ORIGINAL ARTICLE

Outcomes of Revision Open Reduction and Dega Osteotomy after Failed Surgery of Developmental Dysplasia of HIP (DDH)

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Abstract

Background: ***Developmental dysplasia of the hip (DDH) is a significant and extensively researched subject in pediatric orthopaedics. In Revision, surgery aims to overcome the reason for the failed primary treatment and improve the acetabular coverage.***

Aim: ***To evaluate the clinical and radiological outcomes of revision open reduction and Dega osteotomy after failed surgery of DDH.***

Methods: ***This research has been conducted on 20 cases (16 unilateral and four bilateral). All the patients had unsuccessful treatment for DDH. Aged ranged from two to five years, all patients underwent a comprehensive assessment, which included the collection of obstetric history, family history related to DDH, and details of any previous treatment interventions. Furthermore, a clinical examination was conducted, accompanied by radiological evaluations.***

Results: ***A highly statistically significant improvement was observed in Acetabular Index (AI) degree, radiological evaluation, and clinical evaluation by McKay between Pre-operative and Postoperative (P-value <0.001). A statistically insignificant variance was discovered among previous treatment groups regarding radiological grade, AI degree, revision surgery, postoperative AI degree, Center-Edge Angle (CE) angle, and postoperative clinical evaluation by McKay among the studied patients.***

Conclusions: ***With Dega osteotomy, we obtained normal or near-normal radiological parameters with insignificant increase in the rate of AVN in DDH cases. we support the use of the Dega acetabuloplasty in cases of revision open reduction after failed surgery of developmental dysplasia of hip, in kids age group between two to five years.***

Keywords: Dega Osteotomy; Open Reduction; Failed Surgery; Developmental Dysplasia; Hip

1. Introduction

Hip dislocation in DDH is a critical and extensively researched subject in paediatric orthopedics. Nonetheless, its management continues to pose a challenge in routine practice. The primary causes for secondary operation and unfavorable long-term results are unsuccessful reduction, avascular necrosis of the femoral head, re-dislocation, and residual dysplasia. [1,2]

The objective of management for DDH is to achieve and maintain a stable concentric reduction at the earliest opportunity .[1,2]. Nonetheless, open reduction infrequently fails, and re-dislocation occurs.[3,4] The failure to achieve a stable, concentric reduction following primary open reduction of developmental dysplasia of the hip primarily results from unsuccessful acetabular remodeling, subsequently compounded by technical errors related to insufficient soft-tissue release .[3]

The reported probability of failure or re-dislocation following open reduction via an anterolateral technique ranges from zero percent to eight percent.[5-7]

In cases of failure or redislocation, the doctor faces numerous challenges that are higher than those experienced during the first surgeries for developmental dysplasia of the hip. The 2nd line of operation choices or an alternative strategy ought to be continuously prepared prior to the operation. Revision operation for developmental dysplasia of the hip typically enhances functionality. [2, 8, 9]

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While exceptional outcomes are not likely in every revision case, the relocation of a dislocated femoral head remains essential for promoting femoral head and acetabulum development.[8]

Revision surgery aims to achieve a stable, concentric reduction of the femoral head and improve the acetabular coverage of the femoral head, with sufficient soft-tissue release.

The work aimed to assess both the clinical and radiological outcomes of performing a revision open reduction combined with a Dega osteotomy in patients who had previously undergone unsuccessful surgical treatment for DDH 9.

2. Patients and methods

This research involved 20 patients, comprising both unilateral and bilateral cases of failed management for developmental dysplasia of the hip, affecting a total of 24 hips. The participants were between 2 and 5 years old and included both genders. The monitoring duration varied between six and twelve months. Informed written consent was obtained from the cases' relatives. The research obtained approval from the Ethical Committee of Al-Azhar University hospitals and has been carried out between October 2022 and October 2024.

Exclusion criteria included individuals aged over five or under two years, those who failed nonsurgical treatment, had successful open or closed reduction, had neuromuscular or congenital disorders, and had active infections.

