SHELF ACETABULOPLASTY FOR PERTHES' DISEASE : 12-YEAR FOLLOW-UP

I. C. M. VAN DER GEEST, M. A. P. KOOIJMAN, M. SPRUIT, P. G. ANDERSON, P. M. A. DE SMET

The goal of all therapies for Perthes' disease is to achieve an optimal shape of the acetabulum and an optimal coverage of the femoral head. Thirty patients who were included in this follow-up study (mean follow-up 12 years) underwent a shelf acetabuloplasty for Catterall group III or IV. The mean IOWA hip score at follow-up was 96 (max. 100 points, range 74-100). The mean acetabular-head quotient increased from 82.9 % pre-operatively to 107.9 % postoperatively, and remained 102.4 % at follow-up. There was a decrease in mean lateral subluxation ratio from 1.44 pre-operatively to 1.27 postoperatively, which remained 1.23 at follow-up. According to the Stulberg classification in the 18 adult hips, 6 hips had a good result (Stulberg 1 or 2), 10 hips had a fair result (Stulberg 3), and 2 hips had a poor result (Stulberg 4 or 5). These results appear to be better than the natural history as described by Stulberg. Shelf acetabuloplasty can be considered as an appropriate surgical treatment for severe cases of Perthes' disease.

Keywords : Perthes' disease ; shelf acetabuloplasty.
Mots-clés : maladie de Legg-Calvé-Perthes ; butée ; acétabuloplastie.

INTRODUCTION

The goal of all therapies for Perthes' disease is to achieve an optimal shape of the acetabulum and an optimal coverage of the femoral head and to prevent late arthritis (13). Shelf acetabuloplasty increases the coverage of the femoral head and prevents lateral or upward migration of the femoral head (11) and, therefore, can be a useful treatment for Perthes' disease. To date, only three articles have reported on shelf acetabuloplasty as a therapy for Perthes' disease. Kruse *et al.* (8) described long-term functional and radiographic outcomes for two groups of patients : one group had a shelf acetabuloplasty while the other group was managed by conservative treatment. In the case series reported by Willet *et al.* (16) and by Daly *et al.* (3), children aged > 8 years with Perthes'disease were treated with shelf acetabuloplasty. In the present study the long-term results of shelf acetabuloplasty for Catterall group III and IV cases of Perthes' disease were evaluated.

PATIENTS AND METHODS

Between 1980 and 1992, 45 patients with Perthes' disease underwent a shelf acetabuloplasty at the Sint Maartenskliniek in Nijmegen. In this study the 30 patients who had unilateral Perthes' disease with no other operative treatment of the disease and a follow-up of at least 5 years were included. Of the excluded patients, 4 had bilateral Perthes' disease, 2 had a subsequent femoral osteotomy, 8 could not be located, and 1 had died of a cause unrelated to the operation. The study group contained 23 boys and 7 girls. The right hip was affected 14 times, the left hip, 16 times.

Department of Orthopaedics, Sint Maartenskliniek, Nijmegen, The Netherlands.

Correspondence and reprints : P. G. Anderson, Department of Orthopaedics, Sint Maartenskliniek, PO Box 9011, 6500 GM Nijmegen, the Netherlands.

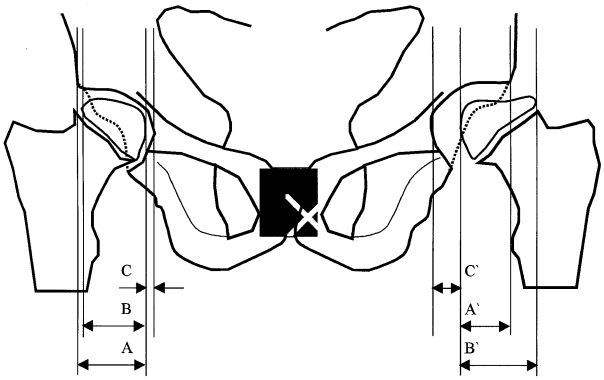


Fig. 1. — Measurement of lateral subluxation and acetabular coverage.

The figure shows a schematic drawing of a pelvic radiograph in which A and A' are the distances between the rim of the acetabulum and the medial border of the femoral head, B and B'are the distances between the lateral rim of the femoral head and the medial border of the femoral head, and C and C' are the distances between the medial acetabular border and the medial border of the femoral head.

