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ASSESSMENT OF PRE AND INTRAOPERATIVE INDICATIONS OF SALTER INNOMINATE OSTEOTOMY IN DEVELOPMENTAL DYSPLASIA OF HIP (DDH) IN CHILDREN AGED (18-36)MONTHS

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BACKGROUND

The management of developmental dysplasia of the hip aims for early diagnosis and treatment. It is claimed that adequate acetabular remodelling is possible only during the first18 months of life. After this, satisfactory development cannot always be assured by non-operative treatment following closed reduction (Salter and Dubos 1974). Innominate osteotomy was originally designed for children with delayed presentation of developmental hip dysplasia and those in whom earlier treatment had failed to produce remodeling (Salter 1961). Reorientation of the acetabulum makes the reduced hip more stable, increases the load-bearing area of the acetabulum in the weight-bearing position, and does not alter its shape or volume.

Aims of study

1-Assess the accuracy of pre-operative acetabular index (AI) measure as an indicator of salter osteotomy in comparing with the intraoperative assessment regarding the stability of the hip in children aged (18—36)months.
2-compare the results of open reduction with and without salter's osteotomy in the management of developmental dysplasia of hip(DDH) in this age group.

PATIENTS AND METHODS

Sixty one patients,(82)hips who had developmental dysplasia of the hip. were treated by open reduction with or without salter innominate osteotomy in AL-wasity teaching hospital from November 2015 to November 2017, last surgery done at November 2016.

The period of follow up was 12 months. we include patients aged 18--- 36 months. Children with neuromuscular disease and children with recurrent dislocation after previous open reduction were excluded. Of the (61)patients there were(52)girls and (9) boys,(36)bilateral(15 of them operated unilateral and 21 operated bilateral) and (25)unilateral (9 right and 16 left).

Operative technique

All operations were done under general anesthesia by one surgeon at AL-Wasity teaching hospital.

Supine position with a small pad under the hip that will be operated then the site of surgery was prepared with antiseptic and drapping.

Assessment of adductor muscle group of the involved side, if it was tight, then adductor tenotomy will be done by the open method, releasing the adductor group(the adductor longus and adductor brevise) then the wound closed.

Open reduction was done by anterior approach (bikini incision)starting from just inferior to the middle of iliac crest, extending anteriorly to just inferior to the anterior superior iliac spine and continuing to about the middle of the inguinal ligament.

Release the subcutaneous tissue and identify the entry plane between the Sartorius and tensor facia lata muscles, identify the lateral femoral cutaneous nerve and protect it. Incise the apophysis of the iliac crest and release the lateral side through subperiosteal dissection and packing it for hemostasis to reduce blood loss.

The Sartorius' muscle is preserved, identify the straight head of rectus femoris muscle and apply a stay suture and release it near its origin of anterior inferior iliac spine, release the reflected head of rectus femoris muscle of joint capsule, release the joint capsule of any soft tissue attachment laterally, superiorly and infero-medially, identify iliopsoas tendon and release it near its insertion to the lesser trochanter.

The capsule was opened in a T-shaped incision from the most medial aspect of the capsule to the most lateral, and continue the incision along the anterior border of the femoral head and neck. a stay suture1or 2 nylon applied at the angles of the capsule flaps, the ligamentum terese is identified and released from the femoral head and excised from the acetabulum, the acetabular cavity was cleared of soft tissue (pulvinar)and release the transverse acetabular ligament, then another tow stay sutures with 1or 2 nylon applied at medial capsule one at most

inferomedial capsule and second just above it. then the femoral head gently reduced into the acetabulum.

At this stage and before closure of the joint capsule a test for stability was carried out.

The aim of this test is to identify the position of maximum stability of the hip and the appropriate osteotomy can then be carried out when necessary to achieve a stable concentric reduction.

We considered a stable open reduction to be present when the hip remained reduced with axial loading with the leg in 30degree of flexion, 30 degrees of internal rotation and 30 degrees of abduction. the component of this position was then removed sequentially beginning with the flexion.

These were the main findings
1.hip stable in a neutral position: open reduction and capsular repair are sufficed.
2.hip stable in internal rotation and abduction: require proximal femur derotation or varus derotation osteotomy.
3.hip stable in flexion and abduction: require pelvic (salter)osteotomy.
4.hip stable in flexion, internal rotation and abduction: require pelvic (salter)osteotomy and also proximal femur derotation osteotomy .(if a more internal rotation is needed to maintain stable reduction after salter osteotomy.
5. if the head becomes displaced superiorly from the acetabulum when the hip is adducted or anteriorly when it is extended or externally rotated, osteotomy of the innominate bone (salter)is performed

When salter needs to perform, the medial side of iliac apophysis is released strictly subperiosteally and packing it for hemostasis, continued the release distally till expose the anterior inferior iliac spine.