All patients underwent a comprehensive assessment involving detailed history taking (including obstetric history, family history of DDH, and prior treatments), clinical examination (assessing unilateral and bilateral dislocation signs), and radiological evaluation (including pelvic X-rays and measurements of the CE angle, acetabular index, and degree of dislocation). Follow-up was conducted clinically using modified McKay criteria 9 and radiologically through Severin classification .[9]

Operative techniques:

All procedures were conducted under general anaesthesia. The initial phase involved assessing hip for determining the necessity for adductor tenotomy. An adductor tenotomy has been conducted in all cases during the initial procedure. however, an additional adductor tenotomy was required for 21 hips, while 3 hips did not necessitate this procedure. Open reduction was carried out in every case included in this study.

Open Reduction:

The case was positioned supine with a roll placed under the iliac crest. A bikini incision was utilized. The subcutaneous tissue has been dissected transversely till the deep fascia was found, followed by a longitudinal incision along the medial edge of the Sartorius muscle, passing through the area located between the Sartorius and the iliopsoas. The lateral femoral cutaneous nerve has been located and carefully retracted laterally. The proximal rectus femoris has been detached and retracted laterally to expose the anterior surface of the capsule; subsequently, a T-shaped incision was made. Following the release of the iliopsoas tendon and the transverse ligament of the acetabulum, the ligamentum teres and fibro-fatty pulvinar were excised. The present investigation identified hypertrophy of the ligamentum teres in fourteen hips, whereas it was either rudimentary or absent in ten hips. Subsequent to the cleansing of the acetabulum, a challenge was made to reposition the femoral head within the acetabulum.

A transverse acetabular ligament is then sectioned, followed by cleaning and debridement of the acetabular floor with a nibbler to reveal the articular cartilage. Hypertrophied fibro-adipose tissue was identified in all patients in this series, and its removal was essential to facilitate concentric reduction of the femoral head. After the acetabulum was cleaned, an attempt was made to reduce the femoral head into the acetabulum. During the stability assessment, we encountered one of several scenarios: the hip remained stable in a neutral position, which required no additional reconstruction. This is allowing for a straightforward open reduction with capsular repair (no cases were included in this study). If reduction was unattainable due to a high femoral head or tight reduction, which could potentially lead to avascular necrosis (AVN), then femoral shortening was indicated. This was performed in five hips, with the hip being stable in internal rotation and abduction.

Femoral procedure:

The length of femoral shortening was determined intraoperatively. A transverse osteotomy immediately distal to the inferior pole of the lesser trochanter is performed. Reducing the femoral head in the acetabulum & measuring the overlap of the osteotomized segments. The amount of overlap between the proximal and distal fragments is measured. A segment corresponding to this amount is removed from the distal fragment using an oscillating saw. Fixation by small DCP started at the proximal segment. Any degree of Varus or derotation needed can be performed simultaneously in the distal fragment. Then, fixation of the distal fragment. The lateral incision of the thigh is closed in layers .[10]

An adequate capsulorrhaphy was subsequently conducted. The extensive, redundant superior pocket of the capsule must be excised through plication and overlapping of its free edges. Capsule must be tightened medially & anteriorly using the vest-over-pants fastening method. When it is too lax and redundant, a portion can be excised. With the hip dislocated, nonabsorbable sutures are passed through the medial portion of the capsule, still attached above the acetabulum. The needles are left on the sutures and held with clamps. The hip is reduced, and the supralateral segment of the capsule is brought medially and distally with a Kocher clamp. This holds the hip internally rotated and deeply seated in the acetabulum. The sutures are passed through the capsule in this position and tied. Any redundant capsule is imbricated over this closure with nonabsorbable sutures. The two halves of the iliac apophysis were sutured together along the iliac crest. Sartorius and rectus femoris muscles are re-approximated to their origins to prevent flexion contracture. The wound is closed using standard procedure .[11]

Dega osteotomy:

Begin by separating the iliac apophasis, initiating incision at the anterior superior iliac spine (ASIS) and extending it as far as feasible. A subsequent subperiosteal dissection of the tensor fascia lata (TFL) will be conducted to reveal the ilium and the complete degree of the anterolateral capsule. Expose outer tables of ilium and achieve a subperiosteal dissection towards the sciatic notch, ensuring that any hemorrhage from the bony nutrient foramen is adequately managed.

