Preoperative Predictors of Early Failure Following Hip Arthroscopy
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Abstract
The purpose of this study was to identify cases of early failure following hip arthroscopy and compare to cases in which no additional surgery was required during a 2 year postoperative period. The 2 cohorts were evaluated to identify potential preoperative predictors of early failure following hip arthroscopy. Early failure was defined as conversion to total hip arthroplasty (THA) within 2 years of arthroscopic surgery.

Study variables included gender, age, preoperative diagnosis, minimum joint space, lateral center edge angle (LCEA), the presence or absence of subchondral acetabular cysts, and the size of cysts (<1cm or ≥1cm).

The differences between the 2 cohorts in gender, age, and preoperative diagnosis were not statistically significant. Mean minimum joint space, LCEA, and presence of acetabular subchondral cysts were statistically different between the successful and failure cohorts. The difference in size of the cysts between cohorts was not statistically significant. Following multivariate analysis, the presence of acetabular subchondral cyst remained the only independent pre-operative predictor of failure following hip arthroscopy.

The presence of a subchondral acetabular cyst on MRI is associated with a high rate of THA following hip arthroscopy. While other predictors of early failure following hip arthroscopy may exist, we feel our study results should prove useful in counseling patients regarding appropriate treatment options for hip pain.

Introduction
Hip arthroscopy is a rapidly growing field with clear indications for treating multiple disorders, including femoroacetabular impingement (FAI), labral pathology associated with hip dysplasia, abductor tendon and trochanteric bursal pathology, and coxa saltans. Numerous studies document successful outcomes following arthroscopic treatment of these conditions, particularly FAI. However, few studies have focused on predictors of early failure following hip arthroscopy.

A recent series of 20 patients showed that Outerbridge grade III chondromalacia noted during hip arthroscopy for FAI was a strong predictor of subsequent need for total hip arthroplasty at an average of 1.4 years following the index procedure. Unfortunately, preoperative radiographs and Tonnis grading proved to be poor predictors of early failure in this study. A larger series of 111 cases of hip arthroscopy for labral debridement identified Outerbridge grades III or IV and advancing age as independent predictors of eventual hip replacement. While intra-operative findings are strong prognosticators of success or failure following surgery, they are not useful in the preoperative counseling of patients regarding the risk of hip replacement following hip arthroscopy.

Other studies have identified preoperative predictors of severe intra-articular pathology at the time of surgery. A series of 355 hips were retrospectively reviewed to identify preoperative predictors of grade 3 or 4 Outerbridge changes at the time of surgery. Multivariate regression analysis showed that male sex, alpha angle >50°, increasing age, and Tonnis grade 1 or 2 on plain radiographs were independent predictors of severe intra-articular pathology. The conversion rate to total hip arthroplasty in this very large cohort was not evaluated. In 2009, a small series evaluated the relationship between a novel radiographic finding, delamination cysts, and surgical findings during hip arthroscopy. The presence of a subchondral acetabular cyst on preoperative radiographs was associated with acetabular cartilage delamination in 15/16 hips undergoing arthroscopy for labral debridement. This series did not report on the effect of the radiographic finding of a delamination cyst on the success or failure of hip arthroscopy.

The purpose of this study was to identify cases of early failure following hip arthroscopy and compare to cases in which no additional surgery was required during a 2 year postoperative period. The 2 cohorts were evaluated to identify potential preoperative predictors of early failure following hip arthroscopy. We hypothesized that the presence of an acetabular cyst on preoperative MRI was a predictor of early failure.

Methods
Between May 2006 and October 2009, a single-surgeon consecutive case series of 263 hip arthroscopies was retrospectively reviewed. All cases of hip arthroscopy for the treatment of debilitating hip pain secondary to FAI, labral tear, or labral tear associated with hip dysplasia, were evaluated for inclusion in the study. The diagnosis of FAI was based on clinical exam (typical pain pattern, anterior or posterior impingement sign, restricted
range of motion, alpha angle >50°, or LCEA greater than 40° on plain radiographs and MRI. Labral tear was diagnosed based on clinical exam (mechanical symptoms and pain with provocative maneuvers) and MRI finding of labral injury. The diagnosis of hip dysplasia was based on a LCEA of <20°.

Inclusion criteria consisted of a complete medical record, including preoperative MRI scan and plain radiographs. Two cohorts of subjects were evaluated: early failures of hip arthroscopy, defined as conversion to total hip arthroplasty within 2 years of the index procedure, and successful cases of hip arthroscopy. Successful hip arthroscopy was defined as patients who have not had any additional operative intervention during the initial 2 year postoperative period. Exclusion criteria included any patient whose preoperative radiographs and/or MRI were not available for review.

