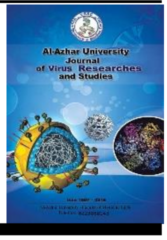
Al-Azhar University Journal

for Virus Research and Studies



Comparative Study between Salter and Dega Osteotomy's in the Management of Developmental Dysplasia of the Hip in Walking Age Children

Omar Abdul-Rahman Ahmed [1], Mahmoud Ali Ismail[1] and Amro Muhammed Reda Ali[1]

[1]Department of Orthopedic Surgery, Faculty of Medicine for Girls, Al-Azhar University.

***E-mail: demora@live.com**

Abstract

Osteotomies of the pelvis have been reported as a common method of treating DDH. Their goal is to strengthen the sacroiliac and coxofemoral joints so that the femoral head is better protected. Concentric reduction of the hip is the major goal of therapy since it improves both functional and anatomical outcomes. After receiving clearance from the local committee and obtaining informed consent, this comparative research was carried out. Between April 2021 and October 2022, 20 DDH patients aged 1 to 4 years old participated in this research. By comparison between types of fixations, patients' complications and regarding clinical evaluation there was no statistically significant difference between Salter osteotomy and Dega acetabuloplasty regarding hip stability at the final examination. For the treatment of DDH in young children, we may conclude that both the Salter and the Dega pelvic osteotomy provide equivalent results with an acceptable minimal incidence of postoperative problems. The downside of Salter osteotomy is that hardware must be removed during a second operation, which is not the case with Dega osteotomy.

Keywords: DDH, Salter, Dega, Osteotomy, acetabuloplasty.

1. Introduction

From frank dislocation to sublaxation and instability to dysplasia of the femoral head and acetabulum, all of these hip anomalies fall under the umbrella term "developmental dysplasia of the hip" (DDH). Since it more clearly captures the progressive nature of the ailment, this word has replaced the less accurate "congenital dysplasia of the hip [1]. When the hip is dislocated, the femoral head no longer articulates with the acetabulum. The severity of a dislocated hip may range from mild to severe. The femoral head is still in touch with the acetabulum, but it has been displaced from its usual position (thus the term "subluxated hip"). When a posteriorly directed, force is applied to a hip in adduction, and the femoral head is displaced beyond the acetabular borders, we say that the hip is dislocatable. Similarly, if there is just little gliding of the femoral head, the hip is considered subluxable. Changes in the size, shape, and structure of the acetabulum are all features of acetabular dysplasia.[2]. There are two distinct categories of dislocations: A normal dislocation is one that happens in a healthy newborn either before or after birth. Teratologic dislocation is a prenatal complication of neuromuscular diseases.[3]. It is essential for the proper growth of the hip that the femoral head be positioned so that it fits completely into the acetabulum. When a kid first begins to walk, the joint in the hip should be stable and the anatomy should be correct; otherwise, the hip will not grow correctly [4]. The optimum functional result may be achieved with early diagnosis and treatment. There are a variety of screening programs available for DDH detection. Some children with DDH are not diagnosed until much later in life, despite attempts to identify and treat all instances as soon as possible after birth. The diagnosis age affects the course of treatment for DDH. Surgery becomes more complex, and the functional result worsens as patients become older.[5].

2. Patients and Methods

This research compared the effectiveness of open reduction with or without femoral shortening in combination with either the Salter or Dega pelvic osteotomy for the treatment of late-presented DDH. After receiving approval from a local committee and obtaining permission from each participant, researchers at Beni-Suef University Hospital analyzed data from patients visiting the orthopedic department. Twenty DDH patients who had surgery between April 2021 and October 2022 were recruited in the research, provided they met the inclusion and exclusion criteria. Before beginning the investigation, approval was given by a human ethics commission.

2.1 Inclusion criteria

Male and female infants and babies aged 1 to 4 who have never had surgery previously are included.

2.2 Exclusion criteria

Dislocation of the hip diaphysis in children diagnosed with cerebral palsy, in children who were pre-treated surgically, and in children with teratologic, post-septic, or neuromuscular hip dislocation.

2.3 Sampling technique

Systematic random sampling was used in this investigation.

2.4 Preoperative history and clinical examination

A complete medical history was obtained, including age, gender, and adverse effects. Walk unusually. This illness runs in the family. Prior medical care obtained. Connections with oddness.

2.5 Unilateral hip involvement

Excess skin folds on one side or the other. Restricted abduction. Galeazzi's sign is there.

2.6 Bilateral dislocation

Waddling walk is definitely there. Partial abduction in both eyes. Having a perineum that is unusually broad. Lumbosacral hyperlordosis.

2.7 Radiological evaluation

All patients had a standard plain x-ray of their pelvis taken (anteroposterior view), which included imaging of both hip joints. Before and after surgery, radiographs were taken to evaluate the acetabular index and Shenton line alignment, as well as the sphericity and radiodensity of the femoral head.

2.8 Plan of treatment

In this study, the treatment strategy was developed after taking into account both preoperative clinical and imaging results as well as intraoperative data. Dega pelvic osteotomy was done on 10 hips, whereas 10 additional hips underwent open reduction, capsulorrhaphy, and salter osteotomy (high dislocation above the level of AIIS).

2.9 Preoperative plan

The need for pelvic osteotomy was determined based on clinical and radiological data.

2.10 Intraoperative plan

We investigate and decide on: The protection of the femoral head. The amount of femoral neck anteversion (reflected by the degree of internal rotation needed for femoral head reduction). Hip stability following surgical or nonsurgical reduction.

2.11 Testing the stability, we were confronted with one of the following situations

- When the hip is at rest, stability is present. A straightforward open reduction with a capsular repair is all that is needed here.
- The hip does not move when flexed or abducted. An osteotomy of the pelvis is warranted in this case.
- There is no correlation between hip abduction and internal rotation and instability. This calls for consideration of a derotational osteotomy of the upper femur.

