11-2021

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ABSTRACT

Objective: To perform a systematic review of the findings of iliopsoas release as it relates to resolution of snapping, improvement of groin pain and associated complications.

Design: Systematic Review

Data Sources: Four electronic databases: PubMed/MEDLINE, EMBASE, CINAHL and Web of Science were searched identifying all literature pertaining to surgical treatment of a snapping hip/coxa saltans, iliopsoas impingement or iliopsoas tendinitis. A total of 818 studies were identified. Two reviewers independently screened the titles, abstracts, and full text articles for eligibility.

Eligibility Criteria: All studies published in English that reported on iliopsoas release for snapping hip/coxa saltans, iliopsoas impingement or iliopsoas tendinitis reporting outcomes or associated complications were eligible.

Results: A total of 48 articles were included in this review. Three surgical indications were identified for iliopsoas release; internal snapping hip, labral tear secondary to iliopsoas impingement and iliopsoas tendinopathy following total hip arthroplasty. Arthroscopic techniques appeared to be superior to open techniques with regards to reoccurrence of snapping (5.1% vs. 21.7%) and groin pain relief (89.1% vs. 85.6%) with fewer complications (4.2% vs 21.1%) overall.

Conclusions: Both open and arthroscopic iliopsoas release have been shown to be a successful treatment options regardless of the surgical indications identified in this review. Arthroscopic release demonstrated a decreased failure rate, fewer complications, and improved outcomes when compared to open procedures.

INTRODUCTION

Anterior hip pain can be attributed to a number of causes, ranging from femoroacetabular impingement to osteoarthritis. Pathologic conditions affecting the iliopsoas tendon have also been identified as a cause of significant hip pain and disability[1,2]. In younger patients, this often presents as a painful 'snapping hip', or internal coxa saltans.[3] This phenomenon occurs in select patients where the iliopsoas tendon subluxes over the iliopectineal eminence or femoral head, and is often associated with an audible 'snapping' that causes pain.[4–7] The subluxation event can often be clinically reproduced by moving the hip from a flexed and abducted position to an extended and adducted position, where the tendon moves from a lateral position to a medial position along the pelvic brim.[4] Alternatively, in younger patients, one can also see 'iliopsoas impingement' on the anterior labrum, causing an associated labral tear at the 3 o'clock position as initially described by Domb et al.[8]

In older patients, snapping hip or iliopsoas impingement are typically less common. More commonly, however, they may develop iliopsoas tendinopathy following total hip arthroplasty (THA). In this well recognized scenario, patients can experience continued anterior hip pain, typically worsened active hip flexion.[9] It is often associated with mechanical impingement of the iliopsoas attributable to acetabular component malposition,[10–12] cement extrusion,[13–15] screw impingement, or increased offset. [9,14,16]

Regardless of the underlying cause, non-surgical intervention is the first line treatment for both age demographics. This may include physiotherapy, with focused stretching, strengthening and oral anti-inflammatories. Particularly in older patients, targeted injections into the iliopsoas bursa can be helpful for both diagnostic and

therapeutic purposes. However, following a failed trial of conservative treatment, iliopsoas release is often indicated. [3,17–19] This can be accomplished in an arthroscopic or open fashion.

An arthroscopic release can be performed via a transcapsular approach through the central compartment [20], peripheral compartment [21] or via direct release from the lesser trochanter in an endoscopic, fluoroscopy-guided approach.[17] Similarly, a variety of open releases have been described with fractional lengthening of the iliopsoas tendon at the level of the joint, or releasing the tendon directly from the lesser trochanter.

Due to the significant variability in surgical indications, technique and clinical outcome reporting, the efficacy of iliopsoas release is poorly understood. Consequently, the objective of this systematic review is to summarize the efficacy and associated complications with iliopsoas release, stratified by surgical indication.

