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EVALUATION OF MEDIAL APPROACH (LUDLLOF) FOR OPEN REDUCTION OF DEVELOPMENTAL DYSPLASIA OF THE HIP IN CHILDREN

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Abstract

Developmental dysplasia of the hip is a challenging surgical problem, there are many controversies regarding its management. Open reduction via medial approach is one of its treatment options, which needs further work to evaluate its role in management of Developmental dysplasia of hip. In this study, we tried to put an answer whether the medial incision of open reduction of developmental dysplasia of the hip is valuable in terms of stability, avascular necrosis, effect of age and the need for further procedures.

Out of the ninety Children with DDH received within two years, twenty five of them needed open reduction through Ludloff's approach; they were subjected to full assessment including detailed history and clinical examination in addition to radiographic evaluation. The remaining sixty five patients underwent closed reduction and hip spica cast application.

Regarding those patients treated by open reduction, seven were males while eighteen were females, sixteen of them are below one year of age, trials of closed reduction under general anesthesia with arthrographs taken during the procedure to obtain the optimal range of hip movement with no benefit, so they were operated upon through the medial (Ludloff) approach.

We found that this approach have more easy access to the hip joint, no need for blood transfusion and shorter time (20-30) minutes for each hip in relation to other approaches in the same age group. Serial follow up clinically and radiographically was performed to all patients.

Postoperative complications included six hips with avascular necrosis of femoral head according to Kalmachi and MacEwan classification. No redislocation and infection was recorded. In conclusion, this method provides a stable and concentrically reduced hip.

Introduction

Developmental dysplasia of the hip generally includes subluxation (partial dislocation) of the femoral head, acetabular dysplasia, and complete dislocation of the femoral head from the true acetabulum in addition to teratogenic type. In newborn with true congenital dislocation of the hip, the femoral head can be dislocated and reduced into and out of the true acetabulum, while in an older child, the femoral head remains dislocated and secondary adaptive changes in the bony and soft tissue components of the hip will occur[1].

The early diagnosis greatly improves the outcome in developmental hip dysplasia (DDH)[2], but despite the instigation of early corrective treatment, there are still a small percentage of hips that are resistant, or it is probably dangerous to perform closed reduction techniques on them[3].

The medial approach for open reduction of developmental dislocation of the hip (DDH) was introduced by Ludloff[4], this methods has been described as a simple and requiring minimal dissection and tissue destruction; it allows correction of the anteroinferior tightness by releasing the tight iliopsoas tendon and the constricted antero-inferior part of the capsular ligament. Although results of this procedure have been described in many reports, the outcome remains controversial[5,6].

Patients & Method

This is a prospective study carried out from November 2012 to November 2014 included 90 children (25 boys, 65 girls) with (110) developmentally dysplastic hips below age of 16 months in Al-Basrah General Hospital. All of them were evaluated preoperatively excluding the teratological and neuromuscular causes. Management started by closed reduction with or without adductor tenotomy followed by immediate intraoperative hip arthrography to assess the outcome in reference to the concentric profile of reduction and its stability in the accepted safe zone.

Twenty five patients (29 hips) out of the 90 patients (7 boys, 18 girls) have failed closed reduction as proved by the intraoperative arthrogram and were subjected to immediate open reduction utilizing Ludloff's medial approach.

Operative technique

A 4–5 cm transverse skin incision centered over the anterior margin of the adductor longus, parallel and 1 cm inferior to the inguinal crease was performed.

The adductor fascia was divided longitudinally and the adductor longus which was already divided percutaneously and retracted distally. The space between the adductor brevis and the gracilis muscle was entered taking care to avoid damage to the branches of the medial circumflex artery. The iliopsoas tendon was identified, its sheath opened, and the tendon sharply divided and allowed to retract proximally. The hip capsule was identified and divided. The transverse acetabular ligament divided. The ligamentum teres was divided off the femoral head and acetabulum sharply. A rongeurs was used to remove the pulvinar fat. At this point, the hip was easily reduced. Stability was checked. The wound was irrigated with saline and the homeostasis was achieved. The subcutaneous tissue was closed with vicryl 3-0 and the skin with Nylon 3-0.

