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Periacetabular Osteotomy for the Treatment of Symptomatic Acetabular Dysplasia in Patients with and without Labral Tears

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Abstract

Background: Periacetabular osteotomy has been established as an effective treatment for symptomatic acetabular dysplasia. However, dysplasia is frequently associated with in intra-articular pathologies such as labral tears. The purpose of the present study was to evaluate the clinical outcomes and radiographic correction of periacetabular osteotomy for acetabular dysplasia in patients with labral tears compared with those in patients without labral tears.

Methods: We retrospectively reviewed thirty-six hips in thirty-six patients who had undergone curved periacetabular osteotomy combined with arthroscopy of the hip to assess labral pathologies between January 2011 and January 2012. Twenty-four hips in twenty-four patients who had acetabular dysplasia with labral tears (the labral tear group) were compared with twelve hips in twelve patients who had acetabular dysplasia without labral tears (the non-labral tear group). We compared the two groups based on the Harris hip score, radiographic correction, and reoperations.

Results: The mean Harris hip score improved from 76.8 points preoperatively to 90.3 points postoperatively in the labral tear group and from 75.5 points preoperatively to 92.8 points postoperatively in the non-labral tear group. There were no significant differences in the radiographic parameters between the two groups pre- or postoperatively. The Tönnis grades improved in two hips and progressed in two hips in the labral tear group and improved in two hips and progressed in one hip in the non-labral tear group. There were two reoperations for labral tears in the labral tear group, compared with no reoperation in the non-labral tear group.

Conclusions: Periacetabular osteotomy for the treatment of symptomatic acetabular dysplasia with or without labral tear provides equivalent short-term pain relief and functional outcomes. Additionally, we did not demonstrate a statistically increased risk of progression of osteoarthritis and reoperations in association with labral tears.

Key words: Acetabular dysplasia, Periacetabular osteotomy, Arthroscopy, Labral tear

Introduction

Acetabular dysplasia is the most common cause of secondary osteoarthritis[1, 2]. It is characterized by morphological abnormalities, including a shallow acetabulum and reduced acetabular cover of the femoral head, that result in chronic mechanical overload of the acetabular rim and structural instability[3, 4]. The initial physiological response is hypertrophy of the labrum to compensate for the joint incongruence, but the mechanical overload may ultimately result in degeneration, tear, or detachment of the acetabular labrum[5]. Arthroscopic examinations of intra-articular lesions in acetabular dysplasia have found a high prevalence of labral tears[6]. Hip arthroscopy is considered the gold standard for diagnosing labral abnormalities.

Periacetabular osteotomy has been established as an

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effective treatment for symptomatic acetabular dysplasia to relieve hip pain and prevent the progression of secondary osteoarthritis[7-10]. Because periacetabular osteotomy redirects the acetabulum into a mechanically more appropriate position, thereby decreasing the shear forces and load at the acetabular rim, thought to be the cause of the intra-articular lesion[11]. However, previous studies reported that the presence of a labral tear influenced negatively the outcome of periacetabular osteotomy[12-14]. We hypothesized that periacetabular osteotomy for acetabular dysplasia in patients with labral tears would yield similar clinical outcomes and improved radiographic correction without an increased risk of progression of osteoarthritis or reoperations after a short-term follow-up. The purpose of the present study was to evaluate the clinical outcomes and radiographic correction of periacetabular osteotomy for acetabular dysplasia in patients with labral tears as compared with those in patients without labral tears.

Materials and Methods

We retrospectively reviewed thirty-six hips in thirty-six patients who had undergone curved periacetabular osteotomy[15-18] combined with arthroscopy of the hip between January 2011 and January 2012. All of the surgical procedures were performed by the senior author (M.N.). Patients were excluded from the study if they had undergone previous surgery, other secondary diagnoses such as Legg-Calvé-Perthes disease, radiological evidence of advanced osteoarthritis (Tönnis Grades 3 and 4)[19], and if they were not evaluated for at least two years after surgery.

