Second-look Arthroscopic Findings after Periacetabular Osteotomy in Patients with Acetabular Dysplasia

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Running title: Second-look Arthroscopic Findings after PAO

Abstract

Background:

The purpose of this study was to examine the intra-articular pathology in patients with dysplastic hips undergoing periacetabular osteotomy (PAO).

Methods:

We performed hip arthroscopy at the time of PAO and at a mean of 15 (range, 11–27) months postoperatively as a second-look arthroscopy in 36 hips. The 36 patients comprised 35 females and one male, with a mean age of 38.3 (range, 18–64) years at the time of the primary surgery. We examined the clinical features and radiological and arthroscopic findings.

Results: At the time of the primary surgery, cartilaginous damage was found on the acetabular side in 16 hips, and on the femoral side in 12 hips. Labral tears were found in 26 of the total 36 hips (72.2%). The radiological parameters were improved by PAO. At the time of the second-look arthroscopy, three hips showed improvement (3/36 hips, 8.33%) and seven showed exacerbation (7/36 hips, 19.4%) of cartilaginous damage on the acetabular side. On the femoral side, five hips showed improvement (5/36 hips, 13.9%) and eight showed exacerbation (8/36 hips, 22.2%) of cartilaginous damage. In the 26 hips with labral tears at the time of the primary surgery, spontaneous repair was not found at the time of the second-look arthroscopy.

Conclusions:

Upon second-look arthroscopy after PAO, we did not find any substantial changes in labral tears. If patients have residual pain after PAO caused by a labral tear, we recommend surgical repair based on these findings.

Level of Evidence: Therapeutic study, Level IV.

Key words: Second-look arthroscopy, Periacetabular osteotomy, Developmental dysplasia of the hip, Labral tear

Footnotes

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Introduction

A variety of periacetabular osteotomies (PAOs) have been proposed for the treatment of developmental dysplasia of the hip (DDH) in adolescents and young adults, and reported to show satisfactory results [1,2]. Curved periacetabular osteotomy (CPO), which Naito et al. first described in 1995 [3], is a type of spherical PAO that may be used for the treatment of symptomatic DDH. The concept has much in common with other PAOs.

Patients with DDH may present with cartilaginous damage, labral hypertrophy, and labral tears owing to acetabular rim overload [4,5], and this can lead to secondary osteoarthritis. In recent studies, the frequencies of labral tears in DDH were found to be large (65.3–88.4%) [6–9]. Furthermore, Fujii et al. [10] reported that symptomatic DDH was associated with a high incidence of intra-articular lesions in hip arthroscopy at the time of corrective osteotomy. Kim et al. [7] performed combined arthroscopic surgery and PAO for 43 consecutive hips, and reported good results over the medium term. However, when a labral tear found at the time of the surgery was followed up conservatively, it remained unclear whether damage to the cartilage and labrum would spontaneously improve after acetabular reorientation by CPO. If a labral tear was followed up conservatively and showed improvement, the primary arthroscopic surgery may have been unnecessary. We investigated the intra-articular disease patterns in patients undergoing CPO combined with hip arthroscopy for the treatment of symptomatic hip dysplasia. Furthermore, we performed a second-look arthroscopy at approximately 1 year after the primary surgery, and observed the changes in the intra-articular disease patterns. The aim of this study was to evaluate the intra-articular disease patterns after CPO in a group of patients, and to examine the changes in labral tears after CPO.

Patients and methods

This study was retrospective. We performed CPO combined with hip arthroscopy in 129 patients with symptomatic dysplastic hips from January 2011 to April 2015. Thirty-six of the patients underwent a second-look arthroscopy at a mean of 15 (range, 11–27) months after the primary surgery. The 36 patients comprised 35 females and one male, with a mean age of 38.3 (range, 18–64) years at the time of the primary surgery. The mean body mass index (BMI) at the time of the primary surgery was 22.1±3.8 (range, 15.6–34.1) kg/m^2. Six of the 36 patients underwent osteochondroplasty with CPO at the same time. Labral tears were not treated during the arthroscopy performed at the time of the primary surgery.

Surgical Technique

All arthroscopies were performed with the patient in the supine position with traction using the midanterior and anterolateral portals. The CPO was performed after the arthroscopy using a surgical technique described by Naito et al. [3] (Fig. 1). For the CPO, the direct anterior approach was used for surgical exposure and the procedure was undertaken through the osteotomized anterior superior iliac spine. After the osteotomy, a curvilinear C-shaped osteotomy was performed. The acetabular fragment was reoriented to obtain adequate coverage of the femoral head and then fixed with three poly-L-lactic acid screws. Subsequently, when radiographic findings and/or intraoperative findings suspicious for femoroacetabular impingement were found, the patients underwent combined osteochondroplasty with CPO. The osteotomized anterior superior iliac spine was adjusted to its original position and fixed with two titanium cannulated cancellous screws. All patients were followed-up postoperatively, and the patients underwent a second-look arthroscopy at the time when the screws of the anterior superior iliac spine were removed.

