ORIGINAL ARTICLE

Evaluation of the Results of Operative Treatment of Hip Dysplasia in Children after the walking age

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ABSTRACT

Background: Treatment of neglected developmental dysplasia of the hip (DDH) in children after the walking age has been a challenge to the orthopedic surgeons. It is usually surgical at this age ground.
Methods: The study included 12 patients, they had been treated by different combinations of open reduction, femoral (shortening, derotation and varus) and pelvic (Salter) osteotomy. The age at the time of the operation ranged from 18 to 60 months.
Results; At the end of follow-up (a mean of 33.5 months), the overall final clinical result was excellent in 4(33%) patients, good in 6(50%) patients, fair in ONE (8%) patients and poor in one (8%) patient, satisfactory in 9(75%) patients and unsatisfactory in 3(25%) patients. The radiological result was Class I (excellent) in 6(50%) patients, Class II (good) in 3(25%), Class III (fair) in 2(10%) patients and Class IV (poor) in One (8%) pts. It was satisfactory in (3%) and unsatisfactory in 2(15%) patients.
Conclusion: We concluded that operative treatment of neglected DDH after the walking age is a technically demanding procedure but when performed properly by an experienced surgeon it gives satisfactory results.
Keywords: Developmental dysplasia of the hip, Salter; Dega; Pelvic osteotomy

INTRODUCTION

Developmental dysplasia of the hip (DDH) includes femoral head subluxation or dislocation and/or acetabular dysplasia[1]. There will always be children who reach ambulatory age with developmental dysplasia of the hip, either secondary to delayed diagnosis or failed treatment. The treatment of DDH after the walking age group is usually surgical due to the fact that the pathological changes present at this age as severe contracture of the muscles, tendons and capsule around the hip increased shallowness of the acetabulum, excessive femoral anteversion, hypertrophoid inverted labrum, excessive pulvinar, maldirected acetabulum would make closed reduction very difficult and forcible that may lead to redislocation and avascular necrosis of the femoral head. This has led many authors to advise open reduction in this age group[2]. The goals of open reduction are to: (1) safely reduce the dislocated hip and to surgically recreate normal anatomy (as closely as possible) and (2) to reorient the biomechanical relationships such that the development of degenerative hip disease is delayed or prevented. To achieve these goals various pelvic osteotomies had been used. Reshaping osteotomies have been used such as the Pemberton and Dega osteotomies, redirectional osteotomies, including the single innominate Salter osteotomy and the triple innominate Steel osteotomy, or salvage procedures when the joint is irreducible and painful such as Chiari and shelf operations[1,3,4].

The choice of the type of pelvic osteotomy depends on careful pre-operative assessment of the severity of the acetabular dysplasia and also the age of the patient at the time of treatment[5]. The remodeling capacity of the acetabulum decreases steadily in the first 6 or 7 years of life so if the acetabulum contains the femoral head poorly an attempt should be made to improve the acetabular cover[6]. Concurrent primary femoral shortening is nearly always necessary in severe cases with a high dislocation before open reduction to allow gentle reduction and avoid pressure on the head. Varus and derotational osteotomies are less required as the acetabular dysplasia is more common[6].

Undiagnosed or neglected congenital hip dislocation up to adolescent or adult life may be complicated by labral tears and early osteoarthritis. The treatment at this stage can be either a salvage procedure or hip arthroplasty[7].

The aim of this study was to assess the early clinical and radiographic results of surgical treatment of DDH after the walking age.

PATIENTS AND METHODS

Twelve patients (8 females and 4 males) with typical DDH were included. They presented with variable degrees of congenital maldevelopment of the acetabulum or the proximal part of the femur or both.

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The right hip was involved in 7(58%), while the left in 5(42%). The youngest age was 18 months and the oldest was 60 months.