2.12 Evaluation of the results

All patients were monitored using the modified Severin grading system in the clinic and the Severin categorization system for imaging.

Table (1): Distribution of the cases according to age (n=20).

Items	Number (%)
	Age (years)
≤2	11 (55%)
>2	9 (45%)
	Age (mean±SD)
Mean±S.D.	2.35±0.753
	Sex
Male	4 (20.0%)
Female	16 (80.0%)

Table (2): Distribution of the studied cases according to side.

Side	Number Percent
Left	11 (55.0%)
Right	8 (40.0%)
Bilateral	1 (5.0%)
Total	20 (100.0%)

2.13 Surgical technique

General anesthesia and a radiolucent operating table were used for all procedures. The patient was placed supine, with a roll beneath their ilium to slightly elevate the afflicted side. Preparation and draping were performed on the afflicted pelvic half and the complete lower leg. At first, an adductor tenotomy was done Figure .1. To perform open reduction, a curved antero-lateral (Bikini) incision was made, beginning 1 cm below the midpoint of the iliac crest and continuing anteriorly, inferiorly and medially down to the point where the anterior superior iliac spine (ASIS) became centered. This incision was called a "Bikini" Before bluntly dissecting the gap between the tensor fascia and the sartorius, it was necessary to locate and preserve the lateral femoral cutaneous nerve. This nerve was located directly medial to the space between the tensor fascia laterally and the sartorius medially. The iliac apophysis was cut all the way to the iliac crest by the scalpel. A flap consisting of the abductor muscles and tensor fascia late was excised from the lateral iliac wall after being exposed subperiosteally by a periosteal elevator. This flap was then reflected laterally toward the greater sciatic notch. Following this, the subperiosteal surface of the inner wall was exposed to the notch. The bleeding was staunched by applying a sponge to both sides of the ilium. The anterior inferior iliac spine was located and dissected to reveal the straight head of the rectus femoris (AIIS). Just below the pelvic rim, the iliopsoas tendon was located on the bottom of the muscle and separated, Figure .2. Following the cutting of the connected capsule, the reflecting head of the rectus muscle was liberated. Because the capsule was attached to the lateral wall of the ilium in some patients, the superior border of the acetabulum had to be reached by bluntly slicing the superolateral segment of the capsule. In other instances, the capsule was not attached to the lateral wall of the ilium. This was accomplished with the use of a cobb dissector or periosteal elevator. Upon discovery of the capsule, an incision was made along the acetabular border, leaving a medial margin of 4-6 mm. The transverse acetabular ligament was cut from slightly above the greater trochanter and the incision was made vertically from medial to lateral. A transverse incision was created in the capsule and joined to the first vertical incision, completing the T form. The capsules were excessively thick and enlarged in every case. The patient's hip was then flexed and externally rotated so the surgeon could see the acetabulum more clearly. The real acetabulum depth was determined by identifying and severing the ligamentum teres from the pelvic head while holding it in place using Kocher forceps. All hips had thickened ligamentum teres. Scissors cut it away from the acetabulum. When doing open reduction, the ligamentum teres provides a reliable marker for the actual acetabulum, even in patients with a well-developed fake acetabulum. To clean the acetabular floor, the hypertrophied fibrofatty tissue was nibbled away until the articular cartilage was exposed. To do a concentric reduction of the femoral head, removal of this tissue was required. The head reduction was made possible by cutting the transverse acetabular ligament. The femoral head was then required to be lowered into the acetabulum, which was the following step. The greater trochanter was flexed, abducted, and rotated medially while traction and pressure were applied. When an osteotomy was performed to shorten the femur, the patient no longer had to cram his or her head into their neck.

- Hips where the femoral head may be decreased were evaluated for stability and the requirement for contemporaneous femoral or pelvic osteotomy, or both.
- A femoral varus derotational osteotomy was recommended if the hip was stable in internal rotation and abduction.

- An osteotomy of the pelvis was performed if the hip showed stability in flexion and abduction.
- Additional femoral derotational and varus osteotomy as well as pelvic osteotomy were performed if the hip joint was stable in flexion, internal rotation, and abduction.

Concomitant femoral shortening osteotomy was recommended if femoral head reduction occurred during loading with the leg in the neutral position.

Figure 1: Adductor tenotomy.

Figure 2: Iliopsoas and straight head of rectus release.

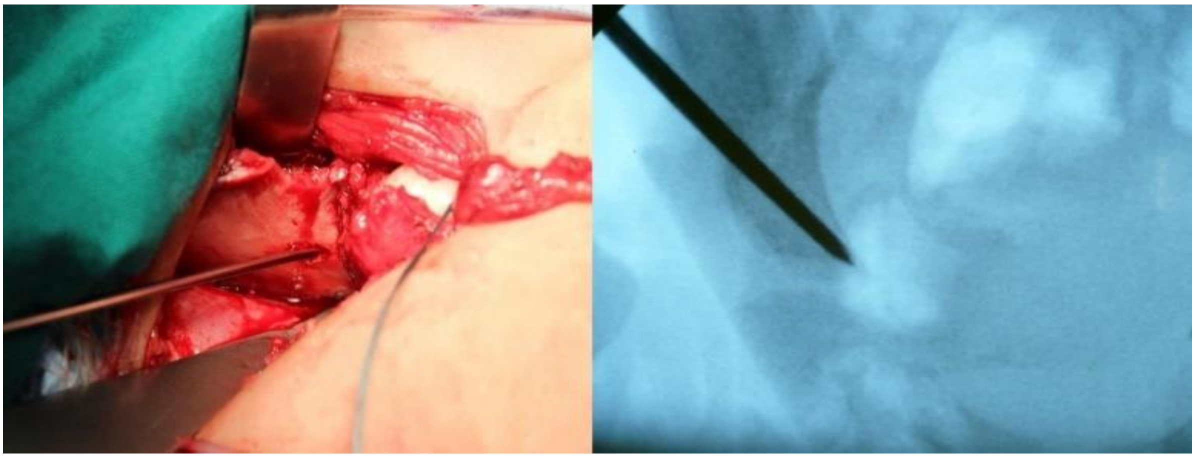


Figure 3: Guide wire insertion under fluoroscopy.

