

## Original Article

# Prevalence of Baker's cysts in painful primary osteoarthritis of the knee: a musculoskeletal ultrasound study

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**Objectives:** To investigate the prevalence of the Baker's cyst in patients with primary painful knee osteoarthritis (OA).

**Methods:** Prospective clinical and musculoskeletal ultrasound (MUS) findings in 150 patients with primary painful knee OA diagnosed by ACR criteria were studied. The relationship between the Baker's cyst and the variables joint effusion, synovitis, osteophytes and radiological grades of Kellgren and Lawrence were analysed.

**Results:** Baker's cysts were demonstrated by MUS in 54 (21.2%) of 254 knees or 40 (26.7%) of 150 patients. Only 18 (33.9%) of 54 cysts had been diagnosed clinically. One of the 54 cysts ruptured. Joint effusion, synovitis and osteophytes were detected in 59.8%, 30.3% and 48.8% of knees respectively. There was a highly significant correlation between the presence of Baker's cyst with knee effusion and synovitis ( $p < 0.001$  and  $p < 0.001$ , respectively). There was also a significant correlation of the presence of Baker's cyst with osteophytes and the radiographic grade ( $p < 0.01$  and  $p < 0.05$ , respectively).

**Conclusion:** The results indicate that Baker's cysts are common in knee OA, and that they may be missed clinically. Therefore, MUS should be more widely employed by clinicians in the diagnosis of Baker's cysts, which may sometimes be accompanied by significant morbidity.

**Key words:** Baker's cyst, musculoskeletal ultrasound, knee osteoarthritis

## Introduction

Baker's cysts (popliteal cysts) commonly arise as an abnormal distension of a communicating gastrocnemio semimembranous bursa [1]. They occur in a variety of knee conditions, chiefly osteoarthritis (OA), rheumatoid arthritis, and meniscal injuries [2-4]. These fluid-filled cysts are important because they may be overlooked or

may mimic other conditions. The distended bursa can appear clinically as a posterior mass, mimicking a true soft-tissue mass, or popliteal artery aneurysm [5]. A cyst may cause pseudothrombophlebitis and cellulitis due to leakage or rupture [6-8] and deep venous thrombosis [9] or ischemia [10] as a result of direct compression of the popliteal vein and artery, respectively. The frequency of Baker's cysts in patients with knee OA is unknown. In recent years, musculoskeletal ultrasound (MUS) has emerged as a reliable, rapid, highly sensitive, noninvasive technique for the diagnosis and evaluation of Baker's cysts [11]. We undertook this prospective study to determine (a) the prevalence of Baker's cysts in patients with knee OA and (b) the relationships of Baker's cysts with effusion, synovitis, osteophytes, and radiographic grade.

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## Materials and Methods

One hundred and fifty consecutive patients (59 males and 91 females) attending the outpatient rheumatologic clinic with unilateral or bilateral primary knee OA according to ACR criteria [12] were included. Their mean age was  $65.2 \pm 11.8$  (range 45~95) years. The median disease duration was  $3.5 \pm 2.6$  (range 0.4~12) years. No patients had a clinical history of mechanical knee derangement, inflammatory arthritis, microcrystalline arthropathy, or knee trauma or surgery. No patient had received arthrocentesis and/or an intra-articular steroid injection during the last 3 months. Informed consent was obtained from all patients prior to the clinical, radiographic, and MUS evaluations.

### Clinical assessment

Clinical evaluation of both knees was performed by two authors of this study who recorded demographic data, and duration of symptoms from each patient. Information on symptoms (swelling or pain) from the knee and popliteal fossa was specifically sought. The posterior knee was examined in full extension and in up to 90° of flexion, as the patient lay flat on his/her back with the examiner's thumb around the anterior of the knee while the fingers posteriorly palpated deeply and firmly into the fossa; the examiner lifted the relaxed knee through various degrees of flexion. The round, smooth, fluctuant, transilluminating, often- tender mass exhibited increased tension on extension and may have softened or disappeared on flexion to 45° (Foucher's sign) [13].

### Radiographic assessment

Weight-bearing anteroposterior (AP) and lateral knee radiographs were read by a third rheumatologist (HYL) who was blinded to the clinical and MUS findings assessed the severity of OA on the AP view using the Kellgren and Lawrence (K & L) scale (with scores of 0-4) [14].

### US assessment

All patients underwent a MUS examination of the knees by a rheumatologist (FCL) who was experienced in this technique and blinded to the clinical and radiographic assessments, using a commercially available ultrasound real-time scanner (Model2356A, EnVisor, Philips) with a multi-frequency linear transducer (7~12 MHz) and color Doppler ability. The MUS examination was performed according to a standardized scanning method [15]. The following

techniques were used: transverse and longitudinal scans through the suprapatellar recess, longitudinal scans laterally and medially to the patella and along the joint space (patients with supine and knees extension position), and longitudinal and transverse scans of the popliteal fossa (patients with prone and knees extension position).

