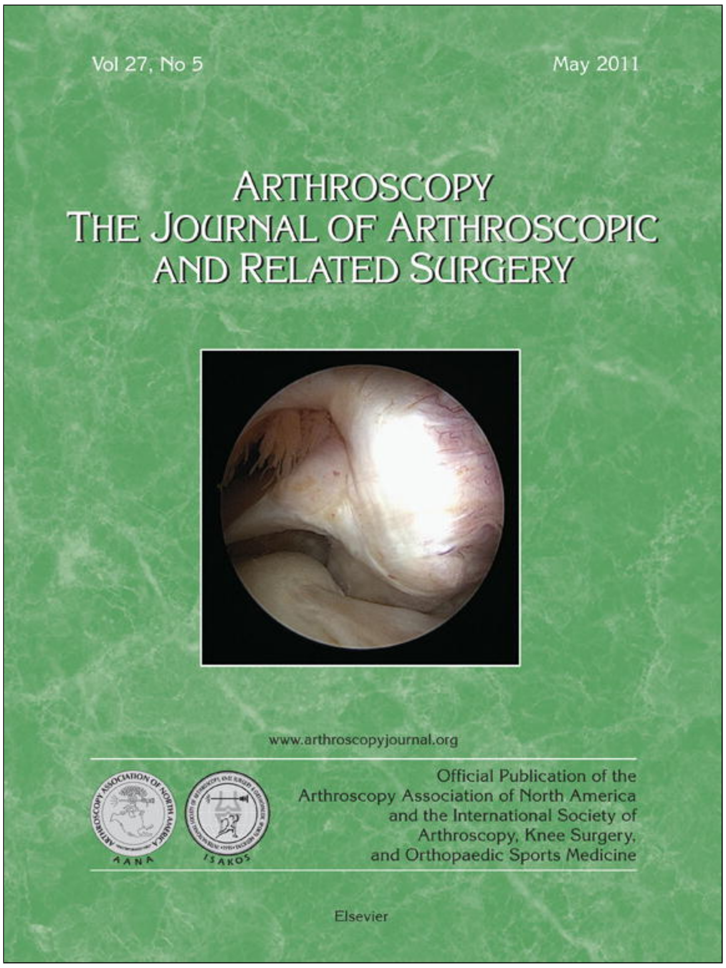
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Response to Diagnostic Injection in Patients With Femoroacetabular Impingement, Labral Tears, Chondral Lesions, and Extra-Articular Pathology

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Purpose: The purpose of this study was to compare the percent relief from injection among subjects with arthroscopic findings of femoroacetabular impingement (FAI) and labral and chondral pathologies while controlling for coexisting extra-articular pathology. **Methods:** We retrospectively reviewed 72 consecutive subjects (54 female and 18 male subjects), aged 29.9 ± 10.4 years (range, 16 to 55 years), who underwent hip arthroscopy. Three separate analyses of covariance compared the percent relief after injection between groups based on surgically confirmed type of impingement (none, cam, pincer, or combined), labral pathology (none, mild, or torn), and chondral pathology (none, mild acetabular abnormality, acetabular delamination, or femoral lesion) while controlling for the presence of extra-articular pathology (iliotibial band, iliopsoas tendinopathy, or bursitis). **Results:** The results of analysis 1 ($F_{3,67} = 1.96$, $P = .128$, partial $\eta^2 = .081$) and analysis 2 ($F_{2,68} = 0.008$, $P = .992$, partial $\eta^2 = .000$) indicated no significant main effect for FAI and labral pathology, respectively, on percent relief from injection. The results for analysis 3 indicated a significant main effect for chondral pathology of the hip on the percent relief from injection ($F_{3,67} = 3.03$, $P < .05$, partial $\eta^2 = .128$). Post hoc analysis showed that those with mild chondral pathology of the acetabulum and those with acetabular delamination had significantly greater percent relief compared with those without chondral pathology. Extra-articular pathology did not influence the percent relief from injection in any of the analyses. **Conclusions:** Subjects with chondral damage had greater relief from injection than those without, regardless of severity. The presence and severity of FAI and labral pathology did not influence the percent relief from injection. Concurrent extra-articular pathology did not alter the interpretation of the percent relief from injection. Therefore the interpretation and diagnostic value of an anesthetic injection in those with primary intra-articular pathology does not need to be altered by the presence of coexisting extra-articular hip pathology. **Level of Evidence:** Level IV, therapeutic case series.