2.14 Dega osteotomy

A guidewire is inserted under fluoroscopic supervision at the most caudo-medial point of the curved marking line, as shown in the Figure. This is done to guarantee that the osteotomy exits at the right location, which is directly above the horizontal limb of the triradiate cartilage, Figure 3. A one-centimetre bone distance was carefully maintained while the outer cortex was sliced perpendicularly with a quarter-inch straight osteotome. The osteotomy was finished with a curved quarter inch osteotome that converged on the ischium's triradiate cartilage. By moving the osteotome medially and caudally, we were able to cut through the inner anterior two-thirds of the ilium via the inner table. This osteotomy begins distal to the triradiate cartilage and cuts through the outer table of the posterior ilium. The remaining two-thirds of the inner cortex as well as the posterior column have not been affected by the damage. Acetabulum lateral tilt increases with increased posterior cut extent and increased quantity of unresected inner cortex. The osteotomy site may be opened with controlled leverage by inserting a wider, half-inch curved osteotome, figure. This enables for comfortable implantation of the graft in the middle third of the osteotomy, Figure .4.

The osteotomy site was maintained by implanting two bone grafts of the appropriate size. Bone grafts are created using either the segment of the femur that is removed during femoral shortening or a bi-cortical piece of bone from the iliac crest. The femoral head should be adequately covered by the grafts, their height and location checked, and the dysplastic acetabulum corrected to the proper degree. This was evaluated using hip stability testing under fluoroscopic guidance. The grafts did not need Kirschner wires since the undamaged sciatic notch and the posteromedial cortical hinge allowed intrinsic rebound at the osteotomy site. To reduce the size of the capsule and improve the patient's range of motion, the surgeon performed a procedure called capsulorraphy. This included using non-absorbable sutures to stitch together the overlapping margins of the capsular incision. Sutures were used to join the two iliac apophyseal fragments. Both the bikini and femoral osteotomy incisions required the use of absorbable sutures to seal the subcutaneous tissue and the skin.

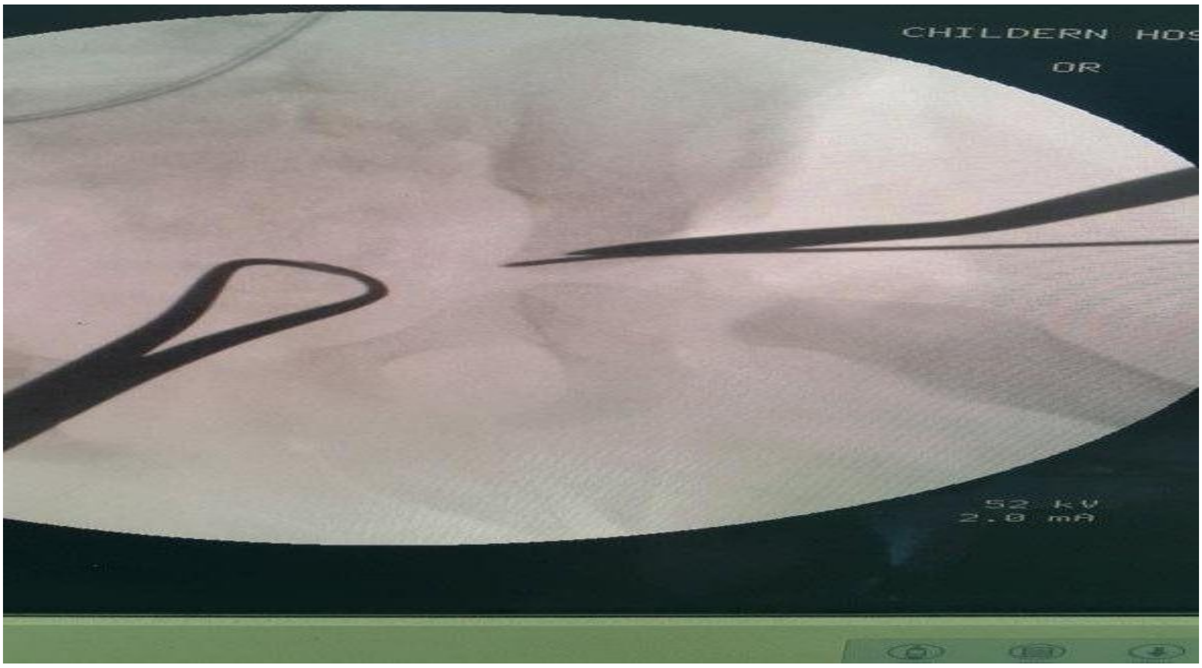


Figure 4: The triradiate cartilage is targeted by the curved osteotomy in a dega osteotomy.

2.15 Salter osteotomy

Cutting using a Gigli saw from below the notch to a position adjacent to the anterior inferior iliac spine exposes a large portion of the iliac bone and finishes the transiliac osteotomy. The osteotomy is stabilized with two K-wires. During the procedure, a radiograph was taken for quality control purposes. The youngster was positioned supine so that an anteroposterior image could be captured. The absence of diastasis and anterior displacement of the distal piece are two hallmarks of a successful osteotomy, Figure 5.

