Original Article

Eighty-One Percent of Unrepaired Interportal Capsulotomies Showed Healed Capsules on Magnetic Resonance Imaging 5 Years After Primary Hip Arthroscopy

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Purpose: To evaluate whether unrepaired interportal capsulotomy presents with capsular defect on magnetic resonance imaging (MRI) 5 years after primary hip arthroscopy and to determine its effect on functional results and findings of osteoarthritis on radiographs or MRI scans. **Methods:** Patients with femoroacetabular impingement (without arthritis or dysplasia) were retrospectively reviewed after arthroscopic labral repair or debridement and femoroplasty through interportal capsulotomy without closure. Patients were assessed preoperatively and at a minimum of 5 years postoperatively using patient-reported outcomes (Hip Outcome Score—Activities of Daily Living scale, modified Harris Hip Score, and visual analog scale pain score), radiographic measures, and MRI scans. **Results:** Forty patients (42 hips) were deemed eligible for the study and were evaluated. Of the hips, 81% had healed capsules, whereas 8 (19%) had capsular defects on the latest MRI scan. There were 3 hips with subchondral edema in the defect group compared with 1 in the healed-capsule group ($P = .01$) on the latest MRI scan, which was not present on preoperative MRI (still positive on multivariate analysis when the preoperative alpha angle was also taken into consideration). Functional results did not differ between the groups ($P > .05$). **Conclusions:** In this study, 81% of interportal capsulotomies healed without repair at 5 years after primary hip arthroscopy. **Clinical Relevance:** Understanding the prevalence and implications of unhealed capsulotomies could encourage surgeons to be meticulous in capsular closure.

There has been a growing increase in hip arthroscopy use to treat hip disorders.[1] A capsulotomy is performed to enhance vision and maneuverability inside the joint. The most used capsulotomy technique involves interportal capsulotomy extending from the anterior portal to the anterolateral portal.[2] However, whether to repair this capsulotomy at the end of the procedure remains a controversial issue. Most meta-analyses and studies report similar or superior results with capsular repair compared with an unrepaired capsule.[3-12] However, some literature suggests that keeping the capsule unclosed after hip arthroscopy may result in better postoperative functional scores than closing the capsule.[2,13] The current literature attributes this difference in outcomes to factors such as the surgeon's learning curve, early use of unrepairable capsule techniques, and adjustments made during surgery for variables such as cam excision and labral treatment.[2-13]

A second controversial issue is whether the capsule will heal with the repair. Some studies still report capsular defects with repair, whereas others report complete healing without repair[14-20]; most have assessed the completeness of healing less than 2 years after the surgery. Magnetic resonance imaging (MRI) has been reported to show substantially more reliability for the detection of subchondral cysts compared with the grading of osteoarthritis, especially on radiographs.[21]

The purposes of this study were to evaluate whether unrepaired interportal capsulotomy presents with

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capsular defect on MRI 5 years after primary hip arthroscopy and to determine its effect on functional results and findings of osteoarthritis on radiographs or MRI scans. The hypothesis was that capsular defects present at medium-term follow-up would be associated with more frequent MRI cartilage damage findings than in the capsule-healed group.

Methods

Patient Enrollment

Local ethics committee approval was obtained. Patients who were treated with primary hip arthroscopy between January 2013 and September 2018 with interportal capsulotomy without capsular closure, who had at least a 5-year follow-up, and who underwent MRI examination at the latest follow-up and preoperatively were included. Patients were excluded if they had avascular necrosis, advanced-level hip osteoarthritis (Tönnis grade 3),[22] or dysplasia (based on the lateral center-edge angle); underwent any previous ipsilateral hip surgical procedures; underwent revision hip arthroscopy; had incomplete radiographs or MRI scans; or could not be reached. Surgery was indicated when patients had persistent hip pain refractory to conservative treatment for at least 3 months. Femoroacetabular impingement was diagnosed based on clinical symptoms and radiographic findings (alpha angle $> 55°$ for cam deformity using the Dunn 45° view).[23,24]

Surgical Technique and Rehabilitation Protocol

The patient was placed supine on a hip arthroscopy–specific traction table to obtain appropriate hip distraction against a well-padded perineal post. Horizontal interportal capsulotomy improved visualization and access to the central compartment.

