Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-10, Issue-2 | March-April 2024
https://doi.org/10.53339/aimdr.2024.10.2.7
Page no- 58-65 | Section- Research Article (Orthopaedic Surgery)

Outcome of Surgical Treatment of Unilateral DDH Between one to Three Years Old Children

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Received: 13 October 2023
Revised: 20 December 2023
Accepted: 12 January 2024
Published: 29 February 2024

Abstract

Background: Developmental dysplasia of the hip (DDH) refers to a wide range of anatomical hip abnormalities, including fixed irreducible dislocation and subtle dysplasia. This study evaluates the clinical and radiological outcome of open surgical treatment of unilateral DDH in children aged 1 to 3 years. The aim of this study was to evaluate the outcome of open surgical treatment of unilateral DDH in children aged 1 to 3 years. **Material & Methods:** This prospective observational study evaluated the outcome of open surgical treatment of unilateral DDH in children aged 1 to 3 years, who underwent surgery at NITOR and Green Life Medical College Hospital, Dhaka from May 2019 to February 2021. The children were selected by purposive non-random sampling and met the inclusion and exclusion criteria based on their age, diagnosis, and previous treatment. The data was presented on categorical scale as frequency and corresponding percentage, while the quantitative data was presented as mean and standard deviation (SD). **Results:** The study was evaluated the outcome of open surgical treatment of unilateral DDH in 25 children aged between 1 to 3 years old (17 females and 8 males). The results showed that the treatment was effective in reducing the acetabular index and increasing the centre edge angle in most cases, with a statistically significant difference between the pre-operative and post-operative values. The final outcome was satisfactory (excellent to good) in 22 (88.00%) cases and unsatisfactory (poor) in 3 (12.00%) cases, based on both clinical and radiological criteria. The mean values of the pre-operative and post-operative acetabular index were 35.88 and 27.64, respectively, while the mean value of the post-operative centre edge angle was 22.04±4.400. **Conclusions:** It can be concluded that, young children having DDH can safely be treated with an open reduction with satisfactory result in short-term follow up.

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Keywords:- Developmental dysplasia of the hip, Open surgical treatment, Acetabulum, McKay criteria, Severin classification.

INTRODUCTION

Developmental dysplasia of the hip (DDH) refers to a wide range of anatomical hip anomalies, including fixed irreducible dislocation and subtle dysplasia.[1] It can cause long-term consequences like early-onset osteoarthritis, chronic pain, and lower quality of life.[2] The worldwide incidence of DDH ranges between 1 and 34 instances per 1000 births.[3]

The wide spectrum of incidence can be due to differing methods of diagnosis, timing of evaluation, definition of DDH, clinical experience of reporting physicians, and the genuine difference in incidence that is attributed to genetics and environmental variables.[4]

Early detection and intervention are crucial for the successful management of DDH. Several screening approaches have been proposed, including clinical examination, ultrasound, and radiography, but no one has agreed on the best strategy or diagnostic criteria.[5] All newborns should be screened for DDH using a neonatal hip screening physical examination.[6] If a physical examination is uncertain or there is an associated risk factor, ultrasonography should be done to confirm or rule out the diagnosis in children younger than 3 months, and pelvic radiography for older children.[7,8]

The clinical manifestation of DDH varies according to the child's age and severity of hip dysplasia.[9] Newborns appear with hip instability, infants have limited hip abduction on examination, and older children and adolescents present with limping and joint pain. The newborn is subjected to Ortolani's and Barlow's provocative tests. Other potential signs include the galeazzi sign, trendelenburg sign, telescopic sign, thigh or gluteal fold asymmetry, and leg length discrepancy. Bilateral dislocation results in an excessively large perineal gap and a waddling gait. Sonographic exams, X-rays, CT scans, and MRIs are also required to diagnose and predict the patient's prognosis.[10]

The remodeling capacity of the acetabulum decreases steadily in the first 6 or 7 years of life. Therefore, early intervention is recommended to improve the acetabular coverage of the femoral head.[11] In general, younger and less severe cases can be treated with non-surgical treatments, such as bracing, harnessing, or splinting; however, older and more severe cases require surgical correction, such as closed or open reduction, osteotomy, or arthroplasty.[12] The treatment goal is to achieve and maintain a safe concentric reduction of the hip in order to create an ideal environment for the development of the femoral head and acetabulum, avoid avascular necrosis (AVN), and reduce the risk of early osteoarthrosis.[13]

The present study intended to assess the outcome of open surgical treatment for unilateral DDH in children between the ages of one and three.

