

Intertrochanteric varus osteotomy for Perthes' disease

Radiographic changes after 2–16-year follow-up of 126 hips

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We analyzed various prognostic factors in 112 children operated on for Perthes' disease (Catterall's groups II–IV); special attention was paid to acetabular changes and postoperative containment. The radiographic results of 126 intertrochanteric femoral varus osteotomies were analyzed 2–16 years postoperatively. Catterall's grouping or head-at-risk phenome-

non, bicompartimentalization of the acetabulum, and preoperative subluxation of the femoral head did not correlate with the result. The result was worse in cases operated on in the healing phase of the disease and in patients operated on at the age of 9 years or older. The strongest prognostic factor was containment of the femoral head after osteotomy.

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We analyzed the radiographic results of intertrochanteric femoral varus osteotomy in the treatment of Perthes' disease in 112 children. Radiographic results of 102 of these patients were previously reported (Hoikka et al. 1986). In the present study, special attention was paid to bicompartimentalization of the acetabulum, superolateral subluxation of the femoral head, and postoperative containment of the femoral head.

Patients and methods

Totally, 112 patients (126 hips) with Perthes' disease underwent intertrochanteric varus osteotomy at our hospital between 1969 and 1985. The Thomas splint was used as a conservative method in the treatment of Perthes' disease before 1976. In 1976, intertrochanteric varus derotation osteotomy was applied for the treatment of Perthes' disease, and the treatment with the Thomas splint was abandoned. During this shift period, there were 70 hips that had been treated with the Thomas splint for 14 (3–40) months and that were later operated on.

When analyzing radiographs, we observed 25 hips in 20 patients as having an exceptionally severe course of the disease (Poussa et al. 1991). The radiographic findings differed from the typical findings of Perthes' disease, many of them being more characteristic of various epiphyseal dysplasias (Spranger 1976, Crossan et al. 1983, Herring and Hotchkiss 1987). These

changes, which appeared at a very early phase of the disease, included lateral calcification extending far lateral towards the greater trochanter, deformation and widening of the femoral head before the fragmentation stage, sclerotic epiphysis surrounded by a ring of looser bony tissue, deformation and widening of the femoral neck, and extensive sclerotic changes in the metaphysis. No other findings indicating epiphyseal dysplasias were found. These patients were excluded from the present analysis. Thus, 92 patients (101 hips), 76 boys and 16 girls, were included in this series. The mean age at operation was 8 (5–13) years. The mean follow-up period after the operation was 7 (2–16) years.

The indication for operation was subluxation of the femoral head or severe disease (Catterall's groups II–IV with signs of head-at-risk or progression of the disease despite conservative treatment). There were 14 hips in Catterall's group II, 49 hips in group III, and 38 hips in group IV. The signs of head-at-risk were recorded (Catterall 1982); the femoral head was considered to be at risk if two or more signs were present. Intertrochanteric osteotomy was performed removing a bone wedge based medially. The fixation was performed in most cases with staples followed by application of a plaster cast for 6–8 weeks. Full weight bearing was allowed after removal of the cast. In osteotomies fixed with an AO-plate, no plaster cast was used postoperatively.

Radiographic evaluation was performed by 3 of the authors of this paper. The anatomic result was assessed according to the criteria of Catterall (1982).

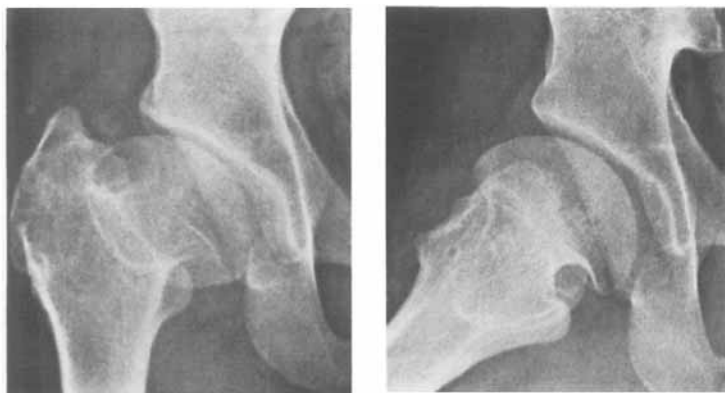


Figure 1. A poor result after intertrochanteric varus osteotomy in Perthes' disease, anteroposterior and Lauenstein's projections. The proximal femur is deformed, but the contour of the joint surface of the femoral head is spherical. The contour of the acetabulum is severely dysplastic, which makes the result poor.