The maximum thickness of the synovial membrane of the anterior wall of the suprapatellar recess and the maximum anteroposterior width of the effusion were measured on the longitudinal suprapatellar scan (taking care not to squeeze the recess by avoiding firm compression of the probe). A compression test was used to differentiate joint fluid and the synovial membrane. During compression of the suprapatellar recess, movable fluid disappeared, while the synovial membrane remained in the imaging plane [16]. Joint effusion detected by MUS was defined as an anechoic area and graded as 0 / absent; (<2 mm), 1 / mild; (2~5 mm), 2 / moderate; (>5~10 mm), or 3 / severe; (>10 mm) [17]. Synovitis was defined as hypoechoic synovial hypertrophy with a thickness of >2 mm and was graded on the same scale used in other studies: 0 (<2 mm), 1 (2~5 mm), 2 (>5~8 mm), and 3 (>8 mm) [17,18]. Osteophytes were detected as irregularities in the bone contour.

Baker's cyst was identified when the gastrocnemius semimembranous bursa was filled with anechoic or hypoechoic fluid and showed a transverse diameter of >4 mm. A ruptured Baker's cyst showed a pointed distal aspect [19]. Baker's cysts were evaluated and graded on a scale of 0~3 according to the size: 0, (no Baker's cyst); 1, (small, <2 cm); 2, (medium, 2~5 cm); and 3, (large, >5 cm) [20].

We performed US scanning of both knee in 20 (5 males and 15 females) asymptomatic healthy volunteers (40 knees). Their mean age was  $65.3 \pm 4.6$  (range 50~75) years.

### Statistical analysis

Statistical analysis was performed using the standard software package SPSS 11.0 for Windows. Chi-squared test was used to evaluate the correlations of Baker's cyst with effusion, synovitis, osteophytes, clinical findings, and radiographic grade.

## Results

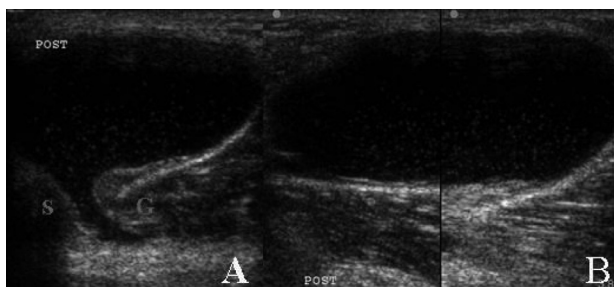
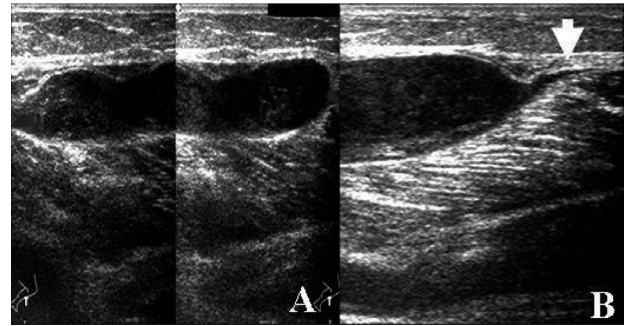
Clinical, MUS, and radiographic findings in 254 OA knees are presented in Table 1. Baker's cysts (Fig. 1) were demonstrated by MUS in 54 (21.2%) of 254 knees

**Table 1.** Clinical, musculoskeletal ultrasound and radiographic findings in 254 osteoarthritic knees

|                                |             |
|--------------------------------|-------------|
| Clinical findings              |             |
| Age (years) (mean, SD)         | 64.4 ± 11.4 |
| Knee involved                  |             |
| Right knee (n, %)              | 135 (53.1)  |
| Left knee (n, %)               | 119 (46.9)  |
| MUS findings                   |             |
| Baker's cyst                   |             |
| Grade 0: None (n, %)           | 202 (78.7)  |
| 1: <2 cm (n, %)                | 26 (10.2)   |
| 2: 2~5 cm (n, %)               | 19 (7.5)    |
| 3: >5 cm (n, %)                | 9 (3.5)     |
| Effusion                       |             |
| Grade 0: <2 mm (n, %)          | 102 (40.2)  |
| 1: 2~5 mm (n, %)               | 85 (33.5)   |
| 2: >5~10 mm (n, %)             | 49 (19.3)   |
| 3: >10 mm (n, %)               | 18 (7.1)    |
| Synovitis (synovial thickness) |             |
| Grade 0: <2 mm (n, %)          | 177 (69.7)  |
| 1: 2~5 mm (n, %)               | 63 (24.8)   |
| 2: >5~8 mm (n, %)              | 11 (4.3)    |
| 3: >8 mm (n, %)                | 3 (1.2)     |
| Osteophyte, n (%)              |             |
| Absent (n, %)                  | 130 (51.2)  |
| Present (n, %)                 | 124 (48.8)  |
| Radiographic findings          |             |
| K & L grade                    |             |
| Grade I (n, %)                 | 60 (23.6)   |
| Grade II (n, %)                | 104 (40.9)  |
| Grade III (n, %)               | 73 (28.7)   |
| Grade IV (n, %)                | 17 (6.7)    |

