Chapter 19
Anterior Knee Pain: Diagnosis and Treatment

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Abbreviations

AMZ	Anteromedialization
CT	Computed tomography
MCL	Medial collateral ligament
MRI	Magnetic resonance imaging
NSAID	Nonsteroidal anti-inflammatory drug
PFPS	Patellofemoral pain syndrome
TT-TG	Tibial tubercle-trochlear groove distance

Introduction

Anterior knee pain is a common and challenging complaint. The differential diagnosis is broad, and making a diagnosis can be difficult due to vague physical manifestations and psychosocial contextual overlap, which may skew the patient's symptoms and perception of pain. There are numerous discrete entities that can contribute to anterior knee pain; therefore, a thorough history and focused physical examination is essential. This chapter outlines the most common causes of anterior knee pain including patellofemoral pain syndrome (PFPS), patellar tendinopathy, quadriceps tendinopathy, and pes anserine bursitis. The relevant structures are shown in Fig. 19.1.

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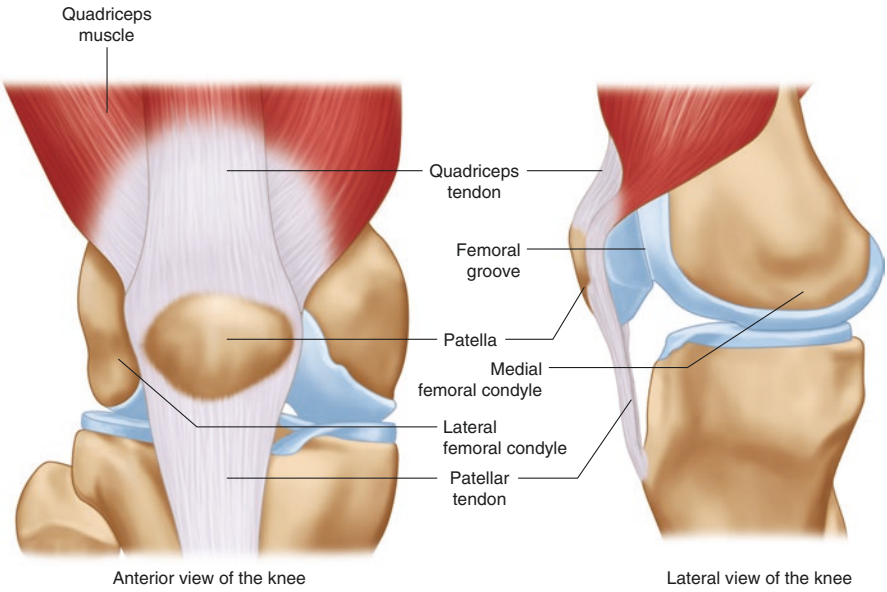

Fig. 19.1 Anatomy of the anterior aspect of the knee

Patellofemoral Pain Syndrome

Epidemiology

The etiology of anterior knee pain can be confusing as many terms are often used interchangeably to describe pain associated with patellofemoral symptoms. In general, patellofemoral symptoms reflect pain or instability, with some overlap between the two. Patellofemoral pain syndrome (PFPS) is generally classified as anterior or peri-patellar knee pain that occurs with activities that load the patellofemoral articulation, such as ascending or descending stairs. Patellar instability with true subluxation or dislocation is an entirely different entity with a completely separate treatment algorithm. PFPS is more common in females and often follows a change in levels of activity, such as an increase in running mileage or adding squats and lunges to a gym workout routine. Some studies have suggested that nearly 15–40% of patients presenting to the sports medicine physician have PFPS; however, there remains little consensus on its etiology or the factors responsible for causing pain.

Clinical Presentation

The patient presenting to the physician with PFPS will often complain of achy pain along the anterior aspect of the knee with associated pain in the peri-patellar region or directly behind the patella (Fig. 19.1). These symptoms are worsened by

activities that require deep or prolonged knee flexion such as jumping, stair climbing, running, or sitting for an extended period of time. Patients may report vague pain with activity and occasional sharp or shooting pain around the anterior aspect of the knee or may complain that their knee feels like it will "buckle" or "give way."

True patellar instability indicates that the patella has come out of the trochlear groove. This is usually a traumatic event or can occur in someone with significant patellar laxity. In PFPS, a "buckling" or "giving way" sensation may be secondary to quadriceps inhibition and proximal muscle weakness. Patients may perceive instability; the evaluation needs to distinguish frank dislocation versus quadriceps inhibition/weakness pain resulting in knee "buckling" or "giving way." The patient may also complain of patellar crepitance or grinding without pain.

