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*ORIGINAL STUDY*

# Outcome of varus derotation closed wedge osteotomy in Perthes disease

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**The aim of this study is to evaluate the clinical and radiological outcome of varus derotation osteotomy in Perthes disease. We studied 45 children with a mean age of 9.2 years, belonging to Herring's lateral pillar group B and C treated with varus derotation osteotomy. Containment was achieved in all patients on postoperative radiographs. At a mean follow-up of 6.4 years, good results were obtained in 23, fair in 20, and poor in 2 patients using Catterall's postoperative classification. Radiological evaluation was done using Mose's index and the epiphyseal quotient. Statistical analysis has concluded that better outcome was achieved in patients younger than 10 years of age as compared to those older than 10 years. Our study suggests that varus derotation osteotomy is an effective and easy surgical containment method for children with severe Perthes disease, especially who are younger than 10 years of age.**

**Keywords** : Perthes disease ; varus derotation osteotomy ; outcome.

## INTRODUCTION

The principal aim of treatment of Perthes disease is to minimise the deformation of the femoral head softened by the disease process, in order to prevent future development of degenerative changes and restore the normal range of hip motion. The natural history of Perthes disease is that of a self-limited condition with a very variable course. The disease is mild in children younger than 6 years of age, in whom good functional outcome can be achieved with conservative treatment in the form of non weight bearing and analgesics (*3,14,23*). It has been shown frequently, however, that there is a group of patients who definitely benefit from containment, either surgical or nonsurgical. Containment of the femoral head within the concavity of the acetabulum decreases the mechanical load on the weight bearing area of the hip joint, thus protecting it against deformation and allowing the normal development of the femoral head and acetabulum. Surgical containment can be achieved, among others, using a femoral or a Salter osteotomy.

Varus derotation osteotomy (VDRO) was described over half a century ago, and is now a popular method for the operative treatment of Perthes disease. It has been shown by many authors to improve clinical and radiological outcomes in patients (*5,6,9,13,15*). Varus derotation osteotomy increases the coverage of the femoral head by varus angulation and correction of the rotation. Thus, the

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forces acting on the weight bearing portion of the femoral head are redirected laterally and anteriorly which helps to control the lateral displacement by realigning the epiphyseal line.

## MATERIAL AND METHODS

This is a prospective study in 45 children with Perthes disease operated in our department from 1997 to 2002. Preoperatively the hips were classified radiographically using Herring's Lateral Pillar Classification (*8*). Only children more than 6 years of age at the time of diagnosis and with Lateral Pillar Group B and C were included in the study. According to the Waldenström classification of stages of Perthes disease, all patients were in the fragmentation stage at the time of surgery. A minimum of 30° of free abduction was a prerequisite for surgery. None of the patients who met the criteria for operative treatment were given a trial of conservative treatment before proceeding to surgery. A total of 54 cases were operated during this period. Bilateral hip involvement was seen in 4 cases, which were excluded from our study. Complete follow-up was available in 45 cases, 41 males and 4 females : the remaining five cases were lost to follow-up. Mean age at presentation was 9.2 years (range : 7 to 12.5). The right hip was involved in 21 children, the left hip in 24. The mean time between diagnosis and surgery was 2 months.

All patients were operated by the senior author. The surgical procedure used was a varus derotation femoral osteotomy. It was done using a lateral approach, with a closed wedge osteotomy, removing a wedge of bone from the intertrochanteric region medially. A varus correction of about 30° was done, with a target neck shaft angle of 110° postoperatively. The distal fragment was externally rotated and the fragments were fixed in slight extension to improve anterior coverage. The osteotomy site was fixed using a small-fragment dynamic compression plate. Postoperatively no spica cast was applied. Immobilisation was kept up to 8 weeks after which gradual weight bearing was started, depending on the consolidation of the osteotomy site.

At follow-up, all hips were evaluated clinically and radiographically. Clinical evaluation included range of joint motion, limping, limb length discrepancy and Trendelenburg sign. Limb length discrepancy was determined by placing a block under the shorter limb to level the pelvis.

Plain anteroposterior and lateral radiographs were obtained at follow-up visits. Catterall's post operative classification was used to classify the hips into good, fair and poor, which is based on the range of hip motion, hip symptoms and radiography (*3,24*). An asymptomatic hip with full range of motion and with a round and well-contained femoral head was classified as good. A fair result included an asymptomatic hip with slight restriction of movements, especially in internal rotation. The head is round but broadened and not fully contained within the acetabulum, up to one-fifth being uncovered. A hip which was not free of symptoms and with restriction of movements was classified as poor. Radiologically a poor outcome was associated with a flattened, broad and irregular femoral head with adaptive changes in the acetabulum and widening of the medial joint space.

