# Peritrochanteric Space Disorders: Anatomy and Management

# 33

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## 33.1 Introduction

The term greater trochanteric pain syndrome [1] was coined to recognize other causes of pain localized to the tip of the greater trochanter, attributed at the time only to "bursitis" [2, 3]. Improved knowledge of the anatomy and recognition of pathology, in addition to advances in imaging [4], have developed the term to include abductor tendon pathology and external coxa saltans as well as trochanteric bursitis, encompassing the regional pathologic pain generators [5]. In fact, inflammation of the bursae is now commonly associated with abductor pathology [6, 7]. Patients who have been diagnosed with trochanteric bursitis recalcitrant to conservative measures may have abductor tendinopathy. In selected cases, surgical treatment with either an open approach or a peritrochanteric endoscopy is indicated [8].

GTPS is now known as a common cause of lateral hip pain, with an incidence ranging from 10% to 25% of the general population and a prevalence of 17.6% [9–11]. Clinical presentation is usually described as dull pain to the lateral aspect of the hip, occasionally radiating posteriorly and into the thigh, which worsens during activity and is tender to pressure. Several risk factors have been previously described in the literature, such as age groups in the fourth to sixth decade of life, female gender, obesity, osteoarthritis, and lower back pain [10, 12–14]. Patients with GTPS may experience limitation to their disability and quality of life similar to patients with severe osteoarthritis and are less likely to be in full-time work [15].

Accurate diagnosis of the underlying etiology is fundamental to treat GTPS successfully. Inflammation of trochanteric bursae has been attributed to different causes. One proposed cause is repetitive friction between the greater trochanter and ITB associated with overuse, trauma, and altered gait. Isolated bursitis is uncommon, as image studies have shown that patients diagnosed with bursitis actually have abductor tears, tendinosis, or a thickened ITB [15–17].

Advances in MR imaging as well as endoscopic surgery have contributed to the more precise diagnosis of gluteus medius and minimus tears, leading to the acknowledgment that these muscle tendons may undergo a degenerative process leading to a tear similar to that of the rotator cuff of the shoulder [15, 18, 19]. External coxa saltans is another differential diagnosis, caused by the repetitive rubbing of the ITB over the greater trochanter, which may lead to a thickened ITB and trochanteric bursitis. This is due to the anterior translation of the ITB when the hip moves from extension to flexion, which may cause audible snapping that can be painful; however, snapping is frequently asymptomatic [15].

## 33.2 Anatomy

The anatomy of the peritrochanteric space has been well described [9, 16]. The majority of patients have three to four identifiable bursae peripheral to the greater trochanter (Fig. 33.1a–c). Their main function is to cushion and enable smooth motion of the gluteus tendons, ITB, and tensor fascia lata (TFL); the largest of these is located between the gluteus maximus muscle and gluteus medius tendon (subgluteus maximus bursa); this bursa is commonly referred to as the trochanteric bursa [20].

The most superficial structure of the peritrochanteric space is a fibromuscular sheath composed of the gluteus maximus, tensor fascia lata, and ITB. The gluteus maximus inserts into the posterior aspect, while the tensor fascia lata inserts into the superior and anterior aspects of the ITB. The fascia lata that encloses these structures extends superiorly without muscle attachment to the tubercle of the iliac crest. Distal to the hip joint, the ITB has a thick expansion—the gluteus maximus sling—that inserts on the posterolateral femur. The ITB crosses the knee joint distally and inserts onto Gerdy's tubercle on the anterolateral aspect of the proximal tibia.

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B. C. Werner (ed.), *MRI-Arthroscopy Correlations*, https://doi.org/10.1007/978-3-030-94789-7_33

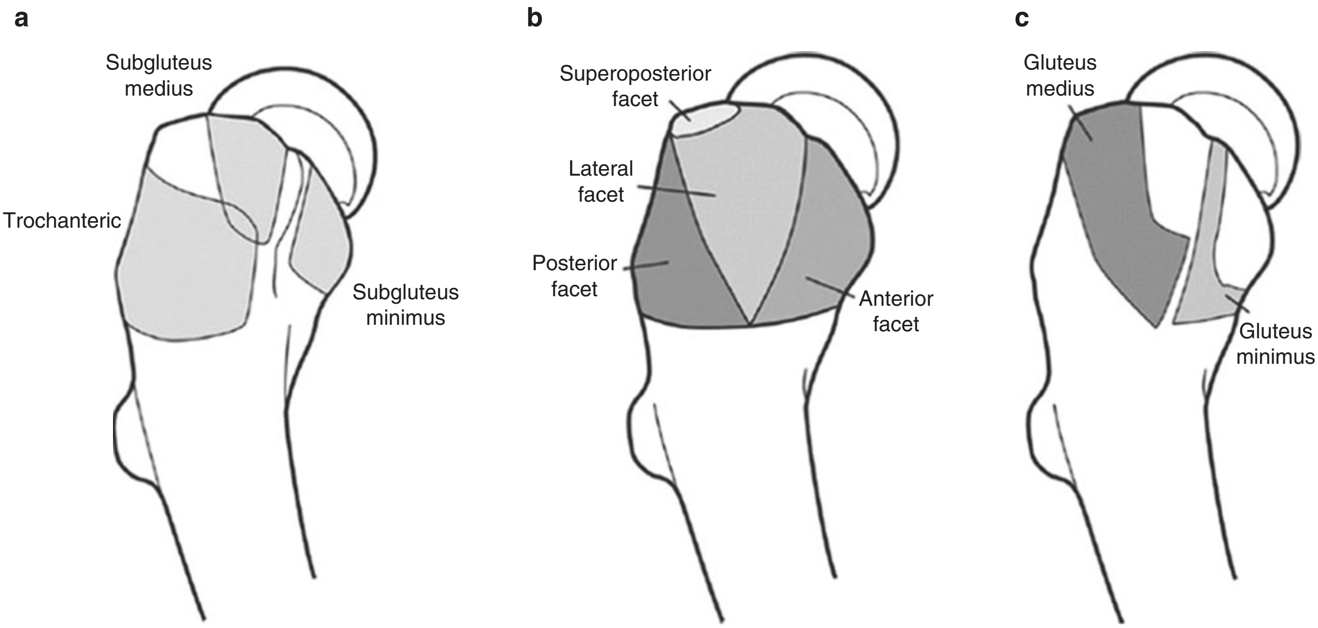


**Fig. 33.1** (**a**–**c**) Anatomy of greater trochanter with tendinous insertion sites and bursae. (**a**) The three main bursae and their positions. (**b**) Geometry of greater trochanter with different facets. (**c**) Footprints of gluteus medius and minimus tendon insertions (**a**–**c**: *From* Domb et al. [22]; *with permission*)

The hip abductor muscles are the tensor fascia lata, the gluteus minimus, and gluteus medius muscles; the last two have insertions in the greater trochanter. The smaller gluteus minimus originates from the anterior inferior iliac spine (AIIS) to the posterior inferior iliac spine (PIIS), runs parallel to the femoral neck, and inserts into both the hip capsule and lateral facet beneath the gluteus medius [21]. The gluteus medius has a fan shape and originates from the anterior superior iliac spine (ASIS), outer edge of the iliac crest, and posterior superior iliac spine (PSIS). Depending on the source, it has two or three insertion points on the greater trochanter: a thick insertion from the central posterior portion of the muscle on the superoposterior facet of the greater trochanter, a thin lateral portion that inserts on the lateral facet of the greater trochanter, and a microscopic insertion on the anterior facet of the greater trochanter (Fig. 33.1c) [16]. The tensor fascia lata is the major abductor of the hip, and it originates from the iliac crest and inserts into the anterior aspect of the iliotibial tract [22].

## 33.3 History and Physical Examination

Obtaining a thorough history as well as performing a complete physical examination of the hip is fundamental to reach the correct diagnosis in patients with lateral hip pain. Important factors to consider pathology are age, chief complaint, symptom onset and duration, alleviating and aggravating factors, and previous treatments. Aggravating factors may include side bending, sitting prolongedly, and sleeping or exerting pressure over the affected side. Painful mechanical symptoms, such as snapping, catching, clicking, locking, and popping, may indicate a structural problem.

Assessment of previous treatments must include previous surgical treatment of the hip and corticosteroid injections. Surgical access through a lateral approach to the hip is important, as it may have involved access through a portion of the abductors, causing iatrogenic partial tears that can chronically degenerate the abductor tendons and cause complete tears in the long term. This is not uncommon in treatment of proximal and shaft femoral fractures, especially while inserting intramedullary devices through the greater trochanter [23]. Corticosteroid injections in the vicinity of tendons are controversial as, although they may provide short-term relief, they have been described to potentially weaken the tensile strength of the tendon and potentially lead to tearing [24].

Physical examination includes determination of height, weight, and body mass index. The clinician should assess if the patient's posture as standing with a slightly flexed hip and ipsilateral knee or listing to the contralateral side while sitting could indicate hip pathology. Trendelenburg gait, also known as abductor lurch, may indicate abductor pathology [25]. A short-leg limp can indicate ITB pathology or leg-length discrepancy. Active and passive range-of-motion should then be measured in a comparative manner to the contralateral hip, including flexion, extension, internal and external rotation, adduction, and abduction. Strength evaluation includes hip flexors, extensors, abductors, adductors, hamstrings, and quadriceps. Tenderness is usually present in palpation of the greater trochanter.

Provocative tests include finding weakness or pain in resisted abduction in the lateral decubitus. The modified resisted internal rotation test [26] is performed in supine position; the patient is asked to flex the hip and knee to 90°, while the clinician moves the hip to 15° to 20° of external rotation and positioning one hand on the medial aspect of the knee while the other hand is on the lateral aspect of the ankle to resist adduction and internal rotation, respectively. The patient then exerts internal rotation of the hip while moving the knee towards the midline while simultaneously moving the foot away from the midline; both movements are resisted by the clinician's hands.

