

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

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### Abstract

**Objectives:** To assess the results of simultaneous open reduction and Salter Innominate Osteotomy for developmental dysplasia of the hip in our context where there is a tendency for these cases to present late without having undergone any treatment previously. **Material and Method:** We retrospectively reviewed the record files and radiographs of 22 dislocated hips of 20 patients managed with simultaneous open reduction and Salter osteotomy at Hospital and Rehabilitation Centre for Disabled Children from 1999 to 2001. Only eight patients with 9 hips with purely developmental dysplasia of hip aged one to seven years were included. The acetabular index on the initial and final radiographs was measured. The neck shaft angle was also measured. All radiographs were evaluated to determine the presence of avascular necrosis of the femoral head and position of the head after the operation. Clinical results were determined using modification of the McKay criteria ( Pain, ROM, LLD, Containment and Gait) . Follow-up ranged from a minimum of 1 year to a maximum of 5 years (average 3 years and 1 month). **Results:** The results were excellent in 7 hips (77.77%) good in 1 hip (11.11%) and poor in 1 hip (11.11%) according to modified McKay criteria.. No complications related to infection, graft fracture, vascular or neural injury were encountered. **Conclusion:** When case selection for surgical treatment is appropriate, a reasonable excellent to good result can be expected even in cases such as ours which present late.

**Key Words:** Developmental Dysplasia of Hip, Open Reduction, Salter Osteotomy

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### Introduction:

Most children with hip dislocations or dysplasia presenting our hospital for evaluation are result of infection. Developmental Hip dysplasia is an uncommon problem so far in our society. The reason for this may be related to the social custom of carrying the newborn with the hips in wide abduction. Most of the literature regarding hip screening indicates that all cases of DDH may not be detectable at birth and that all late cases are not always previously misdiagnosed cases.<sup>1</sup> In a country such as ours where screening program is nonexistent and medical care scarce, it is not uncommon to see patients presenting late for treatment<sup>2</sup>. Treatment of DDH in older children who have begun to walk is difficult due to adaptive shortening of extraarticular soft tissues, and deformity of the bony structure including acetabular dysplasia, angulation and rotation of the proximal femur<sup>3</sup>. The success rate of the treatment of DDH is directly proportional to the age at the time of treatment<sup>2,3</sup>. This study assessed the clinical and radiographic results, complications following simultaneous open reduction and Salter osteotomy with or without derotation varus osteotomy in 9 developmental dysplasia of hips in 8 patients managed at HRDC from 1999 to 2001.

### Materials and Methods:

We retrospectively reviewed the record files and radiographs of 22 dislocated hips of 20 patients managed with simultaneous open reduction and Salter osteotomy at HRDC from 1999 to 2001. The following cases were excluded:

- a. Dislocation due to neuromuscular diseases
- b. Dislocation due to infection of the hips
- c. Previous treatment for dislocation or treatment other than described
- d. Two different procedures for bilateral dislocation
- e. Cases with associated foot anomalies
- f. Fracture of femur following the procedure while on hip spica
- g. Children lost to follow up after 3 months of operation

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Only 8 patients (9 hips) with purely developmental dysplasia of hip aged one to seven years (average 4 years and 4 months) who underwent simultaneous open reduction and Salter osteotomy were included in this study. One patient aged 7 years underwent additional varus derotational osteotomy. All patients underwent preoperative skeletal traction for 2 weeks. A case with bilateral dislocation was operated in two settings an interval of one year. Hip spica cast was given to all cases postoperatively for 3 months.

The acetabular index on the initial and final radiographs was measured. The neck shaft angle was also measured. All radiographs were evaluated to determine the presence of avascular necrosis of the femoral head and position of the head after operation.

Clinical results were determined using modification of the McKay criteria (Pain, ROM, LLD, Containment and Gait)<sup>4</sup>.

