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## **Impact of bone deformities and labral and cartilage lesions on early functional results of arthroscopic treatment of femoroacetabular impingement**

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### Summary

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**Introduction.** - Femoroacetabular conflict (FAC) is a common cause of inguinal pain. Its treatment has a failure rate between 2.9% and 13.2%. The objective of our study was to investigate the influence of preoperative bony deformities (DO), labrum lesions (LL), and cartilage lesions (LC) on the clinical outcomes of patients who benefited from arthroscopic treatment of CFA.

**Material and Method.** - A prospective operative study included patients undergoing hip arthroscopy for DWI. Patients had a complete radiographic workup preoperatively and at 1 year and an NAHS score for clinical evaluation. Hips > Tönnis 1, coxa profunda (ECV > 35), and borderline dysplasia (ECV < 25) were excluded. Czerny's classification was used for the labrum and Beck's for the cartilage. The objective of our study was to investigate the influence of preoperative OD, LL, and LC on the clinical outcomes of patients who had benefited from arthroscopic treatment of CFA. Our primary hypothesis was that lesion type did not influence early functional outcome at 1 year regardless of the technique used for the labrum.

**Results.** - One hundred ninety-seven patients were included. The mean preoperative NAHS score was  $59.1 \pm 17.5$ . 145 patients benefited from labral suture (73.6%), 42 from labral resection (21.3%), and 10 from conservative treatment (5.1%). At 1-year follow-up, the mean NAHS was  $88.1 \pm 15.3$ . The improvement was significant ( $p < 2.2, 10^{-16}$ ). It was also significant in the subgroups debridement, conservative, and suture. Bone lesions (LO) were significant in the population (postoperative alpha angle at  $48.2^\circ$  vs.  $66.7^\circ$ , sign of crossing present postoperatively in 14.5% vs. 62.9%). No statistically significant difference was found between patients' functional scores based on the extent or type of labral lesion or type of chondral lesion. At follow-up 3 patients (1.5% of the population) required repeat hip arthroscopy. **Conclusion.** - Our study showed that the early functional outcome of arthroscopic treatment of DWI was not influenced by the extent of the bony deformity (alpha angle and VCE), the extension or type of labral lesion, and the type or extension of this chondral lesion. In our study, regardless of OD, LL, and LC, the clinical outcome at one year was satisfactory if all bone abnormalities were considered during arthroscopic treatment.

**Level of evidence.** - IV; non-comparative prospective study

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## 1. Introduction

Femoro-acetabular conflict (FAC) is recognized as a cause of hip or inguinal pain in the young active subject [1]. There are 3 types of CFA: conflict by CAME effect, by pinch effect or mixed. It is most often accompanied by chondro-labral lesions. Hip arthroscopy can be used to treat bony deformities, labrum lesions, and some cartilaginous lesions [2]. It is also said to accelerate recovery and reduce the rate of complications, pain and postoperative morbidity compared to open techniques [2].

However, the failure rate of this procedure varies from 2.9% to 13.2% [3,4]. This can be defined by the persistence of pain, stiffness despite rehabilitation, or an inability to return to activities of choice [5]. The most common cause of failure is persistence of the causative bone lesions (LO), but it may also be due to past imperceptible acetabular dysplasia, soft tissue laxity with microinstability [6], or incipient coxarthrosis [7]. Options then include repeat hip arthroscopy, open surgery (peri-acetabular osteotomy) or sometimes total hip replacement (THR) [7].

Clinical and demographic criteria predictive of good outcomes of hip arthroscopy for DWI are clearly defined [2]. The radiographic data predictive of postoperative outcome of hip arthroscopy are in the vast majority of cases radiographic OA scores. The predictive OL of poor results found in the literature are of 2 types: hip dysplasia and CFA by morbid effect [2-11]. Our study excludes patients with an ECV  $> 35^\circ$  or  $< 25^\circ$ . Therefore, it is only interested in non-dysplastic hips. In fact, patients with a hip with a Tönnis stage  $> 1$  were also excluded, the influence of OL was more specifically sought.

