Popliteal Cysts: A Current Review

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abstract

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Baker’s cyst, or popliteal cyst, is a fluid-filled mass that is a distention of a preexisting bursa in the popliteal fossa, most commonly the gastrocnemio-semimembranosus bursa. This bursa is unique in that it communicates with the knee joint, unlike other periarticular bursae, via an opening in the joint capsule posterior to the medial femoral condyle. Many have theorized that this opening creates a valve-like mechanism in the presence of effusion that contributes to the formation of these cysts in adults. Popliteal cysts rarely manifest alone and are most often found in conjunction with other intra-articular pathologies and inflammatory conditions, such as osteoarthritis, meniscus tears, and rheumatoid arthritis. In children, popliteal cysts are only occasionally associated with these conditions and are more often an incidental finding discovered during a routine physical examination. Popliteal cysts may present as either a chronically persistent or relapsing condition or as an acute and dramatic condition that can occur in the case of cyst rupture presenting as pseudothrombophlebitis. Ultrasound and magnetic resonance imaging have proven to be consistent and accurate in the confirmation of popliteal cysts, with magnetic resonance imaging becoming the modern imaging modality of choice. This review discusses the anatomy and etiology of popliteal cysts, describes the common clinical presentations, reviews the differential diagnoses, and provides guidance for proper diagnostic imaging. It also provides a comparison of current conservative, minimally invasive, and invasive treatment options, along with a discussion of results. Postoperative rehabilitation depends largely on the condition associated with the popliteal cyst.

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of the possible cystic lesions around the knee joint, popliteal cysts are the most prevalent.\(^1\) Popliteal cysts most commonly form by distention of the gastrocnemio-semimembranosus bursa, which is located in the medial aspect of the popliteal fossa. These cysts are also referred to as Baker’s cysts, a name given to the condition after Baker’s classic case description of popliteal swelling. The gastrocnemio-semimembranosus bursa is situated between the tendons of the gastrocnemius and semimembranosus muscles and is a normal anatomic finding. This bursa has been found to communicate with the knee joint capsule via a transverse opening in the posterior capsule at the level of the medial femoral condyle, where the gastrocnemius tendon merges with the joint capsule.\(^3\) Most often, this opening takes the shape of a horizontal slit measuring 4 to 24 mm.\(^4\) The communication between the bursa and the joint capsule is almost nonexistent in children, and the presence of this opening increases in frequency with age. The integrity of the joint capsule decreases with age, and it is theorized that this opening results from a tear in the degenerated joint capsule.\(^5, 6\) Rauschning\(^6\) observed that, when no opening was found, capsular thinning was seen in the same area and noted that the cyst is simply a herniation of synovium, as originally postulated by Baker.\(^2\) A true ganglion cyst can form, usually by fluid leakage through a horizontal or oblique medial meniscus tear, forming a wall of dense fibrous connective tissue (not synovium) as a distinguishing feature (Figure 1).

The communication between the gastrocnemio-semimembranosus bursa and the joint capsule, which allows for the movement of synovial fluid between the 2 spaces, has been shown by arthrography.\(^3\) A valvelike mechanism that allows only unidirectional flow from the joint into the bursa has been found in some of these openings. Intra-articular and intracystic pressure measurements have been made in the knees of patients with rheumatoid arthritis who have popliteal cysts, and in every case intracystic pressure was higher than intra-articular pressure. Various manipulations were performed, and it was found that although intra-articular pressure could be raised, it tended to return to the original level on release. With a popliteal cyst, however, in some cases where intracystic pressure increased, the pressure did not drop after release. Squeezing the cyst also had no effect on lowering pressure. These findings of fluid accumulating in the popliteal cyst and not being able to leave, despite high pressure, indicate the presence of a 1-way valve-type mechanism. There is some discrepancy as to the nature of the valve mechanism, and a ball or Bunsen-type mechanism has been suggested.\(^6\) Others believe it to be a functional valve mechanism created by the interaction of the tendons of the gastrocnemius, semimembranosus, and semitendinosus pulling and compressing the opening.\(^6\) Either way, unidirectional flow of fluid has been shown and is believed to play a role in the development of popliteal cysts. In light of these findings, popliteal cysts generally develop under conditions where effusion is present, such as intra-articular pathology and inflammatory or degenerative disease. The extra fluid may be pushed into the gastrocnemio-semimembranosus bursa to help maintain normal knee joint pressure, leading to higher than normal pressure in the bursa. Although the fluid contents of the cyst may absorb through the lining, loose bodies and fibrotic pieces cannot absorb fluid and can cause dense concentrations of solid material to accumulate in the bursa.\(^6\)