A 4.5-mm arthroscopic burr was used to perform acetabuloplasty. Degenerative labral tears or tears with multiple cleavage planes were considered irreparable, and unstable flaps were selectively debrided. Tears that involved the base of the labrum with chondrolabral disruption were repaired using 1 to 3 suture anchors. Traction was then released, the peripheral compartment was entered, and decompression of the cam deformity was performed and confirmed by intraoperative fluoroscopy and arthroscopic dynamic examination. The capsule was routinely left open at the end of the procedure.

All patients were instructed to use crutches to limit weight bearing for 2 weeks. Daily passive range-of-motion exercises were begun on the first postoperative day. At 3 weeks, active range of motion and full weight bearing were commenced. After 6 weeks, strengthening and light treadmill walking were begun. For the first 4 weeks, daily oral anti-inflammatory medication was prescribed.

Table 1. Patient Demographic Variables, Radiologic Parameters, and Functional Results

Category	Healed Capsule	Capsular Defect	*P* Value
No. of hips	34	8	
Age, yr			
Mean (SD)	36 (10)	42 (7)	.09
Range	16-57	31-55	
BMI			
Mean (SD)	27 (3)	27 (2)	.8
Mean (range)	27 (18-33)	27 (24-31)	.8
Sex, n (%)			.2
Female	15 (44)	2 (25)	
Male	19 (56)	6 (75)	
Symptom duration, mo	17 (3-48)	16 (8-36)	.8
Follow-up time, yr	7 (5-10)	7 (5-10)	.7
Laterality: right, n (%)	15 (44)	4 (50)	.5
Smoker, n (%)	18 (52)	3 (37)	.3
Tönnis grade, n (%)			
Preoperative			.5
0	18 (52)	3 (37)	
1	15 (44)	5 (62)	
2	1 (2)	—	
Postoperative			.5
0	7 (20)	1 (12)	
1	21 (61)	3 (37)	
2	5 (14)	4 (50)	
3	1 (2)	—	
Change (postoperative − preoperative)	0.5 (0.5)	0.7 (0.4)	0.2
Labrum treatment, n (%)			0.2
Debridement	7 (20)	1 (12)	
Repair	27 (80)	7 (87)	
Radiographic parameters			
Preoperative alpha angle (Dunn), °	79 (7)	85 (4)	.03*
Preoperative LCEA, °	37 (8)	39 (7)	.3
Postoperative alpha angle, °	48 (4)	49 (8)	.8
PROs			
Preoperative			
HOS-ADL	52 (11)	50 (9)	.1
mHHS	57 (12)	51 (10)	.2
VAS pain score	6 (1)	7 (1)	.6
Postoperative			
HOS-ADL	86 (10)	81 (14)	.4
mHHS	90 (10)	82 (16)	.09
VAS pain score	1 (1)	2 (1)	.2

NOTE. Data are presented as mean (SD) or mean (range) unless otherwise indicated.

BMI, body mass index; HOS-ADL, Hip Outcome Score–Activities of Daily Living scale; LCEA, lateral center-edge angle; mHHS, modified Harris Hip Score; PRO, patient-reported outcome; SD, standard deviation; VAS, visual analog scale.

*Statistically significant ($P < .05$).

Radiographic Measures and Outcome Scores

Radiographs were obtained and evaluated in all patients, consisting of anteroposterior supine pelvis and 45° Dunn radiographs. Osteoarthritis was graded using

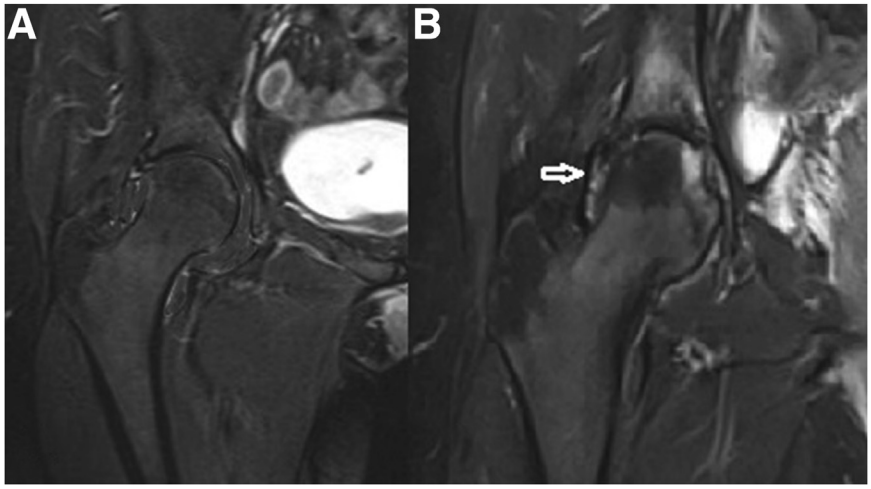

Fig 1. Preoperative (A) and postoperative (B) coronal T2-weighted magnetic resonance images of right hip in patient with prominent acetabular subchondral edema on latest scan. The arrow indicates the healed capsular defect.