Important questions to ask include the onset of symptoms in relation to a change in exercise routine or trauma. Sharp, painful catching, locking, and recurrent effusions are red flags that should alert the physician that further diagnostic imaging and a referral to an orthopedist may be necessary. In particular, a knee effusion can suggest a full-thickness cartilage defect, causing symptoms. A prepatellar effusion would suggest prepatellar bursitis (septic or aseptic).

Physical examination may demonstrate pain on palpation of the peri-patellar tissues and retinaculum. Patellar mobilization in the medial-lateral and proximal-distal direction can be tested as well as an assessment of patellar tilt and tracking throughout the patient's range of motion. The examiner should note any direction of increased laxity, tightness, or apprehension on the part of the patient. The presence of a "J-sign," which is a lateral deviation of the patella as the knee is brought from flexion to terminal extension, can signal an imbalance between the medial (vastus medialis) and lateral (vastus lateralis) muscles.

Strength testing is a critical part of the clinical evaluation as muscular weakness and imbalance can lead to disrupted patellofemoral mechanics. The examiner should assess not only quadriceps strength but also hip flexor, hip abductor, as well as abdominal and lumbar core muscles. Weakness of the hip and core muscles can disrupt coronal plane mechanics leading to dynamic patellar mal-tracking.

Differential Diagnosis and Testing

Patellofemoral pain syndrome is a clinical diagnosis; there is no single imaging test or physical exam that establishes the diagnosis with certainty. As such, the clinician should rule out other causes of knee pain including patellar instability, patellar tendon or quadriceps tendon pathology, prepatellar bursitis, chondral pathology, meniscus tear, loose bodies, osteoarthritis, radicular pain, or a systemic cause that may portend a poor outcome if not treated. The clinician should be wary of a diagnosis other than PFPS in a patient with knee pain and persistent painful mechanical symptoms or evidence of an effusion (Table 19.1).

For most patients presenting with anterior knee pain, the best imaging studies to obtain initially are weight-bearing plain radiographs including an AP, PA flexion,

Table 19.1 Differential diagnosis of anterior knee pain

Diagnosis	Presentation	Diagnostic testing	Conservative management	Indications for surgery	Operative management
Patellofemoral Pain Syndrome	– Peri-patellar pain – Positive "J-sign" – Decreased strength of hip flexors/abductors/ quadriceps	– Clinical diagnosis is often adequate – Plain radiographs to evaluate alignment and dysplasia – MRI to evaluate cartilage	– Physical therapy (strengthening hip/thigh musculature) – Ice and anti-inflammatories	– Persistent pain after conservative management	– Knee arthroscopy with debridement for cartilage abnormalities – Tibial tubercle osteotomy for patella maltracking
Patellar Tendonitis	– Tenderness over inferior pole of patella – Tenderness along patellar tendon – Positive "Bassett's sign"	– Clinical diagnosis is often adequate – MRI to confirm diagnosis	– Physical therapy (eccentric exercises, iontophoresis) – Ice and anti-inflammatories – activity modification	– Persistent pain after conservative management	– Tendon debridement with or without microfracture/ drilling
Quadriceps Tendonitis	– Tenderness over superior pole of patella	– Clinical diagnosis is often adequate – MRI to confirm diagnosis	– Physical therapy (eccentric exercises) – Ice and anti-inflammatories – Activity modification	– Persistent pain after conservative management	– Tendon debridement with or without microfracture/ drilling

Pes Anserine Bursitis	– Tenderness and local selling 5 cm below anterior-medial joint line	– Clinical diagnosis is often adequate	– Physical therapy – Ice and anti-inflammatories – Activity modification – Injection	– Persistent pain after conservative management	– Drainage/ removal of bursa
Meniscus Tear	– Joint line tenderness (medial/lateral) – Effusion – Positive McMurray's (see Chap. 18) – Pain with deep squat	– MRI to confirm diagnosis	– Physical therapy – Ice and anti-inflammatories – Activity modification – Injection	– "Locked knee" – Persistent pain after conservative management	– Knee arthroscopy with partial meniscectomy or meniscal repair if indicated
Osteoarthritis	– Pain – Stiffness – Possible effusion	– Plain radiographs will show joint space narrowing/osteophytes/sclerosis/ subchondral cysts	– Physical therapy – Weight loss – Ice and anti-inflammatories – Activity modification – Injection (corticosteroid) – Visco-supplementation	– Persistent pain after conservative management	– Total knee arthroplasty

