A PROSPECTIVE STUDY OF CHILDREN WITH UNTREATED CATTERALL GROUP 1 PERTHES' DISEASE

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Twenty-four hips in twenty children affected by Group 1 Perthes’ disease have been reviewed to assess the radiographic result after a minimum follow-up of four years. The children were allocated to Group 1 prospectively after examination of the early radiographs and no specific treatment of the affected hip was provided. The radiographic end results assessed by three methods were good even in those cases in which the additional stress of containment splintage of the contralateral hip was applied.

Since the publication of Catterall’s retrospective study of the natural history of Perthes’ disease (Catterall 1970, 1971) it has been possible to allocate patients, at a relatively early stage of the disease, to one of four groups according to the radiological extent of the involvement of the epiphysis of the femoral head. In Group 1 are those patients in whom the posterior, lateral and a variable amount of the anterior parts of the epiphysis of the head have been spared, the epiphysial height maintained and no sequestrum has been formed.

The importance of testing the assertion that “The natural history of untreated Perthes’ disease cannot be improved in Group 1 cases, where the results are good almost irrespective of age” (Catterall 1971) is two-fold. First, if the statement is correct yet is ignored, many children will be subjected to treatment unnecessarily; it has been apparent from the records kept by one of us (M. H. M. H.) that some such children have, in the past, been treated by prolonged splintage and even by operation. Secondly, if the assertion is correct, then future reviews of the treatment of Perthes’ disease should clearly be based on patients suffering from more severe involvement than Group 1 disease since good results in these cases would confer no merit on the treatment being studied. It was with these points in mind that this prospective study of patients with Group 1 Perthes’ disease was undertaken.

MATERIALS AND METHODS

Since 1970 all the children registered at the Perthes’ Clinic of the Royal Orthopaedic Hospital, Birmingham, have been assigned on diagnosis to one of the four groups according to the described radiographic criteria of Catterall (1971). Children whose hips were designated as Group 1 received no specific treatment. The diagnosis was explained to the parents, as was the possibility that the child’s hip might become painful, at which times simple analgesics could be given and crutches could be used although they seldom were. The parents were also advised to have the child excused physical education and contact sports. The children were followed up and radiographed at intervals of three to six months until reconstitution was considered complete.

The radiographic criteria for diagnosing Group 1 involvement were that the disease involved only part of the epiphysis of the femoral head and no sequestrum was formed; that the lateral portion of the epiphysis, as seen on the anteroposterior radiograph, showed neither fragmentation nor collapse, thus offering a buttress against epiphysial crushing; and that in the “frog” lateral projection the posterior part of the epiphysis was preserved and there was always a portion of uninvolved, or only slightly involved, bone spreading forwards to cover the epiphysial plate up to its anterior margin (Fig. 12).

It was not always possible to assign a grouping to hips affected by Perthes’ disease at the first attendance, particularly if the child was seen at an early stage of the disease. In such cases further radiographs were taken after three months and from the appearance shown on these two sets of radiographs the grouping was decided.

We have found an almost continuous spectrum of involvement of the epiphysis of the femoral head in Perthes’ disease, from the most minor changes which may be found in normal children to total involvement. We therefore decided on an arbitrary lesser degree of radiographic change, and a hip was only included in this study if the epiphysis was affected over a sector of a circle greater than 40 degrees (Fig. 1) and if the lesion was more than 2 millimetres deep on the anteroposterior or lateral projection (Fig. 2). In some cases the Group

![Fig. 1]

Fig. 1

Diagrams of anteroposterior and lateral projections of the femoral head to show the arbitrary minimal criteria which justified inclusion in this study.
1 lesion was part of bilateral disease. When the contralateral hip was more severely involved and required active treatment which included the use of abduction plaster casts (Broomstick plasters) the Group 1 hip was inevitably contained; all Group 1 hips which had received such treatment for six months or longer were excluded from this study.

Since 1970 Group 1 Perthes' disease had been diagnosed in fifty-seven hips in forty-seven patients (forty-three boys, four girls). Thirty-three hips were excluded from this study for the following reasons: two hips in one patient later showed radiographic changes characteristic of a more severe degree of involvement; three hips in three patients received more than a brief period of incidental treatment; five hips in four patients did not fulfil the arbitrary minimal criteria; and in twenty-three hips in nineteen patients the follow-up did not exceed four years.

Twenty-four hips in twenty children (seventeen boys, three girls) remained for study. The average age at presentation was five years (range two years nine months to nine years eight months). Sixteen of the twenty-four hips received no treatment, four hips were treated in abduction plaster-casts for less than three months and four others for less than six months. The period of follow-up varied from four years two months to six years eleven months.

The radiographic results were assessed by three methods. The first method was that of Mose (1964), using a transparent template of concentric circles the radii of which varied by 2 millimetre increments: if the subchondral border of the epiphysis corresponded to the same circle in both the anteroposterior and the "frog" lateral radiographs the result was categorised as good; if there was a deviation from the circular outline or a discrepancy of less than 2 millimetres between the two projections the result was categorised as fair; and if the discrepancy was 2 millimetres or more the result was categorised as poor. In each case the normal superomedial flattening of the epiphysis at the insertion of the ligamentum teres was ignored.