**Results:**

Of the 8 patients 2 were male and 6 were female. One patient had bilateral involvement, 3 patients had

right side involvement and 4 patients had left side involvement. Of 8 patients 3 were younger than 4 years of age and 5 were older than 4 years of age. (Table 1)

Follow-up ranged from a minimum of 1 year to a maximum of 5 years (average 3 years and 1 month). (Table 1)

The average preoperative acetabular index was 34 degrees (range 18-50), and the average postoperative acetabular index was 15.22 degrees (range 10-20). The average preoperative neck shaft angle was 142 degrees (range 130 -160), and the average postoperative neck shaft angle was 141.11 degrees (range 130-150). (Table 1)

Pain following surgery was noted in 1 hip. This was the same case with subluxation, avascular necrosis and resorption of the femoral head. (Table 1)

Postoperative average flexion and abduction were 107.08 degrees and 30.75 degrees respectively. (Table 2)

**Table 1.** Clinical and radiological details of patients included in this study with McKay grading.

Cases	Age at Op. (Years)	Follow Up	AI (Degrees)		NSA (Degrees)		LLD (cm)		Modified McKay Grading	Remarks	
			Preop.	Post op.	Pre op.	Postop.	Preop.	Postop.			
SK	4	14 months		35	10	140	135	2	0	Excellent	
KS	6	5 years	Rt.	44	20	135	140	0	0	Excellent	B/L DDH
			Lt.	50	20	135	145	0	0	Excellent	
HP	1	2 Years		42	20	143	150	2	0	Excellent	
SG	4	5 years		25	20	140	130	3.5	3	Poor	Pain, Subluxation, AVN, Resorption of Femoral Head, Lost to Follow up
PD	7	4.5 Years		20	12	130	145	2.5	0.3	Excellent	Derotation Varus Osteotomy
PS	3	3 Years		20	15	140	140	2	0.5	Excellent	
JK	3	1 Year		42	10	155	145	3	0.5	Excellent	
MJ	7	3 Years		18	10	160	140	3.5	0.5	Good	AVN

Op. Operation AI Acetabular Index NSA Neck Shaft Angle LLD Leg Length Discrepancy B/L Bilateral AVN Avascular Necrosis

**Table 2.** Range of motion: Flexion and Aduction ( Degrees)

<b>Flexion</b>	60-140° ( average 107.08 )
<b>Abduction</b>	15-45° (average 30.75)

Marked leg length discrepancy of 3 cm was noted in 1 case. This case was the same child with avascular necrosis of the femoral head, subluxation of femoral head and preoperative 3.5cm leg length discrepancy.( Table 1)

All hips were concentrically reduced, except for 1 hip. Subluxation was noted in 1 hip (11.11%). The age at operation was 4 years. This patient was lost to follow up after 9 months of surgery though she was advised further treatment. She again revisited the hospital 5 years after the surgery with pain and marked shortening of the affected limb.

Avascular necrosis of the femoral head was noted in 2 hips (22.22%). The ages at operation were 4 and 7 years respectively. One of the cases has complete resolution of head.

Functional results were rated as excellent in 7 hips (77.77 %), good in 1 hip (11.11%) and poor in 1 hip (11.11%) according to modified McKay criteria<sup>4</sup>. (Table I, II and Illustrations I & II)

**Illustrations I Excellent result: Preoperative, postoperative 3months & 3 years**  
**X- rays**



**Preop.**



**F/U 3 months**



**F/U 3 Years**

## Illustration II Complication: Avascular necrosis of femoral head



### Discussion

DDH is rare in our patient population and is very easily confused with other causes of hip dislocation. A careful history and examination and a critical analyses of radiographs may guide the examiner to the correct diagnoses. Hip sepsis which ranks number one as the cause of hip dislocation or subluxation in neonatal age group generally produces a more profound effect on the femoral head, whereas in DDH acetabular dysplasia is more pronounced.. The successful treatment of DDH includes concentric reduction, maintenance of joint congruity, maintenance of the hip in stable position with out interference of the blood supply, minimization of immobilization time and good remodeling of the hip<sup>3</sup>.