Hip pain can be caused by a variety of intra- and extra-articular structures.[1-4] Differentiating the specific source of pathology can be challenging yet is critical to appropriate patient management. History, location of symptoms, and clinical examination, however, have proven to be inadequate in identifying the specific sources of pain.[5-8] Magnetic resonance imaging (MRI) arthrogram using gadolinium is considered to be accurate in identifying a labral tear.[1] However, it is not clear whether a labral tear, when identified, is the primary source of hip pain.[2,7] MRI arthrogram may also have limitations in identifying chondral lesions.[3] Therefore fluoroscopically guided anesthetic diagnostic intra-articular injection is commonly used to improve the accuracy of presurgical diagnoses. Diagnostic injection helps to differentiate intra-articular hip pain from extra-articular sources such as the lumbosacral spine, iliopsoas, adductors, abdominal aponeurosis, iliotibial band, bursae, or gluteal muscles that often complicate clinical presentation of

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symptoms.[4,7,9-11] According to Byrd and Jones,[7] diagnostic injection identified 90% of those patients with intra-articular pathology confirmed by hip arthroscopy. However, the actual percentage of relief was not quantified, and the specific source of intra-articular pain was poorly defined.[7] We also do not know how the presence of coexisting extra-articular pathology influences the response to injection in the presence of intra-articular hip pathology.

Current evidence suggests that femoroacetabular impingement (FAI) initiates degenerative hip disease.[12-14] McCarthy et al.[14] proposed the following progression of intra-articular hip disease: (1) excessive loading of the labrum, (2) fraying of the articular margin of the anterior labrum, (3) tearing along the articular margin of the anterior labrum, (4) delamination of the articular cartilage from the articular margin adjacent to the labral lesion, and (5) global labral and articular cartilage degeneration. FAI, labral, and chondral pathologies may occur as a natural sequence of hip disease. This would explain the failure of diagnostic injection to differentiate the primary source of hip pain. We believe that quantifying the percent relief from an anesthetic injection may provide useful information to evaluate patients with potential intra-articular pathology. It may further reflect the extent to which the patients may attribute pain to intra-articular versus extra-articular sources. To date, no study has investigated the percent relief from injection in patients with arthroscopically confirmed findings of intra-articular hip pathology and how the presence of coexisting extra-articular pathology may influence the response to diagnostic injection.

The purpose of this study was to compare the percent relief from injection among subjects with arthroscopic findings of intra-articular hip disease including FAI and labral and chondral pathologies. Our hypothesis was that subjects with more progressive evidence of intra-articular pathology, distinguished by labral tearing and chondral delamination, would have a greater response to intra-articular injection than those without pathology. A second purpose was to determine the influence of coexisting extra-articular pathology on the response to injection. Our hypothesis was that subjects with coexisting extra-articular pathology would have less pain relief.

