Original Article

Short Term Outcome of Varus Derotation Osteotomy in Late Presenting Perthes Disease

Narendra Joshi, Soumya Shrikanta Mohapatra[1], Mahaveer Prasad Goyal, Shiv Kumar Goyal, Rakesh Kumar, Mukesh Saini

Department of Orthopaedics and Traumatology, SMS Medical College, Jaipur, Rajasthan, [1]Department of Orthopaedics, All India Institute of Medical Sciences, Bhubaneswar, Odisha, India

Abstract

Background: Untreated Perthes disease can lead to osteoarthritis by the fourth decade. The treatment is conservative for children <6 years, operative within the age group of 6–9 years. Late onset Perthes, older than 9 years or more, are notorious with the aggressive course with poor outcome. However, literature do not come to a consensus between conservative and operative management. This study evaluates the clinical and radiological outcome of varus derotation osteotomy (VDRO) in Perthes disease presenting late with age 8 years or more. **Materials and Methods:** 15 children (13 males and 2 females) with the mean age of 9.4 years belonging to modified Elizabethtown classification Stage IB, IIA, IIB treated with open wedge VDRO between 2008 and 2014 were included in this study. Seven patients (46.67%) were of >10 years of age at presentation. All patients had limitation of abduction and internal rotation. Eight patients (53.33%) had pain at the hip and 12 patients (80%) had limp. Mean time between diagnosis and corrective surgery was 3 weeks. **Results:** The evaluation was done using caput index (CI) and epiphyseal quotient (EQ) and articulotrochanteric distance radiologically, range of motion and Harris Hip Score for clinical outcome. All the measurements were carried out on pre- and postoperative X-rays after 3 years followup and compared with the contralateral normal hip. After a mean followup period of 3.4 years, we noted the statistically significant difference between pre- and postoperative values. We noted that all (100%) children in Stage IB, IIA and 50% children in Stage IIB achieved satisfactory results. There was a significant change (P = 0.000) in CI among all the patients after surgery. The final EQ after 3 years of VDRO was 0.606 and was significant (P = 0.0000). **Conclusion:** In our opinion, based on the encouraging short term radiological and clinical outcomes, VDRO may be regarded as a treatment procedure for late presenting Perthes disease in stage IB, IIA, IIB.

Keywords: *Caput index, late presenting, epiphyseal quotient, Perthes, varus derotation osteotomy*
MeSH terms: *Osteotomy, Perthes disease, osteoarthritis, hip*

Introduction

Perthes disease is a self-limiting disease in childhood with a variable course.[1] However, in some, it may lead to deformation of the femoral head and subsequently early osteoarthritis by the fourth decade. The age of presentation, grade of the disease, and the sphericity of femoral head are the prognostic factors of the disease.[2] All modes of treatment aim to prevent the head from deformity by containment of the femoral head before the revascularization stage (Waldenstrom staging)[3] sets in. The containment of femoral head within the acetabular cavity decreases the mechanical load bore by the head and allows normal development of the head and the acetabular cavity and maintains the joint congruency. The containment of the femoral head may be done by conservative means in the way of traction, braces, or operative methods. According to literature surgical containment both by varus derotation osteotomy (VDRO) and Salter innominate osteotomy have similar results; however, Salter procedure is a demanding procedure with risk of neurovascular injury.[4] VDRO involves varus angulation and correction of rotation, thereby increasing the coverage of femoral head in the acetabulum and re-directing medially and anteriorly to control the lateral displacement of the femoral head.[2]

The disease is mild in the younger age group of <6 years of age and can be managed conservatively using traction, nonweight bearing, and analgesics.[5,6] Children between 6 and 9 years need surgical containment of the femoral head.[7-11] Literatures regarding protocol of treatment for children of more than 9 years of age remain controversial. They are

How to cite this article: Joshi N, Mohapatra SS, Goyal MP, Goyal SK, Kumar R, Saini M. Short term outcome of varus derotation osteotomy in late presenting perthes disease. Indian J Orthop 2018;52:133-9.