The average of operative time was 20–30 minutes for each hip and the surgical steps with the postoperative notes were documented in the patient's medical records. Postoperatively, a bilateral hip spica cast using fiber glass was applied for all patients in 90–100 degrees of flexion and 45-55 degrees of abduction on the operated side, with 10-20 degrees of internal rotation, this spica was kept for 8 weeks then changed to above knee spica for another 6 weeks, then complete removal of spica and started physiotherapy. Post-operative 3rd generation cephalosporin (ceftriaxone) was used for 2-3 days in a dose 50 mg per Kg intravenously. X-ray for pelvis and both hips was taken in the 1st day postoperatively then repeated every month during the period of follow up.

All patients were followed up clinically according to the Modified McKay criteria[7].

Results

This study included 25 patients, seven males (28%) and eighteen females (72%) with DDH (table I), twenty one patients (84%) unilateral and four patients(16%) bilateral which were subjected to open reduction via the Ludloff's medial hip approach. They have a mean age of 11.9 months, (range from 7–16 months) at time of surgery, our follow-up period was ranged from 4-23 months, with a mean of 14.8 months (table II).

Table I: Age and gender of patients participating in this study.

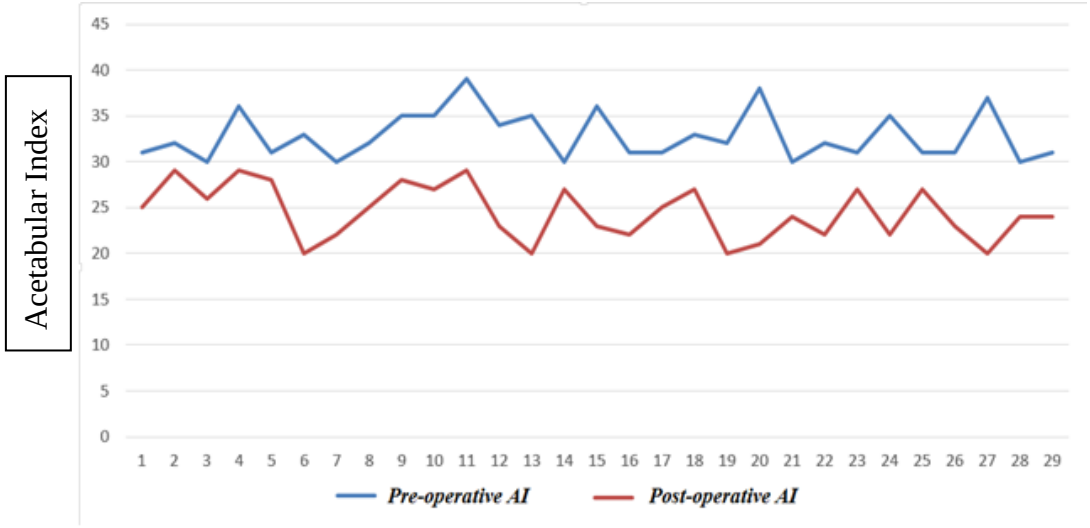
AGE(MONTHS)	MALE	FEMALE	TOTAL
6-12	5	11	16
12-16	2	7	9
6-16	7	18	25

Table II: The overall data for patients who underwent Ludloff's medial approach.

Case No.	Gender	Age M	Mean follow Period M	Side	Acetab. Index Preop.	Acetab. Index Postop.	Kalamchi MacEwen grade	Modified McKay criteria
1	Female	7	16	Unilateral	31	25	No AVN	Excellent
2	Female	8	10	Unilateral	32	29	No AVN	Excellent
3	Female	8	11	Bilateral	R=30 L=36	R=26 L=29	No AVN	Excellent
4	Female	8	13	Unilateral	31	28	Grade 1	Good
5	Female	10	16	Unilateral	33	20	No AVN	Excellent
6	Female	10	20	Unilateral	30	22	Grade 1	Good
7	Female	11	4	Bilateral	R=32 L=35	R=25 L=28	No AVN	Excellent
8	Female	11	23	Bilateral	R=35 L=39	R=27 L=29	No AVN	Excellent
9	Female	12	16	Unilateral	34	23	Grade 2	Good
10	Female	11	11	Unilateral	35	20	No AVN	Excellent
11	Female	13	14	Unilateral	30	27	No AVN	Excellent
12	Female	10	16	Unilateral	36	23	No AVN	Excellent
13	Female	14	15	Unilateral	31	22	Grade 3	Fair
14	Female	12	19	Unilateral	31	25	No AVN	Excellent
15	Female	13	9	Unilateral	33	27	No AVN	Excellent
16	Female	14	8	Unilateral	32	20	No AVN	Excellent
17	Female	15	10	Unilateral	38	21	No AVN	Excellent
18	Female	16	14	Unilateral	30	24	No AVN	Excellent
19	Male	10	14	Unilateral	32	22	No AVN	Excellent
20	Male	13	12	Unilateral	31	27	Grade 2	Fair
21	Male	12	16	Bilateral	R=35 L=31	R=22 L=27	No AVN	Excellent
22	Male	16	14	Unilateral	31	23	Grade 1	Good
23	Male	11	14	Unilateral	37	20	No AVN	Excellent
24	Male	14	18	Unilateral	30	24	No AVN	Excellent
25	Male	11	19	Unilateral	31	24	No AVN	Excellent

