Prognosis in Perthes' disease after noncontainment treatment

106 hips followed for 28–47 years

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The results in 96 patients (106 hips) with Perthes' disease who had had conservative noncontainment treatment were studied after 35 (28–47) years. At skeletal maturity, the radiographic result was poor in 65 hips. At the average age of 43 years, radiographic signs of arthrosis were found in 48 patients (51 hips); 5 patients had had hip replacement and 13 patients had symptoms justifying that procedure. At early phases of the disease, radiographs showed bicompartmentalization of the acetabulum in 24 percent of the hips, but the acetabulum normalized in the majority. There was no difference in long-term prognosis between Catterall's Groups III and IV; two or more signs of head-at-risk were not of prognostic value.

The patients' age at diagnosis and the shape of the femoral head at skeletal maturity were the most reliable prognostic factors.

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We report the results of noncontainment treatment after a long follow-up of Perthes' disease with analysis of prognostic factors, notably acetabular changes.

Patients and methods

Between 1946 and 1958, 246 patients with Perthes' disease were referred to our hospital. This material was reviewed by Edgren (1965). 172 of these patients could be traced. 152 were alive and asked to attend a follow-up examination. Where there was no reply, two additional attempts were made. A total of 96 patients (106 hips) participated in the follow-up study. Adequate radiographs were available from the onset of the disease in 84 patients (93 hips). Because of the low follow-up rate and to avoid misleading conclusions, the radiographic data of the rest of the original patients were examined. Radiographs were found from the onset of the disease in 94 patients (107 hips) and at or near skeletal maturity in 81 patients (93 hips). This material served as a control group for comparisons.

87 of the present 96 patients were boys and 9 were girls. The mean age of the patients at the time of diagnosis was 7 years with 35 patients (37 hips) under 7 years, 37 patients (40 hips) 7–9 years, and 24 patients (29 hips) over 9 years.

Catterall's groups, signs of head-at-risk and the contour of the acetabulum were recorded from the primary radiographs by visual estimate. Bicompartmentalization of the acetabulum was defined as division of the acetabulum into two separate pockets (Yngve and Roberts 1985). Osteoporosis of the acetabulum or upper femoral region in the early stages of the disease was noted by visual comparison with the contralateral side.

Using Catterall's (1971) classification, 1 percent of hips were graded as Group I, 3 percent Group II, 46 percent Group III, and 50 percent as Group IV. Two or more head-at-risk signs were found in 67 percent of the hips with adequate radiographs. Subluxation of the femoral head was found in 72 percent of the hips.

At skeletal maturity the sphericity of the femoral head was determined using a template of concentric circles (Mose 1977). A deviation of 2 mm in the sphericity of the joint surface was allowed for classification of the results as good or fair. If the deviation was > 2 mm or there was a difference of > 2 mm between the joint surfaces in anteroposterior and lateral projections, the result was considered poor. The final radiographic result at maturity was assessed according to Catterall's (1971) criteria.

All patients had been treated conservatively, 80 hips by Thomas splint and shoe elevation, and 26 hips with bed rest or crutches.

The clinical and radiographic follow-up examinations were performed 35 (28–47) years after the disease had been diagnosed; the average age of the patients at that time was 43 (34–54) years. In the eval-

Table 1. Radiographic arthrosis at follow-up

No	54
Mild	22
Moderate	14
Severe	15
Total	105

Table 2. Radiographic results at skeletal maturity versus Catterall (1971) Groups III and IV prognostic signs. *P* 0.51

	Catterall group	
	III	IV
Good	12	8
Fair	6	9
Poor	25	24
Total	43	41

Table 3. Radiographic results at skeletal maturity versus 2 or more signs of head-at-risk . *P* 0.15

	2 or more signs of head-at-risk	
	No	Yes
Good	10	10
Fair	3	12
Poor	15	34
Total	28	56

uation of prognostic correlations, to avoid misleading inferences, only hips affected earlier were accepted in bilateral cases. 5 patients had undergone total hip replacement and were excluded from evaluation. One patient refused to be radiographed at the follow-up examination.

Mobility of the hip joint and leg-length discrepancy were recorded; the Mayo hip score was used (Kavanagh and Fitzgerald 1985). Standing anteroposterior radiographs with straight knees and Lauenstein lateral radiographs were taken. The former included the iliac crests and the lumbar spine. All radiographs were evaluated three times. Arthrosis on plain radiographs was graded as *mild*—subchondral sclerosis, slight narrowing of the joint space, *moderate*—sclerosis, narrow joint space, osteophytes and small cysts, or *severe*—joint space less than 1 mm, sclerosis, deformation, cysts and large osteophytes.

Statistical methods

The FREQ procedure of the SAS program (SAS Institute Inc. 1985) was used. The Cochran-Mantel-Haenszel chi-square test was used for linear association between an ordinal-scaled response and covariables. Statistical significance was expressed as a one-sided probability of *P*-value (significance level 0.01).

Results

On the initial radiographs, bicompartmentalization of the acetabulum was identified in 22/93 hips. Osteoporosis was found in early phases of the disease in 73/93 hips.

At skeletal maturity the radiographic result was good in 22/106, fair in 19 and poor in 65 hips. At follow-up, radiographic arthrosis was found in 51/105 hips (Table 1), with 15 graded as severe. The Mayo hip score and pain alone correlated with arthrosis ($P < 0.001$).

The radiographs at skeletal maturity correlated with later arthrosis ($P < 0.001$); there was no arthrosis at follow-up in any of 22 cases where the radiographic result at the cessation of growth had been good. Catterall Groups III and IV did not correlate with the radiographic result at maturity (Table 2); two or more signs of head-at-risk were not of prognostic value (Table 3). Subluxation of the femoral head alone correlated better with the late results, but its prognostic value (*P* 0.038) remained a little obscure, as did bicompartmentalization (*P* 0.044).