Patients who had undergone arthroscopy were classified into one of two groups: the first group included patients who had the presence of a labral tear (the labral tear group), and the second group included patients who did not have the presence of a labral tear (the non-labral tear group). The labral tear group included twenty-four hips (twenty-four patients), and the non-labral tear group included twelve hips (twelve patients). Patients from the labral tear and non-labral tear groups had mean ages of 39 (range, 17–59) years and 38 (range, 17–58) years, respectively, at the time of surgery. The mean duration of follow-up for the labral tear and non-labral tear groups was 35 (range, 26–44) months and 33 (range, 25–38) months, respectively. The clinical data for both patient groups are shown in Table 1. There were no significant differences in sex ($p = 0.54$), age at the time of surgery ($p = 0.97$), or duration of follow-up ($p = 0.19$). The study was approved by our institutional review board. All patients gave informed consent prior to their participation in the study.

Surgical indications for the curved periacetabular osteotomy included acetabular dysplasia with symptoms, such as pain that was tolerable but made the patient feel discomfort and caused some limitations of daily activities for more than three months, a lateral center-edge angle[1] of less than 20° on anteroposterior radiographs, and an improvement in joint congruency in the abducted position on the anteroposterior radiograph[15, 20]. In addition, a femoral head-neck osteochondroplasty was performed if there was a visible femoral deformity such as a higher alpha angle >60°, restricted internal rotation of the hip (<20° at 90° of flexion), and/or palpable impingement at 90° of hip flexion with combined internal rotation (0–20°)[21]. In the labral tear group, twelve of the twenty-four hips underwent curved periacetabular osteotomy and combined femoral head-neck osteochondroplasty. In the non-labral tear group, none of the twelve hips underwent curved periacetabular osteotomy and combined femoral head-neck osteochondroplasty.

Surgical Technique

Curved periacetabular osteotomy was performed with a direct anterior approach with the patient in the supine position, as described previously[15, 22]. The skin incision of this osteotomy was relatively small, approximately 9 cm long. For surgical exposure, we used a modified Smith-Petersen approach[11], and little damage was caused to the hip abductor muscles because the gluteal muscles were not stripped from the bone[23, 24]. The anterior superior iliac spine was osteotomized with the inguinal ligament and sartorius muscle attached and then retracted medially with the lateral femoral cutaneous nerve and neurovascular bundle. The supra-acetabular portion of the iliacus muscle was detached, and the inner table of the pelvis was stripped sharply. As the first step in the procedure, a c-shaped osteotomy line was marked using an airtome from the proximal part of the anterior inferior iliac spine to the distal part of the quadrilateral surface, and an osteotomy line also was marked at a point just medial to the iliopubic eminence of the superior ramus of the pubis. After the osteotomy line was checked with intraoperative fluoroscopy, an osteotomy of the quadrilateral surface was performed using a curved chisel. The elevator was then introduced into the space between the distal joint capsule and the psoas tendon. When the tip of the elevator contacted the ischium, the chisel was inserted along the elevator, and the direction of the blade toward the infracotyloid groove was confirmed using intraoperative fluoroscopy. Although the body of the ischium was not visible, this region could be palpated and confirmed using intraoperative fluoroscopy. The chisel was hammered a few centimeters into the ischium. Finally, the superior ramus of the pubis was osteotomized using a curved chisel with a rounded end. To reorient the acetabular fragment, one hook was inserted at the osteotomy site proximal to the anteroinferior iliac spine and the fragment was drawn distally. Another hook was attached to the osteotomy site on the superior pubic ramus and to draw the fragment proximomedially. The curvilinear c-shaped osteotomy enabled smooth acetabular reorientation and medialization because the osteotomy surfaces had the same curvatures. The acetabular fragment was redirected and fixed temporarily with a Kirschner wire. The hip was flexed and rotated internally to verify that there was no excessive anterior or lateral correction that might lead to femoroacetabular impingement. To confirm a lack of femoroacetabular impingement, the anterior part of the hip joint capsule was palpated when the hip was placed in flexion and internal rotation. If abutment of the anterior femoral head-neck on the anterior rim of the acetabulum was detected, the acetabular fragment of retroversion was rotated posteriorly or an osteochondroplasty was performed on the femoral head-neck junction deformity to relieve the impingement. The hip joint capsule was exposed between the rectus femoris lying beneath the sartorius along the inner wall of the incision and laterally to the gluteus medius beneath the tensor fasciae latae. The reflected origin of the rectus femoris muscle could be cut if it interfered with the exposure. The anterior capsule was then incised in a z-shaped fashion. The femoral head-neck junction deformity was resected, initially with a curved osteotome and then with a burr, to improve the head-neck ratio. The image intensifier or intraoperative radiographs were used to ensure that the desired goals were achieved, namely, that the femoral head was adequately covered by the reoriented acetabular fragment and that the hip was medialized. Two or three poly-L-lactic acid screws were used to fix the reoriented acetabular fragment. The osteotomized anterior superior iliac spine was then returned to its original position and fixed with two cannulated cancellous screws.