According to the Tonnis classification[8] (Grade I: Capital femoral ossification center is medial to Perkins line, Grade 4: Ossification center is above superior acetabular rim). Eleven hips had a grade 4 dislocation while one had a grade 2 dislocation. Three patients had a history of breech presentation, one of them had a history of a twin pregnancy. All patients in this study were subjected to clinical examination pre-operatively and at the end of follow-up. Trendelenburg test, limping, hip stability in supine position, presence or absence of deformity and the range of motion were assessed at the last patient visit. Clinical evaluation of patients was done according to a combination of modified MacKay criteria and modified Harris hip score (Table I)[9,10]. Antero-posterior radiographs were used to measure the acetabular index (AI) and the center-edge angle (CEA) pre-operatively, post-operatively and at the end of follow-up. Changes in the femoral head as regard sphericity and the radiodensity were also looked at. Values of the acetabular index greater than 30^{o} were considered abnormal and indicative of impending dislocation. All patients in this study had an acetabular index above 30 degrees which were considered abnormal. The average acetabular index pre-operatively was 44 ± 2.5 (range, 38-49). All patients in this study had negative CEA pre-operatively, except one patient whose CE angle was 10 pre-operatively. Radiological evaluation at the end of follow-up was done according to the modified Severin radiographic criteria (Table 2)[9].

All patients in this study were subjected to one stage operative treatment in the form of: open reduction, pelvic osteotomy (Salter) and/or femoral derotation and shortening followed by a period of immobilization in a hip spica cast for about 2 months (Table 3). The plan of treatment in this work has been based on the pre-operative clinical and imaging findings, together with intra operative findings.

Surgical techniques: All operations were done under general anesthesia. Adductor tenotomy was done as a first step. Open reduction was done through a curved antero-lateral incision starting at the middle of the iliac crest 1 cm below it and extended anterior, inferior and medially up to a point where the anterior superior iliac spine becomes centered midway in the incision it was done in all patients in this study. Femoral osteotomy was done through a separate lateral femoral incision and fixed with a small fragment dynamic compression plate. It was in the form of shortening, varus and derotation. Pelvic osteotomy (Salter) was done through the anterior incision of open reduction. Salter osteotomy was done in 12 hips. Salter osteotomy was completed by a gigli saw and the graft was taken from the iliac crest.

Statistical analysis: Statistical analysis was done using SPSS version 9.0. T-test was used to analyze the relations between the obtained results and the different variables. Five percent level of significance was chosen.

RESULTS

The patients were followed both clinically and radiologically for duration of 24 months. At the end of follow-up, final clinical and radiological results were evaluated (Tables 4,5). The overall final clinical results were excellent in 4 patients (33%), good in 6(50%), fair in 1(8%) and poor in one patient (8%), satisfactory (excellent and good) in 10 patient (83%) and unsatisfactory (fair and poor) in two patients (16%). The radiological end result was Class I (excellent) in 6 patients (50%), Class II (good) in 3(25%), Class III (fair) in two (10%) and Class IV (poor) in 1 patient (8%). The results were satisfactory in 10(83%) patients and unsatisfactory in 2(25%) patients.

Table 1: Modified MacKay criteria and modified Harris hip score

Pain	40
No pain	30
Mild pain, no effect on ordinary activities	20
Moderate pain, moderate limination of ordinary activities	10
Severe pain, severe limitation of ordinary activities	0
Paint at rest	
Limp	10
No	0
Limp	
Trendelenburg sign	10
Absent	0
Present	
Stability of the hip in supine position	
Stable	10
Unstable	0
Deformity Absence of deformity Presence of deformity where any of the following is present More than 30^{O} fixed flexion deformity More than 10^{O} fixed adduction contracture More than 10^{O} fixed internal rotation in extension Limb length discrepancy more than 2 cm	10 0
The range of motion	
Full range Mild limitation Moderate limitation Severe limitation	20 15 10 0

Acetabular index (AI) improved in all hips at final evaluation. The mean pre-operative AI was 44±2,5. At the end of follow-up it was reduced to an average of 23±3 (range, 20-30) and there was statistically significant difference between the pre-operative AI and that at the final evaluation. Center edge angle (CEA) improved in all patients at the end of follow-up. The average CEA post-operatively was 31+9 (range, 10-50) and there was statistically significant difference between pre-operative CEA and that at the final evaluation. The mean age had no statistically significant effect on the final outcome.