Other provocative tests include the single-leg stance test for 30 s and the resisted external derotation test in the supine position [27]. The latter is performed in the supine position with the hip and knee flexed at 90° and the hip in external rotation, which usually relieves the pain. Patients are then asked to return to neutral rotation, against resistance. A positive test would reproduce pain. The Ober test can be performed with the hip in extension, neutral, and flexion, when assessing for contractures of the ITB, gluteus medius, and gluteus maximus, respectively. To attempt to elicit a snapping ITB, the clinician can attempt moving the affected limb from flexion, abduction, and external rotation to extension, adduction, and internal rotation.

## 33.4 Differential Diagnosis

The diagnosis of GTPS may be challenging due to the multiple possible sources of pain surrounding the hip, including intra- and extra-articular hip pathology, and sources outside of the hip. Intra-articular sources include labral tears, loose bodies, femoroacetabular impingement, capsular laxity, ligamentum teres rupture, and osteoarthritis. Extra-articular sources include stress fractures, piriformis syndrome, and neoplasms [28]. Sources of hip pain that are outside the hip include sacroiliac disorders, lumbar spondylosis, and lumbar radiculopathy. Also, patients with a history of total hip arthroplasty, especially through an anterolateral approach, may have iatrogenic injury to the abductor mechanism or its innervations [21]. A complete list of differential diagnoses of hip pain is shown in Table 33.1.

**Table 33.1** Differential diagnosis of hip pain

| Location of pain | Anatomic structures | Differential diagnoses |
|---|---|---|
| Intra-articular hip | Bone | Femoroacetabular impingement |
| | | Dysplasia |
| | | Osteonecrosis |
| | | Loose body |
| | Cartilage | Labral tear |
| | | Degenerative joint disease/ osteoarthritis |
| | Others | Ligamentum teres tear |
| | | Synovitis |
| | | Capsulitis |
| Extra-articular hip | Muscle/tendon/ bursa | Adductor strain |
| | | Iliotibial band syndrome |
| | | Iliopsoas complex disorders |
| | | Piriformis/hip external rotator disorders |
| | | Greater trochanteric pain syndrome |
| | | Hamstring complex disorders |
| | Bone | Stress fracture |
| | | Epiphysitis |
| | | Transient osteoporosis |
| | Nerve | Meralgia paresthetica |
| | | Genitofemoral nerve disorders |
| | | Ilioinguinal nerve disorders |
| | | Sciatic nerve disorders |
| | Others | Sports hernia |
| | | Pelvic visceral pain |
| Peripheral anatomy | Axial | Disk disorders |
| | | Facet disorders |
| | | Lumbar strain |
| | | Vertebral fracture |
| | Radicular | Spinal stenosis |
| | | Radiculopathy |
| | | Spondylolisthesis |
| | Sacroiliac | Sacroiliac disorders |

## 33.5 Imaging

Common imaging studies used to assess GTPS are plain X-ray images, ultrasonography, and magnetic resonance imaging. The development of technology to provide with more accurate and well-defined imaging has contributed immensely to the description of normal and pathologic anatomy of the peritrochanteric space. Not only developments in imaging have contributed to identify the anatomic structures but also to a better understanding of their role [29–32].

Standard radiography is commonly utilized to rule out hip degenerative joint pathology and anatomic findings such as femoroacetabular impingement (FAI) and hip dysplasia. Irregularities in the greater trochanter have been previously related to tendon abnormalities in the literature [33], and recent studies have described pertrochanteric calcifications, usually found as enthesophytes proximally and distally, are strong predictors for the presence of full-thickness tears of hip abductors, and the size of the findings was correlated to the severity of the injury [34].

Ultrasonography (US) has shown effectiveness in the diagnosis of GTPS, with high sensitivity and positive predictive value [35]. Previous studies using US have demonstrated patients with a diagnosis of trochanteric bursitis only present dilated bursa sacs in 20% of the cases compared to gluteal tendinosis (50%) and thickened ITB (28.5%) [15]. Benefits of US include allowing dynamic evaluation, especially when confirming external snapping of the trochanter against the ITB, as well as utilizing the probe as a palpating tool to assess the anatomic structures specific to the localization of pain. This is especially useful to guide diagnostic/therapeutic injections to determine pain resolution.

The gold standard for diagnosis of GTPS remains MRI [9, 36]. This study allows for visualization of intra- and extra-articular structures and is useful to identify multiple causes of pain. Abductor pathology can be adequately assessed and has been characterized previously. A thickened tendon and increased signal intensity on T2-weighted images were characteristic of tendinosis. Partial-thickness tears are evident as focal discontinuity of the gluteus medius fibers, and complete tears are defined as those involving retraction of the tendon [7, 30].

MRI has also been used for pathologic classification systems. As the hip abductors have been compared to the rotator cuff of the shoulder, the Goutallier and Fuchs classification system [37, 38] which uses the fatty tissue surrounding the tendon and muscle to determine the severity of the tear has been applied to classify abductor tendon tears and their prognosis following surgical treatment into four grades [18].

External snapping hip MRI findings have historically been associated with thickening of the iliotibial band (ITB) [39]. Development of imaging has allowed for recent studies to determine the diameter of the ITB in patients with greater trochanteric pain syndrome, who required surgical endoscopic release, compared to asymptomatic control groups [40]. Average thickness of the ITB for patients with GTPS was 5.61 ± 2.10 mm compared to 3.77 ± 0.79 mm in the control group, showing statistical significance. Trochanteric bursitis can also be evident on MRI as inflammated tissue surrounding the greater trochanter.

## 33.6 Treatment

### 33.6.1 Conservative

The initial line of treatment is usually nonsurgical, which includes rest, activity modification, anti-inflammatory medications, physical therapy, and injections. Conservative management has been described to successfully treat most patients [41]. Ultrasound has also been therapeutically utilized as part of the physical therapy protocol with good results [42]. Anti-inflammatory drugs may provide analgesia in addition to other conservative measures, such as avoiding to sleep on the affected side [43]; however, this may be limited by the pathologic pain generator. In the setting of tendon tears, for example, these measures may be of little aid in ceasing symptoms.

The use of injections as a line of treatment includes corticosteroids as well as biologic injections. Cortisone injections have been studied to describe their short-term effects [41, 44–46]. Some of the described benefits include pain improvement from 49% to 100%, reduction in opioid consumption, and reduction in the mean VAS for pain. However, studies evidence a large variability of outcome measures, and there may be conflict to determine the real risk/benefit due to the possibility of causing tendon tears. A surging novel therapy to treat GTPS is injections with platelet-rich plasma (PRP). A recent systematic review of literature compared surgical treatment to PRP injections with comparable results after treatment, evidencing statistically and clinically significant improvements based on patient-reported outcome scores (PROS) [47]. Even as the pros and cons of biologic injections apparently outweigh corticosteroid injections, future prospective, randomized controlled trials are needed in the field to determine the role of injections to provide mid- and long-term relief in the treatment of GTPS.

Lastly, the modality of extracorporeal shockwave therapy (ESWT) has been studied to determine its benefits in the treatment of tendinopathy [42, 48, 49]. Authors found improved pain and function in the short term compared to other conservative treatment modalities, including cortisone injections. Superior outcomes were also found in the shockwave cohort for patient-reported outcomes, such as VAS and HHS. The apparent effectiveness in the treatment of GTPS makes ESWT another option to consider shy of surgical treatment.

### 33.6.2 Surgical

After conservative measures have failed to provide relief for a period of at least 3 months, surgical treatment should be considered [50]. Treatment should be dedicated to the etiology of the pain. Open and endoscopic techniques can be used for each purpose.

As with many surgical procedures, open techniques have given way to arthroscopic and endoscopic solutions. Hip arthroscopy has made significant advances since its introduction in 1931 and popularization during the late 1980s and early 1990s [51–53]. These surgical techniques and other technological achievements have helped expand hip arthroscopy to extra-articular anatomic regions, which is considered peritrochanteric endoscopy. The peritrochanteric endoscopic borders are the tensor fascia lata and ITB laterally, the abductor tendons superomedially, the vastus lateralis inferomedially, and the gluteus maximus muscle superiorly and its tendon posteriorly [54].

Hip arthroscopy and peritrochanteric endoscopy can be utilized based on surgical goals; however, portal placement, visualization pearls, and other procedural nuances have been described. The use of the same portals for evaluation of the central and peripheral compartment disorders was described by Voos et al. Using this technique, the anterior portal offers the best access to the peritrochanteric space [5]. The portal is obtained by making an incision 1 cm lateral to the anterior superior iliac spine within the interval of the tensor fascia lata and sartorius. A standard 30° or 70° arthroscope is utilized for endoscopic purposes.

Surgical treatment for each individual pathology will be described in the following section with a case-based example, including figures describing the relationship between MRI and arthroscopy.

## 33.7 Case 1: Recalcitrant Trochanteric Bursitis

### 33.7.1 History/Exam

A 55-year-old female presented to orthopedic clinic with a 1-year history of left hip pain. She cannot recall the initial onset of pain; however, she began to experience pain with prolonged standing, sitting with the affected leg crossed, or lying on the affected side. Pain has progressively worsened in the past 4 months. She was able to locate the pain to the lateral aspect of her hip and noted that it radiated down the lateral aspect of the thigh. She described pain as dull and constant and rated it 5 on a scale of 0–10.

She visited her primary care practitioner and began a course of physical therapy and NSAIDs. She states she had to discontinue physical therapy after four sessions, as pain worsened significantly. As pain began to limit her activities of daily life, she requested to be referred to an orthopedic clinic.

On the physical exam, she presented with normal gait. Palpation to the greater trochanter was tender and mimicked the pain she experiences. Range of motion of the hip was quantified as 110° of flexion, 15° of internal rotation (which was painful), 40° of external rotation, and 30° of abduction. Resisted abduction caused discomfort but showed no weakness. Ober's test was positive as well as a mild anterior impingement test. She presented no snapping of the hip during the physical exam. Neurovascular assessment was intact.

