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SYMPOSIUM: ADVANCED HIP ARTHROSCOPY

Joint Space Predicts THA After Hip Arthroscopy in Patients 50 Years and Older

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Abstract

Background All patients considering joint-preserving hip arthroscopy should be educated on the risk of THA after arthroscopy. The degree of radiographic osteoarthritis predicts subsequent THA. To provide patients with the best information, the best radiographic measure that predicts THA after hip arthroscopy should be identified.

Questions/purposes We therefore determined if Tönnis grade, Kellgren-Lawrence grade, or joint space narrowing was superior in predicting THA after hip arthroscopy.

Methods We retrospectively reviewed 203 patients 50 years of age or older treated with hip arthroscopy between March 2007 and October 2010. Of these, 96 patients met the study inclusion criteria. Sixty-five did not undergo THAs during the followup time (non-THA group) and 31 patients did (THA group). We determined Tönnis grade, Kellgren-Lawrence grade, and/or joint space narrowing before arthroscopy. The median followup for the non-THA group was 54 months (95% confidence interval, 49.9–58.9 months).

Results In 81% of the patients, joint space accurately predicted THA or non-THA, whereas Kellgren-Lawrence was accurate in 73% and Tönnis grade was accurate in 65%. On binary logistic regression, the only predictor (r^2 = 0.45) of THA was joint space of 2 mm or less.

Conclusions Measuring joint space by determining if any measurement is 2 mm or less predicts patients progressing to THA after hip arthroscopy approximately 80% of the time. At this early time point, joint space measurements were the most accurate predictor of THA and should be used in patient education to define the risk of early failure from hip arthroscopy.

Level of Evidence Level III, prognostic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

As the population ages and the number of hip arthroscopies continues to grow, it is important to determine factors that may predispose patients to THA [8]. Philippon et al. [19] recently showed that in the older population, 20% of patients 50 years of age and older required THAs within 3 years of their hip arthroscopies. For some active patients, delaying hip arthroplasty for 3 to 5 years by undergoing arthroscopy may be acceptable, but for some patients, it

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.
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may not. All patients considering joint-preserving hip arthroscopy should be educated on the risk of THA that peaks within the first 3 to 5 years after arthroscopy. It is critical to identify preoperative factors to counsel patients on the risks of joint arthroplasty after arthroscopy and improve patient satisfaction with treatment.

In recent decades, surgeons have increasingly relied on imaging techniques that allow superior visualization of intraarticular and periarticular soft tissue structures. MRI allows assessment of the chondral surfaces of the hip with reasonable accuracy [1, 2, 20]; however, as a result of insurance coverage, it is not available for all patients because of cost. Radiographic assessment remains the most common method available for preoperative evaluation. To evaluate the severity of osteoarthritis (OA), several grading systems are used in the hip. These include the Tönnis grading system (described for the hip) [5, 24] and the Kellgren-Lawrence (K-L) grading system (described for any joint) [11]. These two grading systems differ for each grade (Table 1), and it is unclear which scale would better predict subsequent THA. However, we have shown joint space narrowing as a predictor of THA after hip arthroscopy [17, 19] and therefore this can be used as criteria for identifying patients at risk for early conversion to THA after hip arthroscopy. The current literature describes all of these radiographic measures as predictors; however, it is unclear which measure is the superior predictor of THA. There is limited research comparing these radiographic measures and the risk of THA. For patients to make an informed decision, the most accurate predictors need to be determined.

Table 1. Kellgren-Lawrence and Tönnis grading systems

Grade	Kellgren-Lawrence	Tönnis
0		No sign of osteoarthritis
1	Doubtful narrowing of joint space and possible osteophytic lipping	Increased sclerosis of the head and acetabulum, slight narrowing of the joint space, and slight lipping at the joint margins
2	Definite osteophytes and possible narrowing of joint space	Small cysts in the head or acetabulum, increasing narrowing of the joint space, and moderate loss of sphericity of the head
3	Moderate multiple osteophytes, definite narrowing of joint space, some sclerosis, and possible deformity of bone contour	Large cysts in the head or acetabulum, severe narrowing or obliteration of the joint space, severe deformity of the head, and necrosis
4	Large osteophytes, marked narrowing of joint space, severe sclerosis, and definite deformity of bone contour	

The objective of this study was to determine if Tönnis grade, K-L grade, or joint space narrowing best predicted THA after hip arthroscopy.

