

## One stage surgery using subtrochanteric osteotomy versus two stage surgery using supracondylar femoral derotation osteotomy in treatment of developmental dysplasia of the hip joint for older children

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### ABSTRACT

**Background:** The one stage surgery of open reduction and subtrochanteric femoral osteotomy with or without pelvic osteotomy, has been an accepted method of treatment of congenital hip dislocation in older children. This approach obtains predictable reduction and results in a low rate of osteonecrosis despite the higher rate of operative and postoperative morbidity like prolonged anesthesia time, large incisions and more immediate postoperative complications. Two-stage surgery might, therefore, help in avoiding the above-cited disadvantages.

**Aim of the study:** Is to compare the results obtained by using either one-stage surgery by subtrochanteric or two-stage surgery by supracondylar femoral derotational osteotomies in the management of developmental dysplasia of the hip joint.

**Patients and Methods:** This is a randomized controlled trial involving children under the age of 2.5 years with developmental dysplasia of the hip and attending Basrah General Hospital between December 2010 till August 2012. Thorough clinical examination and laboratory investigations were done for all the patients and only 30 patients with 39 dislocated hips whom did not require femoral shortening and need >10-15 degrees of acetabular roof index correction using pelvic osteotomy were included in this study. Each patient was randomly allocated into one of the two surgical procedures; procedure A was one-stage surgery and procedure B was two-staged surgery. At the end of the study period, a total of 30 patients under the age of 2.5 years were recruited for this study, 16 patients underwent procedure A and another 14 underwent procedure B. The patients were followed-up for 12-18 months and evaluated clinically & radiologically depending on McKay and Severin's clinical and radiological criteria respectively.

**Results:** Thirty patients with 39 dislocated hips were managed. Patients age ranged from 1.5 to 2.5 years; all of them were females having no associated skeletal anomaly. The outcome of one-stage surgery showed better clinical (78.9%) and radiological results (88.8%) in comparison to two-stage surgery which showed 45% clinical and 70% radiological results, however, the time of technical procedure and other morbidities for example; risk of infection (20%), preoperative blood transfusion (100%), respiratory distress (13.5%) were relatively greater in one-stage surgery.

**Conclusion:** The results of this study showed that one-stage operation resulted in better joint realignment, without increasing risk of avascular necrosis, and more hip joint physiological and anatomical remodeling affinities, despite of its prolonged time and more rate of immediate postoperative morbidity. While in the two-staged surgery, the clinical and radiological outcomes were less successful than those with one-stage operation, though immediate postoperative morbidities were less.

علاج خلع الورك الولادي بالجراحة بواسطة استخدام قص أعلى عظم الفخذ بمرحلة واحدة خلافا لقص أسفل عظم الفخذ بمرحلتين.

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**الخلفية:** الجراحة بمرحلة واحدة لعلاج خلع الورك الولادي باستخدام قص أعلى عظم الفخذ مع أو بدون قص عظم الحوض، وكان وسيلة مقبولة لعلاج خلع الورك الخلقي في الأطفال الأكبر سنا. هذا النهج يحصل على تخفيض و نتائج يمكن التنبؤ بها في انخفاض معدل تنخر العظم على الرغم من ارتفاع معدل الإصابة بالأمراض بعد العملية الجراحية لفترة طويلة مثل وقت التخدير، وجروح كبيرة و مضاعفات ما بعد الجراحة أكثر إلحاحا. في هذه الدراسة، نقسم إجراءات علاج هذه الحالة إلى مرحلتين بدلا من مرحلة واحدة.

هدف الدراسة: لمقارنة النتائج التي تم الحصول عليها باستخدام الجراحة إما مرحلة واحدة عن طريق الجراحة تحت المدور (أعلى عظم الفخذ) أو مرحلتين بواسطة قص و تدوير عظم الفخذ فوق اللقمة (أسفل عظم الفخذ) في علاج خلع مفصل الورك الولادي.

المرضى وطرق العلاج: هذه دراسة عشوائية تشمل الأطفال أقل من ثلاث سنوات من العمر مع خلع الورك و اللذين راجعوا مستشفى البصرة العام في الفترة بين ديسمبر ٢٠١٠ وحتى اغسطس ٢٠١٢ وأجريت الفحوصات السريرية لجميع المرضى فقط ٣٠ مريض الذين يعانون من خلع الورك من ٣٩ مريض الذي لا تتطلب تقصير الفخذ وجميعهم بحاجة < ١٠ الى-١٥ درجة من تصحيح السقف الحقي باستخدام قص عظم الحوض تم تضمينهم في هذه الدراسة.

