



Original article

Does acetabular dysplasia affect outcome in arthroscopic treatment of cam femoroacetabular impingement? Case-control study with and without acetabular dysplasia



Marcelle Mercier^{a,*}, Antoine Danguin^b, Edouard Ollier^c, Nicolas Bonin^d

^a Service de chirurgie orthopédique et traumatologique, CHU Lyon Sud, 165, Chemin du Grand Revoyet, 69310 Pierre-Bénite, France

^b Chirurgie orthopédique et de traumatologie, CHU Nord Saint-Étienne, 42270 Saint Priest en Jarez, France

^c Unité de recherche clinique, innovation, pharmacologie, CHU Nord Saint-Etienne, 42055 Saint-Étienne, France

^d Lyon Ortho Clinic, clinique de la Sauvegarde, 29, avenue des Sources (Bât B), 69009 Lyon, France

ARTICLE INFO

Article history:

Received 21 March 2017

Accepted 24 October 2018

Keywords:

Femoroacetabular impingement

Cam effect

Dysplasia

Borderline dysplasia

Hip arthroscopy

ABSTRACT

Background: Arthroscopic management of femoroacetabular impingement (FAI) is classically contraindicated when acetabular dysplasia is associated, although this is controversial in case of moderate dysplasia or isolated cam effect. A case-control study was therefore conducted comparing borderline (center-edge angle (CEA), 20–24°), moderate (15–19°) and severe dysplasia (< 15°) (group D) versus a control group with normal acetabular cover (CEA, 25–30°). The aims were 1) to determine functional results and satisfaction, and 2) to correlate functional results with severity of dysplasia and of cam effect.

Hypothesis: Improvement in functional scores and satisfaction is lower in group D than in controls, due to non-correction of dysplasia.

Material and method: A single-center, single-surgeon retrospective comparative case-control study included all patients with isolated cam-effect FAI and dysplasia but without osteoarthritis (group D) or with isolated cam-effect FAI without dysplasia (controls) operated on during the study period. Cases of mixed impingement were excluded. Preoperative and last-follow-up functional variables included McCarthy's modified Harris Hip Score (mHHS) and Christensen's Non-Arthritic Hip Score (NAHS).

Results: Between 2011 and 2014, details of 407 patients operated on by arthroscopy were entered in a data-base. Twenty patients (22 hips) were included in group D, with CEA < 25° (mean, 19 ± 3.1; range, 10–23°). The control group comprised 23 patients (25 hips) with CEA > 25° (mean, 29 ± 2.1°; range, 25–30°) matched for gender, age and body-mass index. Mean follow-up was 29.6 ± 14.1 months (range, 14–58 months) in group D and 31.4 ± 10.6 months (range, 15–57 months) in the control group ($p = 0.66$). For functional scores, the two groups showed respectively 9.9 (–34 to +47) ($p = 0.038$) and 10.4 (–20 to +48) ($p = 0.0038$) gain in mHHS (non-significant: $p = 0.943$). Mean gain in NAHS was 16.6 (–19 to +33) ($p = 0.0001$) and 13.7 (–11 to +47) ($p = 0.0002$), respectively (non-significant: $p = 0.56$).

Conclusion: Short-term functional results for cam FAI treatment were equivalent with < 25° acetabular cover (mean, 19°; range, 13–24°) or normal cover. Longer-term assessment is indispensable to determine the impact of dysplasia and its severity.

Level of evidence: III, case-control study.

© 2018 Elsevier Masson SAS. All rights reserved.

1. Introduction

Femoroacetabular impingement (FAI) is increasingly common in mechanical hip pathology in young subjects [1–3]. Arthroscopic treatment of cam-effect FAI is now a recognized procedure

of proven efficacy [1–3]. Cam-effect FAI shows morphologic acetabular variants, sometimes associating dysplasia. Treatment of moderate and severe acetabular dysplasia is consensual, with augmentation or reorientation, although some authors consider orientation independent of dysplasia [4]. Arthroscopic treatment is more controversial, and restricted to borderline dysplasia [5].

Several authors consider arthroscopy not to be recommended in significant dysplasia (center-edge angle (CEA) < 20°), especially when a pincer effect is to be corrected [6–9]. In isolated cam FAI,

* Corresponding author.

E-mail address: mercier.marcelle@gmail.com (M. Mercier).

on the other hand, arthroscopic treatment in case of dysplasia has been little studied [10–13].