Abbreviation: K & L grade = Kellgren and Lawrence radiological grade.

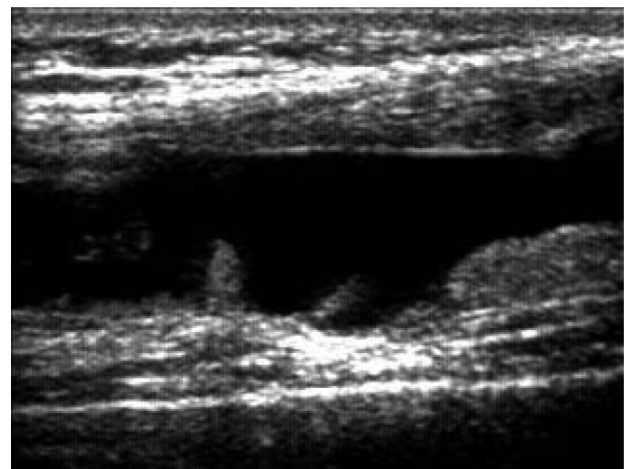
or 40 (26.7%) of 150 patients, 14 (25.0%) of whom had bilateral cysts. Cysts size ranges in size from 0.5 to 10 cm in diameter (longitudinal scan). The majority (83.3%) of cysts were small to medium (<5 cm). Evidence for rupture or leakage was seen in 1 (Fig. 2) of the 54 Baker's cysts. Joint effusion (Fig. 3) was detected in

**Figure 1.** Ultrasonography of Baker's cyst. A: Transverse view, G: Gastrocnemius tendon, S: Semimembranosus tendon, B: Longitudinal view.**Figure 2.** Ultrasonography of ruptured Baker's cyst. A: Longitudinal view of body, B: Irregular border (white arrow) with fluid extension to Gastrocnemius tendon.

59.8% of knees. Synovitis (Fig. 3) and osteophytes were detected 30.3% and 48.8% of knees respectively.

A clinical diagnosis of a cyst agreed with the MUS findings in only 18 (33.9 %) of 54 knees. In the remaining 36 (66.1%) knees, cysts were detected by MUS but were not found on the physical examination. Patient's subjective complaints of swelling behind the knee correlated with MUS findings in only 15 (27.8%) of 54 knees.

Relationships of knee effusion, synovitis, osteophytes, and radiographic grade with the presence of Baker's cyst are presented in Table 2. A high correlation was noted between the presence of Baker's cysts and knee effusion. An effusion was present in 43 of 54 (88.9%) knees with cysts, compared to 96 of 200 (48.0%) knees without cysts ( $p < 0.001$ ). A high correlation was also noted between the presence of Baker's cysts and synovitis. Synovitis was present in 33 of 54 (61.1%) knees with cysts, compared to 44 of 200 (22.0%) knees without cysts ( $p < 0.001$ ). The presence of a Baker's cyst

**Figure 3.** Ultrasonography of suprapatellar pouch of knee with effusion (E) and synovium (black arrows).

**Table 2.** Relationships of knee effusion, synovitis, osteophyte, and radiographic grade with Baker's cysts

| Predictive factor    | Baker's cyst   |               | p       |
|----------------------|----------------|---------------|---------|
|                      | Present (n, %) | Absent (n, %) |         |
| Effusion             |                |               |         |
| Present (n, %)       | 48 (88.9)      | 104 (52.0)    | <0.0001 |
| Absent (n, %)        | 6 (11.1)       | 96(48.0)      |         |
| Synovitis            |                |               |         |
| Present (n, %)       | 33 (61.1)      | 44 (22.0)     | <0.0001 |
| Absent (n, %)        | 21 (38.9)      | 156 (78.0)    |         |
| Osteophyte           |                |               |         |
| Present (n, %)       | 34 (63.0)      | 90 (45.0)     | <0.05   |
| Absent (n, %)        | 20 (37.0)      | 110 (55.0)    |         |
| K & L grade          |                |               |         |
| Grade I, II (n, %)   | 28 (51.9)      | 136 (68.0)    | <0.05   |
| Grade III, IV (n, %) | 26 (48.1)      | 64 (32.0)     |         |

Abbreviation: K & L grade = Kellgren and Lawrence radiological grade.

was correlated with osteophytes and the radiographic grade ( $p < 0.05$  and  $p < 0.05$ , respectively).