2.16 Femoral osteotomy

When varus femoral shortening and femoral derotation osteotomy were both necessary. To do this, a 5–8 cm long lateral incision was made across the proximal femur, beginning just below the greater trochanter. The vastus lateralis muscle was torn and the underlying bone was revealed. The femoral head was secured in an internal rotation and abduction position using a Kirschner wire before the femoral osteotomy. The proximal two screws were used to secure a dynamic compression plate with four holes, each measuring 3.5 mm in diameter. An oscillating saw was used to perform the femoral osteotomy, and a bone segment was removed to achieve the desired amount of shortening, which was evaluated intra-operatively by measuring the overlap between the proximal and distal parts of the femur. Taking the patient's slant into account, the distal bone fragment was turned externally such that the patella points upward. After moving the plate to its new location on the bone, the distal screws were put in. Figure shows how a little pre-bending of the plate improved its coaptation with the shaft after derotation, Figure .7.

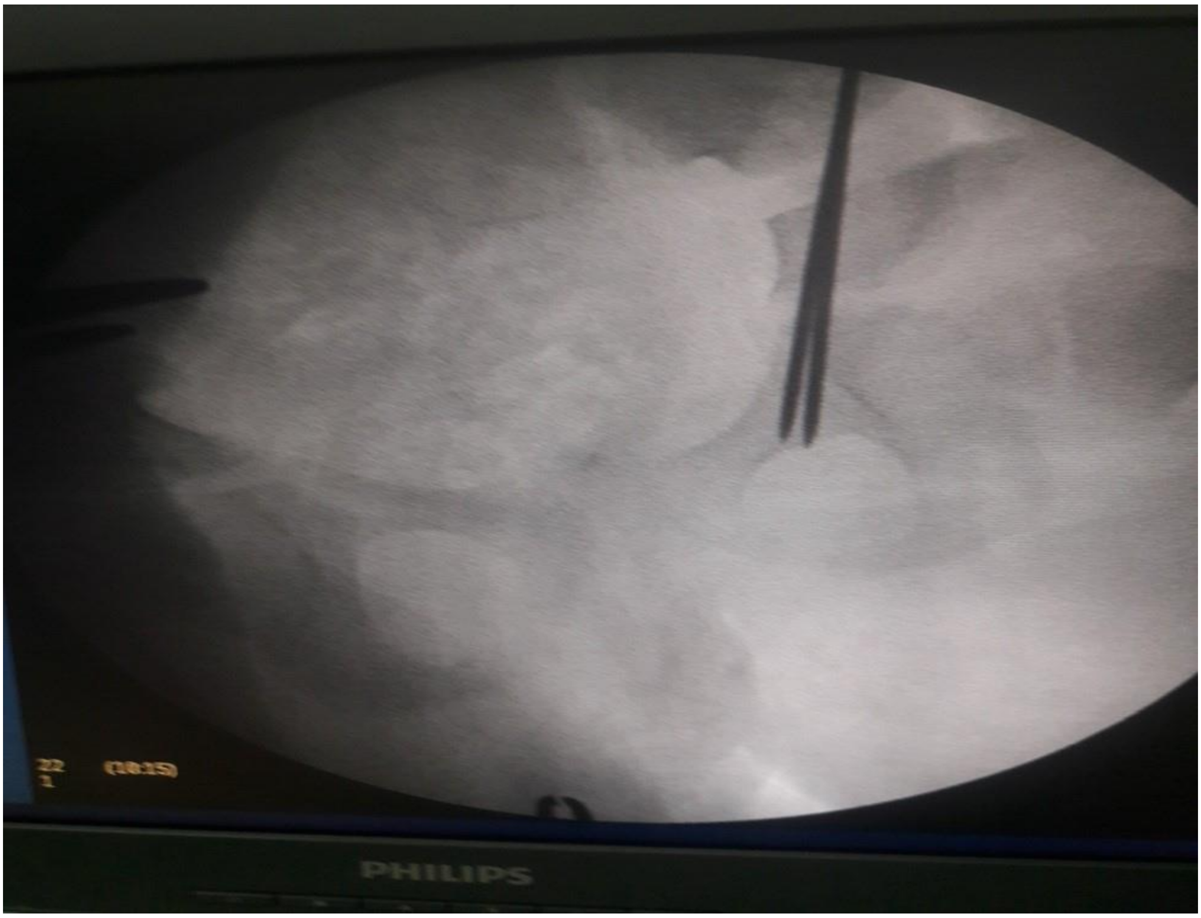


Figure 5: The salter osteotomy is stabilized with two K-wires.

Figure 6: Post-operative X-rays showing Salter.

Figure 7: Femoral osteotomy.

2.17 Post-operative care

For eight to twelve weeks, the kid is immobilized in a hip spica at an angle of 40 degrees of abduction, 60 degrees of flexion, and no rotation. After a day of observation and postoperative x-rays, the youngster was released from the hospital with detailed instructions for his mother on how to care for his cast and any potential issues that could arise. Give the mother a card with three follow-up appointments on it: the first, two weeks after the operation, to check on the wounds and the cleanliness of the cast; the second, one and a half months after the operation, to determine whether the cast needs to be changed and to take new x-rays to monitor the reduction and the healing of the pelvic osteotomy; the third, at the end of the third month of casting, to remove the cast and take new x-rays to verify the reduction. After the cast was taken off, the patient was told to start doing things like weight bearing and hydrotherapy. Following cast removal at three and six months postoperatively, X-rays were taken to check for avascular necrosis of the femoral head, containment of the head, regression of the acetabular index, healing of the osteotomies, and other postoperative complications.

2.18 Data management and statistical analysis

Information was gathered, coded, reviewed, and put into IBM SPSS version 20 (Statistical Package for the Social Sciences). We utilized raw numbers and percentages for the qualitative data, while mean, standard deviation, and ranges were used for the parametric quantitative data, and the median and interquartile range were used for the non-parametric quantitative data (IQR). The chi-square statistic will be used to test for statistical significance between the two groups on the categorical variables. The groups' differences on the scale variables will be identified using an independent t-test. To monitor shifts in scale variables, we'll use a paired t-test. The margin of error allowed was 5%, and P 0.05 = Statistically Significant.