MATERIAL & METHODS

With the assistance of a medical librarian (S.H.), a comprehensive search strategy was developed to search Pubmed/MEDLINE, EMBASE, CINAHL and Web of Science aimed at identifying all literature pertaining to surgical treatment of a snapping hip/coxa saltans, iliopsoas impingement or iliopsoas tendinitis. The research question and corresponding search terms were formulated *a priori*, modifying them accordingly in each database to maximize search results. The search terms used as single or combination terms were psoas, iliacus, iliopsoas, release, and tenotomy. The search was conducted in October 2017 and included all studies up until that time. Additionally, relevant inclusion and exclusion criteria were applied. Inclusion criteria included: (1) arthroscopic or open iliopsoas release; (2) studies of all levels of evidence; (3) studies published in English; (4)

studies reporting clinical outcomes or complication data. Exclusion criteria included: (1) systematic reviews; (2) review articles; (3) articles not reporting on clinical outcomes or complications; (4) iliopsoas release for pediatric conditions such as developmental hip dysplasia or cerebral palsy. Additional review of reference lists of included articles was performed to identify articles not initially captured in the database search.

The primary outcome measure of our study was; (1) recorded outcomes following iliopsoas release, particularly as it pertains to resolution of groin pain or snapping and (2) complications reported following iliopsoas release. Secondary outcomes included surgical technique and patient reported clinical outcome tools. Our hypothesis is that arthroscopic iliopsoas release results in improved resolution of groin pain with fewer reoccurrences of snapping or other complications when compared to open release.

Data Extraction

Following compilation of all relevant titles and abstracts, systematic screening was performed by two independent reviewers (R.L., R.D.) to identify articles for full-text review. For the initial full-text review, all systematic reviews were included to allow screening of the reference list for any additional articles that were not identified with our initial search strategy. Articles were also included for full-text review if it was unclear whether they satisfied both inclusion and exclusion criteria.

Data Analysis

Data was subsequently extracted and compiled into an Excel spreadsheet (Microsoft Excel 2017, Microsoft, Redmond WA), including details of study design, patient demographics (age, gender), surgical indication, sample size, follow-up duration

and percentage, clinical outcome tools, outcomes and associated complications. Descriptive statistics were calculated to reflect percentages and frequencies for outcomes measures analyzed.

RESULTS

Study Selection & Quality

The search strategy yielded a total of 818 articles of which 56 studies proceeded to full text review. A PRISMA flowchart demonstrates the selection of articles based on inclusion and exclusion criteria (Figure. 1). Following full text review, a total of 48 articles met the inclusion and exclusion criteria and were the subject of this review.

All studies were level IV evidence, consisting of case series (n = 36; 75%) or case reports (n= 10; 20.8%) except two studies; a level I randomized control trial (n=1; 2.1%) and a level III cohort study (n=1, 2.1%).

Surgical Indications

This systematic review identified 3 surgical indications for iliopsoas release: (1) internal snapping hip (n=28; 58.3 %),[5–7,17,19–42] (2) labral tear secondary to iliopsoas impingement (n=4; 8.3%), [8,43–45] and (3) iliopsoas tendinopathy following THA (n= 15; 31.3%). [10,13–16,46–55] One case report (n=1; 2.1%) [56] documenting hip dislocations following hip arthroscopy, iliopsoas release was performed but initial surgical indications were for CAM impingement with no mention of internal snapping hip or iliopsoas impingement.

Study Demographics

The review included a total 923 patients (951 hips) that underwent an iliopsoas release; 723 patients (730 hips) were treated arthroscopically and 200 patients (221 hips) were treated with an open release. (Table 1.) All studies included were conducted between 1984 and 2017. The mean age of the participants was 34.0 (range, 12 - 82). The mean patient follow-up period was 26.6 months (range, 2 -144 months). Amongst the thirty-two studies † recording gender, for the arthroscopically treated patients, males comprised 186 of 608 patients (30.6%), compared with 63 of 169 (37.3%) treated with an open release. An overview of all studies can be found in Appendix Table 1.

Internal Snapping Hip: A total of twenty-eight studies comprising 678 patients (701 hips) underwent iliopsoas release for internal snapping hip. The mean age of participants treated with iliopsoas release for internal snapping hip was 29.5 (range, 24-82) with a mean patient follow up period of 29.6 months (range, 5-120 months) Of the included studies, nineteen studies [5–7,17,19–28,36,37,39–41] utilized an arthroscopic technique for release, while nine studies [29–35,38,42] used an open approach.

