

[Imaging]

Treatment of Popliteal (Baker) Cysts With Ultrasound-Guided Aspiration, Fenestration, and Injection: Long-term Follow-up

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Background: The purpose of this study was to determine the efficacy of ultrasound-guided aspiration, fenestration, and injection as a treatment in patients with symptomatic popliteal cysts.

Hypothesis: Ultrasound-guided aspiration, fenestration, and injection (UGAFI) is an effective and safe treatment option for symptomatic popliteal cysts.

Study Design: Retrospective cohort study.

Level of Evidence: Level 3.

Methods: Patients who received a UGAFI of popliteal cysts from 2008 to 2011 were identified. Preaspiration (PA) and follow-up Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, cyst recurrence, complications, cyst complexity, and size were obtained and compared for statistical significance. UGAFI involved aspiration of fluid through a spinal needle, fenestration of the cyst walls and septations, and injection of 1 mL (40 mg) triamcinolone (Kenalog) and 2 mL 0.5% bupivacaine (Sensorcaine) into the decompressed remnant.

Results: The mean PA WOMAC score (48.55) improved significantly at final follow-up (FFU) to 17.15 ($P < 0.0001$) for 47 patients. Within the WOMAC subcategories, there was also a significant difference in pain (PA, 10.68; FFU, 3.94; $P < 0.0001$), stiffness (PA, 4.51; FFU, 1.77; $P < 0.0001$), and physical function (PA, 31.34; FFU, 12.17; $P < 0.0001$). There were 6 reaspirations for recurrence (12.7%), and 1 patient underwent unicompartmental knee arthroplasty. There were no infections or other complications.

Conclusion: Significant clinical improvement in patients with symptomatic popliteal cysts can be achieved via UGAFI as the sole treatment.

Clinical Relevance: UGAFI is a safe and effective option as the sole treatment modality for symptomatic popliteal cysts.

Keywords: Baker cyst; popliteal cyst; knee; ultrasound-guided; cyst aspiration; musculoskeletal ultrasound; osteoarthritis; pain management

Popliteal cysts are a common source of knee pain. With an incidence ranging from 10% to 58%, they are considered the most common mass in the popliteal fossa.^{14,19,23} Despite the eponym *Baker cyst*, it was Adams in 1840 who first described an enlarged bursa beneath the gastrocnemius possessing a valvular

communication with the joint.^{4,5,12} Baker described an intra-articular etiology producing an irreversible flow of synovial fluid from the joint into a bursa between the gastrocnemius and semimembranosus tendons, forming a cyst.^{4,5,11,12,14,17} The resultant fluid-distended bursa, known as the gastrocnemiosemimembra-

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The authors report no potential conflicts of interest in the development and publication of this article.

DOI: 10.1177/1941738115585520

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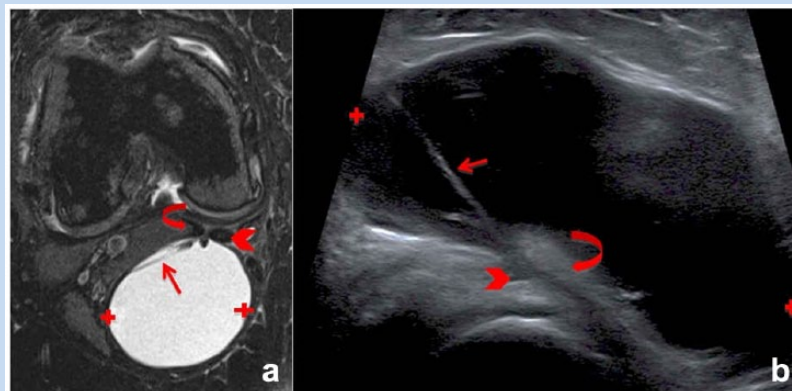


Figure 1. (a) Axial, proton density, fat-suppressed magnetic resonance image (MRI) and (b) axial ultrasound image of the same patient. Both images demonstrate a large mildly complex popliteal (Baker) cyst (calipers), with internal septations (arrows), extending posteriorly between the medial head of the gastrocnemius (curved arrow) and the semimembranosus tendon (chevron). Note: the patient was positioned (A) supine for MRI and (B) prone for ultrasound.

nus bursa, is a composite of the subgastrocnemius bursa located underneath the medial head of the gastrocnemius tendon and a bursa between the medial head of the gastrocnemius and the semimembranosus (Figure 1).² Ultrasound has 100% sensitivity, specificity, positive predictive value, negative predictive value, and accuracy in the diagnosis of a Baker cyst.²³

