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Research article

Outcome after arthroscopic labral surgery in patients previously treated with periacetabular osteotomy: a follow-up study of 43 patients

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ABSTRACT

To identify factors predicting failure after hip arthroscopy in patients with previous periacetabular osteotomy (PAO) defined as a conversion to total hip replacement (THR) and to evaluate the patient reported outcome scores. Of 55 hips treated with hip arthroscopy after PAO from Aug 2008 to 2012 at Aarhus University Hospital, 43 hips were included (median age: 36.1 yrs, range 16.3–56.9 yrs). Indications were unacceptable pain, a positive FABER and impingement test and signs of labral damage on MR-arthrography. Outcomes were evaluated with mHHS and HOS. Failure was defined as conversion to a THR. Nine hips were converted to a THR. Kaplan-Meier survival rate was 52.8% (95% CI, 10%–83.8%) at 6.5 years follow-up. Statistically significant predictors of failure: joint space width after PAO <3.0 mm and Tönnis grade of 2. Fourteen hips needed revision hip arthroscopy. Labral damage was present in 84% of the hips. In 42% of the hips cartilage lesions of Becks grade >3 were found. Mean mHHS and HOS were 65.7 and 68.8 respectively at follow-up. A NRS pain score of >3 in rest and during activity were present in respectively, 43% and 62% of the patients. Hip arthroscopy after PAO demonstrated limited clinical benefit with no decrease in pain levels and 21% of patients needing reoperation to THR. Radiographic signs of joint degeneration after PAO are predictors of faiElure. Further studies are needed to clarify what role hip arthroscopy should play in this patient group.

INTRODUCTION

Management of symptomatic developmental dysplasia of the hip (DDH) in the young adult remains challenging. It is a complex disease with both osseous and intraarticular causes [1–3]. Untreated, studies have shown that the DDH will lead to osteoarthritis of the hip. The Bernese periacetabular osteotomy (PAO) [4] is the preferred treatment today. In the literature it is described how the bony malformation in dysplastic hip and the following pathological joint biomechanics results in high prevalence of intraarticular pathology in the affected hips [5–11]. Despite refinement of the surgical technique [12–15] some patients will have continuous hip symptoms after the reorientation of the acetabulum [6]. Clinical failure defined by a high WOMAC pain score ≥ 10 at medium to long term follow-up after PAO or the need for a conversion to a THR have been well described in the literature [16–18]. There is no consensus of the best way of treating the intraarticular pathology in relation to the PAO. The literature describes both open arthrotomy during PAO [19] and hip arthroscopy assisted PAO in which intraarticular pathology can be addressed at the time of the PAO procedure [20]. Another strategy is to treat intraarticular pathology related to DDH after PAO using hip arthroscopic labral and bony procedures in patients with continued symptoms after PAO [6]. Treatment of femoroacetabular impingement (FAI) that involves labral pathology has been treated arthroscopically with good results [21–23]. A recent study

by Larson et al. [24] demonstrating inferior outcome in patients with DDH treated arthroscopically for intraarticular pathology compared to a FAI cohort. Other studies have shown failure/high reoperation rate in treating DDH only arthroscopically without addressing the osseous malformation [25]. Preservation of the acetabular labrum rather than debridement is in the literature described with superior results in patients with femoroacetabular impingement [26–29], however the treatment of labral pathology in dysplastic hips still needs to be clarified.

Since 2003, we have been offering DDH patients a PAO using the minimal invasive technique described by Troelsen et al. [14]. In case of continuous hip pain after PAO a hip arthroscopy procedure was performed to address labral and cartilage damage. However, the initial follow up after hip arthroscopy indicated inferior results in this patient group compared to FAI patients.

The present study therefore was primarily to determine patient reported outcome and hip survival rate after hip arthroscopy in hips with previous PAO and secondly to determine radiographic significant factors predicting failure after hip arthroscopy in terms of conversion to a total hip replacement (THR). We hypothesized that patients did not have significantly improved subjective outcome and that conversion to hip arthroplasty was above 10% within 2 years following PAO and hip arthroscopy.