3. Results

Table 4 displays the results of the clinical evaluations conducted on the study group, showing that the vast majority (50%) had grade 1, followed by 25% with grade 2, 20% with grade 3, and 5% with grade 4. Table 5 reveals that 15 people (75 percent) in the study group were classified as having a Severin post grade of 1. whereas just 3% had completed high school and 10% had completed grade 6. Table 6, we can see that 19 out of the 20 people examined had perfect Shenton line alignment. 5% had shattered or dislocated bones. The types of osteotomies performed on the sample population are listed below. Both the Dega and Salter types of osteotomies were present, with each accounting for 10%. Table 8 displays Al findings for the study group, showing that preoperatively, Al varied from 27.4 to 55.6, with a mean value of 35.25±5.339, and that postoperatively, Al reduced dramatically to a mean value of 23.3±35.688, with a 6 month follow up. When comparing AI results before and after surgery, there were no discernible differences between Dega and Salter. There were no complications in 85 percent of the study population, whereas 5 percent had dislocation and 5 percent suffered a distal femur fracture, as shown in the table below. Shortening and AVN were present in 1% (1 person). Statistical analysis of the data presented in the table Relation between Type of Osteotomy and clinical assessment reveals no significant differences between the groups. As can be shown in Table (11), no statistically significant differences exist between the various types of osteotomies and the Severin post-categorization. There was no statistically significant correlation between osteotomy type and Shenton line alignment, as shown in Table (12). No statistically significant differences can be seen in Table (13) between clinical assessment and AI (Follow up to 6 months). There were no statistically significant variations in the relation between age and clinical assessment, as shown in Table (14).

Table (3): Distribution of the studied cases according to Tönnis preoperative grading (n = 20).

Tönnis preoperative grading	Number (%)
Grade 2	5 (25%)
Grade 3	5 (25%)
Grade 4	10 (50.0%)
Total	20 (100%)

Table (4): Distribution of the studied sample according to patient's clinical evaluation.

Clinical Evaluation	**Number (%)**
Grade 1	10 (50.0%)
Grade 2	5 (25%)
Grade 3	4 (20%)
Grade 4	1 (5.0%)
Total	20 (100%)

Table (5): Distribution of studied sample according to patient's Severin post classification.

Severin post classification	**Number (%)**
Grade 1	15 (75%)
Grade 2	3 (15%)
Grade 6	2 (10%)
Total	20 (100%)

Table (6): Distribution of studied sample according to patient's Shenton line alignment.

Shenton line alignment	**Number (%)**
Intact	19 (95.0)
Broken Dislocated	1 (5.0%)
Total	20 (100%)

Table (7): Distribution of the studied sample according to patient's type of osteotomy.

Type of Osteotomy	**Number**	**Percent**
Dega	10 (50.0%)	
Salter	10 (50.0%)	
Total	20 (100%)	

Table (8): Comparison between two types of treatment according to patient's Al.

Al	**Pre**	**Post**	**Follow up to 6 months**
Dega (n=10)			
Range	27.4 – 55.6	14.0 – 27.7	14.0 – 32.0
Mean ± S.D.	35.31±6.521	18.97±3.327	23.88±5.601
P_1 -Value		(before vs after) <0.001*	(before vs follow up) <0.001*
P_2 -Value			(after vs follow up) 0.023*
Salter (no=10)			
Min. – Max.	27.4 – 42.0	14.10 – 31.1	12.0 – 34.0
Mean ± S.D.	35.19±3.997	19.49±5.007	22.79±5.867
P_1 - Value		(before vs after) <0.001*	(before vs follow up) <0.001*
P_2 -value			(after vs follow up) 0.189
P value between groups	0.967	0.775	0.669

Table (9): Distribution of the studied sample according to patient's complications.

Complications	**Number (%)**
No	17 (85%)
Dislocated	1 (5.0%)
Distal Femur Fracture	1 (5.0%)
AVN and shortening	1 (5.0%)
Total	20 (100 %)

Table (10): Comparison between Type of Osteotomy and clinical evaluation after the operation.

Clinical Evaluation	Type of Osteotomy		X^2	P
	Dega	Salter		
	No. (%)	No. (%)		
Grade 1	7 (70.0%)	7 (70.0%)	1.333	0.721
Grade 2	1 (10.0%)	0 (0.0%)		
Grade 3	1 (10.0%)	2 (20.0%)		
Grade 4	1 (10.0%)	1 (10.0%)		
Total	10 (100%)	10 (100%)		

Table (11): Comparison between Type of Osteotomy and Severin post classification.

Severin post classification	Type of Osteotomy		X^2	P
	Dega	Salter		
	No. (%)	No. (%)		
Grade 1	8 (80.0%)	7 (70.0%)	0.400	0.818
Grade 2	1 (10.0%)	2 (20.0%)		
Grade 6	1 (10.0%)	1 (10.0%)		
Total	10 (100%)	10 (100%)		

Table (12): Relation between Type of Osteotomy and Shenton line alignment.

Shenton line alignment	Type of Osteotomy		X^2	P
	Dega	Salter		
	No. (%)	No. (%)		
Intact	9 (90.0%)	9 (90.0%)	0.000	1.000
Broken Dislocated	1 (10.0%)	1 (10.0%)		
Total	10 (100%)	10 (100%)		

Table (13): Relation between clinical evaluation and AI (Follow up to 6 months).

AI (Follow up to 6 months)	Clinical Evaluation				F	P
	Grade 1	Grade 2	Grade 3	Grade 4		
Dega (n=10)	n=7	n=1	n=1	n=1		
Range	14.0 – 29.0	24.86	22.0	24.0	0.421	0.887
Mean ± S.D.	23.59±5.162	24.86	22.0	24.0		
Salter (n=10)	n=7	n=0	n=2	n=1		
Range	12.0 – 29.0	----	19.0 – 34.0	25	0.233	0.524
Mean ± S.D.	21.52±5.899	------	25.17±5.947	25		

Table (14): Relation between age and clinical evaluation.

