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OPERATIVE VERSUS CONSERVATIVE TREATMENT OF CALVÉ-LEGG-PERTHES DISEASE

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The results of treatment in two groups of patients with Calvé-Legg-Perthes disease are compared, one group having received conservative treatment consisting of bed rest and avoidance of weight-bearing, and the other operative treatment consisting of a subtrochanteric varus-rotational osteotomy without any restrictions of physical activity after healing of the osteotomy.

In both groups the femoral head destruction was classified according to Catterall, and thus the operatively treated group on the whole had more seriously affected hips than the conservatively treated group.

Although the main advantage of operative treatment is the short period of time spent in bed and the otherwise unrestricted physical activity, the results showed very little difference between the degree of femoral head congruity, the covering of the head by the acetabulum and the preservation of leg length and hip motility after operative as compared with conservative treatment.

A retardation of skeletal maturity is present particularly in patients with bilateral affections.

Key words: Calvé-Legg-Perthes disease; comparison; operation; skeletal immaturity; treatment

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At the Orthopaedic Department, Regional Hospital in Trondheim, operative treatment of Calvé-Legg-Perthes disease was started in 1973 using a varus-derotation subtrochanteric osteotomy.

The aims of the present study have been: 1) To compare the results of operative and conservative treatment; 2) To evaluate Catterall's classification as regards prognosis (Catterall 1971) and indications for operation; 3) To investigate the possible adverse effects of varus-derotation osteotomy, especially the possibility that this operation causes more limping and shortening of the affected leg than does conservative treatment; 4) Finally, to study the skeletal age in children with Calvé-Legg-Perthes disease.

PATIENTS AND METHODS

The material consists of 58 patients with 63 affected hips. Thirty patients with 31 affected hips were operatively treated with varus-derotation osteotomy, whereas 28 patients with 32 affected hips were treated conservatively.

In the *operatively treated group* the follow-up time after the operation was 3 years or more, on average 4.5 years (3–6.5 years). Twenty-seven patients had unilateral and 3 bilateral affection. There were 3 girls and 27 boys. The average age at the onset of the disease was 5.6 years (3–11 years), and the interval between the onset of the disease and the operation 7.5 months (2–27 months). The mean age at operation was 6.2 years (3–11.5 years).

Prior to the operation skin traction was applied for a sufficient time, a few days or weeks, to relieve any muscle spasm and pain and to increase the motility of the hip. The osteotomy was performed just distal to the lesser trochanter and fixation secured by means of a 4-hole plate, pre-bent to increase the varus angle by 20–30 degrees; the distal fragment was rotated externally by 20–30 degrees. After the operation a hip spica was applied and after 4 months the child was allowed to walk with full weight-bearing without any restrictions. The plate was removed 1 year after the operation. A typical case is shown in Figure 1.

