CHIARI PELVIC OSTEOTOMY FOR OSTEOARTHRITIS SECONDARY TO HIP DYSPLASIA

INDICATIONS AND LONG-TERM RESULTS

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Of 142 Chiari pelvic osteotomies for osteoarthritis in dysplastic hips, most performed by Chiari himself, we were able to review 82 and obtain information about 18 by questionnaire. All patients were over 30 years of age at operation; follow-up averaged 15.5 years. Twenty hips had undergone secondary total hip replacement.

The outcome was good in 75%, fair in 9% and poor in 16%. High osteotomies all gave good results, and the result also depended on adequate medialisation. Statistics were worse for patients over 44 years of age at the time of operation.

For osteoarthritis secondary to hip dysplasia, the Chiari pelvic osteotomy is an alternative procedure to early hip replacement. In contrast to intertrochanteric osteotomy, it has the advantage of facilitating the implantation of an acetabular prosthesis should arthroplasty become necessary at a later stage.

Chiari used his method of osteotomy primarily for the treatment of hip dysplasia and subluxation in infants (Chiari 1953), but this procedure has been increasingly replaced by operations that preserve the original articular cartilage. Nevertheless, in incongruent hips with disproportion between the femoral head and the acetabulum, Chiari pelvic osteotomy is still an important operative technique (Wagner and Keck 1973; Reynolds 1986; Lack et al 1987). Chiari himself reported mainly individual cases and gave no detailed long-term results (Chiari 1968). We have tried to make good this deficiency by reviewing his patients with osteoarthritis caused by hip dysplasia who had been followed up from 10 to 20 years.

PATIENTS AND METHOD

Between 1968 and 1977, 142 hips in 123 patients, all over 29 years of age, were treated by Chiari pelvic osteotomy at the orthopaedic department of the University of

Vienna. Of these, we were able to review 100 hips in 83 patients after 10 to 21 years (mean 15.5), 82 of them clinically and radiologically and 18 by questionnaire. There were equal numbers of right and left hips, with bilateral operations in 17 patients. The 77 women and six men had a mean age at operation of 38 years (30 to 59) and at follow-up of 54 years (41 to 79).

Eighty hips had been treated by pelvic osteotomy alone, 12 had also had a valgus intertrochanteric femoral osteotomy, six a varus osteotomy, and two a trochanteric displacement osteotomy. The indication for intertrochanteric osteotomy had been improvement in congruency as shown by radiographs in adduction or abduction. Valgus osteotomy was often used where there was ovoid deformation of the head of the femur. Of the 100 operations, 88 were performed by Chiari himself.

Operative technique. Chiari (1955, 1977) has given details of the technique. We therefore refer only to the essential points, and to subsequent changes which we have made.

The operation is performed on a traction table with the hip in 30° external rotation and slight abduction; we use an image intensifier. An 8 to 10 cm incision starts 2 cm behind the anterior superior iliac spine and curves distally, being convex medially. Deep to the femoral fascia, the medial margin of tensor fascia lata is exposed, partially freed at its origin and retracted laterally. The periosteum over the iliac crest is then incised and elevated from the bone for 4 cm externally and 2 cm internally by means of a raspatory.

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The gluteus medius is then retracted laterally and posteriorly, and the femoral head is palpated. Gluteus medius is split in the direction of its fibres and gluteus minimus, which lies underneath, is retracted posteriorly, so that the sciatic notch can be cleared of periosteum with a raspator. Radiolucent spatulae are then inserted into the sciatic notch, one medially and one laterally. Bone levels are now checked with the image intensifier.

The dorsal margin of the reflected head of rectus femoris is removed from the capsule with scissors. The highest point on the bone reached by this tendon is a marker for the level of the osteotomy. The osteotomy ascends from this curved line towards the opposite anterior superior iliac spine. It is performed with chisels, cutting the cortical bone first in a circular shape, convex upwards. It is convenient to use several chisels placed next to each other to cut the whole width of the outer cortical bone in the curved line of the rectus tendon. The curve at its posterior edge serves to prevent any posterior movement of the head during displacement. Finally, the internal cortical bone is osteotomised and the division completed. Medialisation of the lower fragment is achieved by abduction of the hip, allowing impaction in a position of considerable medial displacement. This impaction of the distal fragment may sometimes be obstructed by a residual bony connection posteriorly.