Arthroscopic examinations of the hips were performed with the patient in the supine position, utilizing the anterior and anterolateral portals[25]. The condition of the acetabular labrum was classified according to the classification of Beck as normal, degeneration, full-thickness tear, or detachment[26]. Acetabular labral tears were defined as the presence of a full-thickness tear or detachment.

Postoperatively, active motion exercises were initiated on the first postoperative day. Partial weight-bearing using two crutches or a walker was allowed on the third postoperative day, and full weight-bearing was allowed after eight weeks postoperatively.

Radiographic Evaluation

Preoperative and postoperative acetabular measurements were evaluated for several markers, including the lateral center-edge angle[1], acetabular roof obliquity[27], acetabular head index[28], acetabular head lateralization index[29] on the anteroposterior pelvic radiograph, and anterior center-edge angle on the false-profile radiograph[30].

Femoral measurements were made on preoperative and postoperative radiographs for patients who underwent curved periacetabular osteotomy and femoral head-neck osteochondroplasty. There was no postoperative assessment of femoral correction for patients who underwent periacetabular osteotomy only as no intervention was performed on the femoral head-neck junction. Femoral deformity was evaluated according to the alpha angle on the frog-leg-lateral hip radiograph[31].

Severity of osteoarthritis pre- and postoperatively was classified according to Tönnis grades:[19] Grade 0, normal joint space with no degenerative changes or signs of osteoarthritis; Grade 1, subchondral sclerosis, with minimal joint-space narrowing and osteophyte formation; Grade 2, hip with subchondral cyst formation and moderate joint-space narrowing; Grade 3, hip with severe or complete, but localized joint-space narrowing; and Grade 4, hips with extensive or severe cartilage loss. Radiographic measurements were made with use of Rapideye™ Hyper (Toshiba, Tochigi, Japan) on personal computers.

Clinical Evaluation

All patients were evaluated both preoperatively and at the time of the latest follow-up with use of the Harris hip score[32]. In this system, we included pain, function, and range of motion.

Statistical Analysis

Mann–Whitney U tests were used to compare Harris hip scores and radiographic parameters between both groups. The Wilcoxon signed-rank test was used to compare the pre- and postoperative radiographic parameters within the same group. Fisher's exact test was used for the clinical factors, pre- and postoperative osteoarthritis grade, and progression of the osteoarthritis grade between both groups. Statistical significance was defined a priori as $p < 0.05$. Statistical analyses were performed using SPSS software, version 17.0 (SPSS, Chicago, Illinois, USA).

Results

The results for the radiographic parameters in both groups are also shown in Table 1. The mean values of all the postoperative radiographic parameters showed improvements compared with those of the preoperative

Table 1. Patient data and radiographic evaluations in the labral tear and non-labral tear groups

Parameters	Labral tear group (N=24)	Non-labral tear group (N=12)	p value
Sex (M:F) (no. of hips)	2:22	0:12	0.54
Age (year)	38.5 (17 to 59)	37.7 (17 to 58)	0.97
Duration of follow-up (months)	34.9 (26 to 44)	33 (25 to 38)	0.19
Radiographic evaluation			
Center-edge angle* (degree)			
Preoperative	9.5 ± 7.5 (−7 to 18)	10.2 ± 4.9 (1 to 17)	0.96
Postoperative	30.1 ± 4.9 (21 to 38)	31.1 ± 5.0 (24 to 39)	0.57
Acetabular roof obliquity* (degree)			
Preoperative	19.8 ± 5.0 (12 to 31)	20.3 ± 3.9 (17 to 30)	0.51
Postoperative	5.2 ± 4.6 (−6 to 15)	4.6 ± 3.8 (0 to 11)	0.48
Acetabular head index* (%)			
Preoperative	61.0 ± 8.0 (40 to 76)	61.0 ± 4.7 (53 to 68)	0.79
Postoperative	83.2 ± 5.5 (68 to 92)	82.7 ± 7.7 (64 to 89)	0.61
Anterior center-edge angle* (degree)			
Preoperative	7.2 ± 11.8 (−14 to 24)	9.9 ± 7.3 (−8 to 19)	0.63
Postoperative	27.7 ± 10.9 (9 to 45)	30.5 ± 9.1 (14 to 49)	0.52
Head lateralization index*			
Preoperative	0.59 ± 0.06	0.61 ± 0.06	0.19
Postoperative	0.56 ± 0.06	0.58 ± 0.06	0.23
Alpha angle* (degree)			
Preoperative	57.7 ± 15.7 (33 to 88)	45.9 ± 5.2 (37 to 55)	0.04
Postoperative	41.1 ± 9.3 (33 to 52)	NA	
Tönnis grade (preoperative/postoperative) (no. of hips)			0.78/0.64
0	10/11	6/6	
1	10/8	4/5	
2	4/5	2/1	
Progression of osteoarthritis grade (no. of hips) (%)	2 (8%)	1 (8%)	0.98