كل مريض اختير عشوائيا إلى واحدة من اثنين من العمليات الجراحية؛ الإجراء: الذي هو الجراحة مرحلة واحدة و إجراء ب: الذي هو الجراحة بمرحلتين. في نهاية فترة الدراسة، وشملت ما مجموعه ٣٠ مريضا تحت سن ٢.٥ سنة في الدراسة، خضع ١٥ مريض لإجراء آ و ١٥ مريضا خضع لإجراء ب. تمت متابعة المرضى لمدة ١٢ الى-١٨ شهرا وتقييمها سريريا وإشعاعيا اعتمادا على تقييم مكاي و المعايير السريرية والإشعاعية في تقييم سيفيرين على التوالي.

النتائج: أدرج الثلاثون مريض الذين يعانون من ٣٩ خلع مفصل الورك ، كان المرضى تتراوح أعمارهم ١.٥-٢.٥ سنوات ، وجميعهم من الإناث مع عدم وجود أي شذوذ في الهيكل العظمي . وأظهرت نتائج الجراحة بمرحلة واحدة نتائج أفضل بالمقارنة مع الجراحة على مرحلتين ، ومع ذلك وقت الإجراء التقني و الحالات المرضية الأخرى على سبيل المثال؛ خطر الالتهاب، وخطورة نقل الدم، و ضيق في التنفس وكانت أكبر نسبيا في الجراحة بمرحلة واحدة.

الاستنتاج: ويستنتج من نتائج هذه الدراسة أن العملية بمرحلة واحدة أسفرت عن أفضل إعادة لتشكيل مفصل الورك، ومعدلات أقل لتنخر رأس عظم الفخذ بسبب نقص التغذية الدموية، على الرغم من اخذ وقت أكثر وكثرة الاعتلالات بعد الجراحة على الفور. بينما في الجراحة بمرحلتين كانت النتائج السريرية والشعاعية أقل من تلك التي مع عملية بمرحلة واحدة ، على الرغم من قلة الاعتلالات المرضية بعد الجراحة على الفور.

## INTRODUCTION

**D**evelopmental dysplasia of the hip (DDH) includes a wide spectrum of pathology ranging from mild acetabular dysplasia, frank dislocation (luxation), partial dislocation (subluxation), and instability where the femoral head comes in and out of the socket, and an array of radiographic abnormalities that reflect inadequate formation of the acetabulum.<sup>[1,2]</sup>

The primary goal of treatment for developmental dysplasia of the hip is concentric reduction of the femoral head. A dislocated hip that is not reduced perfectly can lead to femoral head deformities and acetabular dysplasia with subsequent gait abnormalities, limitation of some hip movements, pain, and early osteoarthritic changes.<sup>[3]</sup> Since the early 1990s, the one-stage surgery of open reduction and subtrochantric femoral osteotomy with or

without pelvic osteotomy, has been an accepted method of treatment of congenital hip dislocation in older children. This approach obtains predictable reduction and results in a low rate of osteonecrosis<sup>[4]</sup> despite the higher rate of post-operative morbidity, prolonged anesthesia time (3-4 hours), large incisions and more immediate postoperative complications.<sup>[5]</sup>

**Aim of the study:** is to compare the results obtained by using either one- stage surgery by subtrochantric or two-stage surgery by supracondylar femoral derotational osteotomies in the management of developmental dysplasia of the hip joint.

## PATIENTS AND METHODS

This is a randomized controlled trial involving children under the age of 2.5 years old with developmental dysplasia of the hip and were

attending Basrah General Hospital in the period from December 2010 to August 2012. Prior to surgery, thorough clinical examination and important laboratory investigations were done. The patients were selected so they didn't require femoral shortening to avoid bias since this step can be done only in subtrochanteric osteotomy. All patients need > 10-15 degrees of acetabular roof index correction using Dega pelvic osteotomy.<sup>[1]</sup> One blood unit was prepared for each patient, then each patient was randomly allocated into one of the two surgical procedures A or B.

### ***Procedure A***

Patients underwent one-stage operation of open reduction through Somerville approach,<sup>[1]</sup> T-shaped incision of the capsule, obstacles were removed, open reduction of the femoral head, and suturing of the capsule. All patients had Dega pelvic osteotomy<sup>[1]</sup> and iliac crest autograft was used without fixation by K-wire. Through lateral incision, femoral derotational osteotomy was done by cutting the femur in subtrochanteric region and fixing by plate and screws. The wound closed without drain. Both incisions were closed using 3 zero Vicryl (Polyglycolic Acid) absorbable suture by subcuticular suturing method, followed by bilateral spica casting with hip flexion and abduction 30 degrees without internal rotation for 3 months.

### ***Procedure B***

Patients were treated by two-staged operations:

\*First stage surgery: including; open reduction of the femoral head and Dega pelvic osteotomy {similar to procedure A} and cast spica in 30 degrees flexion abduction hip with 30-45 degrees of internal rotation position was applied for 6 weeks. The wound closed without drain.

