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Research article

Iliopsoas tendonitis after hip arthroscopy: prevalence, risk factors and treatment algorithm

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ABSTRACT

The incidence of iliopsoas tendonitis (IPT) has not previously reported following hip arthroscopy for femoroacetabular impingement with or without labral tears. (i) What is the incidence of IPT following hip arthroscopy; (ii) are there any demographic risk factors and (iii) are there any operative techniques that are risk for IPT? Retrospective study. Hip arthroscopy patients from 2005 to 2012 were included. Patients were diagnosed via physical examination findings and were excluded if they had pre-operative IPT. Records were reviewed for demographics, operative reports and operative procedures. All patients received either labral debridement, labral repair, osteoplasty or a combination of those procedures. A standardized rehabilitation protocol was used. Of 252 patients, 60 (24%) had IPT. Twenty-eight (47%) had symptom resolution with activity modification, physical therapy and NSAIDs. Thirty-two (53%) required corticosteroid injection at a mean of 25 weeks after surgery. Seven (12%) required revision arthroscopy and iliopsoas release to resolve the symptoms. There were no patient-specific risk factors, differences based on surgical technique, and number of portals did not matter. Patients should minimize exercises that activate the iliopsoas after hip arthroscopy. The cause of IPT could be related to unaddressed abnormal mechanics, tendon scarring or improper physical therapy. Further studies are needed to investigate the reasons for this, as well as specific techniques to lower its incidence. The incidence of IPT after hip arthroscopy has an incidence of 24%. Additionally, we provide readers with a rehabilitation protocol to minimize this complication.

What is known about the subject: This subject has not previously been described.
What this study adds to existing knowledge: We are the first to report IPT after hip arthroscopy.

INTRODUCTION

As the diagnosis of hip pain in the young patient evolves, more patients are being treated with hip arthroscopy every year [1]. The procedure can be used to treat a variety of pathologies, including intra-articular lesions (e.g. labral pathology, loose bodies, chondral injury), femoracetabular impingement (FAI) and other extra-articular processes such as psoas impingement or internal/external snapping hip syndrome. The exact diagnosis and etiology of hip pain can be complicated by a variety of diagnoses, different pathologies and difficulty in isolating where the origin of the pain is. Labral pathology is a common indication for hip arthroscopy, with a report of 69% incidence of labral tears in asymptomatic individuals [2]. Some studies have even implicated the iliopsoas tendon in the etiology of certain labral tears [3–6]. Hip arthroscopy is a technically challenging procedure that has a steep learning curve [7]. There are numerous reports of persistent hip pain following hip arthroscopy usually due to inadequate treatment, recurrent symptoms or failure to address the underlying etiology [1]. Therefore, the diagnosis of pain after hip arthroscopy is difficult to determine.

Iliopsoas tendonitis (IPT), psoas impingement and internal hip snapping have all been described as potential causes of hip pain [6, 8–16]. However, no reports exist that describe psoas tendinitis after hip arthroscopy in the immediate post-operative period. IPT has been alluded to in reference to the challenges of developing appropriate rehabilitation protocols following hip arthroscopy [17]. However, despite some protocols specifying exercises that minimize iliopsoas activation in the post-operative period, there can be considerable variability in how physical therapists rehabilitate patients. In the senior authors' practices, this was noticed as a potentially preventable and treatable cause of post-operative pain.

The purpose of this study was to answer the following questions: (i) what is the incidence of post-operative IPT following hip arthroscopy; (ii) are there any demographic risk factors for IPT and (iii) are there any operative techniques that put patients at increased risk for post-operative IPT? Additionally, a rehabilitation protocol will be presented for management and suggestions will be provided for prevention of IPT.

PATIENTS AND METHODS

Patients were reviewed from two institutions over a 5-year period who underwent hip arthroscopy by either of the two senior authors (M.K. and Y.M.Y.). All patients had a minimum 2-year follow-up. A total of 340 patient records were reviewed. Patients were excluded who had previous hip surgery ($n = 38$), and who had a diagnosis related to iliopsoas pathology as the reason for hip arthroscopy or who underwent iliopsoas release at the time of arthroscopy ($n = 50$). This left 252 patients for evaluation. All patients were seen at 6 weeks, 3 months, 1 year and yearly thereafter for follow-up.