The incidence of concomitant intra-articular disorders with popliteal cysts is high (94%).^{10,21} Underlying meniscal, ligamentous, and osteochondral derangements result in joint effusion and popliteal cyst formation in adults.^{2,3,5,10-12,18-21} Contemporary treatment algorithms have focused on the surgical correction of the principal etiology prior to cyst aspiration in an effort to avoid cyst recurrence in such patients.^{2,3,20} Conversely, popliteal cysts are a frequent finding in an otherwise normal pediatric knee, and thus, treatment modalities for these patients tend to be more conservative.^{11,22} Recent studies have shown significant clinical improvement of cysts in adults treated with ultrasound-guided aspiration and corticosteroid injection, with postprocedure resolution of the cysts sonographically at follow-up.^{4,6,7,9}

Previous studies have investigated the efficacy of ultrasound-guided aspiration and intra-articular or cyst corticosteroid injection in the setting of knee osteoarthritis yielding favorable outcomes.^{1,4} Although promising, such studies primarily report results for a single diagnosis. Our hypothesis is that ultrasound-guided aspiration is a safe and effective initial treatment modality for symptomatic adult popliteal cysts, even in the setting of osteoarthritis or other internal knee derangement.

METHODS

Internal review board approval was acquired, and informed consent was obtained from all participants enrolled via telephone interview.

All subjects were 18 years or older and underwent ultrasound-guided aspiration and fenestration of symptomatic popliteal cysts between 2008 and 2011. Patients younger than 18 years and any patients with acute ligamentous injuries, mechanical symptoms, and lack of magnetic resonance imaging (MRI) were excluded. Demographic data, cyst size, cyst complexity, and presence of intra-articular pathology identified on MRI, preaspiration (PA) and final follow-up (FFU) Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores were obtained from the medical record and patient interview. Also recorded were any cyst recurrences or complications. Complex cysts were defined as those possessing wall thicknesses greater than 3 mm, internal septations, and internal content (ie, synovitis or intra-articular bodies). PA and FFU WOMAC outcome scores were compared using a 2-tailed Student *t* test. PA WOMAC scores were obtained immediately before the UGAFI. FFU WOMAC scores were obtained at telephone follow-up interview.

The standardized WOMAC orthopaedic questionnaire employed to evaluate clinical outcomes assessed the 3 dimensions of pain, stiffness, and physical functioning pre- and postaspiration. Recurrence data were obtained during patient interviews and chart review and were defined as the reaccumulation of cyst requiring reaspiration or other intervention. Further comparisons were made within each clinical subcategory of the WOMAC score (ie, pain, stiffness, deficit of physical functioning).

All subjects underwent sonographic confirmation of the popliteal cyst using gray scale, color, and power Doppler imaging. Once the presence of a popliteal cyst was confirmed, skin anesthesia via injection of 1% lidocaine without epinephrine was obtained under sterile conditions and direct sonographic visualization.

An 18-gauge, 3.5-inch spinal needle was then advanced posteriorly into the cyst using an “in-plane needle approach”

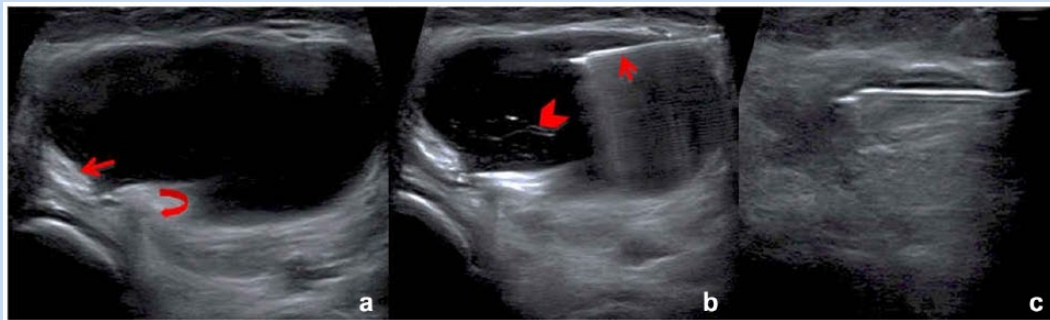


Figure 2. Axial ultrasound images of the patient in Figure 1. (a) Large popliteal cyst extending posteriorly between the medial head of the gastrocnemius (curved arrow) and the semimembranosus tendons (straight arrow). (b) Ultrasound-guided needle placement into the cyst (straight arrow). Note the echogenic internal synovitis (chevron). (c) Ultrasound-guided aspiration of cyst content, resulting in decompression of the cyst walls.



Figure 3. Representative photograph showing the probe and needle position during the procedure. The transducer is placed in the anatomic axial plane and the needle introduced from a posteromedial approach using the “in-plane” technique. A “wider footprint” transducer is preferable, as it allows visualization of both the popliteal neurovascular bundle and needle during the procedure, thereby decreasing the chance of injury.