Figure 2. An 8-year-old boy with Perthes' disease before surgery. Acetabular bicompartimentalization is seen as a division of the acetabulum into two pockets.

Two months after intertrochanteric varus osteotomy, the femoral head is well contained. Bicompartimentalization of the acetabulum is still evident.

The final result is good. The acetabulum has regained a normal contour.

In a good result, the femoral head was round and well contained within the acetabulum, which showed no adaptive changes. In a fair result, the head was round, but a little broadened, and might not be fully contained within the acetabulum; some adaptive changes in the acetabulum were accepted. In a poor result, the head was not round or the acetabulum was dysplastic (Figure 1). Sphericity of the femoral head was determined using a template of concentric circles (Mose 1964, 1980). A deviation of 2 mm in the sphericity of the joint surface was allowed on anteroposterior and lateral projections in cases with a good or fair result. If the deviation was >2 mm or if there was a difference of >2 mm between the joint surfaces on anteroposterior and lateral projections, the result was considered poor. The contour of the acetabulum was evaluated according to Yngve and Roberts (1985). Bicompartimentalization of the acetabulum was identified as division of the acetabulum into two separate pockets (Figure 2). Superolateral subluxation of the femoral head

was subjectively assessed. A superior subluxation was considered if Shenton's line was broken (Stulberg et al. 1981). Postoperative containment was evaluated by visual impression on radiographs taken 2-3 months after surgery; the femoral head was considered contained if the femoral head was well within the acetabulum. Flatness of the acetabulum was measured in unilateral cases both on the affected side and on the other side with no signs of Perthes' disease (Figure 3).

Results were analyzed using a standard statistical software program. Fisher's exact two-tail test was used in the analysis of two-by-two cross tabulations; the test for linear trend was used in the analysis of two-by-more-than-two cross tabulations; and Pearson's chi-square test was used in the analysis of other cross tabulations. The Student's *t*-test and paired *t*-test were used in comparison of normally distributed variables, and Wilcoxon's test was used when the variables were not normally distributed.

Table 1. Radiographic results after intertrochanteric femoral varus osteotomy for Perthes' disease

Patients Hips	Result	Catterall's group			Head at risk		Bicomp		Sublux		Bicomp+ sublux		Operation in healing phase		Postop contained	
		II	III	IV	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes	No
All 101	Good	9	28	20	6	51	41	16	45	12	47	10	46	11	54	3
	Fair	3	10	11	1	23	15	9	18	6	19	5	15	9***	20	4****
	Poor	2	11	7	2	18	11	9	17	3	17	3	9	11	9	11
< 9 yrs 80	Good	9	25	19	6	47	38	15	41	12	43	10	43	10	50	3
	Fair	0	7	9	1	15	10	6	11	5	12	4	11	5**	13	3****
	Poor	0	5	6	1	10	7	4	9	2	9	2	5	6	5	6
> 9 yrs 21	Good	0	3	1	0	4	3	1	4	0	4	0	3	1	4	0
	Fair	3	3	2	0	8	5	3	7	1	7	1	4	4	4	4*
	Poor	2	6	1	1	8	4	5	8	1	8	1	4	5	4	5

Bicomp Bicompartmentalization of the acetabulum.

Sublux Superolateral subluxation of the femoral head.

* $P < 0.05$, ** $P < 0.02$, *** $P < 0.005$, **** $P < 0.001$.

Table 2. Flatness of the acetabulum (percentage, mean SE) preoperatively and at the follow-up control

Result		N	Flatness, affected hip		Flatness, normal hip		P
All hips	Preop	69	26	0.4	30	0.4	< 0.001
	Postop	60	27	0.6	31	0.4	< 0.001
Good	Preop	39	26	0.5	30	0.5	< 0.001
	Postop	36	28	0.6	32	0.6	< 0.001
Fair	Preop	15	26	1.2	29	0.7	< 0.02
	Postop	11	24	1.1	32	0.8	< 0.001

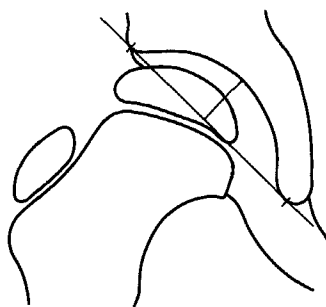


Figure 3. Flatness of the acetabulum was measured dividing the depth of the acetabulum by the distance between the tip of the teardrop and the lateral upper edge of the acetabulum.

