

A One Stage Open Reduction With Salter's Innominate Osteotomy And Corrective Femoral Osteotomy For The Treatment Of Congenital Dysplasia Of The Hip

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Citation

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Abstract

Background: Reorientation of the acetabulum is often necessary in the treatment of neglected dislocations in children with developmental dysplasia of the hip. Salter in 1961 described the innominate osteotomy for acetabular dysplasia by redirection of the acetabulum as one piece. We retrospectively reviewed our results in children of walking age group who had undergone a one stage procedure with Salter's innominate osteotomy, open reduction and femoral osteotomy (TRIAD).

Methods: 39 hips were reviewed in 31 patients. The average patient age at surgery was 32 months (range 18-84 months). Pre-operative radiological evaluation of hips identified 29 type III and 10 type IV hips based on the Tonnis grading system in the treatment of congenital dislocation of hip.

Results: The mean duration of follow-up was 45 months (range 31-73 months). At the latest review 74.3% clinically and 66.6% radiologically were good or excellent. Avascular necrosis was identified in 4 hips (10.3%). One hip required revision open reduction and one patient developed pelvic osteomyelitis.

Conclusions: Our initial experience with the TRIAD yielded a satisfactory result in our series. The treatment time can be significantly shortened by a one stage procedure. Most favourable results were obtained in < 4 year age group.

INTRODUCTION

Developmental dysplasias of the hip is a common entity in the western world usually presenting as a complex orthopaedic problem. Conservative and operative treatment aims at normalization of the articular congruity to promote the development of the joint elements by mutual stimulation. It is claimed that adequate acetabular remodeling is possible during the first 18 months of life. After this, satisfactory development cannot always be assured by non-operative treatment following closed reduction.¹ As the child gets older more secondary deformities develop which can be grouped under 3 major pathological entities, acetabular dysplasias, subluxation of the femoral head with femoral neck-shaft and antiversion deformities and secondary soft tissue contractures. Many treatment options have been proposed for developmental dysplasias of the hip. Among these are (1) closed reduction^{2,3}, (2) closed reduction combined with pre-operative traction or adductor tenotomy⁴, (3) open reduction⁴, (4) open reduction combined with either a femoral or pelvic osteotomy^{5,6,7,8,9,10,11,12,13} and (5) open reduction combined with pelvic and femoral

osteotomies.^{14,15,16} All these protocols have advantages and disadvantages.

The combined use of open reduction with Salter innominate osteotomy and corrective femoral osteotomy under the same anesthetic, is controversial. It has been suggested that this combination may increase the rate of complications, in particular of avascular necrosis of the femoral head.^{14,17} The redirection of the acetabulum to provide increase anterior coverage may lead to secondary posterior subluxation or dislocation.¹⁸

The purpose of this study was to determine the effectiveness, safety and to assess the incidence of complications of the TRIAD procedure in DDH. This procedure has the theoretical advantage of decreasing the need for subsequent operations for femoral or acetabular deformities and eliminating the need for prolonged post-operative casting or splinting.

PATIENTS AND METHODS

39 hips in 31 patients operated for the developmental

dysplasia of hip with a one-stage open reduction, Salter innominate pelvic osteotomy and femoral shortening derotation-varization osteotomy were reviewed. The study was conducted in patients who were operated between 1987 to 1996 in our institute pediatric orthopaedics and traumatology hospital. Children who had neurologic diseases, teratologic dislocation and any prior surgical treatment including open reduction were excluded from this study.

There were 24 girls and 7 boys; the affected hips were left sided in 13 and right sided in 10. Eight patients were affected bilaterally. The mean age at diagnosis was 14.6 months (birth to 41). The mean age at operation was 32 months (18 to 84) and the mean follow-up from operation to the latest review was 45 months (31 to 73).

Twelve patients had previous conservative treatment of which 10 had undergone closed reduction and splintage while the other 2 were treated by traction and closed reduction. Seven of the above 12 patients had only satisfactory to poor results.