\*Second stage surgery; after 6 weeks a femoral supracondylar derotational

osteotomy is performed through lateral distal femoral approach without any metal fixation and cast spica is applied for another 6 weeks. No drains, neither blood transfusion nor intravenous fluid was needed in the second stage of operation. At the end of the study period, a total of 30 patients under the age of 2.5 years were recruited for this study, 16 patients (19 hips) underwent procedure A and another 14 patients (20 hips) underwent procedure B.

### ***Follow up***

In the first postoperative day, x-ray examination was done for all patients in both procedures to check femoral head reduction and congruity. All patients treated with ceftriaxone parenteral IV injection 500mg once daily during the period of hospitalization, then they were discharged home after 3-4 days for procedure A and 1-2 days for procedure B and kept on oral antibiotic suspension of amoxicillin-clavulanic acid (Augmentine) 315mg, three times daily for 7 days. All patients were checked after 2 weeks for general clinical assessment and operative wound assessment by pulling and inspecting the post operative wound dressing without changing the spica cast. After that, the patients were evaluated clinically every month, for any complication of the operation such as sores and also for the state of spica i.e. whether it is broken or damaged. Radiological evaluation was done for all patients at the first post operative day and then monthly for detection of the femoral head position and remodeling of acetabulum, healing of the femoral derotational osteotomy depending on McKay and Severin's clinical and radiological criteria respectively.<sup>[6,7]</sup> In this study, average duration of follow-up of patients for both procedures was 12-18 months after removal of spica cast.

## RESULTS

Thirty patients with 39 dislocated hips were included in this study. Patient's age ranged between 1.5-2.5 years, all of them were females having no associated skeletal anomaly and were distributed into procedure A and B according to age as shown in (Table-1).

**Table 1. Distribution of the patients according to age.**

Age (years)	Procedur A	Procedure B
1.5-2	6	8
2-2.5	9	7
<b>Total</b>	15	15

The distribution of the patients according to the number of affected hip is demonstrated in (Table-2).

**Table 2. Distribution of patients according to number of affected hip.**

	Procedure A	Procedure B
Unilateral	13 hips	8 hips
Bilateral	6 hips (3 patients)	12 hips (6 patients)
<b>Total no.</b>	19 hips	20 hips

Regarding procedure A, the time of operation ranged between 3-4 hours. All patients required preoperative blood transfusion and intravenous fluid. They were discharged home after 3-4 days.

Regarding procedure B, the time of operation for the first stage was about 1-2 hours. Blood transfusion was needed postoperatively in two patients only. Postoperatively, three patients were given intravenous glucose-saline solution, while in the second stage, the duration of surgery was about 30-60 minute and they were discharged home after 1-2 days as shown in (Table-3).

**Table 3. Operative and postoperative characteristics of both procedures.**

Procedure	Duration of operation	Blood transfusion	Postoperative i.v fluid	Days of hospitalization
<b>A</b>	4 hours	19 hips	19 hips	3-4 days
<b>B</b>	1-2h 1 <sup>st</sup> stage 0.5-1h 2 <sup>nd</sup> stage	2 hips	3 hips	1-2 days

The clinical findings were advocated to criteria applied by McKay<sup>[6]</sup> clinical grading system 12-16 months after removal of spica and the results

showed better outcomes for procedure A as demonstrated in (Table-4).

**Table 4. Evaluation of clinical outcome of procedure A & B according to McKay<sup>[6]</sup> grading system.**

Procedure	Excellent	Good	Fair and poor
<b>A</b>	8 hips (42.1%)	7 hips (36.8%)	4 hips (20.1%)
<b>B</b>	4 hips (20%)	5 hips (25%)	11 hips (55%)

Also in this study all patients were evaluated according to postoperative radiological findings utilizing Severin's<sup>[7]</sup> radiological criteria. The

results regarding procedure. A had more favorable outcome as shown in (Table-5).

**Table 5. Evaluation of radiological outcome of procedure A & B according to Severin<sup>[7]</sup> criteria.**

Procedure	Total no. of dislocated hips	Excellent	Good	Fair
A	19	6 hips (31.5%)	11 hips (57.3)	2 hips (10.2%)
B	20	2 hips (10%)	12 hips (60%)	6 hips (30%)

**Postoperative complications**

In this study, patients who underwent one-stage operation, 2 patients developed respiratory distress and were admitted to intensive care unit for close follow-up and splitting of spica cast was done for them. Two patients developed urine retention and catheterization was done for them. Also during follow-up three patients developed superficial stitch infection treated with dressing and antibiotics. Regarding procedure B which was two-stage surgery, it was less demanding as it included less

dissection and its durations was shorter, about 2 hours for first stage surgery and about 1 hour for the second stage. None of these patients required preoperative blood transfusion but following first stage operation two patients needed blood transfusion and three needed intravenous fluid during recovery. In this study the postoperative morbidities related to type of surgery occurred more with procedure A, as illustrated by the following (Table-6).

