



Triple pelvic osteotomy for the treatment of symptomatic acetabular dysplasia in adolescents and adults : A review of 42 hips

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We treated 42 hips with symptomatic acetabular dysplasia using triple pelvic osteotomy. The mean age of the patients was 20.7 years (12–47). The median follow-up was 50.3 months. The average Harris hip score improved from 74 to 92 points. Significant improvement from the preoperative to the latest follow-up evaluation was seen radiologically with reference to the center-edge angle, the anterior center-edge angle, the acetabular index and the femoral head extrusion index. Shenton's line was intact in 9 hips before the operation and it was intact in 40 hips at the latest follow-up. The cross-over sign was present in 15 hips before the operation and it was present in one hip after the operation. The results of this study demonstrated that triple pelvic osteotomy provides improved radiographic results and good symptomatic relief in acetabular dysplasia.

Keywords : hip dysplasia ; acetabular dysplasia ; triple pelvic osteotomy.

accomplish a prominent recovery of the dysplasia (7,24,27). The goals of the surgery are reorientation of the dysplastic acetabulum and normalization of the biomechanical relationship of the acetabulum and the femoral head. As a result, progressive degenerative osteoarthritis is delayed or can be prevented (15). Various types of acetabular and pelvic osteotomies have been described to redirect the dysplastic acetabulum (4,6,17,19,21,23). The Tönnis type triple pelvic osteotomy was designed to perform osteotomies close to the hip joint and also it avoids any major ligament attachment to the acetabular fragment which provides greater motion for acetabular fragment.

INTRODUCTION

The major deformity in developmental dysplasia of the hip involves the acetabulum, which presents as being smaller and shallower than normal. This poorly developed acetabulum causes an insufficient coverage of the femoral head, which results in a reduced weight-bearing surface and altered joint mechanics (8,24). Therefore, only an operation on the pelvic side of the joint can be expected to

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This study aimed to evaluate the clinical and the radiological outcome following triple pelvic osteotomy described by Tönnis et al (23) for the treatment of symptomatic acetabular dysplasia.

PATIENTS AND METHODS

We retrospectively reviewed 37 patients (42 hips) with symptomatic acetabular dysplasia who were treated with triple pelvic osteotomy between April 2007 and May 2012 (Figure 1,2). All operations performed by the senior author (CB). This study was approved by the institutional ethics committee. There were 34 women (38 hips) and 3 men (4 hips). The mean age at the time of operation was 20.7 years (range 12–47). They were followed for a mean of 50.3 months (24–85) after the osteotomy. The operation was performed on the right hip in 16 patients, the left in 16 patients and bilaterally in five.

In all patients osteotomies were carried out as described by Tönnis et al (23). In contrast to the original technique; the ischial osteotomy was extended to the border of the tuber ischium in order to increase the contact surface of the osteotomy site. Differently we performed an oblique pubic osteotomy with minimal periosteum dissection for avoiding pseudoarthrosis. Also no fixation was used for the ischial and the pubic osteotomies (Figure 3). Three screws were used for fixation of the iliac osteotomy. All patients received

thrombosis prophylaxis with low molecular weight heparin (Enoxaparin) for 4 weeks. No patient received prophylaxis for heterotopic ossification. Mobilization on crutches was started two days after the operation. Patients were not allowed to bear weight for 6 weeks. The crutches were usually discharged 3 months after the surgery.

Clinical evaluation was based on preoperative and final follow-up Harris hip scores (9). Radiographic parameters were measured preoperatively and at latest follow-up included the acetabular index of Sharp (AI) (20), center-edge angle (CEA) (28), the anterior CEA on false profile view according to Lequesne and Seze (3), the status of Shenton's line, the femoral head extrusion index (10) and the presence of cross-over sign (18). The film focus



Fig. 1. — Preoperative radiography of a right acetabular dysplasia in a 20 year-old female



Fig. 2. — Preoperative false profile view of the right hip.



Fig.3. — Postoperative AP pelvis radiography.

distance was 110 cm in all cases and all pre-operative and post-operative radiographs were evaluated by the same author (MEB) using the same goniometer.

The degree of osteoarthritis was evaluated preoperatively and at the latest follow-up by using modified Tönnis grades of osteoarthritis (7). Heterotopic ossification was classified according to the system of Brooker et al (2).

The criteria for operation included a minimum of six months of persistent hip pain and the evidence of acetabular dysplasia on the radiographs.

Percentage, average and mean standard deviation were used as descriptive statistics. The compliance of the interval data with normal distribution was evaluated using the Kruskal-Wallis test. The non-parametric circumstance bearing interval data was compared with the Wilcoxon test. The McNemar test was used to compare the independent groups.