The range of motion is calculated according to the following

	Arc of motion	**Index**	**Max. possible**
Flexion	0-45^o (45^o) 45-90^o (45^o) 90-110^o (20^o) 110-130^o (20^o)	1 0.6 0.3 0	45 27 6 0
Abduction	0-15^o (15^o) 15-20(5) 2-45(25)	0.8 0.3 0	12 15 0
External rotation in extension	0-15 Over 15^o	0.4 0	6 0
Internal rotation in extension	Any	0	0
Adduction	0-15 Over 15	0.2 0	3 0
Extension	Any	0	0
Total maximum possible value=1.00.5 Overall range of motion = Total maximum possible valuex0.05			

Table 2: Modified Severin radiographic criteria

Class I (excellent)	Normal hip with a center-edge angle > 25^o.
Class II (good)	Concentric reduction, abnormal shape of head, neck or acetabulum with CEA > 25^o.
Class III (fair)	Dysplastic hip with mal developed acetabulum roof CEA>20, no subluxation
Class IV (poor)	Subluxation (femoral head displaced cranially and laterally)
Class V (poor)	Femoral head articulates with a false acetabulum.
Class VI (poor)	Complete redislocation.

Table 3: Methods of treatment

Method	**Frequency**	**%age**
Open reduction (OR), Salter	1	08
OR, femoral osteotomy, Salter	11	92
Total	12	100

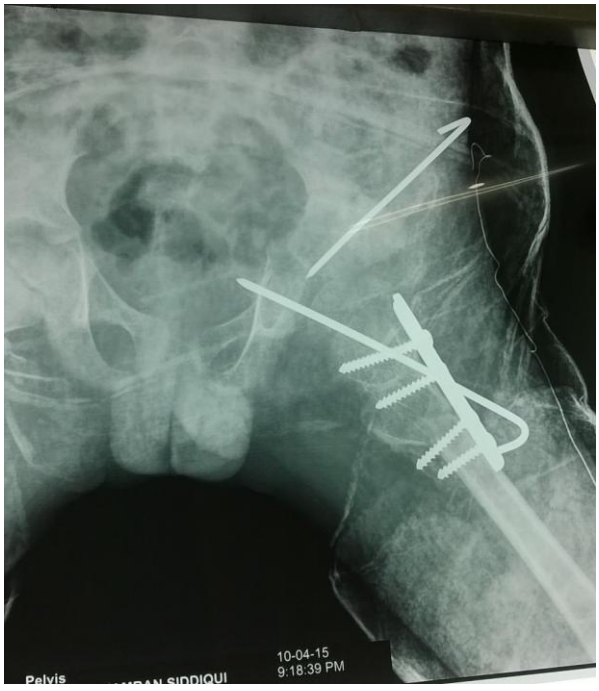
Table 4: The overall final clinical result.

Final clinical result	**Frequency**	**%age**
Excellent	4	34
Good	6	50
Fair	1	08
Poor	1	08

Table 5: The final radiological result.

Severin criteria	**Frequency**	**%age**
Class I	6	50
Class II	3	25
Class III	2	16
Class IV	1	08

Fig. 1: Immediate post op.



DISCUSSION

There always will be children who reach ambulatory age with developmental dysplasia of the hip, either secondary to delayed diagnosis or failed treatment. Once, identified, treatment of developmental dysplasia of the hip in this age group is based largely on the experience of the surgeon. Although treatment varies from closed reduction to open reduction with combined femoral and pelvic osteotomies, the goals are largely to obtain a concentric reduction without recurrence of subluxation or dislocation and without stiffness or avascular necrosis. Despite concerns that open reduction leads to joint stiffness and increased incidence of avascular necrosis, the merit of open reduction in this age group are clear. It provides visual confirmation of the adequacy of reduction while generally exposing the femoral head to less trauma. In addition, open reduction gives the surgeon the opportunity to assess the amount of acetabular dysplasia[12].

In this age group, Zionts and MacEwen[13] found that closed reduction was associated with a high rate of avascular necrosis (23.7%) and a high incidence of secondary procedures for recurrent subluxation or persistent acetabular dysplasia. They found that nearly 66% of their patients treated with traction, adductor tenotomy, and closed reduction under general anesthesia required secondary surgical procedures. Similarly Mardem-Bey- and MacEwen[14] found that 66% of children of walking age with development dysplasia of the hip who had undergone closed reduction required additional surgery, compared with 33% of such patients treated with open reduction.