Position a broad retractor in the sciatic notch, approaching from both medial and lateral aspects to safeguard neurovascular structures. Subsequently, the release reflected the head of the rectus Femoris and traced it posteriorly. Outline the osteotomy procedure by inserting the guidewire, beginning slightly cephalad to the anterior inferior iliac spine and directing it towards the inner wall, positioned just above the triradiate cartilage. Progress guidewire under fluoroscopic guidance, utilizing both anteroposterior (AP) and obturator oblique views. This wire is going to act as a reference for determining the appropriate level and orientation of osteotomy.

The osteotomy commenced above the anterior inferior iliac spine (AIIS). It is important to maintain at least one centimeter of intact bone above the acetabulum. The incision should be initiated laterally, using an osteotome to create a cut in the ilium that is directed medially and inferiorly, following the alignment of the guidewire towards the medial aspect of the triradiate cartilage. Obtain the desired correction/coverage by levering the cortex down with a wide osteotome. Fluoroscopy was utilized to assess the correction.

Autograft wedges or allograft wedges from the iliac crest or a concurrent femoral shortening osteotomy were utilized. When the osteotomy site is being levered down to achieve the desired correction/coverage, the size of the bone graft is assessed. The wedge graft should be introduced from the lateral to the medial direction. The bone graft must be stable if wedged into the ilium, and it is crucial to place the largest piece of graft in the area that requires the most coverage. Subsequently, fluoroscopy was utilized to assess the graft and make corrections. Subsequently, the ROM is assessed. Following that, reattach the musculature and the apophysis. Next, the wound should be closed in layers.

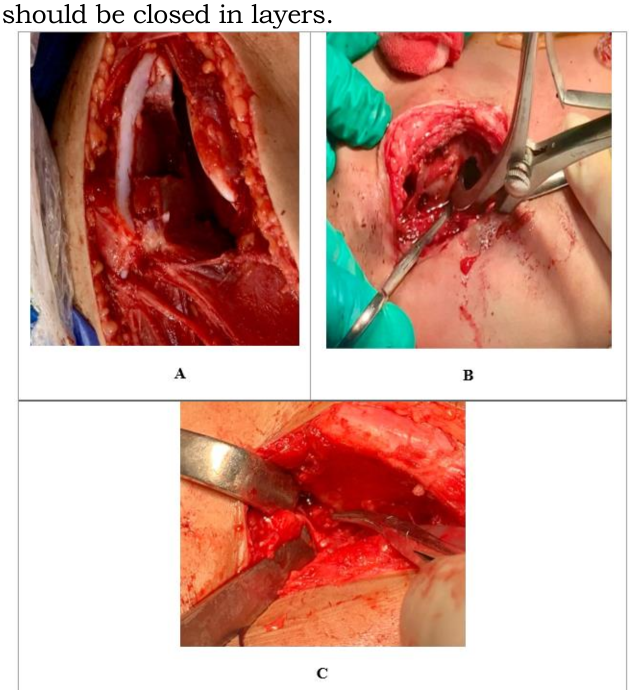

Figure 1. (A): Intraoperative view showing the splitting of the iliac apophysis during open reduction of the right hip. (B): Intraoperative view during Dega osteotomy of the right hip, showing exposure of the acetabulum and surrounding structures. (C): Intraoperative view illustrating graft positioning in Dega osteotomy of the right hip, highlighting the exposure and preparation of the acetabulum for graft placement.