the Tönnis classification,[22] and the lateral center-edge angle was measured using anteroposterior pelvis radiographs according to the method described by Wiberg.[25] Patient-reported outcomes, which included the Hip Outcome Score—Activities of Daily Living scale,[26] modified Harris Hip Score,[27] and visual analog scale pain score, were collected by direct contact with patients. The Hip Outcome Score—Activities of Daily Living scale, visual analog scale pain score, and modified Harris Hip Score were recorded the day before the surgical procedure and at the latest follow-up assessment.

MRI Analysis

A musculoskeletal radiologist (A.I.A.) analyzed each postoperative and preoperative MRI scan. The technique used for detecting capsular defects has been previously described by Strickland et al.[16] Capsular integrity was diagnosed on the T2-weighted sequence in the coronal plane. MRI scans were also assessed for the presence of subchondral cysts and subchondral sclerosis.

Statistical Analysis

Data analysis was performed using SPSS Statistics for Windows (version 24; IBM). $P < .05$ was considered statistically significant. The effect of dichotomous or categorical variables, including side, sex, and treatment method for the labrum (debridement or repair), was analyzed using the Fisher exact test or χ^2 test. Continuous variables (age, alpha angle, etc.) were analyzed using the Mann-Whitney *U* test.

Results

Forty subjects (42 hips) were included for analysis. There were 8 hips (19%) with capsular defects on the latest MRI scan. Demographic variables and functional results are reported in Table 1. The only variable showing a significant difference between the capsular defect group (n = 8) and the healed-capsule group was the preoperative alpha angle, which was higher in the defect group.

There were 3 hips with subchondral edema in the defect group compared with 1 in the healed-capsule group ($P = .01$) on the latest MRI scan, which was not present on preoperative MRI; this difference still yielded positive outcomes on multivariate analysis when the preoperative alpha angle was also taken into consideration (multivariate logistic regression analysis constant [B], 3; standard error, 1.4; $P = .03$) (Fig 1). There was 1 newly formed subchondral cyst in the defect group compared with 2 in the healed-capsule group ($P = .4$).

Discussion

The most important finding of this study was that 81% of the hips with unrepaired interportal capsulotomies did not have a capsular defect on MRI 5 years after hip arthroscopy. Capsular repair and healing of the capsule are still controversial issues in the literature. Evidence exists that capsular defects may remain with repair, whereas some studies have reported complete healing without repair.[14-20] This mostly depends on the interportal capsulotomy size and follow-up time, given that Strickland et al.[16] reported complete healing with no repair at 24 weeks, as none of the capsulotomy sizes exceeded 3 cm. With the longest-term follow-up period in the literature, our study partially supports this, showing that most of the capsules (81%) healed without repair; the rest did not, probably owing to the larger interportal capsulotomy size.

Most studies and reviews have reported superior functional results with capsular repair compared with nonrepair.[3-12] However, evidence remains that nonrepair may result in better postoperative functional

scores than capsular closure.[2,13] A recent systematic review by Kaplan et al.[2] showed similar functional results at a minimum 5-year follow-up after capsular repair. However, the unrepaired group underwent more labral debridement than the repair group. The authors tried to explain the poor results seen in previous studies, regardless of capsular management, with the evolving techniques in the area of hip arthroscopy.[2]

More important is whether nonhealing of the capsule leads to earlier joint degeneration and/or osteoarthritis development. We tried to analyze this using preoperative and postoperative conventional radiographs and MRI scans. As expected, owing to low reliability, our study could not find a difference between the 2 groups regarding Tönnis grading or change in osteoarthritis grade on radiographs.[21,28] Recently, it was reported that MRI had strong reliability for detecting subchondral cysts but did not improve osteoarthritis grading compared with radiographs.[21] Supporting this observation, our study found more subchondral edema in the unhealed group.