METHODS

Consecutive patients who underwent hip arthroscopy by a single orthopaedic surgeon specializing in hip arthroscopy for hip pain were retrospectively reviewed. All subjects underwent a presurgical evaluation that included clinical examination measures as described by Martin et al.[15] and pertinent diagnostic imaging. Key components of the clinical examination included strength and range-of-motion measures of the hip, observation of gait and single-leg stance, and FAI tests. Impingement tests included the flexion–adduction–internal rotation test, dynamic internal rotation impingement test, dynamic external rotation impingement test, and lateral rim impingement test. Additional tests for intra-articular pathology included the flexion-abduction-external rotation (FABER) and resisted straight-leg raise. Anterior-posterior and cross-table axial view radiographs were used to assess joint space and morphologic variants of the hip joint. MRI arthrography was used to verify morphologic variants and chondrolabral pathology of the hip joint. It also was used to help identify the presence of extra-articular pathology of the hip joint. During MRI arthrography, a solution of 0.05 mL of gadolinium and 3 mL of iodinated contrast was mixed with an anesthetic solution consisting of 6 mL of 1% lidocaine, 6 mL of 0.25% bupivacaine, and 80 mg of triamcinolone and injected into the hip under sterile conditions by use of fluoroscopic guidance. Subjects who had a previous MRI arthrogram were given the same anesthetic concentration (6 mL of 1% lidocaine, 6 mL of 0.25% bupivacaine, and 80 mg of triamcinolone) through a fluoroscopically guided injection of the hip. All subjects were given verbal and written instructions describing how to interpret and document their percentage of pain relief after the injection. Pain relief was graded on a continuous scale, with no relief rated as 0% and complete resolution of symptoms rated as 100%. Patients were specifically asked to perform activities that commonly aggravated their hip symptoms within the first 2 hours after injection. Patients documented the activity and percent relief experienced within that time frame. This study was approved by an institutional review board before initiation.

Patients in whom there was a suspicion of intra-articular pathology in whom 6 weeks of physical therapy had failed were informed of treatment options that included hip arthroscopy. All surgeries were performed by the same orthopaedic surgeon using a standard supine approach with a 2- or 3-portal technique as described by Byrd and Jones.[7] The presence of intra-articular pathology including type of FAI, labral pathology, and chondral lesions to the femoral head and/or acetabulum was documented, in addition to the presence of extra-articular pathology of the iliotibial band, iliopsoas, or trochanteric bursa of the hip.

Group Classifications

Presurgical and operative findings were used to classify patients into groups based on the presence and type of impingement, labral pathology, and chondral pathology.

Femoroacetabular Impingement: Cam impingement was suspected in patients with a provocative impingement test and an α angle greater than 50° or an anterior offset less than 10 mm.[16] Cam impingement was confirmed by the presence of an abnormally prominent femoral head–neck junction, abutment with the acetabulum and/or labrum during dynamic impingement tests,[15] and a pattern of chondral labral damage to the anterior-superior region of the acetabulum under arthroscopic evaluation of the hip joint, as described by Beck et al.[17] Pincer impingement was suspected in patients with provocative impingement testing and either a lateral edge angle greater than 35° or prominent anterior acetabular wall identified by a cross-over sign by anterior-posterior radiographs.[16] Surgical confirmation of pincer impingement was made during arthroscopic visualization of impingement during dynamic testing,[15] and evidence of narrow circumferential damage to the acetabular rim and/or labrum.[17] Patients with a provocative impingement test, at least 1 morphologic characteristic from either classification of impingement by radiograph or MRI arthrogram, and a mixed pattern of chondral-labral damage confirmed by arthroscopic visualization during dynamic impingement tests were classified as the combined cam-pincer group.[15] The absence of morphologic variants defined by aforementioned radiograph or MRI arthrogram characteristics and a lack of impingement by arthroscopic visualization of dynamic impingement testing classified patients as the non-FAI group.

Labral Pathology: Patients were also classified by the presence of labral pathology. Patients were suspected to have labral pathology based on positive intra-articular tests (painful and limited internal rotation, FABER, or resisted straight-leg raise test[15]) and MRI arthrogram indicating labral abnormality. Surgical confirmation was made by visualization and probing of the labrum. On the basis of arthroscopic findings, the labrum was categorized into 1 of 3 groups: (1) normal—no labral pathology, (2) minimal—labral integrity and stability maintained but arthroscopic evidence of bruising or fraying, and (3) significant—labral tearing of the intersubstance or chondral-labral junction that compromises labral integrity.