Chiari's patients were immobilised for three weeks in a Whitman plaster with no internal fixation. We now use osteosynthesis by two Kirschner wires for three weeks, and up to six weeks if there is any instability. We normally allow the patient to mobilise on the fifth day. Weight-bearing is allowed after the Kirschner wires have been removed. During rehabilitation, efforts are made to strengthen the gluteal muscles.

Clinical assessment. Our clinical evaluation of the results took into account the pre-operative and postoperative grades of pain and mobility, and the Trendelenburg sign at review, using the criteria of the Deutsche Gesellschaft für Orthopädie und Traumatologie (Tönnis 1987, Table I). We also recorded the subjective opinion of the patients. Our final assessment into good, fair or poor categories also reflected the period of relief of pain in

those patients who later required a total hip replacement. Details of this are given in Table II.

Radiological assessment. We measured the centre-edge angle of Wiberg (1939) to record acetabular coverage, the VCA angle of Lequesne (Lequesne and de Sèze 1961) for anterior coverage, the Ullmann-Sharp angle (Ullmann 1939; Sharp 1961) for the inclination of the acetabulum, and the ACM angle (Idelberger and Frank 1952) for the depth of the acetabulum. We used the decentring distance (MZ, Tönnis 1987) to evaluate the relation between the centres of the femoral head and the acetabulum; the acetabulum head index (Heyman and Herndon 1950) for head coverage; and the Busse (Busse, Gasteiger and Tönnis 1972) hip score as a combination of both. We graded osteoarthritic change pre-operatively and at review according to Tönnis (1987).

Finally, we evaluated the influence of the operative technique on the outcome, especially the level of the osteotomy, and the age of the patient at the time of operation.

RESULTS

Complications. There were no complications in 95% of cases. Two patients had partial peroneal paresis which recovered, two had thrombo-embolic complications and one had an extension contracture of the hip which required manipulation under anaesthesia.

Table II. Grading of clinical results after pelvic osteotomy for osteoarthritis in dysplastic hips

Grade	Patient's opinion	Pain*	Mobility*	Delay before THR (yr)
Good	Satisfied	0 or 1	1 or 2	Over 12 years†
Fair	Partly satisfied	2	2 or 3	Over 8 years†
Poor	Not satisfied	3	3 or 4	Less than 8 years

*see Table I

†with a long period free of pain

Table I. Grades of pain and hip mobility (Tönnis 1987)

Grades	
Pain	0 - none 1 - after walking > 1 hour 2 - after walking < 1 hour 3 - permanent
Hip mobility	0 - full 1 - flexion up to 110°, extension 0°, other planes 20° to 30° 2 - flexion to 90°, lack of extension 10° to 15°, internal rotation 0°, abduction 0° to 10° 3 - flexion < 90°, contracture in external rotation 10° to 20°, adduction contracture 10° to 20° or abduction contracture 10° to 20° 4 - contracture with major malposition, or ankylosis

Table III. Radiological evaluation (mean values) of hips treated by Chiari osteotomy for osteoarthritis secondary to dysplasia

	Pre-op n = 100	Post-op n = 100	Latest review n = 80
CE angle (degrees)	0.3	40	41
VCA angle (degrees)	2.7	47	48
ACM angle (degrees)	57	52	51
Ullmann-Sharp angle (degrees)	50	41	40
Distance MZ (mm)	13.6	6.7	8.4
Acetabulum-head index (per cent)	58	-	97
Hip score (Busse)	35	16	16

Clinical results. The pre- and postoperative levels of pain and mobility are shown in Figures 1a and b. Secondary total hip replacement had been performed in 20% of the patients. These were excluded from the percentage results given in Figures 1a and b, but are included in the scheme of evaluation in Table II. This analysis showed that 75% had clinically good results, 9% fair and 16% poor.