Address for correspondence:
Dr. Soumya Shrikanta Mohapatra, Senior Resident, Department of Orthopaedics, All India Institute of Medical Sciences, Bhubaneswar, Odisha, India, and C/O: Mr. Balram Sharma, 263/1, Civil Lines, Baraf Khana, Gurgaon - 122 001, Haryana, India.
E-mail: orissatiger@gmail.com

Access this article online

Website: www.ijoonline.com

DOI: 10.4103/ortho.IJOrtho_196_16

Quick Response Code:

considered to have a poor prognosis. However, Noonan *et al*.[11] showed in their studies that surgical containment by varus osteotomy in patients between 9 and 10 years of age scored better than conservative management. However, literature is against this observation too. Muirhead-Allwood and Catterall.[12] and Bayliss *et al*.[13] showed that surgical containment in Perthes disease in whom age is more than 8 years have poor results.

We hypothesized that since Perthes is a temporary ischemic condition;[14] a proximal femoral osteotomy changes the milieu of vascular status of the femoral head and hastens its healing even in late presenting Perthes disease. Further, a containment of femoral head within the acetabulum should guide remodeling of the softened femoral head toward normalcy as it heals. We studied 15 Perthes hips that presented late at the age of 8 years or more and analyzed the short-term clinical and radiological outcomes of VDRO in them.

Materials and Methods

15 children (13 males and 2 females) of 8–12 years of age group at Stages IB, IIA, IIB (modified Elizabethtown classification) treated by VDRO between 2008 and 2014 were included in this prospective study.[15] A magnetic resonance imaging was done to rule out revascularization stage. The head at risk signs were not considered. Patients who had restriction of movements at presentation in the affected hip were treated with traction for 1–2 weeks to decrease the muscular spasm and allow synovitis to subside and any improvement in range of motion was noticed. Patients who regained painless movements were included in the study and underwent open wedge VDRO at proximal femur. Exclusion criteria included bilateral hip involvement, hinged abduction, and restriction of movements even after traction for 2 weeks. The mean time between diagnosis and corrective surgery was 3 weeks.

Operative procedure

All the patients were operated by the same senior orthopedic surgeon using a lateral approach in supine position. A proximal femoral open wedge VDRO was carried out under an image intensifier. A varus correction of 15°–20° was aimed at and the target neck shaft angle was 110°–120° intra-operatively. 15°–20° of external rotation correction was done at the osteotomy site. The osteotomy site was fixed with a molded 3.5 mm dynamic compression plate and screws. The proximal most screw in the plate was placed through the greater trochanter after drilling the lateral aspect of the trochanteric growth plate. Uncooperative subjects were immobilized with a hip spica till union of the osteotomy site. Gradual weight bearing was started after the consolidation at the osteotomy site.

Clinical parameters

Patients were followed up at 2 weeks for suture removal, then every 2 months for a year. Thereafter, they were followed up 6 monthly for the next 2 years. At each followup patients were assessed clinically for range of motion, deformity, gait, limb length discrepancy, Harris Hips Score.

Radiological parameters

Radiologically we reviewed the anteroposterior (AP) and lateral X-ray of both the hips of the patient. All the measurements were carried out on preoperative and postoperative X-rays after 3 years followup. In an ideal situation, the femoral head is round. The anatomical center of the femoral head was found out by accommodating the femoral head within an optimal sphere in both AP and lateral X-ray. The maximum diameter of the femoral head is *D*. The minimum radius (*s*) is measured from middle of *D* to the surface of the femoral head. The *D* and *s* are an average of respective values in both the views. The sphericity of the femoral head was measured using caput index (CI) ([$s \times 2$]/*D*) [Figure 1].[1]

The epiphyseal quotient (EQ) and articulotrochanteric distance were calculated from the X-rays (the EQ is the ratio of the epiphyseal index of the involved head with that of the uninvolved head. The epiphyseal index is calculated by the greatest height of the epiphysis divided by its width. The articulotrochanteric distance is the height between the tip of the greater trochanter and a line through the functional center of the head of the femur).