Preoperative studies included 2 view plain radiographs (centered anteroposterior (AP) pelvis and modified Dunn view) and hip MRI (non-contrast or MRI arthrogram). A single sports medicine fellowship-trained orthopaedic surgeon experienced in hip arthroscopy performed all arthroscopic procedures. A standard 2-or 3-portal supine method was utilized. All cases of FAI underwent decompression of the impinging lesions and repair versus debridement of any associated labral pathology. All cases of labral tearing were treated with repair versus debridement of the labrum at the discretion of the operating surgeon. Postoperatively, patients were allowed partial weight bearing, with crutches, for 3-4 weeks. Physical therapy was performed to optimize range of motion and regain muscle strength. Aggressive activities were discouraged for 3 months.

Study variables included gender, age, preoperative diagnosis, minimum joint space, LCEA, the presence or absence of subchondral acetabular cysts, and the size of cysts (<1 cm or ≥1 cm). In addition, an attempt was made to contact all patients in the successful cohort to confirm that no additional surgery was performed on the involved hip since the last follow-up visit.

A single sports medicine fellow measured minimum joint space and LCEA on AP radiographs. All preoperative hip MRIs were reviewed by a fellowship trained musculoskeletal radiologist for the presence and size of subchondral acetabular cysts. The radiologist was blinded to both the arthroscopic findings and clinical outcomes.

Due to the small sample size and inability to assume normal data distribution, the Fisher’s exact test was selected for analysis of all categorical variables. The Mann-Whitney-Wilcoxon 2-sample rank test was utilized to compare continuous variables. The significance level was set at a p-value = 0.05. Following univariate analysis, all statistically significant study variables were entered into a multivariate logistic regression model to identify independent preoperative predictors of failure and to calculate odds ratios. An independent biostatistician consultant performed all statistical calculations.

Institutional review board approval was obtained for the performance of this retrospective study.

Results

Of the 263 consecutive cases of hip arthroscopy, a total of 68 successful patients, with a minimum 2 year follow-up, and 23 patients who had failed hip arthroscopy met inclusion criteria, for a total of 91 patients. Of these patients, 43 had available for review both preoperative radiographs and MRIs and, thus, formed the patient population for this study. Of the 43 patients, 16 patients were classified as failures and 27 patients were classified as successful, based on our definitions. See Figure 1 for details.

Univariate Analysis

Nine men and 18 women made up the successful cohort, while 5 men and 11 women composed the failure cohort. This difference is not statistically significant (p=1.0). The mean age of the successful cohort was 45.15 years (range, 33 to 65 years), while the mean age of the failure cohort was 51.38 years (range, 33 to 69 years). This difference is not statistically significant (p=0.08). The successful cohort was made up of 2 cases of dysplasia with labral tear, 16 cases of FAI, and 9 cases of labral tear. The failure cohort was made up of 3 cases of dysplasia with labral tear, 12 cases of FAI, and 1 case of labral tear. The difference in preoperative diagnosis was not significant (p=0.10). The mean minimum joint-space was 3.93mm (SD=1.1mm) in the successful
cohort and 2.63 mm (SD=1.7mm) in the failure cohort. This difference is statistically significant (p=0.01). The mean LCEA was 37.8° (SD=10.7°) in the successful cohort and 32.5° (SD=10.3°) in the failure cohort. This difference is statistically significant (p=0.04). In the successful cohort, 3 of the 27 patients had acetabular subchondral cysts versus 12 of the 16 patients in the failure cohort having acetabular subchondral cysts. This difference is statistically significant (p<0.0001). In the successful cohort, 2 patients had a cyst measuring <1cm, and 1 patient had a cyst measuring ≥1 cm. In the failure cohort, 8 patients had a cyst measuring <1cm and 4 patients had a cyst measuring ≥1 cm. This difference is not statistically significant (p=0.5). See Table 1 for a summary of univariate results.

Multivariate Analysis

Minimum joint space, LCEA, and the presence of acetabular subchondral cyst were entered into the multivariate logistic regression model. The presence of acetabular subchondral cyst remained the only independent preoperative predictor of failure following hip arthroscopy. Exact odds ratio for acetabular subchondral cyst was 21.4 (confidence interval=3.8, 177). Subjects with at least one acetabular subchondral cyst were 21 times more likely than those without a cyst to experience treatment failure.

Of the 27 successful patients, 24 (89%) were reached via telephone. All confirmed that they had not had any additional surgery to the involved hip since last follow up.

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Successful (n=27)</th>
<th>Failure (n=16)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>9 male, 18 female</td>
<td>5 male, 11 female</td>
<td>1.0</td>
</tr>
<tr>
<td>Age</td>
<td>45.15 years</td>
<td>51.38 years</td>
<td>0.08</td>
</tr>
<tr>
<td>Pre-op diagnosis</td>
<td>D 2, FAI 16, L 9</td>
<td>D 3, FAI 12, L 1</td>
<td>0.10</td>
</tr>
<tr>
<td>Joint space</td>
<td>3.93 mm</td>
<td>2.63 mm</td>
<td>0.01</td>
</tr>
<tr>
<td>LCEA</td>
<td>37.8°</td>
<td>32.5°</td>
<td>0.04</td>
</tr>
<tr>
<td>Presence of cysts</td>
<td>3/27</td>
<td>12/16</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Size of cyst</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyst &lt; 1 cm</td>
<td>2/27</td>
<td>8/16</td>
<td></td>
</tr>
<tr>
<td>Cyst ≥ 1 cm</td>
<td>1/27</td>
<td>4/16</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations. D, dysplasia with labral tear; FAI, femoroacetabular impingement; L, labral tear.

