SYMPOSIUM: 2013 HIP SOCIETY PROCEEDINGS

Is Intraarticular Pathology Common in Patients With Hip Dysplasia Undergoing Periacetabular Osteotomy?

Benjamin G. Domb MD, Justin M. Lareau MD,
Hasan Baydoun MD, Itamar Botser MD,
Michael B. Millis MD, Yi-Meng Yen MD, PhD

Abstract

Background Periacetabular osteotomy (PAO) enables correction of bony acetabular deficiency in the setting of hip dysplasia. Patients with insufficient acetabular coverage often have intraarticular pathology, but the degree of this pathology has been incompletely characterized. We have used arthroscopy as an adjunct to PAO to further delineate intraarticular pathology in patients with hip dysplasia with mechanical symptoms.

Questions/purposes We documented the arthroscopic incidence of (1) femoral and acetabular chondral pathology, (2) femoral neck cam lesions, and (3) internal snapping or ligamentum teres pathology among patients having arthroscopy before PAO.

Methods We reviewed all 16 patients (17 hips; mean age at surgery, 21 years; range, 12–33 years) with hip dysplasia who underwent PAOs and concomitant hip arthroscopy at our institutions from October 2010 to March 2012. During this period, 80 patients underwent PAOs, making the arthroscopic cohort 21% of the total cohort. Indications for concomitant hip arthroscopy were mechanical symptoms consistent with labral pathology identified on MRI. We documented pathology involving the labrum, chondral surface, ligamentum teres, cam deformity, and psoas tendon.

Results Arthroscopy revealed significant intraarticular pathology in all patients. Fourteen hips had anterosuperior labral tears, and three hips had preoperative findings of internal snapping hip. Eleven hips had femoral cam-type lesions in addition to dysplasia, and 16 hips had articular chondral injury. Two hips had full-thickness ligamentum tears, and 13 hips had partial-thickness tears.

Conclusions Intraarticular pathology at the time of PAO is common. Future studies are needed to rigorously address the use of arthroscopic intervention during PAO and the impact on clinical outcome compared to PAO alone.

Level of Evidence Level IV, diagnostic study. See Instructions for Authors for a complete description of levels of evidence.

B. G. Domb, J. M. Lareau, I. Botser
Hinsdale Orthopaedics, Hinsdale, IL, USA

B. G. Domb
American Hip Institute in Chicago Loyola University Stritch School of Medicine, Chicago, IL, USA

H. Baydoun
Armstrong County Memorial Hospital, Kittanning, PA, USA

M. B. Millis, Y.-M. Yen
Department of Orthopaedic Surgery, Child and Adult Hip Unit, Harvard Medical School, Boston Children's Hospital, Boston, MA, USA

Y.-M. Yen (✉)
Department of Orthopaedic Surgery, Division of Sports Medicine, Boston Children's Hospital, 300 Longwood Avenue, Boston, MA 02115, USA
e-mail: Yi-Meng.Yen@childrens.harvard.edu

Introduction

Developmental dysplasia of the hip (DDH) is one of the most common etiologies of osteoarthritis in adults, accounting for up to 20% to 40% in young adults [7, 8, 14, 25, 40, 45, 47]. DDH occurs when there is osseous undercoverage of the femoral head by the acetabulum. When the acetabulum is shallow, the labrum may become hypertrophied and can play a larger role in weightbearing and joint stability. The reduced area of the acetabular articular surface results in increased contact forces within the hip [8, 15, 28, 35]. Additionally, elongation of the ligamentum teres can accompany lateral subluxation of the femoral head within the acetabulum [3, 31]. These factors can lead to tears to the labrum and ligamentum teres and articular cartilage injury [29, 36]. Surgical realignment procedures can make the congruous dysplastic hip more stable and may reduce or eliminate symptoms. The Bernese periacetabular osteotomy (PAO) corrects the instability of the dysplastic hip with preservation of the integrity of the pelvic ring and improves abnormal hip mechanics [24]. Despite the effectiveness of the PAO in reducing or eliminating symptoms in most patients, medium-term clinical results show failure rates approaching 24% at 10 years [9, 10, 12, 13, 18, 44].