MATERIALS AND METHODS

From the Danish Hip Arthroscopy Registry (DHAR) [30], we identified 55 patients with DDH treated with a hip arthroscopy from August 2008 to December 2012. Ten patients with Legg-Calvé-Perthes disease were excluded. Prior to the hip arthroscopy all had been treated with a periacetabular osteotomy (PAO) by a very experienced PAO-surgeon (KS). Two patients with hip arthroscopy procedures performed before PAO were excluded; hence forty-one patients (43 hips) were included in the study. All patients included had significant dysplasia preoperatively with median CE-angles of 19° (IQ 6°–23°) and AI-angle at 11° (IQ 7°–16°) and postoperatively to respectively, 35° (IQ 32° – 37°) and 2° (IQ 2° – 6°). Mean time from PAO to hip arthroscopy was 3 years (range 0.3–12.2 years). Indications for hip arthroscopy were unacceptable pain during daily activities and signs of acetabular labral damage on MR-arthrography. Contraindication to early hip arthroscopy was radiographic evidence of non-healed osteotomies. A positive FABER and impingement test was positive in 95% of the cases (42 hips). DHAR is a national registry using prospective web-based collecting of (patient reported outcome measurement) PROM data from patients before hip arthroscopy and at specific follow-up intervals [30]. The surgeon includes perioperative radiographic data, intraoperative surgical technique and intraarticular pathology. Then patients are subsequently requested by e-mail contact to complete PROM scores and at 1, 2 and 5 years follow-up. All arthroscopies were performed by a very experienced hip arthroscopist (BLU) with the patients in supine position and using standard antero-lateral and mid-anterior portals [21]. The majority of the patients had signs of pincer impingement and subsequent trimming of the acetabulum and labral repair was performed with suture anchors. Femoral osteochondroplasty was performed in most patients. It was not standard procedure to close the capsule at that time.

Radiographic evaluation of the hip joint was performed by one author (BLU) based on standing pelvic radiographs taken after PAO, but prior to hip arthroscopy. On conventional radiographs following parameters were measured: the centre-edge angle of Wiberg [1], the acetabular index angle [31], presence of an os acetabuli [9], the alpha-angle [32], the minimal joint space width (JSW) at the lateral sourcil [33] and the Tönnis grade of osteoarthritis [31]. Retroversion of the acetabulum was identified if a cross over sign was present (crossing of the anterior and posterior rim) [34–36] and with a prominent ischial spine sign [37]. Coxa profunda was defined as the acetabular fossa being medial to the ilioischial line. Table I describes the radiographic parameters prior to arthroscopy of the evaluated cohort.

From the DHAR the following perioperative parameters were retrieved: Labral and cartilage injuries and procedures performed during hip arthroscopy. The acetabular cartilage injury was classified using the Beck's classification [38], which describes cartilage lesions based on the depth and the extent of the cartilage injury examined by direct vision. Labral damage was classified using a modified classification from Lage et al. [39].

During January and February 2015 mHHS (modified Harris Hip Score) [40] and HOS (Hip Outcome Score) [41] questionnaires and numerical rating scale (NRS) pain scores during rest and activity were collected from the patients. Furthermore patients were asked about the need of and conversion to a total hip replacement (THR) and their willingness to repeat the treatment course was collected.

STATISTICAL ANALYSIS

Normally distributed data is presented as means with 95%CIs range, and not normally distributed as medians with interquartile ranges. Possible predictors for failure were identified calculating crude hazard ratios using cox regression analysis. The proportional-hazard assumption requirements were tested using log-log plots. Hip

Table I Radiographic characteristic of the 41 patients (43 hips) before hip arthroscopy