Clinical Evaluation	Age		X^2	P
	≤2 years (n=11)	>2 years (n=9)		
	No. %	No. %		
Dega (n=10)	n=7	n=3		
Grade 1	5(71.4%)	2 (66.7%)	3.2	0.362
Grade 2	1(14.3%)	0 (0%)		
Grade 3	1 (14.3%)	0 (0%)		
Grade 4	0 (0%)	1 (33.3%)		
Salter (n=10)	n=4	n=6		
Grade 1	3(75%)	4 (66.7%)	0.774	0.679
Grade 2	0 (0%)	0 (0%)		
Grade 3	1(25%)	1 (16.7%)		
Grade 4	0 (0%)	1 (16.7%)		

4. Discussion

To improve the likelihood of a satisfactory functional and anatomical result, therapy focuses on achieving concentric reduction of the hip. Patients with DDH are best treated when still infants. If this is not an option, therapy should begin as soon as feasible and no later than the age of 4 to make the most of the hip joint's innate remodeling potential.[6]. It might be challenging to treat developmental hip dysplasia (DDH) in children who are mobile. A consistent concentric reduction in older children requires an osteotomy of the pelvis. The Dega osteotomy is one of the most often performed osteotomies in the therapy of DDH, even though considerable uncertainty still surrounds the actual technique. Dega and his employees are to blame for a lot of this muddle. Dega's original osteotomy was briefly noted in a 1964 German paper, but it wasn't until 1969 that he referred to it as a supra-acetabular semicircular osteotomy in one of his own publications on the operation.[7]. The mean age was 2.350.753 years (range: 1-4 years). Six men (30 percent) and fourteen women (70 percent) were diagnosed (70 percent). Lesion distribution was as follows: 8 (40%), 11 (55%), and 1 (5%) bilateral. Hung et al [8] investigation corroborated our findings; they found that there were 105 males (24.9%), 316 females (75.1%), 56 unilateral cases, 295 left cases, and 70 right cases (16.6 percent). 15.1 months old at start of operations (12 - 36 months). In addition, Kandil et al. [9] reported that a total of 34 children (18 girls and 14 boys) between the ages of 1.5 and 3 years old participated in the research. Bilateral dislocation occurred in 4 cases, whereas 19 suffered dislocation on the left side and 11 on the right. Hip abnormalities, including as acetabular dysplasia and high-riding dislocations, are together known as developmental dysplasia of the hip (DDH). Several variables make it more challenging to repair a dislocated hip in a kid who has started walking, including acetabular dysplasia, extra-articular soft tissue adaptation, increased femoral anteversion, capsular constriction, and fixed inversion of the limbus. Several surgical options are available for individuals who come late [10]. Nineteen of the twenty participants (or 95% of the sample) had normal Shenton line alignment, whereas one had a fractured, dislocated line (or 5% of the sample). Ten (50%) of the individuals in the study group had dega osteotomies, and the same number received salter osteotomies. There were 11 Severin I hips (68.5%), 4 Severin II hips (25%), and 1 Severin IV hip (broken Shenton's line) at the conclusion of the research. Among the participants in the present investigation, Al values varied from 27.4 to 55.6, with a mean of 35.25±5.339; following surgery and 6 months of follow-up, however, these values had dropped dramatically to 23.33±5.688. Concerning problems, the data reveal that 17 people (85%) in the study group had no issues at all, whereas one person (5%) experienced a dislocation, one person (5%) experienced a distal femur fracture, and one person (5%) experienced AVN and shortening. Our findings were consistent with those of El-Sayed et al. [12], who found that across all subgroups, there was a statistically significant difference ($p<0.05$) between mean pre- and post-operative AI values, as well as between mean post-operative values and mean AI values at the final follow-up measurement. In this series, issues large and minor were documented. In three cases, for instance, a superficial wound infection was diagnosed and treated without affecting the final outcome. At the most recent follow-up, no patients who had sustained injuries to the superficial lateral cutaneous nerve of the thigh still reported symptoms or consequences from their injuries. After their casts were taken off, three patients had posttraumatic supracondylar fractures of the femur; nevertheless, these fractures were managed conservatively and did not compromise the patients' long-term prognoses. Moreover, López-Carreo et al. [13] found that 12 percent of patients who had Dega osteotomy experienced direct problems, whereas 34 percent of patients who underwent Salter osteotomy did so. Four patients (9%) in the Dega group experienced some stage of avascular necrosis, and one patient (2%) experienced reluxation. Three months following surgery, one patient had a fracture at the location of the derotational femur osteotomy, while another patient presented with a two-centimeter overgrowth of the pelvic limb that had undergone femoral osteotomy. They found avascular necrosis (in varying stages) in the hips of 13 patients (23%), subluxation in the hips of 3 patients (5%), and reluxation in the hips of 3 patients (5%); Four months after the Salter osteotomy, a fracture occurred at the location of the derotational femoral osteotomy, and in two cases, the therapy indirectly caused ipsilateral overgrowth of the pelvic limb by 2 cm. Regarding tonnis preoperative grading, our data suggest that 75 percent of the sample had grade 4, whereas 12 percent had grade 2, and 1 in 8 only reached grade 3. According to the severin post categorization, 31 people (77.5%) in the sample group were in the first grade, 7 people (17.5%) were in the second, and 2 people (5.0%) were in the third. Out of the total number of people evaluated, 24 (60.0%) were classified as having a grade 1 clinical condition, 13 (32.5%) as having a grade 2 condition, 1 (2.5%) as having a grade 3 condition, and 2 (5.0%) as having a grade 6 condition. Studies by Ibrahim et al. [14] corroborated our findings; they found that femoral shortening was unnecessary in all but hip dislocation of Tönnis Grade 2, dislocation of Tönnis Grade 3 in one hip, and dislocation of Tönnis Grade 4 in thirteen hips. The lack of statistical significance (P=0.133) supports this interpretation. There were 17 Severin's class I hips (43.6%), and all of them had good clinical outcomes. Thirteen out of fifteen (38.5%) hips in Severin's class achieved good clinical findings, whereas two out of fifteen (13.3%) did not. Clinical success was achieved in 4 out of 5 (80%) hips with Severin's class. There were two class V hips (5.1% of total) that had poor clinical outcomes. Clinical outcomes were significantly correlated with radiological findings (P 0.001). Ruszkowski and Pucher treated developing hip dislocation with a Dega transiliac osteotomy and open reduction at the same time.