(continued)

Table 19.1 (continued)

Diagnosis	Presentation	Diagnostic testing	Conservative management	Indications for surgery	Operative management
Fracture	– Tenderness – Possible effusion	– Presence on plain radiographs/MRI/CT scan	– Non-weight-bearing with crutches – Activity modification	– Displacement – Fracture not healing	– Open reduction, internal fixation
Patellar/ Quadriceps Tendon Rupture	– Palpable defect – Effusion – Unable to perform straight leg raise	– Clinical diagnosis is often adequate – Plain radiographs will show patella alta/baja – MRI to confirm diagnosis	– Surgical intervention is indicated unless risks outweigh benefits	– Full thickness tendon rupture	– Patellar/ quadriceps tendon repair
MCL sprain/tear	– Tenderness over MCL – Pain/laxity with valgus stress – Effusion	– Clinical diagnosis is often adequate – MRI to confirm diagnosis	– Physical therapy – Knee brace – Ice and anti-inflammatories – Activity modification	– Knee instability/ laxity-full thickness tear	– MCL repair versus reconstruction

MRI magnetic resonance imaging, *CT* computed tomography, *MCL* medial collateral ligament

30° flexed lateral, and bilateral Merchant view. The weight-bearing AP and PA flexion views allow for the assessment of osteochondral lesions and arthritic change in the medial and lateral tibiofemoral compartments. The lateral X-ray can provide important information similar to the coronal views as well as an assessment of patellar height and the presence of trochlear dysplasia. Bilateral Merchant views allow for an evaluation of the patellofemoral joint including alignment, patellar tilt, and the presence of arthritis (Fig. 19.2).

Advanced imaging such as computed tomography (CT) and magnetic resonance imaging (MRI) is indicated in patients with PFPS who fail 3–6 months of conservative management. CT is useful for evaluating for any bony pathology as well as patellar height and the tibial tubercle-trochlear groove distance (TT-TG). The TT-TG is a measurement of the distance between the tibial tubercle and the deepest part of the trochlear groove. In patients with a TT-TG of 20 mm or greater, the tibial tubercle is too lateral, and the resultant vector of pull of the extensor mechanism results in mal-tracking of the patella. MRI can also be used to quantify TT-TG distance. Additionally, MRI is valuable for assessing the chondral surfaces and subchondral bone for cartilage abnormalities or evidence of arthritic changes. Both MRI and CT are good studies for analyzing trochlear morphology and dysplasia.

Non-operative Management

The majority of patients presenting with PFPS will improve with a comprehensive rehabilitation management strategy including nonsteroidal anti-inflammatories, ice, and physical therapy. Studies have demonstrated that 85% of patients improve with 8 weeks of appropriate physical therapy. The physician must be knowledgeable as to the correct protocols for PFPS rehabilitation as physical therapists differ considerably in the exercises they recommend. Initially, rehabilitation should consist of tactics aimed at reducing symptoms including activity modifications and modalities to improve flexibility and patellar tracking. The restoration of normal knee mechanics with capsular stretching and vastus medialis strengthening has long been the primary focus of rehab protocols in the treatment of patients with PFPS. As our knowledge of normal knee kinematics has evolved, the hip and core (abdominal/lumbar) musculature has emerged as another important aspect of treatment. Improving not only the strength but also the endurance of the hip and core muscles has been shown to better maintain the kinematics of the extensor mechanism.

Indications for Surgery and Operative Management

Surgical intervention for treatment of PFPS is rarely indicated, as most patients improve with conservative management. Accurate diagnosis is necessary for surgery to be successful. Cartilage injury on the underside of the patella or in the