Within arthroscopically treated patients: eight studies utilized a transcapsular release accessed via the central compartment [6,7,20,22,24–26,41]; four studies utilized a transcapsular release via the peripheral compartment [21,27,39,40]; three studies utilized an endoscopic release at the level of the lesser trochanter [17,23,36]; two studies directly compared arthroscopic approaches (transcapsular peripheral compartment release vs. endoscopic LT release; transcapsular central compartment vs. endoscopic LT); [5,28] ; and two studies [19,37] did not mention the level of release.

† 5–8,14,15,17,20,22–35,43–47,49,50,54,55

Within the nine studies utilizing an open approach, seven involved a fractional lengthening at the level of the joint [29–32,34,35,42] and two studies involved release at the lesser trochanter.[33,38]

Iliopsoas Impingement: A total of four studies, including 78 patients (82 hips), underwent iliopsoas release for iliopsoas impingement. [8,43–45]. The mean age of participants was 27.3 (range, 24-82) with a mean patient follow up period of 17.7 months (range, 3-24 months). All included studies utilized an arthroscopic approach; three studies using a transcapsular release via the central compartment [8,43,44] and one case report through the peripheral compartment. [45]

Iliopsoas tendonitis following THA: A total of fifteen studies, comprising 167 patients (168 hips) underwent iliopsoas release for persistent tendonitis following a THA. Of the included studies, seven utilized an arthroscopic technique [47–50,52,53,55] and eight performed an open release.[10,13–16,46,51,54] The mean age of all patients was 56.7 (range, 24-82) with a mean follow up period of 22.7 months (range, 2 -144 months). Within studies performing an arthroscopic release, five employed a transcapsular technique for release [48–50,52,53], one used an endoscopic release at the level of the lesser trochanter [55], and one utilized either an endoscopic release at the level of the lesser trochanter or transcapsular release. [47] Within studies performing an open release, five studies [14–16,46,54] used an open release at the level of the lesser trochanter, one study performed an iliopsoas tendon fractional lengthening at the level of the joint [13], one case report [51] performed a release at the level of the lesser trochanter and the anterior aspect of the revision acetabular shell, and one study did not specifically mention the level of release. [10].

Clinical Outcomes

A variety of clinical outcomes were reported amongst all studies including standardized patient reported outcomes measures (PROM), recurrence of snapping, groin pain resolution and post-operative complications.

Patient Reported Outcome Measures (PROM)

PROM included the modified Harris Hip Score (mHHS) [8,14,20,22,23,25,26,36,44] followed by the Harris Hip Score (HHS) [10,14,27,43,53,54] and Western Ontario and McMaster Universities Osteoarthritis Index. [5–7,17,28,55] Other scores included the Hip Outcome Score for sports (HOS Sport) and activities of daily living (HOS ADL) [8,20,26,27,49], visual analogue scale (VAS) [22,25–27,49], Non-Arthritic Hip Score (NAHS) [26,38], Vail score [22], Oxford Score [47], Hip Osteoarthritis Outcome Score (HOOS) [52], and Postel-Merle d'Aubigne Score [55].

Internal Snapping Hip: mHHS was reported in six studies [20,22,23,25,26,36] (167 hips), demonstrating an average increase of 24.2. HHS was reported in one study [27] (25 hips) resulting in an average increase of 19. WOMAC scores in 5 studies [5–7,17,28] (93 hips) demonstrated an improvement of 28.8 points. Three studies [20,26,27] (147 hips) reported on HOS ADL & Sport and found an average increase of 19.6 and 24.3 respectively. (Table 2)

Iliopsoas Impingement: mHHS was reported in two studies[8,44] (55 hips) demonstrating an average increase of 36.1. HHS was reported in one study[43] (26 hips) and was found to demonstrate an increase of 24. HOS ADL & HOS Sport were reported within 1 study [8] (25 hips) and found an increase of 18.6 and 27.3, respectively. (Table 2)

