International Journal of Research in Orthopaedics
Nama KG et al. Int J Res Orthop. 2025 Sep;11(5):1252-1258
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20252658

Case Series

Functional outcome of varus derotation osteotomy in late presenting Perthes disease: a case series

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Received: 21 June 2025
Revised: 25 July 2025
Accepted: 31 July 2025

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ABSTRACT

Late-onset Perthes disease, particularly in children older than nine years, is known to have a more aggressive course and a less favorable prognosis, often progressing to osteoarthritis by the fourth decade of life if left untreated. While younger children are usually managed conservatively, and those aged 6-9 years may benefit from surgical intervention, the optimal treatment strategy for children aged 8 years and above remains controversial. This case series evaluates the clinical and radiological outcomes of varus derotation osteotomy (VDRO) in 12 children (10 males, 2 females) with a mean age of 9.4 years, treated at the Department of Orthopaedics, Government Medical College, Kota, between 2020 and 2025. All patients were classified as stage IB, IIA, or IIB based on the modified Elizabethtown classification and presented with restricted hip abduction and internal rotation. Hip pain was reported in 58.33% of cases, and 75% had a limp. VDRO was performed approximately three weeks after diagnosis. Five patients (41.67%) were older than 10 years at presentation. Outcomes were assessed at an average follow-up of 3.4 years. Radiological evaluation included the caput index (CI), epiphyseal quotient (EQ), and articulotrochanteric distance, while clinical assessment used range of motion and the Harris Hip Score. Significant improvements were observed in CI (p=0.000) and EQ (mean postoperative value 0.606; p=0.0000). Favorable results were seen in all patients with stage IB and IIA disease, and in 50% of those with stage IIB. VDRO appears to be an effective option for late-presenting Perthes disease in this age group.

Keywords: Perthes, Varus derotation, Osteotomy, Caput index, Late presenting, Epiphyseal quotient

INTRODUCTION

Perthes disease is a childhood condition characterized by temporary disruption of blood supply to the femoral head, with a course that varies widely among individuals. In certain cases, it can result in femoral head deformation, ultimately predisposing the hip to early-onset osteoarthritis, typically by the fourth decade of life.[1]

The prognosis is influenced by factors such as the patient's age at presentation, the severity of the disease, and the degree of femoral head sphericity.[2] The central objective of treatment is to prevent deformation by achieving containment of the femoral head within the acetabulum before the revascularization phase, as described in the Waldenstrom classification.[3] Effective containment helps to reduce mechanical stress on the femoral head, supports more physiologic remodeling, and preserves joint congruity between the femoral head and the acetabular socket.

Containment strategies may be conservative-utilizing methods like traction or orthotic bracing-or surgical. Among surgical options, both varus derotation osteotomy (VDRO) and Salter innominate osteotomy are widely practiced, with literature suggesting comparable long-term outcomes. However, the Salter procedure is technically more complex and carries a higher risk of neurovascular complications.[4] VDRO, on the other hand, achieves containment by creating a varus angulation and correcting

malrotation of the proximal femur. This improves acetabular coverage of the femoral head and facilitates its medial and anterior redirection, which is essential to control lateral subluxation. In children younger than six years, Perthes disease typically follows a milder course and can often be managed conservatively with measures such as traction, restricted weight-bearing, and analgesics.[5,6] For children aged between six and nine years, surgical containment of the femoral head is usually recommended.[7-11]

However, there is ongoing debate in the literature regarding the optimal management of patients older than nine years, as outcomes in this group are generally considered less favorable. Some studies, such as that by Noonan et al, suggest improved outcomes with varus osteotomy in children aged 9 to 10 years when compared to conservative treatment. In contrast, other authors, including Muirhead-Allwood et al, Catterall et al, and Bayliss et al, have reported that surgical containment in patients older than eight years yields suboptimal results.[11-13]

Perthes disease is understood to result from a transient interruption in the blood supply to the femoral head. With this in mind, we hypothesized that performing a proximal femoral osteotomy could improve the local vascular milieu and potentially promote healing, even in cases with delayed presentation.[14] Moreover, maintaining the femoral head within the acetabulum may promote improved remodeling of the necrotic but still moldable femoral head throughout the healing process. This study examines the short-term clinical and radiological results of VDRO performed in 12 children who presented with Perthes disease at the age of eight years or above.