A current challenge is therefore to identify the good and poor prognostic factors accessible during arthroscopic management of causative or induced joint injuries [5]. The influence of the type of causal bone deformity (OD) on early functional outcomes has been mostly studied in patients with hip dysplasia [7,8,11-13] but little on the outcome of CFA surgery [14]. Regarding induced lesions, debridement of a labrum lesion (LL) is reported to have a poor prognosis [5] and the current preference is for labrum retention [15,16]. Cartilage lesions (CL), especially at the labro-cartilage junction, also play a major role in the clinical outcome of hip arthroscopy [17]. The objective of our study was to investigate the influence of the type of preoperative OD, preoperative LL and LC on the clinical outcome of patients who benefited from arthroscopic treatment of CFA. Our primary hypothesis was that the type of bony (cam, pincer, or mixed), labral, or limited cartilage lesion (Beck 0, 1, or 2) [12] does not influence early functional outcome at 1 year.

## 2. Matériel et méthode

A prospective study was carried out in 8 centers, 5 private clinics and 3 university hospitals (CHU).

### 11.1. Selection criteria

The study included patients from 9 senior surgeons, operated between July 2017 and July 2018 for hip arthroscopy for DWI. Patients had to be older than 18 years, with no previous surgical history of the hip under consideration. They had to have preoperative imaging that included: an en face pelvis radiograph, an en face hip radiograph, a DUNN profil, and imaging with contrast injection (arthro-scanner or arthro-MRI). An identical radiographic workup was performed at 1 year after surgery. The quality of each X-ray was monitored [18,19].

### 11.2 Exclusion criteria

Patients with a Tönnis grade > 1 [20], a Wiberg VCE angle < 25° or > 35° [21] or a recoil <1 year on the preoperative radiographic workup were excluded.

### 11.3 Endpoints.

The primary endpoint was the NAHS score [22] at 1 year. Secondary endpoints were the occurrence of further conservative surgery (hip arthroscopy or open surgery) or the placement of a THP. Patients were classified into 3 subgroups according to the procedure performed on the labrum: debridement/resection, conservative or suture.

#### 11.3.1. Radiographic evaluation

Each included patient benefited from a coxometry preoperatively and at one year. These were performed manually by the operator. Acetabulum coverage was assessed by Wiberg's VCE angle [21], Hilgenreiner's HTE angle [23]. Nötzli's alpha angle was measured by the DUNN profil [24]. A crossing sign, acetabular protrusion of the femoral head, and coxa profunda were looked for [18].

#### 11.3.2. Intraoperative assessment

An accurate arthroscopic assessment of the LL and LC was performed. The location and extension of the LL was defined according to Woyski et al.

[25] (lesion < 3H or > or = 3H). LLs were classified according to Czerny et al [26] (lesion without inferior extension Czerny type 1a + 1b vs lesion with inferior extension Czerny type 2a, lesion without degenerative aspect Czerny type 2a and 3a vs lesion with degenerative component Czerny type 2b and 3b). The chondro-labral junction and the LCs were classified according to Beck et al [12] (Beck 0 and 1 vs Beck 2).

Tableau 1  
score NAHS.

	The entire population (n = 197)	Treatment Debridement/Resection (n = 42)	Treatment Conservative (n = 10)	Treatment Suture (n = 145)
NAHS preop	58.7	63.8	64.4	63.7
NAHS M12	93.7	93.7	90.6	95
p-value	<2,2 10 <sup>-10</sup>	1,7 10 <sup>-0</sup>	0,009	9,6 10 <sup>-13</sup>

Tableau 2  
Preoperative radiographic data

	T	U	I
	o	e	a

population (n = 197)

	Treatment Debridement/Resection (n = 42)	Treatment Conservative (n = 10)	Treatment Suture (n = 145)	p-value
Angle alpha (°)	66,7 ± 12,0	72,1 ± 11,7	65,9 ± 12,7	0,002
VCE (°)	29,6 ± 3,3	33,7 ± 6,4	30,9 ± 5,9	0,04
HTE (°)	7,7 ± 5,1	3,9 ± 4,3	6,3 ± 5,5	0,05
Coxa profunda (17,1 %)	29 (15,3 %)	4 (9,5 %)	1 (12,5 %)	0,5
Protrusion	6 (3,2 %)	0	5 (3,7 %)	1
Cross over	122 (62,9 %)	23 (54,8 %)	95 (66,0 %)	0,3

Tableau 3  
Données radiographiques à un an.