[15] looked back at 33 hips in 26 children at a mean age of 9 years and 5 months. All of the patients were infants or toddlers. The majority of patients (89%) and radiographic images (72%), at the most recent follow-up, showed excellent or good outcomes. Dega operation outcomes were rated as excellent or good in 88.3 percent of patients, whereas Salter osteotomy outcomes were rated as excellent or good in 78.1 percent of cases, as reported by López-Carreo et al. [13]. Both osteotomies showed similar results statistically ($P > 0.05$). Additionally, Zheng et al. [16] found that the fineness ratio was 82.6% based on the Severin X-ray standards, which rated the surgical outcomes as outstanding in 31 instances (41.3%), good in 31 cases (41.3%), fair in 9 cases (12%), and bad in 4 cases (5.4%). In this study, the researchers found that just 29 percent of the participants had undergone femoral derotation osteotomy (72.5 percent). Average femoral shortening was 1.2 centimeters in Ibrahim et al [14] .'s investigation (range, 1 to 2). In this research, femoral head reduction required femoral shortening in 14 hips (34.9 percent), however the addition of femoral shortening did not substantially alter the outcome as a whole (p=0.259). As shown by Neto et al. [17], femoral head necrosis severity was assessed. In eight individuals, necrosis was absent, in two it was bilateral, and in eleven it was solitary. Of the 42 hips operated on, 27 showed no signs of necrosis (64.29%), 5 showed signs of type 1 necrosis (11.9%), 4 showed signs of type 2 necrosis (9.52%), and 3 showed signs of type 4 necrosis (0.74%). (7.14 percent). They could not identify any statistically significant difference in respect to the afflicted side. Only one patient in the research had AVN and contraction (2.5 percent). The present investigation found no statistically significant differences between the types of osteotomies in terms of clinical assessment. Statistical analysis of the data for the correlation between osteotomy type and Severin post-categorization found no significant differences. Severin's radiological grading system Ten individuals from each group are shown, confirming our results. This research was conducted by Kandil et al. [9]. The outcomes for both groups were similar (P=0.611). Modified McKay's criterion and Severin's categorization yielded an 89% success rate (32 of 36 hips). Group I had an 89.5% success rate, whereas group 2 had an 88.2% success rate (P=1.000). After open reduction and capsulorrhaphy, patients were randomly assigned to either a Salter or Dega pelvic osteotomy with or without femoral shortening osteotomy. However, El-Sayed et al. discovered that more patients in the Dega group than in in terms of radiological results, those in the Salter group fared very well or adequately. Patients in the B subgroup who had Dega osteotomy had substantially (p 0.05) better final radiographic results across the board in terms of preoperative dislocation severity (29 out of 30) [12]. Statistically considerably improved clinical outcomes in favor of Dega osteotomy were reported by López-Carreo et al. [13]. Barrett et al. [18] found that 75% of patients who had Salter osteotomy had high or outstanding clinical outcomes. On the other hand, Ruszkowski and Pucher [15] reported an 89% success rate with Dega osteotomy, while Grudziak and Ward [19] claimed that all of their patients who received Dega osteotomy had good final clinical findings. The earlier in life a patient had a proper diagnosis and treatment, the better their clinical outcome would be. Infancy and early childhood were selected for this study due to the favorable growth and remodeling capacity of the acetabulum and the importance of early reduction in the development of a normal hip joint. There are a variety of reasons why researchers cannot directly compare data from studies of DDH patients done at different institutions. [20]. In contrast, El-Sayed et al. [12] found that the preoperative mean value of the AI in patients treated with the Dega acetabuloplasty was 39.87 in the A age subgroup and 43.54 in the B age subgroup. Immediately after surgery, these numbers were adjusted to 26.32 and 19.82. The A and B subgroups had an average degree of correction of 20 and 25, whereas the greatest degree of correction for each group was 35 and 45. The AI readings of patients in the B subgroup were found to be better corrected both immediately postoperatively and at the last follow-up evaluation. In contrast, the A and B subgroups' mean preoperative AI values for Salter osteotomy were 41.56 and 38.77, respectively. The pre- and post-osteotomy mean AI scores, respectively, were 20.41 and 21.95. After Salter osteotomy, the average amount of AI correction was 18° for the A group and 19° for the B group. There was no difference in AI decrease between the younger and older age groups after Salter osteotomy. Correction levels as high as 25 and 28 were seen in the A and B categories, respectively. Evidence was found in support of the Dega osteotomy at the p 0.05 level of significance. In addition, López-Carreo et al. [13] found that patients younger than 8 years old (90.71) had the best AI correction following Dega osteotomy hip surgery, with 53% of those patients achieving a correction greater than the study's median (181); in contrast, patients older than 8 years old (9.3%) obtained a mean of 161 descent over AI but failed to surpass the study's median (181). Among patients whose hips were corrected with the Salter osteotomy, 84% of those less than 3 years old had better results than the study means (111), whereas just 5% of those older than 8 years old had better results (111).