The presence of popliteal cysts depends on the population studied and the technique used for diagnosis. In studies of asymptomatic knees in adults, popliteal cysts were identified in 4.7% to 37% of cases.\(^7, 8\) These variances in prevalence could be caused by differences in definitions; Johnson et al\(^6\) simply looked for the presence of a gastrocnemio-semimembranosus bursa that communicated with the joint, not necessarily a pathologic presentation of the bursa. In pediatric populations, the prevalence of popliteal cysts has been reported as 6.3%.\(^9\) Although the prevalence of popliteal cysts varies, these cysts generally occur secondary to other intra-articular pathology in adults.\(^8, 10, 11\) Sansone et al\(^8\) found that 94% of popliteal cysts were associated with a disorder of the knee. The most common disorder was meniscal lesions, followed by anterior cruciate ligament tear and/or chondral lesions. Of the meniscal lesions, 70.2% were medial meniscal tears, often involving the posterior horn of the medial meniscus. Another study considered inflammatory conditions associated with popliteal cysts in patients at a rheumatology clinic. In 145 patients who had 180 popliteal cysts, 50.6% had osteoarthritis, 20.6% had rheumatoid arthritis, 13.9% had gout, 7.8% had seronegative spondylarthritis, and 7.2% had pyrophosphate arthropathy.\(^12\)

**Clinical Presentation**

In children, a popliteal cyst is most often an incidental finding on physical examination. Occasionally a child or parent sees or feels a cyst and becomes concerned about the presence of a mass.\(^13\) The cyst usually develops before age 15 years, is asymptomatic, and is not associated
with knee effusion. Occasionally, cysts are associated with intra-articular pathology (osteochondritis dissecans, meniscus tear) or seronegative or positive arthropathy, but in most cases they are simply distention of a primary gastrocnemio-semimembranosus bursa and are believed to occur as a result of local mechanical irritation.14 When a cystic mass around the knee is evident, imaging and diagnostic workup are appropriate.

Typical adult clinical presentation is vague posterior knee pain, possible localized swelling or mass, and a feeling of tightness in the popliteal region. Many times, the history and physical findings are more consistent with other pathologies associated with the cyst, such as meniscus tear or arthritis. Physical examination may show a tender palpable mass in the medial popliteal fossa, although this finding is subjective and is somewhat dependent on the physician’s opinion and experience. Most cysts are found on the medial side of the posterior knee and are reported more rarely on the lateral side.15 The cyst is usually rounded, smooth, and fluctuant, and may feel tense in extension, but this is a difficult finding to quantify.6 This hardness of the cyst in full extension followed by softening with knee flexion is known as Foucher’s sign, and it is attributed to relaxation of the gastrocnemius and soleus muscles.16 Large popliteal cysts may interfere with normal range of motion by limiting full flexion and full extension.17 It has been reported that fewer than half of patients with a confirmed popliteal cyst via ultrasonography had positive findings on clinical examination.12 The literature shows conflicting results on the correlation between the presence of a popliteal cyst and effusion with synovitis.12,18 The differential diagnosis of a popliteal mass primarily includes a benign or malignant tumor (synovial, bone, fatty, or hamartoma), popliteal aneurysm, deep venous thrombosis (DVT), meniscal cyst, and ganglion cyst.19-22 Because popliteal cysts are lined by synovium, they are subject to disease processes such as inflammation, osteochondromatosis, pigmented villonodular synovitis, and synovial sarcoma. All of these have been reported in the literature.20,23

