

# Results of open reduction and Salter innominate osteotomy for developmental dysplasia of the hip

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**Abstract.** We aimed to evaluate the clinical and radiological results of open reduction (OR) and Salter innominate osteotomy (SIO) for patients with developmental dysplasia of the hip (DDH).

In this study, the results of 45 instances of OR and SIO treatment on 36 DDH patients between 2004 and 2012 were evaluated retrospectively. 28 (77.77%) of the patients were female and 8 (22.33%) of them were male. The mean age was 28.8 (18-55) and the mean follow-up period was 41.8 months (6-101). A recovery percentage was calculated by measuring the acetabular index on plain radiographs recorded before surgery, immediately after surgery, and final checkup. During patients' final checkup, the clinical evaluation was performed according to a modified version of McKay's criteria and the evaluation of the range of the joint motion was carried out according to the Trevor-Johns-Fixen scoring system.

The acetabular index values recorded from patients' hips had an average of 39.9 (35-47) degrees before the operation, but had a mean of 30.5 (20-35) degrees after the operation and an average of 18.5 (10-30) degrees during the final checkup. Clinically, excellent results were obtained in 22 hips (49%), good results were obtained in 17 hips (38%), and satisfactory results were obtained in 4 hips. Two of the patients could not be evaluated since they could not be mobilized due to cerebral palsy. Re-dislocation emerged in 3 hips (6.6%), deep infection emerged in 1 hip (2.2%), and a supracondylar femur fracture emerged for 1 patient (2.2%).

OR and Salter's innominate osteotomy is a highly effective surgical technique in the treatment of DDH cases that have lasted more than 18 months.

Key words: Congenital hip dysplasia, operative therapy

## 1. Introduction

In the eastern part of our country, the newborn screening program for patients with the developmental dysplasia of hip (DDH) has yet to be widely established. Since DDH cannot be diagnosed in the early period, conservative treatments cannot be performed, so the rate of the complication increases and the chance of success declines. Serious physical disorders, along with psychological and social problems, are observed in patients whose treatments are delayed (1).

The main purpose in the treatment of DDH is to provide anatomical and stable reduction (1,2,3).

Mostly, it is not possible to obtain a stable joint without intervening in the acetabular structure for patients who were not treated until the 18th month (4).

Many surgical procedures have been described for DDH treatment in the late stages. Different results related to the efficacy of open reduction (OR) and innominate osteotomy (SIO) have been described in the literature by Salter (2,5).

This study will evaluate clinical and radiographic results for patients with DDH treated with OR and SIO.

## 2. Material and method

In this study, the results of 45 instances of OR and SIO treatment on 36 DDH patients between 2004 and 2012 were evaluated retrospectively. Of the 36 patients enrolled in the study, 28 (77.77%) of the patients were female and 8 (22.33%) of them were male. The average surgery age of the patients evaluated was 28.8 (18-55) and the mean follow-up period was 41.8 months (6-101).

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Table 1. Modified McKay Clinical Evaluation Criteria

Group 1	Very good	No pain and limping, Trendelenburg test is negative, movements are complete.
Group 2	Good	No pain, but a slight limping, Trendelenburg test is negative and movement is slightly restricted.
Group 3	Median	No or mild pain. Trendelenburg test is positive or negative. There is limping and reasonable loss of mobility.
Group 4	Bad	There is a pain and Trendelenburg test is positive. There is limping and severe loss of motion.