Several authors have reported a high incidence of labral tears associated with hip dysplasia [11, 16, 19, 22, 30, 41]. Failure in tension of the hypertrophied labrum seems the most common mode of labral injury in dysplasia, but inversion of the labrum can also occur, leading to tearing [5, 17]. Ross et al. [41] recently reported that more than 60% of patients undergoing PAO had concomitant intraarticular pathology (labral tears or chondral damage) by direct arthroscopic visualization. Byrd and Jones [4] reported on arthroscopic débridement of the labrum and articular cartilage in dysplastic hips with improved results at 1 year. However, a recent report by Parvizi et al. [38] reported minimal relief with labral débridement in the setting of dysplasia. Open labral débridement with an anterior arthrotomy at the time of PAO has also been reported with good results [21, 27]. In a study by Matheney et al. [34], 15 of 135 hips that had undergone PAO required arthroscopic intervention consisting of a labral débridement or chondroplasty for continued mechanical symptoms. We chose a subset of patients with hip dysplasia and mechanical symptoms who were undergoing PAO and performed arthroscopy as an adjunctive procedure before the PAO.

We therefore documented the arthroscopic incidence of (1) femoral and acetabular chondral pathology, (2) femoral neck CAM lesions, and (3) internal snapping or ligamentum teres pathology among patients having arthroscopy before PAO.

Patients and Methods

Patient Selection

After obtaining institutional approval, we reviewed our institution's hip database to identify patients who underwent PAO with concomitant arthroscopy performed by the senior authors (BGD, JML, MBM, YMY) from October 2010 to March 2012. The decision to proceed with PAO was made by the senior authors based on history, physical examination, and radiographs consistent with symptomatic dysplasia. All patients had preoperative AP, false-profile, Dunn lateral, and Von Rosen radiographs for review. All patients had a lateral center-edge angle of 17° or less (Fig. 1). We obtained delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) on all patients to evaluate intraarticular pathology preoperatively and assess the extent of cartilage degeneration [23]. Patients with joint space narrowing or other radiographic evidence of arthritis changes (> Tönnis Grade 1) were not considered for PAO. We excluded patients with other secondary diagnoses such as Legg-Calvé-Perthes disease, slipped capital femoral epiphysis, or septic arthritis. Patients who had undergone previous open surgery were also excluded from this study. The decision to add a concomitant arthroscopy to the PAO was based on the physical examination findings of clicking, locking, or other mechanical symptoms and findings on dGEMRIC suggestive of labral pathology. We identified 16 patients who met our inclusion criteria. During this time period, a total of 80 patients underwent a PAO, making the arthroscopic cohort 21% of the total number of patients. There were 12 females and four males, with a mean age at the time of surgery of 21 years (range, 12–33 years) (Table 1). Two patients had previous arthroscopic surgery at another institution. Both previous arthroscopies included labral débridement; one patient also had a femoral osteoplasty, while the other had a labral repair and acetabular rim trimming. Both patients reported a short period of improvement after arthroscopy, followed by recurrence of their symptoms.

Data Collection

Preoperative and intraoperative findings were noted. Lateral and anterior center-edge angles were measured. Preoperative MRI was obtained and evaluated for the following: labral tears, chondral flaps, bony edema patterns, and dGEMRIC index. The dGEMRIC index refers to the longitudinal relaxation time after penetration of gadolinium and is reported as a value ranging from 50 to 1500 milliseconds, with lower scores indicating more disease. Intraoperatively, labral tears were described according to location (clock face), size, and Seldes classification [42]. Peripheral acetabular labral-articular