Initial measures of rest, activity modification, and an ultrasound-guided corticosteroid injection were provided in her initial visit, which included a local anesthetic and provided 80% relief within the first 30 min after the injection. After 2 weeks, patient was indicated to resume physical therapy, which included ultrasound and massage, as well as ROM and strengthening exercises. Patient referred relief from 5 to 2/10 for 6 weeks after the injection but progressively worsened, and 3 months after her initial visit, she presents with the same symptoms as her initial visit.

### 33.7.2 Imaging

Standard radiographic views were obtained and included anterior/posterior pelvis, right hip false profile, bilateral Dunn views, and a right hip cross-table lateral. Images demonstrated intact joint spaces; however, cam lesion and small crossover sign are noted.

Due to the ongoing symptoms, MR arthrogram of the right hip was obtained. Coronal fat-saturated T2-weighted images are shown in Fig. 33.2a–b, and axial fat-saturated T2-weighted images are shown in Fig. 33.3a–c. Figure 33.3b–c evidences moderate amount of edema lateral to the greater trochanter, which can be interpreted as bursitis, shown with the blue arrow. In addition, mild signal heterogeneity can be viewed in the substance and insertion of the abductor tendons indicating the tendinosis, and possibly a low-grade tear is shown by the blue arrow. A labral tear is also evidenced.

The patient's clinical and radiographic presentation was consistent with trochanteric bursitis, although she also had mild signs and symptoms of femoroacetabular impingement. Given her failure to improve with conservative treatment, the patient elected to proceed with surgery and was consented for right hip endoscopic trochanteric bursectomy and debridement, as well as a possible gluteus medius repair if endoscopic evidence of tearing was seen. Patient was also consented for arthroscopic treatment for FAI and the labral tear.

### 33.7.3 Arthroscopy

The patient was placed in the supine position in the operating room, on a post-less traction table. Traction was applied to the hip under fluoroscopy. Intra-articular access was obtained through an anterolateral 12 o'clock portal [55], followed by a mid-anterior portal. A capsulotomy was made parallel to the acetabular rim connecting the two portals. Diagnostic arthroscopy and intra-articular procedures were completed first.

A blunt obturator was used to reinsert the arthroscope into the peritrochanteric compartment through the mid-anterior portal. A thickened band of bursa is seen in Fig. 33.4a. The shaver was introduced via the anterolateral portal (Fig. 33.4b) and trochanteric bursectomy, and peritrochanteric debridement was performed (Fig. 33.4c). The remainder of the peritrochanteric space was examined, including the gluteus medius and maximus tendon insertions, which were found to be intact.

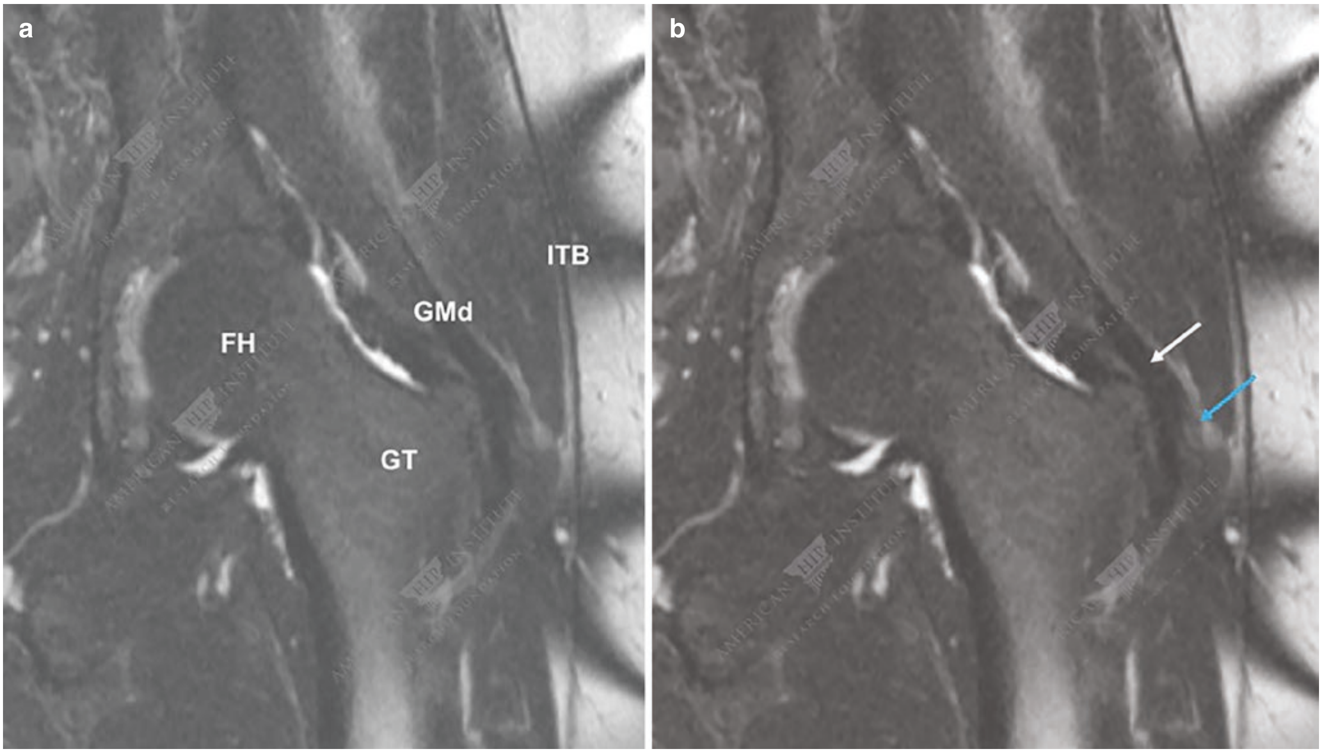


**Fig. 33.2** (**a**) Coronal fat-saturated T2-weighted image. The anatomic structures being scrutinized: *GM* gluteus medius, *FH* femoral head, *GT* greater trochanter, *TB* trochanteric bursa, *ITB* iliotibial band. (**b**) Mild signal heterogeneity can be seen at the insertion of the abductor tendons indicating tendinosis evidenced by the *white arrow*. A moderate amount of fluid and edema is seen lateral to the GT suggesting bursitis as shown by the *blue arrow*

### 33.7.4 Discussion

Open surgical treatment led to arthroscopic techniques for the treatment of recalcitrant trochanteric bursitis, which now has been performed for years [56, 57]. Isolated trochanteric bursitis is rare; commonly it is found in addition to a thickened ITB or pathology of the abductors [4, 15]. Open or arthroscopic surgical management of this condition is effective but rarely necessary lending to a paucity of high-level research. Fox et al. retrospectively reported on 27 patients treated with arthroscopic bursectomy for recalcitrant trochanteric bursitis. At a minimum of 1 year, 23 out of 27 patients had "good or excellent" results immediately postoperative with no complications. Symptoms recurred in one patient at 1 year and two patients at 5 years [58].

The case presented had concomitant abductor tendinosis and femoroacetabular impingement with a labral tear, in addition to the trochanteric bursitis. The rationale for surgical treatment for refractory trochanteric bursitis should be accompanied by preoperative planning that includes a high degree of suspicion for coexisting intra- and extra-articular pathology.

## 33.8 Case 2: External Snapping Hip

### 33.8.1 History/Exam

A 38-year-old female presents to the orthopedic clinic with right hip pain for more than 10 years. She states that since her early teenage years, she feels occasionally that her hip "dislocates" referring to a clunking sensation; however, it only started causing pain in the past 10 years approximately. Pain associated with the clunking has acutely worsened and now feels like "she is being kicked." She localized it to the lateral aspect of the hip, and after she feels the snapping, it was rated 8 out of 10 and described it as sharp and deep. She states that she can reproduce the snapping when walking or balancing on uneven surfaces. She feels relief when she rests after the episodes for a short period of time; however, afterwards she feels a constant ache which improves slightly after taking NSAIDs. She was instructed to begin physical therapy by her family physician and completed about 4 months, after which she has felt stronger, but the painful clunk persists.

On physical examination, she presents with a normal gait pattern. Her bilateral hip range of motion is as follows: 120° of flexion, 30° of internal rotation with pain, 50° of external