All patients were evaluated radiologically and clinically. Pre-operative grading of dislocation was based on Tonnis classification₂₃. 29 grade III (74.4%) and 10 grade IV (25.6%) hips were identified on pre-operative radiological evaluation.

SURGICAL TECHNIQUES

We followed the recommendations of Salter and Dubos (1974)^{1, 18} for the innominate osteotomy surgical technique and the femoral osteotomy was similar to that described by Pregrag Klisic (1976)₂₀. The operative procedure involved a single incision. Salter's bikini incision is extended distally towards the greater trochanter after which it is curved and extended along the lateral aspect of the femur.

The capsule was opened through a T shaped incision, the medial limb of the T passing over the hour glass constriction and down to include the transverse ligament. The joint is opened and its relationship to the soft tissue structures is studied. The interposed soft tissues in the joint are excised. The femoral osteotomy is carried out by the gigly saw at the lower border of the lesser trochanter. Femoral shortening is done on the distal fragment with the amount being estimated by the amount of superior dislocation of the femoral head. It corresponds to the distance between the upper pole of the femoral head and the roof of the true acetabulum in pre-

operative radiographs.

Redundant capsule was excised and a capsulorrhaphy performed in all cases with the lateral suture being passed through the apex of the everted limbus to ensure that the latter remained outside the head, thereby helping to provide a stable reduction. Femoral osteotomy was fixed by an angled plate by achieving the neck-shaft angle to 110° and correcting the femoral antitortion to <20°.

After the open reduction, capsulorrhaphy and femoral osteotomy and its fixation, a pelvic osteotomy was performed as described by Salter and Dubos. Attempts were made to reduce the acetabular index to <20° and ideally close to 0°. The resected femoral segment was used as a bone graft for the pelvic osteotomy and in cases of insufficient graft it was then obtained from the iliac crest. Pelvic osteotomy was fixed by two Kirschner wires.

Post-operatively, the hips were immobilized in a 1 ½ hip spica for 6-8 weeks. This was changed to an abduction splint for a further 4 weeks during which time the hips were mobilized progressively under the guidance of a physiotherapist. Kirschner wires were removed after consolidation of the osteotomy site. Progressive walking was advised after the removal of the Kirschner wires. Patients with bilateral dysplasias had the procedures on both hips at a mean interval of 4.3 months (range 3 to 13 months).

RESULTS

All patients were assessed clinically and radiologically. Clinical assessment was done on modified Mc Kay's classification (Table II)⁹, radiological assessment was done on Severin's classification₂₁ and avascular necrosis was assessed on Bucholz and Ogden's classification (Table I).₂₂ At the latest review 74.3% were clinically and 66.6% were radiologically found to have excellent to good results (Table III). The average acetabular index decreased from 39° pre-operatively (range 25-55°) to 11° post-operatively (range 6-24°). The average neck-shaft angle decreased from 131° before surgery (range 125-146°) to 116° after surgery (range 108-141°). The average post-operative central-edge angle was 41° (Range 22-61°).

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Figure 1

Table I. Bucholz and Ogden's classification of avascular necrosis of femoral head in Congenital dislocation of hip.22

Grade	Definition
I	Sites of temporary vascular occlusion, irregular ossification in secondary center.
II	Metaphysial and epiphysial irregularities, premature fusion of lateral epiphysis and metaphysis.
III	Impaired longitudinal growth of capital femoral epiphysis, irregularly shaped femoral head.
IV	Impaired longitudinal and latitudinal growth, pre mature epiphysial closure.

Figure 2

Table II. Modified criteria of Mc Kay for clinical evaluation of results of hip reduction.9

Clinical Result	Definition
Excellent	Painless, stable hip; no limp; >15° internal rotation; negative Trendelenburg sign.
Good	Painless, stable hip; slight limp; slight decrease in hip motion; negative Trendelenburg sign.
Satisfactory	Minimum pain; moderate stiffness; positive Trendelenburg sign.
Poor	Significant pain; gross stiffness; positive Trendelenburg sign.