Sphericity of the femoral head was evaluated using the Mose Index (*5*), in which anteroposterior and lateral views were studied by superimposing a template of concentric circles on the radiographs. According to this index, the results were classified as good if the head was spherical on anteroposterior and lateral radiographs. Fair results were those in which the head was not spherical but deviated less than 2 mm from the concentric circles and poor if there was more than 2 mm of deviation.

The Epiphyseal Quotient was measured by dividing the epiphyseal index (greatest height of the epiphyses divided by its width) of the involved head by that of the uninvolved head. A quotient of 0.6 was classified as good, 0.4 to 0.6 as fair, and less than 0.4 as poor (*16*).

The articulotrochanteric distance was measured as the vertical distance between the tangent to the highest point of the hip joint to the tip of greater trochanter. It indicates the overgrowth of the greater trochanter in relation to the femoral head.

The nominal data were analysed using the chi square test. Results with a p-value of $< 0.05$ were taken as significant.

## RESULTS

The mean age at follow-up was 15.6 years (range : 13.5 to 17) and the mean follow-up was 6.4 years (range : 5 to 11). Preoperatively, 23 patients were classified as having a Herring lateral pillar group B and 22 a group C. Good results were observed in 23, fair in 20, and poor in 2 patients according to Catterall's postoperative classification (table I).

Containment was achieved in all patients as recorded on postoperative radiographs. The mean change in the femoral neck shaft angle was 26° degrees, achieving a mean neck shaft angle of 112°

Table I. — Follow-up results of 45 patients in relation to the preoperative Herring's lateral pillar group and the age of the patient

| Age (years) | Catterall post operative Classification | | | | | |
|---|---|---|---|---|---|---|
| | (Herring group B) | | | (Herring group C) | | |
| | Good | Fair | Poor | Good | Fair | Poor |
| < 10 | 13 | 4 | 0 | 6 | 4 | 0 |
| > 10 | 4 | 2 | 0 | 0 | 10 | 2 |


***Fig. 1.*** — a) Pre-operative radiograph showing a Herring grade B Perthes disease in the initial stage according to Waldenström's classification. b) Radiograph after 8 year follow-up of the same patient showing a spherical and well contained femoral head with an epiphyseal quotient of 0.75.

on the immediate postoperative radiographs. The mean neck shaft angle at the time of follow-up was 117° (range : 102 to 125) compared to 128° on the contralateral side. Follow-up radiographs demonstrated adequate reossification of the femoral heads and Shenton's line was also maintained in all patients.

The classification of the disease at presentation was significantly associated ($p < 0.05$) with the outcome. Seventeen of the 23 patients in the Herring lateral pillar group B had achieved good results (fig 1) as compared to only 6 out of the 22 patients in the lateral pillar group C. Two patients had a poor outcome and belonged to the Herring lateral pillar group C (fig 2).

Age of the patient at the time of diagnosis was also found to have a significant bearing on the functional outcome of the disease. Eighteen children were older than 10 years at the time of diagnosis, and good results were achieved in only 4 children in this group, compared to 19 good results out of 27 children who were younger than 10 years