Iliopsoas tendonitis following THA: HHS was reported within four studies (37 hips), demonstrating an average increase of 30.7 overall. Three studies utilized an open release (30 hips), [10,14,54] with an average increase of 29.2, while the arthroscopic study (7 hips) [53] resulted in an average increase of 36.9. WOMAC scores were reported in one arthroscopic study (10 hips) [55] and resulted in an increase of 50.0 postoperatively. HOS ADL & Sports scores were reported in one small study (2 hips) [49] with a reported increase of 29.6 and 1.4 respectively. (Table 2)

Recurrence of Snapping

Internal Snapping Hip: Overall, recurrent snapping occurred in 61 of 616 hips (9.9%) despite surgical release. Within this cohort, 24/61 (39.34%) required revision surgery to address the recurrent snapping. In one study, 2/8 (25%) who underwent open revision fractional releases required a third release.[29] Arthroscopic iliopsoas release demonstrated a significantly lower prevalence of recurrence at 5.1% (22 of 436 hips) whereas open release was found to occur at 21.7% (39 of 180 hips). Within the arthroscopic cohort, examination by level of release found no reoccurrences with release at level of LT (0 of 44 hips), however, release within the central and peripheral compartment were found to have a prevalence of 8.9% (11 of 123 hips) and 2.9% (1 of 34 hips) respectively. Open release demonstrated an increased prevalence with release at the level of the LT (35.5%, 11 of 31 hips) compared to fractional lengthening (18.8%, 28 of 149 hips) (Table 3.)

Relief of Groin Pain

Improvement in groin pain was documented in 33 articles.[‡] The majority of patients treated with iliopsoas release demonstrated complete relief of groin pain or lack of significant residual pain, regardless of the indication or surgical technique (87.9 %; 478 of 544 hips). Arthroscopic (89.1%; 312 of 350 hips) and open release, (85.6%; 166 of 194 hips), demonstrated similar success rates within their cohorts. Results of pain relief as per level of release can be found in Table 3.

Internal Snapping Hip: Iliopsoas release for internal snapping found an overall success rate of 89% (307 of 345 hips). Arthroscopic release found 90.6% (173 of 191 hips) pain relief whereas open release demonstrated a success rate of 87% (134 of 154 hips).

Iliopsoas Impingement: Two studies reported on groin pain relief following release for iliopsoas impingement, reporting relief in only 77.4% (24/ 31 hips) of patients; however, all but one of these patients came from a single study.[44] Seven of these patients were found to have persistent groin pain but within these patients; one developed degenerative joint disease, one avascular necrosis and two had chronic greater trochanteric bursitis.

Iliopsoas tendonitis following THA: The majority of patients (87.5%, 148 of 168 hips) treated following a THA reported pain relief, with arthroscopic treatment demonstrating a higher improvement in pain relief (89.8%, 115 of 128 hips) when compared to an open release (80.0%, 32 of 40 hips).

Complications

‡ 6,10,13–17,19,23,25–27,29–33,36,38,43–55

A total of 57 complications (excluding recurrent snapping) were reported amongst 36 articles within this review. [§] Assuming multiple complications did not occur in the same patient, the complication rate was 9.5% (57 of 598 hips) amongst all patients who underwent iliopsoas release in series' or case report's that reported on complication rates. The complication rate following arthroscopic release was found to be much lower (4.2%; 17 of 408 hips) compared to open release (21.1%; 40 of 190 hips). A breakdown of all reported complications can be found in Table 4 & 5.

Internal Snapping Hip: Fifty-one complications (12%; 51/425 hips) were reported in this cohort). Arthroscopic release demonstrated a significantly lower rate of 4.8% (12 of 250 hips) compared to open release at 22.3% (39 of 175 hips). Complications included: hip flexor weakness, lateral femoral cutaneous nerve loss, anterior hip dislocation, painful bursa, heterotopic ossification, hematoma, abdominal compartment syndrome, partial femoral nerve palsy, joint stiffness, genital numbness, and pseudo aneurysm of femoral circumflex artery.

