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Research article

Clinical and Radiographic Outcomes of Salter Osteotomy in Patients with Developmental Dysplasia of the Hip Joint: A study conducted in Ahvaz Imam Khomeini Hospital during 2006 to 2016

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ABSTRACT

Background and Objective: Developmental dysplasia of the hip (DDH) encompasses a spectrum of disorders associated with abnormal development of the hip, which might appear any time including during fetal life, infancy, or childhood. The aim of this study was to assess the clinical and radiographic outcomes of the patients underwent Salter innominate osteotomy (SIO) surgery.

Methods:A retrospective study was conducted on 40 children (44 hips) with developmental dysplasia of the hip in Imam Khomeini Hospital, Ahvaz, Iran during 2006 to 2016. The inclusion criteria included age range of 18 months to eight years of age and acetabular index being higher than or equal to 40 degrees. The exclusion criteria included connective tissue diseases, secondary dislocation due to previous infection. After surgery, patients were evaluated clinically, and with regard to the rate of the dislocation or subluxation of hip joint, hip joint congruity, and radiographic findings based on the Severin's criteria, Tonnis radiological classification, and McKay's classification, and acetabular index, respectively.

Results: Acetabular index after surgery was significantly reduced compared with before surgery.Based on the Tonnis classification 90.9% of patients were on class I, II in postoperative.Based on the McKay's classification 79.53% of patients showed good to excellent results after surgery. In assessing postoperative radiographic findings based on theSeverin's criteria 78.52% of patients were in the class Ia and Ib.

Conclusion: Salter innominate osteotomy can be used as a good method for treatment of patients with Developmental dysplasia of the hip at an early age.

Keywords: Developmental dysplasia of hip, Osteotomy, Salter method

INTRODUCTION

Acetabular dysplasia is a known cause of early osteoarthritis of the hip joint. Pelvic osteotomies reduce the pressure on the edge of the shallow acetabulum by increasing contact area and normalizing forces acting on the hip joint during weight bearing(1, 2). The cause of developmental dysplasia of the hip is unknown but certain factors such as sex, birth order, family history, intrauterine position, type of delivery, joint laxity and postnatal positioning are among known causes of developmental dysplasia of the hip. Predisposing factors related to the developmental dysplasia of the hip are divided into three main groups: 1. Physiological, 2. Mechanical, and Genetic(3-5).Choosing the appropriate acetabular osteotomy depends on the age, pathologic anatomy of the acetabulum, the proximal femur and the experience of the surgeon(6, 7).

Pemberton pericapsular osteotomy (PPO) and Salter innominate osteotomy (SIO) are the most common pelvic osteotomies(6-10). In ages over one and half year the shape of hip bones usually changes. In Salter osteotomy surgery, surgeon breaks the hip bone in certain areas and places them in a proper position to fuse in the new position and the modified form of the bones around the hip joint to become more natural. Pemberton method of surgery is technically more difficult to perform. In addition to that, this surgery changes the configuration and capacity of the acetabulum, and may lead to asymmetrical relationship between the acetabulum and the femoral head. Therefore, the need for the reconstruction of the acetabulum might arise. In Iran, the common practice of the treatment of congenital dislocation in ages 1.5 years and above is open reduction and Salter osteotomy(11). The aim of this study is to assess the clinical and radiographic outcomes of Salter Osteotomy surgery method in patients with developmental dysplasia of the hip joint. The findings of this research may lead to finding a suitable method (osteotomy Salter or Pemberton) as one of the key actions in the treatment of developmental dysplasia of the hip joint in patients aged over two years, which ultimately improves the treatment goals and quality of the life in patients.