Figure 3

Table III : Post-operative clinical results based on the modified Mc Kay's classification and the radiological results based on the Severin's classification.

GROUPS	I (<2 yrs)	II (2-4 yrs)	III (4-6 yrs)	IV (>6 yrs)	TOTAL
No. of patients	11	15	8	5	39
CLINICAL					
Excellent	6 (54.55%)	4 (26.67%)	2 (25%)		12 (30.77%)
Good	3 (27.27%)	9 (60%)	3 (37.5%)	2 (40%)	17 (43.59%)
Satisfactory	2 (18.18%)	2 (13.33%)	3 (37.5%)	2 (40%)	9 (23.08%)
Poor				1 (20%)	1 (2.56%)
RADIOLOGICAL					
Grade I	5 (45.46%)	7 (46.67%)	1 (12.5%)		13 (33.33%)
Grade II	4 (36.36%)	4 (26.67%)	3 (37.5%)	2 (40%)	13 (33.33%)
Grade III	2 (18.18%)	3 (20%)	3 (37.5%)	1 (20%)	9 (23.08%)
Grade IV		1 (6.66%)	1 (12.5%)	2 (40%)	4 (10.26%)

Figure 4

Table IV : Post-operative complications after combined open reduction , Salter innominate osteotomy and femoral shortening , derotation , variazation osteotomy.

	Number	Percentage
Avascular necrosis	3	7.7
Secondary subluxation	1	2.6
Surface infection	1	2.6
Pelvic Osteomyelitis	1	2.6
Significant limb length discrepancy	2	5.1
Femoral diaphysial fracture	1	2.6

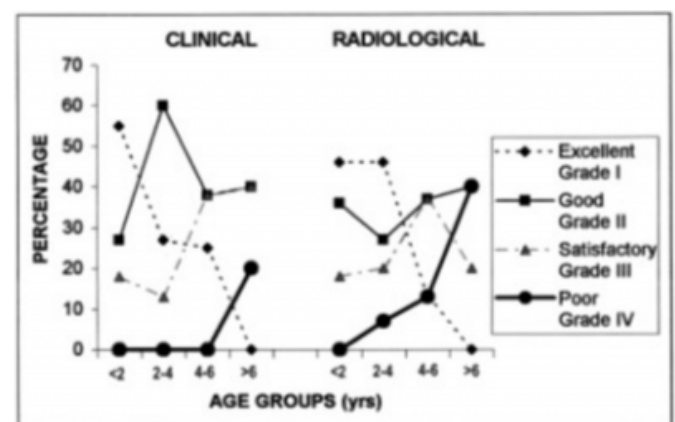
Four hips developed avascular necrosis. 3 were grade II and one was grade III . All the above four grade II and grade III hips had an unsuccessful closed reduction with a prolonged conservative treatment. Three had been asymptomatic and painless after three years of surgery while the other is being kept under observation for further treatment.

One hip required a revision open reduction after 2 weeks. This patient went on to develop grade II avascular necrosis. After surgery one patient went on to develop osteomyelitis of the ilium. 6 weeks after the initial surgery the K-wires were removed from the pelvis along with sequestrectomy. No further intervention for osteomyelitis was necessary after three years of implant removal. 8 patients developed leg-length discrepancies of which six were of asymptomatic and <1 cm while the other two had >1.8 cm shortening. 3 hips (7.7%) developed coxa magna, but in no case did this interfere with the concentricity of reduction or the radiological grading. Other complications are listed in table IV.

Results were analysed in various age groups to identify the most favourable age group for the TRIAD. Group I (<2 yrs), Group II (2-4 years), Group III (4-6 years) and Group IV (>6years). Result curves are shown in figure I. No significant difference was noticed in group I and group II while the success rates significantly decreased in group III and group IV. Worst prognosis was noticed in group IV with 60 % of the patients having satisfactory to poor results both clinically and radiologically.