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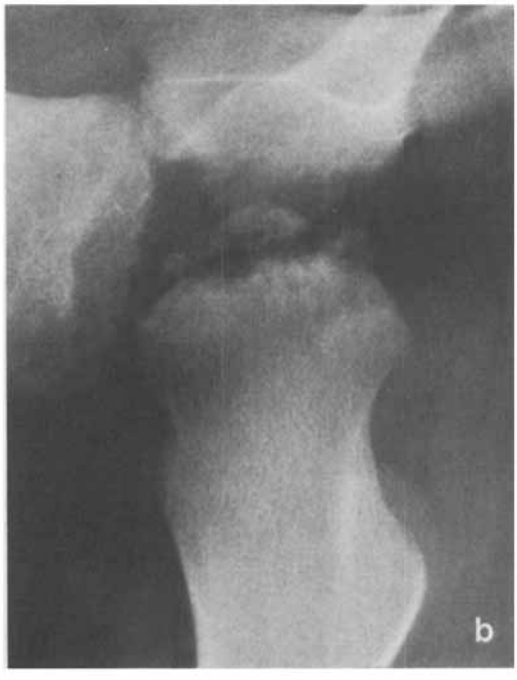
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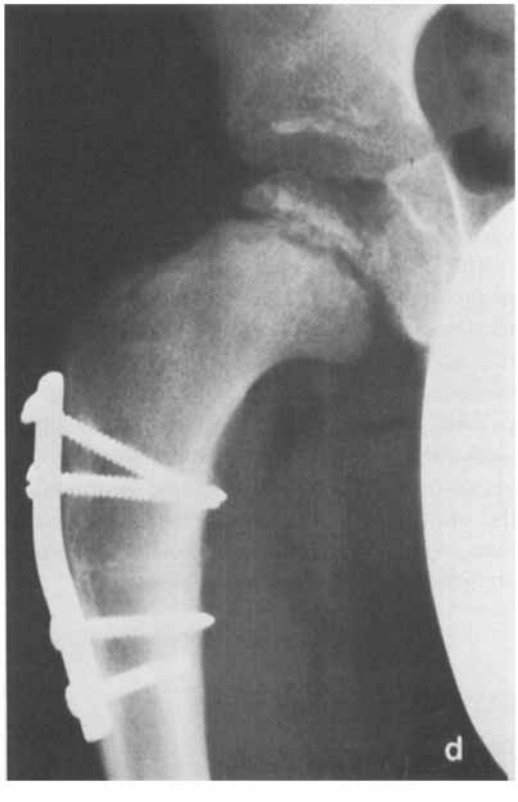
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Figure 1. Anteroposterior (a) and lateral (b) roentgenograms of the right hip of a boy aged 6 years at the onset of the disease. Catterall group 4 affection with "head-at-risk". Roentgenogram of the same hip after a subtrochanteric varus-derotation osteotomy (c), and 4 months after the operation (d). Anteroposterior (e) and lateral (f) roentgenograms of the hip 4 years later. The result is classified "good".

The operatively treated group represents patients from the catchment area of the Region Hospital in Trondheim. Patients who were not submitted to operation, had no treatment except for occasional short periods of skin traction to relieve pain, and were not restricted in their physical activity. No patient with an unmistakable Catterall group 1 affection was operated upon. However, in four operated cases the initial grouping was incorrect, and the further course of the disease proved that they should have been classified as Catterall group 1.

In the *conservatively treated group* the follow-up time after the onset of the disease was on average 7.7 years (4–13 years). Twenty-four patients had unilateral, and 4 had bilateral affection of the hip. There were 4 girls and 24 boys. The average age at the onset of symptoms was 5.4 years (2–10 years); the average time from onset of symptoms to admission to hospital was 3 months ($^1/_2$–7 months).

The conservatively treated group consists of all cases of Calvé-Legg-Perthes disease treated at the County Hospital in Ålesund from 1970–1975, altogether 25 patients. To this group are added 3 patients conservatively treated in Trondheim before 1973.

After skin traction and bed rest for an average of about 9 months further weight-bearing was avoided by means of a Snyder sling for about 18 months.

In comparing the results, the initial roentgenograms in anteroposterior and Lauenstein's projections were studied and the affections classified into the groups 1–4 according to Catterall (Catterall 1971, 1977), viz. group 1 having only affection of the anterior part of the femoral head with no collapse and no sequestrum formation, while in groups 2 and 3 an increasing part of the head is affected and there is sequestrum formation, and, finally, in group 4 the entire head is affected.

The so-called "head-at-risk signs" were also recorded, described as (1) Calcification lateral to the epiphysis of the head; (2) Lateral subluxation of the head. An increased joint space between the head and a "tear-drop" of 2 mm or more is considered as significant (Schiller & Axer 1972); (3) Gage's sign, due to an

Table 1. Distribution of the patients according to their Catterall grouping. Operated group shows more serious affections

	Classification according to Catterall				Total	Number of "head-at-risk"
	1	2	3	4		
Operatively treated group	4	7	10	9	30	17
Conservatively treated group	8	9	8	6	31	11

erosion in the lateral epiphysis and adjacent metaphysis; (4) Horizontally situated growth plate; and (5) Metaphyseal reactions.

The presence of two or more of these signs is supposed to make the prognosis less favourable, and, thus, according to Catterall the head is "at risk".

It may be difficult to classify the degree of head involvement in the initial roentgenograms. In such cases further roentgenograms were taken some 2–3 months later, and from these two sets of early roentgenograms the grouping was determined, as recommended by Blakemore & Harrison (1979).