Post-operatively, the following tests were used to diagnose for IPT: pain with resisted hip flexion in the seated position, Stintchfield test [18], and the psoas stretch test [19]. All have been previously described for accurate diagnosis of IPT [20]. Patients had to have at least one of these tests recorded positive for them to be diagnosed with post-operative IPT. All patients were diagnosed at the 6 week post-operative visit or later, in order to differentiate between it and post-surgical pain, and all were treated with the treatment algorithm proposed in Fig. 1. The specific rehabilitation treatment protocol is outlined in Fig. 2. This involved modification of their physical therapy regimen to a previously described regimen that minimizes iliopsoas activation [17], increasing gluteal activation and daily non-steroidal anti-inflammatory medication (NSAIDs). Patients who did not respond to this were then treated with a single corticosteroid and local anesthetic injection into the iliopsoas tendon or bursa, which served as both a diagnostic and therapeutic tool. For patients whose symptoms remained refractory to an injection, they underwent repeat arthroscopy for iliopsoas tendon release.

Patient-specific factors were collected and analyzed to determine if there were any that pre-disposed them to IPT after hip arthroscopy. These included patient age, gender, race, BMI, affected side and diagnosis. There were 94 men (37%) and 158 women (63%) who had a mean age of 22 years (range 10–57 years). The mean BMI was 23.7 kg m^{-2} (range 16.9–38.3 kg m^{-2}). The right hip ($n = 149$, 59%) was predominantly operated on.

Diagnoses were based on intra-operative findings. They included an isolated labral tear in 19 patients (8%), a labral tear in the setting of FAI in 159 patients (63%), and a labral tear in the setting of developmental dysplasia of the hip (DDH) in 9 patients (3%). Sixty-five patients (26%) had a diagnosis of FAI alone without labral tear.

Procedure-specific factors are related to two surgical techniques that were used when performing hip arthroscopy for patients in this study. Each of the senior authors (M.K. and Y.M.Y.) had their preferred technique for portal placement; intra-operative procedures were performed similarly between the two surgeons. Surgeon #1 (M.K.) operated on 130 patients (52%), and Surgeon #2 (Y.M.Y.) operated on 122 patients (48%). Surgeon #1 uses a three-portal technique that utilizes a standard anterior portal. Surgeon #2 uses a two-portal technique with a mid-anterior portal. Both techniques have been previously described elsewhere and have similar overall reported outcomes. Based on their intra-operative findings, patients underwent either osteoplasty alone ($n = 43$, 17%), and labral debridement alone ($n = 11$, 4%), labral debridement with osteoplasty ($n = 151$, 60%) or labral repair with osteoplasty ($n = 47$, 19%). No patients underwent isolated labral repair. Capsulotomy was routinely performed as part of the procedure, and the traction was routinely let down after 2 h for all procedures by both surgeons. Labral tears were seen in the 12' to 3'-o-clock position in right hips, and the 9' to 12'-o-clock position in left hips. The capsulotomy was not routinely closed in any patients during this time period. Any patients who underwent revision arthroscopy in this patient cohort only had iliopsoas tendon release performed; there were no bony or labral procedures at the time of revision arthroscopy.

All de-identified data were collected using Microsoft Excel (Microsoft Corporation, Redmond, Washington, DC, USA) and statistics were calculated using JMP 8 (SAS Institute, Cary, NC, USA). Continuous data were