The patients with an age of one year and below comprised 60% (sixteen patients) of the operated group. The mean of the acetabular Index readings pre-operatively was 32.83° ranged from 30°-39° and post-operative acetabular index mean was 24.45° ranged from 20°-29°, a mean reduction of acetabular index post-operatively from the pre-operative readings equal to 8.37° was observed during our follow-up, figure 1 show this reduction in plotted graphs.

Figure1: The reduction in acetabular index in operated hips.



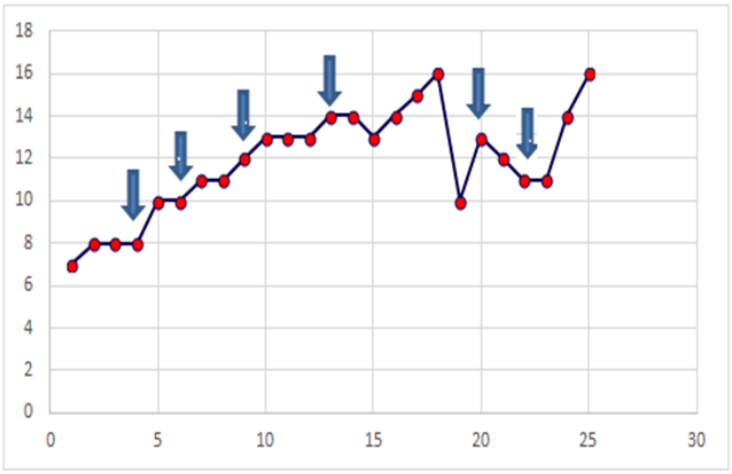
No. of operated hips

There were 6 patients with postoperative avascular necrosis of the femoral head; they comprise a percentage of 20.6% from the remaining patients group who underwent medial hip approach for reduction, as shown in the table III.

Table III: Postoperative AVN grades according to Kalmachi criteria.

AVN Grade	Number of hips	Percent
No AVN	23	79.31%
Grade 1	3	10.34%
Grade 2	2	6.90%
Grade 3	1	3.45%
Total	29	100%

Figure 2: The age at which the avascular necrosis occurred in this study.



occurrence of AVN according to age in the postoperative sample

In this study, a satisfactory result was obtained after medial approach reduction in 25 patients (29 hips) as it was 89.65%. We define the satisfactory outcome as any patient with no major post-operative complication or with a mild AVN (goes with Grade 1 in Kalamchi-MacEwen System), the unsatisfactory results was defined as any case with a major or important post-operative complication such as; infection, major neurovascular injury, redislocation, and moderate to severe AVN (goes with Grade 2, 3 and 4 in the Kalamchi-MacEwen System).

Table IV: The postoperative complications

Complications	Number of cases	Percentage
Postoperative Infection	0	0
Postoperative AVN	6	20.69%
Postoperative Re-dislocation	0	0
Major neurovascular complications	0	0

Discussion

Developemental dysplasia of the hip is still one of the major pediatric affections of the general well-being of both the individual and his/her community in term of adulthood hip arthritis and its sequels not to mention the stigma that it holds for the young female in our community.

The surgical approach used in open reduction remains a controversial issue. Avascular necrosis of the femoral head and damage to the physis are the main complications following such surgery, with a variable reported incidence, ranging from 0 to 67%[6-8].

Numerous other possible complications can occur, including redislocation, stiffness of the hip, infection and possibly the most devastating with the avascular necrosis of the femoral head. The rate of femoral head necrosis varies substantially; depending on the study, it may be anywhere from 0% to 73%[9]. frequent studies demonstrated that extreme abduction, especially when combined with extension and internal rotation, results in a higher rate of avascular necrosis[10,11].

No matter which operative approach is used, there is still a considerable incidence for the need of revision surgery. Following a medial approach, revision surgery via a lateral approach is considerably easier through fresh tissue planes[12].