Because of their size and location, popliteal cysts can press against other anatomic structures in the posterior knee. Compression of the popliteal artery or vein can cause ischemia or thrombosis, respectively, whereas compression of the tibial or peroneal nerve can cause peripheral neuropathy.24 Although popliteal cysts typically present as a chronic condition, they can present acutely if the cyst dissects or ruptures into the soft tissue. Ruptured popliteal cysts typically present as calf pain that is sometimes severe and is accompanied by calf swelling. Patients have described having a mass in the popliteal fossa that disappears as the calf pain and swelling appear.13,25 Calf pain and swelling are also present in DVT or superficial thrombophlebitis, and the clinical imperative is to rule out DVT with appropriate diagnostic imaging studies.26

Pseudothrombophlebitis has the same clinical presentation as DVT or superficial thrombophlebitis, but is caused by another condition, such as a ruptured popliteal cyst. It has been reported that in 2% to 6% of patients with suspected DVT, a symptomatic popliteal cyst is the cause. It is possible to have both DVT and pseudothrombophlebitis, but this occurs rarely.27 Discoloration or ecchymosis in the calf, at the medial malleolus, or on the dorsum of the foot is a distinguishing feature of a ruptured cyst because bloody synovial cyst fluid dissects inferiorly.28-30 Caution is advised because giving a patient with a ruptured popliteal cyst anticoagulants for suspected DVT may lead to increased bleeding from the cyst and has resulted in compartment syndrome.13

Compartment syndrome has also been reported in the case of a ruptured popliteal cyst without previous treatment with anticoagulation, but it may have been the result of mechanical and pharmacologic factors specific to that case.13,31 When a ruptured cyst appears in conjunction with inflammatory joint disease, the fluid that dissects into surrounding tissue may cause irritation and the patient may have persistent itching on the skin of the calf.9 Although cyst ruptures are not common, the complications are unique to the individual and various factors must be considered. In general, a history of seronegative arthritic disease or rheumatoid arthritis may be indicative of a ruptured cyst in the case of acute calf pain and swelling. Ruptured cysts are more prevalent in patients with inflammatory pathology than in those with degenerative pathology.12 Treatment of ruptured cysts typically involves treating resultant complications, but ruptured cysts without complications have been reported to resolve spontaneously with supportive conservative care, such as compression and elevation of the limb.9

Diagnostic Imaging

Multiple imaging techniques may be used in the diagnosis and assessment of a popliteal cyst. Plain radiographs are simple and readily available, but they provide limited information about the popliteal cyst. However, they may help in identifying associated articular disorders, such as loose bodies in the cyst or the general findings of osteoarthritis and inflammatory arthritis. Other imaging techniques are often more suitable for diagnosing popliteal cysts. Previously, arthrography was commonly used in the imaging of popliteal cysts, but disadvantages such as the invasiveness of the procedure and the possibility of contrast extravasation have been made apparent.12 The injection of contrast causes an increase in knee joint pressure that may push fluid into the gastrocnemio-semimembranosus bursa, distending a previously normal bursa and giving the impression of a popliteal cyst. When arthrographic studies were compared with ultrasound scans, some patients who were positively diagnosed with a popliteal cyst on arthrogram had negative findings for popliteal cyst on ultrasound.33 In the same
study, the cysts generally appeared larger on arthographic images compared with sonographic images. Arthrography is also invasive and involves exposure to radiation.

Ultrasound quickly became a popular replacement for arthrography in imaging for the presence of popliteal cysts. Ultrasound is readily available, relatively inexpensive, and noninvasive, and it involves no exposure to radiation. On ultrasound, a popliteal cyst appears as a well-defined and unilocular collection of anechoic or hypoechoic fluid between the tendons of the medial head of the gastrocnemius and semimembranosus. Ultrasound allows assessment of the size of the cyst; its relationship to adjacent muscles, tendons, and vessels; and the presence of intracystic loose bodies or septations. In addition, it can differentiate these cysts from disorders such as popliteal aneurysms and ganglion cysts. There are 3-dimensional ultrasound systems that take a series of 2-dimensional images and combine them using volume measurement software to automatically calculate an accurate cyst volume. The ability to assess cyst volume quickly and accurately would increase the efficiency of tracking the status of a popliteal cyst. Ultrasound, however, is not sensitive to intra-articular lesions, and so further imaging is needed to confirm the presence of an associated internal derangement.