Fig. 1A–B (A) In a preoperative standing AP radiograph, the lateral center-edge angle measures 13°. (B) In a preoperative false-profile view, the anterior center-edge angle measures 11°.
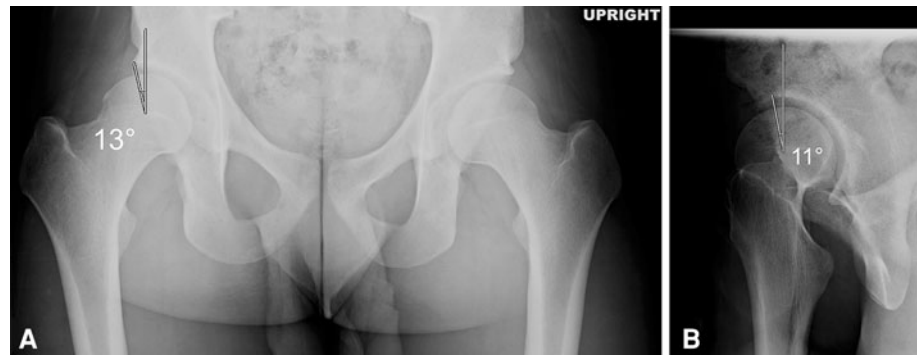

Table 1. Demographics and descriptions of intraarticular hip pathology and treatment

Variable	Value
Number of patients/hips	16/17
Sex (number of patients)	
Female	12
Male	4
Age (years)*	21 ± 6.7 (12–32)
Side (number of hips)	
Right	11
Left	6
Lateral center-edge angle (°)*	11 ± 7.5 (10–17)
Anterior center-edge angle (°)*	8 ± 11 (0–20)
Traction time (minutes)*	39.3 ± 20.5 (15–72)
Preoperative dGEMRIC index*	531 ± 90.1 (324–726)
Previous surgery (number of patients)	2
Labral tears (number of hips)	
Total	14
Seldes Type I	8
Seldes Type II	5
Combined	1
Position of clock face (hours)*	2.3 ± 0.75 (1–3)
Chondral injury (number of hips)	
Total	16
Acetabular	14 (6 abrasion chondroplasty; 2 microfracture)
Acetabular and femoral	2 (2 abrasion chondroplasty)
Ligamentum tears (number of hips)	
Total	15
Low grade	5
High grade	8
Full thickness	2

* Values are expressed as mean ± SD, with range in parentheses; dGEMRIC = delayed gadolinium-enhanced MRI of cartilage.

disruption lesions were classified according to the acetabular labrum articular disruption (ALAD) classification [19]: softening of cartilage adjacent to the labrum (ALAD1), early
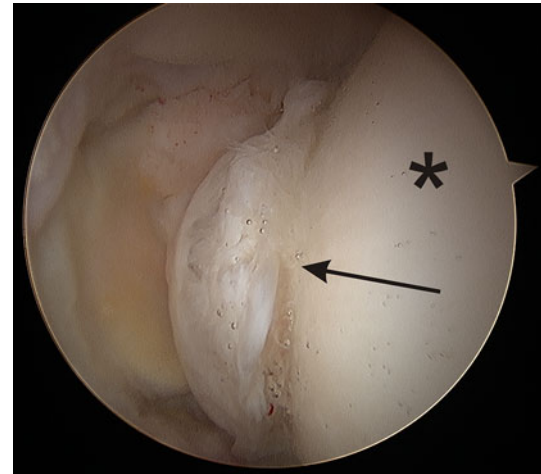

Fig. 2 An arthroscopic view shows fraying of the ligamentum teres suggestive of microinstability (arrow). The asterisk is the articular surface of the femoral head.

peel back of the cartilage (ALAD2), large chondral flap (ALAD3), and complete loss of cartilage (ALAD4). Ligamentum teres pathology was classified as normal, a low-grade partial-thickness tear, a high-grade partial-thickness tear, or a full-thickness tear. Surgical traction was applied for the arthroscopy, and total traction time was recorded (Table 1). Peripheral arthroscopy was done to dynamically confirm cam deformity seen on preoperative radiographs.