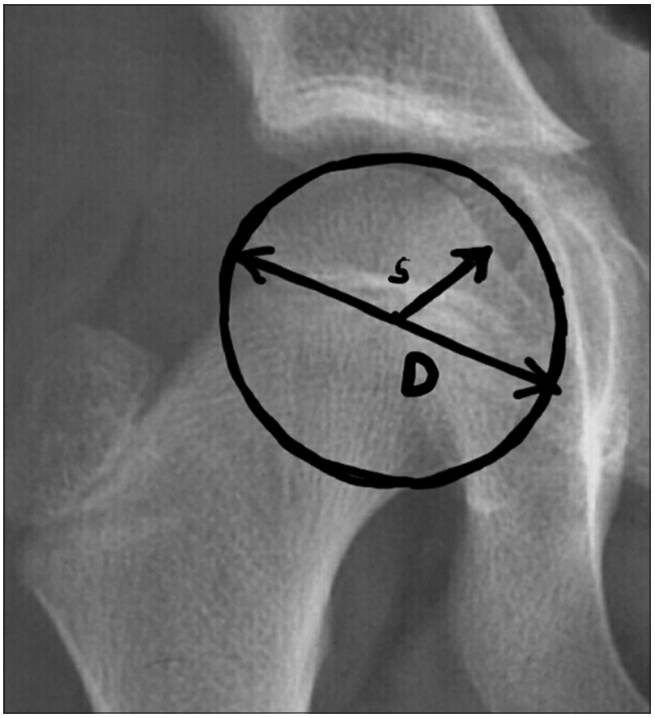

Figure 1: X-ray (right) hip joint anteroposterior view showing, "D" the maximum diameter of the head and "s" the minimum radius from the middle of D to the surface of the femoral head

The EQ was graded as good (>60%), fair (40%–60%) and poor (≤40%).[16] All the radiological parameters were calculated using the AGFA computed radiography operating system on a true size (100%) radiograph. The clinical and radiological parameters of the affected hip were compared with the contralateral normal hip.

We classified the results of treatment of hips along the following criteria:[17]

Good - radiologically: Spherical head fully contained by the acetabulum: (EQ over 60%, Clinically: No symptoms, full range of hip movements); Fair - radiologically: Caput congruent, more than 4/5 of the head covered (EQ within 40%–60%, Clinically: No symptoms, slight restriction of hip movements); Poor - radiologically: Caput irregular, more than 1/5 of the head uncovered (EQ <40%, Clinically: Symptoms present, marked restriction of hip movements).

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

Age (years)	Stage IB, cases (%)	Stage IIA, cases (%)	Stage IIB, cases (%)	Total cases
<10	2 (13.33)	4 (26.66)	2 (13.33)	8
≥10	3 (20)	2 (13.33)	2 (13.33)	7
Total	5 (33.33)	6 (40)	4 (26.66)	15

Statistics

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.

Results

Radiological parameters

The mean age at presentation was 9.4 years (range 8–12 years). Seven patients (46.67%) were of >10 years of age at presentation. All patients had the limitation of abduction and internal rotation at presentation. Eight patients (53.33%) had pain at the hip and 12 patients (80%) had limp. According to modified Elizabethtown classification 5 patients (33.33%) belonged to Stage IB,