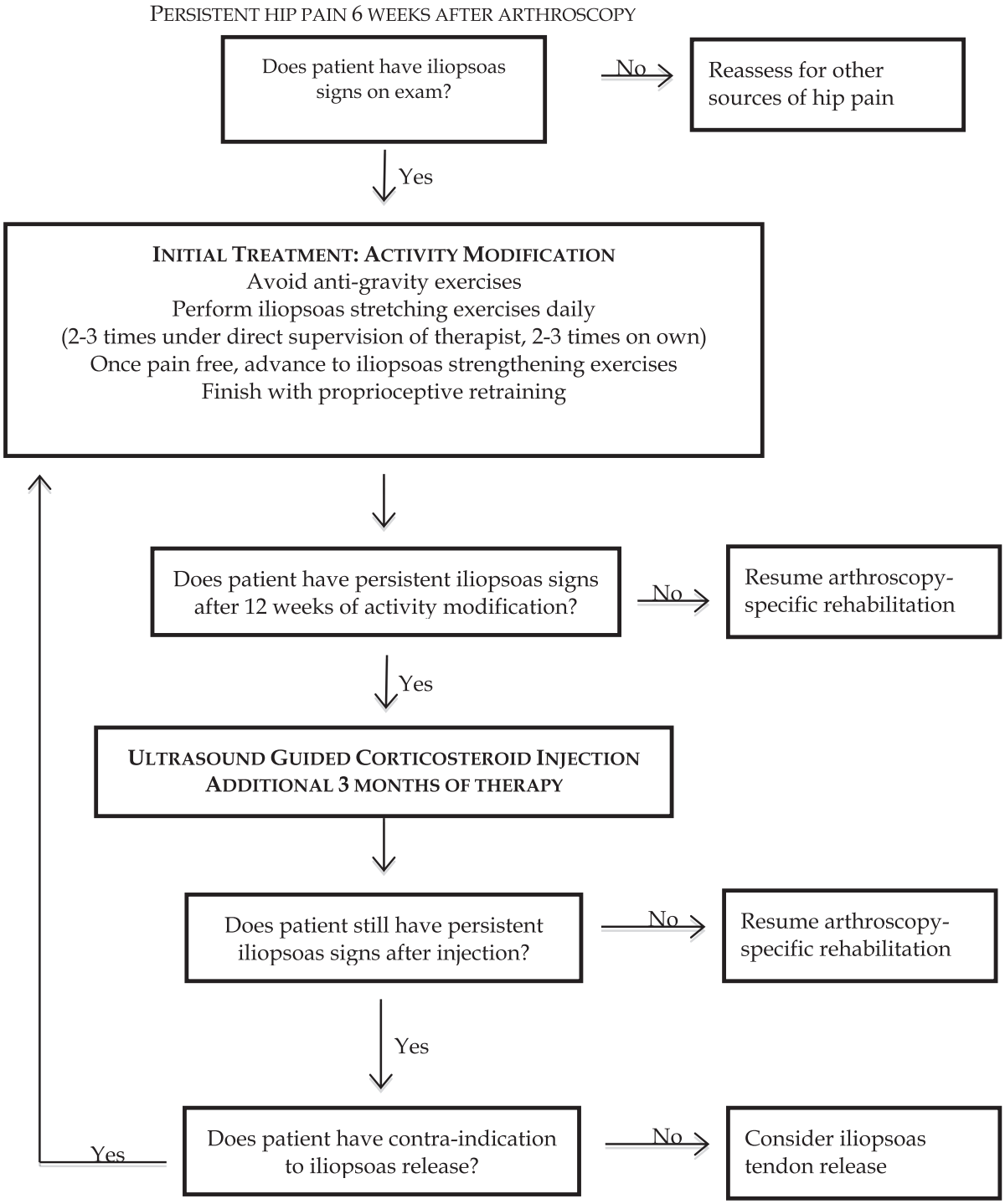