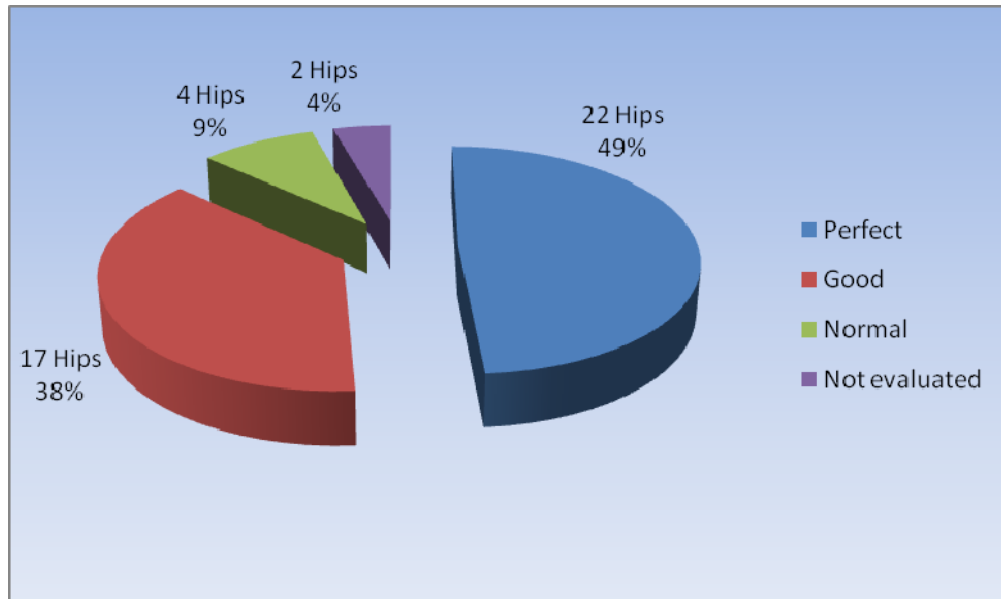


Fig. 1. Distribution of patients according to the modified McKay criteria.

Patients who had regular clinical and radiological follow-ups and whose follow-up periods were more than 6 months were included in the study. Patients who underwent femoral osteotomy along with SIO, those who were previously exposed to medial approach were excluded from our study. Revision cases were also excluded.

During the surgery, the patients with adductor tension were treated with adductor tenotomy (4). OR and SIO were applied to all patients in line with Salter's original technique (4). After the surgery, the patients were followed up in pelvipedal casts for 45 days. The casts of the patients were removed at the end of the 6<sup>th</sup> week and a Denis-Browne splint was applied to the operated hip with an internal rotation of 5-10 degrees. This splint was applied for 24 hours in the first 45 days and in the following 45 days it was applied only at night.

In the patients' last polyclinic checkups, clinical results, such as the range of passive motion in the hip joint, pain, Trendelenburg test, and limping were evaluated based on the criteria

of modified MacKay (Table 1) (6). The values for the acetabular index (AI) in the last checkups before and after the operation were measured from plain radiographies. The difference between the last AI values before the operation and the last checkup, and the AI value before the operation, was accepted as the percentage of AI recovery  $((AI1-AI2) / AI1)$ . The ranges of joint motion (ROM) in the last controls of the patients were graded according to the Trevor-Johns-Fixen scoring system (7).

While the descriptive statistics for the categorical variables were expressed as numbers and percentages, for the continuous variables, statistics were expressed as mean, standard deviation, minimum, and maximum values. In the comparisons which were made in terms of continuous variables, the student's t-test and paired comparison t-test were used. To determine the relationship between the categorical variables, a chi-square test was used. Statistical significance was set at 5% and the SPSS 13 statistical package program was used for the calculations.

### 3. Results

The results of the modified-McKay clinical assessment are given in Figure 1. Two patients were not evaluated because they had cerebral palsy.

In our study, the average AI values of the operated hips was 39.9 (35-47) degree in the preoperative period. However, AI values in the final radiography measure had an average of 18.52 (10-30) degree. The average AI difference in the preoperative period and final control was calculated to be  $21.404 \pm 0.832$  (standard error). In addition, the improvement in AI in the hips after the surgery was determined at 11.86 degree on average. The relationship between the follow-up period and the percentage of AI recovery was found to be significant ( $r=0.34$ ,  $p<0.05$ ). According to this, the percentage of AI recovery increases as the follow-up time increases.

According to the Trevor-Johns-Fixen scoring system, the examination results of the range of the joint motion has been given in Figure 2.

A deep infection developed in one hip over the course of our study. The wound area of the patient was washed extending over the hip joint under general anesthesia and debrided. K-wires were removed and the infection was treated with intravenous antibiotic therapy. In the final control, it was seen that this patient's hip also improved in terms of the clinical evaluation of McKay.

In our study, one patient developed a supracondylar femur fracture after a Denise brown splint had been applied. Re-dislocation was seen in 3 patients in our study. OR was performed on two of these hips dislocated after the operation, while derotation was performed following femoral osteotomy. However, one patient did not agree to another surgery.

Figure 3 provides the radiographs of a patient to whom OR and SIO was performed. In the final checkup of the patient after 85 months, the patient was evaluated as perfect according to the criteria of McKay.