After an average 15-year follow-up, there was still a significant improvement in pain level, but there had been a clear decrease in mobility.

As regards subjective opinion, 37% of the patients were very satisfied, 39% were satisfied, 10% felt that something had been gained, and 14% were not satisfied. The average period of postoperative pain relief was 6.5 years (0 to 20), and the period of improvement was 11.6 years (0 to 20).

At review, of the patients who had not had a secondary hip replacement, 42% had no limp, 3% used a walking stick and 55% had a definite limp. The limp was of the Duchenne type in 25%, due to shortening in 16% and to pain in 6%; there was a combination of causes in the other 8%.

Radiological results. The radiological assessment is shown in Table III. There were marked improvements in CE angle, VCA angle, the acetabulum head index and Busse hip score. However, there had been an increase in arthritic changes during the follow-up period.

Influence of operation and age. Two operative factors appeared to influence the results. High osteotomies, that is those in which a step-like arrangement of the acetabular roof was seen radiologically (see Fig. 4b), had good results in all nine cases. Medialisation of the hip also had a significant effect on the outcome: the good results had an average medialisation of 27.5 mm, while the fair and poor hips had an average of 20.5 mm.

Operations performed under the age of 45 years gave good results in 80%; operations at 45 years or older gave only 50% good results.

Subsequent hip replacement. In all, 20% of the hips have required total replacement, at an average 11.5 years (2 to 19) after the osteotomy. Of this group about a third said that the osteotomy had been worthwhile, a third were partially satisfied and a third were not satisfied with the pain relief and time gained by the first operation.

Fig. 1a

Pain levels before operation (white) and at review (hatched). Patients who have had a secondary total hip replacement are shown separately.

Fig. 1b

Levels of mobility of the hip before operation (white) and at review (hatched). Patients who have had total hip replacement are excluded.

Fig. 2a

Fig. 2b

Fig. 2c

Fig. 2d

Left hip of a 31-year-old woman with pain on exertion. Figure 2a – Slight osteoarthritis, loss of sphericity of the femoral head with coxa valga, CE angle 5°. Figure 2b – Postoperative film shows correct height of osteotomy and good medialisation. Figures 2c and 2d – At 11 years 9 months follow-up there is full lateral and anterior hip cover, and a congruent roof with a CE angle of 49°. The patient was free of pain.

Fig. 3a

Fig. 3b

Fig. 3c

Fig. 3d

Fig. 3e

The left hip of a 35-year-old woman with bilateral dysplasia and osteoarthritis. Figure 3a – There is a cyst in the acetabular roof, the CE angle is -6° , and she had pain on exertion. Figure 3b – After operation. Figure 3c – At two years, the typical appearance of a high osteotomy. Figures 3d and 3e – Twenty years later there is an increase in arthritic changes, but the CE angle is 40° , and the VCA angle 26° . The hip is completely pain free.

DISCUSSION

There are three important requirements for the success of a joint-preserving operation for the treatment of osteoarthritis secondary to hip dysplasia:

- 1) the creation of a larger articular surface to reduce the average joint pressure;
- 2) an approach that preserves muscle strength, so as not to make worse the muscular insufficiency associated with hip dysplasia; and
- 3) the creation of a favourable situation for a total replacement should this become necessary at a later stage.

The Chiari pelvic osteotomy appears to fulfil these requirements better than other operations. A varus intertrochanteric osteotomy can only produce a larger articular surface in cases of slight acetabular dysplasia; and in general, intertrochanteric osteotomies do not relieve excess joint pressure in dysplastic acetabula during exertion (Wagner and Keck 1973). Triple osteotomies are not usually indicated where osteoarthritis already exists, and extensive surgical approaches may damage the gluteal musculature. Since both hips are often affected hip arthrodesis is not a genuine alternative.