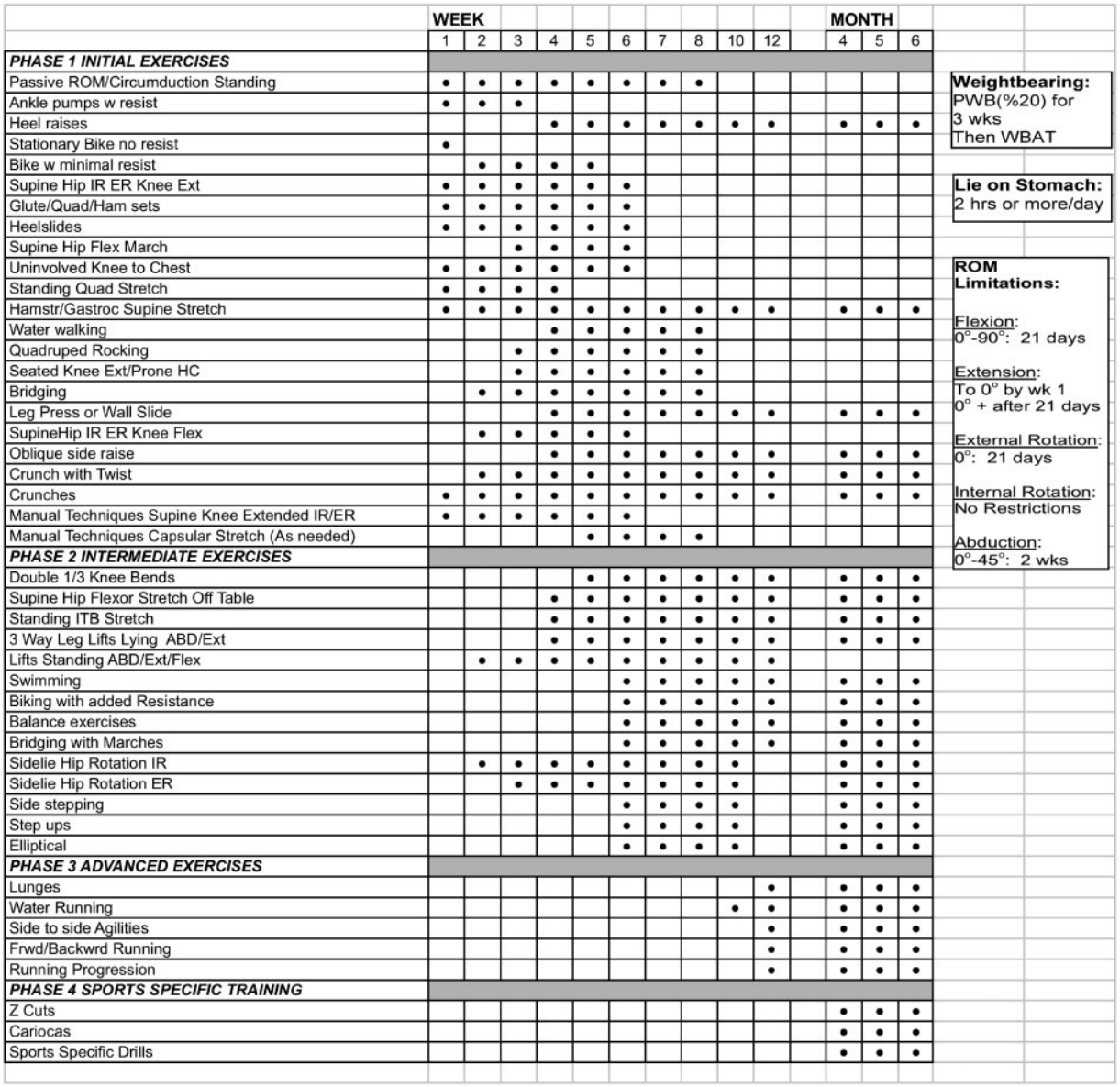