CASE REPORT

The study was conducted at the Government Medical College, Kota, between January 2020 and January 2025. A total of 12 children (10 boys and 2 girls), with a mean age of 9.4 years, were included. All patients were classified as Stage IB, IIA, or IIB according to the modified Elizabethtown classification. Each patient underwent an open-wedge varus derotation osteotomy (VDRO). At the time of presentation, five patients (41.67%) were over 10 years of age. All participants exhibited limited hip abduction and internal rotation, with 58.33% complaining of hip pain and 75% demonstrating a limp. The average interval from diagnosis to surgical intervention was around three weeks.

Magnetic resonance imaging (MRI) was performed in all cases to exclude those in the revascularization stage. “Head at risk” signs were not used as exclusion criteria. Patients presenting with movement restriction in the affected hip were initially managed with traction for 1–2 weeks to alleviate muscle spasm and reduce synovitis. Improvement in the range of motion was assessed during this period.

Inclusion criteria

Only those who regained pain-free hip mobility were selected for inclusion and subsequently underwent proximal femoral varus derotation osteotomy (VDRO).

Exclusion criteria

Children with bilateral hip involvement, presence of hinged abduction, persistent movement restriction despite two weeks of traction. The average time between diagnosis and surgical correction remained approximately three weeks across the cohort.

Operative procedure

All surgical procedures were performed by the same senior orthopedic surgeon using a standard lateral approach with the patient in the supine position. A proximal femoral open-wedge VDRO was carried out under fluoroscopic guidance. Intraoperatively, a varus correction of 15°–20° was achieved, targeting a neck-shaft angle between 110° and 120°. Additionally, 15°–20° of external rotation correction was made at the osteotomy level. Stabilization of the osteotomy was accomplished using a pre-contoured 3.5 mm dynamic compression plate (DCP) secured with screws (Figure 3). The most proximal screw was inserted through the greater trochanter after carefully drilling through the lateral aspect of the trochanteric physis. In cases where patient cooperation was limited, immobilization with a hip spica cast was employed until radiological union of the osteotomy was confirmed. Gradual weight-bearing was introduced following adequate consolidation at the osteotomy site.

Clinical parameters

Patients were initially reviewed at 2 weeks postoperatively for suture removal (Figure 4), followed by evaluations every 2 months for the first year. Subsequent follow-ups were conducted every 6 months over the next two years. During each visit, clinical assessment included evaluation of range of motion, presence of deformity, gait pattern, limb length discrepancy, and Harris Hip Score.

Radiological parameters

Anteroposterior (AP) and lateral radiographs of both hips were reviewed for all patients. Measurements were taken from preoperative images (Figure 1) and repeated at the three-year postoperative follow-up (Figure 5). Under normal anatomical conditions, the femoral head is spherical. To assess sphericity, the femoral head was superimposed onto the most appropriate circle on both anteroposterior (AP) and lateral radiographic views to identify its anatomical center. The maximum diameter of the femoral head was noted as D, and the shortest distance (s) from the midpoint of D to the femoral head surface was measured. Measurements for D and s were taken on both views and averaged. The sphericity of the femoral head

was then quantified using the Caput Index (CI), calculated as.

CI=2s/D

This index was used to quantitatively evaluate changes in femoral head morphology over time. Radiographic analysis included calculation of the epiphyseal quotient (EQ) and articulotrochanteric distance. The EQ was determined by comparing the epiphyseal index of the affected femoral head to that of the contralateral, unaffected side. The epiphyseal index itself was derived by dividing the maximum vertical height of the epiphysis by its corresponding width. The articulotrochanteric distance was defined as the vertical measurement from the tip of the greater trochanter to a line passing through the functional center of the femoral head.

EQ values were categorized as follows.[15]

Good: >60%, Fair 40%–60%, Poor≤40%.

All measurements were performed using the AGFA computed radiography system on standardized radiographs displayed at 100% magnification (true size). Radiological and clinical parameters of the affected hip were systematically compared with those of the unaffected, contralateral side.

Treatment outcomes were classified based on combined radiological and clinical criteria as follows.[16]

Good

Radiographically, the femoral head remained spherical and fully contained within the acetabulum with an EQ >60%. Clinically, patients were asymptomatic and had a full range of hip motion.

Fair

The femoral head was congruent, with more than 80% coverage, and EQ ranged between 40% and 60%. Clinically, patients remained asymptomatic but had mild restriction in hip mobility.