We therefore undertook a case-control study comparing borderline (CEA 20–24°), moderate (15–19°) and severe dysplasia (< 15°) (group D) versus matched controls with normal cover (CEA 25–30°). The objectives were 1) to determine functional results and satisfaction, and 2) to correlate functional results and severity of dysplasia (CEA angle) and of cam (alpha angle). The study hypothesis was that group D would show less improvement in functional scores and satisfaction than controls, due to uncorrected dysplasia.

2. Material and methods

2.1. Patients

In a single-center, single-surgeon retrospective comparative non-randomized case-control study, details of all patients scheduled for arthroscopy in our center since 2011 were, with their consent, entered in a data-base. Data comprised clinical variables (age, gender, height, weight), hip measurements (CEA and alpha angles), date of surgery, and incidents, complications and any re-operation. Preoperative assessment comprised McCarthy's modified Harris Hip Score (mHHS) [14] [15], Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) [16] and Christensen's Non-Arthritic Hip Score (NAHS) [17]. Symptomatic FAI was defined by clinical factors including inguinal pain occurring mainly on hip flexion and on impingement test in flexion-abduction-internal rotation [18]. Cam effect was defined by alpha angle > 55° on Ducroquet lateral X-ray and/or on axial CT slices through the femoral neck [19]. CEA angle was measured on AP standing pelvic X-ray.

Group D inclusion criteria comprised: patient operated on between January 2011 and December 2014 for isolated cam FAI, with CEA angle < 25°. Exclusion criteria comprised: radiographic osteoarthritis on the Tonnis classification, alpha angle < 55°, and hip pain etiology other than FAI. A control group of patients operated on during the same period for isolated cam FAI without dysplasia (CEA 25–30°), matched for alpha angle, age, gender and body-mass index (BMI), was constituted from the data-base. All patients were operated on by the same surgeon, using the same procedure.

2.2. Methods

Surgery was performed under general anesthesia. Patients were positioned with wide pubic support, both lower limbs in extension and slight abduction. Under traction, an anterolateral portal was located by fluoroscopy, and a mid-anterior portal was performed under arthroscopy; the two were linked by capsulotomy. The joint was explored for exhaustive labrum and cartilage lesion assessment. The cam was reamed first under traction and then in flexion with traction released. No capsule closure was performed at end of procedure.

2.3. Assessment

Functional results and satisfaction were assessed postoperatively on clinical scores (mHHS, WOMAC and NAHS), and a self-administered satisfaction questionnaire at last follow-up. McCarthy's modified Harris Hip Score is the tool most widely used in recent reports on FAI [20]. Any revision surgery or total hip replacement was considered as failure of arthroscopy. Finally, patients were asked "Would you undergo the same operation again under the same circumstances?"

2.4. Statistical analysis

Statistical analysis used R software [21] (R. Core Team), with non-parametric and parametric tests as appropriate.

Clinical scores were compared between groups on Wilcoxon-Mann-Whitney test, and pre- versus postoperative scores on Student test. Satisfaction scores were compared on Chi². A univariate ANOVA (ANalysis Of VAriance) was used to identify predictive factors for clinical results.

The significance threshold was set at 0.05%. Patients lost to follow-up were not included in analyses. The study was an intention-to-treat rather than per-protocol design.

3. Results

Between 2011 and 2014, details of 407 patients undergoing hip arthroscopy for any indication were entered in a data-base. Table 1 presents data for those finally included. Group D comprised 20 patients (22 hips) and the control group 23 patients (25 hips). Four patients (5 hips) in group D were lost to follow-up: eg., 11%. The two groups were comparable. Mean follow-up was 29.6 ± 14.1 months (range, 14–58 months) in group D and 31.4 ± 10.6 months (range, 15–57 months) for controls ($p = 0.66$).

Table 2 presents functional results. There were no significant inter-group differences in score gains ($p > 0.05$). Table 3 presents patients with moderate or severe dysplasia and negative HHS gain.

Table 4 presents correlations between functional results and severity of dysplasia and of cam: CEA and alpha angles showed no correlations with gains on the various scores ($p > 0.05$).

There were no failures for revision surgery in either group. One case of asymptomatic Brooker grade 1 capsule ossification [22] was found on group D radiographs at 44 months.

4. Discussion

Studies of arthroscopic treatment of acetabular dysplasia variably report good [12,23,24] and poor results [9]. The present study found significant postoperative improvement in all functional scores, without difference according to dysplasia. As dysplasia was not corrected, it was difficult to say whether patients suffered more from their dysplasia or from impingement. It is debatable whether severe dysplasia should be left uncorrected; however, all patients showed improvement and not all those with negative mHHS gain had severe dysplasia. Interportal capsulotomy involving a quarter of the capsule surface only partially sections the pubofemoral ligament, conservation of which probably avoided aggravation of instability.