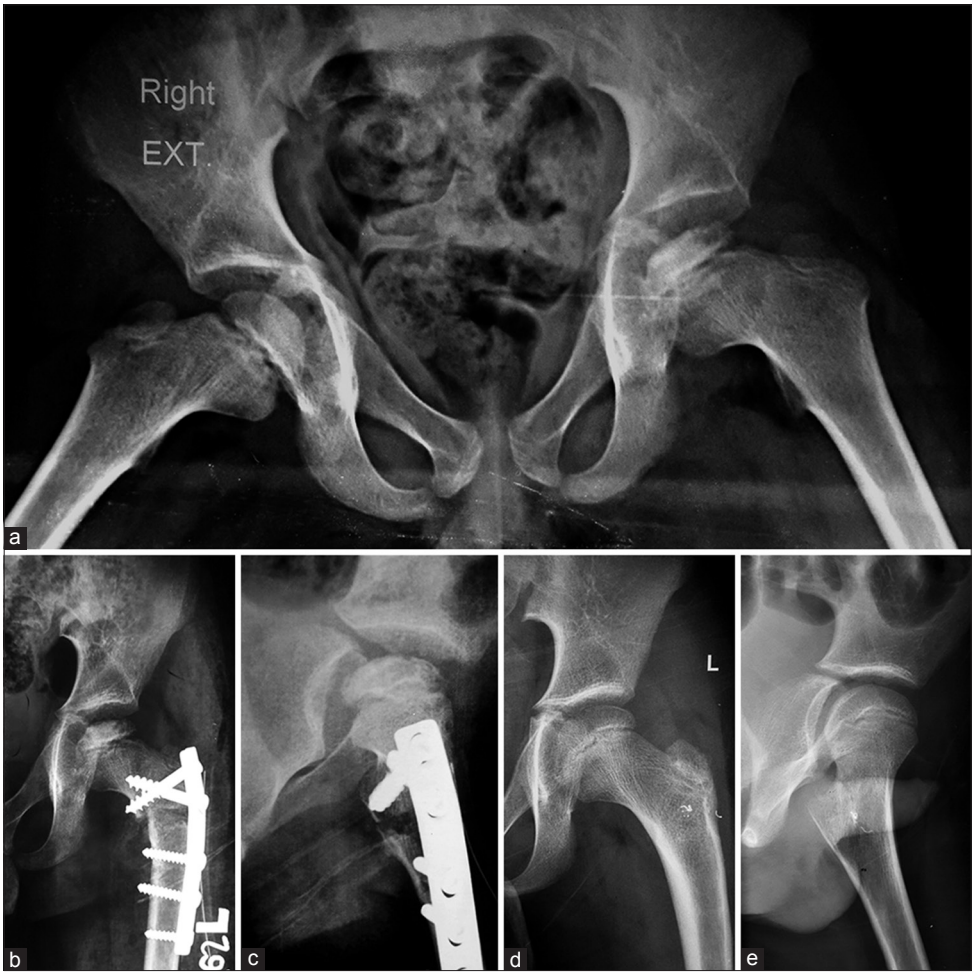

Figure 2: (a) Preoperative radiograph of pelvis anteroposterior view showing Stage IB Perthes disease (b) Immediate postoperative radiograph anteroposterior view and (c) lateral view showing VDRO and plate *in situ* (d) Final radiological outcome after 3 years anteroposterior view (e) lateral view showing well contained hip