It appears from Table 1 that there was a greater number of seriously affected hips in the operatively than in the conservatively treated group. The reason for this difference is obviously that the operatively treated patients were selected, i.e. there was a preoperative exclusion of patients in whom operative treatment was not indicated. Thus, the two groups are comparable with regard to average age at the onset of the disease, the relation boys/girls and unilateral/bilateral affection, but the hips in the operatively treated group are on the whole more seriously affected. This must be taken into consideration in evaluating the results of treatment.

In the *follow-up examination* a clinical as well as a radiological assessment was made.

In the *clinical* study the patients were asked about pain, and were examined for the presence of a limp or a positive Trendelenburg sign. Also any leg-length discrepancy was recorded and the range of movement in both hips was measured.

The *radiological study* consisted of examination of the roentgenograms of the hip joints in the anteroposterior and Lauenstein projections, measurement of the length of the femur and the tibia in both legs from orthoroentgenograms (Green at al. 1946) and determination of the skeletal age according to the method of Greulich & Pyle (1959).

The sphericity of the femoral head was measured according to Mose (1964), using a transparent template with concentric circles drawn at 2 mm intervals. If the bony outline of the femoral head falls within the same circle in both the anteroposterior and the Lauenstein

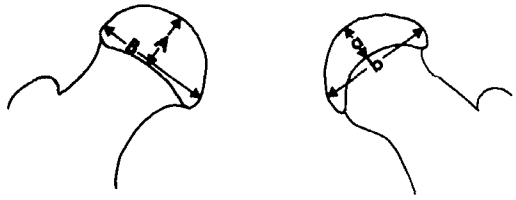

Figure 2. The epiphyseal quotient: $\frac{\frac{a}{b}}{\frac{A}{B}} 100$

projections, the result is considered good. If there is a deviation from the circular outline of less than 2 mm in both projections, the result is fair, while a poor result shows a deviation of more than 2 mm in either projection.

The epiphyseal height was measured by means of the epiphyseal quotient calculated as the height-to-width percentage (Figure 2). Hips with an epiphyseal quotient under 60 per cent were classified as fair or good depending on the sphericity of the head (Mose 1964).

The criteria used in classifying the results of treatment of the hips in the two groups were:

Good	Radiologically:	Spherical head fully contained by the acetabulum; epiphyseal quotient over 60 per cent.
	Clinically:	No symptoms, full range of hip movement.
Fair	Radiologically:	Caput congruent, more than 4/5 of the head covered; epiphyseal quotient under 60 per cent.
	Clinically:	No symptoms; hip movement slightly restricted.
Poor	Radiologically:	Caput irregular, more than 1/5 of the head uncovered.
	Clinically:	Symptoms; movement markedly restricted.

The clinical symptoms tended to give a better rating than did the roentgenological changes, and in no case was a poor or fair clinical result combined with a better roentgenological result. If, on the other hand, a good or fair clinical result was combined with a less satisfactory roentgenological one,. the classification was according to the latter.

The applied criteria are similar to those used in other studies (Sundt 1949, Meyer 1966 and Lloyd-Roberts et al. 1976) for the sake of comparison.

RESULTS

The clinical and roentgenological results of treatment at follow-up are shown in Table 2.

There seems to be a predominance of "Good"

results over "Fair" results in the operatively treated group, but little difference as regards poor results.

Two complications occurred in the operated group. One child sustained fracture of the femur shortly after removal of the plate. He was treated with a plaster spica, and the end result was good. In the other case an exaggerated outward rotation had to be reduced by reoperation. Also in this patient the end result was good.

The relationship between the poor results in 13 hips at follow-up and the Catterall grouping of the hips in the initial roentgenograms is shown in Table 3. It appears that in a large proportion of hips with extensive affections and signs of "head-at-risk", the result is poor regardless of the treatment. Thus, the present investigation strongly supports the view that the end result may be predicted from the early roentgenograms.

The average shortening of the affected leg in the operatively treated group was 0.8 cm and in the conservatively treated group 1 cm. In both groups a positive Trendelenburg sign was observed in 3 patients.

In the total material of 58 patients the skeletal maturation at follow-up was retarded by 17 months on average, with a maximum of 54 months. In no patient was the skeletal age greater than the chronological. The distribution of retardation according to Catterall's classification is shown in Table 4. It appears that whereas there are insignificant differences in retardation between the Catterall groups, there is a marked increase in retardation in patients with bilateral affections.