**Table 6. Surgical outcome of both procedures.**

	A: one stage Operation	B: two-stage Operation
Duration of surgery	3-4 hours, prolonged	1-2 hours 1st stage, 0.5-1 hour 2 <sup>nd</sup> stage.
Blood transfusion	All patients during surgery	2 patients after surgery
Intravenous fluid	All patients	3 patients
Respiratory distress	2 patients	0
Urinary retention	2 patients	0
Hospitalization	3-4 days	1-2 days

After discharge of the patients and during the follow-up period, the following complications in both procedures were noticed as shown in (Table-7).

**Table 7. Short term complications for procedure A & B.**

Complications	Procedure a	Procedure b
Infection	3 hips	0 hips
Redislocation	0 hips	4 hips
Avascular necrosis	0 hips	3 hips
Joint stiffness	0 hips	5 hips

## DISCUSSION

The primary goal of treatment for developmental dysplasia of hip is concentric reduction of the femoral head. A dislocated hip that is not reduced properly can lead to femoral head deformities and acetabular dysplasia with subsequently gait abnormalities, limitation of some hip movements, pain, and early osteoarthritic changes.<sup>[3]</sup> The one stage surgery of open reduction and subtrochanteric femoral osteotomy with or without pelvic osteotomy, has been an accepted method of treatment of congenital hip dislocation in older children. This approach obtains predictable reduction, and results in a low rate of osteonecrosis<sup>[4]</sup> despite the higher rate of post operative morbidity like prolonged anesthesia time (3-4 hours), large incisions and more immediate postoperative complications.<sup>[5]</sup> In procedure B the operative treatment was divided into two stages because it is difficult to control femoral head reduction and performing supracondylar femoral derotational osteotomy in one surgical session and again it will be along-time procedure. In this study, differences noticed concerning clinical outcome for patients treated by one stage surgery than those with two stage surgery using McKay criteria. 78.9% of treated hips by one-stage surgery had got excellent and good grade compared with only 45% for patients treated by two-stage surgery. Better outcomes were found for patients treated by one-stage surgery which include open reduction and subtrochanteric femoral derotational osteotomy concerning the rate of osteonecrosis and deformity remodeling despite the higher rate of postoperative morbidity like prolonged anesthesia time 3-4 hours and large incisions. Also they developed more immediate postoperative complications like respiratory distress in 2 patients, urinary retention in 2 patients and superficial stitch's infection in 3 patients keeping in mind that all patients treated by

one-stage surgery demanded blood transfusion which carry risk of diseases transmission and allergic reaction. For the long term management of patients treated by one-stage surgery the femoral fixation metals was used, which will require another surgery for removal of that metal in the future, while patients treated by two-staged operation in which subtrochanteric femoral derotational osteotomy is substituted by second-stage femoral supracondylar derotational osteotomy done 6 weeks later, the postoperative morbidities were less, no metal was used for fixation, hence no future surgical removal needed. Although the two-stage surgery is less demanding operation and with less postoperative morbidities but subtrochanteric femoral derotational osteotomy in one-stage surgery allows the surgeon to evaluate the degree of femoral anteversion that is needed to be corrected more precisely. This will make femoral head congruity within acetabulum much better, hence better clinical and radiological outcome, while by using supracondylar femoral derotational osteotomy, femoral anteversion correction will not be adjusted accurately and less femoral head congruity obtained. Zadeh, et al<sup>[8]</sup> indicated that open reduction, pelvic osteotomy combined by subtrochanteric femoral osteotomy yielded good results in their study which involved 95 developmental dislocated hips with a mean age of 2 years. Another supportive research by Mahomet et al<sup>[9]</sup> founded similar results regarding developmental dysplasia of hip that treated by one-stage operation. El-Sayed, et al<sup>[10]</sup> also mentioned 88% excellent to good results and 12% fair to poor results for patients treated by one-stage surgery. Up to my knowledge, no other research concerned with treatment of developmental dysplasia of hip using two stage method of supracondylar femoral osteotomy was used for femoral anteversion correction.

**Conclusion,**

In this study, one-stage operation resulted in a better joint realignment, lowest avascular necrosis rates, and more hip joint physiological & anatomical remodeling affinities, despite of its prolonged time and more rate of immediate postoperative morbidities. While in the two-stage surgery, the clinical and radiological outcome was less than those with one stage operation, though immediate postoperative morbidities were less.

**Recommendation,**

We recommend the one-stage surgery for treatment of developmental dysplasia in older children to be the first choice of treatment although its long and demanding surgery.

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