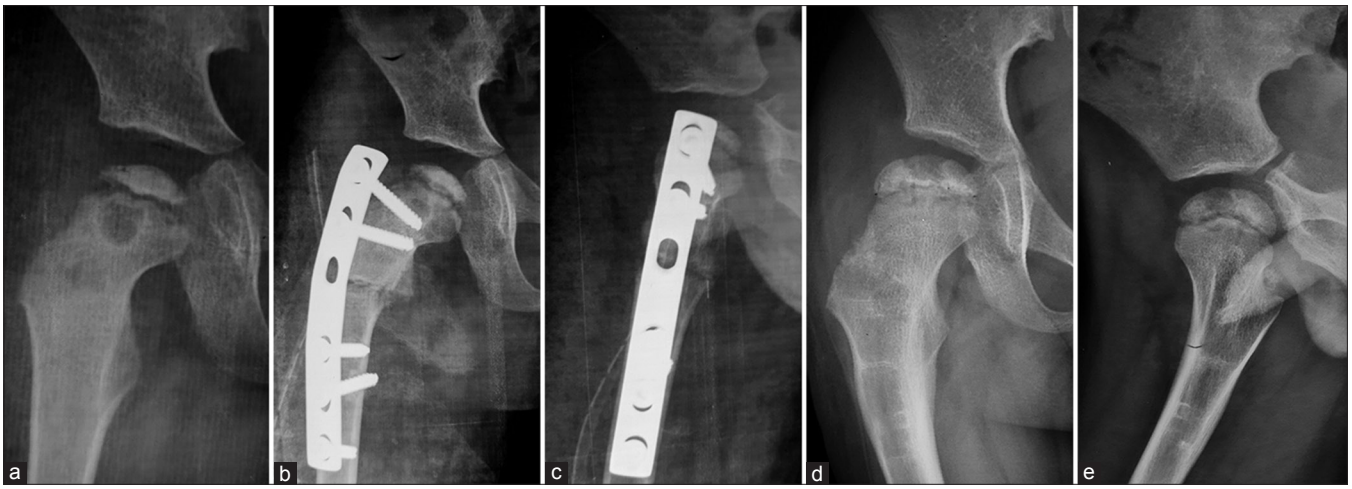

Figure 3: X-ray right hip joint anteroposterior view showing (a) Stage IIA perthes disease at the time of presentation (b) Immediate postoperative radiograph anteroposterior view (c) lateral views showing VDRO and implant in situ (d) Final radiological outcome after 3 years anteroposterior view (e) lateral view showing well contained hip

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	15	1.84	2.82
Affected hip	15	29.4	14.51

t=−7.221 with 28 degrees of freedom, P=0.0001. SD=Standard deviation

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

EQ	Stage IB			Stage IIA			Stage IIB		
(years)	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
<10	2	0	0	4	1	0	0	1	0
≥10	2	1	0	1	0	0	0	1	2

EQ=Epiphyseal quotient

Table 4: Clinical parameters

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

6 patients (40%) belonged to Stage IIA and 4 patients belonged to Stage IIB. In this study, the distribution of cases in Stage IB, IIA, IIB [Table 1] as per age had no significant variation (Fischer exact test $P > 0.05$). The mean period of the union of osteotomy site was 2 months (range 1.5-3 months).

After complete followup, the final CI of the affected and the normal hip was evaluated, and change in CI of the normal hip was compared to change in CI of the affected hip after surgery. We noted that all patients in Stage IB, IIA [Figure 2] had a satisfactory sphericity of the femoral head (CI ≥75) whereas in Stage IIB [Figure 3], only two patients (50%) achieved satisfactory results. However, there was a significant change ($P = 0.000$) in CI in Stage IB, IIA, IIB. With respect to age, there was no significant variation of outcome in terms of CI. Table 2 shows the significant outcome of VDRO in terms of CI.

The mean value of EQ at diagnosis was 0.395 and the final EQ at 3 years followup after VDRO was 0.606. The change in the EQ in the affected hip after VDRO was significant ($P = 0.0000$). According to EQ in four patients (80%) of Stage IB, five patients (83.33%) of Stage IIA had a good outcome. Similarly, one patient (20%) each in Stage IB, Stage IIA and two patients (50%) in stage IIB had a fair outcome. The only two patients having poor outcome belonged to Stage IIB (50%) [Table 3].

The outcome of cases did not vary significantly as per age group in Stage IB, IIA, IIB ($P > 0.05$). Likewise, outcome of cases did not differ significantly as per stage of presentation (Stage IB, IIA, IIB) in both the age groups (<10 and ≥10 years).

Clinical parameters

Clinically 3 patients (20%) complained of limping. Two had purely Trendelenburg gait, one patient had a short limb gait. Children with postoperative trochanteric overgrowth and lower articulotrochanteric distance (mean of 1.0 cm) were the ones associated with Trendelenburg gait, whereas the mean articulotrochanteric distance of children with normal gait was 1.74 cm. No patient reported residual pain