Right angle forceps inter through the sciatic notch from the medial side to lateral and gently take the Gigli saw, protecting the soft tissue on medial and lateral aspects of the iliac bone and stabilize the pelvis make a straight osteotomy at the innominate bone extended from the sciatic notch to the anterior inferior iliac spine.

A triangular bone graft taken from the iliac wing just proximal to the anterior superior iliac spine, then by towel clip applied to the distal part of osteotomy, pulling it anteriorly, inferiorly and laterally the bone graft then applied at the osteotomy site (opening site),using two k-wires for fixing the osteotomy site with the graft, applied through the site of graft taken (the defect site) proximal to the osteotomy site, directed distally passing through the graft to the distal part of osteotomy bone. Check the acetabulum if there is a k-wire in to it. After that reduce the head of the femur into the acetabulum and check the stability again.

After confirming the reduction and stability of the hip joint, close the capsule by using the stay sutures taken previously, closing the apophysis of ilium and subcutaneous tissue by absorbable suture and the skin by 3/0 nylon in subcuticular suture.

Dressing the site of surgery, then one and one half spica cast applied by using spica frame. The spica lasts for 6-8weeks then changed to abduction broomstick for 4-6 weeks then removed. At day zero all the patients were given a single dose of IV. antibiotic with an x-ray of the pelvis.

RESULTS

Association between tonnis grade and type of surgery

Tonnis grade	Type of surgery						p-value
	OR			SO			
	No.	%	%	No.	%	%	
I	1	100.0%	4.0%	0	0.0%	0.0%	0.04
II	15	44.1%	60.0%	19	55.9%	33.3%	
III	7	18.9%	28.0%	30	81.1%	52.6%	
IV	2	20.0%	8.0%	8	80.0%	14.0%	
Total	25	30.5%	100.0%	57	69.5%	100.0%	

Mean of AI pre and one year after for each type of surgery

Type of surgery		Mean of AI	Std. Deviation	p-value
OR N=25	AI pre-operation	33.8	4.3	0.01
	AI year after	27.5	2.5	
SO N=57	AI pre-operation	39.7	2.8	0.01
	AI year after	23.1	3.4	

AI=Acetabular index

Mean difference of AI (pre-op and 1 year after) according to the type of surgery

Type of surgery	Mean of AI	Std. Deviation	p-value
OR(N=25)	6.3	4.5	0.01
SO(N=57)	16.6	4.0	

Mean value of CEA according to the type of surgery

Type of surgery	Mean of CEA	Std. Deviation	p-value
OR(n=25)	23.2	4.7	0.03
SO(n=57)	25.9	3.1	

Association of outcome and type of surgery

MC key	Type of surgery				p-value
	OR		SO		
	No.	%	No.	%	
Excellent	9	36.0%	20	35.1%	0.9
Good	14	56.0%	31	54.4%	
Fair	2	8.0%	6	10.5%	

Frequency and percentage of complications

Complications	No.	%(from total)	%(from patients with a complication)
AVN (II&III)	4	4.9	28.6
LLD	2	2.4	14.2
SC #	1	1.2	7.1
SPICA SORE	1	1.2	7.1
Subluxation	3	3.7	21.4
Superficial infection	3	3.7	21.4
Total	14	17.1	100.0
0(no complication)	68	82.9	
Total	82	100.0	

Association of Severin grades and type of surgery

		Type of surgery				Total ROW	Total Column	p-value
		ORrow	column	SO row	column			
Severin	I	0		1		1	1	0.7
		0.0%	0.0%	100.0%	1.8%	100.0%	1.2%	
	II	22		48		70	70	
		31.4%	88.0%	68.6%	84.2%	100.0%	85.4%	
	III	1		7		8	8	
		12.5%	4.0%	87.5%	12.2%	100.0%	9.8%	
	IV	2		1		3	3	
		66.7%	8.0%	33.3%	1.8%	100.0%	3.6%	
Total		25		57		82	82	
		30.5%	100.0%	69.5%	100.0%	100.0%	100.0%	

DISCUSSION

The treatment for DDH has the basic premise of attaining stable concentric reduction of the hip into the functional weight-bearing position. Instability of the reduction originates from poor positioning of the acetabulum in the anterior and lateral directions. Open Reduction in association with Salter's osteotomy of the iliac bone in order to redirect the acetabulum is today a classical treatment method[1].

In our study on (82) hips for patients aged (18---36m) mean age 26.1M(±6.7SD)for a period of follow up (12Months).