Magnetic resonance imaging is considered the gold standard in the visualization and characterization of masses about the knee. An MRI can confirm the cystic, unicocular nature of the benign popliteal cyst; evaluate its relationship to anatomic structures in the joint and surrounding tissue; and delineate associated intra-articular pathologies. In addition, MRI is noninvasive and does not involve exposure to radiation. On MRI scan, a popliteal cyst appears as a delineated mass with low signal intensity on T1-weighted image, intermediate signal intensity on proton density image, and high signal intensity on proton density–weighted fat saturation image. A distinct advantage of MRI is the ability of axial images to visualize a fluid-filled neck of the cyst communicating with the joint (Figure 1). This information can be useful when surgery is the choice of treatment. Popliteal cyst leakage or rupture can be seen by edema with high signal intensity in the adjacent soft tissue and fascial planes.

When choosing a method of diagnostic imaging, numerous factors must be considered. One consideration is that MRI is less available and more expensive than arthrography and ultrasound. Ultrasound is a reasonable choice for quickly assessing a potential popliteal cyst. However, follow-up with MRI may be necessary to confirm the cyst and diagnose coexistent knee joint pathology.

TREATMENT AND OUTCOMES

There are many treatment options for popliteal cysts, dictated by the underlying cause and associated condition. Sometimes no treatment or simple supportive measures result in spontaneous resolution of the cyst or at least reduction in associated symptoms. If not, both minimally invasive and surgical techniques are alternatives.

Ultrasound-guided aspiration with corticosteroid injection is a relatively low-risk and successful procedure for the treatment of knee osteoarthritis complicated with a popliteal cyst. In the study by Acebes et al., patients with knee osteoarthritis and symptomatic popliteal cysts were injected intra-articularly with corticosteroids after aspiration of the cyst. At follow-up 4 weeks later, the authors observed a significant decrease in knee pain and swelling and a significant reduction in cyst size. There was a significant reduction in cyst wall thickness in 43% of patients and improved range of motion in 66% of patients. Decreased cyst size correlated with increased range of motion. Although no patient showed progression of cyst size or cyst wall thickness, follow-up occurred only 4 weeks after treatment and the long-term effectiveness of this procedure was not shown.

Another option is a similar procedure in which corticosteroid is injected directly into the popliteal cyst. This method was used in another study where patients with knee osteoarthritis were categorized into 2 groups based on the complexity of their popliteal cyst. Approximately 25% were classified as complex, which meant that the cysts had septations or other abnormal findings. These patients underwent ultrasound-guided aspiration and direct injection of corticosteroids into the cyst and then had follow-up at 1 week, 1 month, and 6 months. At 6 months, cyst volume had decreased compared with preprocedure volume and patients experienced an overall decrease in knee pain. Signs of cyst relapse were seen in 6 patients at 6-month follow-up. Of interest, all relapsing cysts had been classified as complex at baseline. Complex cysts may be difficult to aspirate and inject because of septations and intracystic debris, and this could interfere with the outcome of the procedure. Categorizing popliteal cysts before treatment may help to guide therapy because complex cysts do not seem to have a good long-term response to intracystic corticosteroid injection.

More recently, intra-articular corticosteroid injections were compared with intracystic corticosteroid injections in patients with knee osteoarthritis. Measurements were taken 2, 4, and 8 weeks after the procedure. Both groups experienced reduction of cyst volume at week 2, and the size remained stable at follow-up. However, the patients who had intracystic injection had significantly lower cyst diameter and cyst wall thickness at weeks 4 and 8 than those who had intra-articular injection. Although both methods are suitable treatment options in patients with knee osteoarthritis, direct injection into the popliteal cyst may provide greater reduction in cyst size.