Surgical Technique

Arthroscopy was performed in the supine position using anterolateral and midanterior portals. Muscular paralysis was employed with general endotracheal anesthesia for the arthroscopic portion of the procedure. The neuromuscular blockade was reversed for the PAO portion of the procedure. Initially, a full diagnostic arthroscopy of the central compartment was performed. Partial capsulotomy was employed as needed to enable subsequent arthroscopic procedures. The PAO was performed after the arthroscopy using a surgical technique described by Ganz as modified

Fig. 3A–B (**A**) In a postoperative AP radiograph, the lateral center-edge angle measures 23°. (**B**) In a postoperative false-profile view, the anterior center-edge angle measures 23°.
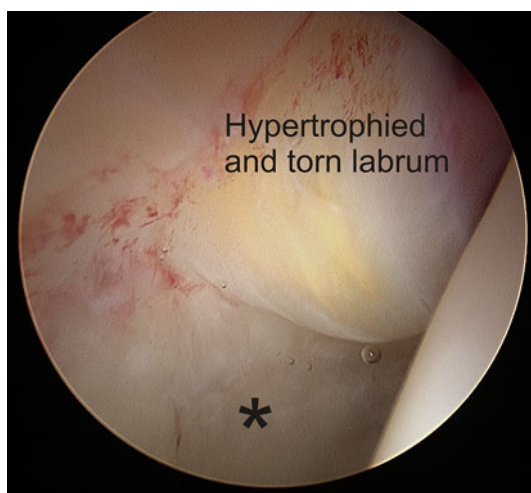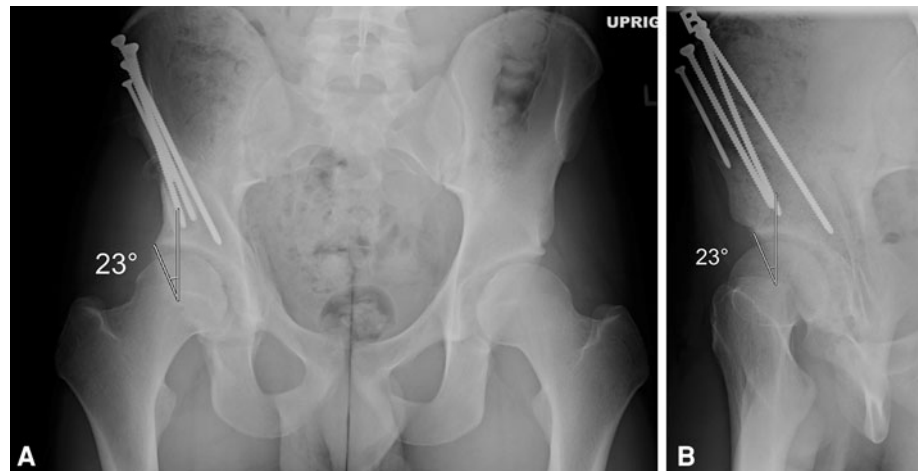

Fig. 4 In an arthroscopic view, the labrum is hypertrophied and, under the yellowish area of degeneration, has separated from the acetabulum. The asterisk denotes the acetabular cartilage, which is softened.

Fig. 5 An arthroscopic view shows the repair of the torn labrum shown in Figure 4 using suture anchors to secure the tissue.

by Murphy et al. [33] with or without sparing of the rectus tendon (Fig. 2). There were no medical or surgical complications in this small cohort of patients at an average of 1.5 year of followup.

Results

Arthroscopy revealed concomitant intraarticular pathology in all patients. Preoperative dGEMRIC diagnosed 16 of 17 hips with a labral tear. A total of 14 of 17 patients had labral tears identified arthroscopically (Table 1). Labral tears were located in the anterosuperior portion (Fig. 3). Mean tear size was 8 mm located at 2.3 hours on the clock face (range, 1–3 hours; SD = 0.75 hours). Tears were Seldes Type I in eight hips, Seldes Type II in five, and combined Seldes Types I and II in one. The Seldes Type II
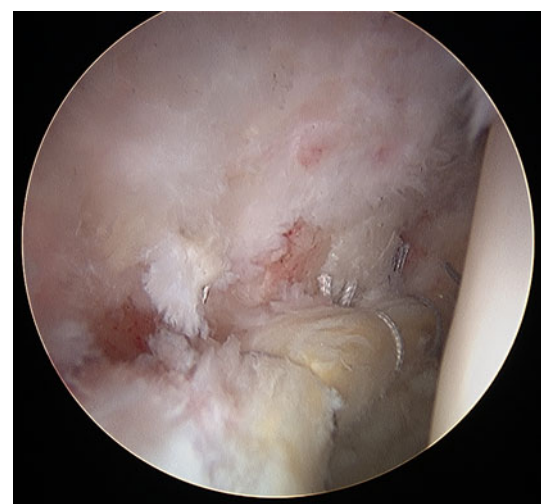
labral tears involving an intrasubstance split or fraying were treated with labral débridement while the Seldes Type I tears that were detached from the acetabulum required a labral repair (Fig. 4).