Fig. 1. Treatment algorithm for iliopsoas tendonitis after hip arthroscopy.

compared using two-tailed Student's *t*-tests. Categorical data were compared using a two-tailed Fisher's exact test. *P* values of ≤ 0.05 were considered statistically significant. Institutional Review Board approval was obtained for this study.

RESULTS

There were 60 patients (24%) who had at least 1 clinical sign positive for post-operative IPT. All patients were treated according to the algorithm presented in Fig. 1. Twenty-eight patients (47%) had their symptoms resolve



	WEEK											MONTH			
	1	2	3	4	5	6	7	8	10	12		4	5	6	
PHASE 1 INITIAL EXERCISES															
Passive ROM/Circumduction Standing	•	•	•	•	•	•	•	•							**Weightbearing:** PWB(%20) for 3 wks Then WBAT
Ankle pumps w resist	•	•	•												
Heel raises				•	•	•	•	•	•	•		•	•	•	
Stationary Bike no resist	•														
Bike w minimal resist		•	•	•	•										
Supine Hip IR ER Knee Ext	•	•	•	•	•	•									**Lie on Stomach:** 2 hrs or more/day
Glute/Quad/Ham sets	•	•	•	•	•	•									
Heelslides	•	•	•	•	•	•									
Supine Hip Flex March			•	•	•	•									
Uninvolved Knee to Chest	•	•	•	•	•	•									**ROM Limitations:**
Standing Quad Stretch	•	•	•	•											
Hamstr/Gastroc Supine Stretch	•	•	•	•	•	•	•	•	•	•		•	•	•	Flexion: 0°-90°: 21 days
Water walking				•	•	•	•	•							
Quadruped Rocking			•	•	•	•	•	•							
Seated Knee Ext/Prone HC			•	•	•	•	•	•							Extension: To 0° by wk 1 0° + after 21 days
Bridging		•	•	•	•	•	•	•							
Leg Press or Wall Slide				•	•	•	•	•	•	•		•	•	•	
SupineHip IR ER Knee Flex		•	•	•	•	•									External Rotation: 0°: 21 days
Oblique side raise				•	•	•	•	•	•	•		•	•	•	
Crunch with Twist		•	•	•	•	•	•	•	•	•		•	•	•	
Crunches	•	•	•	•	•	•	•	•	•	•		•	•	•	Internal Rotation: No Restrictions
Manual Techniques Supine Knee Extended IR/ER	•	•	•	•	•	•									
Manual Techniques Capsular Stretch (As needed)					•	•	•	•							Abduction: 0°-45°: 2 wks
PHASE 2 INTERMEDIATE EXERCISES															
Double 1/3 Knee Bends					•	•	•	•	•	•		•	•	•	
Supine Hip Flexor Stretch Off Table				•	•	•	•	•	•	•		•	•	•	
Standing ITB Stretch				•	•	•	•	•	•	•		•	•	•	
3 Way Leg Lifts Lying ABD/Ext				•	•	•	•	•	•	•		•	•	•	
Lifts Standing ABD/Ext/Flex		•	•	•	•	•	•	•	•	•					
Swimming						•	•	•	•	•		•	•	•	
Biking with added Resistance						•	•	•	•	•		•	•	•	
Balance exercises						•	•	•	•	•		•	•	•	
Bridging with Marches						•	•	•	•	•		•	•	•	
Sidelie Hip Rotation IR		•	•	•	•	•	•	•	•			•	•	•	
Sidelie Hip Rotation ER			•	•	•	•	•	•	•			•	•	•	
Side stepping						•	•	•	•			•	•	•	
Step ups						•	•	•	•			•	•	•	
Elliptical						•	•	•	•			•	•	•	
PHASE 3 ADVANCED EXERCISES															
Lunges										•		•	•	•	
Water Running									•	•		•	•	•	
Side to side Agilities										•		•	•	•	
Frwd/Backwrd Running										•		•	•	•	
Running Progression										•		•	•	•	
PHASE 4 SPORTS SPECIFIC TRAINING															
Z Cuts												•	•	•	
Cariocas												•	•	•	
Sports Specific Drills												•	•	•	

Fig. 2. Recommended physical therapy algorithm following hip arthroscopy to minimize joint reaction forces as well as iliopsoas muscle activation during the post-operative period.

with activity modification, physical therapy and NSAIDs alone, within 6 weeks. Thirty-two patients (53%) went on to require corticosteroid injection into the iliopsoas bursa. The mean time of injection was 25 weeks after surgery. Of the 32 patients who had an injection, symptoms resolved in all but 7 patients (12%), who had only a transient response. These remaining patients had tenotomy performed, which resolved the symptoms.

There were no patient-specific risk factors for post-operative IPT (Table I). There were 17 out of the 94 men (18%, 95% Confidence Interval, 12–27%) and 43 out of 158 women (27%; 95% Confidence Interval, 21–35%) who had IPT post-operative. The original diagnosis, BMI, race and side of surgery did not affect the incidence of IPT.

There was no difference in the incidence of IPT following hip arthroscopy based on surgical technique or procedure performed (Table II). There were 34 patients out of 130 (26%) who had post-operative IPT after the 3-portal technique, and 26 patients out of 122 (21%) who IPT after the 2-portal technique ($P = 0.38$). Furthermore, the type of procedure performed did not influence whether or not the patient went on to develop post-operative IPT.