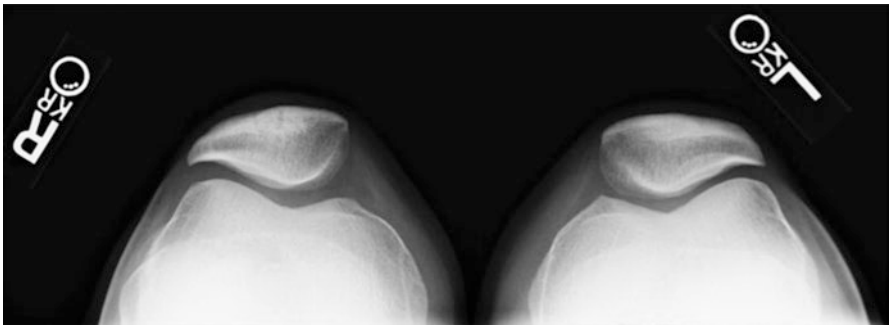

Fig. 19.2 Bilateral Merchant (sunrise) radiographic views of the knees

trochlear groove can often be treated with arthroscopic debridement. Should the patient fail or plateau after several months of dedicated rehab and exhibit evidence of mal-tracking, imaging studies should be performed to assess TT-TG distance and patellar height. Patients with evidence of lateral mal-tracking on exam with TT-TG distance greater than 20 mm are candidates for anteromedialization (AMZ) of the tibial tubercle combined with a possible proximal realignment procedure such as a lateral release or lengthening. In the past, many patients with lateral mal-tracking were treated with an isolated lateral release. This has fallen out of favor as many patients treated with a lateral release continued to have persistent pain and even developed iatrogenic medial instability. Current surgical treatment for lateral mal-tracking of the patella includes a tibial tubercle osteotomy, with or without a lateral release or lateral lengthening and vastus medialis advancement—depending on glide and tilt—performed through a single anterior incision. Using a saw, the tubercle is cut in the coronal plane in an oblique manner from an anteromedial to posterolateral direction. An oblique cut in this manner will allow for anteriorization with medialization of the tubercle. The cut tubercle is usually secured using two screws (Fig. 19.3). Typical medialization is approximately 10–15 mm with subsequent anteriorization of 10–15 mm depending on the angle of the osteotomy. This surgery requires a long postoperative rehabilitation. The patients are kept partial weight-bearing with crutches until there is healing at the osteotomy site which can take 6–8 weeks. Return to sports or athletic activities takes a minimum of 6 months.

Expected Outcomes

With some time and effort, 85–90% of patients with anterior knee pain secondary to PFPS will improve with conservative management. With better flexibility and strengthening of the hip and thigh musculature, improved load transfer and knee kinematics will result in enhanced functional capacity and a decrease in symptoms. In patients who have persistent pain and evidence of mal-tracking, an AMZ tibial tubercle osteotomy can provide significant symptomatic relief as this sufficiently

Fig. 19.3 Tibial tubercle transfer secured with two screws

unloads the affected area and improves tracking. The use of an AMZ to treat chondromalacia of the lateral facet and inferior pole has also been met with good to excellent results in the majority of patients.

Patellar Tendinopathy

Epidemiology

Patellar tendinopathy is a common cause of anterior knee pain especially in the younger population. It is also referred to as "jumper's knee," since it is most common in athletes that participate in jumping sports, such as basketball and volleyball. However, patellar tendinopathy may be caused by any sport or activity that places repetitive load on the patellar tendon, such as football. It is most frequently diagnosed in athletes from ages 15 to 30 years and is more common in men than women. The onset of pain is usually insidious. The condition begins with microscopic injury to the tendon, with delayed healing because of repetitive loading or overuse.

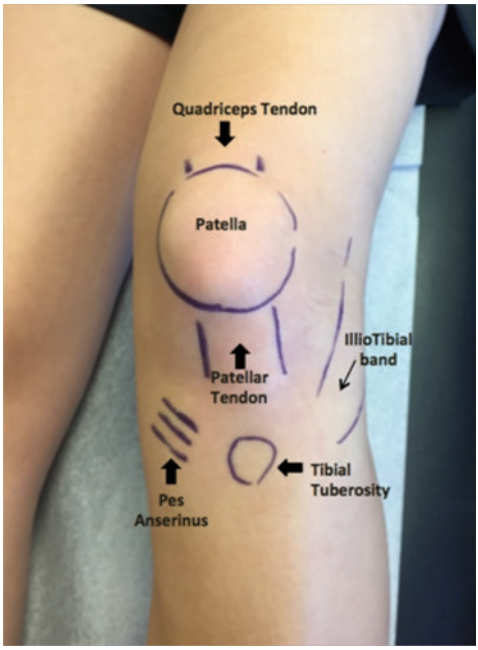

Fig. 19.4 The anatomy of the knee

Clinical Presentation

Patients with patellar tendinopathy will localize the pain over the anterior aspect of the knee, below the patella (Fig. 19.4). More specifically, the pain is most predominantly confined over its insertion at the inferior pole of the patella. Patients mainly complain of pain and typically do not experience mechanical symptoms, such as locking and catching or swelling. The pain is usually worse with activity (placing increased load on the tendon) and can be very limiting to an athlete. Going down the stairs or sitting for an extended period of time may exacerbate pain.