Chondral Pathology: Chondral pathology was suspected in patients with intra-articular examination findings and radiologic or MRI arthrogram evidence of chondral abnormality. Patients with radiologic evidence of hip osteoarthritis of Kellgren-Lawrence grade III or greater were not deemed candidates for arthroscopy and were excluded. All participants underwent arthroscopic exploration for potential chondral damage. On the basis of arthroscopic evaluation of the acetabulum and femoral head, patients were categorized into 1 of 4 categories: (1) no chondral pathology (similar to Outerbridge grade 0); (2) subchondral junction pathology of the acetabulum without disruption of the articular surface, commonly referred to as chondrolabral wave or a bubble sign (similar to Outerbridge grade I); (3) acetabular delamination distinguished by separation of the articular cartilage from the subchondral bone with clear disruption of the continuity of the articular cartilage (similar to Outerbridge grades II to III); and (4) lesions to the femoral head that were graded by the Outerbridge scale.

Extra-Articular Pathology: Extra-articular pathology was suspected in patients based on location and nature of patient complaints, clinical examination, and MRI. Endoscopic evaluation of the peritrochanteric space was performed in patients with complaints of lateral hip pain or snapping that accompanied clinical findings of palpable sensitivity, provocative resisted testing of the hip abductors, reproduction of a snapping iliotibial band, or MRI evidence of high signal on T2-weighted sequences of the trochanteric bursa.[18] Iliopsoas tendinopathy was suspected in patients with complaints of a painful snapping hip that was reproducible with extension of the hip from a flexed position, reproduction of symptoms with resisted testing of iliopsoas, or high signal changes of the tendon on T2-weighted sequences of MRI.[19] Diagnosis was confirmed by endoscopic visualization of fraying, thickening, or abnormality to the continuity of the iliopsoas tendon and/or accompanying bursa. Endoscopic evaluation of the peritrochanteric space and iliopsoas was performed with passive hip motion to confirm a source of patient complaints of "snapping hip" in which appropriate "release" techniques were used if necessary.[19]

Table 1. *Frequency and Percentage of Surgical Findings*

	No. of Subjects	% of Total Subjects
FAI		
Not present	6	8.3
Cam impingement	29	40.3
Pincer impingement	2	2.8
Both cam and pincer impingement	35	48.6
Labral pathology		
Not present	17	23.6
Labral abnormality (mild changes of bruising or fraying)	12	16.7
Labral tear	43	59.7
Chondral pathology		
Not present	38	52.8
Mild chondral abnormality of acetabulum (chondral wave or bubble sign)	9	12.5
Acetabular delamination	19	26.4
Femoral head chondral lesion	6 (total)	8.3
Grade II*	4	
Grade IV*	2	
Extra-articular		
Iliotibial band	26	36.1
Iliopsoas tendinopathy	42	58.3
Trochanteric bursitis	7	9.7

*Graded on Outerbridge scale.

Subjects

In total, 72 consecutive surgical patients who reported their percent relief from injection within 2 hours of injection and had arthroscopic surgery of the hip consented to participate in the study. Patients who were non–English speaking and did not report pain relief from injection within the 2-hour post-injection time frame were excluded. The sample population included 54 female and 18 male subjects. The mean age was 29.9 ± 10.4 years (range, 16 to 55 years). Table 1 shows the frequency and percentage of operative findings for the subjects. The mean pain relief from injection was 82.3% ± 21.3% (range, 10% to 100%) for all subjects.