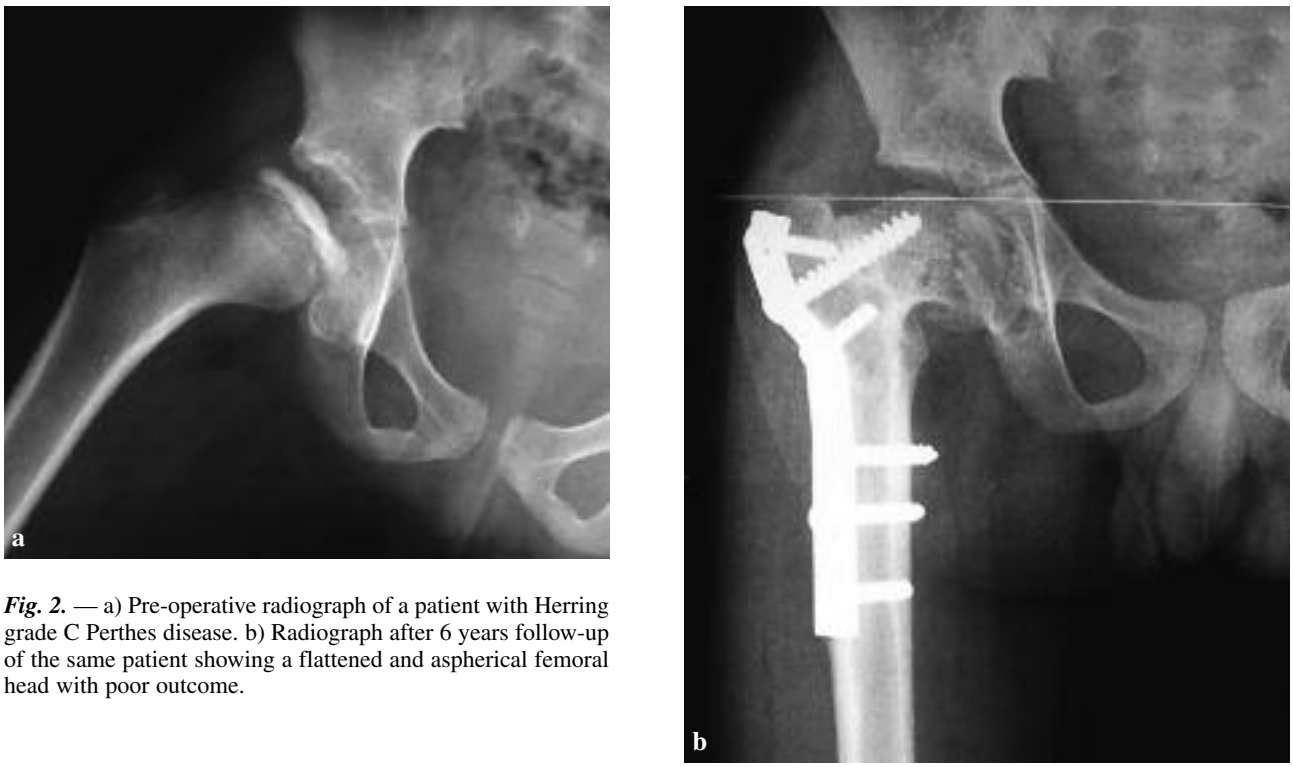


***Fig. 2.*** — a) Pre-operative radiograph of a patient with Herring grade C Perthes disease. b) Radiograph after 6 years follow-up of the same patient showing a flattened and aspherical femoral head with poor outcome.

(table I). The mean value of the epiphyseal quotient was 0.54. According to this radiological criterion, 15 patients had a good , 26 a fair and 4 a poor result (table II). Age of the patient at the time of diagnosis also significantly ($p < 0.05$) affected the epiphyseal quotient. The Mose Index was good in 15 patients ; fair in 24 and poor in 6 (table III).

The mean articulo-trochanteric distance in the 11 patients with a Trendelenburg gait was 1 cm (range : 0.3 to 1.3). In the 34 patients without a Trendelenburg gait, on the other hand, the mean articulo-trochanteric distance was 1.8 cm. There was no evidence of osteoarthrosis of the joint in the form of joint space narrowing, subchondral cysts or sclerosis on follow-up radiographs. None of the patients showed features suggestive of osteochondritis dissecans.

Clinically 43 hips were silent and 2 patients complained of persistent hip pain. Limping was observed in 15 patients : 11 of them had a Trendelenburg gait and 4 had a short limb gait. Limb length discrepancy was seen in 12 patients. The mean shortening was 1.1 cm (range : 0.6 to 1.5). There was no limitation of range of motion of the hip joint in 35 patients. Limitation of abduction and internal rotation was seen in 10 patients (an average of 10° of abduction and 8° of internal rotation). Thirty-eight patients could sit in a squatting and cross legged position. There was no instance of nonunion of the osteotomy site.

## DISCUSSION

The most important independent prognostic factors in Perthes disease are the extent of involvement and the age at presentation. Patients presenting with a higher grade of involvement (Herring C) tend to have a greater collapse of the femoral head, more pronounced deformities of the femoral head and neck, with greater limitation of hip range of motion and a poor prognosis (*4,10,14,23*). Most authors agree that patients younger than 6 years of age have a good prognosis, and outcome usually does not vary despite treatment (*2,21,23-25*). Children between 6 and 9 years of age are considered to have a variable prognosis and they usually benefit from surgical containment (*7,11,19,20,24*). Patients who are older than 9 years at onset are considered to have a