Data Collection

Preoperative, intraoperative, and postoperative findings were noted. We examined the clinical features and radiological and arthroscopic findings. Radiographic parameters including the lateral center-edge (CE) angle, acetabular roof obliquity (ARO), and acetabular head index (AHI) were evaluated on supine anteroposterior pelvic radiographs. The osteoarthrosis was graded using the Tönnis classification system [11].

Cartilaginous damage was assessed according to the modified Outerbridge classification system [12]: grade 0, normal cartilage; grade 1, superficial fibrillation, softening, or both; grade 2, fragmentation and deep fissuring; grade 3, erosion down to the subchondral bone. The labral condition was evaluated according to the Beck classification [13], as normal labrum, degeneration, full-thickness tear, or detachment.

Statistical Analysis

The correlations between the arthroscopic and radiological findings were examined. Statistical analyses were performed using SPSS ver. 20.0 for Windows (IBM Japan Ltd., Tokyo, Japan). The changes in the arthroscopic and radiological findings were analyzed by the Kruskal–Wallis test. Values of $p<0.05$ were considered to indicate statistical significance.

Institutional Review Board Approval

This study was conducted at the Department of Orthopaedic Surgery, Fukuoka University Faculty of Medicine, Fukuoka, according to approved medical and ethical guidelines, and the study protocols were approved by the Fukuoka University Institutional Review Board (approval number 15-8-13).

Results

At the time of the primary surgery, cartilaginous damage was found on the acetabular side in 16 hips (grade 1, nine hips; grade 2, five hips; grade 3, two hips; grade 4, no hips), and on the femoral side in 12 hips (grade 1, eight hips; grade 2, two hips; grade 3, two hips; grade 4, no hips). Labral tears were found in 26 of the 36 hips (normal, five hips; degeneration, five hips; detachment, 22 hips; full-thickness tear, four hips). The mean CE angle improved from 10.2 (range, −10.6–24.4) degrees preoperatively to 26.2 (range, 13.7–46.9) degrees postoperatively, the mean ARO improved from 22.0 (range, 10.2–40.8) degrees preoperatively to 5.2 (range, −13.5–13.4) degrees postoperatively, and the mean AHI improved from 63.7 (range, 41.4–77.7) percent preoperatively to 80.8 (range, 64.3–103.8) percent postoperatively (Table 1).

At the time of the second-look arthroscopy, three hips showed improvement (3/36 hips, 8.33%) and seven hips showed exacerbation (7/36 hips, 19.4%) of cartilaginous damage on the acetabular side (Fig. 2). On the femoral side, six hips showed improvement (6/36 hips, 16.7%) and eight hips showed exacerbation (8/36 hips, 22.2%) of cartilaginous damage. In the 26 hips with labral tears at the time of the primary surgery, spontaneous repair was not found at the time of the second-look arthroscopy. New labral tears were detected in three of five patients with normal appearance or degeneration of the labrum at the time of the primary surgery. Several factors (age, BMI, CE angle, ARO, and AHI) were compared among the repaired, unchanged, and deteriorated groups for the cartilage and labrum. However, none of these factors showed significant correlations among the three groups (Tables 2–4).

Discussion

Patients with DDH may come to attention because of the presence of cartilage damage and/or labral tears. Labral tears were first reported in 1986 by Dorrell and Catterall [14], who described that such tears detected at high frequency in patients with DDH, and that the symptoms of a labral injury were often mixed with the symptoms of DDH. In recent studies, labral tears in DDH were present in 48 of 71 (65.8%) [6], 38 of 43 (88.4%) [7], 14 of 17 (82.4%) [8], and 79 of 121 (65.3%) [9] patients. In our study, 26 of 36 hips (72.2%) were found to have labral tears at the time of the primary surgery, and this result was similar to the previous studies. The tears would have been caused by the abnormal stress distribution over the weight-bearing surface of the hip joint in DDH, as reported by Genda et al. [5].

Siebenrock et al. [15] reported worse long-term outcomes of PAO associated with moderate to severe osteoarthritis, a labral lesion, and a suboptimal acetabular index. Matheney et al. [2] reported that 15 of 135 hips (11%) were treated with a subsequent arthroscopy because of chondral and/or labral lesions at an average of 6.8 years after PAO. Similarly, we found that labral tears after PAO did not repair spontaneously. Surgical repair is required when pain remains after PAO and a labral tear is suspected.