Radiographic characteristics	*Value*
Characteristic on pelvic and hip radiographs	
Centre-edge angle (*deg*) (before PAO)	
Median (interquartile range)	19° (6°–23°)
Range	0°–28°
Centre-edge angle (*deg*) (after PAO)	
Median (interquartile range)	35° (32°–37°)
Range	25°–51°
Acetabular index angle (*deg*) (before PAO)	
Median (interquartile range)	11° (7°–16°)
Range	–3°–22°
Acetabular index angle (*deg*) (after PAO)	
Median (interquartile range)	2° (2°–6°)
Range	1°–10°
Alpha angle (*deg*)	
Median (interquartile range)	78° (75°–85°)
Range	55°–114°
Tönnis grade of osteoarthritis	
0	19 (44%)
1	21 (49%)
2	3 (7%)
Presence of an os acetabuli	3 (7%)
Minimal joint space width (mm)	
Median (interquartile range)	4 (3–4)
Range	2–4
Sign of crossover	22 (49%)
Presence of ischial spine sign	17 (40%)
Cam	41 (95%)
Pincer	39 (91%)
Coxa profunda	12 (28%)

Table II Demographic and surgical data for the 41 patients (43 hips)

Parameter	*Value*
Age of time of hip arthroscopy (years)	
Median (interquartile range)	36.1 (26.2–42.9)
Range	16.3–56.9
Sex (number of hips)	
Female	41 (95%)
Male	2 (5%)
Duration of traction (min)	
Median (interquartile range)	35 (30–45)
Range	20–90
Damage to the labrum	36 (84%)
Beck	
0 (normal)	3 (7%)
1 (malacia; fibrillation)	7 (16%)
2 (debonding; wave sign)	16 (37%)
3 (cleavage; thinning of cartilage)	12 (28%)
4 (defect; full-thickness defect)	5 (12%)
Resection of the acetabular rim	36 (84%)
Refixation of the labrum	34 (79%)
Microfracture performed	4 (9%)

survivorship with conversion to THR as an end point was calculated using the Kaplan-Meier survival analysis. For the survivorship analysis all hips were included, however for the PROM evaluation only patients with hips not converted to a THR were included. STATA 12 software package (StataCorp LP, College Station, TX, USA) were used for all calculations.

RESULTS

Forty-three hips (41 female hips) (Table II) were evaluated. Mean follow-up since the first hip arthroscopy was 3.5 years (range 2.1–6.5 years). Fourteen hips (32%) had a re-arthroscopy during follow-up time. Re-arthroscopy was mainly performed due to capsular scar tissue and non-healing of the labrum. Nine hips out of 43 hips (21%) were converted to a THR during follow-up. Mean time

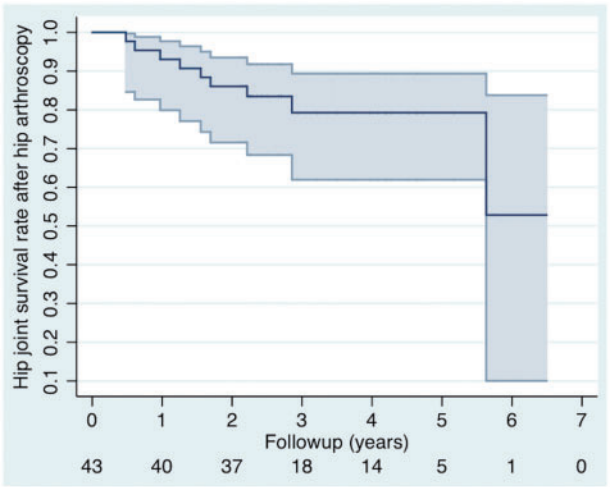

Fig. 1. Kaplan-Meier survivorship curve (with 95% CI) showing conversion to THR and an end point for 43 hips. Five year hip survival rate is 79.3% (95%CI 62%–89.3%), however only 52.3% (95%CI 10%–83.8%) at 6.5 years. Particular within the first 2 years the hips seems to have a higher risk for conversion to a THR. Below the x-axis each number of hips available for follow-up is given.