Iliopsoas Impingement: Two complications (6.5%, 2/31 hips) were reported in this cohort. Both complications were noted in one study [44], where both patients were noted to have chronic greater trochanteric bursitis.

Iliopsoas tendonitis following THA: Four complications (2.8% (4 of 142 hips) were reported in this cohort. Three occurred within arthroscopically treated patients (2.4%, 3 of 127 hips) while only one occurred amongst patients that underwent an open release (6.7%; 1 of 15 hips). Complications included: anterior hip dislocation,

§ 5,7,10,14–17,20–23,25–31,33–36,38–42,44,45,47–49,52,53,55,56

compressive hematoma and breakage of arthroscopic blade requiring open conversion within the arthroscopic cohort and heterotopic ossification within the open cohort.

DISCUSSION

The most significant findings of this review, which encompassed 923 patients (951 hips), included the identification of three primary surgical indications: internal snapping hip, iliopsoas impingement and iliopsoas tendinitis following THA. PROM reporting was extremely heterogeneous across all studies, but where reported demonstrated improvements postoperatively. Due to heterogeneity in the outcome measures utilized, no meaningful statistical comparisons could be performed. Considering all indications, arthroscopic techniques appeared to be superior to open techniques with regards to reoccurrence of snapping (5.1% vs. 21.7%) and groin pain relief (89.1% vs. 85.6%) with fewer complications (4.2% vs 21.1%) overall.

Three arthroscopic techniques have been described for release of the iliopsoas tendon for internal snapping hip; transcapsular release from the central compartment [20], transcapsular release from the peripheral compartment [21], and endoscopic release from the LT [17]. While difficult to make definitive conclusions based on discrepancies in patient numbers between levels of release, our review indicates that release at the level of the LT results in the fewer reoccurrences of snapping when compared to release in the central or peripheral compartment (0% vs. 9.2%). This is in contrast to a previous systematic review by Khan et al. [1] of internal snapping hip. In their review of 129 patients that underwent iliopsoas release either at the LT or transcapsular, they noted no reoccurrences

in either group. In the only level I study included in this review, Ilizaliturri et al [33] performed an RCT of iliopsoas release at the level of LT or within the peripheral compartment and found no difference in clinical results or reoccurrence. On the other hand, open techniques demonstrated an increased rate of reoccurrence of snapping when performed at the level of the LT when compared to fractional lengthening (31.4% vs 19.3%). Again, heterogeneity between groups make definitive conclusions difficult in this comparison.

Iliopsoas tendinitis following THA has been associated with oversized or retroverted acetabular cups [57,58]. Arthroscopic release offers an attractive option, as opposed to acetabular revision, as it is minimally invasive and is associated with fewer complications and a high success rates. [54] Chalmers et al [10], examined 49 patients with tendonitis post THA treated with non-operative and operative treatments (either acetabular revision or open iliopsoas release). The authors noted improved clinical outcomes in isolated tendon release if cup prominence was less than 8 mm. Consequently, they recommend an isolated iliopsoas release be performed for patients meeting these criteria.

Despite hip flexion weakness being a common concern following iliopsoas release, it has been poorly studied to date. This review found a wide variety in assessments of hip flexion strength from noted subjective weakness [32,34,38] to ability to climb stairs [14,17,33] to straight leg raise [17,47,52] to seated hip flexion grading, [23,34,36,47] thus making any overall assessment of hip flexion weakness difficult and was not an outcome measure included in this review. Brandenburg et al [24] has provided the only assessment of hip flexion strength beyond simple clinical grading. In their series of 36 patients, when

compared to control, arthroscopic iliopsoas release demonstrated 25% muscle loss and 19% reduction in seated hip flexion strength by MRI and dynamometer evaluations respectively. Certainly, further accurate objective testing is required especially when considering an iliopsoas release in younger active patient populations.