MATERIALS AND METHODS:

This was a retrospective study on the treatment outcomes of 40 patients (44 qualified hip joints) with DDH referring to Ahvaz Imam Khomeini hospital between year 2006 and 2016. The study was approved by the ethics committee of the University of Medical Sciences of Ahvaz (code of ethics: IR.AJUMS.REC.1396.26). Informed consent was received from all patients. Study population consisted of children with DDH with minimum age of 10 months and a maximum age of eight years with acetabular index higher than or equal to 40 degrees, who had undergone Salter osteotomy. In case of the need for and to prevent hip joint reduction under pressure and to reduce osteonecrosis of the femoral head, femoral shortening was performed. Then capsulorrhaphy was conducted and spica cast was done for eight weeks. Subjects were excluded from the study in cases of acetabular index less than 40, age less than 10 months or more than eight years, having connective tissue diseases, secondary dislocation due to previous infection, and having acetabular dysplasia with special syndrome background. All patients clinically, and based on McKay's classification(12)underwent clinical examination, in terms of the presence of hip pain, patient claudication, range of motion of hip joint, and presence or absence of Trendelenburg sign. Radiography assessment was performed for all patients before surgery and acetabular index (AI), and the amount of dislocation or subluxation of the of the hip joint based on Tonnis radiological classification(13), and hip joint congruity according to the classification of Severin's criteria(14) were recorded for each patient. To determine The AI and the degree of dislocation of the hip joint based on Tonnis classification were determined using the last radiography taken during follow-up. The evaluation of the results of radiography of the treatment was also carried out according to Severin's criteria based on the last radiography of the follow-up of the patients. To investigate the existence of osteonecrosis of the femoral head based on MacEwen and Kalamchi classification system(15), during the follow-up, all radiographs of the patients were evaluated and the results were recorded. Other side effects were also asked and recorded in the last follow-up. At the last follow-up patients were evaluated with McKay's classification.

RESULTS

In this study, the treatment outcomes of 40 patients (44 qualified hip joints) with DDH including 4 (10%) boys and 36 (90%) girls, who had undergone osteotomy using Salter method, were evaluated. Mean age of patients at the time of surgery was 16.84 ± 2.96 months (10 - 24 months) and in the last follow up was 59.72 ± 18.2.The involved side of the patients included 11 patients (%25) with right side involvement, 21

patients (47.72%) with left side involvement and 8 patients (18.18%) with both sides involvement. From 4 patients who had two-sided involvement, 4 of patients had only one hip going under Salter Osteotomy operation and the other side was operated using another method and 4 patients had both their hips treated with Salter method and were studied (Table 1).

Table 1. The state of the involved side in the patients

The involved side		Patients (%)	
Right		11 (25%)	
Left		21 (47.72%)	
Both side	Both side treated with salter method	8 (18.18%)	4
	One side treated with salter method		4

Acetabular index before operation was 39.94 ± 1.57 degrees in average, while in radiography after the surgery in average it reduced to 21.76 ± 2.37degrees (19 to 30 degrees). The amount of the reduction of acetabular index with regard to before operation was significant.

In the clinical evaluation based on McKay's classification, from the total sum of 44 hips 19 cases (43.18%) were poor and 25 cases (56.81%) were fair. In the last performed clinical examination during last visit after operation 21 hips (47.72%) were excellent, 14 cases (31.81%) were good, 5 cases (11.36%) were fair and 4 cases (9.09%) were poor, which compared to before surgery they had significant statistical difference and with regard to clinical status, improvement was reported (P= 0.001) (Table 2).

Table 2. Clinical assessment of patients based on McKay's classification

Grade	Before surgery (%)	In the last follow up (%)
Excellent	-	21 (47.72%)
Good	-	14 (31.81%)
Fair	25 (56.81%)	5 (11.36%)
Poor	19 (43.18%)	4 (9.09%)

For the extent of hip joint dislocation before treatment based on Tonnis classification, from the total of 44 hips, 18 cases (40.9%) were in class III, 26 cases (11.44%) were in class IV. After surgery, this amount included 33 cases (75%) in class I, 7 cases (15.9%) in class II, 2 cases (4.54%) in class III, and 2 cases (4.54%) in class IV. The obtained results show statistically and clinically significant improvements compared to pre-surgery (P=0.000) (Table 3).