Suzuki et al. [16] reported that cartilage repair was observed on the acetabular side in five of 38 hips (13.2%) and on femoral side in four of 38 hips (10.5%) at 18.9 months after conventional osteotomy. Even though our study was similar, our evaluation of a total of 36 hips revealed that fibrocartilaginous regeneration tissue was present in three hips on the acetabular side and six hips on the femoral side at the time of the second-look arthroscopy. Fujisawa et al. [17] reported that regeneration of articular cartilage in knee joints was observed after high tibial osteotomy, and that the regeneration was correlated with the degree of knee alignment. Furthermore, Itoman et al. [18] reported that fibrocartilaginous regeneration tissue was observed after successful valgus osteotomy. For these cartilage repair processes, the effects of load improvement after the osteotomy are considered to be involved. Some studies have presented results for the load improvement after PAO. Hipp et al. [19] simulated PAO using computed tomography scans. In most cases of DDH, contact pressures were decreased by as much as 50% when the acetabulum was rotated in the frontal and sagittal planes. Furthermore, Hingsammer et al. [20] reported that the delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC) index was decreased in dysplastic hips after PAO. We suggest that the improvement in mechanical stress [21] may promote hyperplasia of the fibrocartilaginous regeneration tissue after CPO in these patients. However, no factors were significantly correlated among the change groups for the cartilage and labrum in this study. These findings may have arisen because the present study included hips with Tönnis grade 0 and no labral tears.

Limitations

This study has several limitations. First, the period from the primary surgery to the second-look arthroscopy was short, because the second-look arthroscopy was performed at the time of removal of the hardware used for retouchment of the anterior superior iliac spine. We feel that the intra-articular findings may change over a longer follow-up period. Second, we did not classify the locations of the cartilage damage and labral tears. We consider that it will be helpful to examine the results of PAO and the necessity of arthroscopic treatment with PAO at the same time.

In conclusion, upon second-look arthroscopy after PAO, we did not find any substantial changes in labral tears. If patients have residual pain after PAO caused by a labral tear, we recommend surgical repair based on these findings.

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Table 1. Baseline characteristics and preoperative and postoperative radiographic parameters.

Parameter		
No. of hips	36	
Sex (male:female) (no. of hips)	1:35	
Age (years)	38.3±12.1	
BMI (kg/m^2)	22.1±3.8	
	Preoperative	Postoperative
CE angle (degrees)	10.2±8.3	26.2±6.5
ARO (degrees)	22.0±7.3	5.2±5.3
AHI (%)	63.7±9.9	80.8±8.3

BMI: body mass index (weight/height squared); CE angle: lateral center-edge angle; ARO: acetabular roof obliquity; AHI: acetabular head index.

Data are presented as means ± SD.

Table 2. Findings for articular cartilage

Acetabular cartilage	Repaired	Unchanged	Deteriorated	*p*-value
No. of hips	3	26	7	-
Age (years)	48.3±4.0	36.5±12.3	40.4±12.4	0.122
BMI (kg/m^2)	21.9±1.6	22.3±4.4	21.5±1.1	0.950
Radiological findings before osteotomy				
Tönnis grade (0/1/2/3)	0/1/2/0	6/15/5/0	0/5/2/0	-
CE angle (degrees)	7.4±5.3	11.3±8.8	7.3±6.8	0.195
ARO (degrees)	27.1±3.5	21.3±7.7	22.4±6.7	0.314
AHI (%)	54.4±6.9	65.2±10.3	62.1±7.9	0.122
Radiological findings at second-look arthroscopy				
Tönnis grade (0/1/2/3)	0/1/2/0	6/15/5/0	0/4/3/0	-
CE angle (degrees)	20.7±1.5	27.2±7.1	25.3±3.9	0.153
ARO (degrees)	9.0±1.0	4.4±5.9	6.5±2.8	0.079
AHI (%)	73.4±1.8	81.9±8.6	80.1±7.8	0.150

BMI: body mass index (weight/height squared); CE angle: lateral center-edge angle; ARO: acetabular roof obliquity; AHI: acetabular head index.

Data are presented as means ± SD.

Table 3. Findings for femoral head cartilage

Femoral head cartilage	Repaired	Unchanged	Deteriorated	*p*-value
No. of hips	6	22	8	-
Age (years)	46.3±12.8	35.8±12.3	39.1±9.5	0.160
BMI (kg/m^2)	23.2±4.5	22.0±4.1	21.7±1.8	0.789
Radiological findings before osteotomy				
Tönnis grade (0/1/2/3)	0/3/3/0	5/14/3/0	1/4/3/0	-
CE angle (degrees)	13.1±7.7	9.7±8.2	9.3±9.4	0.731
ARO (degrees)	20.2±6.2	21.9±7.7	23.5±7.6	0.639
AHI (%)	65.0±11.6	63.4±9.9	63.7±10.0	0.554
Radiological findings at second-look arthroscopy				
Tönnis grade (0/1/2/3)	0/3/3/0	5/14/3/0	1/3/4/0	-
CE angle (degrees)	28.8±10.3	25.4±6.0	26.6±4.1	0.745
ARO (degrees)	2.5±8.4	5.5±4.7	6.6±4.0	0.619
AHI (%)	82.6±12.7	81.2±6.7	78.3±9.2	0.828

BMI: body mass index (weight/height squared); CE angle: lateral center-edge angle; ARO: acetabular roof obliquity; AHI: acetabular head index.