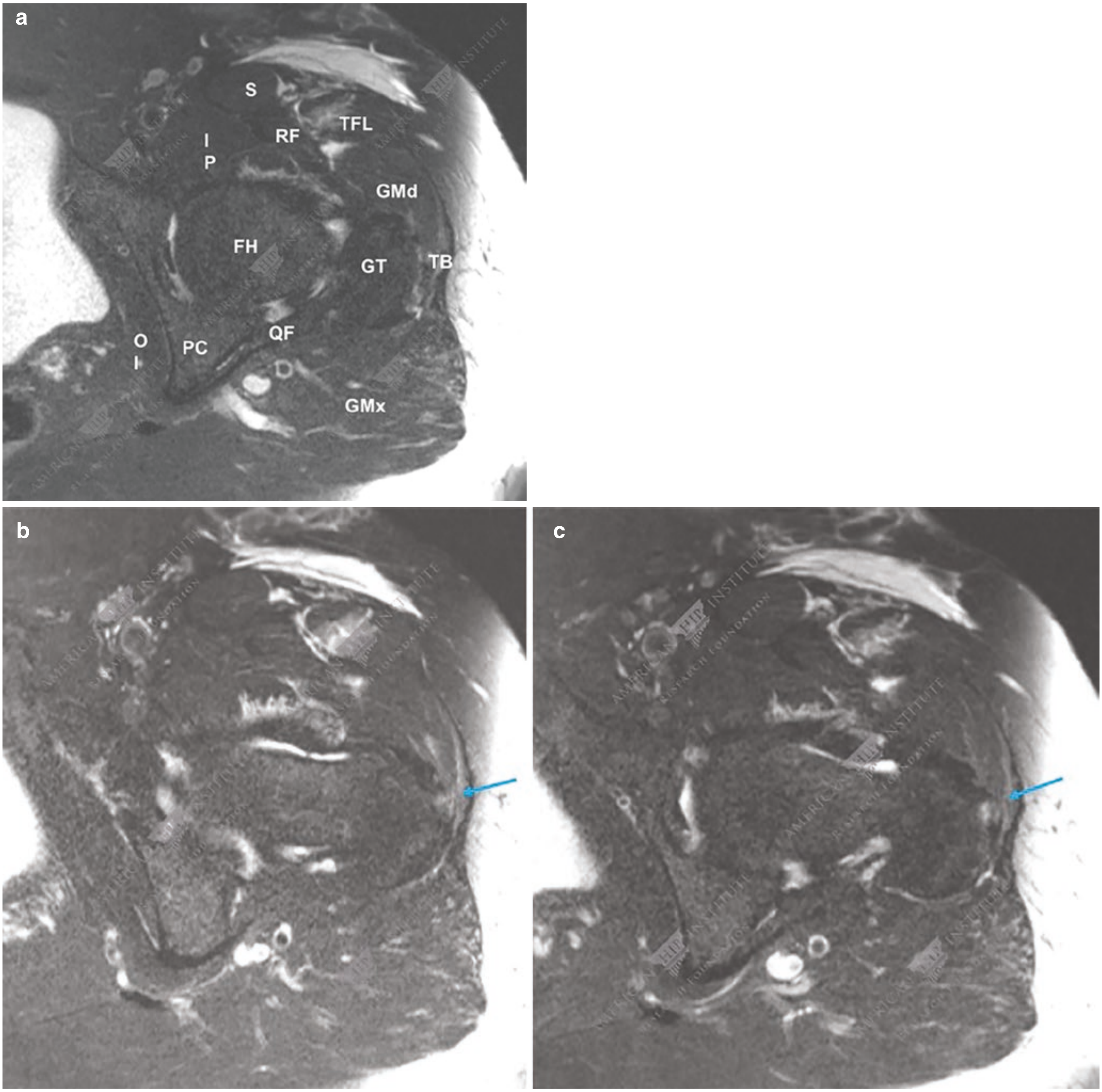


**Fig. 33.3** (**a**) Axial fat-saturated T2-weighted image. Surrounding anatomic structures in clockwise direction: *S* sartorius, *IP* iliopsoas, *FH* femoral head, *OI* obturator internus, *PC* posterior column, *QF* quadratus femoris, *GMx* gluteus maximus, *TB* trochanteric bursa, *GT* greater trochanter, *GMd* gluteus medius, *TFL* tensor fascia lata, *RF* rectus femoris. (**b**–**c**) A moderate amount of fluid and edema is seen lateral to the GT suggesting bursitis as shown by the *blue arrow*

rotation with pain, and 50° of abduction. She denies pain directly over the greater trochanters, however, does admit to tenderness over the piriformis. External snapping is noted during the physical exam, while the patient was lying on the contralateral side, while flexing the affected side, which replicated the painful symptoms she described. The patient also exhibits a positive Ober's test and a mildly positive FABER test. Muscle testing of the lower extremities reveals 5/5 strength bilaterally. Additionally, bilateral lower extremities are neurovascularly intact.

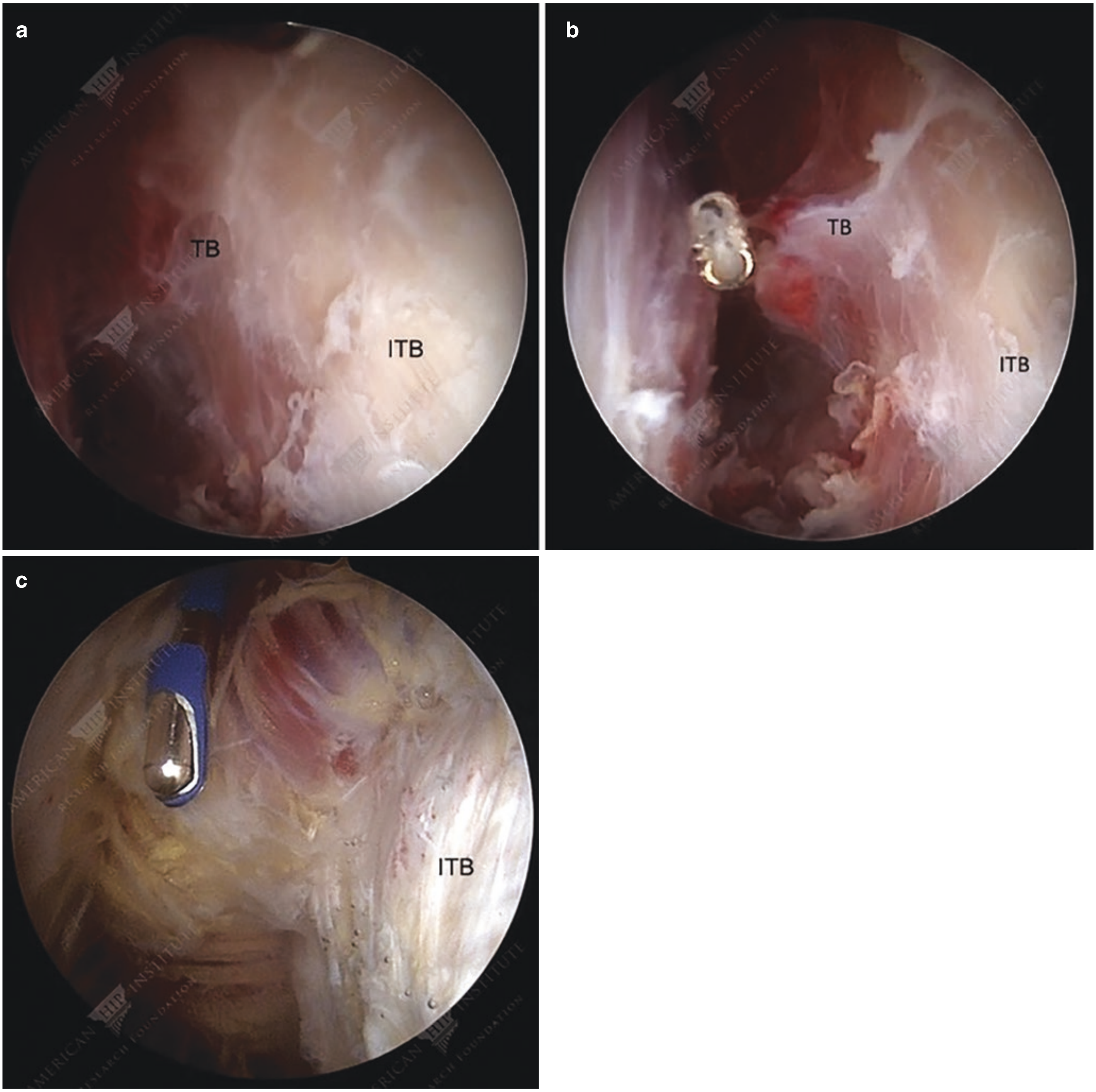


**Fig. 33.4** (**a**) A thickened band of bursa is seen (TB) on the trochanteric space; the iliotibial band (ITB) is also evidenced. (**b**) An arthroscopic shaver is introduced and seen performing trochanteric bursectomy. (**c**) View of the iliotibial band (ITB) after trochanteric bursectomy

### 33.8.2 Imaging

Radiographic imaging, which included a supine AP view of the pelvis, false profile, and Dunn views, revealed preserved joint spaces. There was 25% crossover sign, and a small cam lesion was noted. An MR arthrogram was performed to assess for intra- and extra-articular pathology, due to the patient's symptoms. Figure 33.5a, b depicts coronal and axial T2 fat-saturated weighted MR images. A thin hypointense line lateral to the greater trochanter (GT) represents the ITB, which appears slightly thickened, and surrounding tissue edema and bursitis are also seen; visualization of the ITB is more accurately evidenced in axial images, as they show its proximal to distal trajectory.

After patient failed all conservative management of the external snapping hip related to a contracted ITB, the decision was then made to proceed with surgery.