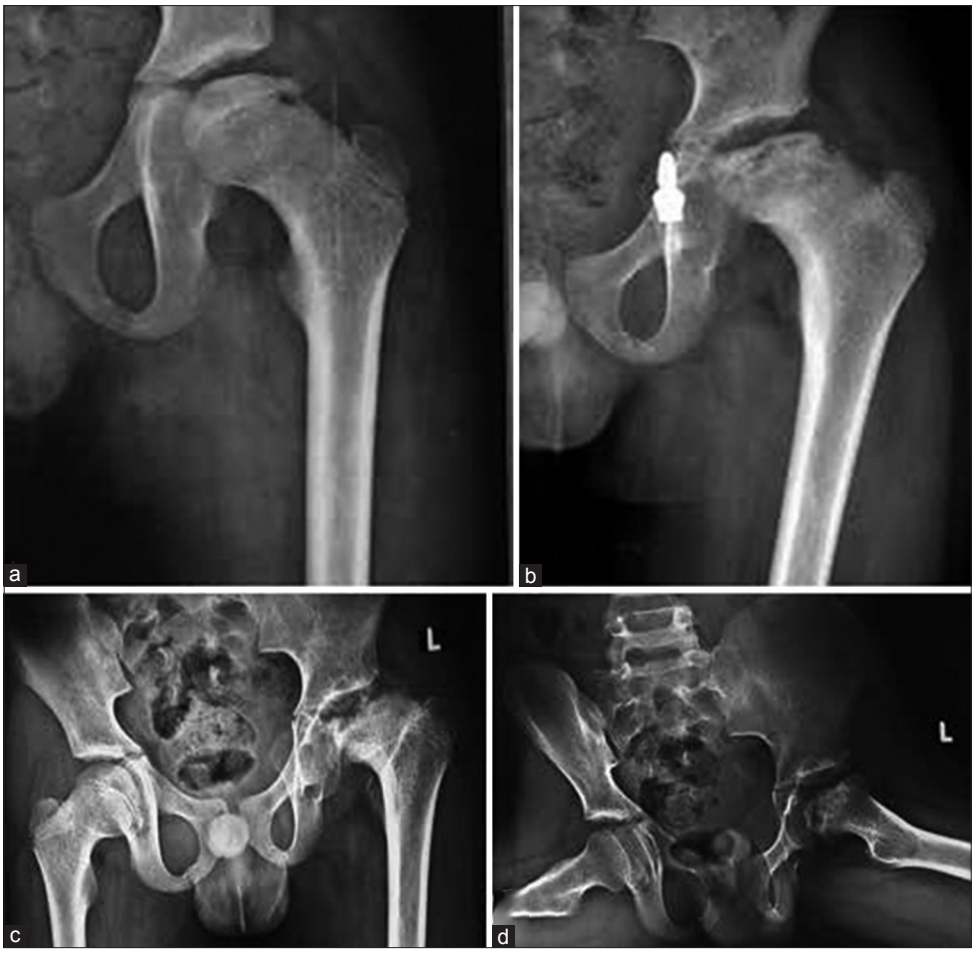

Figure 4: Natural course of a late presentation of Perthes disease (a) X-ray (left) hip joint anteroposterior view showing at presentation Stage IB perthes disease (b) After 8 months of presentation with Stage IIB (c) X-ray pelvis with both hip joints anteroposterior view and (d) frog leg lateral view showing natural course of a late presentation of Perthes disease at 15 months with total destruction of epiphysis

in the hip. All the patients could sit cross-legged and were able to squat. Two patients had the restriction of terminal abduction and internal rotation. No one had fixed deformity of the hip. One patient had delayed deep infection at the surgical site for which antibiotic beads were used. So, weight bearing was delayed in this patient. The mean Harris Hip Score was 93.2 (range 86–100) indicating satisfactory hip function [Table 4]. The above results are encouraging and leaving a late presenting perthes hip to its natural course [Figure 4] is ambiguous.

Discussion

So much has been studied on Perthes disease over the century, yet it still continues to be an idiopathic disease with variable natural history and unpredictable outcomes. The disease has been classified in various ways to quantify the severity. We used modified Elizabethtown classification in our study. This classification is based on the stages of evolution of the disease. Joseph *et al*.[17] have assessed the classification system and found the system to be prognostically useful.

Irrespective of classification systems, the treatment aims to restore the sphericity, the epiphyseal height and the congruity of the joint in the long term which is main prognostic factor. Studies to quantify the morphology of femoral head and the acetabulum continue to develop. Various authors have used Moses index[18] in their studies. However, it is not possible to measure some femoral heads using Moses index which are not circular enough to fit the outline of the Moses Ring as quoted by Dickens *et al*. In their study they found it difficult to fit moses rings to every femoral head. Foresighting this problem we avoided moses rings.[17,19] Hence, we used CI and the EQ as a measure of the sphericity in our study. Shigeno and Evans[20] stated that femoral head deformation was more significant in AP radiograph than lateral in fragmentation stage. However, Cho *et al*.[21] put forward that in children the femoral head is deformed both in the sagittal and coronal plane. Herring *et al*.,[22] Fredensborg,[23] Heyman and Herndon,[24] Mose[18] used AP radiographs only. In our study, we took into account both the AP and lateral radiographs.

