Bursae of the Knee: A Clinical and Radiological Review with an Emphasis on MR Imaging Findings

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Purpose

To review the anatomy, clinical presentation, management and MRI findings of various bursae of the knee.

Methods and Materials

Utilizing a keyword search program offered at our institution we conducted a search for any radiology MRI report mentioning the word "bursitis." Subsequently 6 board certified musculoskeletal radiologists then selected the best case examples of each type of bursitis to include in this educational review. Thereafter, an in-depth literature review was conducted to provide an up to date educational exhibit with both clinical and radiological relevance.

Results

Introduction:
A bursa is a fluid-filled sac located around joints whose main purpose is to reduce friction between adjacent moving structures. There are a variety of causes that can lead to inflammation of the bursae (also known as bursitis) including overuse, trauma, infection and hemorrhage. Collagen vascular diseases and inflammatory arthropathies are also less commonly implicated.

In this educational exhibit we will review many of the common and uncommon bursae of the knee with an emphasis on MR imaging manifestations.

Anatomic correlation and a review of clinical presentation and current management will also be discussed.

Anteriorly Located Bursae:

1. Prepatellar bursa

Anatomy:
Located between the patella and overlying skin. Allows patella to slide freely beneath the skin during flexion and extension of the knee.

Some debate as to whether the prepatellar bursa is a unicompartmental structure, bicompartmental or tricompartmental structure. Study in American Journal of Roentgenology describes a majority of patients demonstrating a trilaminar appearance of the prepatellar bursae. Aguiar et. al. also found that while the prepatellar bursa was typically located anterior to the patella, there was both medial and lateral extension of this bursa.

**Clinical presentation:**

Most common type of bursitis affecting the knee.

Also known as housemaid's knee.

Clinically, patients present with pain and swelling over the patella.

Most commonly due to recurrent minor trauma such as with prolonged or repeated kneeling leading to frictional stress and associated inflammation.

Acute injury such as a direct fall on the patella may lead to a hemorrhagic bursitis.

Pyogenic prepatellar bursitis is common, particularly in children.

Bursae may be so distended that it leads to marked swelling of the knee and the mistaken diagnosis of pyogenic arthritis may be made.

Crucial to avoid this mistake because if the pyogenic bursitis is drained appropriately pyogenic arthritis is prevented. However, if patient is taken to operating room for presumed pyogenic arthritis (when the diagnosis is really pyogenic prepatellar bursitis) this may lead to unnecessary intervention and may actually lead to a pyogenic arthritis from spilled contents of the bursitis into the knee joint.

Patients with pyogenic prepatellar bursitis may also present with reactive inguinal lymphadenopathy and visible abrasions, old wounds or puncture wounds along the knee.

**Management:**
Non-septic prepatellar bursitis is treated conservatively with rest, icing of the knee, anti-inflammatory drugs and elevation of the affected knee.

Refractory or severe cases have been treated with aspiration of bursal fluid with administration of steroid injections (i.e. cortisone).

Some authors advocate aspiration of the bursal fluid and analysis in all cases to exclude a pyogenic prepatellar bursitis.

Regarding pyogenic prepatellar bursitis:

Debate as to the most appropriate treatment:

McAfee and Smith suggest administration of oral antibiotics, believing that surgery and drainage are unnecessary.

Wilson-MacDonald argue that oral antibiotics are insufficient and recommend intravenous antibiotics.

Other authors suggest surgical intervention with bursal irrigation and drainage tube placement.

Bursectomy has also been suggested in refractory cases.

**MRI findings:**

Please refer to Fig. 1 demonstrating a classic case of prepatellar bursitis.

### 2. Superficial infrapatellar bursa

**Anatomy:**

The superficial infrapatellar bursa is located more distally than the prepatellar bursa, in the subcutaneous fat between the distal third of the patellar tendon and the overlying skin.

Debate as to whether this bursa is congenital in nature or adventitial, with it developing due to repetitive kneeling.
This bursa has been found in 55% of cases in a cadaveric investigation.

**Clinical presentation:**

Also known as Clergymen's knee.

Caused by chronic trauma due to occupational kneeling and acute direct trauma.

Unlike prepatellar bursitis, this bursitis is usually caused by kneeling in an upright position.

Clinically presents as pain and swelling inferior to the patella.

**Management:**

Generally treated conservatively, with compression, ice packs and analgesics. Rarely requires complete immobilization or drainage.

**MRI findings:**

Due to its location, superficially within the subcutaneous soft tissues, on imaging it should be differentiated from subcutaneous edema: edema is more diffuse along the knee whereas bursitis presents as a more confluent localized fluid collection.

Fig. 2 and Fig. 3 demonstrate cases of superficial infrapatellar bursitis.

**3. Deep infrapatellar bursa**

**Anatomy:**

Located directly posterior to the distal third of the patellar tendon, just proximal to its insertion onto the tibial tubercle.

No communication with the knee joint.