Total hip replacement may be complicated by problems with acetabular bone stock. This has been reported with cementless polyethylene acetabular implants (Lintner et al 1988) and suggests that current designs are not yet ideal.

The Chiari osteotomy is especially suitable for severe dysplasia of the hip. With the appropriate operative technique to increase both lateral and anterior coverage, impressive improvement in the radiological appearances can be achieved, as shown by the increase in CE angle and VCA angle. For optimum coverage, attention must be paid to two aspects of the operative technique: the semi-circular shape of the osteotomy, which provides congruent anterior coverage (see Fig. 2), and sufficient medialisation which provides lateral coverage and also shortens the lever arm of body-weight, thus improving the efficiency of the pelvitrochanteric muscles. This may reduce the joint pressure by as much as 30% (Kadner 1985). However, too much anterior cover may limit the flexion range postoperatively. We consider that the minimum pre-operative range of flexion should be at least 75° .

We were surprised that all the so-called 'high' osteotomies gave good results, though this has been

Fig. 4a

Fig. 4b

Fig. 4c

Fig. 4d

Figure 4a – Left hip of a 37-year-old woman with osteoarthritis secondary to hip dysplasia and pain on exertion. Before operation, CE angle – 21° . Figure 4b – After a 'high' osteotomy (level 8 mm) with a joint space index of 3.5. Figures 4c and 4d – After 16 years, the step-like arrangement of the acetabular roof is still discernible, but there is complete lateral and anterior development of sclerosis. The CE angle is 48° and the VCA angle 60° . There was some sensitivity to changes in the weather, but only slight discomfort on exertion.

reported by Jaster (1974). A feature of all the hips with high osteotomies was radiographic sclerosis, indicating the transmission of load to the new acetabular roof (see Fig. 3d). This suggests that a thick fibrous cartilaginous pad must have developed between the femoral head and the high roof, to transmit the force. Another explanation is that an already thickened capsule caused the osteotomy to be performed at a higher level.

Medialisation and good lateral cover seem to be important for a good result, despite the possibly adverse effect of the steeply positioned medial wall of the original acetabulum. This steep angle has been regarded as a disadvantage of the Chiari osteotomy (Küsswetter and Magers 1984), but it seems that when osteoarthritic changes have already damaged the original articular cartilage, it is better for it to be replaced functionally by the metaplastic fibrocartilage of the capsule (Utterback and MacEwen 1974; Ishii and Asai 1978; Zlatic et al 1988).

During the long-term follow-up, radiological signs of osteoarthritis were seen to progress. This implies that the Chiari osteotomy failed to halt or reverse the degenerative process. Widening of the joint space is not evidence of improvement of the arthritis (Figures 3 and 4). Since we cannot predict the rate of progression of untreated osteoarthritis in dysplastic hips, it is not possible to say whether it was slowed down by the Chiari osteotomies.

The benefit of combining intertrochanteric osteotomy with pelvic osteotomy are difficult to assess (Kerschbaumer and Bauer 1979; Windhager et al 1989). The presence of severe coxa valga is the only certain indication for simultaneous varus femoral osteotomy. Chiari himself considered that where there was an oval deformation of the femoral head pelvic osteotomy may produce a local increase in pressure at its apex, and that

this was an indication for simultaneous valgus osteotomy (Chiari 1968). The combined procedure results in an increase in the area available for the transmission of force on both sides of the new joint (Winkler and Weber 1977; Schreiber 1979). Therefore, where there is marked incongruity between the acetabulum and the femoral head, simultaneous intertrochanteric osteotomy should be considered. The decision depends on the study of radiographs taken in abduction and adduction, possibly in combination with arthrography. When both procedures are required, the pelvic osteotomy should be performed first to avoid stressing the femoral osteosynthesis during the pelvic displacement.

We have found that the results of Chiari osteotomy are poor if it is performed on patients aged 45 years or more. Total hip replacement is preferred. However, it should not be forgotten that a pelvic osteotomy, even if it provides only a few years relief of symptoms, does make the later implantation of a prosthetic acetabulum much easier.

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