The mean age at onset in our study is 9.4 years (range 8–12 years). In the study by Joseph *et al*.,[25] the age at onset was 8.14 years and by Saini *et al*.[2] it was 9.2 years.

The treatment protocol for older patients >8 years of age remains controversial. Noonan *et al*.,[11] Saini *et al*.,[2] Sponseller *et al*.,[26] Lloyd-Roberts *et al*.,[27] and McElwain *et al*.[28] in their studies concluded that the results of VDRO were satisfactory in patients younger than 10 years in comparison to the natural history or noncontainment methods. Muirhead-Allwood and Catterall[12] reported that in children who present over the age of 7 years lateral subluxation of the femoral head almost always occurs at some stage of the disease. Bayliss *et al*.[13] went a step ahead and reported that in such age groups earlier the containment of the head, better the prognosis. In such consensus, we did not wait for the subluxation of the femoral head as an indication for surgery. In our study, we obtained satisfactory outcome by VDRO for all patients of 8–12 years of age with Stage IB, IIA, IIB. Better radiological results were obtained in Stage IB and IIA patients than Stage IIB patients. CI of the affected femoral head was found to have improved after VDRO and the clinical results in both the grades were encouraging.

In this study, we performed trochanteric epiphysiodesis to prevent trochanteric overgrowth. However, two patients still had a trochanteric overgrowth and associated Trendelenburg gait with complaints of limping. Langenskiöld.[29] and Matan *et al*.[30] have recommended trochanteric epiphysiodesis to prevent trochanteric overgrowth. In our study, one patient reported shortening. However, he had a shortening of <2 cm. Both shortening and Trendelenburg gait have been reported with VDRO. However both improve with time as the osteotomy site remodels and skeletal maturity is attained.[31]

In our study, in the three patients in whom we used hip spica postoperatively two had the terminal restriction of abduction and internal rotation of the hip. The use of a hip spica postoperatively has been reported to have stiff hips.[32,33] Small size of the study group, short follow up period are the limitations of the study. However it is yet to be seen how these femoral heads behave as they attain skeletal maturity. We continue to monitor our patients to determine their long term outcomes.

Conclusion

Nevertheless, the discussion remains to which are the treatment that gives the best outcome in late onset Perthes disease. Based on the encouraging short-term radiological and clinical outcomes in this study we confirm the validity of remodeling capacity of the femoral head in late presenting perthes hips following proximal femoral osteotomy. VDRO may be regarded as a treatment procedure for late presenting perthes hips in stage IB, IIA and IIB.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Eijer H, Berg RP, Haverkamp D, Pécasse GA. Hip deformity in symptomatic adult Perthes' disease. Acta Orthop Belg 2006;72:683-92.
2. Saini R, Goyal T, Dhillon MS, Gill SS, Sudesh P, Mootha A. Outcome of varus derotation closed wedge osteotomy in Perthes disease. Acta Orthop Belg 2009;75:334-9.
3. Waldenstrom H. The first stages of coxaplana. J Bone Joint Surg 1938;20:559-66.
4. Kitakoji T, Hattori T, Kitoh H, Katoh M, Ishiguro N. Which is a better method for Perthes' disease: Femoral Varus or Salter osteotomy? Clin Orthop Relat Res 2005;430:163-70.
5. Canavese F, Dimeglio A. Perthes' disease: Prognosis in children under six years of age. J Bone Joint Surg Br 2008;90:940-5.
6. Rosenfeld SB, Herring JA, Chao JC. Legg-Calve-Peres disease: A review of cases with onset before six years of age. J Bone Joint Surg Am 2007;89:2712-22.
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 Am 2004;86-A:2121-34.
8. Kamegaya M, Saisu T, Ochiai N, Hisamitsu J, Moriya H. A paired study of Perthes' disease comparing conservative and surgical treatment. J Bone Joint Surg Br 2004;86:1176-81.
9. 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;6:751-7.
10. Poussa M, Yrjönen T, Hoikka V, Osterman K. Prognosis after conservative and operative treatment in Perthes' disease. Clin Orthop Relat Res 1993;(297):82-6.
11. Noonan KJ, Price CT, Kupiszewski SJ, Pyevich M. Results of femoral varus osteotomy in children older than 9 years of age with Perthes disease. J Pediatr Orthop 2001;21:198-204.
12. Muirhead-Allwood W, Catterall A. The treatment of Perthes' disease. The results of a trial of management. J Bone Joint Surg Br 1982;64:282-5.
13. Bayliss N, Margetts M, Taylor JF. Intertrochanteric femoral osteotomy for Legg-Calve-Peres disease. J Pediatr Orthop B 1994;3:15-7.
14. Joseph B. Management of Perthes' disease. Indian J Orthop 2015;49:10-6.
15. Joseph B, Varghese G, Mulpuri K, Narasimha Rao K, Nair NS. Natural evolution of Perthes disease: A study of 610 children under 12 years of age at disease onset. J Pediatr Orthop 2003;23:590-600.
16. Moberg A, Hansson G, Kaniklides C. Results after femoral and innominate osteotomy in Legg-Calvé-Perthes disease. Clin Orthop Relat Res 1997;334:257-64.