Poor

The femoral head appeared irregular, with less than 80% acetabular coverage and an EQ <40%. Clinically, patients reported symptoms and showed significant limitation in hip movements.

Statistics analysis

We used IBM SPSS (Version 20.0, Armonk, NY:IBM Corp, USA) Statistics software for analysis of our results. Fischer's exact test for subject distribution, Student unpaired t-test for change in CI, Fischer's exact test for results in terms of EQ was used. The statistical significance value (P) was set to 0.05.

Radiological parameters

The average age at presentation was 9.4 years, with a range of 8 to 12 years. Of the 12 patients, five (41.67%) were older than 10 years at the time of diagnosis. All patients exhibited restricted hip abduction and internal rotation at presentation. Hip pain was reported in seven cases (58.33%), while ten patients (75%) presented with a limp. According, to the modified Elizabethtown classification, four patients (33.33%) were categorized as Stage IB, five patients (41.66%) as Stage IIA, and three patients (25%) as Stage IIB. Distribution of disease stages across different age groups showed no statistically significant variation (Fisher's exact test, p>0.05) [Table 1]. The average time to achieve union at the osteotomy site was two months, with a range from 1.5 to 3 months.

Table 1: Age and severity group (Modified Elizabethtown classification) wise distribution of the patients.

Age (in years)	Stage IB (%)	Stage IIA (%)	Stage IIB (%)	Total cases
<10	1 (6.66)	4 (33.33)	2(16.66)	7 (58.33%)
>10	3 (25)	1 (6.66)	1(6.66)	5 (41.67%)
Total	4	5	3	12

Table 2: Outcomes in affected hip in comparison to normal hips in terms of caput index.

Group	N	Mean change in caput index	SD
Normal hips	12	1.84	2.82
Affected hips	12	29.4	14.51

Table 3: Outcome in terms of postoperative epiphyseal quotient (EQ), age at presentation, and severity group.

EQ (in years)	Stage 1B			Stage IIA			Stage IIB		
	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
<10	1	0	0	3	1	0	0	1	0
>10	2	1	0	1	0	0	0	1	1

Table 4: Clinical parameters.

Clinical parameters	Operated Hip	Normal Hip
Harris hip score	93.2 (86-100)	100
Physical examination (in median degrees)		
Flexion	136º	140º
Extension	10º	10º
Abduction	35º	40º
Adduction	40º	40º
Internal rotation	40º	45º
External rotation	40º	40º
Limb length discepancy	One patient (1.5 cm)	None

At final follow-up, the caput index (CI) of both the affected and contralateral normal hips was assessed. The change in CI of the affected hip postoperatively was compared with that of the unaffected side to evaluate the effectiveness of surgical intervention. All patients classified as Stage IB and IIA demonstrated satisfactory femoral head sphericity (CI ≥75) (Figure 2). Among those in stage IIB, two out of three patients (66.7%) achieved similar outcomes. Statistical analysis revealed a highly significant improvement in CI across all stages (IB, IIA, and IIB) following surgery (p=0.000). When stratified by age, no significant difference in CI outcomes was observed, indicating that patient age at the time of surgery did not influence the extent of improvement in femoral head sphericity. The overall CI-related outcomes following VDRO are detailed in Table 2.

At the time of diagnosis, the mean epiphyseal quotient (EQ) of the affected hips was 0.395. Following VDRO, the mean EQ improved significantly to 0.606 at the three-year follow-up, with statistical analysis confirming this change as highly significant (p=0.0000). Outcome classification based on final EQ values revealed that three patients (75%) in stage IB and four patients (80%) in stage IIA achieved a good result (EQ >60%). A fair outcome (EQ between 40%–60%) was observed in one patient each from stage IB and IIA, and in two patients (66.66%) from stage IIB. The only poor outcome (EQ≤40%) was recorded in a single patient (33.34%) from stage IIB. These results are summarized in Table 3.

There was no statistically significant variation in treatment outcomes across different age groups within each disease stage (IB, IIA, and IIB) (p>0.05). Similarly, when comparing outcomes between stages of presentation (stage IB, IIA, IIB) across the two age groups (<10 years and ≥10 years), no significant differences were observed. This suggests that both age at presentation and disease stage did not independently influence the final outcome following VDRO.