Data Analysis

Data were entered into a commercially available spreadsheet (Excel; Microsoft, Redmond, WA) according to the following variables: age, gender, and percent relief from injection. Also recorded were the categorization of FAI, labral pathology, chondral pathology, and extra-articular pathology of the iliotibial band, iliopsoas, and/or trochanteric bursa. A statistical software package (SPSS, Chicago, IL) was used for all statistical procedures. Three separate analyses of covariance (ANCOVAs) were performed. Analysis 1 compared percent relief from injection among patients based on findings of FAI. This allowed comparison of subjects with cam-type impingement, pincer-type impingement, and combined cam-pincer type impingement and subjects without FAI findings. Analysis 2 compared subjects based on labral findings. This compared subjects in 3 categories of labral involvement: (1) no labral pathology, (2) mild labral pathology of bruising or fraying but integrity maintained, and (3) labral tearing of the intersubstance or chondral-labral junction that compromises labral integrity. Analysis 3 compared subjects based on findings of chondral involvement. Comparison of patients with chondral pathology was performed between the following groups: (1) no chondral pathology, (2) subchondral junction pathology of the acetabulum without disruption of the articular surface (chondral wave or bubble sign), (3) acetabular delamination distinguished by separation of the articular cartilage from the subchondral bone with clear disruption of the continuity of the articular cartilage, and (4) lesions to the femoral head. The presence of extra-articular pathology was controlled by serving as the covariate. A planned post hoc analysis using a Bonferroni confidence interval adjustment compared the specific differences between each group for each respective analysis. The Levene test was

Table 2. *ANCOVA Summary Table for Patients With FAI*

Source	Sum of Squares	Degrees of Freedom	Mean Square	F Statistic	Significance	Partial η^2
Corrected model	2,872.27	4	718.07	1.66	.170	.090
Extra-articular	298.09	1	298.09	0.688	.410	.010
FAI	2,548.27	3	849.42	1.96	.128	.081
Error	29,033.28	67	433.33			
Total	518,990.00	72				

NOTE. No significant difference was observed in relief from injection based on the presence and type of FAI. The presence of extra-articular pathology did not influence the percent relief from injection.

Table 3. *ANCOVA Summary Table for Patients With Labral Pathology*

Source	Sum of Squares	Degrees of Freedom	Mean Square	*F* Statistic	Significance	Partial η^2
Corrected model	331.71	3	110.57	0.238	.869	.010
Extra-articular	324.98	1	324.98	0.700	.406	.010
Labral tear	7.71	2	3.86	0.008	.992	.000
Error	31,573.79	68	464.32			
Total	518,990.00	72				

NOTE. No significant difference was observed in relief from injection based on the presence of labral pathology. The presence of extra-articular pathology did not influence the percent relief from injection.

performed to assess equality of variance. In circumstances where the Levene test reached significance, equal variances were not assumed and data were therefore interpreted by use of the Games-Howell post hoc test.

RESULTS

The results of analysis 1 indicate no significant main effect for FAI on percent relief from injection: $F_{3,67} = 1.96$, $P = .128$, and partial $\eta^2 = .081$ (Table 2). Extra-articular pathology did not influence the reported percent relief: $F_{1,67} = 0.688$, $P = .410$, and partial $\eta^2 = .01$. Similarly, the results of analysis 2 indicate no significant main effect for labral pathology: $F_{2,68} = 0.008$, $P = .992$, and partial $\eta^2 = .000$ (Table 3). Again, the presence of extra-articular pathology did not influence the percent relief from injection: $F_{1,68} = 0.700$, $P = .406$, and partial $\eta^2 = .01$. Tables 4 and 5 show the adjusted and unadjusted mean percent relief according to type of FAI and labral pathology, respectively. The ANCOVA results for analysis 3 indicate a significant main effect for chondral pathology of the hip on the percent relief from injection: $F_{3,67} = 3.03$, $P < .05$, and partial $\eta^2 = .128$ (Table 6). The covariate of extra-articular pathology did not influence the percent relief from injection: $F_{1,67} = 0.59$, $P = .30$, and partial $\eta^2 = .004$. Adjusted means and unadjusted means for chondral pathology groupings are listed in Table 7. Planned post hoc analysis showed that patients with mild chondral pathology of the acetabulum and those with acetabular delamination had significantly greater percent relief than those without chondral pathology (Table 8). There was no statistical difference between these 2 groups. There were no statistical difference between subjects with chondral lesions to the femoral head and those without evidence of chondral lesions.