Results

Catterall's grouping, head-at-risk phenomenon, acetabular bicompartmentalization, or preoperative subluxation of the femoral head did not correlate with the final outcome (Table 1). However, in patients under 9 years of age, the results were better in Catterall's group II than in groups III and IV. The outcome was worse in hips operated on in the healing phase of the disease, in patients operated on at the age of 9 years or older, or if the femoral head was not contained postoperatively (Table 1). In patients operated on at the age of 10 years or older, a good result was not obtained in any of the 9 cases, 4 of which had a poor result. Catterall's grouping, head-at-risk phenomenon, bicompartmentalization of the acetabulum, superolateral subluxation of the femoral head, or operation at the healing phase did not influence the postoperative containment. The acetabulum was flatter on the affected side than on the contralateral normal side both preoperatively and at the final follow-up examination (Table 2). There were six hips with a poor result in which the joint surface of the femoral head was spherical but the acetabulum was dysplastic.

In the 25 atypical hips, the result was fair in two hips and poor in 23 hips.

Discussion

We used the criteria for a good, fair, and poor result mainly according to Mose (1964, 1980) and Catterall (1982). However, the result in six hips with a dysplas-

tic acetabulum was judged poor, although the joint surface of the femoral head was spherical. This criterion might be considered too strict, but it must be borne in mind that even slightly dysplastic hip joints may be prone to secondary arthrosis (Saito et al. 1985, Harris 1986).

Because no hips were in Catterall's group I, a complete evaluation of results according to Catterall's groups could not be made. Although the results did not correlate with groups II–IV when all the hips were included, the Catterall's grouping was of prognostic significance in the patients under 9 years of age, where all nine hips in group II had a good result.

Thirty-one patients had been operated on in the healing phase of the disease. This was often due to the fact that the Thomas splint had been used primarily and the operation was performed only in cases in which containment was not obtained. An operation in the healing phase and an operation on older patients are often followed by an unsatisfactory result (Edgren 1965, Axer et al. 1980, Laurent and Poussa 1980, Catterall 1982, Hoikka et al. 1986), which was true in the present series, too. However, a poor result may also ensue in younger patients who are operated on before the commencement of the healing phase of the disease, even in cases with less extensive involvement of the femoral head. Consequently, new prognostic factors in addition to Catterall's grouping and head-at-risk signs are needed. Acetabular changes and subluxation of the femoral head have been noticed, but the prognostic significance of these findings is unknown (Danielsson et al. 1982, Yngve and Roberts 1985). Yngve and Roberts (1985) described acetabular deformation, which they called bicompartimentalization, as the acetabulum appeared to be divided into two pockets. This deformation was a sign of poor prognosis in nonoperated on patients. In the present series of operated on hips, bicompartimentalization of the acetabulum was observed frequently, but it did not influence the final result. Neither did preoperative subluxation of the femoral head alone or combined with acetabular bicompartimentalization have an effect on the result. The most important factor affecting the course of the disease was postoperative containment of the femoral head within the acetabulum. Accordingly, in the cases with acetabular bicompartimentalization and superolateral subluxation, containment of the femoral head in most cases allowed the hip joint to regain an almost normal contour. We tried to find risk factors affecting postoperative containment; Catterall's grouping, head-at-risk phenomenon, acetabular bicompartimentalization, superolateral subluxation of the femoral head, or operation at the healing phase of the disease did not influence postoperative containment. It is probable, however, that, although containment was obtained in

cases operated on in the healing phase, congruency of the hip joint was not obtained in all the cases, because deformation of the femoral head and acetabulum had already occurred.

In 11 of the 18 hips in which postoperative containment was not achieved, the result was poor. Accordingly, intertrochanteric varus osteotomy was not a satisfactory method in these cases; possibly better containment could have been obtained by innominate osteotomy, which has been suggested in cases where other methods might not allow containment (Kliscic et al. 1985, Salter 1984).

There was a substantial difference in the flatness of the acetabulum between the affected hip and contralateral normal hip both preoperatively and at follow-up. This was also true in the cases with a good result, suggesting that, although the femoral head and acetabulum are spherical and congruous, normal anatomy of the hip joint is not obtained in Perthes' disease.

In the atypical cases the prognosis was poor irrespective of whether or not bicompartimentalization or superolateral subluxation existed, and whether or not the femoral head was postoperatively contained. In cases with these atypical changes, intertrochanteric varus osteotomy should probably not be performed (Poussa et al. 1991).

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