Installation of irritating substances into cystic, fluid-filled cavities, known as
sclerotherapy, has a fairly long history. Agents such as ethanol, phenol, tetracycline, and group A Streptococcus pyogenes have all been used to sclerose cystic cavities. Sclerotherapy was used in a patient who had a meniscal tear and a recurrent symptomatic popliteal cyst. The popliteal cyst had significantly decreased in size on MRI more than 7 months after serial injection of a sclerosing agent (12.5% dextrose and morrhuate sodium). Although patients are reported to experience a positive outcome with these methods, most series are small and a higher level of evidence is needed to support this treatment as safe and effective. Use of fibrin glue as a sealant has needed to support this treatment as safe and effective. Use of fibrin glue as a sealant has some appeal, but this technique has yet to be supported in the literature.

Although conservative and minimally invasive measures are available to treat some of the conditions associated with popliteal cysts, not all may improve without invasive intervention. Currently, arthroscopic procedures are most commonly used to treat the conditions associated with popliteal cysts and to address cysts directly. Historically, open excision has resulted in unacceptably high recurrence rates. Open excision is also associated with much more morbidity and possible complications because of the need for a posterior s- or z-shaped incision in the popliteal area.

The primary goal of surgical intervention in symptomatic popliteal cysts is to resolve the underlying intra-articular pathology and reduce chronic effusion. There is a theory that simply removing the cause of effusion will cause the popliteal cyst to resolve spontaneously. This was tested in a group of 20 patients who were treated for meniscal tears, chondral lesions, a combination of the two, or synovitis. Meniscal lesions were treated with partial meniscectomy, whereas chondral lesions were treated based on severity, with treatment ranging from no treatment for low-grade lesions to debridement for mid-grade lesions to microfracturing for high-grade lesions. Patients who had synovitis underwent synovectomy. Nothing was done arthroscopically to the cyst or the communication, and of the 16 patients who underwent follow-up evaluation 1 to 3 years after the procedure, the cysts had persisted in 11. It may be important to note that 10 of the 11 persisting cysts occurred in patients who had grade III or IV chondral lesions preoperatively, which suggests that arthroscopic treatment of these high-grade lesions may be limited, or at least may not reduce effusion adequately to allow the popliteal cysts to resolve on their own. This finding also raises the question of whether effusion alone is the culprit or if abnormal or restricted communication between the gastrocnemio-semimembranosus bursa and the joint prevents proper fluid movement in the presence of effusion.

Another approach has been reported in which intra-articular pathologies were treated in a standard arthroscopic fashion and then the valvular communication was corrected by opening the orifice to 3 to 4 mm with a motorized shaver. The rationale for this approach was that widening and clearing the communication between the joint and the cyst restores bidirectional fluid flow and a normal gastrocnemio-semimembranosus bursa. In all cases, reduced dimension of the cyst was noted sonographically at 3-month follow-up, followed by decreased size and frequently complete resolution by 12-month follow-up.

Others believe that popliteal cysts are best treated by closing the communication to the cyst. Twenty-two patients were treated arthroscopically for meniscal tears, chondral lesions, or a combination. In addition to these procedures, an arthroscopic suturing technique via an accessory posteromedial working portal was performed to close the communication into the popliteal cyst (Figure 2). Postoperative MRI at 2-year follow-up showed that the cyst had disappeared in 64% of patients, was

reduced in size in 27%, and had persisted in only 9%. Ninety-six percent of patients experienced significant clinical improvement at 2-year follow-up.

Other approaches go a step further and include cystectomy in addition to arthroscopic treatment of internal joint derangements. One study examined the outcome of resection of the valvular opening with hand baskets and a shaver and excision of the wall of the cystic cavity when a fibrous membrane, septae, or nodules were seen in the cyst.51 Of 31 patients treated with this procedure, 94% had significant clinical improvement at follow-up at a mean of 36 months. Follow-up MRI at an average of 8.6 months showed that the cyst had disappeared in 55% of patients and had significantly reduced in size in the remaining 45%. This approach was supported by a similar study with 105 patients that showed uniformly good clinical outcome and no recurrences of the cyst at 2-year follow-up.52

Arthroscopic intervention is favored over open excision because of the successful outcomes of arthroscopic treatment for conditions associated with popliteal cysts. Arthroscopy is minimally invasive, is associated with lower risk, directly addresses both intra-articular pathology and the cyst, and allows early aggressive rehabilitation.

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