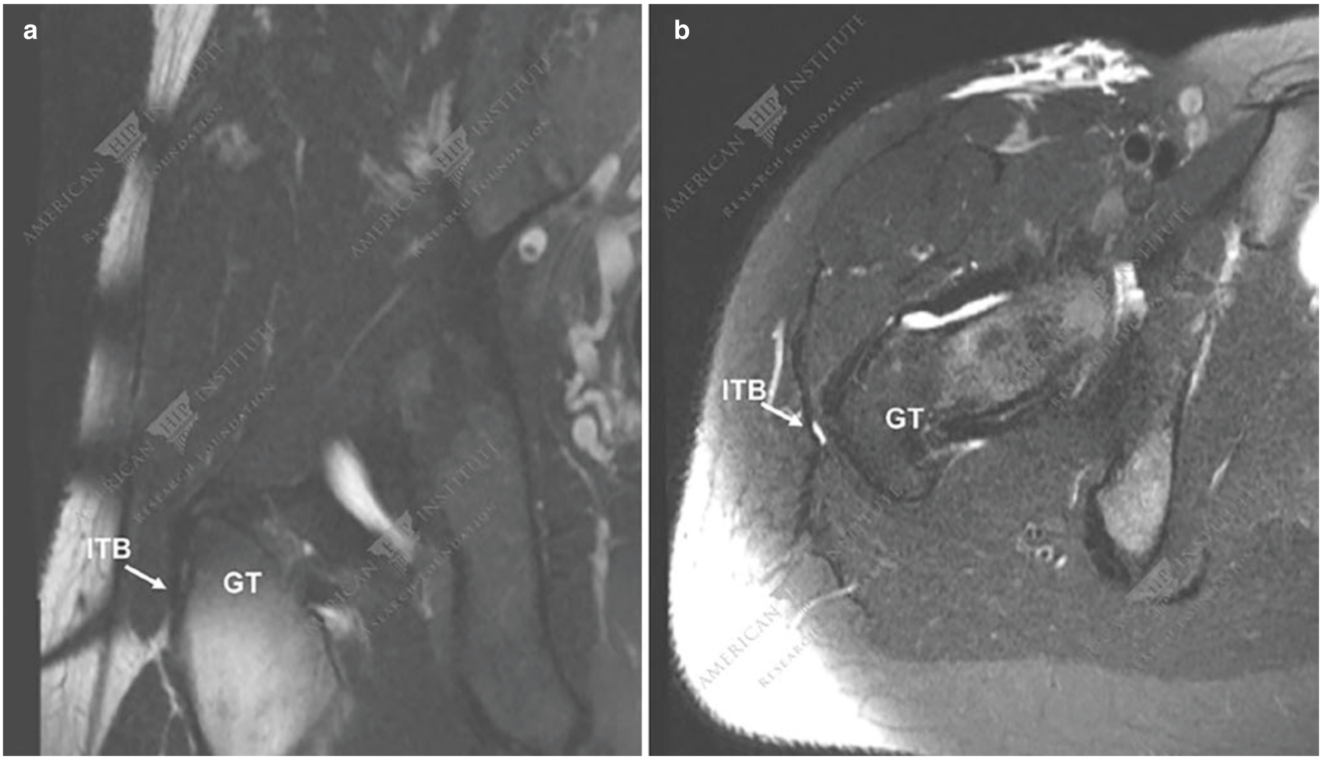


**Fig. 33.5** (**a**) Coronal T2 fat-saturated weighted MRI of a patient presenting with right external snapping hip (GTPS) shows a thin hypointense line lateral to the greater trochanter (GT) which represents the iliotibial band (white arrow). (**b**) A thickened iliotibial band (ITB) with peripheral edema is evidenced in an axial T2 fat-saturated weighted MRI (white arrow)

### 33.8.3 Arthroscopy

The patient was brought to operating room placed in the supine position on a post-less traction table. Traction was applied to the hip under fluoroscopy. Intra-articular diagnostic arthroscopy and intra-articular procedures were completed first. A capsular plication was completed prior to turning attention to the peritrochanteric space.

The arthroscope was placed into the peritrochanteric compartment via a mid-anterior portal and the shaver through the anterolateral portal. Trochanteric bursectomy and debridement were performed. The entire peritrochanteric space was examined, including the gluteus medius and maximus tendon insertions. No abductor pathology could be identified. Next, a radiofrequency wand was used to perform a cross-shaped incision in the IT band in the area overlying the greater trochanter to address the external snapping hip (Figs. 33.6 and 33.7a–b).

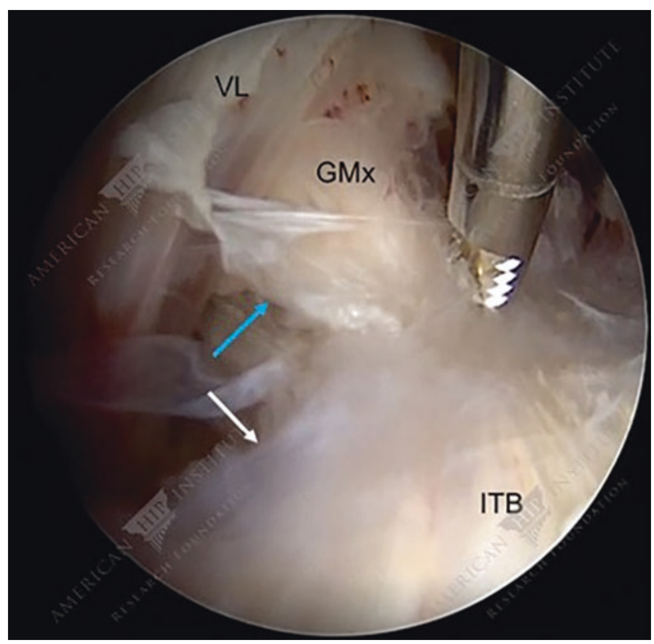


**Fig. 33.6** Peritrochanteric endoscopy of the left hip. The arthroscope is inserted in the distal mid-anterior portal viewing lateral. Note the trochanteric bursa (blue arrow) present during shaver insertion and bursectomy, as well as a thickened iliotibial band (ITB). As the trochanteric bursal tissue is removed, the ITB tendon is identified, as well as the gluteus maximus (GMx) and vastus lateralis (VL)

### 33.8.4 Discussion

External coxa saltans, or external snapping hip, is most commonly due to thickened portions of the posterior ITB or the anterior border of the gluteus maximus sliding over the

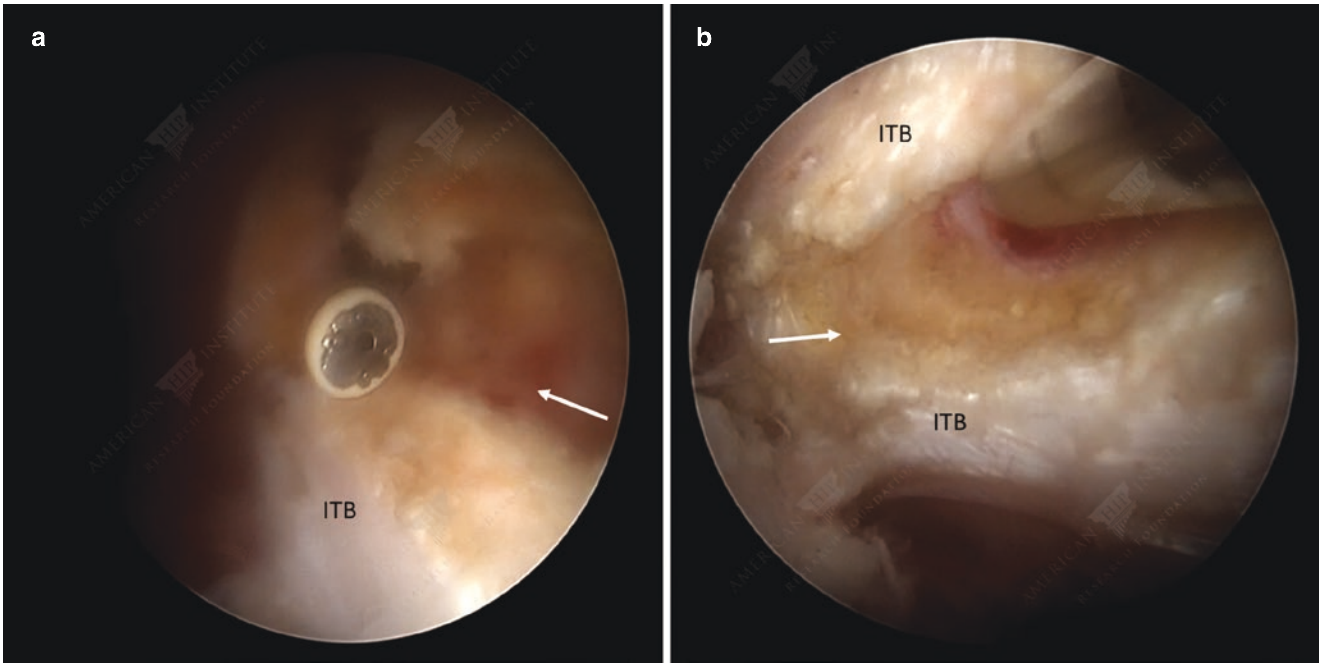


**Fig. 33.7** (**a**, **b**) Peritrochanteric endoscopy of the left hip. The arthroscope is inserted in the distal mid-anterior portal viewing cephalad and lateral. The electrocautery is being used to divide the iliotibial band (ITB) overlying the trochanter (white arrow). A completed iliotibial band release is evident on **b**

greater trochanter [59]. Flexing the hip causes the posterior thickened band to snap anteriorly in relation to the greater trochanter. The main cause for increased tension in the ITB is still unknown as the biomechanical repercussions of its modification [60].

Ilizaliturri et al. were first to describe an all-endoscopic technique in 2006 [61]. The technique consisted in a diamond-shaped partial resection of ITB directly overlying the greater trochanter along with trochanteric bursectomy. Polesello et al. described a technique hypothesizing that endoscopic release of the gluteus maximus tendon (GMT) near its insertion at the linea aspera would have a similar effect on ITB tension and provide similar results [60]. Recent literature has described endoscopic techniques to be efficient treatment of the external snapping hip [62], and patients have presented with improved outcome scores even in the presence of intra-articular pathology [63].

## 33.9 Case 3: Gluteus Medius Tear

### 33.9.1 History/Physical

A 64-year-old female presenting with right hip pain for 2 years with progressive deterioration of symptoms. It is aggravated by bending to and sleeping on the left side as well as prolonged sitting. Patient has consulted several physicians, having been treated with conservative measures, such as physical therapy NSAIDs, as well as pain medication and oral and injected corticosteroids with no relief.

Physical examination reveals a right-sided Trendelenburg gait. Right hip range of motion is 120° of flexion, 20° of internal rotation, 40° of external rotation with pain, and 30° of abduction. She has significant tenderness to palpation over her greater trochanter. There is a positive modified resisted internal rotation test, as well as a resisted abduction. Her strength is 5/5 throughout the right lower extremity with the exception of her abductors, which are 4/5 with pain. Neurovascular exam is intact.

### 33.9.2 Imaging

X-ray views of the right hip were obtained. Joint spaces were intact; however, there is mild osteophyte formation on the lateral aspect of the acetabulum. Greater trochanter exhibits enthesophyte changes. MRI was obtained for suspicion of an abductor tendon tear. Figures 33.8a, b and 33.9a, b depict coronal and axial T2 fat-saturated weighted MRI cuts, respectively. Partial-thickness tears of the gluteus medius (GMd) and gluteus minimus (GMin) are evidenced in Fig. 33.8.