The lateral subluxation is defined as the ratio of the width of the medial joint space of the affected (left) hip to the distance in the unaffected (right) hip (C'/C). The acetabular head quotient is defined as the quotient of A'/B' of the affected hip divided by the quotient of A/B of the unaffected hip times 100.

The mean age of the patients at the time the diagnosis was made was 6.6 (3.0-9.4) years. Conservative treatment was started first and included traction followed by brace or cast (19), only brace or cast (5), only traction (2), a wheelchair (2), and supervised neglect (2). After at least six months of conservative treatment, 12 hips were in Catterall group III and 18 hips in group IV, and shelf acetabuloplasty was indicated. According to the Herring classification 11 hips were in group B and 19 hips in group C. The Waldenström classification (15) at the time of surgery was stage 1 : 1 hip ; stage 2 : 16 hips ; and stage 3 : 13 hips. At surgery the mean age was 8.0 (4.7-11.1) years.

During surgery the anterolateral approach was used and the glutei muscles were stripped from the ilium. The reflected head of the rectus femoris was divided from the straight head and a trough was created on the anterosuperior side of the hip joint, where a corticocancellous bone graft from the ilium wing was inserted. This was stabilized by reattaching the reflected head of the rectus femoris to the straight head. Postoperatively, all patients received additional cast immobilization, in two-thirds of the patients for 6 to 12 weeks.

The mean duration of follow-up was 12 (5.6-18.4) years, with a mean age at the present follow-up of 19.9 (11.8-29) years. At the present follow-up, all 30 patients were reviewed. The patients were seen by the same person (PdS) for history, physical examination, and a pelvic radiograph. Twenty-six patients were evaluated using the IOWA hip score (9). Pain and function scores were available for three of the patients for whom no complete IOWA hip score was available.

Assessment was performed independently by two authors (IvdG, PdS) on radiographs obtained pre-operatively, 6-12 months postoperative, and at the present follow-up. The lateral subluxation, acetabular head coverage and Stulberg classification were used to assess the results of the shelf acetabuloplasty, and to compare these results with other studies concerning the results of treatment of Perthes' disease (7, 8, 14, 16). On the pelvic radiographs the lateral subluxation was measured as the width of the medial joint space, and the ratio of this distance to that in the unaffected hip (14) was calculated as shown in fig. 1. The coverage of the femoral head by the acetabulum in the affected hip was expressed as a percentage of the unaffected hip (acetabular head quotient) (6) (fig. 1).

At the present follow-up, the 18 adult patients were categorized according to the Stulberg classification (14).

Statistical analysis was conducted using Student's t-test and differences were considered significant with $p < 0.05$.

RESULTS

Clinical results

The mean IOWA hip score (n = 26) at follow-up was 96 (max. 100, range 74-100) points. When only pain and function were scored (n = 29), the mean score was 68 (max. 70, range 51-70) points.

Radiographic measurements

The values for acetabular coverage and lateral subluxation at the 3 assessment points are shown in table I. Lateral subluxation at the last follow-up was significantly reduced in comparison to the preoperative measurement ($p = 0.021$) while the acetabular coverage had significantly increased ($p = 0.001$). During the follow-up period, there was no significant change in lateral subluxation or in

Fig. 2. — Fig. 2.a shows the right hip of a 6-year-old patient with a Catterall group IV hip with head at risk signs. The lateralisation is 4 mm. Fig. 2.b shows the hip 4 years after shelf acetabuloplasty. At that time the patient had normal hip function. On the radiograph there is complete restoration of the femoral head and no lateralisation.

Table I. — Acetabular coverage (%) and lateral subluxation ratio

	Acetabular coverage %	Lateral subluxation ratio
Pre-operatively	82.9 (49-101)	1.44 (0.88-2.33)
Postoperatively	107.9 (71-145) *	1.27 (1.00-2.00) **
Follow-up (mean follow-up 12 y)	102.4 (70-126) *	1.23 (0.60-2.00) *

* $p < 0.05$ in comparison to pre-operative results
** $p < 0.01$ in comparison to pre-operative results

acetabular coverage with respect to the postoperative values. According to the Stulberg classification of the adult patients (n = 18), 6 had a good result (Stulberg 1 and 2), 10 had a fair result (Stulberg 3), and 2 had a poor result (Stulberg 4 and 5). In table II with the patients subdivided into categories related to age at onset, the outcome of the present study is compared to the results found by Ippolito *et al.* (7) in conservatively treated Catterall group III and IV hips. The radiographic results of three patients are shown in fig. 2, 3, and 4.