17. Dickens DR, Menelaus MB. The assessment of prognosis in Perthes' disease. J Bone Joint Surg Br 1978;60-B:189-94.
18. Mose K. Methods of measuring in Legg-Calvé-Perthes disease with special regard to the prognosis. Clin Orthop Relat Res 1980;150:103-9.
19. Farsetti P, Tudisco C, Caterini R, Potenza V, Ippolito E. The herring lateral pillar classification for prognosis in Perthes disease. Late results in 49 patients treated conservatively. J Bone Joint Surg Br 1995;77:739-42.
20. Shigeno Y, Evans GA. Revised arthrographic index of deformity for Perthes' disease. J Pediatr Orthop B 1996;5:44-7.
21. Cho TJ, Lee SH, Choi IH, Chung CY, Yoo WJ, Kim SJ. Femoral head deformity in Catterall groups III and IV Legg-Calvé-Perthes disease: Magnetic resonance image analysis in coronal and sagittal planes. J Pediatr Orthop 2002;22:601-6.
22. Herring JA, Neustadt JB, Williams JJ, Early JS, Browne RH. The lateral pillar classification of Legg-Calvé-Perthes disease. J Pediatr Orthop 1992;12:143-50.
23. Fredensborg N. The spherical index. A measure of the roundness of the femoral head. Acta Radiol Diagn (Stockh) 1977;18:685-8.
24. Heyman CH, Herndon CH. Legg-Perthes disease: A method for the measurement of the roentgenographic result. J Bone Joint Surg Am 1950;32 A:767-78.
25. Joseph B, Srinivas G, Thomas R. Management of Perthes disease of late onset in Southern India. The evaluation of a surgical method. J Bone Joint Surg Br 1996;78:625-30.
26. Sponseller PD, Desai SS, Millis MB. Comparison of femoral and innominate osteotomies for the treatment of Legg-Calvé-Perthes disease. J Bone Joint Surg Am 1988;70:1131-9.
27. 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 Br 1976;58:31-6.
28. McElwain JP, Regan BF, Dowling F, Fogarty E. Derotation varus osteotomy in Perthes disease. J Pediatr Orthop 1985;5:195-8.
29. Langenskiöld A. Changes in the capital growth plate and the proximal femoral metaphysis in Legg-Calvé-Perthes disease. Clin Orthop Relat Res 1980;150:110-4.
30. Matan AJ, Stevens PM, Smith JT, Santora SD. Combination trochanteric arrest and intertrochanteric osteotomy for Perthes' disease. J Pediatr Orthop 1996;16:10-4.
31. Skaggs DL, Tolo VT. Legg-Calve-Perthes disease. J Am Acad Orthop Surg 1996;4:9-16.
32. Joseph B, Chacko V, Rao BS, Hall AJ. The epidemiology of Perthes' disease in South India. Int J Epidemiol 1988;17:603-7.
33. Joseph B, Pydisetty RK. Chondrolysis and the stiff hip in Perthes' disease: An immunological study. J Pediatr Orthop 1996;16:15-9.