*Data are given as the mean and the standard deviation. NA = not applicable parameters in both groups. Acetabular measurements were not significantly different in the lateral center-edge angles, acetabular roof obliquities, acetabular head indices, anterior center-edge angles, or acetabular head lateralization indices between the two groups pre- or postoperatively. Femoral measurement of the preoperative alpha angle was significantly different between the labral tear group and the non-labral tear group (mean, 57.7° ± 15.7° versus 45.9° ± 5.2°; $p = 0.04$).

The preoperative Tönnis osteoarthritis grade was similar in both groups ($p = 0.78$). In the labral tear group, the Tönnis grade improved in two hips (8%), remained unchanged in twenty hips (84%), and progressed in two hips (8%). One of the latter two hips showed progression from Tönnis Grade 0 to 1, the remaining one hips showed progression from Tönnis Grade 1 to 2. In the non-labral tear group, the Tönnis grade improved in two hips (17%), remained unchanged in nineteen hips (75%), and progressed in one hip (8%). One hip showed progression from Tönnis Grade 0 to 1. There was no significant difference between the two groups in osteoarthritis grade progression ($p = 0.98$).

The clinical scores were similar between the two groups (Table 2). The mean preoperative Harris hip score was 76.8 ± 8.6 for the labral tear group and 75.5 ± 8.6 for the non-labral tear group. At the time of the latest follow-up, the mean score in the labral tear group had improved to 90.3 ± 10.4 ($p < 0.0001$) and the mean score in the non-labral tear group had improved to 92.8 ± 5.2 ($p < 0.0001$). There was no significant differences between the two groups preoperatively ($p = 0.76$) or at the time of the last follow-up ($p = 0.87$).

There were no conversions to a total hip arthroplasty in the two groups, but two hips (8%) in the labral tear group had a reoperation. The two reoperations were performed because of persistent hip pain and suspected labral tear at 15 and 24 months after curved periacetabular osteotomy alone. The two hips had development of symptoms consistent with labral tears and underwent arthroscopic partial labral resection. All patients corresponding to the two hips had relief of the symptoms at the time of the latest follow-up. In the non-labral tear group, there were no reoperations for the treatment of labral tears or secondary femoroacetabular impingement. The difference between the two groups with respect to the rate of reoperations was not significant ($p = 0.54$).

Discussion

The present observational study of thirty-six hips in thirty-six patients was intended to assess the clinical influence of curved periacetabular osteotomy for acetabular dysplasia in patients with labral tears as compared with patients without labral tears, and associated progression of osteoarthritis and reoperations. There was no significant difference between the two groups in terms of hip function. Reoperations were more common in the labral tear group, but the difference was not significant with the numbers available.