Objectives: The aim of this study was to evaluate the outcome of open surgical treatment of unilateral DDH in children aged 1 to 3 years.

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MATERIAL AND METHODS

The prospective observational study was conducted in the Department of Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Sher-E-Bangla Nagar, Dhaka and Green Life Medical College Hospital, Dhaka, from May 2019 to February 2021. The study population consisted of children of both sexes with clinically and radiologically diagnosed unilateral DDH. The study used purposive type of non-random sampling to select 25 children with unilateral DDH within the age group of 1 to 3 years. The inclusion criteria were: being a child within 1 to 3 years of age, having clinically diagnosed unilateral DDH, having failed or not attempted close reduction, and having guardians who gave the consent and were willing to comply with the procedure. The exclusion criteria were: having bilateral DDH, being above 3 years of age, having teratologic or acquired dislocation of hip. The subjects were briefed, consented, and prepared for the surgery. The clinical and radiological outcomes of the treatment were evaluated using the McKay criteria and Severin classification, which are widely used and accepted methods for assessing the correction and function of the hip joint in DDH patients. The data was collected by using pre-tested and validated data collection forms, after getting the institutional approval and the informed consent of the guardians. The data was analyzed by using Microsoft Excel 2010 and SPSS 20. The data was presented on categorical scale as frequency and corresponding percentage, while the quantitative data was presented as mean and standard deviation (SD).

RESULTS

This study selected 25 patients with unilateral DDH who fulfilled the inclusion criteria for this study. They were treated operatively from March 2019 to February 2021 and followed up for at least 24 weeks. The results of this series were as follows. [Table 1] showed age and gender distribution of patients, with a range of 1 to 3 years. The highest number of cases 14 (56.00%) belonged to the 2.6 to 3 years old age group, followed by the 1.6 to 2 years group 6 (24.00%), the 2.1 to 2.5 age range 3 (12.00%), and the less than 1.5 to one year group 2 (8.00%). There were more female patients 17 (68.00%) than male patients 8 (32.00%). [Table 2] showed the pre- and post-operative stability of the hip. Pre-operatively, none of the cases had a stable hip. Post-operatively, 23 (92.00%) cases achieved stability, while 2 (8,00%) cases failed to do so. [Table 3] showed the case distribution according to pre and post-operative acetabular index. The mean pre-operative acetabular index was 35.88 and the mean post-operative acetabular index was 27.64. This difference was statistically significant (p=0.002), indicating an improvement in the depth and shape of the hip socket after the surgery. [Table 4] showed the post-operative centre edge angle, which was measured in 22 cases, with a mean of 22.04±4.400. The distribution of the cases according to the centre edge angle was: 10 (45.50%) cases with 15-20 degrees, 9 (41.00%) cases with 21-26 degrees, and 3 (13.50%) cases with 27-32 degrees. This shows an improvement in the coverage and congruence of the hip joint after the surgery. [Table 5] showed the different surgical procedures performed in this study. The most common procedure was open reduction with femoral osteotomy and hip

