



One-stage bilateral open reduction using the anterior iliofemoral approach in developmental dysplasia of the hip

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The aim of this study was to investigate the safety of one-stage bilateral open reduction using the anterior approach in the treatment of patients with bilateral Tönnis Type III and IV Developmental Dysplasia of the Hip (DDH). Forty-six patients were retrospectively evaluated. Thirty-eight were female, eight were male. The mean age was 16.63 (11-29) months. The mean follow-up period was 27.18 (12-65) months. The mean hospitalization period after surgery was 1.91 (1-5) days. The mean pre-operative hematocrit level was 35.14% (28.1-44.1) and the mean pre-operative hemoglobin level was 11.75 g/dl (9.3-13.6). The mean post-operative hematocrit level was 32.54% (26.7-40.4) and the mean post-operative hemoglobin level was 10.80 g/dl (8.78-12.3). None of the patients required blood transfusion. The mean anesthesia duration was 133.30 (95-180) minutes, and the mean operation duration was 107.58 (70-145) minutes. According to the modified scoring system by Trevor *et al*, excellent results were obtained in 66 hips of 46 patients (71.8%), and good results were obtained in 26 hips (28.2%). Twenty two hips (23.91%), which developed acetabular dysplasia in the follow-up period required a secondary acetabular intervention. According to the Kalamchi and MacEwen classification, Type I avascular necrosis developed in ten hips, Type II in one hip, and Type IV in two hips. One-stage bilateral open reduction using the anterior iliofemoral approach in Tönnis Type III and IV DDH at walking age is a safe, time-saving treatment method that shortens the hospitalization and immobilization periods.

INTRODUCTION

Developmental dysplasia of the hip (DDH) is a major pediatric orthopedic pathology and the most debated disease with respect to its treatment. The aim of the treatment is to provide a stable and concentric reduction, and its maintenance (14).

Bilateral involvement is observed in 20% of patients (14). When patients with bilateral involvement are treated with closed or limited open reduction (iliopsoas tenotomy), both hips can be treated with a one-stage procedure. However, there are a few studies about bilateral Tönnis Type III and IV DDH that cannot be reduced with closed methods

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or limited open reduction, and require standard open reduction. These studies report also about patients treated by a medial approach (18). There is, however, no study in English literature about one-stage bilateral open reduction using the anterior iliofemoral approach in DDH cases. The anterior iliofemoral approach is preferred in more difficult cases when superior obstacles need to be removed. It is also a surgical procedure that lasts longer and leads to more bleeding compared to the medial approach. Therefore, this procedure is traditionally performed in two stages in bilateral cases. However, there is no scientific basis for this approach. Patients who are operated on in two stages are exposed twice to anesthesia and surgery. Accordingly, hospitalization time, treatment costs, complication rates related to surgery and anesthesia, and financial and psychological burden to the patient and family increase. More importantly, the treatment of the second hip is delayed.

The aim of this study was to investigate the safety of one-stage bilateral open reduction using the anterior iliofemoral approach in patients with bilateral Tönnis Type III and IV DDH.

MATERIAL AND METHODS

Forty-six patients with bilateral DDH who underwent one-stage bilateral open reduction using the anterior iliofemoral approach for both hips between the years of 2006-2011 were retrospectively evaluated (Fig. 1, 2). Patients with a teratological dislocation, or who had received treatment before, or had additional tenotomy and derotation osteotomy were excluded from this study. Thirty-eight patients were female, eight were male. The mean age was 16.63 (11-29) months.

Surgery was initiated under general anesthesia at the hip where dysplasia was more severe, as observed on the radiography. The classical Smith-Peterson anterior iliofemoral approach was used. The iliopsoas muscle was cut. The capsule was opened with a t-incision and the ligamentum teres and transverse ligament were cut within the joint. After cleaning the pulvinar, the femoral head was placed into the acetabulum, and plication of the joint capsule was performed. Hip joint stability and safe range of movement were evaluated, and a pelvipedal cast was applied in the safe position, which was generally 35-40° abduction, 30-45° flexion, 0-10° inner rotation, and 35-45° knee flexion.