Mean preoperative dGEMRIC index of the hips was 531 milliseconds (range, 324–726 milliseconds). Under arthroscopic visualization, 16 of 17 hips also had chondral injuries. Chondral damage was located on the acetabular side in 14 hips and was both femoral and acetabular in the remaining two. All acetabular lesions involved the periphery and acetabular rim. Five hips had ALAD1 lesions, eight had ALAD2 lesions, two had ALAD3 lesions, and one had an ALAD4 lesion. Eight hips underwent abrasion chondroplasty of the lesions, while two had microfracture chondroplasty for the lesions (Fig. 5).

Ten hips were identified as having cam deformity by preoperative radiography. Arthroscopic evaluation revealed that 11 hips demonstrated cam-type deformities of the

femoral neck. Three hips had preoperative findings of internal snapping hip. The ligamentum teres was probed and visualized during arthroscopy. We identified ligamentum pathology in 15 hips: five had low-grade partial-thickness tears, eight had high-grade partial thickness tears, and two had full-thickness tears.

Discussion

Over the past decade, the Bernese PAO has become a widely accepted treatment for symptomatic congruous acetabular dysplasia in the mature patient, with satisfactory results seen at short- and medium-term followup [13, 26]. However, despite adequate bony correction, some patients continue to experience pain and mechanical symptoms. Matheney et al. [34] noted that 15 of 135 hips required secondary arthroscopic intervention consisting of a labral débridement or chondroplasty at an average of 6.8 years after PAO. Eleven of those patients reported complete resolution of their pain and symptoms. Long-term followup of PAO shows that specific population subgroups are at a higher risk of failure. Patients with Tönnis Grade 2 and 3 changes tend to have worse outcomes [13, 43, 46]. Patients lacking a congruent joint have historically done worse and gone on to earlier failure [26]. The incidence of a labral tear and its effect on outcome after PAO are still controversial. Several authors reported worse long-term outcomes of PAO when a labral tear was found [43, 48]. Others studies have failed to show this association [26]. Accordingly, we described the frequency of different kinds of intraarticular pathology in dysplastic hips treated with concomitant arthroscopy and Bernese PAO.

Our study had a number of limitations. First, our patient sample was small and there was a significant selection bias within our study cohort. This group was selected based on preoperative mechanical symptoms and findings on dGEMRIC suggestive of labral pathology. Therefore, all patients were suspected of having intraarticular pathology. However, the degree of labral tearing, amount of chondral damage, presence of cam deformity, and amount of ligamentum teres damage were considerable. It is unclear from this study whether these same findings would be present in all patients who underwent PAO in the same time period. Second, our study was purely descriptive; we did not perform any clinical analysis or obtain outcome measures of the patients in this group. This severely limits the ability to interpret the usefulness of arthroscopy as an adjunct to PAO. However, intraarticular pathology was found in all patients, with multiple pathologies present in most patients.