Limitations

Some study limitations exist. First, because the number of unhealed hips is low, this study could not determine the effect of healing on functional results. Second, the size of the interportal capsulotomy was not measured, so its impact on healing needs to be clarified. The last intraoperative status of chondrolabral tissue or grade of the severity of chondrolabral lesions was not reported. However, we have reported the type of labral treatment and measured indirect signs of cartilage damage such as the Tönnis grade and preoperative alpha angle.[29-31] Moreover, preoperative subchondral edema and/or cystic changes have been reported to be linked with cartilage lesion injury at the time of arthroscopy despite a mild radiographic appearance.[32]

Conclusions

In this study, 81% of interportal capsulotomies healed without repair at 5 years after primary hip arthroscopy.

Disclosures

All authors (O.H., S.A., A.I.A., M.C., O.A., B.G., O.G.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Sugarman EP, Birns ME, Fishman M, et al. Does capsular closure affect clinical outcomes in hip arthroscopy? A prospective randomized controlled trial. *Orthop J Sport Med* 2021;9:23259671209631110.
2. Kaplan DJ, Fenn TW, Jan K, Nho SJ. Capsular repair is associated with lower revision rates yet similar clinical outcomes and arthroplasty conversion 5 years after hip arthroscopy: A systematic review. *Arthroscopy* 2023;39:1882-1891.e1.
3. Owens JS, Jimenez AE, Shapira J, et al. Capsular repair may improve outcomes in patients undergoing hip arthroscopy for femoroacetabular impingement: A systematic review of comparative outcome studies. *Arthroscopy* 2021;37:2975-2990.
4. Looney AM, McCann JA, Connolly PT, Comfort SM, Curley AJ, Postma WF. Routine capsular closure with hip arthroscopic surgery results in superior outcomes: A systematic review and meta-analysis. *Am J Sports Med* 2022;50:2007-2022.
5. Dasari SP, Kasson LB, Condon JJ, et al. Systematic review and meta-analysis of studies comparing complete capsular closure against unrepaired hip capsules during hip arthroscopy. *Orthop J Sport Med* 2023;11:23259671231197436.
6. Kunze KN, Vadhera A, Devinney A, et al. Effect of capsular closure after hip arthroscopy for femoroacetabular impingement syndrome on achieving clinically meaningful outcomes: A meta-analysis of prospective and comparative studies. *Orthop J Sport Med* 2021;9:23259671211017468.
7. Bolia IK, Fagotti L, Briggs KK, Philippon MJ. Midterm outcomes following repair of capsulotomy versus nonrepair in patients undergoing hip arthroscopy for femoroacetabular impingement with labral repair. *Arthroscopy* 2019;35:1828-1834.
8. Lin Y, Li T, Deng X, et al. Repaired or unrepaired capsulotomy after hip arthroscopy: A systematic review and meta-analysis of comparative studies. *Hip Int* 2020;30:256-266.
9. Bech NH, Sierevelt IN, de Waard S, Joling BSH, Kerkhoffs GMMJ, Haverkamp D. Capsular closure versus unrepaired interportal capsulotomy after hip arthroscopy in patients with femoroacetabular impingement: Results of a patient-blinded randomised controlled trial. *Hip Int* 2023;33:94-101.
10. Filan D, Carton P. Routine interportal capsular repair does not lead to superior clinical outcome following arthroscopic femoroacetabular impingement correction with labral repair. *Arthroscopy* 2020;36:1323-1334.
11. Atzmon R, Sharfman ZT, Haviv B, et al. Does capsular closure influence patient-reported outcomes in hip arthroscopy for femoroacetabular impingement and labral tear? *J Hip Preserv Surg* 2019;6:199-206.
12. Tahoun MF, Lizano-Díez X, Soler BC, Pons MT. Superior outcomes after arthroscopic treatment of femoroacetabular impingement and labral tears with closed versus open capsule. *Knee Surg Sports Traumatol Arthrosc* 2023;31:4501-4509.
13. Liu L, Zhang Y, Gui Q, et al. Effect of capsular closure on outcomes of hip arthroscopy for femoracetabular impingement: A systematic review and meta-analysis. *Orthop Surg* 2020;12:1153-1163.
14. Nguyen KH, Shaw C, Link TM, et al. Changes in hip capsule morphology after arthroscopic treatment for femoroacetabular impingement syndrome with periportal capsulotomy are correlated with improvements in patient-reported outcomes. *Arthroscopy* 2022;38:394-403.