DISCUSSION

Not only should shelf acetabuloplasty prevent further increase in lateral subluxation, it should

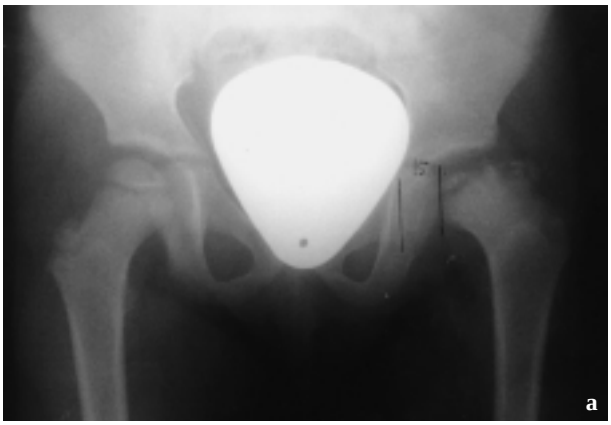
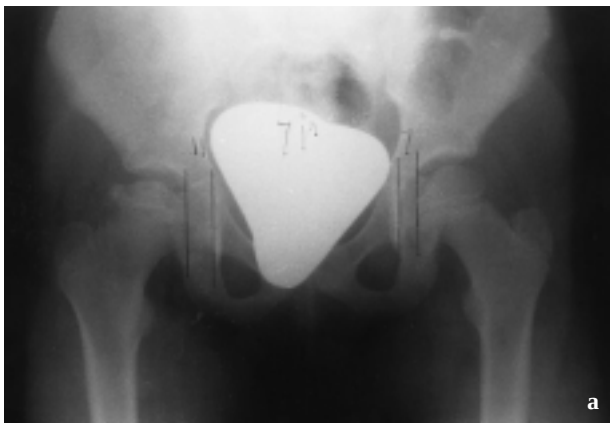


Fig. 3. — Fig. 3.a shows the Catterall group IV hip of a 5-year-old patient with head at risk signs. Lateralisation is 8 mm. Five years after the shelf acetabuloplasty the patient has no pain and only limited endorotation. On the radiograph (fig. 3.b) the lateralisation has decreased to 4 mm.

Table II. — Stulberg classification (numbers of patients versus age at onset)

	Stulberg classification		
	Good (1 and 2)	Fair (3)	Poor (4 and 5)
Age at onset under 5 years			
vd Geest (n = 3)	1	2	0
Ippolito (n = 9)	8	0	1
Age at onset 5-9 years			
vd Geest (n = 13)	6	6	1
Ippolito (n = 19)	4	13	2
Age at onset above 9 years			
vd Geest (n = 2)	0	2	0
Ippolito (n = 8)	0	6	2

also augment the acetabular coverage of the femoral head, and prevent further deformation of the femoral head in cases where conservative treatment was not successful. Hence, the iliac bone graft should cover the anterolateral aspect of the femoral head, and when the femoral head is deformed, the graft should cover the entire head in the anterolateral direction. In our group of 30 patients with Catterall group III and IV Perthes' disease, there was a significant postoperative increase of acetabular coverage and decrease of lateral subluxation that did not change during the follow-up. These results confirmed the expectation of



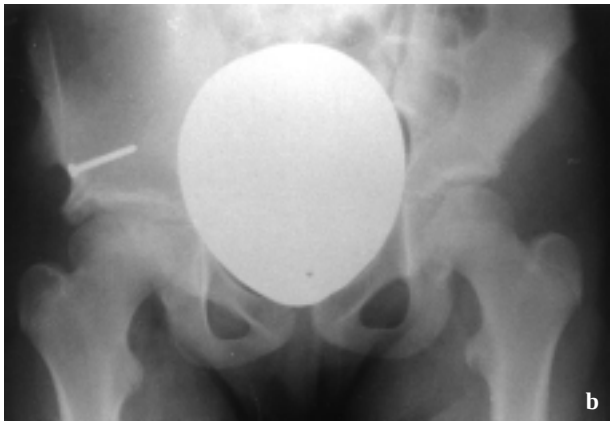


Fig. 4. — In fig. 4.a the right hip of a 7-year-old patient is in Catterall group III with lateralisation of 4 mm. Six years after the shelf acetabuloplasty the patient had no pain and complete function. The radiograph (fig. 4.b) shows no lateralisation, but the femoral head is not spherical and the epiphysis is in valgus.