Patients and Methods

For this cross-sectional prognostic study, our data registry was queried for patients 50 years of age and older who were treated with hip arthroscopy between March 2005 and October 2007 (n = 203). Data were collected prospectively and retrospectively analyzed. All patients included underwent hip arthroscopy for femoroacetabular impingement (FAI) and secondary labral tears by a single surgeon (MJP). Patients were included if had complete quality radiographs, radiographic diagnosis of FAI, prospectively collected radiographic measurements, preoperative modified Harris hip score, and were at least 3 years posthip arthroscopy. Radiographic diagnosis for this study was defined as an alpha angle [18] greater than 55° on cross-table radiograph and/or the center of the femoral head was medial to the posterior acetabular wall (coxa profunda) or the medial wall of the acetabulum crossed the ilioischial line. Forty-one patients were excluded for non-FAI diagnosis, eight for no preoperative modified Harris hip score, and 58 for incomplete radiographs.

All radiographs were graded using the K-L and Tönnis grading systems (Table 1) and joint space was measured. One observer (JCC) documented all measurements to reduce interobserver error. The observer was blinded to the results of the treatment. Radiographic assessments of sclerosis, cyst formation, and osteophyte presence were performed at the lateral, acetabular margin; acetabular fossa; inferomedial, acetabular floor; lateral, femoral head-neck junction; superior weightbearing aspect of the femoral head; and medial and inferior aspects of the femoral head. Sclerosis was considered present if a clear side-to-side difference was noted in the bone density at the areas in question. Osteophytes at the lateral, femoral head-neck junction had to be clearly distinct from a cam lesion. If a smooth transition at the head-neck junction was present, it was considered reflective of impingement anatomy rather than secondary to hip OA. Thus, if prominent reactive bone with irregular contouring was present, it was diagnosed as an osteophyte. Joint space was assessed using a digital caliper system on the Office PACS system (Stryker, Flower Mound, TX, USA) at three locations: the lateral edge of the sourcil, the middle of the sourcil, and in line with the fovea [18]. Patients also completed a preoperative questionnaire that included the modified Harris hip score. The study was approved by the internal review board.

Ninety-six patients met the inclusion criteria and were included in the study. Descriptive characteristics were compared between the THA group and the non-THA group (Table 2) to ensure the populations were similar. The only factor that was different between the two groups was more patients in the THA group than the non-THA group (p = 0.001) underwent acetabular microfractures. In the group that underwent THA, the median time for these patients from index arthroscopy to joint arthroplasty was 23 months (95% confidence interval [CI], 21.7–32.9 months). The median followup for the non-THA group was 54 months (95% CI, 49.9–58.9 months).

To determine if data were normally distributed, data were analyzed using the Kolmogorov-Smirnoff test. For comparison of continuous variables, Pearson's correlation coefficient was used. For comparison of continuous variables, the independent t-test was used for two variables and one-way analysis of variance was used for more than two variables. Nonparametric univariate analysis was performed with the Mann-Whitney U test for comparison of two groups and with the Kruskal-Wallis analysis of variance for comparison of multiple groups. Spearman's rho correlation coefficient (r) was used for assessing associations between continuous variables. To identify independent predictors of THA, a multiple logistic regression model with backward selection was used and the likelihood ratio test served as the criterion for significance in the final model. Statistical analysis was performed using the SPSS (Version 10.1; SPSS Inc, Chicago, IL, USA) software package. All reported p values are two-tailed.

Table 2. Descriptive characteristics of the study group and those patients who required THA

Characteristic	All patients	Patient not requiring THA	Patients requiring THA
Number of patients	96	55	41
Age at surgery (years)	57 (50 to 78)	57 (5)	58 (7)
Males/females	49/47	23:32	24:17
Preoperative modified Harris hip score		60 (14)	55 (16)
Acetabular microfracture	41	14	27
Femoral head microfracture	27	12	15
Type of impingement			
Isolated pincer	4	3	1
Isolated cam	16	10	6
Combined cam/pincer	76	42	34
Labral treatment			
Débridement	21	14	7
Repair	75	41	34

Results

We observed an association between subsequent THA and the K-L grade (p = 0.003) and Tönnis grade (p = 0.002) (Table 3). Patients with Tönnis grades of 2 or 3 were 4.8 times (95% CI, 1.8–12.6) more likely to require THAs. Patients with K-L Grades 3 or 4 were 4.8 times (95% CI, 2.0–11.3) more likely to require THAs. Patients with 2 mm or less of joint space were 12 times (95% CI, 5–34) more likely to undergo THA than patients with greater than 2 mm of joint space. Joint space (2 mm or less = THA) predicted THA in 81% of the patients. Kellgren-Lawrence (Grade 3 or 4 = THA) predicted THA in 73% of the patients and the Tönnis grade (Grade 2 or 3 = THA) had the lowest accuracy at 65%. On binary logistic regression, the only major predictor of THA was joint space of 2 mm or less (r^2 = 0.45; p = 0.001).