Postoperative care:

The child was placed in a hip spica cast for a duration of twelve weeks.[12] A plain X-ray and a CT scan were conducted immediately after the operation. Regular follow-up with radiographs to monitor healing and hip stability (the containment of the femoral head, the regression of the acetabular index, the healing of the osteotomies, and any radiological signs of avascular necrosis of the femoral head). The average duration of monitoring was nine months, with a range of six to twelve months. After the cast was removed, weight-bearing activities, physiotherapy, and active mobilization were recommended.

Statistical analysis

Statistical analysis was conducted using SPSS version 26 (IBM Inc., Armonk, NY, USA). The quantitative variables were represented as mean and SD and compared between the two groups using an unpaired Student's t-test. The qualitative parameters have been expressed as frequency and percentage (%) and assessed with the Chi-square test or Fisher's exact test as applicable. The one-sample Kolmogorov-Smirnov test may be utilized to assess whether a variable follows a normal distribution. A two-tailed P value of less than 0.05 was deemed statistically significant.

3. Results

A total of 20 cases with 24 hips met the inclusion criteria.

The mean age was 2.85 years, with a SD of 0.75 years. Among the patients, 4 (20%) were male, while 16 (80%) were female. Laterality showed that 12 (60%) had right-sided affection, 4 (20%) left-sided, and 4 (20%) bilateral involvement. In clinical observations, four Patients (20%) demonstrated a waddling gait accompanied by restricted abduction, whereas 16 patients (80%) presented with a limping gait also characterized by limited abduction. Radiological assessments classified two hips (8.3%) as Tonnis grade II, 11 hips (45.8%) as grade III, and 11 hips (45.8%) as grade IV, with a mean acetabular index (AI) of 42.04 ± 5.19. Treatment-wise. Out of the total, 10 Patients (41.7%) underwent open reduction, while 14 Patients (58.3%) have been managed with closed reduction, which included K-wire fixation and adductor tenotomy. Post-operative AI averaged 22.08 ± 4.03, and the mean center-edge (C.E) angle was 26.71 ± 5.51. Clinical outcomes per McKay criteria two patients (10%) fair, nine Patients (45%) good, and nine Patients (45%) excellent outcomes. Radiological evaluation per Severin classified 10 Patients (41.7%) as grade I, ten cases (41.7%) as grade II, 2 cases (8.3%) as grade III, and 2 cases (8.3%) as grade IV. Additionally, 2 cases (8.3%) cases had avascular necrosis, and one case (4.2%) had residual acetabular dysplasia. (Table 1)

Table 1. General characteristic, clinical outcomes, radiological grade, AI degree and previous treatment, Radiological evaluation by Severin, and complication of the examined cases (number = 20)

		PATIENTS (NUMBER = 20, NUMBER = 24 HIPS)
AGE (YEARS)		2.85 ± 0.75
SEX	Male	4 (20%)
	Female	16 (80%)
SIDE	Right hip	12 (60.0%)
	Left hip	4 (20.0%)
	Bilateral hips	4 (20.0%)
CLINICAL	Waddling, limited abduction	4 (20.0%)
	Limbing, limited abduction	16 (80.0%)
RADIOLOGICAL TONNIS GRADE	II	2 (8.3%)
	III	11 (45.8%)
	IV	11 (45.8%)
A.I DEGREE		42.04 ± 5.19
PREVIOUS TREATMENT	Open reduction	10 (41.7%)
	Closed reduction + fixation by k wires +adductor tenotomy	14 (58.3%)
REVISION SURGERY	OR + DEGA + AT	16 (66.7%)
	OR + DEGA + AT +VDRO	5 (20.8%)
	OR + DEGA	3 (12.5%)
POST- OPERATIVE A.I DEGREE		22.08 ± 4.03
C.E ANGLE		26.71 ± 5.51
CLINICAL EVALUATION BY MCKAY	Fair	2 (10%)
	Good	9 (45%)
	Excellent	9 (45%)
RADIOLOGICAL EVALUATION BY SEVERIN	I	10 (41.7%)
	II	10 (41.7%)
	III	2 (8.3%)
	IV	2 (8.3%)
COMPLICATIONS	Avascular necrosis	2 (8.3%)
	Residual acetabular dysplasia	1 (4.2%)

Data are expressed as mean ± SD or frequency (%). OR: Open reduction, AT: Adductor tenotomy, VDRO: Varus derotational osteotomy

A highly statistically significant improvement was observed in AI degree, radiological evaluation, and clinical evaluation by McKay among Pre-operative and Post-operative (P-value <0.001). Table 2

Table 2. AI degree, radiological evaluation, and clinical evaluation by McKay pre and postoperative among the studied patients.

