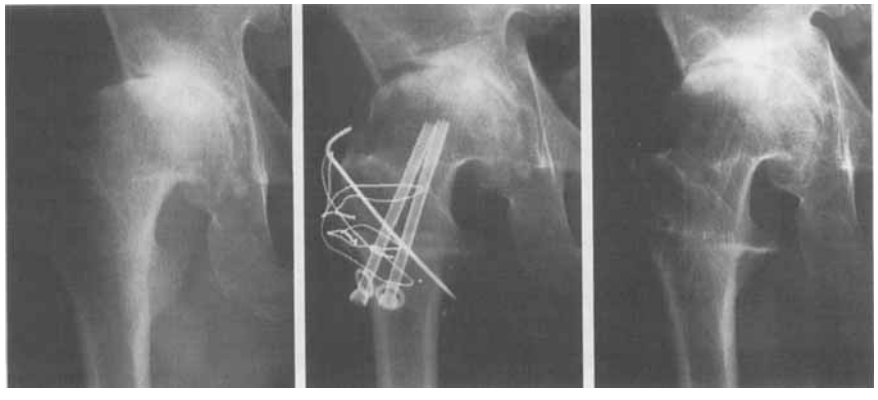

Figure 3. Patient 10. A 41-year-old man preoperatively, immediately after surgery, and at follow-up 5 years after Chiari osteotomy. He was diagnosed as Perthes' disease at 8 years of age but he was not treated.

General table with all the clinical and radiographic data

No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	20	M	R	E	C	11.8	10	23	30	18	15	18	81	40	20	20	20	100	5	30	50	45	75	85	-20	5
2	16	M	L	E	C+F	2	5	17	30	20	15	20	85	30	18	20	20	88	10	36	45	38	61	69	-13	15
3	16	M	R	P	C+F	2.8	5	33	30	20	15	20	85	40	20	20	20	100	5	40	37	35	66	88	-5	3
4	24	M	R	E	C	9	5	55	20	20	15	20	75	40	15	20	17	92	0	42	48	35	49	82	-7	10
5	40	M	R	P	C	7.7	7	13	30	20	20	20	90	40	20	20	20	100	15	45	36	35	65	100	-7	3
5	44	M	L	P	C	3	0	15	30	20	20	20	90	40	20	20	20	100	25	38	40	40	56	72	-10	15
6	37	M	R	P	C+R	5.5	15	29	20	20	15	20	75	30	20	20	20	90	5	28	45	40	58	86	-5	5
7	29	M	R	E	C	8	8	20	10	16	15	20	61	30	20	20	20	90	10	40	50	35	65	83	-7	15
8	19	M	L	E	C	7	7	18	30	20	15	20	85	30	20	20	20	90	5	35	45	40	55	73	-7	10
9	21	M	R	P	C	5.1	10	20	20	20	15	20	75	40	20	20	20	100	10	23	48	45	63	86	-13	10
10	41	M	R	T	C+L	4.8	10	18	10	15	10	11	46	40	17	15	18	90	18	60	45	35	71	85	-3	10
11	42	F	R	A	C+L	2	5	28	10	16	10	18	54	49	20	18	20	98	0	40	45	32	48	79	-5	8
12	47	M	R	P	C	7.9	5	25	30	18	15	13	76	30	12	15	14	71	5	20	45	30	60	72	-5	5
13	56	F	R	A	C+L	6.4	15	26	10	14	15	14	53	30	12	15	17	74	2	5	50	45	71	79	-10	0

A Age
B Gender
  M male
  F female
C Side
  R right
  L left
D Arthrosis stage
  P Prearthrosis
  E Early stage
  A Advanced stage
  T Terminal stage
E Operation
  C Modified Chiari pelvic osteotomy
  L Intertrochanteric valgus osteotomy
  R Intertrochanteric varus osteotomy
F Follow-up, years
G Osteotomy angle, degrees
H Displacement, %

I–M hip score, preoperative
I Pain
J ROM
K Gait
L ADL
M Total score
N–R hip score at follow-up
N Pain
O ROM
P Gait
Q ADL
R Total score
S Center-edge angle, preoeprative
T Center-edge angle, at follow-up
U Sharp's angle, preoperative
V Sharp's angle, at follow-up
W Acetabulum-head index, preoperative
X Acetabulum-head index, at follow-up
Y Acetabular edge angle, preoperative
Z Acetabular edge angle, at follow-up

pelvic osteotomy is not fixed and therefore more displacement should be produced by skin traction (Figure 3).