Many treatment modalities have been reported to achieve an excellent result for DDH with indications depending on the age of the patient and specific pathologic conditions. Treatment becomes more difficult as patients grow older<sup>5,6</sup>. A combination of open reduction with pelvic and or femoral osteotomy is usually required to facilitate stable reduction in the older children. Pelvic osteotomy can redirect the acetabulum, increase the stable zone of the hip, and facilitate the development of the hip toward normal. Osteotomy of the innominate bone, an operation devised by Salter, is useful only when any subluxation or dislocation has been reduced or can be reduced by open reduction at the time of osteotomy. The entire acetabulum together with the pubis and ischium is rotated as a unit, the symphysis pubis acting as a hinge. The osteotomy is held open anterolaterally by a wedge of bone, and thus the roof of the acetabulum is shifted more anteriorly and laterally. The osteotomy is contraindicated in patients

with nonconcentric hips or severe dysplasia. If reduction requires excessive force (compression), especially after a pelvic osteotomy, then femoral shortening is appropriate. Limited varus and derotation can be performed if necessary<sup>7</sup>.

Huang and Wang reviewed a comparative study of nonoperative treatment versus operative treatment of DDH between the ages of 13 and 17 months. They concluded that neglected DDH in patients of walking age was better treated by open reduction plus pelvic osteotomy, with good to excellent results in 31 of 32 hips<sup>3</sup>.

Salter advised innominate osteotomy in between ages 18 months to 6 years. But we selected cases of ages ranging from 1 year to 7 years. We obtained excellent result in the case who was 1 year of age at the time of operation without avascular necrosis of the femoral head Overall excellent result was 77.77 %, good result was 11.11 % and poor result was 11.11% in our series. 100% excellent result was obtained in cases younger than 4 years age, 60% excellent result in cases older than 4 years of age as compared to 93.6%, 56.7% in Salter's series of age groups 1.5-3 years and 4-6 years respectively<sup>8</sup> and 79-96% in 1.5-4 years group, 46-66% in 5-7 years group and 41-75% in older than 7 years in McKay, Berkeley and Severin's series<sup>9</sup>. Kapukaya et al. reported excellent to good result in 95.4%, 72.2% and 62.5% in 1.5-3 years group, 4-6 years group and 7-10 years group respectively<sup>10</sup>.

The acetabular index and neck shaft angle in postoperative follow-up are helpful in understanding

acetabular development and acetabular and femoral relationship. The average improvement of the acetabular index was 18.78 degrees, from 34 degrees (range 18-50) preoperatively to 15.22 degrees (range 10-20) postoperatively. Barrett et al. reported an average 16 degrees improvement in acetabular index with Salter osteotomy<sup>5</sup>. Kapukaya et al. reported an average 16.2 degrees improvement in acetabular index<sup>10</sup>. Keskin et al reported an average 15.4 degrees improvement in acetabular index<sup>11</sup>. In this study improvement of acetabular index was slightly superior. The average neck shaft angle was 142 degrees (range 130-160) preoperatively and was 141.11 degrees (range 130-150).

Avascular necrosis of the femoral head is one of the most serious complications in treating DDH and can lead to leg length discrepancy, head and neck deformities, relative overgrowth of the greater trochanter, acetabular dysplasia, joint incongruity and late arthritis. In our series 2 out of 9 hips (22.22%) developed avascular necrosis. This was seen in cases older than 4 years of age. One patient was lost to follow up for a long time and developed resorption of the head while the other came for regular follow up. The second case was managed with non-weight bearing for a long time and he is now remodelling. Kapukaya et al<sup>10</sup> reported 12.3% Tonnis<sup>12</sup> reported 5.5% and Tomak et al<sup>13</sup> reported 28.9% avascular necrosis in their series.

### Conclusion

Simultaneous open reduction and Salter osteotomy is an effective method owing to correction of acetabular maldirection. When case selection for surgical treatment is appropriate, a reasonable excellent to good result can be expected even in cases such as ours which present late. DDH being a dynamic disorder, the cases reviewed will be closely followed up to see how functional gain or loss will further manifest with time.

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