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spica, which was done in 18 (72.00%) cases. The other procedures were open reduction with hip spica in 6 (24.00%) cases, and open reduction with both femoral and salter innominate osteotomy and hip spica in 1 (4.00%) case. This reflects the preference and expertise of the surgeon and the severity of the deformity. [Table 6] showed the pre- and post-operative range of motion of the hip. Pre-operatively, all cases had restricted range of motion. Post-operatively, 13 (52.00%) cases developed normal range of motion, while 12 (48.00%) cases remained restricted. This difference was not statistically significant (p=0.5). [Table 7] showed the post-operative complications of the hip. Only 1 (4.00%) case developed avascular necrosis of the femoral head, 1(4.00%) case had subluxation of the hip, and 2 (8.00%) cases had re-dislocation of the hip. These complications affected the stability and blood supply of the hip joint after surgery. [Table 8] showed the final outcome based on both clinical and radiological criteria. The outcome was excellent in 12 (48.00%) cases, good in 10 (40.00%) cases, and poor in 3 (12.00%) cases. This shows that most of the patients had a successful correction of the hip joint deformity after the surgery.

Table 1: Age and gender of the study population (N=25).

Variables		**Frequency**	**Percentage (%)**
Age in years	1-1.5	2	8.00
	1.6-2	6	24.00
	2.1-2.5	3	12.00
	2.6-3	14	56.00
	Total	25	100.00
	Mean±SD	2.52±.64	
Gender	Girls	17	68.00
	Boys	8	32.00

Table 2: Distribution according to pre and post-operative stability of hip (N=25).

Stability	**Pre-operative**	**Percentage (%)**	**Post-operative**	**Percentage (%)**
Yes	0	0.00	23	92.00
No	25	100.00	2	8.00
Total	25	100.00	25	100.00

Table 3: Distribution of pre-operative and post-operative Acetabular Index (AI) (N=25).

AI (Degree)	**Pre-operative (AI)**	**Percentage (%)**	**Post-operative (AI)**	**Percentage (%)**	**P value**
15-19	0	0.00	2	8.00	
20-24	1	4.00	3	12.00	
25-29	0	0.00	10	40.00	
30-34	8	32.00	8	32.00	
35-39	9	36.00	1	4.00	
40-46	7	28.00	1	4.00	
Total	25	100.00	25	100.00	
Mean±SD	35.88±5.51		27.64±6.20		0.002

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Table 4: Distribution according to Post-operative Centre Edge Angle (CEA) (N=22).

CEA (Degree)	Frequency	Percentage (%)
15-20	10	45.50
21-26	9	41.00
27-32	3	13.50
Total	22	100.00
Mean±SD	22.04±4.40	

Table 5: Distribution of cases according to operative procedure (N=25).

Operative procedure	Frequency	Percentage (%)
Open reduction with femoral osteotomy and hip spica	18	72.00
Open reduction with hip spica	6	24.00
Open reduction with femoral osteotomy and salter innominate osteotomy with hip spica	1	4.00
Total	25	100.00

Table 6: Distribution of Pre-operative and Post-operative Range of Movement (ROM) (N=25).

Range of movement (ROM)	Pre-operative	Percentage (%)	Post-operative	Percentage (%)	P-value
Decreased	25	100.00	12	48.00	
Normal	0	0.00	13	52.00	
Total	25	100.00	25	100.00	0.5ns

Table 7: Distribution of cases according to Post-operative Complications (N=25).

Complications	Frequency	Percentage (%)
Subluxation	1	4.00
Re-dislocation	2	8.00
Avascular necrosis	1	4.00
No complication	21	84.00
Total	25	100.00

Table 8: Outcome Based on both Clinical and Radiological Criteria (N=25).

Outcome	Frequency	Percentage (%)
Excellent	12	48.00
Good	10	40.00
Poor	3	12.00
Total	25	100.00

DISCUSSION

The purpose of this study was to evaluate the initial clinical and radiographic outcomes of DDH surgical treatment. All patients in this study underwent clinical examinations prior surgery and at the end of the study.