Table I. Comparison of patient-specific risk factors for post-operative iliopsoas tendonopathy

	No post-operative IPT	*Post-operative IPT*	P-*value*
Total	192	60	
Gender			
Male (number [%])	77 (40%)	17 (28%)	0.12
Female (number [%])	115 (60%)	43 (72%)	
Age at arthroscopy mean (range) (years)	21 (10–57)	23 (14–42)	0.87
BMIMean (range) (kg m^{-2})	20.7 (16.9–38.3)	23.7 (17.9–37.2)	0.67
Diagnosis (*n* [%])			
Isolated labral tear	16 (8%)	3 (5%)	0.58
Labral tear and DDH	6 (3%)	3 (5%)	0.45
FAI±labral tear	170 (89%)	54 (90%)	1.00
Race			
White	153 (80%)	42 (70%)	0.16
African American	2 (1%)	0 (0%)	1.00
Asian	3 (1%)	0 (0%)	1.00
Not available	34 (18%)	18 (30%)	
Side of surgery			
Left	81 (42%)	22 (37%)	0.55
Right	111 (58%)	38 (63%)	

IPT, iliopsoas tendonopathy; FAI, femoroacetabular impingement; DDH, developmental dysplasia of the hip.

Table II. Procedure-specific results

	No post-operative IPT	*Post-operative IPT*	P-*value*
Total	192	60	
Surgical approach			
Two portals (number [%])	96	26	0.38
Three portals (number [%])	96	34	
Procedure (*n* [%])			
Labral debridement	8 (4%)	3 (5%)	0.73
Osteoplasty	36 (19%)	7 (12%)	0.24
Osteoplasty and labral debridement	113 (59%)	38 (63%)	0.55
Osteoplasty and labral repair	35 (18%)	12 (20%)	0.55

IPT, iliopsoas tendonopathy; FAI, femoroacetabular impingement; DDH, developmental dysplasia of the hip.

DISCUSSION AND CONCLUSION

Hip arthroscopy is an increasingly popular procedure to treat a variety of hip pathologies [1]. The most common of these include intra-articular pathologies and FAI. As the number of procedures increases, more is learned about optimal surgical indications and rehabilitation techniques [6, 14, 17, 21, 22]. A previously undescribed etiology of post-operative pain after hip arthroscopy is iliopsoas tendonitis (IPT). Although the iliopsoas tendon has been implicated in various hip disorders, including internal snapping hip, instability, psoas impingement and even a causal relationship to certain labral tears, it has not been described as a source of hip pain in the immediate post-operative period after hip arthroscopy. This study set out to define the entity, determine its prevalence and identify risk factors.

There are several limitations to the present study. It is a retrospective cohort study, and as such has the associated limitations. Although we made every effort to eliminate patients who may have had iliopsoas symptoms prior to hip arthroscopy, there is always a possibility of confounding information or selection bias. Furthermore, many of these patients underwent surgical procedures for structural abnormalities around the hip (e.g. cam or pincer impingent, or DDH). Although femoral anteversion was not recorded for all patients, this certainly may factor into the structural factors that predispose patients to IPT after arthroscopic hip procedures. Other limitations include the fact that each surgeon used different surgical techniques. Although there did not appear to be differences in IPT prevalence between the two groups, there may be operator-dependent techniques that vary between the two.

The results of our study are similar to previous reports in the literature pertaining to IPT [6, 14, 17, 22]. Iliopsoas pathology can take a variety of forms and has been reportedly linked to internal snapping hip [8, 12, 15, 16, 23–26], IPT and bursitis [6, 14, 17, 22], and more recently psoas impingement [3, 4, 6, 27], which has been defined to implicate the psoas in labral tears found specifically at the 3'o-clock position. There is no data on incidence of IPT in the general population, and at risk populations, such as high-level athletes and ballet dancers have small case series at best, suggesting that the diagnosis in the general population is rare. Most studies report that the symptoms resolve with a combination of activity modification, physical therapy, NSAIDs and corticosteroid injections. In recalcitrant cases, surgical treatment has been proposed; however, the literature demonstrates mixed results in patients who require surgical release [12, 15, 23–26, 28–32]. Furthermore, there are even reports of the iliopsoas tendon reconstituting years after release and requiring repeat tenotomy [33]. Our study demonstrated that a majority of cases (88%) resolved without the need for further surgical intervention.