Periacetabular osteotomy provides reliable long-term

Table 2. Clinical outcomes in the labral tear and non-labral tear groups

Parameters	Labral tear group	Non-labral tear group	p value
Harris hip score*			
Overall			
Preoperative	76.8 ± 8.6	75.5 ± 8.6	0.76
Postoperative	90.3 ± 10.4	92.8 ± 5.2	0.87
Pain			
Preoperative	26.3 ± 5.8	24.2 ± 6.7	0.45
Postoperative	38.8 ± 7.8	40.0 ± 6.0	0.88
Function			
Preoperative	50.6 ± 4.9	51.3 ± 4.7	0.67
Postoperative	52.4 ± 4.6	52.8 ± 2.9	0.51
Reoperation (no. of hips) (%)	2 (8%)	0 (0%)	0.54

*Data are given as the mean and the standard deviation.

results for patients with symptomatic acetabular dysplasia[9, 10]. However, increasing evidence indicates that the presence of labral lesions may be the cause of persistent hip pain after periacetabular osteotomy. Matheney et al.[10] reported a survival rate of 84% at ten years; 11% of patients had undergone arthroscopic debridement of either painful labral tears at an average of 6.8 years following the periacetabular osteotomy. However, they did not demonstrate that the presence of a labral tear at the time of osteotomy was an independent predictor of failure. The data in that report are similar to those for our labral tear group, in which two (8%) of the twenty-four hips required reoperations for the treatment of labral tears. Kim et al.[33] reported on 40 patients who underwent concomitant arthroscopic treatment of labral pathology in conjunction with a periacetabular osteotomy. At a mean duration of follow-up of 74 months, 9.3% of the patients had progression of the Tönnis grade. The data obtained in this earlier report are similar to the data of our two groups: two (8%) of the twenty-four hips in the labral tear group and one (8%) of the twelve hips in the non-labral tear group demonstrated progression of osteoarthritis, but these hips did not present progression to advanced osteoarthritis. In a study using finite element analysis, it was reported that the labrum in the dysplastic model supported 4–11% of the total load transferred across the joint, while the labrum in the normal model supported only 1–2% of the total load[34]. They also noted that a higher percentage of the load was transferred to the labrum in the dysplastic model because the femoral head achieved equilibrium near the lateral edge of the acetabulum. We performed a curved periacetabular osteotomy, medialization of the femoral head, and improvement of acetabular coverage of the femoral head, which will help obtain normal joint mechanics and will relieve the stress delivered at the acetabular rim and labrum of predisposing to the osteoarthritis and hip pain[15, 35].

The present study demonstrated that the preoperative alpha angle was significantly greater in the labral tear group compared to the non-labral tear group. In a ten-year follow-up study on periacetabular osteotomy, Albers et al.[36] identified predictors of poor outcomes following the procedure: age, lower preoperative Merle d'Aubigné and Postel score, Trendelenburg sign, aspherical head, osteoarthritis, postoperative acetabular retroversion, excessive acetabular anteversion, and undercoverage. In addition, Clohisy et al.[37] reported that the femoral head-neck junction had decreased head-neck offset or abnormal alpha angle in 73.1% cases with symptomatic acetabular dysplasia, and 72% were indicated to have an aspheric femoral head. Those studies suggest that periacetabular osteotomy in the setting of femoral head deformities has the potential to cause secondary femoroacetabular impingement, with resultant labral damage and/or progressive joint degeneration. Nassif et al.[21] reported forty patients who underwent periacetabular osteotomy in conjunction with a femoral head-neck osteochondroplasty and compared them with forty-eight patients who underwent isolated periacetabular osteotomy. They have not demonstrated superior clinical results in association with an adjunctive femoral osteochondroplasty at short-term follow-up. Given these reports, routine osteochondroplasty is not recommended for all patients undergoing a periacetabular osteotomy. Consequently, we recommend that a femoral head-neck osteochondroplasty should be performed if there is a femoral head-neck deformity and/or the presence of a positive impingement sign suggesting risk of secondary femoroacetabular impingement.

Our results demonstrated that curved periacetabular osteotomy assessed at a short-term follow-up may not have a negative impact on the hip function of the labral tear group, the risk of progression of osteoarthritis, or reoperations. We believe that the surgeon should proceed with caution when considering the use of curved periacetabular osteotomy alone to treat acetabular dysplasia with labral tears. However, we have observed that the clinical results of the labral tear group at this duration of follow-up were comparable to the findings of previous studies.

The present study does have its limitations. The first is the retrospective nature of our study. Second, we could not predict the long-term failure rate because the follow-up period was relatively short and not uniform for all patients.

In conclusion, curved periacetabular osteotomy for treatment of symptomatic acetabular dysplasia with or without labral tears provides equivalent short-term pain relief and functional outcomes. Additionally, we did not demonstrate a statistically increased the risk of progression of osteoarthritis and reoperations in association with labral tears.

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