Table III. — Stulberg classification (numbers of patients for Catterall group III and IV patients per study)

Type of treatment	Stulberg classification		
	Good (1 and 2)	Fair (3)	Poor (4 and 5)
Non-operative			
Stulberg (n = 27)	9	10	8
Ippolito (n = 36)	12	18	6
Shelf acetabuloplasty			
Kruse (n = 12)	4	5	3
Daly (n = 27) *	14	8	5
vd Geest (n = 18)	6	10	2

* Includes three patients with Catterall group II.

the shelf acetabuloplasty treatment. Comparison of the changes in lateral subluxation and acetabular coverage with the literature is not possible because the results were not stratified according to the Catterall groups III and IV or the results were not given. The IOWA scores found in our study (mean 96 points, max.100) show a better result than those reported by Kruse *et al.* (91 points) (8). However, the patients in our group were on average younger at follow-up. In table III the results in this study are compared to those of Stulberg *et al.* (14), Ippolito *et al.* (7), Kruse *et al.* (8), and Daly *et al.* (3). The number of patients with a poor result in our patient group is lower than those after conservative treatment as reported by Stulberg *et al.* (14) and Ippolito *et al.* (7). The high percentage of good results reported by Daly *et al.* (3) could be biased as three patients had a less severe form of Perthes' disease (Catterall group II).

Although we only have a limited number of adult patients in our study for whom the disease was diagnosed younger than 5 years or older than 9 years, one can cautiously state that the success of non-operative or operative treatment of Perthes' disease appears to depend upon the age at onset of the disease. For patients older than 5 years at diagnosis of the disease, clinical and radiographic results from shelf acetabuloplasty appear to be better than those of conservative treatment. This finding was confirmed in the studies reported by Daly *et al.* (3) and Willet *et al.* (16), in which patients with onset of the disease after the age of 8 years showed a satisfactory outcome after shelf acetabuloplasty.

In the present study long-term follow-up showed good clinical function, low pain scores, and a satisfactory Stulberg classification in the 18 adult hips. In conclusion, shelf acetabuloplasty for Perthes' disease appears to be an acceptable method of surgical treatment for Perthes' disease, with good clinical and radiographic results at 12-year follow-up. Shelf acetabuloplasty can be recommended in particular for the more difficult treatment groups of Catterall group III and IV hips with age at onset older than 5 years.

REFERENCES

1. Calvé J. Sur une forme particulière de pseudo-coxalgie greffée sur des déformations caractéristiques de l'extrémité supérieure du fémur. Rev. Chir. 1910, 42, 54.
2. Catterall A. The natural history of Perthes' disease. J. Bone Joint Surg., 1971, 53-B, 37-53.
3. Daly K., Bruce C., Catterall A. Lateral shelf acetabuloplasty in Perthes' disease. J. Bone Joint Surg., 1999, 81-B, 380-384.
4. Herring J. A. The treatment of Legg-Calvé-Perthes Disease. J. Bone Joint Surg., 1994, 76-A, 448-458.
5. Herring J. A., Neustadt J. B., Williams J. J., Early J. S., Browne R. H. The lateral pillar classification of Legg-Calvé-Perthes Disease. J. Pediatr. Orthop., 1992, 12, 143-150.
6. Heyman C. H., Herndon C. H. Legg-Perthes Disease. A method for the measurement of the roentgenographic result. J. Bone Joint Surg., 1950, 32-A, 767-778.
7. Ippolito E., Tudisco C., Farsetti P. The long-term prognosis of unilateral Perthes' disease. J. Bone Joint Surg., 1987, 69-B, 243-250.
8. Kruse R. W., Guille J. T., Bowen J. R. Shelf arthroplasty in patients who have Legg-Calvé-Perthes disease. J. Bone Joint Surg., 1991, 73-A, 1338-1347.
9. Larson C. B. Rating scale for hip disabilities. Clin. Orthop., 1963, 31, 85-93.
10. Legg A. T. An obscure affection of the hip-joint. Boston Med. Surg. J., 1910, 162, 202-204.
11. Love B. R. T., Stevens P. M., Williams P. F. A long-term review of shelf arthroplasty. J. Bone Joint Surg., 1980, 62-B, 321-325.
12. Perthes G. C. Über Arthritis deformans juvenilis. Deutsche Zeitschrift Chir., 1910, 107, 11.
13. Salter R. B. Legg-Perthes Disease : The scientific basis for the methods of treatment and their indications. Clin. Orthop., 1980, 150, 8-11.

