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The treatment of Legg-Calvé-Perthes disease

To contain or not to contain

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Abstract In order to evaluate a treatment protocol involving a non-containment method and femoral osteotomy when lateral subluxation of the femoral head develops, 39 children with 42 affected hips were examined radiologically an average of 7 years (4–16½) following the onset of Legg-Calvé-Perthes disease. Twenty-six hips were treated conservatively with an ischial-bearing, Thomas-type splint and 16 with a femoral varus derotating osteotomy. Both Catterall and Herring gradings were used. The end result was evaluated according to the Stulberg classification. All Catterall grade I ($n = 8$) hips had a satisfactory result regardless of age at onset and method of treatment. In Catterall groups II–IV ($n = 34$), age at onset influenced the treatment outcome. In children affected before the age of 8 years, results of conservative treatment were originally satisfactory but were seen to deteriorate with advancing age. In children over 8 years old ($n = 13$), the results clearly favour operative containment.

Introduction

The aim of treatment of Legg-Calvé-Perthes disease is to prevent osteoarthritic changes in adult life. It has been shown that this can be accomplished if the femoral head achieves a spherical form when the healing process is completed [19, 27]. However, treatment remains controversial [2, 10, 13, 15, 17, 21], and the hypothesis that the long-term prognosis is already set by the time the child presents for treatment also needs to be entertained [11]. Because some hips have a good prognosis [3, 5, 17], screening is essential to single out those endangered joints which well benefit from treatment. Although age at onset and extent of the ischaemic insult are believed to be important factors [5, 14], grading of head involvement has proved unreliable [7, 12, 22], and suggestions as to identifying this age group vary widely [4, 9, 18, 21, 26].

When treatment is considered, two main schools of thought may be followed: load relief [13] or containment [1], although conservative containment has not been shown to be superior to a non-containment method [29], and the case for containment by means of surgery has not been settled [9, 11]. Stulberg et al. have shown that lateral and proximal subluxation often results in a flat-shaped femoral head [27]. Fulford et al. did not demonstrate any advantage from femoral osteotomy as compared with non-containment [11].

The patients included in this study were treated with an ischial-bearing, Thomas-type splint and a femoral varus derotating osteotomy when lateral subluxation was seen. Our aim was to evaluate this treatment protocol and to assess prognostic factors.

Material and methods

In the period between 1976 and 1988, 87 patients with Perthes disease were treated in our institution. Only those with a complete set of radiographs since first presentation were included in order to enable an exact grading of head involvement. Thirty-nine patients (31 boys and 8 girls) with 42 involved hips attended a radiological follow-up examination. The average age at onset was 6.3 years (range 1½–12½). In 20 hips the age at detection was under 6 years, in 9 between 6 and 8 years and in 13 over 8 years. Right and left affected hips were equally distributed. Twenty-six hips were treated conservatively and 16 operatively.

Conservative treatment involved application of a hip spica for 6 weeks followed by an ischial-bearing, Thomas-type splint until healing of the femoral head was ascertained. Operative treatment (varus derotation osteotomy) was reserved for those hips which showed lateralisation of the femoral head. Average follow-up from onset of the disease was 7 years (range 4–16½ years) when the patients had reached an average age of 13.2 years (range 6½–21½ years).

The Catterall and Herring grades were determined from the initial radiographs by two observers (H.G., M.H.). Table 1 shows the distribution of grades and the average age at onset for each group.

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Table 1 Catterall and Herring groups with average age at onset, and Stulberg classes of children with Legg-Calvé-Perthes disease

	Mean age	*n*	Stulberg classes			
			I	II	III	IV
Catterall						
1	4.5	8	6	2	–	–
2	7.1	26	4	5	14	3
3	6.3	6	–	4	1	1
4	3.5	2	–	1	1	–
Total	5.4	42	10	12	16	4
Herring						
A	5.7	5	3	1	1	–
B	6.5	25	4	6	13	2
C	7.3	6	–	4	1	1
Total	6.5	36	7	11	15	3

Table 2 The Stulberg classification (*1* larger than normal femoral head, *2* shorter than normal femoral neck, *3* abnormally steep acetabulum)

Class	Definition
Class I	A completely normal hip joint
Class II	A spherical femoral head, but with one or more abnormalities of the femoral head (1), femoral neck (2) or acetabulum (3)
Class III	A non-spherical but not flat femoral head and abnormalities of the femoral head (1), femoral neck (2) or acetabulum (3)
Class IV	A flat femoral head and abnormalities of the femoral head (1), femoral neck (2) and acetabulum (3)
Class V	A flat femoral head and a normal femoral neck and a normal acetabulum

At follow-up examination anteroposterior and lateral frog view (Lauenstein) radiographs of the hip were taken. The outcome was graded according to the Stulberg classification. The grading criteria are shown in Table 2.