	The entire population (n = 197)	Debridement/resection treatment (n = 42)	Conservative treatment (n = 10)	Suture treatment (n = 145)
Angle alpha	48,2 ± 6,6	52,3 ± 7,0	46,1 ± 4,2	47,0 ± 6,2
VCE	29,4 ± 3,9	28,3 ± 3,3	30,6 ± 5,1	29,6 ± 4,0
HTE	6,9 ± 7,0	8,4 ± 4,0	3,9 ± 4,1	6,6 ± 7,8
Cross over	25 (14,5 %)	3 (7,1 %)	2 (25 %)	20 (16,3 %)

### 2.1.1. Functional assessment

Le Non Arthritic Hip Score (NAHS) a été utilisé [22] avec des données recueillies en préopératoire et à un an. Ce score évalue la douleur, la gêne fonctionnelle, les difficultés dans la vie quotidienne and in sports activities.

### 2.1.2. Assessment of postoperative complications

There was one repeat surgery for either iterative revision surgery or THR.

### 2.4. Statistical analysis

Preoperative group comparability was analyzed by a Kruskal-Wallis test, the evolution of the preoperative and postoperative clinical score by the Wilcoxon and Fisher tests. The influence of LL and LC was analyzed by an ANOVA test. A p value of less than 0.05 was considered statistically significant.

### 3. Results

The prospective series included 197 patients. There were no lost to follow-up or incomplete records. There were 123 men and 74 women with a mean age of 33.3 ± 10.3 years. The mean BMI was 23.6 ± 2.9 kg/m<sup>2</sup>. The mean preoperative NAHS score was 59.1 ± 17.5. 145 patients benefited from labral suture (73.6%), 42 from labral resection (21.3%), and 10 from conservative treatment (5.1%). At one year follow-up, the mean NAHS was 88.1 ± 15.3. The improvement was significant (p < 0.002, 10-16). It was also significant in the debridement, conservative, and suture subgroups, the results of which are figured in Table 1. Preoperative radiographic data are figured in Table 2. There was a significant difference between the groups for the alpha and HTE angles. The mean alpha angle was 66.7° ± 12.0 with a lower angle in the suture group having

a mean at 65.2° ± 11.6. The mean VCE angle for the entire population was 30.7° ± 5.6. It was higher in the

conservative group (with a mean of  $33.7^{\circ} \pm 6.4$ ). The demographic data at 1 year figured in Table 3. The mean alpha angle was  $48.2^{\circ} \pm 6.6$ . It was corrected significantly in the total population as well as in the 3 subgroups (Table 4). In the total population the other values were also corrected significantly. Regarding the subgroups, only the sign of the crossover and the HTE angle were not corrected significantly in the conservative treatment subgroup. The distribution of LL and LC figure in Table 5. No statistically significant difference could be demonstrated between the patients' functional scores according to the extent or type of LL or the type of chondral lesion (Table 6). At follow-up, 3 patients (1.5% of the population) required repeat hip arthroscopy for persistent CFA. No patient had a THP.

### 3. Discussion

Our study mainly showed that the early functional outcome of arthroscopic treatment of DWI was not influenced by the extent of bony deformity (alpha angle and VCE), extension, or type of labral lesion.

In our series, all LOs studied (alpha angle, VCE, HTE, and crossing signs) were significantly corrected and the postoperative NAHS score was significantly improved. Thus, OL cannot be a bias in the analysis of our results. In the subgroups (labral resection, conservation of the labrum and labrum suture) only the HTE and the sign of the crossing were not significantly corrected. This may be explained by the low number of patients in the conservative treatment group (10 patients) and therefore the statistical power lacks. Correction of OD

Tableau 4

p comparant les données radiographiques préopératoires et à un an.

	Toute la population	Traitement débridement/réssection	Traite ment conservateur	Traitement suture
Angle alpha	<0,0001	<0,0001	0,03	<0,0001
VCE	<0,0001	<0,0001	0,03	<0,0001
HTE	0,005	0,02	1	0,06
Cross over	<0,0001	<0,0001	0,4	0,0004

Tableau 5

Score NAHS préopératoire et à 12 mois en fonction de la classification de Czerny.