RESULTS

The mean Harris hip score was improved from 74 (range 55–90) preoperatively to 92 (range 77–98) at the time of latest follow-up ($p < 0.001$). The rate of hips in the combined excellent/good Harris hip score category increased from 19% preoperatively to 93% at the final follow-up. There was a statistically significant post-operative improvement in all of the radiological indices (Table I and Figure 4,5).

Preoperatively, 21 hips (50%) had grade 0 osteoarthritis, 17 (40.5%) had grade 1 (Early

joint space narrowing) and 4 (9.5%) had grade 2 (Moderate joint space narrowing and moderate loss of femoral head sphericity) according to Tönnis grades of osteoarthritis. At the latest follow up the number of Tönnis grade 0 hips increased to 31 (73.8%) ($p < 0.001$). Nine hips (21.5%) were Tönnis grade 1 and two hips (4.7%) were grade 2 at the latest follow-up.

Complications

Transient sciatic nerve palsy was seen in 3 patients (7.1%) and all were fully resolved between 7 to 10 months. Non-union of the pubis was seen in 2 patients (4.7%). All were asymptomatic and required no further surgical treatment. Heterotopic ossification developed in 2 hips: Brooker class I in one hip and class II in one hip.

DISCUSSION

The treatment of acetabular dysplasia is controversial. Sometimes acetabuloplasties and pelvic osteotomies are practiced as prophylaxis against osteoarthritis even though there were no evident symptoms (11,26). After ten years of age, acetabular dysplasia cannot be satisfactorily managed with single osteotomies so triple pelvic osteotomies that allow greater acetabular correction become more suitable (23,24). Triple pelvic osteotomies rotate the position of the acetabulum without changing its shape and decrease the stress on the hip joint by increasing the area of the weight-bearing surface (11,15,27).

It was previously shown that an increase in the CE angle caused a decrease in the relative stress on the weight-bearing surface of the hip joint (11,27). Also an insufficient coverage of femoral head after periacetabular osteotomy had found as a risk factor for conversion to total hip arthroplasty (22). The Tönnis type triple pelvic osteotomy was designed to perform osteotomies close to the hip joint for greater acetabular fragment rotation. This osteotomy also leaves sacrospinal and sacrotuberal ligaments in situ and ensures the stability of the pelvis (1,23). In our study, all radiological parameters according to the acetabular reorientation and femoral head coverage showed significant improvement.

Table I. — Radiological evaluation for all hips

	Mean CE angle (range)	Mean anterior CE angle (range)	Mean AI of Sharp (range)	Shenton's line intact (%)	Cross-over sign present (%)	Femoral head extrusion index (range)
Preoperative	3.6 (-12–26)	2.1 (-16–24)	45.9 (40–56)	9 (21.4)	15 (35.7)	36.3 (16.4–62.4)
Latest follow-up	26.9 (7–56)	24.6 (3–42)	31.9 (24–40)	40 (95.2)	1 (2.4)	11.8 (1.8–37.6)
Change	23.3	22.5	14	31	14	24.5
p value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

A number of previous studies on periacetabular osteotomy have reported good results in older patients with advanced osteoarthritis (12,13,29). On the other hand, it was shown that younger patients with low grade osteoarthritis or without osteoarthritis are more likely to be satisfied with the procedure (14,23). Hailer et al (8) stated that patients who were satisfied from the triple pelvic osteotomy had a median age of 21. Van Hellemond et al (26) reported that 64% of the patients had good to excellent results after Tönnis type triple osteotomy at a 15 year follow-up period. In our study, the age distribution and the hip osteoarthritis scores of patients who underwent osteotomy were consistent with the literature. Only three patients were over the age of forty at the time of operation. At the final follow-up 93% of the operated hips had good to excellent clinical results. This rates may seem high when compared to the literature but our median follow-up period was 4.2 years. At the latest follow-up in 12 hips (28.5%) the severity of hip osteoarthritis according to Tönnis grades of osteoarthritis had improved (10 hips grade 1 to grade 0, two hips grade 2 to grade 1) when compared to the pre-operative radiological scores. On the other hand, there was no significant improvement between the immediate post-operative and the latest follow-up radiological scores according to Tönnis grades of osteoarthritis. Therefore, we consider that this data may define as the translocation of the thicker cartilage into the weight-bearing zone of acetabulum according to the osteotomy.