Highly reliable prognostic signs ($P < 0.001$) were the patient's age at the onset of the disease and the sphericity of the femoral head at skeletal maturity.

Discussion

Catterall (1989) has suggested that 57 percent of all patients with Perthes' disease do well without treatment, and clinical results of treatment have been good in many studies (Ratcliff 1967, Gower and Johnston 1971). On the other hand, Saito et al. (1985) found that one quarter of his material of 51 patients had arthrosis already after 18 years. It has been stated that, despite signs of radiographic arthrosis, these patients are most often symptom-free throughout middle age (Mose et al. 1977) and the numbers of hip replacements reported have been quite low. Perpich et al. (1983), in a 30-year follow-up study, reported that 7 percent had undergone this procedure. McAndrew and Weinstein (1984) reviewed 37 hips; 3 arthroplasties had been

Table 4. Data in the present series compared with the control group

	Present series (96 pts,106 hips)		Control group (94 pts,107 hips)	
Age at diagnosis				
< 7	37		39	
7–8	40		38	
> 9	29		30	
Mean	7.3		7.5	
Catterall groups				
I	1		3	
II	3		11	
III	43		40	
IV	46		53	
2 or more signs of head-at-risk	62/93	67%	52/107	49%
Subluxation of the femoral head	67/93	72%	59/107	55%
Radiographic result at skeletal maturity				
Good	22		27	
Fair	19		15	
Poor	65		51	

performed before the patients reached the age of 40.

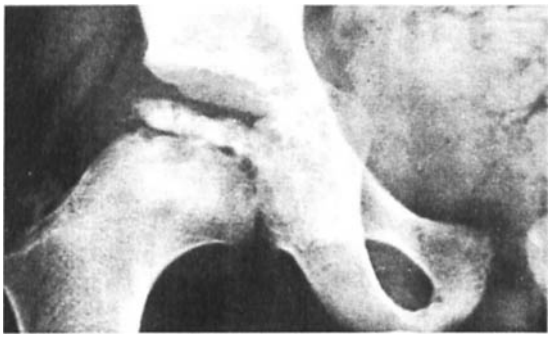
In our series, the follow-up rate was quite low; only 172 (152 alive) of the original 246 patients could be traced, and 96 of them participated in the final follow-up. However, the reported percentages are relatively accurate because the available radiographic data of the relevant control group (94 of the original 246 patients) revealed many similarities with the present series. Although there was some increase in the number of Catterall Groups I and II and decrease in the number of two or more head-at-risk signs and femoral head subluxation, the results at skeletal maturity revealed a trend to poor results also in the control group (Table 4).

The radiographic results in our series were worse than in most earlier reports. These poor results may be explained by referral of more severe cases to our hospital; in the vast majority, the femoral heads were classified as severely affected. Moreover, the age of the patients at the diagnosis was quite high, including 24 patients older than 9 years.

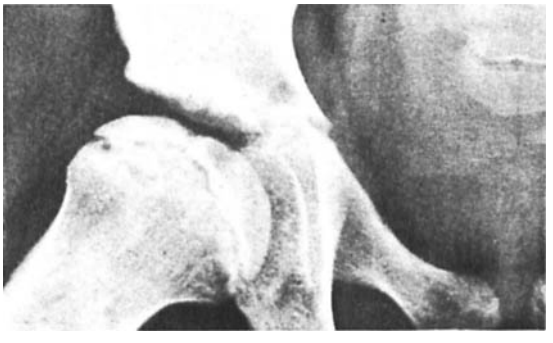
The total incidence of radiographic arthrosis corresponded to many previous reviews (Danielsson and Hernborg 1965) but the occurrence of severe arthrosis with clinical symptoms was increased in our series. Only 5 hip replacements had been made but another 13 hips seemed to require this procedure.

The controversial results with Catterall's groups and head-at-risk signs as indicators of long-term prognosis may partly be due to difficulties in delineating the radiographic hallmarks of these changes (Hardcastle et al. 1980).

Figure 1. A boy with bicompartmentalization of the right acetabulum.



Aged 6, before treatment



Aged 10, the bicompartmentalization has normalized after treatment.

Aged 20, the radiographic result is good.

Our results confirm many previous reports (Salter 1984) that femoral head subluxation is a better prognostic indicator than two or more head-at-risk signs. Still, even femoral head subluxation was only marginally prognostic in the present series.

Yngve and Roberts (1985) described bicompartmentalization and connected it with poor prognosis. Danielsson et al. (1982) and Joseph (1989) described acetabular changes in Perthes' disease and suggested that they may contribute to the prognosis if they per-

sist in adulthood. In the present study, the prognostic significance of bicompartmentalization was rather low and needs further elucidation. Permanent irregularity of the acetabulum probably leads to degenerative changes but normalization of bicompartmentalization could occur during the disease without containment treatment (Figure 1). Joseph (1989) also described radiographic osteoporosis of the acetabular roof. In the present series, osteoporosis of the acetabulum or upper femoral region was found in 73 hips at the initial phase of the disease, i.e. before immobilization. The role of acetabular osteoporosis remains unsolved for lack of more reliable data.

It has been suggested that the prognosis is better and arthrosis less severe and delayed in onset if the joint is congruous and the femoral head spherical at skeletal maturity (Mose et al. 1977, Stuhlberg et al. 1981). This was confirmed in our study. However, the progression of arthrosis may be variable; 15 of 65 hips with poor results at skeletal maturity had no radiographic signs of arthrosis at follow-up.

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