DISCUSSION

This study is the first to quantify the response to an intra-articular anesthetic injection among patients classified by progressive stages of FAI and labral and chondral pathologies. Our primary purpose was to compare the response to anesthetic injection among patients with different sources and stages of intra-articular hip disease. The results supported our hypothesis that subjects with noted chondral damage would have greater relief from injection than those without chondral involvement. However, milder to more progressive chondral pathology was not differentiated by percent relief. In addition, no difference in pain relief was found based on type of FAI or presence of labral pathology. We also anticipated that coexisting extra-articular pathology would lessen the response to

Table 4. *Adjusted and Unadjusted Means for Percent Relief From Injection Based on Presence and Type of FAI*

	Adjusted Means	Unadjusted Means
Group 1: No impingement	63.7	63.7
Group 2: Cam impingement	81.6	81.5
Group 3: Pincer impingement	86.5	85.0
Group 4: Combined cam/pincer impingement	85.7	82.3

NOTE. No statistical difference found between adjusted and unadjusted means. No statistical difference between groups.

Table 5. *Adjusted and Unadjusted Means for Percent Relief From Injection Based on Labral Pathology*

	Adjusted Means	Unadjusted Means
Group 1: No labral pathology	81.9	82.2
Group 2: Mild labral pathology (bruising or fraying)	82.9	82.9
Group 3: Labral tearing	82.2	82.1

NOTE. No statistical difference found between adjusted means for presence of extra-articular pathology and unadjusted means. No statistical difference between groups.

TABLE 6. *ANCOVA Summary Table for Patients With Chondral Pathology*

Source	Sum of Squares	Degrees of Freedom	Mean Square	*F* Statistic	Significance	Partial η^2
Corrected model	4099.09	4	1,024.76	2.47	.05	.128
Extra-articular	122.36	1	122.36	0.30	.59	.004
Chondral pathology	3,775.05	3	1,258.35	3.03	.04	.120
Error	27,806.45	67	415.02			
Total	31,905.50	71				

NOTE. A significant difference was observed in relief from injection based on presence of chondral pathology. The presence of extra-articular pathology did not influence the percent relief from injection.

intra-articular injection. Contrary to our hypothesis, extra-articular pathology did not affect the percentage of relief when intra-articular pathology was present. The results of this study help in the interpretation of patient response to intra-articular injection.

Because intra-articular pathologies to the labrum and chondral surfaces often coexist,[20-23] we believed that the response to injection would differentiate the subjects based on the progression of labral or chondral involvement. We anticipated that the group with the most significant chondral involvement would yield the greatest relief from injection. Previous studies have shown that patients with hip osteoarthritis have an 86% to 100% reduction of pain after anesthetic injection.[9,24] In our study, patients with chondral pathology had approximately 90% improvement in pain after injection. Although those with mild progression of chondral pathology exhibited greater relief from anesthetic injection than those without chondral findings, those with mild chondral involvement did not differ from the group with delamination of acetabular cartilage. These results indicate that the progression of hip joint disease that encompasses pathology to the acetabular chondral surfaces may respond the greatest to injection, regardless of the severity of chondral damage.

TABLE 7. *Adjusted and Unadjusted Means for Percent Relief From Injection Based on Chondral Pathology*

	Adjusted Means	Unadjusted Means
Group 1: No pathology	75.5	75.7
Group 2: Mild chondral abnormality of acetabulum (chondral wave or bubble sign)	93.3	93.6
Group 3: Acetabular delamination	90.0	89.6
Group 4: Femoral head lesion	83.7	83.2

NOTE. No statistical difference found between adjusted means for presence of extra-articular pathology and unadjusted means.

On the contrary, response to injection based on labral pathology or presence of FAI did not influence the percent relief experienced from injection. The contributions of labral pathology to symptoms have been debated. Kim and Azuma[25] identified nociceptors within the labrum, confirming its potential as a source of pain. However, labral tears have been reported frequently in nonsymptomatic patients and may be a part of the natural aging process.[11,26,27] This may explain why surgical procedures that address only apparent labral pathology may have poorer resolution of symptoms than surgeries that address the underlying morphologic abnormality.[28] Given that patients in our study responded similarly to injection regardless of the type of FAI and severity of labral pathology, it is likely that anesthetic injection provides little value in differentiating type of impingement or severity of labral pathology.