In recent years, it is understood that correction of acetabular retroversion is an important factor in periacetabular surgery. In adult hip dysplasia, acetabular retroversion is present up to 25% (7,13,18). A positive post-operative cross-over sign indicates

a retroverted acetabulum. The post-operative acetabular retroversion may cause femoroacetabular impingement and early onset of osteoarthritis, which induces persistent hip pain (5,16,30). Tönnis type triple pelvic osteotomy allows good acetabular fragment rotation, which usually provides significant recovery in the acetabular retroversion. Also we believe that a nonfixed oblique pubic osteotomy may allow greater medialization on the hip joint and may increase the acetabular fragment rotation which may provide better recovery in the acetabular retroversion. In our study only one acetabulum remained retroverted postoperatively and only two pubic nonunion was observed after the operation. All nonunions remained asymptomatic and required no further surgical treatment.

Transient palsy of the sciatic nerve, pseudo arthrosis of the ischium and the pubic ramus, deep venous thrombosis, and pulmonary embolism have been reported as postoperative complications in the literature (8,23,25,26). Postoperatively 3 patients had sciatic nerve palsy in our series. All sciatic nerve palsies occurred among the first 15 hips. We suppose this data reflects the learning curve of the surgical approach.

In recent years it was shown that the prevalence of labral tears and the femoro-acetabular impingement were high in hip dysplasia (13). We did not evaluate the hip joint in the terms of a labral pathology both preoperatively and postoperatively. We consider that this was a weakness of our study.

In summary, we conclude that Tönnis type triple pelvic osteotomy allows adequate acetabular rotation for sufficient femoral head coverage. Furthermore, our results demonstrate that this osteotomy provides good clinical results at short-term to mid-term follow-up. Especially when considering the long

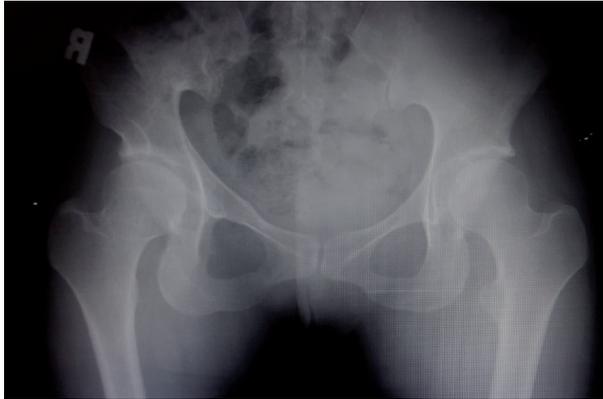


Fig. 4. — AP pelvis radiography 7 years after the operation.

learning curve of Bernese periacetabular osteotomy (7,18), Tönnis type triple pelvic osteotomy with alterations mentioned in our study requires an easier surgical technique and a shorter learning curve, which makes it a suitable treatment option for symptomatic acetabular dysplasia in adolescents and adults.

REFERENCES

1. **Aminian A, Mahar A, Yassir W, Newton P, Wenger D.** Freedom of acetabular fragment rotation following three surgical techniques for correction of congenital deformities of the hip. *J Pediatr Orthop* 2005 ; 25 : 10-13.
2. **Brooker AF, Bowerman JW, Robinson RA, Riley LH Jr.** Ectopic ossification following total hip replacement. Incidence and a method of classification. *J Bone Joint Surg (Am)* 1973 ; 55-A : 1629-1632.
3. **Delaunay S, Dussault RG, Kaplan PA, Alford BA.** Radiographic measurements of dysplastic adult hips. *Skeletal Radiol* 1997 ; 26 : 75-81.
4. **Eren A, Ömeroglu H, Güven M, Ugutmen E, Altintas F.** Incomplete triple pelvic osteotomy for the surgical treatment of dysplasia of the hip in adolescents and adults. *J Bone Joint Surg (Br)* 2005 ; 87-B : 790-795.
5. **Fujii M, Nakashima Y, Noguchi Y et al.** Effect of intra-articular lesions on the outcome of periacetabular osteotomy in patients with symptomatic hip dysplasia. *J Bone Joint Surg (Br)* 2011 ; 93-B : 1449-1456.
6. **Ganz R, Klaue K, Vinh TS, Mast JW.** A new periacetabular osteotomy for the treatment of hip dysplasias: technique and preliminary results. *Clin Orthop* 1988 ; 232 : 26-36.
7. **Garras DN, Crowder TT, Olson SA.** Medium-term results of the Bernese periacetabular osteotomy in the treatment of symptomatic developmental dysplasia of the hip. *J Bone Joint Surg (Br)* 2007 ; 89-B : 721-724.
8. **Hailer NP, Soykaner L, Ackermann H, Rittmeister M.** Triple osteotomy of the pelvis for acetabular dysplasia. *J Bone Joint Surg (Br)* 2005 ; 87-B : 1622-1626.
9. **Harris WH.** Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. *J Bone Joint Surg (Am)* 1969 ; 51-A : 737-755.
10. **Heyman CH, Herndon CH.** Legg-Perthes disease; a method for the measurement of the roentgenographic result. *J Bone Joint Surg (Am)* 1950 ; 32-A : 767-778.
11. **Hsin J, Saluja R, Eilert RE, Wiedel JD.** Evaluation of the biomechanics of the hip following a triple osteotomy of the innominate bone. *J Bone Joint Surg (Am)* 1996 ; 78-A : 855-862.
12. **Ito H, Tanino H, Yamanaka Y, Minami A, Matsuno T.** Intermediate to long-term results of periacetabular osteotomy in patients younger and older than forty years of age. *J Bone Joint Surg (Am)* 2011 ; 93-A : 1347-1354.
13. **Janssen D, Kalchschmidt K, Katthagen BD.** Triple pelvic osteotomy as treatment for osteoarthritis secondary