		PRE-OPERATIVE	POST OPERATIVE	P-VALUE
AI DEGREE		42.04 ± 5.19	22.08 ± 4.03	<0.001**
RADIOLOGICAL EVALUATION	I	0 (0.0%)	10(41.7%)	<0.001**
	II	2 (8.3%)	10 (41.7%)	
	III	11 (45.8%)	2 (8.3%)	
	IV	11 (45.8%)	2 (8.3%)	
CLINICAL EVALUATION BY MCKAY	Poor	20 (100.0%)	0 (0.0%)	<0.001**
	Fair	0 (0.0%)	2 (10%)	
	Good	0 (0.0%)	9 (45%)	
	Excellent	0 (0.0%)	9 (45%)	

Data are presented as mean ± SD or frequency (%)., P-value < 0.05: **: Highly significant as P value <0.001.

A statistically insignificant variance was discovered among previous treatment groups according to age, sex and side, clinical findings, radiological grade and AI degree, revision surgery, postoperative AI degree, CE angle, and postoperative clinical evaluation by McKay among the studied patients.

Table 3. Comparison between types of previous treatment groups regarding demographic data and characteristics, clinical findings, radiological grade, AI degree, revision surgery, postoperative AI degree, CE angle, postoperative clinical evaluation by McKay, radiological evaluation by Severin, and postoperative complications of the studied patients

		OPEN REDUCTION	CLOSED REDUCTION+ ADDUCTOR TENOTOMY	P-VALUE
AGE (YEARS)		2.94 ± 1.02	2.79 ± 0.54	0.680
SEX	Male	6 (75.0%)	10 (83.3%)	0.648
	Female	2 (25.0%)	2 (16.7%)	
SIDE	Right hip	5 (62.5%)	7 (58.3%)	0.774
	Left hip	2 (25.0%)	2 (16.6%)	
	Bilateral hips	1 (12.5%)	3 (25.0%)	
		No. = 8 patients	No. = 12 patients	
CLINICAL	Waddling, limited abduction	1 (12.5%)	3 (25.0%)	0.494
	Limbing, limited abduction	7 (87.5%)	9 (75.0%)	
		No. = 8 patients	No. = 12 patients	
RADIOLOGICAL TONNIS GRADE	II	2 (20.0%)	0 (0.0%)	0.149
	III	5 (50.0%)	6 (42.9%)	
	IV	3 (30.0%)	8 (57.1%)	
A.I DEGREE		40.9 ± 4.38	42.86 ± 5.71	0.374
REVISION SURGERY	OR + DEGA + AT	5 (50.0%)	11 (78.6%)	0.337
	OR + DEGA +	3 (30.0%)	2 (14.3%)	

	AT +VDRO			
	OR + DEGA	2 (20.0%)	1 (7.1%)	
POST- OPERATIVE A.I DEGREE		22.8 ± 3.71	21.57 ± 4.31	0.474
C.E ANGLE		25.8 ± 5.03	27.36 ± 5.93	0.507
		No. = 10 hips	No. = 14 hips	
POSTOPERATIVE CLINICAL EVALUATION BY MCKAY	Fair	1 (12.5%)	1 (8.3%)	0.337
	Good	5 (62.5%)	4 (33.3%)	
	Excellent	2 (25.0%)	7 (58.3%)	
		No. = 8 patients	No. = 12 patients	
RADIOLOGICAL EVALUATION BY SEVERIN	I	3 (30.0%)	7 (50.0%)	0.811
	II	5 (50.0%)	5 (35.7%)	
	I II	1 (10.0%)	1 (7.1%)	
	IV	1 (10.0%)	1 (7.1%)	
COMPLICATIONS	No	9 (90.0%)	12 (85.7%)	0.676
	Avascular necrosis	1 (10.0%)	1 (7.1%)	
	Residual acetabular dysplasia	0 (0.0%)	1 (7.1%)	
		No. = 10 hips	No. = 14 hips	