5. Conclusion

After comparing the results of the Salter and Dega pelvic osteotomies for the treatment of young children with DDH, we can say that the two procedures provide similar outcomes with an acceptable minimal risk of postoperative problems. The downside of Salter osteotomy is that hardware must be removed during a second operation, which is not the case with Dega osteotomy. Better outcomes may be achieved when DDH is diagnosed and treated early. High percentages of happy outcomes after surgery are seen in children who appear beyond the walking age. There is a statistically significant inverse relationship between patient age and the outcome. The outcomes improve with younger ages of children. To minimize the risk to the patient, it is preferable to treat all pathological aspects of DDH at the first operation. Surgeon preference and experience suggest that Salter osteotomy and Dega acetabuloplasty provide equivalent clinical and radiological results. The acetabular index is the best indicator of hip stability because it mimics the bony structure of the hip. Open reduction and removal of all soft tissues hindering reduction and proper alignment of the head into the acetabulum are recommended for effective surgery in the treatment of DDH. Acetabular dysplasia and femoral head covering (AI) The amount of femoral neck anteversion (reflected by the degree of internal rotation needed for femoral head reduction). Hip stability following surgical or nonsurgical reduction. Stability evaluations.

Funding Sources: There was no support for this study from any governmental, private, or non-profit Organization.
Conflicts of interest: No competing interests.

References

1. Guille JT, Pizzutillo PD, MacEwen GD. Development dysplasia of the hip from birth to six months. J Am Acad Orthop Surg. 2000; 8(4): 232– 42.

2. Aronsson DD, Goldberg MJ, Kling TF, Roy DR. Developmental dysplasia of the hip.[Erratum appears in Pediatrics 1994; 94(4 Pt 1): 470.

3. Schwend RM, Shaw BA, Segal LS. Evaluation and Treatment of Developmental Hip Dysplasia in the Newborn and Infant. Pediatric Clinics of North America. 2014; 61(6): 1095-107.

4. Homer CJ, Baltz RD, Hickson GB, Miles PV, Newman TB, Shook JE. Clinical practice guideline: Early detection of developmental dysplasia of the hip. Pediatrics. 2000; 105(4 I): 896–905.

5. Kutlu A, Memik R, Mutlu M, Kutlu R, Arslan A. Congenital dislocation of the hip and its relation to swaddling used in Turkey. J Pediatr Orthop. 2019; 12(5): 598–602.

6. Mulpuri K, Song KM, Goldberg MJ, Sevarino K. Detecção e tratamento não cirúrgico da displasia do desenvolvimento pediátrico do quadril em crianças até os seis meses de idade - Detection and Nonoperative Management of Pediatric Developmental Dysplasia of the Hip in Infants up to Six Months of Age. J Am Acad Orthop Surg. 2015; 23(3): 202–5.

7. Suzuki S. Deformity of the pelvis in developmental dysplasia of the hip: three-dimensional evaluation by means of magnetic resonance image. J Pediatr Orthop. 1995; 15(6): 812–6.

8. Hung NN, Duc HH. Comparative Outcome between Salter Innominate Osteotomy and Zigzag Osteotomy Combined Fibular Allograft for Developmental Dysplasia of the Hip in Children. EC Orthopaedics. 2018; 9: 187-210.

9. Kandil AE, Saeed A, El-Barbary H, Hegazi M, El-Sobky M. Salter versus Dega osteotomy after open reduction of developmental dysplasia of the hip in young children. The Egyptian Orthopaedic Journal. 2013; 48(1): 80.

10. Ganger R, Radler C, Petje G, Manner HM, Kriegs-Au G, Grill F. Treatment options for developmental dislocation of the hip after walking age. Journal of Pediatric Orthopaedics Part B. 2005; 14(3): 139-50.

11. Rampal V, Klein C, Arellano E, Boubakeur Y, Seringe R, Glorion C. Outcomes of modified Dega acetabuloplasty in acetabular dysplasia related to developmental dislocation of the hip. Orthopaedics & Traumatology: Surgery & Research. 2014; 100(2): 207-11.

12. El-Sayed M, Ahmed T, Fathy S, Zyton H. The effect of Dega acetabuloplasty and Salter innominate osteotomy on acetabular remodeling monitored by the acetabular index in walking DDH patients between 2 and 6 years of age: short-to middle-term followup. Journal of children's orthopaedics. 2012; 6(6): 471-7.

13. López-Carreño E, Carillo H, Gutiérrez M. Dega versus Salter osteotomy for the treatment of developmental dysplasia of the hip. Journal of Pediatric Orthopaedics B. 2008; 17(5): 213-21.

14. Ibrahim MM, El-Lakkany MR, Wahba MM, El-Ganainy AA, Aly AM. Combined open reduction and dega transiliac osteotomy for developmental dysplasia of the hip in walking children. Acta Orthop. Belg. 2019; 85: 545-53.

15. Ruszkowski K, Pucher A. Simultaneous Open Reduction and Dega Transiliac Osteotomy for Developmental Dislocation of the Hip in Children Under 24 Months of Age. J Pediatr Orthop. 2005; 25: 695-701.

16. Zheng P, Tang K, Lee R, Ji C, Lin G, Pan X. Surgical treatment of developmental dysplasia of the hip presenting in children above 10 years. Journal of Orthopaedic Science. 2011; 16(2): 165-70.

17 Neto AK, Ferraz A, Foresti FB, Hoffmann RB. Bilateral developmental dysplasia of the hip treated with open reduction and Salter osteotomy: analysis on the radiographic results. Revista Brasileira de Ortopedia (English Edition). 2014; 49(4): 350-8

18 Barrett WP, Staheli LT, Chew DE. The effectiveness of the Salter innominate osteotomy in the treatment of congenital dislocation of the hip. J Bone Joint Surg Am. 1986; 68(1): 79-87.

19 Grudziak JS, Ward WT. Dega osteotomy for the treatment of

congenital dysplasia of the hip. J Bone Joint Surg Am. 2001; 83(6): 845-54.

20 Ucar DH, Isiklar ZU, Stanitski CL, Kandemir U, Tumer Y. Open reduction through a medial approach in developmental dislocation of the hip: A follow-up study to skeletal maturity. J Pediatr Orthop. 2004; 24(5): 493–500.