from primary hip arthroscopy to THR was 3.1 years (range 0.5–6.5 years). The Kaplan-Meier analysis showed a hip joint survival rate of 52.8% (95% CI, 10%–83.8%) at 6.5 years after hip arthroscopy (Fig. 1). Using Cox regression analysis following statistically significant predictors of conversion to THR parameters were identified: joint space width after PAO < 3.0 mm (hazard ratio, 4.60; 95% CI 1.20–17.59) and a Tönnis grade of 2 (hazard ratio, 6.70; 95% CI 1.54–29.16). Six hips (14%) had a joint space width <3 mm. In 42% of the patients a cartilage injury Beck grade of 3 or 4, were present at the acetabulum, however these changes were not related to increased failures (hazard ratio, 2.91; 95% CI 0.72–11.65) (Table III). Labral damage was present in 84% of the hips. In fourteen hips (33%) re-arthroscopy was performed due to continued symptoms of disabling pain. PROM questionnaires (mHHS, HOS) were completed by 88% of patients ($n = 30$) with hips not converted to a THR ($n = 34$). Mean mHHS and HOS preoperative were respectively 63.8 and 67.4 ($n = 11$). Mean mHHS and HOS were 65.7 and 68.8, respectively, at final follow-up ($n = 30$). We did not find any significantly decrease in pain scores from preoperative to follow-up. Mean NRS pain scores in rest and during activity were, respectively, 2.8 and 4.7 at follow-up, compared to 4.5 and 5.5 preoperatively. No significant statistical changes were seen at the follow-up (Table IV). In the group of patients with preserved hips 23 (77%) of patients were willing to repeat surgery.

DISCUSSION

The primary finding of the present study was that an arthroscopic management of labral and cartilage pathology in patients with DDH with a previous PAO procedure did not improve patient symptoms and pain levels. At 2.1–6.5 years follow-up, we found no significant improvement in mHHS, HOS and NRS pain scores compared to preoperative values. Another important finding of managing DDH pathology arthroscopically, was a high conversion rate to THR. Particularly within the first 2 years after arthroscopy conversion to THR occurs, indicating early return of significant symptoms or no symptom improvement after surgery. The Kaplan-Meier method is sensitive to low numbers of patients, and even one conversion to a THR results in a dramatically decreased survival rate, however with wide confidence intervals as seen in Fig. 1. Reducing the survival curve to 5 years would give a survival rate of 79.3% (95% CI 62%–89%).

Predictors for conversion to a THR was joint space width <3.0 mm after PAO and a Tönnis grade of 2. However the degree of labral pathology or presence of grade 3 or 4 injuries of the acetabular cartilage were not predictors for treatment failure and THR conversion as expected. CE-angles after PAO under 30° or above 40° were not correlated to failure.

Previous studies have described the labral pathology in dysplastic hips with degenerative changes, ganglion formation and tears and hypertrophy [7, 9]. Thus a treatment approach addressing this pathology should in theory provide symptom relief. With the rapid evolution of hip arthroscopic surgery over the last decade, treatment of intra articular pathology in patients with DDH has been attempted, however indications for hip arthroscopy in the dysplastic hip with continuous pain after PAO remains unclear. One study has retrospectively investigated the impact of different degrees of dysplasia in patients undergoing hip arthroscopy due to hip pain and impaired hip function. Forty-eight patients with dysplasia (CE angle of Wiberg <20°) and borderline dysplasia (CE angle 20°–25°) were followed 12–60 months after hip arthroscopy [42]. No significant differences in outcome based on improvement in mHHS scores were found between the two groups. The study concluded that radiological evidence of dysplasia is not a contraindication for hip arthroscopy. Another study has demonstrated the challenge of obtaining a clinical efficacy from arthroscopic intervention in DDH. Parvizi [25] followed 36 dysplastic hips for 1–7 years after hip arthroscopy. At early follow-up 6 weeks after surgery functional scores

Table III Crude hazard ratios for predictors of failures

Parameter[a]	*Crude hazard ratio (95% CI)*	P *values*
Preoperative joint space width <3 mm	4.43 (1.16–16.91)	0.030
Preoperative Tönnis grade 2	6.48 (1.49–28.11)	0.013
CE-angle <30° or > 40°	0.48 (0.06–3.92)	0.495
Beck grade ≥3	3.15 (0.79–12.64)	0.105

[a]Joint space width, Tönnis grade and CE-angles measured at radiographs after PAO. Becks grade examined during hip arthroscopy.