15. Kraeutler MJ, Strickland CD, Brick MJ, et al. A multicenter, double-blind, randomized controlled trial comparing magnetic resonance imaging evaluation of repaired versus unrepaired interportal capsulotomy in patients undergoing hip arthroscopy for femoroacetabular impingement. *J Hip Preserv Surg* 2018;5:349-356.
16. Strickland CD, Kraeutler MJ, Brick MJ, et al. MRI evaluation of repaired versus unrepaired interportal capsulotomy in simultaneous bilateral hip arthroscopy: A double-blind, randomized controlled trial. *J Bone Joint Surg Am* 2018;100:91-98.
17. Weber AE, Kuhns BD, Cvetanovich GL, et al. Does the hip capsule remain closed after hip arthroscopy with routine capsular closure for femoroacetabular impingement? A magnetic resonance imaging analysis in symptomatic postoperative patients. *Arthroscopy* 2017;33:108-115.
18. Gao G, Jiao C, Liu J, et al. Healing of joint capsule after hip arthroscopy using interportal capsulotomy and capsular closure influences clinical outcomes. *J Orthop Surg Res* 2022;17:316.
19. Yang F, Zhang X, Xu Y, Huang H, Wang J. Patients with unhealed or partially healed anterior capsules after hip arthroscopy for borderline developmental dysplasia of the hips have inferior patient-reported outcome measures. *Arthroscopy* 2023;39:1454-1461.
20. Bech NH, van Dijk LA, de Waard S, et al. Integrity of the hip capsule measured with magnetic resonance imaging after capsular repair or unrepaired capsulotomy in hip arthroscopy. *World J Orthop* 2022;13:400.
21. Pullen WM, Pierre K, Wong I, et al. MRI does not improve inter-or intrarater reliability for hip arthritis grading systems. *Am J Sports Med* 2023;51:1826-1830.
22. Tönnis D, Heinecke A. Current concepts review—Acetabular and femoral anteversion. *J Bone Joint Surg Am* 1999;81:1747-1770.
23. Mansor Y, Perets I, Close MR, Mu BH, Domb BG. In search of the spherical femoroplasty: Cam overresection leads to inferior functional scores before and after revision hip arthroscopic surgery. *Am J Sports Med* 2018;46:2061-2071.
24. Philippon MJ, Ho CP, Briggs KK, Stull J, LaPrade RF. Prevalence of increased alpha angles as a measure of cam-type femoroacetabular impingement in youth ice hockey players. *Am J Sports Med* 2013;41:1357-1362.
25. Wiberg G. Shelf operation in congenital dysplasia of the acetabulum and in subluxation and dislocation of the hip. *J Bone Joint Surg* 1953;35:65-80.
26. Martin RL, Kelly BT, Philippon MJ. Evidence of validity for the Hip Outcome Score. *Arthroscopy* 2006;22:1304-1311.
27. Thorborg K, Roos EM, Bartels EM, Petersen J, Hölmich P. Validity, reliability and responsiveness of patient-reported outcome questionnaires when assessing hip and groin disability: A systematic review. *Br J Sports Med* 2010;44:1186-1196.
28. Kovalenko B, Bremjit P, Fernando N. Classifications in brief: Tönnis classification of hip osteoarthritis. *Clin Orthop Relat Res* 2018;476:1680.
29. Shapira J, Owens JS, Jimenez AE, et al. Dunn view alpha angle more useful than femoral head-neck offset to predict acetabular cartilage damage in patients with femoroacetabular impingement syndrome undergoing hip arthroscopy. *Arthroscopy* 2022;38:1193-1200.
30. Beaulé PE, Hynes K, Parker G, Kemp KA. Can the alpha angle assessment of cam impingement predict acetabular cartilage delamination? *Clin Orthop Relat Res* 2012;470:3361-3367.
31. Tang H-C, Chen I-J, Sadakah M, Wirries N, Dienst M. Preoperative alpha angles can predict severity of acetabular rim chondral damage in symptomatic cam-type femoroacetabular impingement: A prospective observatory study. *Arthroscopy* 2022;38:1179-1186.
32. Krych AJ, King AH, Berardelli RL, Sousa PL, Levy BA. Is subchondral acetabular edema or cystic change on MRI a contraindication for hip arthroscopy in patients with femoroacetabular impingement? *Am J Sports Med* 2016;44:454-459.