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In this study, the average age of patients who underwent surgical treatment was 2 years and 5 months, with a minimum of 1 year and a maximum of 3 years. Most of the cases (56.00%) were in the age group of 2.6 to 3 years, followed by 1.6 to 2 years (24.00%), 2.1 to 2.5 years (12.00%), and less than 1.5 years (8.00%). The age of the patient at the time of treatment influenced the outcomes of osteotomy.[14] In a study of 74 children who had one-stage surgery for unilateral DDH, the mean age at surgery was 1 year and 9 months (range, 1 year, 6 months to 2 years, 9 months).[15]

Our study included 25 patients with unilateral DDH, of whom 17 (68.00%) were girls and 8 (32.00%) were boys. Another study compared the outcomes of one-stage surgery for unilateral and bilateral Tönnis grade 4 hips in a retrospective study.[16] They found no significant difference in the age and follow-up duration of the groups (P>0.05). The unilateral group had 14 girls and 5 boys, while the bilateral group had 11 girls and no boys.

In this series there were no pre-operative stability of hip among the cases 25 (100%). But post operatively 23 cases (92%) gained stability, whereas 2 (8%) cases failed to achieve stability after operation.

This study measured the acetabular index (AI) and the centre edge angle (CEA) before and after the surgery as the main outcome indicators for DDH treatment. The mean AI decreased from 35.88±5.510 preoperatively to 27.64±6.200 postoperatively, which was a statistically significant improvement (p=0.002). The mean CEA increased from 0 preoperatively to 22.04±4.400 postoperatively (range 150-300), which showed an enhancement in the hip joint alignment and stability. Another study reported similar results in their study of one-stage surgical treatment of DDH in older children, with the mean AI decreasing from 42°±5° to 21°±2° and the mean CEA increasing from 0° to 23.5° (range 21°–26°).[17]

In this study, we performed open reduction with or without osteotomy and hip spica to reduce the hip in 25 patients with unilateral DDH. The most common procedure was open reduction with femoral osteotomy and hip spica, which was done in 18 (72.00%) cases. The other procedures were open reduction with hip spica in 6 (24.00%) cases, and open reduction with both femoral and salter innominate osteotomy and hip spica in 1 (4.00%) case.

In this study, all cases had restricted range of motion. Post-operatively, 13 (52.00%) cases developed normal range of motion, while 12 (48.00%) cases remained decreased. This difference was not statistically significant (p=0.5).

In this study, the post-operative complication of the study was avascular necrosis of femoral head (AVNFH), which occurred in only one case (4%). This is similar to the findings of another study, who reported AVNFH in 7 (11.7%) hips. They also found that AVNFH was more common in cases operated using the anterior approach than the medial approach.[18] Another complication was post-surgical re-dislocation and subluxation, which happened in two patients and resulted in poor outcomes. These complications, along with AVN, are the most important ones seen during treatment of DDH, as many studies have shown.

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In this study, the patients were followed up both clinically and radiologically. The final clinical and radiological results were evaluated at the end of the follow-up period. According to the McKay criteria, the clinical evaluation was Excellent in 12 cases (48.00%), Good in 10 (40.00%) cases, Fair in one (4.00%) and Poor in 2 (8.00%) cases. According to the Severin classification, the radiological outcome was Excellent in 12 (48.00%) cases, Good in 10 (40.00%) cases, and Fair in 3 cases (12.00%). Similar results were reported in another study of 864 hips, with 79.40% of good or excellent outcomes for clinical functional evaluation and 84.70% of good or excellent outcomes for radiographic evaluation.[19]

In this study, the overall outcome at the end of the final follow-up was satisfactory (excellent to good) in 22 (88.00%) cases and unsatisfactory (poor) in 3 (12.00%) cases. A similar result was reported by Siddiqui et al,[11] who found that the overall final clinical outcome was satisfactory in 37 (88.00%) patients and unsatisfactory in five (12.00%) patients after surgical treatment for walking age neglected DDH cases.

Limitations of the study

This study had some limitations that should be acknowledged. First, the study and follow up period were too short to assess the long-term outcome of the surgical treatment of unilateral DDH. Second, the patient's compliance with the post-operative protocol was difficult to ensure, which might have affected the results.

CONCLUSIONS

From this study it can be concluded that, young children having DDH can safely be treated with an open reduction with satisfactory result and without increasing the risk of AVN. Early diagnosis and intervention are the successful treatment of patients suffering from DDH.

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Source of Support: Nil, Conflict of Interest: None declared