The operated leg is fixed by skin traction for 14 days. Sitting on a chair is permitted from the 14th postoperative day. Training for non-weight bearing standing starts from the 21st postoperative day, and non-weight-bearing walking, using 2 crutches, a few days later. The Kirschner wire is usually removed in the fourth postoperative week. In the third postoperative month, partial weight-bearing is permitted after radiographic confirmation of adequate healing of the osteotomy. Full weight-bearing is permitted after 6 months.

Results (Table)

The median hip score significantly improved from 76 (46–90) points preoperatively to 91 (71–100) points at follow-up. Pain was relieved in all except 3 patients and gait ability was improved. The range of motion and the activity of daily life did not improve.

The CE angle, Sharp's angle, acetabulum head index and acetabular edge angle improved in all the patients: the CE angle from 5.0 (0–25)° preoperatively to 37 (5–60)° at follow-up, Sharp's angle from 45 (36–50)° to 37 (30–45)°, the acetabulum-head index from 61 (48–75)% to 83 (69–100)%, and the acetabular edge angle improved from –7.0 (–20 to –3)° to 9.0 (0–15)°.

The median angle of osteotomy was 7.0 (0–15)°, and the median percentage of displacement was 22 (13–55)%.

The stage of arthrosis did not change during the follow-up, except in 1 patient (No. 12). He had a wound infection 3 days after the operation and needed irrigation and drainage of the abscess. Myositis ossificans developed 1 month after the operation.

Discussion

We pay attention to a deformity in the acetabulum, since Saito et al. (1985) reported a strong correlation between the prognosis of Perthes' disease and the ace-

tabular edge angle. Deformities in the acetabulum are not uniform as those in the femoral head. Yngve and Roberts (1985) reported that the acetabular size was increased as compared to the contralateral unaffected hip in 61 of their 65 patients. Bellyei and Mike (1988) reported that the acetabulum becomes slightly dysplastic in the final stage of Perthes' disease. Joseph (1989) found that acetabular changes develop early in the course of the disease and that adults with poor clinical results usually developed acetabular abnormalities.

All our patients had a dysplastic acetabulum, probably caused by coxa magna or coxa plana. A modified Chiari pelvic osteotomy is an adequate procedure for treating acetabular dysplasia, because it not only enlarges the weight bearing area of the acetabulum but also corrects any ascending inclination of the lateral edge of the acetabulum. Moreover, as we use the lateral approach, which is different from the original procedure by Chiari (1953), our procedure improves the short lever arm of the abductor muscles by reattaching the greater trochanter more distally than in its original position. Placement of a bone wedge from a femoral osteotomy between the trochanter and the distal fragment will also effect a more lateral position of the trochanter.

Bailey and Hall (1985) and Graham et al. (1986) reported that more than 50% medial displacement at the level of the osteotomy was desirable. In our series, the percentage of displacement was less than 30% in all except 2 patients. Despite the slight medial displacement at the level of osteotomy, the clinical outcome was good, which might be attributed to correction of the ascending inclination of the lateral edge of the acetabulum.

The principal means of treating coxarthrosis after Perthes' disease should be by correction of the acetabular aspect rather than of the femoral aspect, because coxarthrosis may develop in a hip with acetabular dysplasia (Saito et al. 1985). We therefore performed a modified Chiari osteotomy in 11 hips having pre- or early arthrosis with acetabular dysplasia, including 6 hips with more than 80 points on the hip score, to prevent development or deterioration of arthrosis. In patients with advanced stages, the purpose is to preserve the femoral head and relieve pain so much as possible. Therefore, this method is recommended for pre- or early arthrosis with pain and with acetabular dysplasia, and for advanced stages without marked limitation of motion in patients less than 50 years of age.

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