(Figure 2). The transducer was in the anatomic axial plane and the needle was introduced from a posteromedial approach (Figure 3). The needle was kept away from the adjacent semimembranosus, semitendinosus, gracilis, and medial head of the gastrocnemius to prevent tendon injury. The popliteal neurovascular bundle was constantly visualized sonographically during needle placement to avoid injury. On entering the cyst, the intraluminal content was diluted by injection of 1% lidocaine without epinephrine to facilitate complete evacuation. Once the cyst was completely aspirated and decompressed, the peripheral

Table 1. Patient characteristics

Patient population (n)	47
Sex, n	
Male	10
Female	37
Age, y, mean (range)	55.6 (29-91)
Follow-up, wk, mean (range)	90.2 (4.86-155.71)
Follow-up, wk, median	106.6

walls were fenestrated using the needle tip by puncturing them at a minimum of 6 different locations. Subsequently, the cyst remnant cavity was injected with a therapeutic anesthetic-corticosteroid mixture, consisting of 1 mL (40 mg/mL) of triamcinolone (Kenalog [apothecan]; Bristol-Myers Squibb), 0.5 mL of 1% lidocaine, and 0.5 mL of 0.5% bupivacaine (Sensorcaine; AstraZeneca Pharmaceuticals). Lack of redistention of the decompressed fenestrated cyst remnant with injection of the therapeutic mixture was the determining factor for a successful procedure. Postprocedural knee compression was achieved with an elastic bandage, which was continued for 2 weeks following aspiration to promote adhesion of the decompressed cyst walls.

RESULTS

From 2008 to 2011, a total of 47 patients were enrolled, including 1 with bilateral popliteal cysts, for a total of 48 cysts. Patient demographic data, mean follow-up, and preaspiration cyst size, as determined by the longest dimension in any plane found on ultrasound, were recorded (Tables 1 and 2). Fifteen cysts demonstrated at least 1 sonographic sign of complex

Table 2. Knee and cyst characteristics

Number of patients	47
Number of cysts	48 ^a
Cyst size, cm, mean (range)	3.38 (1.2-7.1) ^b
Complex cysts	15
Wall thickening	8 ^c
Internal septations	6 ^c
Echogenic bodies	3 ^c
Rupture	2 ^c
Internal synovitis	2 ^c
Intra-articular disorders	35 of 48
OA	20 ^d
Tricompartmental OA	9 of 20 ^d
Medial meniscal tear	13 ^d
Lateral meniscal tear	10 ^d
Patellar chondromalacia	5 ^d
Patellar subluxation/tilt	3 ^d
Intra-articular body	2 ^d
Chronic ACL tear	1 ^d
Sclerosis	1 ^d
Prior surgery	5
Arthroscopic meniscectomy	4
ACL reconstruction	1

ACL, anterior cruciate ligament; OA, osteoarthritis.

^aOne patient diagnosed with bilateral popliteal cysts and received bilateral aspirations.

^bMean cyst size determined by the longest dimension found on ultrasound in any plane.

^cIndividual cysts often contained multiple characteristics. Each characteristic is reported separately.

^dIndividual knees often contained multiple disorders. Each intra-articular disorder is reported separately.

features, including 8 with thickened walls, 6 with internal septations, 3 with echogenic loose bodies, 2 ruptured cysts, and 2 with internal synovitis. The cysts exhibited multiple complex features, and their underlying intra-articular diagnoses were identified and analyzed (Table 2).

There was a significant difference in the mean PA WOMAC score of 48.55 and FFU of 17.15 ($P < 0.0001$) (Table 3). Within the WOMAC subcategories, there was also a significant

difference in pain (PA, 10.68; FFU, 3.94; $P < 0.0001$), stiffness (PA, 4.51; FFU, 1.77; $P < 0.0001$), and physical function (PA, 31.34; FFU, 12.17; $P < 0.0001$). There were 6 reaspirations for recurrence (12.7%), and 1 patient eventually underwent a unicompartmental knee arthroplasty (UKA) because of continued knee pain despite aspiration. All of the recurrences were associated with advanced osteoarthritic changes and/or a complex Baker cyst (ie, thickened walls, internal chondral debris, synovitis, and prominent septations). There were no complications identified in the immediate postprocedure period or at final follow-up.