The second method of assessment was by a critical visual grading of the shape of the epiphysis of the femoral head and of any change that had occurred in it during the period of observation (Harrison, Turner and Nicholson 1969): if the capital femoral epiphysis was indistin-

![Fig. 3](image1.png)

![Fig. 4](image2.png)

![Fig. 5](image3.png)

![Fig. 6](image4.png)

Figures 3 and 4—Anteroposterior and lateral projections of the hip of a child aged nine years eight months with a very short history of pain; the radiographic appearances are of those of Group 1 Perthes' disease. Figures 5 and 6—The follow-up radiographs of the same hip four years and four months later; the patient received no active treatment for the hip lesion. End result poor (Mose 1964), Grade III (Harrison et al. 1969), in both projections.
guishable from normal, or from the contralateral side if uninvolved, on the last follow-up radiograph, the result was termed Grade I; if there was no more than minor loss of epiphysial height and the subchondral border was still round, the result was termed Grade II; if there was broadening of the epiphysis and considerable loss of epiphysial height the result was termed Grade III; and if there was flattening and severe deformity of the epiphysis the result was termed Grade IV. This assessment was made on the first and last radiographs in both the anteroposterior and lateral projections from which it could be judged whether the shape of the epiphysis of the femoral head had improved (for example, Grade II+), deteriorated (Grade II−) or remained unchanged throughout the period of observation (Grade II).

The third method of assessment was by measurement of the centre–edge angle (Wiberg 1939) both on diagnosis and at the final follow-up examination to ascertain whether or not there had been a tendency towards increasing subluxation.

RESULTS

All of the children were free from symptoms in the hip affected by Group I Perthes' disease and showed a full range of movement when seen at their last follow-up examination.

According to the categories described by Mose (1964) sixteen of the hips at the time of the last follow-up radiographs were good, six were fair and two were poor. By the visual assessment method of Harrison et al. (1969) the same sixteen hips in the good category (Mose) were found to be Grade I in both the anteroposterior and the lateral radiographic projections; of the six hips listed as fair (Mose), three were Grade II in both the anteroposterior and the lateral projections and three were Grade I in the anteroposterior projection and Grade II in the lateral projection; of the two hips deemed poor (Mose), one was Grade III in both projections (Fig. 3 to 6), the other was Grade III in the anteroposterior projection and Grade II in the lateral projection.

Table I gives the grading of the forty-eight final radiographs (two projections of each of the twenty-four hips). Thirty-eight of them showed an improvement towards normality compared with the appearances at diagnosis, two remained unchanged at Grade I, five remained unchanged at Grade II and three at Grade III. Thus no femoral head epiphysis worsened during the period of follow-up and the majority improved to approach normal shape. First and last radiographic appearances of two hips are shown in Figures 7 to 10 and 11 to 14 respectively.

Of the six fair (Mose) or Grade II assessments, four hips had been downgraded from good (Mose) or Grade I because of a small, localised defect in the ossific nucleus of an otherwise spherical femoral head (Fig. 15). It is
expected that these four hips will improve to the best grade in due course, as has been observed to happen during the follow-up of other similar cases.

The values for the centre–edge angle measured for each hip did not appear to change materially during the period of follow-up: on the first radiographs the angle averaged 24 degrees (range 16 to 30 degrees) and on the last radiographs the average was 26 degrees (range 20 to 33 degrees). This indicated that lateral extrusion of the epiphysis and coxa magna did not occur.

In thirteen of the twenty children the Group I lesion was part of bilateral Perthes' disease, and in nine of these children the treatment given to the more severely affected hip involved the continuous use of the Birmingham containment splint (Harrison et al. 1969) for a period of between seven and thirty-three months. This splint by its action of maintaining the treated hip in a contained position causes the opposite weight-bearing hip to assume an extremely uncontained position (Fig. 16). Of the nine hips with Group I disease which were subjected to this additional stress the results were good (Mose) or Grade I in five cases, fair (Mose) or Grade II in three cases, and poor (Mose) or Grade III in one case.

Table 1. Visual assessment of twenty-four hips from final follow-up radiographs

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<th>Grading</th>
<th>Anteroposterior projection</th>
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Harrison et al. 1969

Figures 11 and 12—Anteroposterior and lateral radiographs of the right hip of a child aged five years. In both projections the lytic changes are largely confined to the centre of the bony epiphysis. The diagnosis of Group I disease requires preservation of the lateral edge of the epiphysis as seen in the anteroposterior view; in addition, the front edge of the epiphysis must always be assessed in the lateral projection. Although irregular lytic changes can be seen to spread forward to the front edge of the epiphysis in the lateral projection, there is a tongue of relatively uninvolved bone (A) which comes to the front of the head and covers the epiphyseal plate; the presence of such bone is mandatory in the diagnosis of Group I disease. These radiographs depict one of the most severely involved epiphyses. Figures 13 and 14—Radiographic appearance of the hip four years two months after diagnosis: the result was good (Mose 1964) or Grade I+ (Harrison et al. 1969).
DISCUSSION

In two hips of this series we had to revise the diagnosis of Group I involvement to a more severe group after two months and ten months respectively. We would suggest two precautions. First, if containment therapy of a hip with Perthes' disease is to be withheld, attendance as an outpatient for continued observation by one experienced surgeon is desirable and radiographs of the hip in two projections at three-monthly intervals are necessary during at least the first year of supervision. The diagnosis of Group I disease should be revised if sequestra appear or if the epiphysis begins to flatten; on the other hand, progressive loss of epiphyseal bone can occur centrally as long as the anterior and lateral segments remain relatively uninvolved. Secondly, if one is unsure of the diagnosis of Group I disease in the initial set of radiographs, it is safer to temporise for three months by applying Broomstick plasters. The disease pattern is likely to be clear in the second set of films.

Our results showed that the epiphysis of a femoral head affected by Group I Perthes' disease will withstand not only the stress of normal childhood activity, but also the additional load of weight-bearing in the "uncontained" position imposed by Birmingham containment splintage of a contralateral diseased hip. This study has endorsed Catterall's (1971) view. The results without treatment were of high grade, except in two patients, aged on diagnosis five years five months and nine years eight months respectively, where no deterioration occurred but an imperfect hip resulted.

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REFERENCES