Assuming that the IPT was not present prior to hip arthroscopy, the authors propose that the etiology of IPT following hip arthroscopy may be related to the specific rehabilitation protocol used after the procedure, altered gait mechanics or a combination of the two. It is common for patients to have abnormal gait mechanics pre-operatively, which may contribute to the hip pain after arthroscopy. In a 2011 study by Philippon et al., the authors suggest that the gluteus medius muscle is weak and accompanied by iliopsoas muscle tendonitis and believed that these clinical entities may be functionally linked [17]. The authors go on to use electromyography to evaluate both iliopsoas and gluteus medius muscle unit activation during a variety of common rehabilitation exercises and find that there is a continuum of muscle activation depending on the specific exercise. They divided exercises into three phases for rehabilitation following hip arthroscopy: in Phase I, the goals of rehabilitation are to ensure joint mobility and minimize muscle atrophy. They prefer exercises that minimize iliopsoas activation in this phase. Phase II progresses to muscular hip stability; however, the authors still warn that 'caution should be exercised in cases where hip flexor tendinitis is present'. Our study supports the observations in Philippon *et al.* and provides the first report in the literature of the possible incidence of IPT after hip arthroscopy. Furthermore, this was brought to our attention because we have had several anecdotal instances in our practice where patients were instructed to be 'non-weight-bearing' by the physical therapist, despite instructions otherwise. These data were not collected routinely for all patients, and future studies could survey the adherence to weight-bearing recommendations by physical therapists following hip arthroscopy. This may in fact increase activation of the iliopsoas muscle and may further contribute to these symptoms post-operatively.

Figure 1 illustrates our proposed algorithm for treating IPT after hip arthroscopy. The diagnosis post-operatively is made solely on physical examination, provided that the patient is at least 6 weeks after the arthroscopic procedure. The first line of treatment is activity modification, specifying only the exercises in Phase I of the algorithm presented in Fig. 2 until the symptoms resolve before progressing to Phase II [17]. If the symptoms persist after 6 weeks, then we recommend a diagnostic and therapeutic corticosteroid injection. With these two changes alone, 88% of patients had complete resolution of their symptoms. For the rare patient who had recalcitrant IPT, we could consider

iliopsoas release. Patients should not undergo iliopsoas release who have a dysplastic hip [12, 23, 25, 26], increased femoral anteversion [30], or who participate in athletic activities that require high hip flexion (e.g. ballet dancers, martial artists etc.) [28]. Iliopsoas musculo-tendinous unit may play a dynamic stabilizer role in patients with increased femoral anteversion, patients with micro-instability or in dysplastic hip patients [30]. With this in mind, the specific physical therapy protocol to minimize IPT is detailed in Fig. 2. Of the patients who underwent a repeat procedure for surgical release, it should be noted that there were no technical issues with the initial procedure, such as aberrant anterior suture anchors, that could have caused the irritation.

IPT is an under-diagnosed, under-reported complication after hip arthroscopy that can restrict the post-operative rehabilitation course if not addressed properly. In this study 24% of patients had post-operative IPT and 88% of those cases responded to non-operative treatment. This incidence of IPT after hip arthroscopy is quite considerable and should be considered in any patient who presents with hip pain following arthroscopy. Causes for this may include hypermobility of the hip, increased lumbar lordosis and pelvic incidence, or other morphologic difference in the female pelvis. Different anterior portal placement (standard anterior versus distal anterior) does not seem to affect the incidence rate of IPT. The cause of IPT is unknown; however, it could be related to abnormal post-operative mechanics, post-operative hematomas near the tendon, post-operative scarring of the tendon, or improper adherence to physical therapy protocols. Further studies are needed to investigate the reason for this complication, and whether strict rehabilitation protocols post-operatively may prevent or lower the incidence.

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CONFLICT OF INTEREST STATEMENT

None declared.

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