On cadaveric examination this bursa was found to be partially compartmentalized, with a fat pad apron extending down from the retropatellar fat pad to partially divide it into anterior and posterior compartments.
Clinical presentation:

Commonly due to overuse of the extensor mechanism of the knee and is commonly associated with excessive running and jumping.

Has been associated with direct trauma over the patellar tendon such as with striking the knee on a hard surface during a fall.

Can be difficult clinically to differentiate this entity from patellar tendon rupture or hemorrhage into the retropatellar fat pad as all of these patients have pain along the distal patellar tendon and are unable to fully flex or extend their knee. Therefore, MRI is very helpful in distinguishing these entities.

When found in adolescents, it is important to differentiate from Osgood-Schlatter disease. The latter is associated with signal abnormality and thickening the distal patellar tendon, absent in deep infrapatellar bursitis. It is important to note that both Osgood-Schlatter and deep infrapatellar bursitis can coexist in the same patient.

Management:

Management is typically conservative with rest, icing and oral analgesics and nonsteroidal anti-inflammatory medications.

However, in cases where bursal fluid is excessive, aspiration with injection of a steroid/anesthetic mixture into the bursa has been performed. The recommended approach in these situations is along the lateral edge of the patellar tendon just proximal to the tibial tubercle.

Importantly, following steroid injection some of the steroid may be absorbed directly into the patellar tendon itself, making it vulnerable to rupture. Therefore, patients should avoid any activities that would put undue stress on the tendon for at least two weeks post injection.

MRI findings:

Triangular fluid collection posterior to the patellar tendon

Normally a small amount of fluid may be seen within this bursa on MR imaging.
Fig. 4 demonstrates a typical case of deep infrapatellar bursitis.

**Posteriorly located bursa:**

4. **Gastrocnemius-semimembranosus bursa**

**Anatomy:**

Located between the tendons of the medial head of the gastrocnemius and semimembranosus muscles.

Can extend medial, lateral, superficial, or deep to these muscles.

May or may not communicate with the knee joint: In children usually does not communicate with the knee joint but in adults it does.

**Clinical presentation:**

When distended with fluid, it is also known as a popliteal cyst or Baker's cyst.

Commonly seen in children although associated intraarticular pathology is rare.

In adults, can become distended for a variety of reason, including synovitis, osteoarthritis, meniscal tears or trauma which increase the joint fluid in the knee which subsequently extends into the communicating bursa.

Presents as swelling or fullness in the popliteal fossa.

Patients typically have posterior knee pain and tenderness.

Cysts often change in size due to fluid communication with joint space.

Large cysts may track into the calf.

Acute rupture of large cysts may cause severe calf pain and swelling clinically mimicking a deep vein thrombosis.
Clinically it is important to perform a detailed neurovascular exam, especially in large cysts which have potential to compress the neurovascular structures in the popliteal space.

**Management:**

Many times no treatment is required and cyst will resolve on its own.

Intraarticular pathology is commonly associated with these cysts. These cysts may recur if intraarticular pathology is not corrected therefore primary treatment is directed at correcting the intraarticular pathology (meniscal tear, osteoarthritis, etc.).

Conservative treatment measures including steroid injections, cyst aspiration (typically performed under ultrasound guidance), icing, rest and compression.

**MRI findings:**

May be simple, multiloculated or septated.

Also, may contain debris and/or loose bodies within the cyst.

A ruptured popliteal cyst results in edema in the surrounding fascial planes and subcutaneous fat, with fluid tracking inferiorly along the medial gastrocnemius muscle plane.

Intracystic hemorrhage or protein rich synovial fluid may result in increased signal on T1 weighted imaging.

Post contrast enhancement of the cyst wall and internal septations following intravenous gadolinium administration can be seen.

Fig. 5 demonstrates a classic case of a simple, uncomplicated popliteal cyst.

**Medially located bursae:**

5. Semimembranosus-tibial collateral ligament bursa
Anatomy:

Located deep to the tibial collateral ligament and adjacent to the semimembranosus tendon.

Classically described as an inverted U shaped bursa.

The proximal deep pocket lies between the semimembranosus tendon and the medial tibial condyle.

The distal superficial pocket lies between the semimembranosus tendon and the tibial collateral ligament.

The two pockets join superiorly forming the base of the U.

This bursa is located between the more superior gastrocnemius-semimembranosus bursa and the more inferiorly located per anserine bursa. This bursa does not communicate with either of these bursa or with the knee joint.

Clinical presentation:

As in other cases of bursitis, repetitive or acute trauma is thought to result in this type of bursitis.

It is thought that during repeated extension, valgus stress and/or external rotation, the semimembranosus tendon is caught in between the medial tibial condyle and tibial collateral ligament leading to undue friction and subsequent bursitis.

Present commonly as acute or chronic posteromedial knee pain.

Can mimic more ominous pathology of internal derangement such as meniscal tears given clinical presentation of medial pain near the joint line. Important to diagnose this entity by imaging so as to preclude unnecessary invasive procedures such as arthroscopy.

Management:

Treatment is usually conservative with cessation of the activity leading to the bursitis as well as rest, ice, compression and nonsteroidal anti-inflammatory agents.
As in other cases of bursitis, refractory cases can be treated with intrabursal injection of steroids.