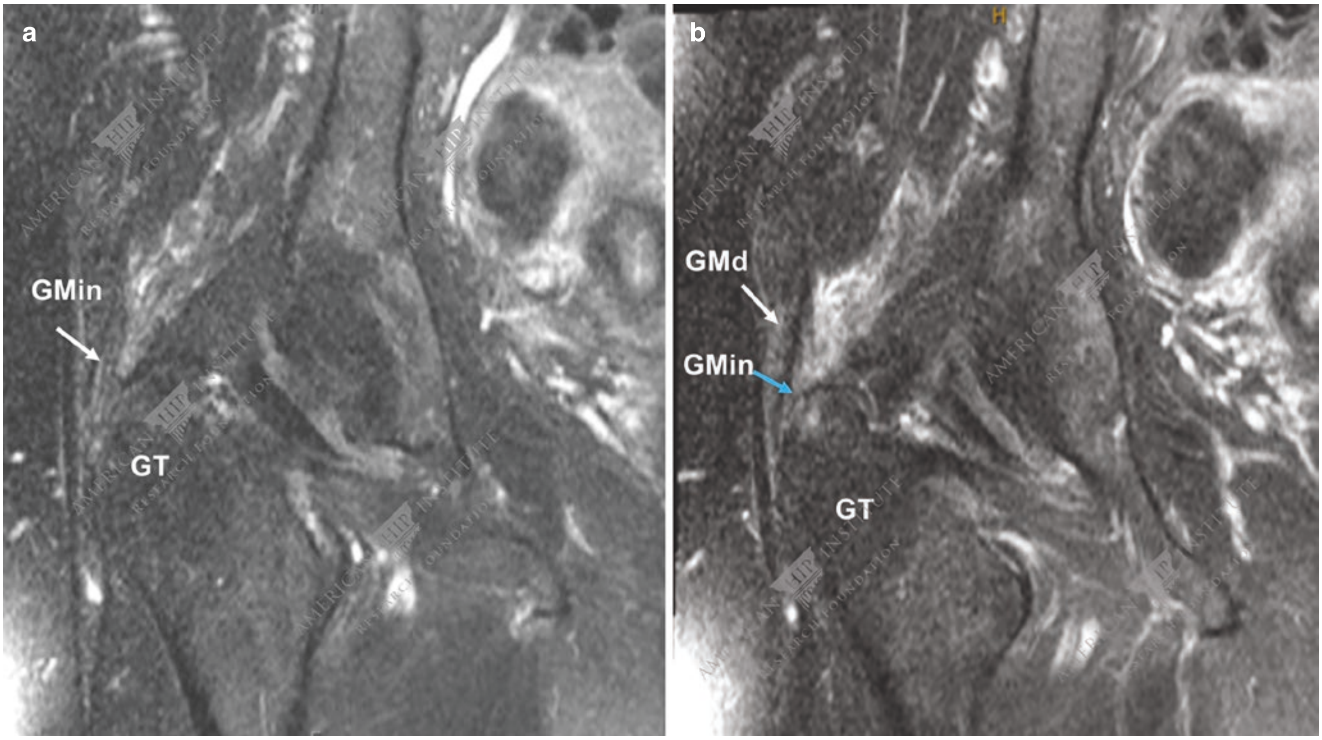


**Fig. 33.8** (**a**) Coronal T2 fat-saturated weighted MRI. A high-grade partial-thickness tear of the gluteus minimus (GMin). (**b**) Coronal T2 fat-saturated weighted MRI. A high-grade partial-thickness tear of the gluteus minimus (GMin) and of the gluteus medius (GMd) tendon from its greater trochanteric (GT) insertion are seen (blue arrow and white arrow, respectively)

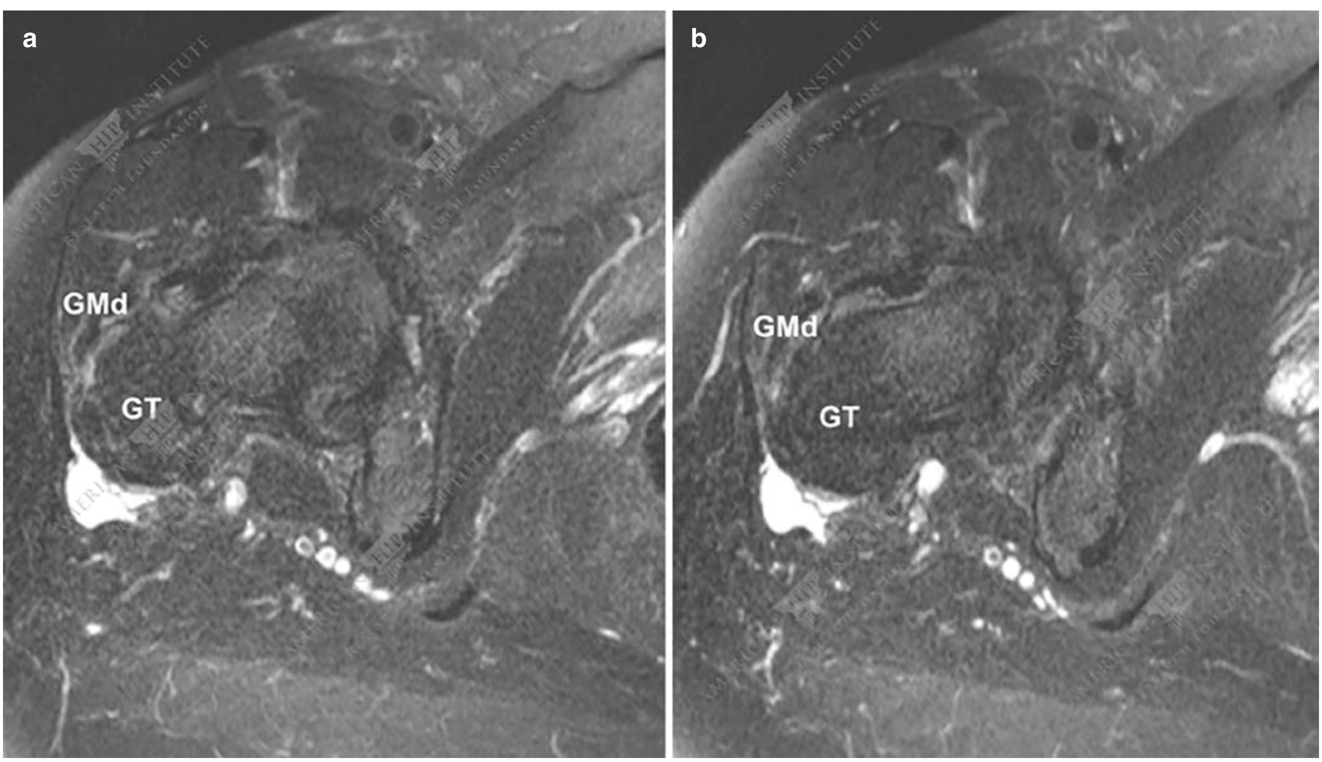


**Fig. 33.9** (**a**, **b**) Axial T2 fat-saturated weighted MRI. Increased signal intensity lateral to the greater trochanter can be attributed to tearing/tendinosis of the gluteus medius (GMd) tendon at its insertion as well as trochanteric bursitis

### 33.9.3 Arthroscopy

The patient continued to have debilitating pain despite conservative management of her abductor tendon tears; therefore, surgical treatment was decided with left hip peritrochanteric endoscopy with gluteus medius repair and trochanteric bursectomy.

Positioning, setup, and portal placement were performed in a similar fashion as the previously described. The peritrochanteric space was then entered, and trochanteric bursectomy and debridement were carried out in a similar fashion with the arthroscope in the mid-anterior portal and shaver in the anterolateral portal. Examination of the gluteus medius tendon insertion confirmed a full-thickness tear (Fig. 33.10). In preparation for reinsertion, the lateral facet of the greater trochanter was decorticated to create a bleeding bed of bone for healing using the burr.

To complete the repair, two knotless anchors were placed in the lateral facet, under fluoroscopy, and two horizontal mattress sutures were passed, with one limb of each suture through the anterior part of the tendon and one limb of each suture through the posterior part of the tendon (Fig. 33.11). The sutures were then cinched down, achieving closure of the tendon over the lateral facet (Fig. 33.12).

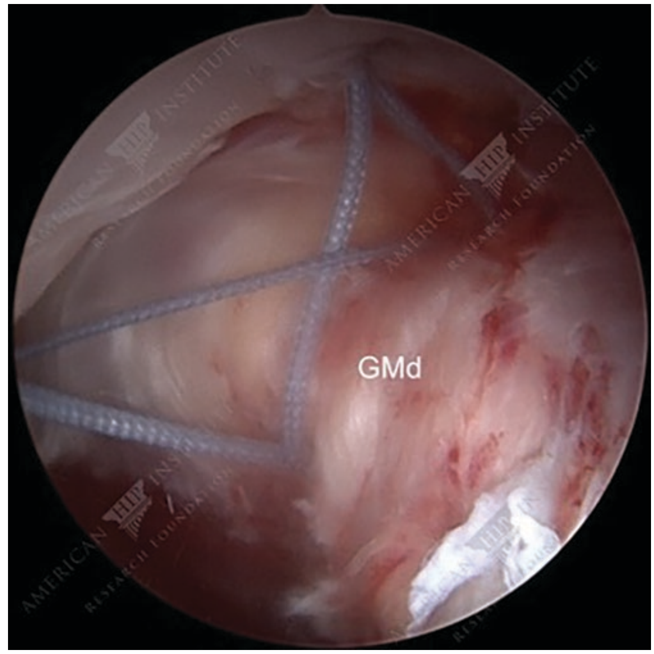


**Fig. 33.11** Left hip peritrochanteric endoscopy viewing cephalad and medial from the distal mid-anterior portal after insertion of two knotless suture anchors and suture passage. Gluteus medius tendon (GMd)