On physical examination, tenderness to palpation is common over the inferior pole of the patella, although tenderness can occur anywhere along the patellar tendon down to its most distal attachment, the tibial tuberosity. Tenderness may be elicited when the knee is either flexed or extended. "Bassett's sign" is a pattern indicative of a patellar tendinopathy: increased pain from palpation is elicited when the knee is extended/tendon is relaxed, with less pain when the knee is flexed. A knee effusion is not common with tendinopathy. If a palpable defect is detected and the patient cannot perform a straight leg raise, this indicates an extensor mechanism disruption and needs immediate evaluation by an orthopedic surgeon. Operative and non-operative treatment for patellar tendinopathy will be addressed together with quadriceps tendinopathy in the Diagnostic Imaging section below.

Quadriceps Tendinopathy

Epidemiology

Similar to patellar tendinopathy, the pain is usually insidious in onset and affects males more than females. It is also very common in sports/activities that involve jumping and can lead to microscopic injury of the tendon. Quadriceps tendinopathy is significantly less common than patellar tendinopathy due to the richer vascularization, which promotes faster and more efficient healing.

Clinical Presentation

Quadriceps tendinopathy differs from patellar tendinopathy based on the location of pain. Though pain is also anterior, in quadriceps tendinopathy, the pain is localized over the attachment of the tendon at the superior pole of the patella (Fig. 19.4). Patients typically experience increased pain with going up and down the stairs and increased activity. Sitting for an extended period of time may also exacerbate pain. As in patellar tendinopathy, knee effusion and mechanical symptoms are not common.

The majority of patients will demonstrate tenderness to palpation just superior to the patella, without palpable defect. There is also frequently pain with resisted leg extension (strength testing of the quadriceps). Just as with the patellar tendon, immediate orthopedic evaluation is indicated for probable rupture if there is a defect where the tendon should be and the patient cannot perform a straight leg raise.

Diagnostic Imaging

Patellar and quadriceps tendinopathies are most often diagnosed based on history and clinical examination. When imaging is used, plain radiographs are a good first choice to determine if there is underlying pathology including degenerative change, calcification in the tendon, or patella mal-tracking. MRI is rarely indicated in these cases and is usually pursued only when conservative management has failed, and surgical intervention is the next option (Fig. 19.5).

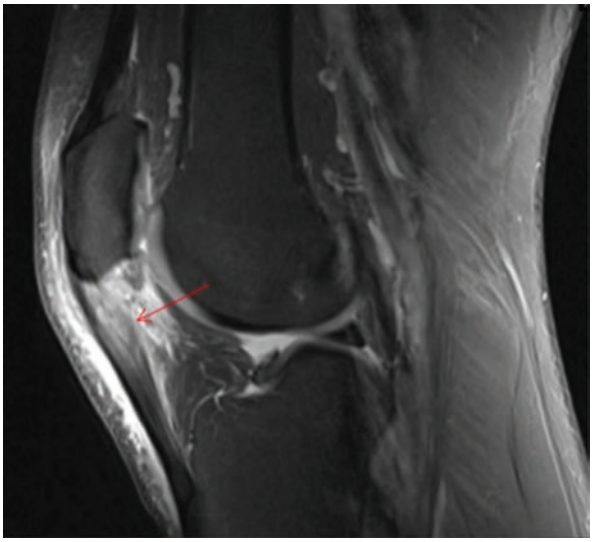

Fig. 19.5 MRI demonstrating chronic patellar tendinopathy

Non-operative Management for Patellar and Quadriceps Tendinopathies

Conservative management is the mainstay of treatment for both patellar and quadriceps tendinopathy, though it may take 3–6 months for some cases to fully resolve in. Physical therapy plays an important role in symptom reduction. More specifically, the eccentric exercises (introduced once the tendon is not considerably irritable) typically enhance rehabilitation and ultimate return to sport/exercise. Stretching and strengthening of the proximal musculature, including hamstrings, quadriceps, hip flexors, and abductors, also is an important aspect of treatment. Nonsteroidal anti-inflammatories (NSAIDs), ice, and activity modification are also beneficial. Surgical intervention is indicated rarely.