Data are represented as mean ± standard deviation or frequency (%). OR: Open reduction, AT: Adductor tenotomy, VDRO: Varus derotational osteotomy.

CASE PRESENTATION

Case 1:

Male child 3 yrs. old with RT side failed surgery of DDH with previous operation open reduction and femoral osteotomy treated by open reduction, adductor tenotomy, femoral shortening and derotational osteotomy and Dega osteotomy. Post-operative A.I degree was 22, C.E angle was 20. Figure 2

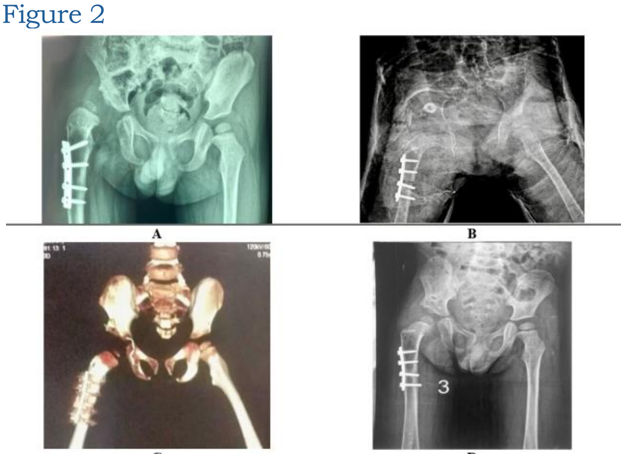

Figure 2: (A) Preoperative X-ray, (B) Immediate postoperative X ray shows pelvis in spica cast with good position of the graft , (C) Immediate postoperative C T shows good reduction of Rt hip with good position of graft in Dega osteotomy, (D) One year postoperative x ray

Case 2:

Female child 2 yrs old with bilateral failed surgery of DDH with history of previous operation of closed reduction and fixation by k wires with adductor tenotomy treated by Open reduction, Dega osteotomy and adductor tenotomy of lt side. Post- operative A.I degree was 22, and C.E angle was 30. Figure 3

Figure 3. (A) Preoperative X-ray, (B) Immediate postoperative X-ray shows LT hip fixed by temporarily k wires in hip spica cast, (C) One year postoperative X ray AP and Frog views show good reduction of both hips with mild changes of lt femoral head (AVN type 1).

4. Discussion

Patients who have previously undergone unsuccessful surgical treatment for DDH may experience several challenges and complications. The treatment Option for patients is revision surgery. This research aimed to evaluate both the clinical and radiological results of performing a revision open reduction combined with a Dega osteotomy. This research involved 20 patients, comprising both unilateral and bilateral cases of failed treatment for DDH, affecting a total of 24 hips. Dega osteotomy is an important step in the management of failed surgery of DDH to prevent residual acetabular dysplasia and to improve hip stability. Many types of acetabular osteotomies are present; either redirectional, such as Salter osteotomy, or reshaping, such as Dega and Pemberton osteotomy. All of these osteotomies are stated to be effective and safe, and the choice between them is according to the surgeon's preference .[13]

López-Carreño and colleagues[14] compared to Salter osteotomy, Dega osteotomy demonstrated significant superiority across nearly all measurements, particularly in cases under eight years of age.

In our study, we did a Dega osteotomy for all cases with failed DDH

Issin and colleagues[15] proved that OR plus Dega osteotomy is an efficient technique for regaining acetabular coverage of the femoral head. It yields improved radiographic outcomes following a five-year monitoring in cases with a mean age of twenty-five months.