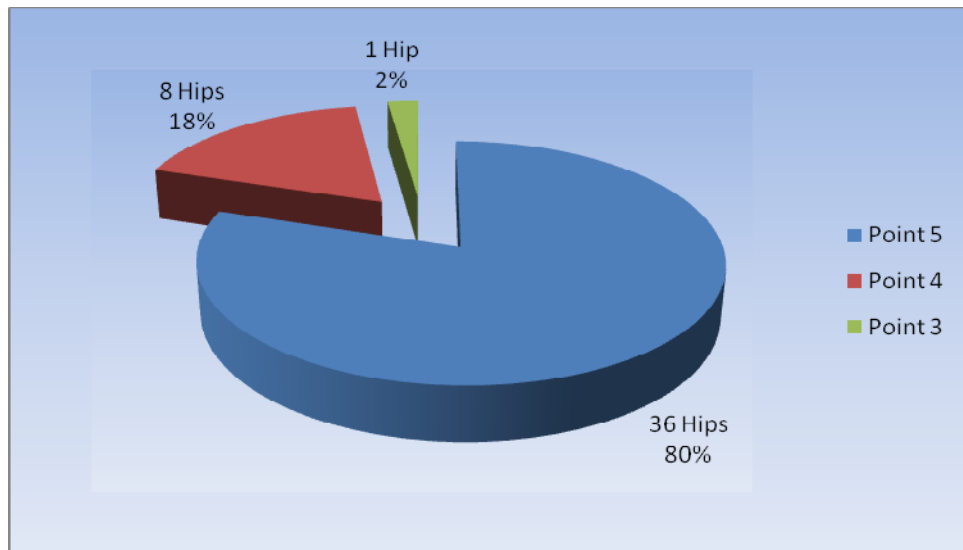


Fig. 2. Evaluation of patients' range of joint motion.



Fig. 3. The patient's radiography in the a) preoperative period, b) early postoperative period and c) follow-up (85 months) period.

#### 4. Discussion

Secondary surgery interventions (femoral osteotomy, pelvic osteotomy or their combinations) are required in addition to OR in patients who were not treated until they were 18 months old. There are several discussions regarding the timing and application of interventions (8). There are authors who propose femoral and acetabular osteotomy with OR at the same session, while others argue that one should wait for the spontaneous remodeling of the acetabulum after concentric reduction (8-10).

It has been reported that the rates of recovery in the AI values were around 10 degrees in the early periods after the operation (11). Also it has been reported that the rate of the recovery rose up to 26 degrees during follow-up (5, 12-15). In our study, the rates of the recovery in AI values in the early period were compatible with the literature, and an increase was recorded in the rates of the recovery in the control measurements. Yet, a significant relationship was not found between the recovery percentage of AI and the age at which the operation was performed.

After OR and SIO, good and excellent results were reported at the rate of 80-98.2 % according to McKay criteria of clinical evaluation (2,5,11,14). It was also reported that there was motion restriction and joint stiffness at rates up to 15% (5,16). The joint contracture in the hip was given at the rate of 1.6%. Performing surgical operations at older ages, complications like infection and the use of an additional surgery like femoral osteotomy negatively affect clinical results (17). The clinical results that we obtained from our patients were similar to the values indicated above. Yet, in another patient with deep wound infection, only 4 points ROM could be reached by performing intensive physiotherapy.

The rates of re-dislocation after the operation have been reported between 3.2 and 5.6% (14,18,19). Failure to perform the femoral derotation of the osteotomy due to the excess of anteversion and inadequate capsulography has been determined as one of the reasons for these complications (7,11,16). In our study, the rate of the re-dislocation was found to be slightly higher (6.6%). In two of our patients who were operated again, excessive femoral anteversion was detected, and they were treated with osteotomy of derotation. As in the literature, the most important reason for re-dislocation was found to be excessive anteversion. Attention should be paid to the excessive anteversion during the operation and derotation osteotomy should be

performed under all circumstances when it is needed.

While the rates of superficial infection in the literature have varied between 1.47% and 5.2% after SIO (20,21), the rates of the deep infection have been given between 1.3% and 2.5% (18,22). Such superficial infection, however, did not develop in any of our patients. Our rate of deep infection (2.2%) was consistent with the literature.

The rates of supracondylar fracture after SIO have been reported between 0.8% and 6.4% (20,22). In one of our patients (2.2%) supracondylar femur fracture developed while the patient was followed-up in Denise brown splint. This patient was treated by encasing in the pelvipedal plaster. The relatives of the patients with DDH should be warned that the fracture of the femur may develop due to the low-intensity traumas.

Consequently, OR and Salter innominate osteotomy is an effective and a safe method in patients with DDH between 18 months and 6 years old. Appropriate selection of patients and attentiveness to possible complications will increase the success of the treatment.

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