Results

Our overall results show that the final result in 10 (24%) hips was Stulberg class I, in 12 (28%) class II, in 16 (38%) class III and in 4 (10%) class IV. We saw no class V results (Table 1, Fig. 1).

When only the Catterall classification was considered, all hips graded as Catterall I ($n = 8$) had a satisfactory result (Stulberg class I and II; Fig. 2). For Catterall II–IV, the results were widely distributed in Stulberg classes I–V (Fig. 3). When the Herring grading was applied, group A was prognostically not as favourable as Catterall I. One hip in this group became Stulberg class III, and three Catterall I hips which achieved a good result were awarded a Herring B grading. For grades B and C there was an equally wide distribution throughout the Stulberg classes as for Catterall II–IV (Table 1).

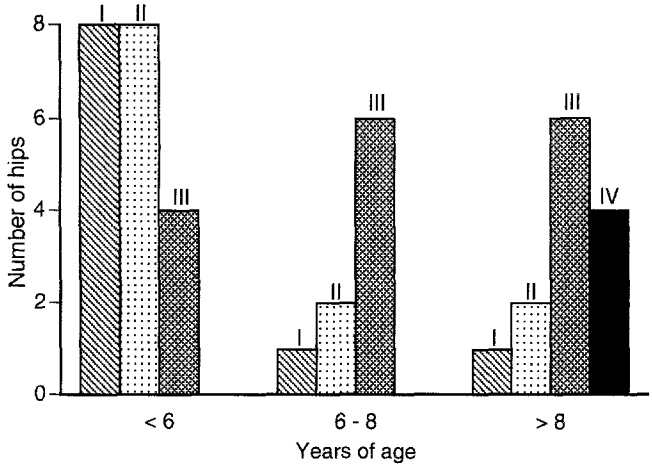

Fig. 1 Distribution of Stulberg outcome (classes I–IV) according to the age at onset of Legg-Calvé-Perthes disease ($n = 42$)

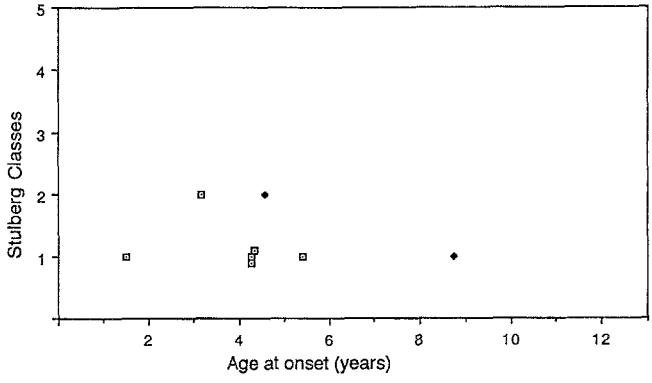

Fig. 2 Stulberg outcome of Catterall group I hips ($n = 8$) according to the age at onset and the method of treatment (◆ operative, ⊡ conservative)

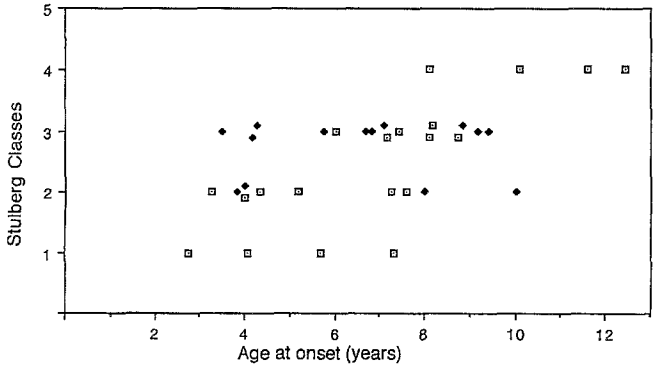

Fig. 3 Stulberg outcome of Catterall groups II–IV hips ($n = 34$) according to the age at onset and the method of treatment (◆ operative, ⊡ conservative)

When the prognosis was related to age at onset, a pattern became visible. In children under 6 years old, the majority of the results were Stulberg classes I and II (16 of 20), between 6 and 8 years old the results showed a definite shift into class III (6 of 9), and over 8 years old classes III and IV results dominated (10 of 13) (Fig. 1).