Table IV Results of patients reported outcome scores (n = 30)

Parameter	*Preoperative* (n = *11*)	*Postoperative* (n = *30*)	P *values*
Mean NRS (95%CI)[a]			
At rest	4.5 (2.9–6.0)	2.8 (1.8–3.8)	0.070
After 15 min of walking[a]	5.5 (4.0–6.9)	4.7 (3.6–5.7)	0.405
Mean mHHS (95%CI)	63.8 (50.0–77.6)	65.7 (56.7–74.7)	0.816
Mean HOS (95%CI)	67.4 (53.3–81.6)	68.8 (60.7–77.0)	0.862

[a]Scale 0–10 (10 worst pain ever).
NRS, Numerical Rating Scale; mHHS, modified Harris Hip Score; HOS, Hip Outcome Scores.

were improved, however scores declined in 24 hips at 2-year follow-up and all these patients required further surgical treatment. Furthermore, 14 hips had accelerated arthritis at 36 months of follow-up and 16 hips ended up with open surgery (PAO, open FAI surgery or THR). Their conclusion was that arthroscopic treatment failed to relieve pain and symptoms long term in DDH patients. This is consistent with findings of the present study where no improvement of patient evaluated outcome was found along with a high conversion rate to THR. Larson et al. compared a FAI and a dysplasia cohort after hip arthroscopy and found inferior result in the dysplastic hips [24]. Other studies have shown improved outcome in FAI hips after arthroscopic treatment of the hip [21].

Gender is an important factor for DDH pathology. In general there is a predominance of female hips reported in the PAO literature [4, 17, 43]. A recent study from Ross et al. [44] found that being of the female sex was a risk factor for failed hip arthroscopy with a need for PAO. In the present study the majority of patients were female (41 of 43 hips), hence any potential sex difference in outcome could not be evaluated.

The optimal treatment algorithm for symptomatic hip dysplasia addressing both intra-articular and extra-articular cause of remains unclear. The PAO is the preferred procedure for reorienting the acetabulum, and studies have described other procedures for addressing the concomitant intra-articular pathology during the PAO such as open arthrotomy during PAO [19] or hip arthroscopy assisted PAO [20]. A recent study with 95 hips (including 12 hips in the present study) with MR-arthrography documented labral pathology found that 27% of the hips required a hip arthroscopy within the first 2 years after PAO due to persistent symptoms [6]. Despite nearly all patients with DDH have labral pathology at time of PAO, 73% of the patients obtained satisfactory outcome from PAO treatment alone. The present study found that early osteoarthritic changes as indicated by decreased joint space width and bony changes as seen at Tönnis grade of 2 are most likely and not the degree of labral pathology were the main factors for continued symptoms rather than labral pathology.

Overall findings of the present study are that hip arthroscopy labral procedures and cartilage debridement in patients with persistent symptoms after PAO had limited clinical benefits from the hip arthroscopy procedure. It can be discussed if these patients show true CAM morphology or represent poor offset and therefore should not be

treated like FAI patients. As a result of these findings, we have changed the management of patients with continued symptoms despite a successfully PAO, so that we no longer offer hip arthroscopy to treat intraarticular pathology. Instead physical therapy and increased focus on extra-articular soft tissue pathology are offered as treatment. The impacts of these measures will need further investigation.

LIMITATIONS

Our study had some limitations. The exclusion of 10 hips due to Legg-Calvé-Perthes disease made the cohort smaller, but more homogenous. However, the reduction of the number of hips weakened the statistical background for the presented data illustrated by the wide confidence intervals. Furthermore the low number of hips and events in the study made it impossible to perform multivariate analysis, and to examine any correlations between risk factors.

Unfortunately, we only had preoperative PROMs from 11 patients, which make it difficult to conclude on the subjective outcome of hip arthroscopy in a patient cohort. A possible limitation could be the lack of postoperative radiographic evaluation of CAM resection after arthroscopy, which means that under correction of CAM deformities could contribute to the poor outcome.

CONCLUSION

Arthroscopic management of labral and cartilage pathology in patients with DDH after PAO demonstrated limited clinical benefit with no decrease in pain levels and 21% of patients needing reoperation to THR. Radiographic signs of joint degeneration after PAO are predictors of failure and need for THR. Further studies are needed to clarify what role hip arthroscopy should play in this patient group.

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CONFLICT OF INTEREST STATEMENT

None declared.

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