Fig. 1. — Preoperative radiography of bilateral developmental hip dysplasia in a 15 month old child.



Fig. 2. — Postoperative radiography.

Patients were recalled for monthly follow-ups during the first 3 months. At the end of 3 months, the cast was removed, and an abduction device was used continuously in the first 2-3 months, and only at night in the following 2-3 months.

Pre- and post-operative hematocrit and hemoglobin levels were evaluated. Low hematocrit and hemoglobin alone were not taken as criteria while, in addition, clinical history and tachycardia were included in the evaluation.

All patients received 250 mg of cefazolin sodium prophylactically before anesthesia, and antibiotic therapy was continued until discharge.

Clinical and radiological examination were performed according to the modified scoring system by Trevor *et al* (15). In this system, scoring was between 20 (maximum)

and 5 (minimum) points with respect to pain, range of motion, limp, functional status, and radiological findings; a score of 18-20 was excellent, 15-17 was good, 12-14 was average, and under 12 was weak. The radiological evaluation of the osteonecrosis in the final control was performed according to the Kalamchi and MacEwen system (5).

Descriptive statistical analyses (mean, standard deviation, and frequency) were performed using "SPSS 15.0 for Windows" statistical software.

RESULTS

The mean follow-up period was 27.18 (12-65) months. The mean hospitalization time after surgery was 1.91 (1-5) days.

The mean pre-operative hematocrit level in whole blood was 35.14% (28.1-44.1) and the mean pre-operative hemoglobin level was 11.75 g/dl (9.3-13.6). The mean post-operative hematocrit level in whole blood was 32.54% (26.7-40.4) and the mean post-operative hemoglobin level was 10.80 g/dl (8.78-12.3). None of the patients required blood transfusion.

The mean anesthesia duration was 133.30 (95-180) minutes, and the mean operation duration was 107.58 (70-145) minutes.

In the post-operative period, none of the patients had a sore throat related to anesthesia while one patient had respiratory distress, which regressed with cortisone and oxygen treatment. Six patients had nausea and vomiting, and recovered with post-operative treatment.

According to the modified Trevor scoring system, excellent results were obtained in 66 hips of 46 patients (71.8%), and good results were obtained in 26 hips (28.2%) (Fig. 3).

Twenty-two hips (23.91%) required a secondary acetabular intervention; one patient required a bilateral Salter osteotomy, three patients a bilateral Pemberton osteotomy, and fourteen patients a unilateral Salter or Pemberton osteotomy.

According to the Kalamchi and MacEwen classification, Type I avascular necrosis, which did not affect hip function, developed in ten hips, Type II in one patient who underwent a Salter osteotomy, and Type IV, which is believed to affect the functional outcome of the hip, developed in two patients.



Fig. 3. — AP radiography after 34 months.

No instances of neurovascular injury, wound site infection or re-dislocation were observed in any patient. One patient was placed in a cast for an additional 25 days due to a supracondylar left femur fracture occurring during cast removal in the third post-operative month.

DISCUSSION

The objective in DDH treatment is to achieve concentric reduction and maintain it during childhood and the adolescent period. In the pre-walking period, primarily harnesses, splints or closed reduction, and pelvic casts can be used for treatment. However, the need for open reduction increases in the post-walking period. Open reduction is performed through the medial or anterior iliofemoral approach. Some authors prefer open reduction using the medial approach due to the short and simple duration of the operation, less bleeding, and less cosmetic scars (13). The medial approach can also be used in bilateral cases due to the short duration of the operation and less bleeding. There are some relevant studies with good results in the literature (18). However, one-stage bilateral open reduction using the anterior iliofemoral approach is probably less performed, and there is no relevant data in the literature. The results of 46 cases treated

with one-stage bilateral open reduction using an anterior iliofemoral approach were evaluated and presented in this study.