Table 2. Results after treatment of the whole material

Result	Operatively treated group	Conservatively treated group	Total
Good	19	16	35
Fair	5	10	15
Poor	7	6	13
Total	31	32	

Table 3. Distribution of the "poor" results related to Catterall grouping

	Poor results	Catterall group 1	2	3	4	"Head-at-risk"
Operatively treated group	7	0	0	3	4	7
Conservatively treated group	6	0	1	3	2	4
Total	13	0	1	6	6	11

Table 4. Retardation of skeletal maturation related to Catterall grouping and bilateral affection

Catterall group	Number of patients	Retardation in months min – max	mean
1	9	0 – 48	18
2	12	0 – 36	16
3	17	0 – 36	16.5
4	15	0 – 54	17.5
Bilateral	7	18 – 54	34

DISCUSSION

The present study indicates that the end results after subtrochanteric varus-derotation osteotomy in the treatment of Calvé-Legg-Perthes disease differ little from those obtained after conservative treatment consisting of bed rest and avoidance of weight-bearing by means of crutches and the Snyder sling. However, the number of good results in proportion to fair results seem to be greater after operative treatment.

The reason for the good results after operation is probably due to the permanent covering of the damaged femoral head by the acetabulum, obtained by the osteotomy. A beneficial effect of the osteotomy *per se* – increased vascularization of the femoral head – may be of additional significance (Axer et al. 1973, Puranen & Heikinen 1976). A prerequisite is that the operation is performed early in the course of the disease (Lloyd-Roberts et al. 1976).

Obviously, an improved covering of the head can be achieved just as well by changing the position of the acetabulum by means of an innominate osteotomy (Salter 1973). However, the tendency

of the leg to rotate externally during the disease is not influenced by the latter operation, which hence must be done at a very early stage. Moreover, a possible effect on the femoral head vascularization would be unlikely to occur.

Finally, the containment of the head can be established by abduction-internal-rotation splints (Bobechko et al. 1968). The splint, however, restricts the motility of the child over a long period of time, and it is difficult to decide when to discontinue the treatment (Harrison et al. 1966, Catterall 1977).

The main advantage of using the femoral osteotomy to achieve the desired covering of the avascular femoral head is, in our opinion, that the child is allowed to lead a normal life as soon as the osteotomy is healed a few weeks after the operation. However, in addition, a secondary benefit seems to occur: the very close scrutiny of the roentgenograms by the surgeon with the intention of operating, prevents some children from being unnecessarily treated (Catterall 1971, Blakemore & Harrison 1979). Thus, in the hospital where operative treatment was employed, unmistakable Catterall group 1 patients were not operated on. The hospital employing conservative treatment, on the other hand, treated all patients. The explanation for this difference is possibly that the consequences of unnecessary conservative treatment are less than are those of an unnecessary operation.

The investigation confirms that there is a strong correlation between the initial damage to the femoral head and the final result, as pointed out by Catterall (1971). Thus, out of the 13 hips with poor results, 12 appeared in groups 3 and 4, and 11 had signs of "head-at-risk" (Table 3). None of the hips with poor results were in group 1. The poor results occurred equally in the operatively and the conservatively treated group.

There has been no lasting deformity or gluteal tilt after the varization procedure and no permanent shortening of the leg ascribable to the osteotomy. On the contrary, the leg length seemed to be as well preserved in the operated as in the non-operated group. A spontaneous correction of the CCD-angle after varization osteotomy is described by Axer et al. (1973) and is possibly due to the effects of disturbing the trochanteric apophysis. The length equalization may in part be due to stimulation of epiphyseal growth by the osteotomy similar to that observed after femoral fractures in children (Edvardsen & Syversen 1976).

The marked retardation of skeletal maturation seen in all patients at follow-up (Table 4) is in accordance with the observations of other authors (Harrison et al. 1976, Bohr 1979). The average retardation amounted to 17 months, varying from 0 to 54 months. The immaturity of the bone may be of pathogenetic significance in the development of the disease, as pointed out by Harrison et al. (1976), Burwell et al. (1978) and Bohr (1979). This assumption is supported by the present observation that children with bilaterally affected hips have a retardation of skeletal maturation amounting to nearly twice the retardation of those with unilateral affection.

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