All Catterall grade I hips had a satisfactory result regardless of age at onset and treatment (Fig. 2). When these

hips are excluded, the influence of age on the result becomes more obvious (Fig. 3).

Finally, the influence of the method of treatment was studied. Since all Catterall I hips had a satisfactory result, they were not included in the following analysis. In conservatively treated Catterall II–IV hips (n = 20), a direct relationship between result and age at onset was seen. In children under 6 years old (n = 7), all results were Stulberg classes I and II, between 6 and 8 years old 3 of 6 results were Stulberg class III, and over 8 years old (n = 7) only class III and IV results were seen. In children treated by femoral osteotomy (n = 14), the results were not age-related, as all were Stulberg classes II and III with the latter predominating (10 of 14). This probably reflects the fact that the most endangered hips were selected for surgery, which may also explain why in children under 8 years old at onset, conservative treatment showed better results. However, children over 8 years old (n = 5) clearly benefitted from operative treatment (Fig. 3).

Discussion

Despite extensive research, the influence of treatment on the natural history of Perthes disease has not been clearly established [2, 4, 9, 11, 13, 15, 17, 18, 21, 29]. The success of treatment can only be measured against the development of arthritic changes in adult life. Long-term studies have contributed towards predicting the prognosis according to the residual deformity after healing of the femoral head is completed. Mose has correlated the sphericity of the femoral head to the incidence of osteoarthritis [19]. Stulberg et al. have shown that in addition to the deformity of the femoral head, its relation to the acetabulum in terms of congruity is equally important [27]. When femoral head deformity is being assessed, Mose's good, fair and poor correspond to Stulberg classes I, II and III–V, respectively. However, the same deformity may present a very different osteoarthritis risk depending on the relationship to the acetabulum as demonstrated when Stulberg classes IV and V are compared. According to the long-term results, the incidence of osteoarthritis for Stulberg classes I–V was 0%, 0%, 0%, 40% and 86% at 30 years, and 0%, 16%, 58%, 75% and 78% at 40 years from onset of the disease, respectively. Because of its high predictive value and ease of application, we have chosen the Stulberg classification to evaluate our results.

Since age at onset and degree of head involvement have been shown to be important prognostic factors [5, 14, 18, 21, 22], we have elected to discuss them individually prior to analysing the influence of treatment.

Age at onset

Although it is widely accepted that age at onset is the most important prognostic factor, controversy exists as to the cut-off point between good and poor results. McAndrew and Weinstein have observed that results are more favourable in hips affected under the age of 8 years [18]. O'Harra et al. (1977) set the age limit at 5 years [21]. However, unsatisfactory results have also been reported for children affected under the age of 5 [26]. Our results have also shown deterioration of the outcome with advancing age. This deterioration was seen to follow a linear pattern, with poor results dominating after the age of 8 years (Fig. 3). Stulberg class IV results were seen only when the disease was detected after the age of 8 years.

Since in a young child the growth potential is more favourable [23], a greater degree of remodelling of the femoral head can be expected, and thus the better results are easily explained. In addition, the smaller body weight may also favour the healing process [6]. The remodelling potential of the acetabulum has also been shown to be greater under the age of 8 years [16]. Stulberg et al. have observed that even when femoral head deformity is present, adaptation of the acetabulum to the shape of the femoral head results in an aspherical congruity which protects the hip from developing osteoarthritis (classes III and IV) [27]. However, in older children the acetabulum fails to remodel, so that the joint remains incongruent, and osteoarthritis is more likely to occur early in adult life (class V). In Stulberg's study class V deformity occurred in children diagnosed after the age of 9 years. In our study no class V results were encountered, which may reflect the fact that the number of hips affected after the age of 9 years is rather small (n = 6).

Catterall and Herring grading

It is believed that the extent of head involvement has a predictive value on the residual deformity of the joint. It therefore seems important to be able to determine the exact involvement early in the course of the disease. The classification introduced by Catterall is still the one most widely used today [5]. However, doubts have been expressed as to its validity. In a multicentre study the interobserver agreement for the Catterall grading of test radiographs was estimated as low as 0.42 [28]. This prompted Herring et al. to propose a revised classification which considers only the height of the lateral pillar on an anteroposterior radiograph. The interobserver agreement of this classification system was given as 0.78 [14]. Application of this grading is only possible when the contralateral hip is not affected.