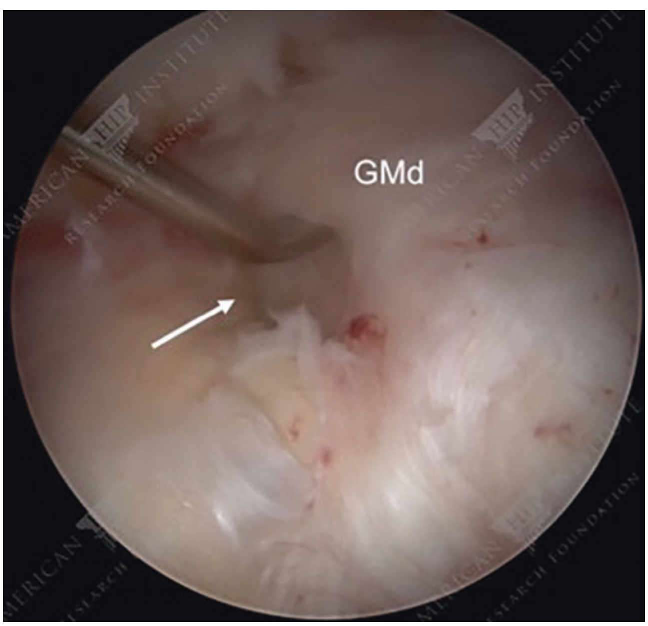


**Fig. 33.10** Left hip peritrochanteric endoscopy viewing cephalad and medial from the distal mid-anterior portal. The gluteus medius muscle and tendon (GMd) are visible. Note the full-thickness tear (*arrow*) involving the gluteus medius tendon, which is being elevated with the use of a probe

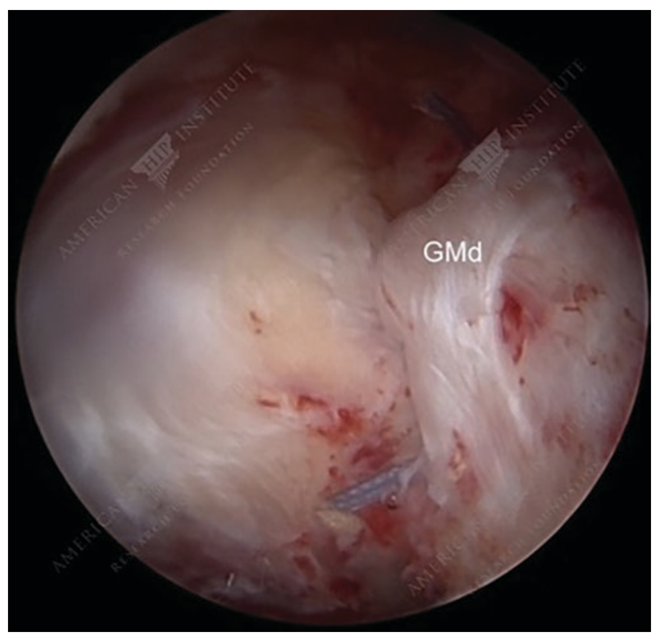


**Fig. 33.12** Left hip peritrochanteric endoscopy viewing cephalad and medial from the distal mid-anterior portal after knot-less suture anchors are tied, approximating the gluteus medius tendon (GMd) to the trochanter

### 33.9.4 Discussion

Initially considered a rare pathology, the current general appreciation, through research and imaging technology advancement, is that abductor tears are common pain generators around the hip joint and should be assessed routinely. The natural history of the tear and imaging findings have been described, as tear seems to happen through a degenerative process beginning with bursitis, leading to tendinopathy, partial thickness tears, and finally full-thickness tears. When the tear is fully completed, the tendon retracts, and atrophy and fatty infiltration are found [64]. The gluteus medius inserts to the greater trochanter in two different sites: a superoposterior facet and a lateral facet [16]. Tears commonly occur from the lateral facet and progressively lead to a full tear propagating posteriorly [65].

Short- and mid-term patient-reported outcome studies have demonstrated the effectiveness and safety of the endoscopic technique in the treatment of gluteus medius tears, as well as favorable patient-reported outcomes [65, 66]. Endoscopic repairs have shown similar benefits as open repairs in outcomes scores, pain scores, and improvement in abduction strength; moreover, they have shown lower complication rates than the open technique [67]. Patients over 50 years old with tears have similar return to activity rates in endoscopic and open repairs [68]; and endoscopic repairs seem to benefit both men and women after surgical treatment [69].

### 33.9.5 Conclusion

GTPS is a common cause of hip pain. Adequate treatment of this pathology is dependent on the correct diagnosis, including careful history, physical exam, and appropriate imaging. Conservative management is the first line of treatment and in most cases will provide relief. In cases with recalcitrant pain, endoscopic surgery has proven a safe and effective method of treatment.

## References


1. Karpinski M, Piggott H. Greater trochanteric pain syndrome. A report of 15 cases. J Bone Joint Surg. 1985;67-B:762–3.
2. Anderson TP. Trochanteric bursitis: diagnostic criteria and clinical significance. Arch Phys Med Rehabil. 1958;39:617–22.
3. Gordon EJ. Trochanteric bursitis and tendinitis. Clin Orthop Relat Res. 1961;20:193–202.
4. Bird PA, Oakley SP, Shnier R, Kirkham BW. Prospective evaluation of magnetic resonance imaging and physical examination findings in patients with greater trochanteric pain syndrome. Arthritis Rheum. 2001;44:2138–45.
5. Voos JE, Rudzki JR, Shindle MK, Martin H, Kelly BT. Arthroscopic anatomy and surgical techniques for peritrochanteric space disorders in the hip. Arthroscopy. 2007;23:1246.e1–5.
6. Kagan A. Rotator cuff tears of the hip. Clin Orthop Relat Res. 1999;(368):135–40.
7. Kingzett-Taylor A, Tirman PF, Feller J, McGann W, Prieto V, Wischer T, Cameron JA, Cvitanic O, Genant HK. Tendinosis and tears of gluteus medius and minimus muscles as a cause of hip pain: MR imaging findings. Am J Roentgenol. 1999;173:1123–6.
8. Lall AC, Schwarzman GR, Battaglia MR, Chen SL, Maldonado DR, Domb BG. Greater trochanteric pain syndrome: an intraoperative endoscopic classification system with pearls to surgical techniques and rehabilitation protocols. Arthrosc Tech. 2019;8:e889–903.
9. Williams BS, Cohen SP. Greater trochanteric pain syndrome: a review of anatomy, diagnosis and treatment. Anesth Analg. 2009;108:1662–70.
10. Segal NA, Felson DT, Torner JC, Zhu Y, Curtis JR, Niu J, Nevitt MC, Multicenter Osteoarthritis Study Group. Greater trochanteric pain syndrome: epidemiology and associated factors. Arch Phys Med Rehabil. 2007;88:988–92.
11. Lievense A, Bierma-Zeinstra S, Schouten B, Bohnen A, Verhaar J, Koes B. Prognosis of trochanteric pain in primary care. Br J Gen Pract. 2005;55:199–204.
12. Fearon AM, Scarvell JM, Neeman T, Cook JL, Cormick W, Smith PN. Greater trochanteric pain syndrome: defining the clinical syndrome. Br J Sports Med. 2013;47:649–53.
13. Tan LA, Benkli B, Tuchman A, Li XJ, Desai NN, Bottiglieri TS, Pavel J, Lenke LG, Lehman RA. High prevalence of greater trochanteric pain syndrome among patients presenting to spine clinic for evaluation of degenerative lumbar pathologies. J Clin Neurosci. 2018;53:89–91.
14. Collèe G, Dijkmans BAC, Vandenbroucke JP, Rozing PM, Cats A. A clinical epidemic-logical study in low back pain. Description of two clinical syndromes. Rheumatology. 1990;29:354–7.
15. Long SS, Surrey DE, Nazarian LN. Sonography of greater trochanteric pain syndrome and the rarity of primary bursitis. Am J Roentgenol. 2013;201:1083–6.
16. Robertson WJ, Gardner MJ, Barker JU, Boraiah S, Lorich DG, Kelly BT. Anatomy and dimensions of the gluteus medius tendon insertion. Arthroscopy. 2008;24:130–6.
17. Pfirrmann CWA, Chung CB, Theumann NH, Trudell DJ, Resnick D. Greater trochanter of the hip: attachment of the abductor mechanism and a complex of three bursae—MR imaging and MR bursography in cadavers and MR imaging in asymptomatic volunteers. Radiology. 2001;221:469–77.
18. Bogunovic L, Lee SX, Haro MS, Frank JM, Mather RC, Bush-Joseph CA, Nho SJ. Application of the Goutallier/Fuchs rotator cuff classification to the evaluation of hip abductor tendon tears and the clinical correlation with outcome after repair. Arthroscopy. 2015;31:2145–51.
19. Bunker TD, Esler CN, Leach WJ. Rotator-cuff tear of the hip. J Bone Joint Surg Br. 1997;79:618–20.
20. Redmond JM, Chen AW, Domb BG. Greater trochanteric pain syndrome. J Am Acad Orthop Surg. 2016;24:231–40.
21. Lachiewicz PF. Abductor tendon tears of the hip: evaluation and management. J Am Acad Orthop Surg. 2011;19:385–91.
22. Domb BG, Nasser RM, Botser IB. Partial-thickness tears of the gluteus medius: rationale and technique for trans-tendinous endoscopic repair. Arthroscopy. 2010;26:1697–705.
23. McConnell T, Tornetta PI, Benson E, Manuel J. Gluteus medius tendon injury during reaming for gamma nail insertion. Clin Orthop Relat Res. 2003;407:199–202.
24. Haraldsson BT, Langberg H, Aagaard P, Zuurmond A-M, van El B, DeGroot J, Kjær M, Magnusson SP. Corticosteroids reduce the tensile strength of isolated collagen fascicles. Am J Sports Med. 2006;34:1992–7.
25. Domb BG, Brooks AG, Byrd JW. Clinical examination of the hip joint in athletes. J Sport Rehabil. 2009;18:3–23.