Figure 5

Figure I: Figure showing the clinical and radiological curve assessments at the latest follow-up in various age groups



DISCUSSION

Once diagnosed the treatment of hip in this age group is

largely on the bias of the surgeon. Despite concerns that open reduction leads to joint stiffness and increased incidence of avascular necrosis, the merits of open reduction are clear.³ Closed reduction has been associated with high incidence of avascular necrosis (23.7%) and a high incidence of secondary procedures (66%).^{2, 23} After the decision has been made a few authors consider corrective femoral osteotomy is quite sufficient for the acetabular remodeling to take place in course of time,^{5, 6, 8} while others such as Salter think that a direct realignment of the acetabulum is a more dependable form of treatment that does not rely on the indirect influence for the acetabular remodeling.¹

There have been numerous reports discussing the merits of a more aggressive surgical approach which includes a single procedure combining an open reduction with a femoral or pelvic osteotomy. Galpin et al¹⁶ have reported 75 %- 85% of satisfactory results radiologically and clinically. Rachid k Haidar et al¹¹ have reported 97.3% clinically and 83.8% radiologically excellent to good results, while Salter and Dubos have reported 93.6% of good to excellent results in children of younger age group.¹

Our review suggests that acceptable results are produced by combined open reduction, Salter innominate osteotomy and femoral shortening, derotation-varization osteotomy. At the latest review 76.9% had clinically and 69.2% radiologically good to excellent results.

On comparing our results with various age groups, our study confirms the claims of Salter and Dubos that the success rate drastically comes down when operated in children of older age group. Results based on the different age groups are listed in figure I.

The most feared complication of treatment in case of dysplastic dysplasia of hip is avascular necrosis and recurrent subluxation. Most of the classification systems for avascular necrosis are comprehensive, and when the radiological changes are minor it is difficult to classify. In our series 4 hips (10.3%) developed avascular necrosis based on Bucholz and Ogdens classification. Of the 4 hips, one hip classified under grade III avascular necrosis is kept under observation for deforming femoral head and limb shortening by 1.8 cms. This patient has so far satisfactory clinical result. Increase incidence of Avascular necrosis was noticed when Salter's osteotomy was combined with Open reduction^{1, 24, 25}. Our data clearly indicates that the possibility of Avascular necrosis in younger age groups of less than four years even

with combined procedures is significantly less than in age groups of greater than four years. Reported rates of the incidence of avascular necrosis vary considerably, ranging from 3.8% - 37%.^{1, 4, 11, 20}

The re-operation rates for secondary subluxation in our series one hip (2.6%) compares favorably with other reports ranging from 5%-14.3%.^{1, 11} A correct technique of capsulorrhaphy helps to prevent posterior displacement in the early post operative period while the hip is still remodeling. The femoral shortening, derotation - varization osteotomy effectively lengthens the soft tissue that cross the hip and decreases the pressure on the femoral head during and after the open reduction.

The combined procedure of open reduction, Salter innominate osteotomy and the femoral shortening, derotation- varization osteotomy is technically demanding as compared with a multistaged procedure for dysplastic dysplasias of hip. While the multistaged procedure has the disadvantages of many in patient periods, reoperation through previous surgical scars, many periods of immobilization and rehabilitation, the combined treatment provided carried out efficiently reduces the treatment period to 12 weeks with no apparent increase in avascular necrosis or reoperation and satisfactory clinical and radiological results. Better results of the TRIAD were noticed in age groups of less than 4 years. In age groups of > 4 years, significant complications were noticed, thereby probably questioning the use of a radical procedure like TRIAD in developmental dysplasia of the hips.

CONCLUSIONS

In summary, the combined procedure is unique to our knowledge, and we support the use of this procedure in cases of high and neglected dislocations (Type III and Type IV) below the age of 4 years for the treatment of developing dysplasia of hips diagnosed late or after failure to respond to previous conservative treatment.

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