Patient function and symptoms as measured by the modified Harris hip score were lower (p = 0.025) in patients who required THA compared with those who did not (53 versus 61). This was also seen in patients with 2 mm or less of joint space, who had lower (p = 0.024) modified Harris hip scores compared with those with greater than 2 mm of joint space (53 versus 61). There were no differences in modified Harris hip score when compared by Tönnis grade (p = 0.264) or when compared by K-L grade (p = 0.272).

Discussion

To determine the best predictor, we evaluated three radiographic measures in this cross-sectional study. To assist patients in making an informed decision regarding hip arthroscopy, it is critical to provide them with the most

Table 3. Comparison of Kellgren-Lawrence grades and Tönnis grades between two groups

Variable	Non-THA, Number (%)	THA, Number (%)
Kellgren-Lawrence grade		
0	29 (57)	8 (20)
1	7 (12)	1 (2)
2	7 (12)	5 (12)
3	9 (16)	14 (34)
4	3 (5)	13 (32)
Tönnis grade		
0	18 (33)	3 (7)
1	11 (20)	4 (10)
2	23 (42)	20 (49)
3	3 (5)	14 (34)

accurate information. Although the current literature describes how these three measures are used in decision-making, it was unclear which measure was superior. To educate patients on the risk of THA after hip arthroscopy, the most accurate predictor needs to be determined. We therefore determined if Tönnis grade, K-L grade, or joint space narrowing was superior in predicting THA after hip arthroscopy.

This study has several limitations. First, considering the referral-type practice of the senior author (MJP), most patients who were included in this study were referred for hip arthroscopy. However, this did provide for a large population of older patients who desired hip arthroscopy. With this group, we were able to identify one radiographic measure that was superior. Second, patients in our practice tended to be athletically inclined individuals who desired function beyond simply regaining activities of daily living and, therefore, may have been less tolerant with reduced activity often seen after THA. This may have led to patients waiting longer for conversion to THA, which may explain the lower modified Harris hip score in the THA group. Because the rate of conversion was not the purpose of this article, this bias did not affect the overall goal of the article.

We found a joint space of 2 mm or less, measured at one of three points, best predicted THA in patients 50 years of age or older. Several articles have used Tönnis grade as a descriptive for outcome studies [6, 9, 13, 15, 16, 22, 25]. One recent article excluded patients with Tönnis Grade 2 or greater and greater than 50% narrowing of the joint space and still had 8% conversion to THA [16]. The Tönnis grade was agreed on by two authors in that study; however, there was no definition for the joint space narrowing [16]. In contrast, another study used Tönnis Grade 2 or greater and joint space < 2 mm as exclusion criteria and found no patients required subsequent hip arthroplasty [22]. In our study, we defined the joint space measurement. This allows for evaluation of a single hip without comparison to the bilateral hip. Many times when changes are seen in one side, the other side also has changes, especially in the patient older than 50 years of age, and K-L grade also identified patients with increased risks of THA. Prior studies [4, 17] have shown that a joint space of 2 mm or less at one of three points, the medial and lateral sourcils or over the fovea, and the presence of Outerbridge Grade IV chondral lesions are associated with arthroscopy failure.

Although efforts have been made to standardize the recommended FAI radiographs, few studies [10, 12, 18] have used radiographic findings to predict surgical outcome. Several studies [14, 15] show a relationship between the Tönnis grade on plain radiographs and the presence of cartilage lesions in the hip at time of surgery. A recent study [13] with a 10-year followup of hip arthroscopy showed the grades of cartilage lesions noted at the time of surgery were predictors of THA. However, the direct correlation between Tönnis grade and risk of conversion to THA has not been shown.

Prior studies [2, 3, 20, 21, 26] have demonstrated an association between K-L grade and the presence and severity of chondral damage and symptoms of OA in the knee on MR images. A few studies [7, 23] have used the K-L grading system to evaluate hips. The K-L grading system has been widely used in the knee literature. It has similar definitions as the Tönnis grade, but it does not use cysts as part of the definitions. As a result of these factors, we believed this scale would provide a good comparison for the other measurement.

Given the aging population and explosion of hip arthroscopy procedures, our findings suggest it is imperative for all surgeons to do a thorough preoperative screening of radiographs. Measuring joint space at three points and determining if any measurement is 2 mm or less are accurate predictors for THA at 3 years after hip arthroscopy. In addition, patients with Tönnis or K-L grades who fall within the higher ranges for either of the scales must be counseled regarding the greater risk for THA. By identifying factors associated with THA, it is our hope that treatment algorithms and surgical indications can be improved, thus reducing the number of patients requiring THAs after hip arthroscopy.

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