	Czerny 1a + 1b (n = 40)	Czerny 2a (n = 44)	p	Czerny 2a + 3a (n = 68)	Czerny 2b + 3b (n = 79)	p
NAHSpreop	50,2 ± 2,1	59,8 ± 2,1	p = 0,023	59,8 ± 2,3	60,3 ± 2,1	p = 0,873
NAHS M12	82,9 ± 2,3 0,180	80,1 ± 2,2	p = 0,5969	78,7 ± 1,9	85,8 ± 1,9	p =

Tableau 6

Score NAHS préopératoire et à 12 mois en fonction de l'étendue de la lésion labrale, de l'étendue et du type de lésion chondrale.

	Lésion labrale localisé e à 1H ou 2H (n = 77)	Lésion labrale étendu e à 3H ou plus (n = 111)	Lésion chondr ale localisé e à 1 h ou 2 h (n = 72)	Lésion chondr ale étendu e à 3H ou plus (n = 75)	Lésion chondr ale Beck 0 et 1 (n = 122)	Lésion chondr ale Beck 2 (n = 65)	p	
NAHSpreop	59,1 ± 2,3	57,7 ± 2,2	p = 0,589	62,1 ± 1,8	59,3 ± 1,9	p =		
NAHS M12	83,3 ± 2,4	89,5 ± 2,2	p = 0,458	83,9 ± 2,2	85,1 ± 2,1	p =		
	0,352	54,9 ± 1,3	81,5 ± 1,9	84,3 ± 1,8	0,772	83,3 ± 2,4	89,5 ± 2,2	p = 0,279

was not significant for the HTE angle in the suture group. This can probably be explained by poorer visualization of the acetabulum roof if the labrum is not completely detached. The improvement in NAHS was significant in all 3 subgroups regardless of the technique used at the labrum, which is in contrast to recent work [16-28]. Thus, labrum preservation would not be a prognostic factor for good clinical outcomes in our series. For Sogbein et al [2], labrum resection is a prognostic factor of poor outcome. However, other studies do not find this result. For Menge et al [29], there is no difference between debridement and repair. At the extreme, in their review of the literature, Sogbein et al [2] found six studies in which labral repair was an operative criterion of poor prognosis, however none of them found significant results.

We did not find any significant difference in clinical outcomes according to the type of LL according to Czerny's classification [26] whether according to its extension to the labrocartilaginous junction (type 1 or 2) or its acute or degenerative nature (subgroup A or B). For Mose et al [30], there is no association between the type of labral lesion and pain, either pre- or postoperatively. However, for Chahla et al [31], the length of the LL is an independent predictor of a good outcome of hip arthroscopy for DWI if the length of the LL is < 2.5 cm. Moderate LCs (Beck 1 and 2) did not appear in our study to have an influence on 1-year outcomes. Beck 3 LCs had a worse NAHS score without a significant difference. This may be explained by the small number of patients with such lesions (8) and by the difficulty of using Beck's classification in particular to differentiate a chondromalacia LC

from a cartilaginous detachment [17]. This study had several limitations. It has a low statistical power notably by the small sample of several subgroups (conservative treatment and debridement). Concerning the OD, we did not study the femoral neck-shaft angle and femoral rotation, which may be prognostic factors [9]. Femoral retroversion [32] is thus recognized as a radiographic pejorative factor. Our patients did not pre-sent LC Beck 4 probably because patients with Tönnis stage > 1 were excluded which limited the study of

the influence of cartilage lesions but allowed for more specific study of the influence of LOs. This study is multi-centric and multi-operator which can be problematic for operator-dependent intraoperative classifications (Beck, Czerny in particular) and the labrum reinsertion techniques used which can introduce bias. The use of MRI classification (Czerny) preoperatively to classify LLs is also debatable. The cut-off of 3 cm for LLs may not have been relevant, with Chahla et al [31] choosing 2.5 cm. Enfin the 1-year follow-up is short.

#### 4. Conclusion

Our study showed that the early functional outcome of arthroscopic treatment of DWI by cam or mixed effect excluding deep hips and borderline dysplasias as well as severe chondral lesions (Tönnis > 1, Beck 3), is not influenced by the extent of preoperative bone deformity (alpha angle and VCE), the extension or type of labral lesion, and the type or extension of chondral injury. In our series, whatever the LO, LL and LC, the clinical evolution at one year is satisfactory if all the bone abnormalities are taken into account during the arthroscopic treatment.

#### Declaration of interest

The authors declare that they have no ties of interest.

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None.

#### Authors' contributions

All authors contributed to the study.

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