Discussion

Arthroscopic treatment of conditions such as femoroacetabular impingement has proven to be an effective means of alleviating hip pain and may prove to be effective in preventing the need for hip arthroplasty in younger individuals. It has been stated that the severity of chondral lesions is highly correlated with surgical outcome after arthroscopic intervention for early hip disease. With this awareness, it is evident that there are patients in whom the degree of degenerative change at the time of surgery precludes effective arthroscopic treatment. As the field of hip arthroscopy expands, it is critical to identify preoperative predictors of early failure to prevent the unnecessary treatment of patients in whom arthroscopy will be ineffective.

Our results have identified at least one preoperative predictor of early failure following hip arthroscopy. In this retrospective cohort comparison study, the presence of a subchondral acetabular cyst on preoperative MRI was shown to be an independent predictor of failure. While the small sample size produced a wide confidence interval, at a minimum patients with a subchondral acetabular cyst on preoperative MRI are 4 times more likely than those without a cyst to require total hip arthroplasty within 2 years following hip arthroscopy.

Failure of the acetabular subchondral bone, indicated by the presence of a subchondral cyst on MRI, is clearly a painful condition. While FAI decompression and treatment of acetabular rim pathology are therapeutic in the setting of chondromalacia or labral tearing, pain secondary to failure of the acetabular subchondral bone
appears to be refractory to arthroscopic treatment. The presence of a subchondral cyst on a preoperative MRI, even in patients with greater than 2 mm joint space on radiographs, should alert the physician to the likelihood of persistent pain following hip arthroscopy and the possibility of rapid progression to THA.

Several other studies have evaluated either preoperative factors or intraoperative findings associated with survivorship after hip arthroscopy. McCarthy et al. retrospectively reviewed 111 cases of hip arthroscopy performed to treat labral pathology. Multivariate analysis showed that patients older than 40 years were 3.6 times more likely to require a THA, and those with Outerbridge grades of III or IV were 20 to 58 times more likely to eventually require a THA. An interesting correlation can be drawn between this larger series and our multivariate analysis. The odds ratio for early THA in patients with a subchondral cyst in our series was 21. This is similar in magnitude to the odds ratio interval of 20 to 58 for THA in patients with grade III or IV changes at the time of surgery obtained by McCarthy et al. It would seem that there is a strong correlation between a preoperative finding of subchondral acetabular cyst on MRI, the intra-operative finding of Outerbridge grade III or IV chondromalacia, and the progression to THA following hip arthroscopy. In fact, in our series, 93% of patients with a subchondral acetabular cyst on MRI were found to have grade IV chondromalacia at the time of surgery.

Horisberger et al. evaluated the outcomes of arthroscopic treatment of FAI in 20 patients with preoperative generalized degenerative changes. In addition to a 50% conversion rate to THA at 1.4 years, the series found a poor correlation between Tonnis grade and the extent of cartilage damage at the time of surgery. Univariate analysis did identify a decreased minimal joint space on plain radiographs as a preoperative predictor of early failure following hip arthroscopy in our study. However, this variable was not significant following multivariate analysis. The average minimal joint space in our failure cohort was 2.6 mm and 13 out of 16 patients in the failure cohort had a joint space of 2 mm or greater. Tonnis grading and minimal joint space measurements are highly subjective. Joint space calculations are subject to measurement errors and magnification errors on non-calibrated radiographs. The Tonnis grade threshold or minimal joint space required to avoid early THA following hip arthroscopy would seem challenging to determine. In contrast, the preoperative presence of a subchondral acetabular cyst on MRI is a much more objective, easily identifiable finding.

A lower average LCEA was noted in our failure cohort. While this finding did not hold up to multivariate analysis, there is a possibility that in a larger series a below average LCEA may reach statistical significance. Clearly patients with a low center edge angle and a subchondral acetabular cyst on MRI are at high risk for THA following hip arthroscopy.

Our study has one major limitation. The sample size was relatively small and minor statistical differences between the 2 groups may exist. Despite the small study size, an independent preoperative predictor of early failure following hip arthroscopy was identified.

Conclusion

The presence of a subchondral acetabular cyst on MRI is associated with a high rate of THA following hip arthroscopy. While other predictors of early failure following hip arthroscopy may exist, we feel our study results should prove useful in counseling patients regarding appropriate treatment options for hip pain.

References