This study builds on the results of previous work by Martin et al.[11] that compared the response to intra-articular injection with MRI arthrogram findings. This earlier study found that only 57% of subjects with a suspected labral tear had greater than 50% improvement in pain. Subsequently, our study compared in-

TABLE 8. *Mean, Standard Error, and Confidence Intervals for Percent Relief From Injection Based on Chondral Pathology*

	Mean	Standard Error	95% Confidence Interval
Group 1: Not present	75.5	3.32	69.1-82.4
Group 2: Mild chondral abnormality of acetabulum (chondral wave or bubble sign)	93.3*	6.82	80-100
Group 3: Acetabular delamination	90.0*	4.73	80.2-99.0
Group 4: Femoral head lesion	83.7	8.36	66.5-99.9

*Statistically different from group 1 at $P < .05$.

TABLE 9. *Surgical Findings of Subjects With Less Than or Equal to 50% Improvement From Diagnostic Injection*

Relief	Impingement Type	Labral Pathology	Chondral Lesion	Extra-Articular Pathology
10%	Not present	Mild fraying	Not present	Iliopsoas, ITB, bursitis
20%	Cam	Complete tear	Not present	Iliopsoas, ITB, bursitis
30%	Cam	Partial tear	Not present	Iliopsoas, ITB
30%	Cam	Complete tear	Not present	Iliopsoas, ITB, bursitis
40%	Cam (mild)	Minimal	Grade II posterior femoral head	Not present
50%	Not present	Partial tear	Not present	Iliopsoas
50%	Cam	Partial tear	Not present	Iliopsoas, ITB
50%	Cam/pincer	Minimal	Not present	Iliopsoas
50%	Cam/pincer	Complete tear	Not present	Iliopsoas, ITB
50%	Cam/pincer	Minimal	Not present	Not present
50%	Cam/pincer	Complete tear	Acetabular delamination	ITB, bursitis

Abbreviation: ITB, iliotibial band.

jection response to surgical findings. Because this sample included only surgical patients, the mean response to injection was generally positive. Patients with FAI (mean, 83.9%) and labral abnormalities (mean, 82.7%) had a positive response to injection but had varied relief of pain (10% to 100%). In our sample 85.7% of subjects had greater than 50% improvement after injection, yet the percent relief was significantly less in subjects without acetabular chondral pathology.

Of particular interest are the subjects who did not have significant relief from injection. From our sample, 11 subjects did not have greater than 50% improvement of symptoms after injection. As noted in Table 9, nearly 80% of subjects had surgical evidence of labral tears and extra-articular pathology. Only 2 of the 11 subjects (18.2%) had chondral pathology, 1 with a femoral head lesion and 1 with acetabular delamination. These trends further support our findings that abnormalities of the labrum in the absence of chondral pathology may not be the primary source of pain for most patients.

Another possible explanation for these findings may be the presence of extra-articular pathology. Sixty-seven percent of subjects from our sample had evidence of extra-articular pathology that included the iliopsoas, iliotibial band, and/or trochanteric bursa. Contrary to our hypothesis, the presence of extra-articular pathology did not significantly lessen the percentage of pain relief experienced after an anesthetic intra-articular injection as shown by the collective results of the ANCOVAs. Therefore the interpretation and diagnostic value of an anesthetic injection in those with primary intra-articular pathology are not changed by the presence of coexisting extra-articular hip pathology. However, extra-articular hip pain may still be the primary source of pain, despite intra-articular findings. We would assume that pain not relieved by intra-articular injection would represent the pain from extra-articular sources. This, however, is challenging to determine, given that subjects often have combinations of intra- and extra-articular pathology. It is possible that extra-articular pathology is asymptomatic and incidental to intra-articular findings. Over 80% of the subjects who did not respond with over 50% improvement of pain from injection had confounding extra-articular pathology. Because our results indicate that the presence of extra-articular pathology does not influence the response to injection, perhaps diagnostic injection could help discriminate symptomatic from asymptomatic intra-articular pathology, especially in patients with suspicion of both intra- and extra-articular involvement. Further investigation is needed to explore this possibility.