Clinical parameters

At final follow-up, two patients (16.66%) reported persistent limping. Of these, one exhibited a Trendelenburg gait, while one presented with a short limb gait. Trendelenburg gait was associated with postoperative trochanteric overgrowth and a reduced articulotrochanteric distance, with a mean value of 1.0 cm.

In contrast, patients with normal gait had a higher mean articulotrochanteric distance of 1.74 cm. None of the patients experienced residual hip pain. All were able to sit cross-legged and perform squatting activities without difficulty. Mild terminal restriction of abduction and internal rotation was noted in one patient, though no fixed deformities were observed.

One patient developed a delayed deep surgical site infection, which was managed successfully with antibiotic-impregnated beads. Consequently, weight-bearing in this patient was postponed until satisfactory infection control and bone healing were achieved. The average Harris Hip Score was 93.2 (range: 86–100), indicating good to excellent functional outcomes in the majority of cases (Table 4). These positive results highlight the potential benefit of surgical intervention, especially given the uncertain prognosis when late-presenting Perthes disease is managed conservatively.

Figure 1: Preoperative radiograph of pelvis anteroposterior view showing stage IB Perthes disease.

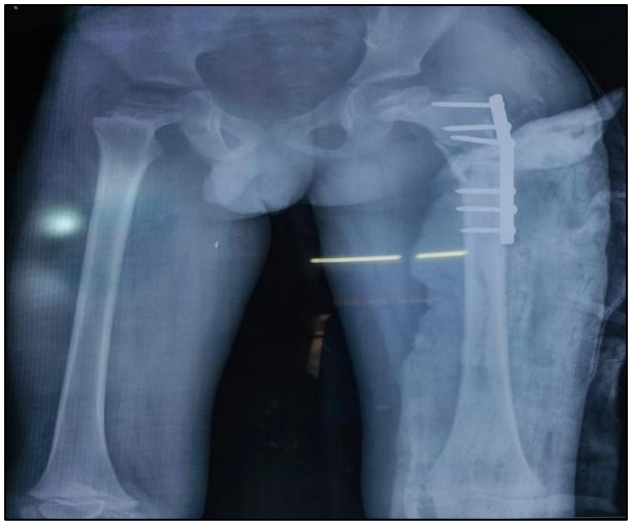

Figure 2: Immediate postoperative radiograph anteroposterior view.

Figure 3: Intraoperative photo showing VDRO with plate insitu.

Figure 4: Postoperative clinical photograph taken at the time of suture removal.

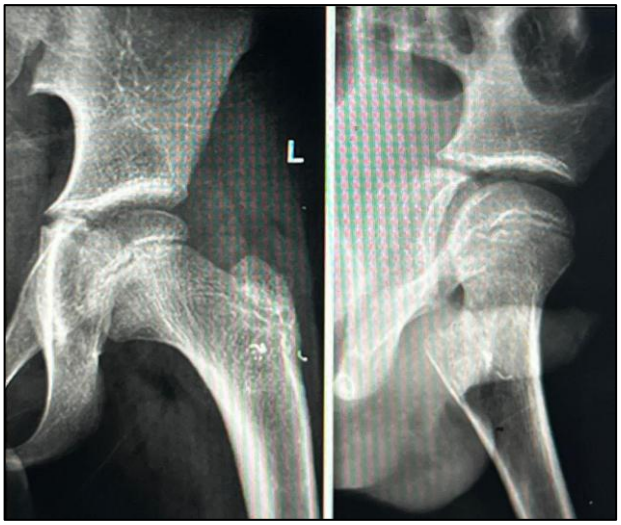

Figure 5: Final radiological assessment at 3-year follow-up shows a well-contained hip on both anteroposterior and lateral view.

DISCUSSION

Although Perthes disease has been extensively studied over the past century, it remains an idiopathic condition with a diverse natural course and outcomes that are often difficult to predict. Various classification systems have been proposed to assess and quantify the severity of the disease. In our study, we utilized the modified Elizabethtown classification, which categorizes the condition based on the radiographic stages of its progression. Joseph et al. have evaluated the relevance and utility of such classification systems in clinical practice.