Fig. 5. — False profile view of the right hip 7 years after the operation

- to developmental dysplasia of the hip. *Int Orthop* 2009 ; 33 : 1555-1559.
14. **Konya MN, Tuhanioglu Ü, Aslan A et al.** A comparison of short-term clinical and radiological results of Tönnis and Steel pelvic osteotomies in patients with acetabular dysplasia. (Article in Turkish) *Eklem Hastalık Cerrahisi* 2013 ; 24 : 96-101.
 15. **Li YC, Wu KW, Huang SC, Wang TM, Kuo KN.** Modified triple innominate osteotomy for acetabular dysplasia: for better femoral head medialization and coverage. *J Pediatr Orthop B* 2012 ; 21 : 193-199.
 16. **Mimura T, Mori K, Kawasaki T, Imai S, Matsusue Y.** Triple pelvic osteotomy: report of our mid-term results and review of literature. *World J Orthop* 2014 ; 5 : 14-22.
 17. **Ninomiya S, Tagawa H.** Rotational acetabular osteotomy for the dysplastic hip. *J Bone Joint Surg (Am)* 1984 ; 66-A : 430-436.
 18. **Peters CL, Erickson JA, Hines JL.** Early results of the Bernese periacetabular osteotomy: the learning curve at an academic medical center. *J Bone Joint Surg (Am)* 2006 ; 88-A : 1920-1926.
 19. **Saito S, Takaoka K, Ono K.** Tectoplasty for painful dislocation or subluxation of the hip. *J Bone Joint Surg (Br)* 1986 ; 68-B : 55-60.
 20. **Sharp IK.** Acetabular dysplasia: the acetabular angle. *J Bone Joint Surg (Br)* 1961 ; 43-B : 268-272.
 21. **Steel HH.** Triple osteotomy of the innominate bone. *J Bone Joint Surg (Am)* 1973 ; 53-A : 343-350.
 22. **Steppacher SD, Tannast M, Ganz R, Siebenrock KA.** Mean 20-year follow-up of Bernese periacetabular osteotomy. *Clin Orthop* 2008 ; 466 : 1633-1644.
 23. **Tönnis D, Behrens K, Tscharani F.** A modified technique of the triple pelvic osteotomy: early results. *J Pediatr Orthop* 1981 ; 1 : 241-249.
 24. **Tönnis D.** *Congenital dysplasia and dislocation of the hip in children and adults.* Berlin : Springer-Verlag ; 1987 ; 356-357.
 25. **Tschauner C, Sylkin A, Hofmann S, Graf R.** Painful nonunion after triple pelvic osteotomy. *J Bone Joint Surg (Br)* 2003 ; 85-B : 953-955.
 26. **van Hellemond GG, Sonneveld H, Schreuder MHE, Kooijman MAP, de Kleuver M.** Triple osteotomy of the pelvis for acetabular dysplasia. *J Bone Joint Surg (Br)* 2005 ; 87-B : 911-915.
 27. **Vukasinovic Z, Spasovski D, Kralj-Iglic V et al.** Impact of triple pelvic osteotomy on contact stress pressure distribution in the hip joint. *Int Orthop* 2013 ; 37 : 95-98.
 28. **Wiberg G.** Studies on dysplastic acetabula and congenital subluxation of the hip joint: with special reference to the complication of osteo-arthritis. *Acta Chir Scand* 1939 ; 83(Suppl 58) : 1-135.
 29. **Yasunaga Y, Iwamori H, Ikuta Y, Yamamoto S.** Rotational acetabular osteotomy for advanced osteoarthritis secondary to dysplasia of the hip. *Arch Orthop Trauma Surg* 1999 ; 119 : 253-257.
 30. **Yasunaga Y, Yamasaki T, Matsuo T et al.** Crossover sign after rotational acetabular osteotomy for dysplasia of the hip. *J Orthop Sci* 2010 ; 15 : 463-469.