Arthroscopic release was associated with a lower complication rate than open procedures regardless of the surgical indication. Amongst patients with internal snapping hip, arthroscopic release at the level of the LT was associated with decreased recurrence of snapping with an increased complication rate, however open release at the level of the LT was associated with an increased rate of recurrence with a similar complication rate. These results are similar to the review by Khan et al[1] except for the noted complication rate within open techniques. Conversely, amongst patients undergoing release for tendonitis following THA, arthroscopic release at the level of the joint or the LT were associated with similar rates of groin pain improvement, but an increased complication rate with release at the level of the joint. A total of 3 complications were noted in patients undergoing arthroscopic release whereas O'Connell et al [2] previous review did not note any complications amongst patients undergoing arthroscopic release. Discrepancies with previous reviews can be explained by the addition of more recent studies.

Postoperative hip dislocations can be a catastrophic complication following any arthroscopic procedure of the hip. There were 2 case reports of 3 hip dislocations following an arthroscopic release of the iliopsoas tendon that were included in this review. Austin et al [52], reported on a 19 year old collegiate long jumper suffering an anterior hip dislocation while jumping following an arthroscopic release within the peripheral compartment. The authors felt a combination of femoral anteversion, capsulotomy

without closure and iliopsoas tenotomy lead to the patient's instability. Sansone et al [56] noted 2 cases of hip dislocations following an arthroscopic release within the central compartment in which both patients were attempting athletic maneuvers. The authors felt that sectioning of the iliofemoral ligament during capsulotomy along with an iliopsoas release represented a potential risk for iatrogenic instability. A systematic review of hip dislocations following hip arthroscopy by Duplantier et al [59] noted post-arthroscopic instability was observed in patients with acetabular under coverage, capsular laxity, iliopsoas release, or labral debridement. While the iliopsoas tendon has been felt to act as a dynamic anterior restraint [39,56,60], certainly care should be taken to assess acetabular and femoral version along with ligamentous laxity when considering an iliopsoas release.

Fowler & Owens [54] noted a further catastrophic complication in a case of abdominal compartment syndrome requiring a decompressive laparotomy in a patient that underwent a labral debridement, removal of a pincer lesion, and iliopsoas release through the central compartment. The capsulotomy and iliopsoas release was performed near the beginning of the procedure which lead the authors to change their practice, leaving the capsulotomy and tendon release till end of procedure to help minimize fluid extravasation.

LIMITATIONS

This study utilized thorough methodology to provide a comprehensive review of the literature following iliopsoas tenotomy, however it is not without limitations and should be interpreted with caution. There is a lack of high quality studies available on this topic, with only one RCT amongst included studies. The eligibility criteria for study inclusion was quite broad allowing for the inclusion of case reports in order to capture all

associated complications of iliopsoas release but subsequently lends itself to less quality paper inclusions. The vast majority of the papers were retrospective reviews of unmatched or controlled cohorts. The heterogeneity in patient cohorts, outcome measures and follow up make the ability to obtain statistically significant conclusions difficult between surgical techniques or level of release. Patients treated arthroscopically often had other concomitant procedures in addition to iliopsoas release that made comparisons of PROM difficult between studies. Within patients that had iliopsoas tendonitis following THA, acetabular cup position was not recorded. Non-operative treatments prior to surgery were also not recorded in this review but should always be the first line of treatment in patients with iliopsoas pathology. Finally, despite a broad eligibility criteria, as with any systematic review, the possibility of non-inclusion of relevant studies can bias our results. Nonetheless, we feel this paper provides a broad descriptive review of iliopsoas release from surgical indications to clinical efficacy to associated complications.

CONCLUSION

Both open and arthroscopic iliopsoas release have been shown to be a successful treatment options regardless of the surgical indications identified in this review. Arthroscopic release demonstrates a decreased failure rate, fewer complications, and improved outcomes when compared to open procedures. This review indicates that arthroscopic release at the level of the LT results in the fewer reoccurrences of snapping when compared to release in the central or peripheral compartment. Future research should focus on improved reporting using standardized outcome measures and objective strength evaluation to allow further analysis of level of release to determine if it is an important factor in outcomes.

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TABLES & FIGURES LEGEND