Regardless of the classification system employed, the primary goal of treatment in Perthes disease is to preserve the sphericity of the femoral head, maintain epiphyseal height, and ensure long-term joint congruity-all of which are key prognostic indicators. Efforts to quantify femoral head and acetabular morphology have led to the development of several radiological indices. Among these, the moses index has been utilized by various researchers.[17] However, as noted by Dickens et al accurate application of the moses index can be challenging in cases where the femoral head lacks sufficient roundness to conform to the moses ring template.[16,18]

Recognizing this limitation, we opted not to use the moses ring method in our study, as it would not yield reliable measurements in all cases. Therefore, in our study, we utilized the caput index (CI) and epiphyseal quotient (EQ) to assess femoral head sphericity. These parameters provided reliable and reproducible measurements throughout the disease course. As noted by Shigeno et al and Evans et al femoral head deformation tends to be more pronounced on anteroposterior (AP) radiographs compared to lateral views during the fragmentation stage, highlighting the importance of careful evaluation in multiple planes.[19]

However, Cho et al emphasized that in children, femoral head deformation occurs in both the sagittal and coronal planes, underscoring the importance of multiplanar evaluation.[20] In contrast, earlier studies by Herring et al, Fredensborg et al, Heyman et al and Herndon et al, and Mose et al relied solely on anteroposterior (AP) radiographs for assessment.[17,21-23] Recognizing the limitations of a single-plane analysis, our study incorporated both AP and lateral radiographs to achieve a more comprehensive and accurate evaluation of femoral head morphology.

The average age at onset of Perthes disease in our study was 9.4 years, with a range between 8 and 12 years. This finding is consistent with previous research, where Joseph et al reported a mean onset age of 8.14 years, and Saini et al observed a mean age of 9.2 years in their cohort.[2,24] The management approach for children older than 8 years with Perthes disease remains a subject of ongoing debate. Several studies, including those by Noonan et al, Saini et al, Sponseller et al, Lloyd-Roberts et al, and McElwain et al, have reported favorable outcomes following varus derotation osteotomy (VDRO) in patients under 10 years of age, when compared to the natural course or non-containment strategies.[2,11,25-27] Muirhead-Allwood et al and Catterall et al observed that children presenting beyond the age of 7 years frequently develop lateral subluxation of the femoral head at some point during the disease. Building on this, Bayliss et al emphasized that early surgical containment in this age group is associated with a better prognosis.[12,13]

In line with these insights, our treatment strategy did not rely on the development of subluxation as a prerequisite for surgery. All patients in our cohort (aged 8–12 years and classified as stage IB, IIA, or IIB) underwent VDRO, and the outcomes were found to be satisfactory. Radiological improvements were more pronounced in stage IB and IIA patients compared to those in stage IIB. Specifically, the caput index (CI) showed significant postoperative improvement, and the clinical outcomes across stages were encouraging. In the study, trochanteric epiphysiodesis was performed as a preventive measure against trochanteric overgrowth.

Despite this, two patients developed trochanteric overgrowth, which was associated with a Trendelenburg gait and complaints of limping. Similar preventive recommendations have been made by Langenskiöld et al and Matan et al to address this concern.[28,29] Additionally, one patient in our series exhibited limb shortening, although the discrepancy was less than 2 cm. Both limb shortening and Trendelenburg gait are recognized complications of VDRO, but these typically show improvement over time as the osteotomy site remodels and the child progresses toward skeletal maturity.[30]

In this study, among the three patients who required postoperative hip spica immobilization, two developed terminal restriction of abduction and internal rotation at the hip joint. This aligns with existing literature, where the use of hip spica has been associated with an increased risk of postoperative hip stiffness.[31,32] While our findings are promising, the study is limited by the small sample size and a relatively short follow-up period. The long-term behavior of these femoral heads as patients progress toward skeletal maturity remains to be seen. We are continuing follow-up of these cases to assess the durability of radiological and functional outcomes over time.

CONCLUSION

Despite ongoing debate regarding the optimal treatment approach for late-onset Perthes disease, our study supports the potential for favorable outcomes with surgical intervention. Based on the encouraging short-term radiological and clinical results, we reaffirm the remodeling potential of the femoral head even in cases presenting at a later age. Proximal femoral varus derotation osteotomy (VDRO) appears to be a viable and effective treatment option for late-presenting Perthes hips classified as stage IB, IIA, and IIB under the modified Elizabethtown system.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Nama KG, Bansal A, Mantri N, Meena RP, Joshi S. Functional outcome of varus derotation osteotomy in late presenting Perthes disease: a case series. Int J Res Orthop 2025;11:1252-8.