There were no significant inter-group differences in functional gain ($p > 0.05$). Regarding the secondary endpoint, CEA and alpha angles did not affect gain on the various scores ($p > 0.05$). The present results agree with literature reports with comparable follow-up. Jayasekera et al. [24] compared arthroscopy in 12 dysplastic hips with mean CEA angle of 15° (range, 9–19°) and 54 control hips with mean CEA angle of 33° (range, 22–45°); 91% ($n = 11$) of the dysplastic hips showed cam FAI and all had labral lesions; at 1 year, mHHS improved significantly ($p = 0.02$) in the dysplastic group, with no inter-group difference. Philippon et al. [10] reported results for labral repair and impingement correction in 28 patients with dysplasia, at a mean 42 months' follow-up, excluding cases of labrum debridement and severe dysplasia (< 15°). Three patients showed isolated cam effect, 24 mixed impingement and 1 pincer effect. Results showed significant improvement in HHS,

Table 1
Group D and control group characteristics.

	Dysplasia group D	Controls	Inter-group comparison (p value)
Number	20 patients, inc. 2 bilateral, and 4 lost to FU (inc.1 bilateral)	25	
Severe (< 15°)	2	0	
Alpha angle (°)	80 ± 0 (80 to 80)		
Moderate (15 to 19°)	3	0	
Alpha angle (°)	74.4 ± 8.4 (65 to 90)		
Borderline (20 to 24°)	17	0	
Alpha angle (°)	73.3 ± 9.6 (50 to 80)		
CEA angle (°)	19 ± 3.1 (10 to 23)	29 ± 2.1 (25 to 30)	p < 0.0001
Alpha angle (°)	74.8 ± 7.8 (60 to 90)	73 ± 9.2 (60 to 90)	0.60
Age (years)	32.5 ± 12.4 (15 to 65)	33.5 ± 8.7 (17 to 51)	0.53
Gender M/F	14/6	18/5	0.61
BMI	23.8 ± 3 (18 to 30)	23.5 ± 3 (19.1 to 30.5)	0.86
FU (months)	29.6 ± 14.1 (14 to 58)	31.4 ± 10.6 (15 to 57)	0.66

BMI: body-mass index; M/F: male/female; FU: follow-up. Results expressed as mean ± standard deviation (range).

Table 2
Results and comparisons of clinical scores between dysplasia group and controls.

		Dysplasia	Controls	Inter-group comparison (p value)
mHHS [14]	Preoperative	64.6 ± 13.5 (37 to 87)	66 ± 12.1 (40 to 82)	0.68
	Last FU	73.7 ± 15.4 (33 to 91)	76.4 ± 14.6 (39 to 91)	0.5
	Gain	9.9 ± 21.7 (-34 to 47)	10.4 ± 17.9 (-20 to 48)	0.83
	Preop/FU (p value)	0.07	0.007	
NAHS [17]	Preoperative	62.5 ± 15.9 (26 to 88)	60.8 ± 16.7 (31 to 90)	0.8
	Last FU	77.7 ± 17.2 (43 to 99)	74.5 ± 15 (48 to 94)	0.36
	Gain	16.6 ± 14.6 (-19 to 33)	13.7 ± 16.8 (-11 to 47)	0.41
	Preop/FU (p value)	0.0002	0.0004	
WOMAC [16]	Preoperative	28.1 ± 15.2 (2 to 65)	30.5 ± 16.3 (1 to 58)	0.63
	Last FU	15.4 ± 12.4 (0 to 34)	19 ± 13.7 (4 to 57)	0.51
	Gain	to 14.2 ± 13.9 (-32 to 13)	to 11.5 ± 16.5 (-39 to 19)	0.64
	Preop/FU (p value)	0.0006	0.002	
Satisfaction	Very satisfied	5 (29%)	8 (32%)	} 0.42
	Satisfied	7 (41%)	7 (28%)	
	Disappointed	4 (23%)	10 (40%)	
	Dissatisfied	1 (6%)	0	
Do again	Yes	13 (76%)	21 (84%)	0.83
Surgical revision		0	0	
Complications		1 (Capsule ossification)	0	-

FU: follow-up; mHHS: modified Harris Hip Score; NAHS: Christensen's Non-Arthritic Hip Score; WOMAC: Western Ontario and McMaster Universities osteoarthritis index. Results expressed as mean ± standard deviation (range) or absolute value (percentage). Complications: scrotal burn or calcification.

from a mean 59 points (range, 20–98) preoperatively to 82 points (range, 45–100) at last follow-up ($p < 0.001$). Functional improvement independent of dysplasia is regularly reported, but it should be noted that follow-up was always too short for any definitive conclusion.