Several types of pelvic osteotomies to stabilize the reduced hip in older children have been described. In this study we used Salter osteotomy. Galpin et al[15] cautioned against posterior instability with Salter osteotomy. In this study there was no resubluxation associated with Salter osteotomy. Excessive femoral neck anteversion is usually present in cases of DDH but it is clinically not apparent in these patients while the hip is in a subluxed or dislocated while the hip is in a subluxed or dislocated position, but it becomes so when the hip is:

Overall range of motion = 5 → full range of motion, =4- < 5→ mild limitation, =3 - < 4→moderate limitation, =2- < 3 → severe limitation. The ovrall clinical result is considered satisfactory when the final score is excellent (91-100) or good (81-90) and unsatisfactory when the score is either fair (71-80) or poor (less than 70) reduced at open reduction where the head is usually reduced and becomes stable after internally rotating the hip. This was found to be true in this study, as 10f hips included were found to need a femoral derotational osteotomy after reducing the femoral head in the acetabulum under vision.

Schoenecker and Strecker[16] found that femoral diaphyseal shortening to be superior to traction as an aid in operative reduction of developmental dysplasia of the hip with a decreased rate of avascular necrosis and a decreased rate of redislocation. Tonnis[8] concluded that sufficient shortening and disection of the ilopsoas tendon and rectus femoris tendon are of great importance in preventing increased pressure and ischemic necrosis. In this study, we found the femoral shortening was needed in most of cases.

A few investigators have evaluated the long term functional and radiographic outcome of a one stage operation for the treatment of DDH in children after a walking age. Most of these studies used different combinations of surgical treatment without standardizing a fixed surgical protocol for treatment as well as differences in patient selection, length of follow-up, and classification systems. This made it difficult to compare their results with ours. Galpin et al. in a study of 33 hips in 25 patients, 2 years of age or older treated by one stage surgical method, they reported satisfactory results clinically in 85% of their patients and radiographically in 75%[15]. Ryan et al[17]. reported their results of operative treatment of cases of DDH as follows: seven hips had excellent results; 11 good results, four fair results and three poor results. Eleven hips had evidence of osteonecrosis. They suggested that a one stage operative procedure consisting of open reduction, femoral shortening and pelvic osteotomy (if necessary) for previously

untreated DDH in children who are three to ten years old can result in remodeling of the acetabulum and a functional hip. Nakamura et al[18]. reported: excellent results in five joints, good in three and fair in three. In this study 10 hips (80%) had good or excellent clinical and radiological results at the final follow up.

The upper age limit for open reduction and the remaining potential for acetabular remodeling are controversial. Ok et al[19]. concluded that, if there is a high likelihood of achievinig a functionally good hip joint with biological remodeling, an open reduction is a reasonable strategy for an untreated dislocation in patients, even those older than 10 years of age. Although many authors suggest an upper age limit of 8 years for treatment, they found that joint remodling continued even after this age after a concentric reduction of the developmentally dislocated hip. In this study we found no relationship between the age at the time of treatment and the final outcome.

In the current study two patients (16%) had resubluxation of the hip. Rudolf et al[20] reported 3 of 54 hips with redislocation. Grill[21] reported 12 of 50 hips with redislocation and resubluxation. Resuzkowski and Pucher[22] reported one of 33 hips in 26 children with redislocation.

CONCLUSION

One stage surgical treatment of DDH after the walking age is an excellent method. For successful surgery, open reduction with removal of all soft tissues impairing reduction as well as optimal positioning of the head into the acetabulum together with a proper capsuloraphy should be done. Correction of acetabular dysplasia by Salter osteotomies is very important to achieve a stable reduction of the hip. Femoral shortening should be prformed in case where tight reduction is achieved to avoid pressure on the femoral head and development of AVN. Femoral derotational osteotomy is usually required with femoral shortening as most of the cases have excessive femoral neck anteversion while varus osteotomy is not necessary in every case.

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