There are limitations to this study that deserve consideration. The diagnostic and surgical interpretations were performed by 1 surgeon who was not blinded to the results of the presurgical findings. Although reliability of the methods used to classify subjects was not performed, we believed that the categories were clearly defined, particularly regarding the presence or absence of labral and chondral lesions, so that the subjects were grouped appropriately. We also recognize that other factors including size or location of chondral pathology could influence the response to injection. Subjects in our study showed similar patterns of chondral damage to those that have been previously described. Mapping of lesions was recorded in the surgical reports in a familiar clock-face description (e.g., 12-o'clock to 2-o'clock position). The description of location was given in varying ranges encompassing the anterior/superior region of the acetabulum in a common distribution that has been previously reported.[17] The similar and slightly varying localization of chondral lesions provides a challenge in assessing any differences in location of lesions. Furthermore, there has been no study investigating the accuracy or reliability of localizing the site of chondral lesions of the hip through arthroscopy. We believe that this is another area of interest for further investigation.

Similarly, sizes of lesions were recorded for patients with large delamination or chondral lesions but not for those with smaller and milder abnormalities. Thus our data could not assess the effect of the size of the lesion. On the basis of previous studies that showed a high percentage of relief from anesthetic injection among patients with global chondral degeneration,[12,25] we could anticipate that size of the lesion may have little effect on differentiating intra-articular pathology. This is supported by our findings that patients with mild chondral pathology had similar relief from injection as compared with those with more significant, delaminated chondral lesions.

The sample for our study also exposes limitations to our findings. The sample population only included patients who were surgical candidates and in whom there was a high suspicion of intra-articular pathology. The patients participating in the study were referred specifically for the surgeon's specialized skills in hip arthroscopy. Seventy-seven percent had MRI arthrogram findings of labral pathology, and most had extensive presurgical evaluation before inclusion in the study. Therefore this sample was a very select group that may not be representative of a normal population of patients with hip pain. The ratio of female-to-male subjects (3:1) was strongly biased to female subjects. This is contrary to findings of previous studies that show a higher frequency of male subjects with the cam or combined cam-pincer type of impingement as compared with female subjects, who more frequently exhibit pincer-type impingement.[29,30] Therefore it is unclear from our sample population how gender may influence interpretation of anesthetic injection findings.

Finally, we do not know how the combination of the anesthetic with the gadolinium contrast used for the MRI arthrogram may have influenced the patient's response to the injection. We did not record who received the anesthetic injection with the MRI arthrogram and who did not. It is uncertain the influence this may have on the results of our study. The gadolinium contrast used for the MRI arthrogram may dull the improvement of pain with the anesthetic or create an irritation to the joint that may actually increase pain. Saupe et al.[31] recently evaluated the response to gadolinium contrast and found that although the hip generally had the most painful reaction compared to the shoulder, elbow, and knee joint, a significant increase in pain was not noted immediately but, rather, 4 hours after injection. We attempted to avoid this problem by recording the percent relief from injection within a 2-hour timeframe and excluded cases that did not comply. Furthermore, a rather large volume of injection may have been a potential source of pain and affected the overall response. Perhaps using a smaller volume of injection would have yielded greater pain relief. Given the recent study by Saupe et al. and the overall high level of pain relief from injection (mean, 82.3%), we do not think it was a factor that influenced the results of this study. However, this may be a topic of interest for further study.

CONCLUSIONS

Subjects with noted chondral damage had greater relief from injection than those without, regardless of severity. The presence and severity of FAI and labral pathology did not influence the variance of the percent relief from injection. Concurrent extra-articular pathology did not alter the interpretation of the percent relief from injection. Therefore the interpretation and diagnostic value of an anesthetic injection in those with primary intra-articular pathology do not need to be altered by the presence of coexisting extra-articular hip pathology.

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