14. Stulberg S. D., Cooperman D. R., Wallensten R. The natural history of Legg-Calvé-Perthes disease. J. Bone Joint Surg., 1981, 63-A, 1095-1108.
15. Waldenström, Henning. The first stages of coxa plana. J. Bone Joint Surg., 1938, 20-A, 559-566.
16. Willet K., Hudson I., Catterall A. Lateral shelf acetabuloplasty : An operation for older children with Perthes' disease. J. Pediatr. Orthop., 1992, 5, 563-568.

SAMENVATTING

I. C. M. VAN DER GEEST, M. A. P. KOOIJMAN, M. SPRUIT, P. G. ANDERSON, P. M. A. DE SMET. Pandakplastiek voor de ziekte van Perthes ; 12 jaar follow-up.

Het doel van alle behandelingen van de ziekte van Perthes is het bereiken van een optimale vorm en overdekking van de heupkop. Dertig patiënten die in deze follow-up studie (gemiddelde follow-up 12 jaar) werden geïncludeerd ondergingen een pandakplastiek voor Catterall groep III of IV. De gemiddelde IOWA heupscore bij follow-up was 96 punten (max. 100, range 74-100). De gemiddelde acetabulaire-kop quotiënt steeg van 82,9% preoperatief naar 107,9% postoperatief en bleef 102,4% bij follow-up. Er was een afname van laterale subluxatie van 1,44 preoperatief naar 1,27 postoperatief en 1,23 bij follow-up. Volgens de Stulberg classificatie voor de 18 volwassen heupen hadden 6 heupen een goed resultaat (Stulberg 1 of 2), 10 heupen een matig resultaat (Stulberg 3) en 2 heupen een slecht resultaat (Stulberg 4 of 5). Deze resultaten komen beter voor dan het natuurlijk beloop zoals beschreven door Stulberg. Pandakplastiek kan overwogen worden als een geschikte behandeling van ernstige vormen van de ziekte van Perthes.

RÉSUMÉ

I. C. M. VAN DER GEEST, M. A. P. KOOIJMAN, M. SPRUIT, P. G. ANDERSON, P. M. A. DE SMET. Résultats à 12 ans de la butée acétabulaire dans le traitement de la maladie de Perthes.

Les traitements proposés dans la maladie de Perthes ont pour but d'obtenir une morphologie optimale du cotyle et une couverture optimale de la tête fémorale. Les auteurs présentent les résultats d'une étude longitudinale qui a porté sur 30 patients suivis en moyenne pendant 12 ans, après butée acétabulaire pour maladie de Perthes de type III ou IV selon Catterall. Le score IOWA pour la hanche au recul final était de 96 (maximum possible : 100 points, extrêmes : 74 et 100). Le pourcentage de couverture de la tête est passé de 82,9% en préopératoire à 107,9% en postopératoire ; il restait à 102,4% au dernier recul. L'indice moyen de subluxation externe est passé de 1,44 en préopératoire à 1,27 en postopératoire et il restait à 1,23 au recul final. La classification de Stulberg appliquée aux 18 hanches des patients parvenus à l'âge adulte montrait un bon résultat au niveau de 6 hanches (Stulberg 1 ou 2), un résultat moyen au niveau de 10 hanches (Stulberg 3) et un résultat médiocre pour deux hanches (Stulberg 4 ou 5). Ces résultats apparaissent meilleurs que l'évolution naturelle décrite par Stulberg. La butée acétabulaire peut être considérée comme un traitement chirurgical adéquat dans les formes graves de maladie de Perthès.