Table 3. Amount of hip joint dislocation before treatment based on Tonnis classification

Grade	Before surgery (%)	In the last follow up (%)
Class I	-	33 (75%)
Class II	-	7 (15.9%)
Class III	18 (40.9%)	2 (4.54%)
Class IV	26	2 (4.54%)

In the assessment of radiography results according to Severin's criteria, observations before operation included 31 hips (70.45%) in class Ivb and 13 hips (29.54%) in class V. While the results after treatment included 33 hips (75%) in class Ia, 8 cases (18.18%) in class Ib, 2 cases (4.54%) in class II and 1 case (2.27%) in class Iva. The comparison of the results before and after surgical treatment of patients was statically and clinically significant and they reported significant improvement (P=0.001) (Table 4).

Table 4. Radiologic outcomes based on Severin's criteria

Grade	Before surgery (%)	In the last follow up (%)
Class Ia	-	33 (75%)
Class Ib	-	8 (3.52%)
Class II	-	2 (4.54%)
Class IVa	-	1 (2.27%)
Class IVb	31 (70.45%)	-
Class V	13 (29.54%)	-

Eight cases (18.18%) from a total of 44 treated hips, in addition to Salter osteotomy, underwent femoral osteotomy as well.Patients were also evaluated for the occurrence of osteonecrosis of the femoral head, which in 2 cases (5.4%) osteonecrosis of the femoral head was reported.

DISCUSSION AND CONCLUSION

Congenital DDH should be treated in the first days of life; otherwise it will enter a complicated stage in terms of treatment. For treatment from the age of one year and older, different treatment methods have been suggested(2, 16-18). In Iran the routine surgery for children 1.5 years of age and older with dislocated hips, is open reduction and Salter osteotomy method. Patients who underwent Salter method surgery in this medical center from 2006 to 2016, including 40 patients (44 qualified hip joints) were evaluated.

Bursalı et al. (2008) evaluated the effectiveness of Pemberton (method) along with Salter osteotomy method in the treatment of the growth of hip dysplasia. In this study, they used 90 patients. In this study, 33 patients (44 hip joints) were enrolled, which were classified into two groups of less than and more than four years of age. In this study, theacetabularindex, Reimers index, acetabular depth-to-width ratios, Severin classification and Tonnis grading were evaluated. Twenty nine patients were girls and four patients were boys. In 19 joints the right side was involved, in 25 the right side was involved, and in eight patients both sides were involved. Clinical evaluation of patients in both groups showed similar results. However, radiographic assessment had showed better results in younger patients(16).In a study with a long term assessment, Ahmadi et al. (2003) investigated the open reduction and Salter osteotomy in patients with congenital dislocation of the hip(17). In this study from 143 hips studied, 66 cases (46.2%) had full hip movement, and 77 cases (53.8%) had different degrees of restriction of movement; and the highest degree of limitation was related to rotation and bending. Natural walking was present in 100 patients. Of 100 patients, 20 hips had necrosis, from other 43 cases with positive Trendelenburg, 27 hips (62.8%) had necrosis of the head of the bone. According to their findings, in patients who had excellent treatment outcome based on Harris Hip Scoring, in 123 hips (76.4%) subjects were less than four years of age at the time of surgery. The results of this study showed that this method is a valuable technique for the treatment of congenital hip dislocation from the ages of 18 months to 4 years, and doing the operation earlier in younger ages will be followed with better results(17).In present study, the patients were also treated at an early age (< 2 years) and the treatment outcomes after surgery were reported significant and substantial. In addition, due to the age of the patients in our study were low, postoperative complications such as necrosis was less reported.

Gulman et al. conducted a study to evaluate the long term treatment outcomes of the patients treated with DDH treated with Salter osteotomy method. In this study, 33 patients (52 hip joints) were studied and followed up in an average period of 13 years. The results of the evaluations were as follows: for 78.9% of hip joints a good or excellent clinical status and for 71.1% of them a good or excellent radiological status was reported. In addition, patients who underwent Salter surgery, the patients of under 4 year old age showed much better clinical (88.4%) and radiological (81.4%) outcomes. Radiological delay of types 2, 3, and 4 of avascular necrosis were seen in 34.6% of samples.