The main limitation of the present study was lack of power due to the small size of each group, precluding certainty as to whether patients with dysplasia were as well-satisfied as the others, and identification of predictive factors. Moreover, dysplasia mainly affects female subjects, who were very much in a minority in the present study. Nor was it possible to form subgroups, due to lack of numbers. This was because we targeted a very precise and well-defined population: cam impingement with dysplasia. Most studies on the subject were more heterogeneous, associating various pathologies with dysplasia treated by arthroscopy, so that interpretation is uncertain. Another limitation was the relatively short follow-up: longer follow-up would have made it possible to check that scores did not deteriorate more rapidly in case of dysplasia. However, findings and treatment were recent, and few

Table 3
Results in patients with moderate or severe dysplasia and all patients with negative mHHS gain.

	Moderate or severe dysplasia	Negative gain
Number	5/22 (23%)	9/47(19%)
CEA (°)	16.6 ± 3.84 (10 to 18)	24.2 ± 6.8 (15 to 30)
mHHS gain (points)	22 ± 17 (-34 to +18)	-11 ± 21 (-34 to -1)
Preoperative alpha angle (°)	74.4 ± 8.45 (65 to 90)	69.5 ± 17 (65 to 90)
Very satisfied or satisfied	3/5 (60%)	0/9 (0%)
Disappointed or dissatisfied	2/5 (40%)	9/9 (100%)
Do again (yes)	4/5 (80%)	4/9 (44%)

Results expressed as mean ± standard deviation (range) or absolute value (percentage). mHHS: modified Harris Hip Score.

studies can claim longer follow-up. The short-term loss to follow-up was another limitation, amplified by the fact that 1 patient had both hips operated on and that the total number of patients was small.

Table 4
Correlations between clinical score gain and anatomic parameters (CEA and alpha angles) on linear regression.

	mHHS gain	p value	NAHS gain	p value	WOMAC gain	p value
CEA angle	0.06 (-0.99 to 1.1)	0.9	-0.18 (-1.05 to 0.68)	0.67	0.23 (-0.6 to 1.07)	0.57
Alpha angle	0.03 (-0.68 to 0.75)	0.93	0.18 (-0.41 to 0.76)	0.54	-0.14 (-0.71 to 0.43)	0.61

mHHS: modified Harris Hip Score; NAHS: Christensen's Non-Arthritic Hip Score; WOMAC: Western Ontario and McMaster Universities osteoarthritis index.

5. Conclusion

Treatment of cam FAI with acetabular cover less than 25° gave functional results no worse than in case of normal cover, even without correcting the dysplasia. Even so, the short follow-up calls for caution, and borderline cases are indicated for this surgery rather than more definite dysplasia, and labrum and capsule should so far as possible be spared to avoid decompensation of instability. Longer follow-up is indispensable to confirm the present findings.

Disclosure of interest

The authors declare that they have no competing interest.

Elsewhere, Nicolas Bonin is a consultant with Stryker and Smith & Nephew and receives royalties as a designer for Dedienne Santé.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Contributions

Marcelle Mercier contributed to data acquisition, analysis and interpretation and drafting the article. Antoine Danguin contributed to study design, data acquisition and statistics. Edouard Ollier contributed to statistics, analysis and interpretation of data. Nicolas Bonin contributed to study design, surgery, revising the article critically for important intellectual content, and final approval of the version to be submitted.