Data are presented as means ± SD.

Table 4. Findings for the labrum

Labrum	Repaired	Unchanged	Deteriorated	*p*-value
No. of hips	1	32	3	-
Age (years)	34	38.9±12.4	33.0±11.5	0.630
BMI (kg/m^2)	23.5	22.1±3.7	22.1±3.7	0.484
Radiological findings before osteotomy				
Tönnis grade (0/1/2/3)	0/1/0/0	5/19/8/0	1/1/1/0	-
CE angle (degrees)	11.0	10.0±8.8	11.9±0.4	0.942
ARO (degrees)	17.8	22.0±7.4	23.5±9.0	0.801
AHI (%)	72.3	63.9±9.6	59.3±15.4	0.546
Radiological findings at second-look arthroscopy				
Tönnis grade (0/1/2/3)	0/1/0/0	5/18/9/0	1/1/1/0	-
CE angle (degrees)	28.8	26.7±6.4	20.4±6.0	0.272
ARO (degrees)	2.4	5.1±5.6	7.1±1.3	0.536
AHI (%)	88.2	80.7±8.4	79.1±9.9	0.484

BMI: body mass index (weight/height squared); CE angle: lateral center-edge angle; ARO: acetabular roof obliquity; AHI: acetabular head index.

Data are presented as means ± SD.

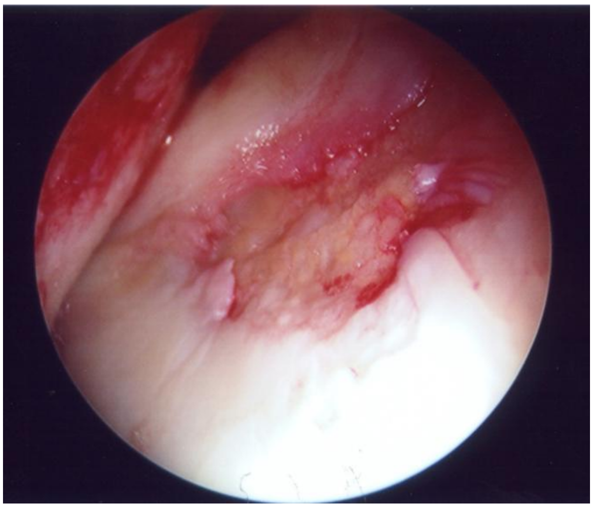
Fig. 1. a Before osteotomy; **b** After osteotomy.

The patient was a 38-year-old female. The diagnosis was left hip dysplasia. The CE angle improved from 16.0 degrees preoperatively to 26.3 degrees postoperatively. The ARO improved from 14.4 degrees preoperatively to 3.8 degrees postoperatively. The AHI improved from 67.4% preoperatively to 84.0% postoperatively.

a

b

Fig. 2. a At the time of the osteotomy. **b** At the time of the second-look arthroscopy. At the time of the osteotomy, we could see eburnation in the anterior acetabulum. At the time of the second-look arthroscopy, we observed hyperplasia of the fibrocartilaginous regeneration tissue in a few cases.



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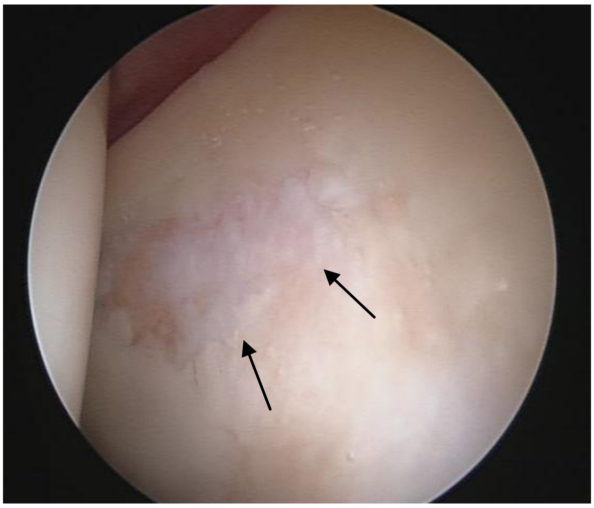

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