The medial approach can be used to access the structures preventing the safe reduction of the hip, such as iliopsoas and adductor longus tendon, inferior capsule, transverse ligament, ligamentum teres and pulvinar, with minimum dissection and blood loss, and the method can be performed bilaterally. However, stable concentric reduction cannot be achieved in Tönnis Type III and IV hip dysplasia solely by removing the barriers in the acetabulum. In Tönnis Type III and IV dysplasia, attachment of the posterior capsule to the iliac side, capsular torsion and contraction of the outer rotator hip muscles prevent the reduction. In these latter hip dysplasias, the anterior iliofemoral approach should be used to remove these barriers proximally. Open reduction using the medial approach is then insufficient. According to Kiely *et al*, open reduction using the medial approach is reliable and appropriate only for low dislocations (6). According to many authors, one of the reasons for preference of open reduction using the medial approach is that the surgical technique is short and simple (2,10,17). However, some authors disapprove, and claim that open reduction using the medial approach is not simple and should be performed only by experienced pediatric orthopedists (16,18). The duration of open reduction using the medial approach was reported between 90 and 137 minutes in bilateral cases (16,18). In our case, the mean duration of the operation including the cast was 107 minutes. From our perspective, one-stage bilateral open reduction using the anterior iliofemoral or the medial approach is similar with respect to difficulty and surgical period, and they both require experience.

However, the anterior iliofemoral approach is usually performed in two stages in bilateral cases because it lasts longer and leads to more bleeding. Although the two-stage procedure is safe, patients need to be hospitalized twice, treatment costs increase, and more importantly, hip treatment is delayed. None of the patients in our series with one-stage bilateral open reduction in bilateral Tönnis Type III and IV DDH had complications related to the long period of surgery, and none required blood

transfusion. From our perspective, one-stage bilateral open reduction using the anterior approach is a safe method in bilateral Tönnis Type III and IV DDH.

The most important benefit of open reduction using the anterior iliofemoral approach is that capsuloraphy can be performed after reduction. The position and shaping of the cast is crucial for the maintenance of reduction. Insufficient abduction may lead to re-dislocation and subluxation, while excessive abduction may lead to avascular necrosis of the femoral head. A well-performed capsuloraphy using the anterior approach helps maintain reduction. Therefore, excessive abduction and flexion position for hips would not be necessary in order to maintain the concentric reduction.

Another important benefit of open reduction using the anterior approach is that it can be performed in adolescents, where capsuloraphy is required in order to reduce subluxation and re-dislocation. Furthermore, using the medial approach a pelvic osteotomy, sometimes needed in adolescents cannot be performed. Moreover, according to some authors (4,11), avascular necrosis after an open reduction using the medial approach is more frequently seen at the age of 2 years and over; therefore, limited use of open reduction using the medial approach is suggested in adolescents. Also, Königsberg *et al* (8) do not suggest open reduction using the medial approach after 12 months of age.

The most important problem in DDH in all age groups is residual dysplasia and subluxation (1). There is no evidence that indicates a relation between these residual problems and the type of treatment. Twenty-two hips (23.91%) required a secondary acetabular intervention. In our cases, the need for a secondary intervention were lower compared to the literature (7,9,12). This is probably due to the shorter follow-up period in our cases. We estimate that this rate will increase and approach the rate of 30-40% reported in the literature as the follow-up period extends.

There are different rates of avascular necrosis in open reduction using both anterior and medial approach reported in the literature (3). Avascular necrosis, mostly Type I, developed in 13 (11.91%) of 92 hips in which one-stage bilateral open reduc-

tion was performed. Although this rate is low, we believe that it would not be accurate to compare it to the variable and complicated data in the literature, especially taking into account the short follow-up period.

In conclusion, open reduction using the anterior approach is the most appropriate technique in Tönnis Type III and IV DDH after walking age. In addition, the one-stage approach leads to shorter hospitalization time, and the treatment of the second hip is not delayed.

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