References

- [1] Polat G, Dikmen G, Erdil M, Aşik M. Arthroscopic treatment of femoroacetabular impingement: early outcomes. *Acta Orthop Traumatol Turc* 2013;47:311–7.
- [2] Trompeter A, Colegate-Stone T, Khakha R, Hull J. Hip arthroscopy for femoroacetabular impingement: results of 118 consecutive cases in a district general hospital. *Hip Int* 2013;23:400–5.
- [3] Gicquel T, Gédouin J-E, Krantz N, May O, Gicquel P, Bonin N, et al. Function and osteoarthritis progression after arthroscopic treatment of femoroacetabular impingement: a prospective study after a mean follow-up of 4.6 (4.2–5.5) years. *Orthop Traumatol Surg Res* 2014;100:651–6.
- [4] Nehme A, Trousdale R, Tannous Z, Maalouf G, Puget J, Telmont N. Developmental dysplasia of the hip: is acetabular retroversion a crucial factor? *Orthop Traumatol Surg Res* 2009;95:511–9.
- [5] Nepple JJ, Clohisy JC. The dysplastic and unstable hip: a responsible balance of arthroscopic and open approaches. *Sports Med Arthrosc Rev* 2015;23:180–6.
- [6] Jackson TJ, Watson J, LaReau JM, Domb BG. Periacetabular osteotomy and arthroscopic labral repair after failed hip arthroscopy due to iatrogenic aggravation of hip dysplasia. *Knee Surg Sports Traumatol Arthrosc* 2014;22:911–4.
- [7] Nassif NA, Schoenecker PL, Thorsness R, Clohisy JC. Periacetabular osteotomy and combined femoral head-neck junction osteochondroplasty: a minimum two-year follow-up cohort study. *J Bone Joint Surg Am* 2012;94:1959–66.
- [8] Matsuda DK, Khatod M. Rapidly progressive osteoarthritis after arthroscopic labral repair in patients with hip dysplasia. *Arthroscopy* 2012;28:1738–43.
- [9] Parvizi J, Bican O, Bender B, Mortazavi SMJ, Purtill JJ, Erickson J, et al. Arthroscopy for labral tears in patients with developmental dysplasia of the hip: a cautionary note. *J Arthroplasty* 2009;24:110–3.
- [10] Fukui K, Trindade C, Briggs KK, Philippon MJ. Arthroscopy of the hip for patients with mild to moderate developmental dysplasia of the hip and femoroacetabular impingement: Outcomes following hip arthroscopy for treatment of chondrolabral damage. *Bone Joint J* 2015;97:1316–21.
- [11] Larson CM, Ross JR, Stone RM, Samuelson KM, Schelling EF, Giveans MR, et al. Arthroscopic management of dysplastic hip deformities: predictors of success and failures with comparison to an arthroscopic fai cohort. *Am J Sports Med* 2016;44:447–53.
- [12] Nawabi DH, Degen RM, Fields KG, McLawhorn A, Ranawat AS, Sink EL, et al. Outcomes after arthroscopic treatment of femoroacetabular impingement for patients with borderline hip dysplasia. *Am J Sports Med* 2016;44:1017–23.
- [13] Murphy SB, Ganz R, Müller ME. The prognosis in untreated dysplasia of the hip. A study of radiographic factors that predict the outcome. *J Bone Joint Surg Am* 1995;77:985–9.
- [14] Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am* 1969;51:737–55.
- [15] McCarthy JC, Busconi B. The role of hip arthroscopy in the diagnosis and treatment of hip disease. *Orthopedics* 1995;18:753–6.
- [16] Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stiff LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol* 1988;15:1833–40.
- [17] Christensen CP, Althausen PL, Mittleman MA, Lee J, McCarthy JC. The nonarthritic hip score: reliable and validated. *Clin Orthop Relat Res* 2003;406:75–83.
- [18] Nogier A, Bonin N, May O, Gedouin J-E, Bellaiche L, Boyer T, et al. Descriptive epidemiology of mechanical hip pathology in adults under 50 years of age. Prospective series of 292 cases: Clinical and radiological aspects and physiopathological review. *Orthop Traumatol Surg Res* 2010;96:S53–8.
- [19] Bellaïche L, Lequesne M, Gedouin J-E, Laude F, Boyer T. French Arthroscopy Society. Imaging data in a prospective series of adult hip pain in under-50 year-olds. *Orthop Traumatol Surg Res* 2010;96:S44–52.
- [20] Khan M, Habib A, de Sa D, Larson CM, Kelly BT, Bhandari M, et al. Arthroscopy up to date: hip femoroacetabular impingement. *Arthroscopy* 2016;32:177–89.
- [21] R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria; 2017. URL <https://www.R-project.org/>. n.d.
- [22] Brooker AF, Bowerman JW, Robinson RA, Riley LH. Ectopic ossification following total hip replacement. Incidence and a method of classification. *J Bone Joint Surg Am* 1973;55:1629–32.
- [23] Byrd JWT, Jones KS. Hip arthroscopy in the presence of dysplasia. *Arthroscopy* 2003;19:1055–60.
- [24] Jayasekera N, Aprato A, Villar RN. Hip Arthroscopy in the presence of acetabular dysplasia. *Open Orthop J* 2015;9:185–7.