Regarding the radiographic evaluation, the mean preoperative A.I. among the cases studied here was 37.9◦(± 4.3◦SD), SO all of them have acetabular dysplasia, (acetabular dysplasia is confirmed when the pre-operative acetabular Index (AI)IS more than 30)[2] when compared with intraoperative assessment of the stability after open Reduction(for all the patients), (57)hips of them needed pelvic osteotomy (salter)to achieve a stable hip, and only (25)hips do not need osteotomy.

Therefor, in the current study, the indication that determines the necessity for doing salter osteotomy or

not was dependent on the intra-operative assessment to achieve a stable hip. In agreement with our data:
-Zadeh et al. used concomitant osteotomy at the time of open reduction to maintain the stability of the reduction and reported satisfactory results in 86% of 82 children (95 hips).[A Concomitant osteotomy should be done at the time of open reduction when necessary to maintain a safe, stable reduction].[2]

-When considered with **M.belen caris and Nicholas M.P.elarke**[3]; the preoperative acetabular index was not different in those hips that required a pelvic osteotomy from those that did not, making this measure a poor initial discriminator.

- Bolland et al[4] **and Albinana et al**[5] found that the acetabular index becomes a reliable predictor of the need for pelvic osteotomy only at an average of 1.5 years or 2 years after the hip reduction respectively.

Therefor in the present study, the patients were divided according to the intraoperative assessment of stability that determines the need for pelvic osteotomy into two groups, group 1: those were treated with an open reduction only, and group 2: those were treated with open reduction and salter Osteotomy, in order to record the results Regarding the **acetabular index**, in this study, the mean preoperative AI for our patients37.9◦ (± 4.3◦SD), AI of group 1(33.8◦) and of group 2 (39.7◦), one year postoperatively the mean AI is (27.5◦) and (23.1◦) for groups 1 and 2 respectively, in the same line with the following previous studies, that treated the patients with open reduction and salter osteotomy.

Adriana Ferraz et al(2014)[6]**, Carvalho Filho et al.(2003**[7]**), El-Sayed et al**.(2012)[8],and **Abdullah et al**.(2012)[9]
- In our study, there was a decreasing trend in AI values with open reduction and salter more than with those treated with open reduction alone and the mean difference of AI (pre-op and 1 year after) in group 1was(6.3◦) and in group 2 (16.6◦). The results demonstrated that differences in the mean value of AI with salter open reduction were significantly higher than open reduction(p=0.01). In this study, the postoperative **Weberg center-edge angle** obtained in our analysis, in group 1 the mean of CE (23.2◦)while in group 2 the mean of CE (25.9◦), we also observed asignificant difference between the two groups (p-value 0.03) .when compared with others that agrees with our data as, **Adriana Ferraz et al(2014)**[6]**,** Wiberg CE angle obtained was 19.4◦.,28◦found by **Carvalho**, **Filho et al**[7] 31◦(±9) and 32.3◦ (±11.9) by **El- Sayed et al. (2012)**[8] oes with **M. Belen Carsi et al,(2015)**[3]**.**

Regarding the **complications**, in our study, there is 17.1% of total had a complication and most of these were **Avascular necrosis** (4 patients) represented 28.6% of complications and all these occur in group 2 (a group of salter osteotomy) and it was typed (II&III)AS graded by the Criteria of kalamchi and MacEwen. **Subluxation** (3 patients) represented 21.4% of complications and these were 66.7% in group 1 and 33.3% in group 2, also there was **superficial infection**(3 patients) represented 21.4 % of complication(33.3% in group 1 and 66.7% in group 2), and (2 patients)14.2 % had **a leg length discrepancy** all of them in group 2(the salter osteotomy is mildly increasing the limb length).[10]

Despite this, the finding showed that there was no significant difference(p=0.2) between the two modalities of surgery.

When considered with Segal et al(1999)[11]) reported a 32% rate of AVN and Sankar et al(2011)[12] 41% AVN and Yagmurlu et al.(2013)[13] described four cases with avascular necrosis among 27 hips that were operated (14%).

Prado et al.[14] reported (9.5%) of subluxation, **RACHID K.et al**[15] **found** (3 of 37 hips) 8.1% AVN,(2 hips)5.4% secondary subluxation, (3 patients) 8.1% superficial wound infection, (2 patients)5.4% supracondylar fracture of the femur and (1 patient)2.7% significant leg length discrepancy.

Both Tachdjian (1982) and Fixsen (1987) suggest that the reasons for failure to maintain a reduced hip are a poorly executed osteotomy, a lax capsulorrhaphy, and excessive femoral anteversion.