Operative Management of Patellar and Quadriceps Tendinopathies

Once it has been determined that conservative management has failed, usually after 6+ months with formal physical therapy, operative intervention is an option. At this point, an MRI may be obtained to definitively confirm the diagnosis and to determine if there are any other pathologies. The surgical procedures usually performed are first an arthroscopy (to evaluate the intra-articular structures including the tendon itself and the patella) and then an open patellar tendon/quadriceps tendon debridement with or without drilling/microfracture. The drilling of the patella (close to the tendon attachment) is performed to stimulate healing through increased

vascularization to the area. Depending on the extent of debridement and quality of the tendon tissue itself, a patient may be put in a brace locked in extension for ambulation for the first 2–4 weeks postoperatively. Formal physical therapy will be beneficial in order for the patient to return to all activities anywhere between 3 and 6 months, depending on the extent of the surgery.

Expected Outcomes

Although patellar and quadriceps tendinopathies may linger for many months, the majority of cases will resolve with conservative measures as outlined above. It is important to determine that the patient is compliant with non-operative management before deciding that he/she has failed. Surgery is usually offered as a last option because there is more risk involved, and the vast majority should have resolution in symptoms if compliant with conservative treatments. If these patients still experience pain after surgery, it is usually secondary to noncompliance or secondary pathology.

Pes Anserine Bursitis

Epidemiology

The exact incidence of pes anserine bursitis is unknown, though it is fairly common among the adult population. Several studies have shown that overweight females are more at risk than male counterparts. Patients with diabetes mellitus also have been shown to be at increased risk of developing pes anserine bursitis. Approximately 5 centimeters (cm) below the anterior-medial joint line is the pes anserinus, where the semitendinosus, gracilis, and sartorius tendons attach. A bursa is located at this attachment site, below the tendons, and can become inflamed either by overuse or direct trauma, resulting in pes anserine bursitis.

Clinical Presentation

Clinically, patients with pes anserine bursitis will localize the pain over the anteromedial aspect of the proximal lower leg, about 5–6 cm below the medial joint line (Fig. 19.3). There will be tenderness to palpation over this area, and usually localized swelling will also be present. In some cases, resisted knee flexion may elicit pain to this area (strength testing of hamstring). Going up and down the stairs may

intensify pain to the area as well. A knee effusion will not be present in isolated pes anserine bursitis.

Given the location of pain on the medial aspect of the knee, it is important that other causes of medial pain are excluded. Other diagnoses that can cause medial knee pain are medial meniscus tear, osteoarthritis, medial collateral ligament pathology, etc., discussed in separate chapters (Table 19.1).

Diagnostic Imaging

Pes anserine bursitis is diagnosed based on history and clinical examination. Plain radiographs will not make the diagnosis but are a good first choice in imaging in order to determine the amount of degenerative changes, whether there are any fractures, etc. MRI is rarely indicated but may be helpful in determining other pathologies of the medial aspect of the knee when the diagnosis is uncertain. Ultrasonography may aid in diagnosis, especially in cases where there is a significant amount of swelling, and can be used when administering an injection for diagnostic and therapeutic purposes.

Non-operative Management

Conservative therapy is the mainstay of treatment for pes anserine bursitis. Management options include ice, NSAIDs, activity modification, and physical therapy. Physical therapy is predominately focused on hamstring stretching and strengthening. Formal physical therapy may also include modalities meant to decrease inflammation and pain, such as topical corticosteroid treatment (iontophoresis with dexamethasone). An injection into the bursa with local anesthetic—with or without corticosteroid—may aid in diagnosis and improve symptoms. The injection serves as a diagnostic tool in that if pain completely resolves after the injection, it can be determined that it was the sole pain generator. Similarly, if the injection provides no relief, then other causes of pain must be considered, with the assumption that if a blind injection was performed, it was in the correct place (Table 19.1). Non-operative treatment should be successful in the majority of cases, and surgical removal of the bursa is reserved for cases that fail to resolve.

Operative Management

Surgical intervention is rarely ever indicated for pes anserine bursitis. This option may be presented to the patient if conservative management fails, usually after 6+ months of conservative treatment. The surgical procedure entails an incision over

the pes anserinus and drainage or removal of the bursa. If there is a bone prominence under the bursa, this will also be removed at the time of surgery. Once the soft tissue is healed, patients will usually start a course of physical therapy until back to all activities at about 2–3 months postoperatively.

Expected Outcomes

Nonsurgical management is the mainstay of treatment for pes anserine bursitis and includes ice, NSAIDs, physical therapy, and local injection. Outcomes are typically excellent. In the very rare occasion that conservative therapy fails, surgical intervention may be implemented. Surgical treatment is the last option given that it is associated with more risk. After surgery, symptoms are expected to resolve, and if not, secondary pathology should be considered.

Suggested Reading

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