Table II. — Outcome in terms of the postoperative epiphyseal quotient and the age at presentation

| EPIPHYSEAL QUOTIENT | | | | | | |
|---|---|---|---|---|---|---|
| Age (years) | Good | | Fair | | Poor | |
| | Mean | Total cases | Mean | Total cases | Mean | Total cases |
| < 10 | 0.67 | 10 | 0.5 | 16 | 0.35 | 1 |
| > 10 | 0.65 | 5 | 0.5 | 10 | 0.36 | 3 |

Table III. — Outcomes in terms of the postoperative Mose Index, and age at presentation

| Moses Index | | | |
|---|---|---|---|
| Age (years) | Good | Fair | Poor |
| < 10 | 12 | 14 | 1 |
| > 10 | 3 | 10 | 5 |

poor prognosis regardless of the extent of the disease (*10,18,23*). This may be ascribed to lesser time available for the deformed femoral head to remodel. Literature is quite confusing regarding the best treatment protocol for such patients as there are contradictory studies about the additional benefit of operative containment in such patients (*1,17*). There are reports in the literature which support the fact that VDRO provides improved results in children older than 9 years of age as compared to the natural history or non-containment methods (*17*). In consensus with this, we also favour the surgical containment in the form of VDRO at our institution for all patients older than 6 years of age with Herring grade B or C.

In the developing countries like India, most of the patients usually present quite late after the disease process had started. In our study also the mean age of presentation was 9.2 years. Comparison with the literature regarding the femoral osteotomies is difficult because of the differences in the patients' age, degree of femoral head involvement and various outcome parameters used in previous studies. However, studies which isolated and recorded the data in older patients have demonstrated improved function in older patients up to 10 years of age, compared with historical series and non-operated control subjects (*13,15,17*). In our study also, children younger than 10 years of age had an improved outcome as compared to those older than 10 years. This is consistent with the report by Noonan *et al* (*17*), who studied the results of femoral varus osteotomy in children older than 9 years of age. They also concluded that better results were achieved in patients between 9 and 10 years of age as compared to those older than 10 (*17*). Similarly, Sponseller *et al* (*22*) demonstrated the improved outcome of surgical containment in patients younger than 10 years of age. Hence, it could be suggested that there is an upper age limit for the effectiveness of the operative containment in Perthes disease, which is most likely around 10 years.

In general, surgical treatment avoids the prolonged duration of non ambulation and bracing associated with conservative treatment, which makes it more independent of the patient's and family's compliance. Techniques of surgical containment include varus derotation osteotomy, Salter's innominate osteotomy and combined femoral and innominate osteotomy. Intertrochanteric varus derotation osteotomy is a commonly used procedure for surgical containment. According to literature, there has not been any significant difference in the outcome of patients treated either by varus derotation osteotomy or by Salter's osteotomy, in terms of hip symptoms, sphericity of the femoral head and congruity of the hip (*12,16*). Salter's osteotomy is a technically demanding procedure with a potential risk of damage to the nearby neurovascular structures in the greater sciatic notch, thereby limiting the wide application of this procedure. On the contrary, varus derotation osteotomy is a technically easy procedure with no additional risk to nearby neurovascular structures ; so it can be easily learnt and reproduced, resulting in its wide applicability. VDRO also carries a theoretical advantage of increasing

the venous drainage of the ill perfused femoral head and thereby improving its vascularity. In addition, trochanteric epiphysiodesis can be executed in the same procedure, if required to prevent the trochanteric overgrowth and associated Trendelenburg gait.

The most common complication of VDRO is shortening of the affected side. It is however a common observation that most of the patients tolerate shortening better than lengthening. Another disadvantage of VDRO is a residual varus of the femoral neck, but relation between the residual varus and the final outcome at maturity has not been established in the literature (*12*). Although higher coverage of the femoral head can be achieved using Salter's osteotomy, its impact on the sphericity of the femoral head or the clinical outcome was not found (*16*).

In our hands, results of varus derotation osteotomy are fairly encouraging considering the late age of presentation, thereby decreasing our threshold of using this procedure in a larger number of patients.