Dega osteotomy offers stable graft positioning. Dega acetabuloplasty additionally provides the benefit of enhancing covering of the anterior or lateral femoral head through alterations in graft size and positioning .[11]

Dega osteotomy allows increasing the anterolateral femoral head coverage as well as the posterior coverage according to the position of the bone graft .[16]

It is technically easy; in Dega osteotomy, you can only expose the outer table, and with the aid of fluoroscopy, you can complete the osteotomy cut. No case of triradiate cartilage injury is present in this study from Dega acetabuloplasty. The intraoperative disruption of the medial wall didn't significantly impact radiographic correction during Dega osteotomy, while also demonstrating satisfactory outcomes in the management of acetabular dysplasia .[17]

After incising the iliac apophysis, Wedge et al.[18] identified minimal, if any, clinical or radiographic deformity of the iliac crest & excellent abductor strength in forty-five-year monitoring research. They do not recommend the iliac crest sparing incision as it interferes with the vascular and nerve supply to hip abductors, results in significant hemorrhage, and injures the origin of abductor muscles, causing a chronic limp. In this investigation, the iliac apophysis was incised from the anterior inferior iliac spine to nearly the midpoint of the iliac crest to expose the iliac crest down to the greater sciatic notch.

It is crucial to insert bone graft for Dega osteotomy against cortical iliac bone rather than cancellous bone for preventing graft impaction and preserve degrees of AI correction.

The study demonstrated significant improvements in both acetabular index (AI) and center-edge (CE) angle following revision surgery. Postoperative AI values showed a marked reduction compared to preoperative levels, reflecting improved acetabular morphology and femoral head coverage. Similarly, the CE angle indicative of hip stability improved significantly, aligning with previously reported results in the literature that emphasize the effectiveness of Dega osteotomy in enhancing acetabular containment.

Radiological evaluation using Severin's criteria indicated that the majority of patients achieved satisfactory outcomes, classified as Grade I or II. These findings suggest that the revision surgery effectively restored hip congruity and prevented residual dysplasia in most cases

In this study, in case No.11 some loss of acetabular index correction at the final follow up was attributed to partial resorption and collapse of the iliac crest graft (AI from 30 postoperativepostoperative to 35 at final follow up).

Coleman SS,[19] found that partial resorption of the graft and recurrence of some degree of the deformity results if the iliac bone is soft. Therefore, he advised to permit ambulation and functional use of the hip for several weeks or months prior to undertaking this osteotomy.

One significant pitfall is tying sutures for capsulorrhaphy before completing the innominate osteotomy. The significant manipulation of the distal osteotomy fragment that includes acetabulum often results in the loosening of the capsular sutures, and there is additionally a risk of undetected intraoperative redislocation .[19]

This research involves procedures that were done in five hips, including the open reduction, Dega osteotomy, and femoral osteotomy. Numerous investigations that support all-in-one-stage surgeries stated eighty-three to eighty-eight percent satisfactory results. These results are similar to the percentages in our results from this series. The remaining 19 hips underwent open reduction with Dega osteotomy without femoral osteotomy.

Wang et al.[20] indicated that developmental dysplasia of the hip with Tonnis II or III dislocation constitutes a risk factor for redislocation or residual acetabular dysplasia following the one-stage procedure. These complications can occur from abnormal pressure applied by the femoral head on the lateral edge of the acetabulum in cases with Tonnis grade II or III developmental dysplasia of the hip. Abnormal pressure results in inadequate acetabular development and increases the risk of hip redislocation or residual acetabular dysplasia post-surgery. Nevertheless, this investigation found a statistically insignificant association between the final outcome and Tonnis grading.

In this study, the average age of 2.85 ± 0.75 years was discovered to have a significant reverse relationship with patient age and final results.

Otaify [21] as well as numerous authors suggest that the outcomes of developmental dysplasia of the hip therapy are predominantly influenced by the child's age at the time of treatment.