**MRI findings:**

MR imaging findings demonstrate a collection around the semimembranosus tendon, with hypointense T1 and hyperintense T2 signal.

Clinical presentation may mimic medial meniscal tear, medial collateral ligament injury, or medial patellar plica thickening. Therefore it is important to exclude said entities.

Differential diagnostic possibilities of fluid collections in this region include an intrameniscal or parameniscal cyst, ganglion cyst, popliteal cyst and pes anserine bursitis.

Fig. 6 demonstrates a classic inverted U shaped appearance of a semimembranosus-tibial collateral ligament bursitis.

**6. Pes anserine bursa**

**Anatomy:**

Located along the medial aspect of the knee at the level of the tibia. It separates the pes anserinus tendons (distal sartorius, gracilis and semitendinosus) from the distal tibial collateral ligament at its tibial insertion.

**Clinical presentation:**

Small amount of fluid within the bursa has been shown in up to 5% of asymptomatic patients; therefore it is thought that not all fluid within the bursa is associated with bursitis.

Many times this bursitis is secondary to excessive friction along the bursa secondary to an overuse injury.

Commonly seen in runners.
More commonly seen in patients with pes planus and genu valgus deformity which can lead to increased pronation and valgus stress at the knee.

Presents as medial knee pain and swelling and can mimic medial meniscal tears and distal tibial collateral ligament tears clinically.

**Management:**

Intrabursal corticosteroid and anesthetic injections are often performed for this bursitis.

As in other types of bursitis, conservative treatment with rest, ice, compression and oral anti-inflammatory agents is also suggested.

Rest until the patient is completely asymptomatic is particularly important as this type of bursitis may easily become chronic in nature.

**MRI findings:**

Classically a T1 hypointense/T2 hyperintense collection is identified along the medial joint, adjacent to the pes anserinus.

Differential diagnostic possibilities include parameniscal and synovial cysts although synovial cysts typically communicate with the joint even though this communication is not always visible.

Fig. 7 demonstrates the classic appearance of a pes anserine bursitis.

**Laterally located bursa:**

7. Fibulopopliteal bursa

**Anatomy:**

As the name would suggest, this bursa is located between the fibular collateral ligament and the popliteal tendon.
May communicate with the subpopliteal recess which is located between the popliteus tendon and the lateral femoral condyle.

**Clinical presentation**

Almost nothing exists in the literature regarding this rare bursa. However, given its location in the lateral knee, it is presumed that in symptomatic patients, lateral sided pain would be most common.

**Management:**

Again, there is relatively little literature describing this rare bursa. However, as in the other types of bursitis described above, presumably conservative treatment is attempted with rest, ice, compression and oral anti-inflammatory agents with corticosteroid injection reserved for refractory or severely symptomatic cases.

**MRI findings:**

Fig. 8 demonstrates a case of fibulopopliteal bursitis.

**Images for this section:**
Sagittal and axial T2 weighted images demonstrate confluent fluid anterior to the patella compatible with prepatellar bursitis.
Sagittal T2 weighted images of the knee demonstrate a confluent fluid collection anterior to the distal third of the patellar tendon compatible with a superficial infrapatellar bursitis.

Fig. 2
Sagittal T1 and T2 weighted images of the knee demonstrate a complex, predominantly T1 and T2 hyperintense fluid collection anterior to the distal patellar tendon compatible with a complex superficial infrapatellar bursitis. Given the complex nature of this fluid, hemorrhagic or infectious bursitis should be considered.
Fig. 4

Contiguous sagittal T2 weighted images demonstrate confluent fluid deep to the distal patellar tendon compatible with deep infrapatellar bursitis.
Sagittal and axial T2 weighted sequences demonstrate a T2 hyperintense fluid collection between the medial head of the gastrocnemius tendon and the semimembranosus tendon compatible with fluid in the gastrocnemius-semimembranosus bursa, commonly known as a popliteal or Baker’s cyst.

Fig. 5
Coronal T2 weighted image demonstrates the classic inverted U shaped appearance of a semimembranosus-tibial collateral ligament bursitis. Notice how intimately this fluid collection is associated with the semimembranosus tendon on the axial T2 weighted image.
Axial T2 weighted image on the left demonstrates the sartorius muscle, gracilis tendon and semitendinosus tendon comprising the pes anserinus. Similar image more distally demonstrates a fluid collection deep to the sartorius, gracilis and semitendinosus tendons compatible with a pes anserine bursitis.

Fig. 7
Axial and coronal T2 weighted images demonstrate a small focal confluens fluid collection between the popliteus tendon and fibular collateral ligament compatible with a fibulopopliteal bursitis.

Fig. 8
Conclusion

While there are many bursae within the knee, bursitis is a commonly forgotten cause of knee pain. In this review we demonstrate the importance for the radiologist to recognize seven basic types of bursae of the knee beginning with a discussion of anatomy and clinical presentation, followed by a review of current management recommendations and ending with MR imaging findings of each of these bursae.

References


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