DISCUSSION

The recurrence rate of 12.7% compares favorably with surgical outcomes reported in the literature, which range from 5% to 70%.^{18,19} Arthroscopic treatment of popliteal cysts in a series of 30 patients achieved optimal or good clinical results in 95% of patients 2 years after treatment.²⁰ In a series of 14 patients, concurrent removal of the capsular fold in addition to cystoscopic debridement achieved optimal clinical results at a mean FFU of 29.7 months.¹⁵ It is beneficial to locate the connection between the joint cavity and the cyst and to create a posteromedial cystic portal to prevent recurrence; in 17 consecutive patients, none had recurrence of the cyst at a mean follow-up of 31 months.³ Surgical intervention must focus on treatment of the associated intra-articular lesion as well as interruption of the communication between the joint space and the popliteal cyst.¹⁸ Ahn et al³ demonstrated the benefit of arthroscopic decompression, with or without a posteromedial cystic portal, in all of their 31 patients. Each patient in their study experienced improvement at FFU of 36.1 months, marked by return to previous activity level, MRI-confirmed disappearance, or statistically significant decrease in cyst size, with no additional surgical intervention required.³

Recent studies have challenged conventional methodology by demonstrating favorable outcomes using ultrasound-guided aspiration and steroid injection of adult popliteal cysts without surgical correction of underlying knee disorders. In 30 osteoarthritic knees with symptomatic popliteal cysts, a single intra-articular triamcinolone acetonide injection achieved significant improvement in pain, swelling, range of motion, cyst size, and wall thickness at follow-up imaging after 4 weeks.¹ Aspiration of 26 popliteal cysts under ultrasound guidance with steroid injection obtained statistically significant improvement on the visual analog pain scale, the pain subcategory of the WOMAC scale, and cyst area after 4 weeks.⁹ Ultrasound-guided popliteal cyst aspiration in a randomized controlled trial of 60 patients with osteoarthritis showed that cyst evacuation in combination with corticosteroid injection and horizontal therapy had the best improvement in the visual analog pain scale and WOMAC scores at 1-month follow-up, but no change in maximum axial area in ultrasound measurements in cysts that remained.⁸ Bandinelli et al⁴ compared cyst sizes in 20 patients receiving intra-articular steroid injections versus 20 patients receiving direct cyst injections,

Table 3. WOMAC and Outcome Data^a

	PA WOMAC	FFU WOMAC	P value ^b
Total scale	48.55	17.15	<0.0001
Subscales			
Pain	10.68	3.94	<0.0001
Stiffness	4.51	1.77	<0.0001
Function	31.34	12.17	<0.0001
	Total	Percentage	
Recurrence ^c	6	12.7	
Complications	0	0.0	

FFU, final follow-up; PA, preaspiration; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

^aWOMAC score represents mean of study population.

^bP values were obtained using the Student *t* test; *P* < 0.05 considered statistically significant.

^cRecurrence defined as reaccumulation of cyst requiring reaspiration.

revealing a significant difference in size reduction favoring direct cyst infiltration. In 2012, Koroğlu et al¹⁶ divided 32 patients into simple or complex cyst groups and followed them 6 months after ultrasound-guided aspiration and direct steroid injection. There was an overall significant volume decrease and clinical improvement, with 6 recurrences all occurring in the complex type.¹⁶ Additionally, lidocaine infiltration has a theoretical benefit of making the collagenous cyst wall more permeable to the steroid, controlling postprocedural pain, decreasing inflammation and wall thickness, and reducing their recurrence; however, this has not been conclusively demonstrated in the literature.^{13,16}

Cyst wall fenestration under direct sonographic visualization using the needle tip and postprocedural compression using the elastic bandage for a minimum of 2 weeks are critical components for a successful intervention outcome with decreased cyst recurrence, as they prevent recurrent synovial fluid imbibition between the cyst walls and promote adherence, resulting in increased fibrin adhesion and scarring of the remnant.

All 6 patients requiring reaspiration and the single individual who underwent UKA had complex cysts, severe osteoarthritic changes, or both. Patient selection based on cyst features as well as the nature and severity of underlying intra-articular disorders may serve to tailor treatment and provide patients with reasonable expectations. Aspiration of popliteal cysts in the setting of osteoarthritis in patients with mild to moderate osteochondral changes, those who wish to delay definitive arthroplasty, or poor operative candidates may achieve provisional symptom relief.

The limitations of the present study include a modest sample size representing a single geographic region. The present study focused on clinical outcomes based on patient surveys, and thus, physical examination findings at FFU were not obtained. Ancillary treatments were not controlled for; therefore,

concomitant over-the-counter drugs and alternative medicine treatments may be confounding factors influencing final outcomes. In addition, the study design with lack of randomized control and comparison groups limits the confidence in the conclusions reached from the data. Furthermore, since cyst wall fenestration was performed in all subjects, we are unsure exactly where the steroid went, as it could have leaked out of the cyst and gone elsewhere.

CONCLUSION

Significant clinical improvement in patients with symptomatic popliteal cysts can be achieved via ultrasound-guided intervention as the sole treatment. These findings were best demonstrated in patients without complex cysts or severe tricompartmental osteoarthritis.

ACKNOWLEDGMENT

The authors would like to thank Michael Rivlin, MD, Radiology, Baylor College of Medicine.

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