Osteonecrosis has been thought to result from excessive pressure over the femoral head or vascular insult[16,17]. It has been postulated to be associated with patient age, degree of displacement, inadequate pre-reduction traction, position of immobilization, and methods of treatment.[18]

In our study the cases complicated with AVN mostly (34-36)months of age and high grade at presentation tonnis grade(II and III)

CONCLUSION

1-The preoperative radiological measures(AI) which determine acetabular dysplasia is a weak indicator for the need of salters osteotomy.
2-the intra-operative test of stability is found to be a reliable indicator for pelvic osteotomy (salter) to achieve a stable hip.
3- Open reduction in association with osteotomy of the iliac bone as described by Salter presented a statistically significant improvement in the angular parameters measured on the patients' radiographs, from before to after the operation.
4-Reorientation of the acetabulum makes the reduced hip more stable, increases the load-bearing area of the acetabulum in the weight-bearing position
5-Avascular necrosis (AVN) and residual acetabular dysplasia are the two main complications of developmental dysplasia of the hip (DDH) treatment.

REFERENCES

1. Bertol P, Ishida A, Macnicol MF. Tratamento da displasia do desenvolvimento do quadril pela técnica de Salter isolada ou associada à osteotomia do fêmur. Rev Bras Ortop. 2004 May; 39(5): 232-44..
2. S. TERRY CANALE, MD AND JAMES H. BEATY, MD. CAMPBELL'S OPERATIVE ORTHOPAEDICS, TWELFTH EDITION. 2013; II(30): 1082-1091 -1098.
3. M.belen caris and Nicholas M.P.elarke.Acetabuloplasties at Open Reduction Prevent Acetabular Dysplasia in Intentionally Delayed Developmental Dysplasia of the Hip: A Case-control Study.2015; 474: 1186.
4. Bolland BJ, Wahed A, Al-Hallao S, Culliford DJ, Clarke NM. Late reduction in congenital dislocation of the hip and the need for secondary surgery: radiologic predictors and confounding variables.J Pediatr Orthop.2010; 30: 676–682.
5. Albinana J, Dolan LA, Spratt KF, Morcuende J, Meyer MD, Weinstein SL. Acetabular dysplasia after treatment for develop-mental dysplasia of the hip. Implications for secondary procedures.J Bone Joint Surg Br.2004; 86: 876886.
6. Adriana Ferraz, Franco Bayer Foresti,Rafael Barreiros Hoffmann.Bilateral developmental dysplasia of the hip treated with open reduction and Salter osteotomy: analysis on the radiographic result. 2 0 1 4; 49(4): 354-357.
7. FILHO GC, Chueire AG, Ignacio H, Carneiro MD, NETO JF, Canesin AC. Surgical treatment of congenital dislocation of the hip after gait: open reduction and Salter osteotomy. Acta ortop bras. 2
8. 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 follow-up. J Child Orthop. 2012; 6: 471–7.
9. Abdullah ES, Razzak MY, Hussein HT, El-Adwar KL, Youssef AA. Evaluation of the results of operative treatment of hip dysplasia in children after the walking age. Alexandria J Med. 2012; 48: 115–22 .
10. tachdjians pediatrics orthopedics\from theTEXAS Scottish Rite hospital for children :2014:5th edition,volume 1,225:228.
11. Segal LS, Boal DK, Borthwick L, Clark MW, Localio Schwentker EP. Avascular necrosis after treatment of DDH; the protective influence of the ossific nucleus. J Pediatr Orthop. 1999; 19: 177–184.
12. SankarWN, Young CR, Lin AG, CrowSA, BaldwinKD, Moseley CF. Risk factors for failure after open reduction for DDH: a mat-ched cohort analysis.J Pediatr Orthop.2011; 31: 232–239.
13. Yagmurlu MF, Bayhan IA, Tuhanioglu U, Kilinc AS, Karakas ES.Clinical and radiological outcomes are correlated with the ageof the child in single-stage surgical treatment of developmental dysplasia of the hip. Acta Orthop Belg. 2013; 79(2): 159–65.
14. Prado JC, Santili C, Baptista PP. Treatment of congenital hip dislocation and subluxation by the Salter technique associated with femur shortening. Rev. bras. ortop. 1984; 19 (6): 203-8.
15. RACHID K .et al . SIMULTANEOUS OPEN REDUCTION AND SALTER INNOMINATE OSTEOTOMY FOR DEVELOPMENTAL DYSPLASIA OF THE HIP.1996; 78-B: 473-476.
16. Salter RB, Field P. The effects of continuous compression on living articular cartilage. J Bone Joint Surg Am 1960; 42: 31-90.
17. Schoenecker PL, Lesker PA, Ogata K. A dynamic canine model of experimental hip dysplasia: gross and histologi-cal pathology, and the effect of position of immobilization on capital femoral epiphyseal blood flow. J Bone Joint Surg Am 1984; 66: 1281-8.
18. Chia-Hsieh Chang et al.Surgical Results and Complications of Developmental Dysplasia of the Hip - One Stage Open Reduction and Salter's. 2011; 34: 89-90.