The results showed that the best time for the surgery is between the ages 18 months to 4 years(18).In present study, for 79.53% of hip joints a good or excellent clinical status and for 83.06% of them a good or excellent radiological status was reported. These results was similar to results of study of Gulman et al. related to patients patients who underwent surgery at age <4. The results of our study confirmed more effectiveness of Salter method inan early age. Considering that the long-term clinical assessment after Salter surgery has been carried out in few studies, the results of this study could confirm the significant

value of the treatment of congenital dislocation of the hip at an early age (10-24 months).

REFERENCES

1. Gillingham BL, Sanchez AA, Wenger DR. Pelvic osteotomies for the treatment of hip dysplasia in children and young adults. Journal of the American Academy of Orthopaedic Surgeons. 1999;7(5):325-37.
2. Wada A, Fujii T, Takamura K, Yanagida H, Taketa M, Nakamura T. Pemberton osteotomy for developmental dysplasia of the hip in older children. Journal of Pediatric Orthopaedics. 2003;23(4):508-13.
3. Force UPST. Screening for developmental dysplasia of the hip: recommendation statement. Pediatrics. 2006;117(3):898-902.
4. Sionek A, Czubak J, Kornacka M, Grabowski B. Evaluation of risk factors in developmental dysplasia of the hip in children from multiple pregnancies: results of hip ultrasonography using Graf's method. Ortopedia, traumatologia, rehabilitacja. 2007;10(2):115-30.
5. Stein-Zamir C, Volovik I, Rishpon S, Sabi R. Developmental dysplasia of the hip: risk markers, clinical screening and outcome. Pediatrics International. 2008;50(3):341-5.
6. Millis MB, Kaelin AJ, Schluntz K, Curtis B, Hey L, Hall JE. Spherical Acetabular Osteotomy for Treatment of Acetabular Dysplasia in Adolescents and Young Adults. Journal of Pediatric Orthopaedics B. 1994;3(1):47-53.
7. Harcke H, Kumar S. The role of ultrasound in the diagnosis and management of congenital dislocation and dysplasia of the hip. JBJS. 1991;73(4):622-8.
8. Tachdjian MO. Pediatric orthopedics: Saunders; 1990.
9. Utterback TD, MacEwen GD. Comparison of pelvic osteotomies for the surgical correction of the congenital hip. Clinical orthopaedics and related research. 1974;98:104-10.
10. Canale ST, Beaty JH, Azar FM. Campbell's Core Orthopaedic Procedures: Elsevier Health Sciences; 2015.
11. Ezirmik N, Yildiz K. Salter innominate osteotomy or Pemberton pericapsular osteotomy in treatment of developmental dysplasia of hip. Turkish Journal of Medical Sciences. 2012;42(6):1058-62.
12. Mckay DW. A Comparison of the Innominate and the Pericapsular Osteotomy in the Treatment of Congenital Dislocation of the Hip. Clinical orthopaedics and related research. 1974;98:124-32.
13. Tönnis D. An evaluation of conservative and operative methods in the treatment of congenital hip dislocation. Clinical orthopaedics and related research. 1976;119:76-88.
14. Schramm M, Hohmann D, Radespiel-Troger M, Pitto RP. The Wagner spherical osteotomy of the acetabulum. J Bone Joint Surg Am. 2004(suppl 1):73-80.
15. Kalamchi A, MacEwen G. Avascular necrosis following treatment of congenital dislocation of the hip. J Bone Joint Surg Am. 1980;62(6):876-88.
16. Bursalı A, Tonbul M. How are outcomes affected by combining the Pemberton and Salter osteotomies? Clinical orthopaedics and related research. 2008;466(4):837-46.
17. Aziz Ahmadi HAH. Open reduction and Salter Innominate Osteotomy for DDH (A long term survey). Iranian Journal of Orthopaedic Surgery. 2003;3(1):15-9.
18. Gulman B, Tuncay IC, Dabak N, Karaismailoglu N. Salter's innominate osteotomy in the treatment of congenital hip dislocation: a long-term review. Journal of Pediatric Orthopaedics. 1994;14(5):662-6.