The advantage of the medial approach over the lateral approach is that there is considerably less dissection involved, operative time is less, blood loss is less, thus potentially enabling simultaneous bilateral procedures to be performed. The medial approach also avoids damage to the iliac apophasis and the scar is more cosmetically acceptable.

The medial approach has been criticized owing to two main potential problems: the first is the inability to improve the stability of the hip after reduction due to lack of access to the lateral hip capsule and limbus[13]. The second is the potential risk of damage to the medial circumflex femoral artery and resultant increased risk in the development of avascular necrosis[14].

In this study, a satisfactory result after medial approach reduction in 25 patients (29) hips was 89.65% at a mean of age equal to 25.5 months. Koizumi et al[15] reported satisfactory results in 23%, at age of 19 years (range, 14–23) follow-up, Matsushita et al[16] in 34%, at 16 years (range, 11–21) follow-up and Ucar et al[17] in 59% at 19.8 years (range, 13–28) follow-up. We think that this difference is related directly to the length of follow-up period, which was the shortest in our study comparing to the others. This may mask any future complication or unsatisfactory results that could occur in our patients group. It needs a further follow-up study for a prolong period of time.

The rate of AVN development in our study was 24% (6 patients from 25). Wataru et al[15] in his study of 33 patients with DDH treated by medial approach found a postoperative AVN rate equal to 42.9%.

The reported incidence of avascular necrosis varies considerably from 4% in the series of Mau et al[18] and 15% in that of Castillo and Sherman[19], to 35.5% in that of Sosna and Rejholec[20].

Mascio et al[12] believe that by performing the capsulotomy at its insertion superiorly into the acetabular rim the risk of damage to these vessels is minimized.

Another factor is the age of the patients at the time of the operation. The mean age of patients in our study was (11.36 months) at time of surgery, 60% of our patients with an age of one year and below. There are some reports that patients younger than one year have good results[19,21-23]. In Kunihiko Okano et al study[24], the mean age at surgery was 14.0 months (range, 6–31 months), and 14 patients (31%) who were treated at more than 18 months were included, they identified AVN in 13 (29%) of 45 hips after operation. An AVN rate of 0–67% has been reported after open reduction through a medial approach[19,21-23], and some describe the relationship between age at open reduction and presence of AVN at follow-up. Mergen et al[23] reported that AVN was only observed at less than seven months and over 18 months. Castillo et al[19] and Mankey et al[23] reported that AVN correlated positively with increased age at surgery.

In our study, age at operation was significantly higher in the patients with AVN than the patients without AVN at follow-up, and all three hips classified as

Kalmachi types II and III were operated upon at more than 13 months of age.
Kunihiko Okano et al[24] also stated that the mean age at surgery was significantly older in the patients with AVN than without AVN (20.0 and 11.6 months, respectively, P<0.001). Another approach, such as the anterolateral method, should be selected for DDH with increased age at operation.
Livio Di Macio et al showed that there is a low incidence of lateral subluxation in these cases and a re-operation rate of only 8%. A revision rate of 19%(25) to 27%(19) has been described with the Ferguson procedure (posteromedial approach).
Similar outcome as in our study have been found by other authors using the medial approach for open reduction[25,26]. In previous studies, however, the medial approach had been reserved for patients older those six months after which the femoral capital epiphysis is present. This is thought to reduce the incidence of a vascular necrosis[8].

Conclusion
Indications:
1-Medial approach is a direct approach to reduce congenital hip dislocation in children below one year of age.
2- It results in concentric reduction of hip without much scarring or, other complications, making post operative rehabilitation relatively rapid.
3-Since it spares anterolateral structures, future reconstructive procedures can be performed easily to treat residual dysplasia.
4-The main drawback is the risk of injuring the Medial circumflex femoral artery with a weighted opportunity for postoperative avascular necrosis of the femoral head.
This can be decreased by a careful surgical dissection and manipulation, the operating surgeon must keep the MCFA in his mind all the time, or else its injury could invite a painful failure to both the surgeon and his patient.
Contraindications:
1-Cannot be done after walking age.
2-when femoral head has migrated proximally.
Recommendation:
We recommend more studies to compare between both of the 2 approaches (anterolateral and medial) with a big sample and for a long period of follow-up till beyond bone maturity to assess more confidently the pro and cons of each in dealing with those difficult cases of DDH who require an open reduction for their remedy.

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