Intraarticular pathology is quite common in the mature dysplastic hip and can include labral, articular cartilage, and ligamentum teres injury [11, 19, 21, 22, 30, 41]. The initial report by Klaue et al. [21] described addressing labral pathology at the time of surgery by intraarticular inspection and labral repair or débridement depending on the tear characteristics. Due to their short followup, they were unable to draw any conclusions relating to the effect of labral débridement or repair. In more recent series, labral tears were present in 49 of 72 [34] and 122 of 170 [29] patients, the majority of whom were surgically treated. In the series by Ross et al. [41], 93% of the labrum in dysplastic hips were either hypertrophic or torn; however, it is not known what type of labral tear occurred. In our study, the majority of labral tears were found to be Seldes I tears, which correlates to the increased stress concentration at the acetabular edge of a hypertrophied labrum. It is not known whether the labrum diminishes in size after PAO correction, although in patients treated with Chiari osteotomy, a massive labral tear was found in all seven patients treated with arthroscopy [16]. Recently, Parvizi et al. [38] cautioned against the use of arthroscopy in the treatment of hip dysplasia. They found that hip arthroscopy with isolated treatment of labral pathology may actually accelerate the arthritis process.

The acetabulum is affected in more than 60% of hips, and acetabular chondral lesions typically involve the anterosuperior and posterosuperior regions [11, 29, 41]. Evaluation by dGEMRIC also shows the acetabular cartilage is often diffusely thinned, even in the absence of any focal lesion in the dysplastic hip [20]. In our series, dGEMRIC index values of 500 milliseconds were corroborated by 15 of 16 hips that had anterosuperior chondral damage at the acetabular periphery. Arthroscopy offers the advantage of a more detailed examination of the articular surface with a magnified picture and the ability to clearly see chondral softening with an arthroscopic probe. We were able to classify ½ of the hips as having an ALAD1 articular softening. The pattern of chondral damage was diffuse, suggesting overload of the shallow acetabulum consistent with that seen by Ross et al. [41].

Within this small cohort, we identified a cam deformity in 10 of 16 hips. While dysplasia and femoroacetabular impingement are known to coexist, to our knowledge, there has only been one study documenting the dysplasia in the presence of FAI. Paliobeis and Villar [37] identified up to 47% of patients treated for femoroacetabular impingement had radiographic evidence of dysplasia. This number depended on the radiographic definition of dysplasia. Cam deformity was identified radiographically and confirmed with arthroscopic dynamic assessment of the femoral head-neck junction abutting against the labrum or acetabulum. It is unknown whether the presence of a cam deformity may have contributed to the intraarticular pathology seen in our patients.

The ligamentum teres can be elongated due to the lateral subluxation of the femoral head within the acetabulum

[3, 31]. Instability of the hip due to the ligamentum teres is referred to as microinstability [2]. More recently, an MRI model showed that femoral head translation increased in vivo in dysplastic hips, suggesting microinstability as another cause of intraarticular damage [1]. Microinstability is exacerbated by sporting activities that require a lot of hip motion and torque, such as football and tennis, which leads to damage to the labrum and cartilage, explaining the high association among ligamentum tears, labral tears, and cartilage lesions [8, 32]. As shown by Botser et al. [2], hips with a low stability index (lateral center-edge angle − acetabular index), and therefore a lesser bony constraint, may be more dependent on the ligamentum as a secondary stabilizer. In this study, the ligamentum teres was at least partially torn or fully torn in almost all hips, suggesting that these dysplastic hips may have microinstability. This finding has not been seen as often in other series [19, 30, 41]. Pathology in the dysplastic hip can also affect the iliopsoas. In one series, two of eight patients who underwent an arthrotomy at the time of a PAO also required fractional psoas lengthening [6]. In our series, three of 17 hips had internal hip snapping and so underwent lengthening of the psoas.

We found that intraarticular pathology frequently coexists with dysplasia. Acetabular labral damage, chondral damage, and cam deformity are common, while ligamentum teres tears may suggest microinstability of the dysplastic joint. Extraarticular correction of the biomechanics by acetabular realignment osteotomy remains the conventional treatment for dysplasia. However, PAO provides limited access to intraarticular pathology. A concomitant arthroscopy at the time of a PAO allows more complete visualization of the hip than anterior arthrotomy, plus improved ability to address intraarticular pathology. There may be a role for hip arthroscopy to identify and treat intraarticular hip pathology in selected dysplastic hips at the time of PAO. However, further studies are needed to evaluate this role, to identify prognostic factors at arthroscopy, and to assess the value of arthroscopic intervention.

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