

Original Article

Outcome of Varus Derotation Osteotomy for Containment of Femoral Head in Advanced Perthes Disease

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Abstract

Background: Legg-Calve-Perthes (LCP) disease, or idiopathic avascular necrosis of the femoral head occurs during early childhood and is caused by impaired circulation in the femoral head. Varus derotation osteotomy (VDO) was described over half a century ago, and is now a popular method for the operative treatment of Perthes disease. **Objective:** To find out the clinical and radiological outcome of varus derotation osteotomy for containment of femoral head in advanced Perthes disease. **Materials and Methods:** This observational study was conducted in the Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka from March 2015 to September 2017. Total 20 cases of advanced Perthes disease were enrolled. Pre- and post-operative period were evaluated by interview and clinical examination by using a semi-structured questionnaire. Demographic and clinical information were recorded. All patients had a pre- and post-operative x-rays. We used visual analog scales (VAS) for scoring pain; Wiberg's central edge angle, epiphyseal extraction index, neck shaft angle and Larson (Iowa) hip score were used to assess the outcome of VDO. Comparison of continuous variables between the two groups was made with Student's t-tests. Comparison of proportions between Herring groups B and C were made with chi-square tests. $p < 0.05$ was considered as significant. All the data were compiled and sorted properly and the quantitative data were analyzed statistically by using Statistical Package for Social Sciences (SPSS 22.0). **Results:** In the present study, mean visual analog scale (VAS) score and epiphyseal extraction index (EEI) were significantly ($p < 0.001$) lower in Herring Group B in comparison to that of Group C, but mean WCEA, NSA and HLS were significantly ($p < 0.001$) higher in Herring Group B in comparison to that of Group C. **Conclusion:** Varus osteotomy gives good results in children aged 6–12 years who do not exhibit any femoral head deformity or flattening, especially those with good containment in abduction in advance Perthes disease.

Key words: Legg-Calve-Perthes; Varus derotation osteotomy; Surgical containment

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Introduction

Legg-Calve-Perthes disease (LCPD) is an aseptic, non-inflammatory, self-limited condition of the immature hip characterized by idiopathic osteonecrosis of the femoral epiphysis, followed by a subchondral fracture, fragmentation, revascularization and remodeling. It is associated with both substantial hip pain and dysfunction during the disease process as well as later in adulthood. If treatment is not initiated early in the disease process, eventual flattening and subluxation of the hip joint occurs.^{1,2} The annual incidence of LCPD ranges between 0.45/100000 reported among black children in South Africa and 21/100000 for children in Liverpool, England³ and 4.4 per 100000 for children of South India.⁴ Boys are affected four times as often as girls, and in 8–24% of patients the disease is bilateral. LCPD is usually diagnosed among children younger than 15 years of age, with a peak for onset between 5 and 8 years of age.⁵ The principle of surgical treatment is to protect the weak, fragmented femoral head from deforming forces until it reforms that are supported by most authors because it offers the advantage of early mobilization.^{6,7} Content surgery can be achieved by addressing either femoral or acetabulum or both. Lately surgery has gained ground against orthosis, especially in risk groups and children over 6 years. There are several possibilities: 1) Salter osteotomy (innominate), which is acetabulum inclination (slant and down) for a better coverage of femoral head, 2) proximal femoral varus osteotomy when femoral neck is descending for 30° for better stability of the hip and 3) the combination of the two. Varus osteotomy is preferred as an early treatment because it allows accurate centering of the femoral head into acetabulum. Derotation must be achieved only if the child has anteversion femoral head and is performed only a few degrees. Innominate Salter osteotomy is a useful treatment in Perthes disease, but recovery of postoperative hip mobility may be difficult.^{7,8}

Many researchers of different countries suggested children over the age of 6 years at onset of the disease and in whom more than half the epiphysis is avascular are likely to benefit from containment.^{9,10} The chances of retaining aspherical femoral head with minimal coxa magna are greater when containment is performed, contrary to earlier views that surgical containment has no effect on the healing process. It has been shown that the duration of the disease is significantly

shortened with a third of children bypassing the stage of fragmentation when a varus osteotomy is performed in the stage of avascular necrosis.¹⁰⁻¹³

In our country very little research work has been conducted to observe the safety and satisfactory outcome of varus derotation osteotomy (VDO) for containment of femoral head in advanced Perthes disease. So the aim of the present study was to assess the safety and satisfactory outcome of varus derotation osteotomy (VDO) for containment of femoral head in advanced Perthes disease in terms of Visual Analogue Scale (VAS), Wiberg's central edge angle, epiphyseal extraction index, neck shaft angle and Larson (Iowa) hip score. The findings may also be helpful as background information for better management of the patients suffering from advanced Perthes disease.

Materials and Methods

This observational study was carried out in the department of Orthopaedic Surgery at Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka during the period of March 2015 to September 2017. Total 20 patients aged 6 to 12 years and of both sexes attending from all corners of the country and different private hospitals of Dhaka city, with the complaints of hip pain and limping, unilateral hip involvement with Herring classification of Perthes disease¹⁴ Group B and C were included. Patients aged over 13 years and less than 6 years with Herring classification of Perthes disease group A and both hip involvements (if both hip joint VDO done then the patient may suffer from intowing gait) were excluded.