26. Walker-Santiago R, Ortiz-Declet V, Maldonado DR, Wojnowski NM, Domb BG. The modified resisted internal rotation test for detection of gluteal tendon tears. Arthrosc Tech. 2019;8:e331–4.
27. Lequesne M, Mathieu P, Vuillemin-Bodaghi V, Bard H, Djian P. Gluteal tendinopathy in refractory greater trochanter pain syndrome: diagnostic value of two clinical tests. Arthritis Rheum. 2008;59:241–6.
28. Tibor LM, Sekiya JK. Differential diagnosis of pain around the hip joint. Arthroscopy. 2008;24:1407–21.
29. Sutter R, Kalberer F, Binkert CA, Graf N, Pfirrmann CWA, Gutzeit A. Abductor tendon tears are associated with hypertrophy of the tensor fasciae latae muscle. Skelet Radiol. 2013;42:627–33.
30. Cvitanic O, Henzie G, Skezas N, Lyons J, Minter J. MRI diagnosis of tears of the hip abductor tendons (gluteus medius and gluteus minimus). Am J Roentgenol. 2004;182:137–43.
31. White LM, Oar DA, Naraghi AM, Griffin A, Safir OA. Gluteus minimus tendon: MR imaging features and patterns of tendon tearing. Skelet Radiol. 2021;50(10):2013–21. https://doi.org/10.1007/s00256-021-03745-4.
32. Belzunce MA, Henckel J, Fotiadou A, Di Laura A, Hart A. Automated measurement of fat infiltration in the hip abductors from Dixon magnetic resonance imaging. Magn Reson Imaging. 2020;72:61–70.
33. Steinert L, Zanetti M, Hodler J, Pfirrmann CWA, Dora C, Saupe N. Are radiographic trochanteric surface irregularities associated with abductor tendon abnormalities? Radiology. 2010;257:754–63.
34. Rosinsky PJ, Yelton MJ, Ankem HK, Meghpara MB, Maldonado DR, Shapira J, Yelton BR, Lall AC, Domb BG. Pertrochanteric calcifications in patients with greater trochanteric pain syndrome: description, prevalence, and correlation with intraoperatively diagnosed hip abductor tendon injuries. Am J Sports Med. 2021;49(7):1759–68.
35. Westacott DJ, Minns JI, Foguet P. The diagnostic accuracy of magnetic resonance imaging and ultrasonography in gluteal tendon tears--a systematic review. Hip Int. 2011;21:637–45.
36. McMahon S, Fleury J. External validity of physical activity interventions for community-dwelling older adults with fall risk: a quantitative systematic literature review. J Adv Nurs. 2012;68:2140–54.
37. Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC. Fatty muscle degeneration in cuff ruptures. Pre- and postoperative evaluation by CT scan. Clin Orthop Relat Res. 1994;(304):78–83.
38. Fuchs B, Weishaupt D, Zanetti M, Hodler J, Gerber C. Fatty degeneration of the muscles of the rotator cuff: assessment by computed tomography versus magnetic resonance imaging. J Shoulder Elb Surg. 1999;8:599–605.
39. Krishnamoorthy VP, Kunze KN, Beck EC, Cancienne JM, O'Keefe LS, Ayeni OR, Nho SJ. Radiographic prevalence of symphysis pubis abnormalities and clinical outcomes in patients with femoroacetabular impingement syndrome. Am J Sports Med. 2019;47:1467–72.
40. Khoury AN, Brooke K, Helal A, Bishop B, Erickson L, Palmer IJ, Martin HD. Proximal iliotibial band thickness as a cause for recalcitrant greater trochanteric pain syndrome. J Hip Preserv Surg. 2018;5:296–300.
41. Lustenberger DP, Ng VY, Best TM, Ellis TJ. Efficacy of treatment of trochanteric bursitis: a systematic review. Clin J Sport Med. 2011;21:447–53.
42. Furia JP, Rompe JD, Maffulli N. Low-energy extracorporeal shock wave therapy as a treatment for greater trochanteric pain syndrome. Am J Sports Med. 2009;37:1806–13.
43. Mallow M, Nazarian LN. Greater trochanteric pain syndrome diagnosis and treatment. Phys Med Rehabil Clin N Am. 2014;25:279–89.
44. Cohen SP, Strassels SA, Foster L, Marvel J, Williams K, Crooks M, Gross A, Kurihara C, Nguyen C, Williams N. Comparison of fluoroscopically guided and blind corticosteroid injections for greater trochanteric pain syndrome: multicentre randomised controlled trial. BMJ. 2009;338:b1088.
45. McEvoy JR, Lee KS, Blankenbaker DG, del Rio AM, Keene JS. Ultrasound-guided corticosteroid injections for treatment of greater trochanteric pain syndrome: greater trochanter bursa versus subgluteus medius bursa. AJR Am J Roentgenol. 2013;201:W313–7.
46. Labrosse JM, Cardinal E, Leduc BE, Duranceau J, Rémillard J, Bureau NJ, Belblidia A, Brassard P. Effectiveness of ultrasound-guided corticosteroid injection for the treatment of gluteus medius tendinopathy. AJR Am J Roentgenol. 2010;194:202–6.
47. Walker-Santiago R, Wojnowski NM, Lall AC, Maldonado DR, Rabe SM, Domb BG. Platelet-rich plasma versus surgery for the management of recalcitrant greater trochanteric pain syndrome: a systematic review. Arthroscopy. 2020;36:875–88.
48. Mani-Babu S, Morrissey D, Waugh C, Screen H, Barton C. The effectiveness of extracorporeal shock wave therapy in lower limb tendinopathy: a systematic review. Am J Sports Med. 2015;43:752–61.
49. Rompe JD, Segal NA, Cacchio A, Furia JP, Morral A, Maffulli N. Home training, local corticosteroid injection, or radial shock wave therapy for greater trochanter pain syndrome. Am J Sports Med. 2009;37:1981–90.
50. Alpaugh K, Chilelli BJ, Xu S, Martin SD. Outcomes after primary open or endoscopic abductor tendon repair in the hip: a systematic review of the literature. Arthroscopy. 2015;31:530–40.
51. Burman MS. Arthroscopy or the direct visualization of joints. J Bone Joint Surg Am. 1931;13:669–95.
52. Byrd JW. Hip arthroscopy utilizing the supine position. Arthroscopy. 1994;10:275–80.
53. Glick JM, Sampson TG, Gordon RB, Behr JT, Schmidt E. Hip arthroscopy by the lateral approach. Arthroscopy. 1987;3:4–12.
54. Strauss EJ, Nho SJ, Kelly BT. Greater trochanteric pain syndrome. Sports Med Arthrosc Rev. 2010;18:113–9.
55. Maldonado DR, Chen JW, Walker-Santiago R, Rosinsky PJ, Shapira J, Lall AC, Domb BG. Forget the greater trochanter! Hip joint access with the 12 o'clock portal in hip arthroscopy. Arthrosc Tech. 2019;8:e575–84.
56. Baker CL, Massie RV, Hurt WG, Savory CG. Arthroscopic bursectomy for recalcitrant trochanteric bursitis. Arthroscopy. 2007;23:827–32.
57. Farr D, Selesnick H, Janecki C, Cordas D. Arthroscopic bursectomy with concomitant iliotibial band release for the treatment of recalcitrant trochanteric bursitis. Arthroscopy. 2007;23:905.e1–5.
58. Fox JL. The role of arthroscopic bursectomy in the treatment of trochanteric bursitis. Arthroscopy. 2002;18:1–4.
59. Allen W, Cope R. Coxa saltans: the snapping hip revisited. J Am Acad Orthop Surg. 1995;3:303–8.
60. Polesello GC, Queiroz MC, Domb BG, Ono NK, Honda EK. Surgical technique: endoscopic gluteus maximus tendon release for external snapping hip syndrome. Clin Orthop Relat Res. 2013;471:2471–6.
61. Ilizaliturri VM, Martinez-Escalante FA, Chaidez PA, Camacho-Galindo J. Endoscopic iliotibial band release for external snapping hip syndrome. Arthroscopy. 2006;22:505–10.
62. Pierce TP, Kurowicki J, Issa K, Festa A, Scillia AJ, McInerney VK. External snapping hip: a systematic review of outcomes following surgical intervention: external snapping hip systematic review. Hip Int. 2018;28:468–72.
63. Zhang S, Dong C, Li Z, Wang Z, Wei M, Tong P, Li C. Endoscopic iliotibial band release during hip arthroscopy for femoroacetabular impingement syndrome and external snapping hip had better patient-reported outcomes: a retrospective comparative study. Arthroscopy. 2021;37(6):1845–52. https://doi.org/10.1016/j.arthro.2021.01.040.
64. Dwek J, Pfirrmann C, Stanley A, Pathria M, Chung CB. MR imaging of the hip abductors: normal anatomy and commonly encountered pathology at the greater trochanter. Magn Reson Imaging Clin N Am. 2005;13:691–704.

65. Perets I, Mansor Y, Yuen LC, Chen AW, Chaharbakhshi EO, Domb BG. Endoscopic gluteus medius repair with concomitant arthroscopy for labral tears: a case series with minimum 5-year outcomes. Arthroscopy. 2017;33:2159–67.
66. Chandrasekaran S, Gui C, Hutchinson MR, Lodhia P, Suarez-Ahedo C, Domb BG. Outcomes of endoscopic gluteus medius repair: study of thirty-four patients with minimum two-year follow-up. J Bone Joint Surg Am. 2015;97:1340–7.
67. Chandrasekaran S, Lodhia P, Gui C, Vemula SP, Martin TJ, Domb BG. Outcomes of open versus endoscopic repair of abductor muscle tears of the hip: a systematic review. Arthroscopy. 2015;31:2057–2067.e2.
68. Meghpara MB, Yelton MJ, Annin S, Rosinsky PJ, Shapira J, Maldonado DR, Lall AC, Domb BG. Return to activity after gluteus medius repair in active patients older than 50 years. Orthop J Sports Med. 2021;9:2325967120967968.
69. Meghpara MB, Bheem R, Haden M, Rosinsky PJ, Shapira J, Maldonado DR, Lall AC, Domb BG. Differences in clinical presentations and surgical outcomes of gluteus medius tears between men and women. Am J Sports Med. 2020; https://doi.org/10.1177/0363546520966335.