We have employed both classification systems. All Catterall grade I hips had a satisfactory result regardless of detection age and treatment (Fig. 2). Catterall has also shown that for grade I involvement, results are good in all age groups [5]. Blakemoore and Harrison reported the results of 24 Catterall grade I hips [3]. The prognosis was good for all of them, and treatment did not influence the outcome. Stulberg et al. have observed that hips achieving a class I result had mild head involvement (Catterall I and II) [27]. However, partial head involvement was frequently associated with a class V result in the older child. O'Harra et al. found that Catterall I and II hips developed

a more spherical head than Catterall III and IV hips [21]. Age at onset was not considered. McAndrew and Weinstein could not confirm the prognostic value of the Catterall classification [18]. Fulford et al. have shown that the initial shape of the femoral head, as determined by arthrography, has a more accurate predictive value for the residual deformity than the Catterall grading [11]. In our patients, if Catterall I hips are excluded, the Stulberg results are found widely distributed throughout the Catterall grades (Table 1).

The Herring classification was simpler to apply, provided the opposite hip was normal. However, the prognostic value of the Herring A group was not as clear as for Catterall I (Table 1). One hip in this group achieved a Stulberg class III result, and three of the prognostically favourable Catterall I hips were classified as Herring B.

Dickens and Menelaus have shown that in some hips the Catterall grade changed during the course of the disease [10]. It has also been our experience that not infrequently accurate Catterall and to a lesser extent Herring grading are only possible in the late fragmentation stage.

Influence of treatment

The treatment methods employed can be divided into non-containment and containment ones. The aim of the former is to reduce the forces on the femoral head so that healing can be optimised [13]. Advocates of containment believe that the femoral head needs to be centered in the acetabulum to prevent deformity [1, 4, 17]. Stulberg et al. have shown that lateral and especially proximal subluxation was associated with development of a flat femoral head and that when class III and IV outcomes were analysed, the degree of subluxation determined the final deformity. However, for class V hips, which are the ones most at risk of developing osteoarthritis, subluxation was not found to be a predominant feature [27].

In practice, no form of treatment was found to be superior. Reports of untreated hips reflect the natural history of the disease. Although the hips reported in these series are not always comparable, good results of non-treatment range between 0 and 88% [3, 5, 17, 20]. Many studies focus on recognition of prognostic signs which may influence the treatment method [5, 8, 14, 24]. Fulford et al., in a randomised study, reported equal results from conservative non-containment and operative treatment [11]. Since they have shown that the end result depended on the initial shape of the femoral head, it could well be that the prognosis of the disease is already determined before treatment is initiated.

The indication for operative treatment remains uncertain. Canario et al. showed that younger children benefitted more from operative treatment [4]. Coates et al. observed exactly the opposite [9]. Their results of operative treatment were superior to those reported by Ippolito et al. [15] for conservative treatment in all age groups except for children under 5 years old. Bayliss et al. advised against surgical treatment in children less than 5 years old [2].

In agreement with Blakemore and Harrison [3], we found no difference between conservative and operative treatment for Catterall grade I hips. Although these hips have a good prognosis, we recommend close follow-up since a more severe grading may be observed during the course of the disease.

In our conservatively treated patients, when Catterall I hips are excluded, the result was seen to be age-related. In children under 8 years old, conservative treatment showed a satisfactory outcome. The final result of all operated hips was Stulberg class II or III. If the observations of Stulberg for the classes III and IV outcome are considered, operative treatment of those hips may have prevented the development of a flat femoral head by achieving centring. Indeed, none of our operated hips developed a Stulberg class IV result. Femoral varus derotation osteotomy is clearly superior to conservative treatment in children over 8 years of age.

The type of conservative treatment also needs to be addressed. The ischial-bearing brace has been shown to produce lateral forces on the hip joint [25]. In our patients who were initially treated with an ischial-bearing caliper, subluxation, leading to surgery according to our treatment protocol, was frequently observed. It can therefore be speculated that if a containment brace had been used, surgery could have been avoided. This, however, would only apply to children under 8 years old, since after that age the results of conservative treatment are unsatisfactory, although no subluxation is present.

In conclusion, Catterall grade I hips have a good prognosis regardless of age at onset and treatment. For Catterall II–IV hips the results of non-containment treatment deteriorate with advancing age. In children over 8 years old, surgery needs to be considered.

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