Study procedure

The patients were diagnosed clinically and radiologically. After taking informed consent, detailed history was taken and physical examination of each patient was performed. A structured case record form was used to interview and collect data. Patients were interviewed and case record form was filled in by the interviewers. Outcome of varus derotation osteotomy for containment of femoral head was measured by using Visual Analogue Scale (VAS), Wiberg's central edge angle, epiphyseal extraction index, neck shaft angle and Larson (Iowa) hip score. All the data were compiled and sorted properly and the quantitative data were analyzed statistically by using Statistical Package for Social Sciences (SPSS 22.0). The results were expressed as

percentage and mean±SD and p<0.05 was considered as significant. Comparisons of continuous variables between the two groups were made with Student's t-tests. Comparison of proportions between Herring groups B and C were made with chi-square tests.

Results

In this study among 20 cases, 10 subjects were of Herring classification of Perthes disease Group B and 10 subjects were of Group C. The mean ± SD age of Group B and Group C were 7.20 ± 1.16 and 10.05 ± 1.66 years respectively and there was statistically significant difference (<0.001) between the groups. In Group B there were 10 males and in Group C there were eight males and two females. In Group B six subjects had right hip and 4 had left hip involvement. In Group C, five subjects had right hip and five had left hip involvement. None had both hips involvement. There was no statistically significant difference between the groups. In all subjects pain was constant and of gradual onset. The mean ± SD duration of pain was 1.70 ± 0.67 and 2.70 ± 0.48 months in Group B and Group C respectively. There was statistically significant difference (<0.001) between the groups (Table I).

Assessment of the study population by different scales

Visual analog scale (VAS) score for pain

The pre-operative mean ± SD VAS score was 7.79 ± 0.95 and 9.30 ± 0.82 in Group B and C respectively. The post-operative mean ± SD VAS score was 1.70 ± 0.57 and 2.10 ± 0.99 in Group B and C respectively. In this study, the mean ± SD VAS score was significantly (p<0.001) lower in Group B in comparison to that of Group C (Table II).

Epiphyseal extraction index (EEI)

The pre-operative mean ± SD EEI was 11.22 ± 1.08 and 72.91 ± 6.20 in Group B and C respectively. The post-operative mean ± SD of EEI was 7.23 ± 0.12 and 31.55 ± 7.63 in Group B and C respectively. In this study, the mean ± SD EEI was significantly (p<0.001) lower in Group B in comparison to that of Group C (Table II).

Wiberg's central edge angle (WCEA)

The pre-operative mean ± SD WCEA was 26.01 ± 3.53 and 20.82 ± 0.69 in Group B and C respectively.

Table I: Baseline characteristics of the study population (n=20)

Parameters	Herring classification				p values
	Group B (n=10)		Group C (n=10)		
	Number	%	Number	%	
Sex					
Male	10	100	08	90	
Female	0	0	02	10	
Hip involvement					
Right	06	60	05	50	0.50
Left	04	40	05	50	
Onset of pain					
Gradual	10	100	10	100	
Sudden onset	0	0	0	0	
Characteristic of pain					
Constant	10	100	10	100	
Intermittent	0	0	0	0	
Sharp	0	0	0	0	
Duration of pain (months)	1.70 ± 0.67		2.70 ± 0.48		

The post-operative mean \pm SD WCEA was 37.66 ± 1.16 and 28.47 ± 1.64 in Group B and C respectively. In this study, the mean (\pm SD) WCEA was significantly ($p < 0.001$) higher in Group B in comparison to that of Group C (Table II).

Neck shaft angle (NSA)

The pre-operative mean \pm SD NSA was 137.57 ± 2.06 and 137.79 ± 0.71 in Group B and C respectively. The post-operative mean \pm SD NSA was 117.29 ± 1.71 and 115.97 ± 2.28 in Group B and C respectively. In this study, the post-operative mean \pm SD NSA was significantly ($p < 0.001$) higher in Group B in comparison to that of Group C.

Larson (Iowa) hip score (LHS)

The pre-operative means \pm SD LHS was 50.08 ± 7.02 and 34.00 ± 2.00 in Group B and C respectively. The post-operative mean \pm SD LHS was 90.50 ± 3.72 and 83.70 ± 9.03 in Group B and C respectively. In this study, mean \pm SD LHS was significantly higher ($p < 0.001$) in Group B in comparison to that of Group C.