## REFERENCES


1. **Aksoy MC, Cankus MC, Alanay A *et al.*** Radiological outcome of proximal femoral varus osteotomy for the treatment of lateral pillar group-C Legg-Calvé-Perthes disease. *J Pediatr Orthop* 2005 ; 14-B : 88-91.
2. **Canavese F, Dimeglio A.** Perthes' disease : Prognosis in children under six years of age. *J Bone Joint Surg* 2008 ; 90-B : 940-945.
3. **Catterall A.** The natural history of Perthes' disease. *J Bone Joint Surg* 1971 ; 53-B : 37-53.
4. **Dickens DR, Menelaus MB.** The assessment of prognosis in Perthes' disease. *J Bone Joint Surg* 1978 ; 60-B : 189-194.
5. **Evans I, Deluca P, Gage J.** A comparative study of ambulation abduction bracing and varus derotation osteotomy in the treatment of severe Legg-Calvé-Perthes disease in children over 6 years of age. *J Pediatr Orthop* 1988 ; 8 : 676-682.
6. **Heikkinen E, Puranen J.** Evaluation of femoral osteotomy in the treatment of Legg-Calvé-Perthes disease. *Clin Orthop* 1980 ; 150 : 60-68.
7. **Herring JA, Kim HT, Browne R.** Legg-Calve-Perthes disease. Part II : Prospective multicenter study of the effect of treatment on outcome. *J Bone Joint Surg* 2004 ; 86-A : 2121-2134.
8. **Herring JA, Neustadt JB, Williams JJ.** The lateral pillar classification of Legg-Calvé-Perthes disease. *J Pediatr Orthop* 1992 ; 12 : 143-150.
9. **Hoikka V, Lindholm TS, Poussa M.** Intertrochanteric varus osteotomy in Legg-Calve-Perthes disease. A report on 112 hips. *J Pediatr Orthop* 1986 ; 6 : 600-604.
10. **Ippolito E, Tudisco C, Farsetti P.** The long-term prognosis of unilateral Perthes' disease. *J Bone Joint Surg* 1987 ; 69-B : 243-250.
11. **Kamegaya M, Saisu T, Ochiai N.** A paired study of Perthes' disease comparing conservative and surgical treatment. *J Bone Joint Surg* 2004 ; 86-B : 1176-1181.
12. **Kitakoji T, Hattori T, Kitoh H.** Which is a better method for Perthes' disease : femoral varus or Salter osteotomy ? *Clin Orthop* 2005 ; 430 : 163-170.
13. **Lloyd-Roberts GC, Catterall A, Salamon PB.** A controlled study of the indications for and the results of femoral osteotomy in Perthes' disease. *J Bone Joint Surg* 1976 ; 58-B : 31-36.
14. **McAndrew MP, Weinstein SL.** A long-term follow-up of Legg-Calvé-Perthes disease. *J Bone Joint Surg* 1984 ; 66-A : 860-869.
15. **McElwain JP, Regan BF, Dowling F.** Derotation varus osteotomy in Perthes disease. *J Pediatr Orthop* 1985 ; 5 : 195-198.
16. **Moberg A, Hansson G, Kaniklides C.** Results after femoral and innominate osteotomy in Legg-Calvé-Perthes disease. *Clin Orthop* 1997 ; 334 : 257-264.
17. **Noonan KJ, Price CT, Kupiszewski SJ.** Results of femoral varus osteotomy in children older than 9 years of age with Perthes disease. *J Pediatr Orthop* 2001 ; 21 : 198-204.
18. **Perpich M, McBeath A, Kruse D.** Long-term follow-up of Perthes disease treated with spica casts. *J Pediatr Orthop* 1983 ; 3 : 160-165.
19. **Pietrzak S, Napiontek M, Kraiz S.** The effect of the therapeutic approach on the course of Perthes' disease and its outcome : Conservative vs. surgical treatment. *Ortop Traumatol Rehabil* 2004 ; 6 : 751-757.
20. **Poussa M, Yrjönen T, Hoikka V.** Prognosis after conservative and operative treatment in Perthes' disease. *Clin Orthop* 1993 ; 297 : 82-86.
21. **Rosenfeld SB, Herring JA, Chao JC.** Legg-Calvé-Perthes disease : a review of cases with onset before six years of age. *J Bone Joint Surg* 2007 ; 89-A : 2712-2722.
22. **Sponseller PD, Desai SS, Millis MB.** Comparison of femoral and innominate osteotomies for the treatment of Legg-Calvé-Perthes disease. *J Bone Joint Surg* 1988 ; 70-A : 1131-1139.
23. **Stulberg SD, Cooperman DR, Wallensten R.** The natural history of Legg-Calvé-Perthes disease. *J Bone Joint Surg* 1981 ; 63-A : 1095-1108.
24. **Than P, Halmai V, Shaikh S.** Long-term results of derotational femoral varus osteotomy in Legg-Calvé-Perthes disease : 26-year follow-up. *Orthopedics* 2003 ; 26 : 487-491.