We have two cases of femoral fracture that were managed conservatively with casting. Our research documented one case of redislocation. In this study, we reported no hip with varus deformity.

Sengar et al.[22], reported one femoral fracture in 201 cases. This was less that that was reported in this study. Sengar et al.[22], and Labaziewicz and Piskorski[23] reported one coxa vara in 201cases and one in seventy-two hips respectively that needed correction.

We found no complications regarding the dislodgement of the graft, the intra-articular extension of the osteotomy, or the premature arrest of the triradiate cartilage.

Based on the six recently published series in the English literature of revisions for failed open reductions of the hip, one hundred twenty-eight cases were stated, and eighty-eight of these cases underwent their Revision open reduction at a different institution than the one that conducted the primary open reduction .[24]

Consequently, the exact details of the original operations are mainly unidentified & there can be a predisposition to attribute failure of the 1st open reduction to technical errors during the primary operation. Preoperative risk factors were not assessed in any of these investigations, and no controls were provided for comparison. Consequently, the risk factors for failure following a technically proficient open reduction are still not well-known.

Despite the overall success, complications involving avascular necrosis (AVN) of the femoral head and residual dysplasia have been detected in a subset of patients. AVN remains a significant concern, with its occurrence linked to the extensive dissection required during revision surgeries and the compromised vascularity of the femoral head. The AVN frequency in our series is ten percent, which supports the idea that avascular necrosis rates following a closed reduction can be similar to those of an open reduction. Connolly and Weinstein[25] stated that the frequency of AVN has been estimated to range from three percent to sixty percent following the open or closed reduction of DDH. The causes for this significant variance can be attributed to the different classification/identification schemes of AVN, the potential for varying avascular necrosis rates among different age groups, and the different surgical techniques used in open reduction.

In our study, on the basis of results during surgery at the time of revision surgeries, based on radiographic findings (X-ray and CT scan) and clinical outcomes, the most prevalent causes of failure were inadequate acetabular coverage of the head following the primary operation. This is due to the fact that certain surgeons emphasize acetabular remodeling over immediate coverage through pelvic osteotomy. Sometimes, due to several factors, remodelling is not enough to cover the head, which gradually becomes lax.

So open reduction only without Dega osteotomy in kids more than 2 years is the most frequent reason for failure of the primary operation in our study. In a group of older kids with DDH, DelBello et al. compared the outcomes of OR alone, OR followed by delayed PO, and OR plus immediate PO. Exclusively. He advised that all cases over the age of eighteen months receive routine PO at the time of OR .[26]

Abnormal femoral version was the 2nd most frequent finding during revision surgeries, affecting five of the twenty cases. A portion of these cases had undergone a prior derotational osteotomy.

Based on this data, we have moved toward a more personalized operating approach suited to a kid's specific level of femoral anteversion, now performing derotational femoral osteotomy for cases with more than fifty degrees of femoral anteversion at the time of open reduction, measured by X-ray and a CT scan. Optimizing femoral version can positively influence acetabular development by directing the resultant forces of muscles surrounding the proximal femur more directly toward the acetabulum.

This study addresses a challenging scenario in managing failed DDH surgeries. By evaluating the effectiveness of revision open reduction combined with Dega osteotomy, the work provides insights into improving surgical techniques and outcomes for complex DDH cases. This could help guide surgeons in decision-making and optimizing treatment strategies for patients with persistent hip dysplasia after initial surgical failure.

The prospective nature of this investigation, nevertheless, limited our ability to obtain goal data on femoral version, thus preventing us from reaching definitive conclusions.

Limitations: Small sample size and short follow-up period.

4. Conclusion

With Dega osteotomy, we obtained normal or near normal radiological parameters with insignificant increase in the rate of AVN in DDH cases. We support the use of the Dega acetabuloplasty in cases of revision open reduction after failed surgery of developmental dysplasia of the hip, in the age group between two and five years. Age has an inverse relationship with the final outcomes. The younger the kid, the better the outcomes.

Disclosure

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Conflicts of interest

There are no conflicts of interest.

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