Fig 1. Pre-operative radiological X-ray pelvis AP view with both hips



Fig 2. Per-operative picture

Table II: Assessment of the study population by different scale (n=20)

Score	Herring classification	Pre-operative	Post-operative	p values
VAS	Group B	7.79 ± 0.95	1.70 ± 0.57	<0.001
	Group C	9.30 ± 0.82	2.10 ± 0.99	<0.001
	p value	<0.001	<0.001	
EEI	Group B	11.22 ± 1.08	7.23 ± 0.12	<0.001
	Group C	72.91 ± 6.20	31.55 ± 7.63	<0.001
	p value	<0.001	<0.001	
WCEA	Group B	26.01 ± 3.53	37.66 ± 1.16	<0.001
	Group C	20.82 ± 0.69	28.47 ± 1.64	<0.001
	p value	<0.001	<0.001	
NSA	Group B	137.57 ± 2.06	117.29 ± 1.71	<0.001
	Group C	137.79 ± 0.71	115.97 ± 2.28	<0.001
	p value	0.254	0.010	
LHS	Group B	50.08 ± 7.02	90.50 ± 3.72	<0.001
	Group C	34.00 ± 2.00	83.70 ± 9.03	<0.001
	p value	<0.001	<0.001	



Fig 3. Post-operative X-ray both hip joints AP view at 2nd week



Fig 4. Post-operative X-ray both hip joints AP view at 6th week



Fig 5. Post-operative X-ray of both hip joints AP view at 6th month

Discussion

The present study was undertaken to observe the clinical and radiological outcome of varus derotation osteotomy for containment of femoral head in advanced Perthes disease. For this study total 20 cases of advanced Perthes disease were selected. Among them 10 subjects were of Herring classification of Perthes disease Group B and 10 subjects were of Group C. Outcome of varus derotation osteotomy for containment of femoral head were measured by using visual analogue scale (VAS), Wiberg's central edge angle, epiphyseal extraction index, neck shaft angle and Larson (Iowa) hip score. In this study sex of all the subjects in Herring groups B and C were almost similar. Statistically significant difference was observed in age of the subjects between the groups. Similar findings were observed in the studies done by the various researchers from different countries.^{2,15} In this study involvement of hip, onset and character of pain of all the subjects in both groups were almost similar and there were no statistically significant differences. But statistically significant difference was observed in duration of pain in between the groups.

In the present study mean VAS score and EEI were significantly ($p < 0.001$) lower in Herring Group B in comparison to that of Group C, but mean WCEA, NSA and HLS were significantly ($p < 0.001$) higher in Herring Group B in comparison to that of Group C. These findings are consistent with findings of other studies.^{2,12,16}

The early goal of treatment is to prevent head deformation by weight-related forces during remodeling and ossification. So containment is the widely accepted treatment principle.¹³ The main indication for operative containment treatment of Perthes disease is age < 6 years along with lateral subluxation and advanced femoral head involvement.¹⁶ The most commonly reported surgical method for the treatment of Legg–Calve–Perthes disease is proximal femoral varus osteotomy. Femoral varus osteotomy improves the intraosseous circulation, the mechanics around the proximal femoral head and subsequently the degree of femoral head sphericity after healing and it permits the regeneration of the

necrotic tissues of the femoral head. It also prevents the subluxation of the femoral head, covering it with the acetabulum. It restores joint congruity and reduces femoroacetabular impingement.¹⁷ On the other hand, the main aims of femoral valgus osteotomy are to reduce hinged abduction during remodeling and to improve the symptoms and the range of motion.¹⁸ In severely deformed femoral heads treated with femoral valgus osteotomy, greater congruency is obtained in adduction rather than in abduction. Several researchers suggested that the effectiveness of valgus osteotomy based on femoral head roundness, femoral head subluxation, and function.¹⁹ They found that this technique helped to keep the deformed femoral head inside the acetabulum during the fragmentation phase so that it could be remodeled to fit neatly inside the acetabulum. Besides this, valgus osteotomy is valuable for relieving hinged abduction after skeletal maturity has been reached.¹⁹

In this study proximal femoral varus derotation osteotomy was done because this method achieves decompression, enables dynamic treatment, does not increase intra-articular pressure and does not cause a frozen joint postoperatively with good coverage of the femoral head in the hip joint. It is also worth-noting that femoral varus osteotomy is said to have certain disadvantages or complications, such as femoral shortening, limping, excessive varus, nonunion and overgrowth and elevation of the greater trochanter. The most important predictor of leg length discrepancy (LLD) is the extent of lateral pillar involvement and no other factor (including age, sex, and treatment modality) is correlated with LLD at skeletal maturity.^{17,20} In the present study we used an open-wedge osteotomy as persistent limb shortening tends to be greater after a closed-wedge osteotomy in the older child. We did not see any progressive change in this parameter during the follow-up period, especially after hardware removal and in the younger boys, but it may decrease with time as the varus angulation of the subtrochanteric osteotomy gradually changes. Limping related to limb length discrepancy or gluteal weakness or both have generally been reported by other authors after a proximal femoral varus osteotomy. In the present study, the author encountered limping, but

the limping gradually improved within eight months after the operation, in agreement with observations reported by other authors. No complications such as delayed union, nonunion, overgrowth or elevation of the greater trochanter were encountered in the present study.

In conclusion, proximal femoral varus osteotomy gives good results in children aged 6–12 years who do not exhibit any femoral head deformity or flattening, especially those with good containment in abduction. Treatment failure is not usually due to the treatment method, it is due to technical errors, inappropriate patient selection and delayed treatment. All recently reported techniques aim to reshape the femoral head in both congruency and size to match the acetabulum and sequentially decrease the impingement, as well as to restore the normal cartilage in the weight-bearing zone of the head.

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