None of the control subjects had a Baker's cyst or other MUS knee abnormalities.

## Discussion

OA is the most frequent primary disorder associated with a Baker's cyst [2-4]. The frequency of OA as a cause of Baker's cysts in adults varies widely in different series, ranging from 6% to 45% [2-4].

The incidence of Baker's cysts in our study group was 21.2% of knees. This finding correlates well with the study by Naredo et al. [19], in which cysts were detected in 22% of knees; but was lower than the report of Fam et al. [21], who noted a 42% rate. We believe that the high prevalence rate of Fam et al. may be a result of their small sample size and use of patients with different severities of knee OA. The significant relationships between the occurrence of Baker's cysts, and the presence of knee effusion and radiographic grade were consistent with results of the study by Fam et al.

The patient population also has an effect on the prevalence of Baker's cysts. Our 26.7 % rate in knee OA patients is within the range of other reports in similar populations [2-4,19,21]. In contrast, studies in patient populations with rheumatoid or other inflammatory arthritides show a much-higher prevalence; a sonographic study of 44 children with juvenile rheumatoid arthritis and other arthritic conditions [22] revealed a 61% prevalence. Similar rates were found in cohorts of cases with rheumatoid arthritis by Merie et al. [23] and

Carpenter et al. [5].

The presumed cause of Baker's cysts in inflammatory and degenerative arthropathies of the knees is effusion [24-26]. Effusion causes increased intra-articular pressure, which then forces joint fluid through a weakened posteromedial joint capsule into the potential space of the gastrocnemiosemimembranous bursa [27,28]. Our data confirmed the relationship between joint effusion and Baker's cysts, while they also suggested statistically significant associations between Baker's cysts and synovitis.

The association between osteophytes and Baker's cysts implies that the altered biomechanics resulting from osteophytes may be enough to squeeze even normal amounts of fluid. This theory was supported by Pedowitz et al. [29].

Most Baker's cysts in our series were small to medium ( $< 5$  cm), asymptomatic, and clinically inapparent. Patient's complaints of swelling in the popliteal space and physical examination findings were poor predictors of cyst presence. Cyst rupture was found in one of 54 cysts, that was similar with some series which reported low incidences of ruptured Baker's cysts in patients with knee OA [30-32].

Limitations noted in our study precluded assessing the diagnostic accuracy of MUS scanning because we focused on the prevalence and significance of Baker's cysts in OA. Baker's cysts may be imaged with a variety of techniques including arthrography, computed tomography (CT), ultrasound, and magnetic resonance imaging (MRI). Confirmation by arthrography was considered impractical and too invasive. CT is expensive and employs ionizing radiation. The limitations of MRI are its expense and availability. Recent studies have indicated that MUS is highly sensitive and specific in detecting Baker's cyst [21,33]. Moreover, a study comparing MUS scanning with MRI showed a high correlation [34].

Another limitation of this study was the inherent operator dependence in the acquisition of the sonographic data and images. Kappa statistics for interobserver variability were not calculated. In addition, MR imaging was not used as the gold standard, and pathologic proof was not presented for the diagnosis of Baker's cysts in our study.

In conclusion, Baker's cysts are common in knee OA, but they may not be found on physical examination. Thus MUS should be more widely employed by clinicians in the diagnosis of Baker's cysts, which may sometimes be accompanied by significant morbidity.

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# 貝克氏囊腫在原發性疼痛退化性膝關節炎之發生率：骨骼肌肉超音波研究

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**目的：**調查原發性疼痛退化性膝關節炎病患中，貝克氏囊腫的盛行率。**方法：**對於150位根據美國風濕學會準則診斷的原發性疼痛退化性膝關節炎病患，進行臨床與骨骼肌肉超音波的研究探討。分析貝克氏囊腫與變數如關節積液、滑膜炎、骨刺及X光分級的關係。**結果：**藉由骨骼肌肉超音波，我們發現在254個膝關節中有54個膝關節(21.2%)有貝克氏囊腫(或在150個病患中有40個病患(26.7%)具有貝克氏囊腫)。在54個貝克氏囊腫中，只有18個(33.9%)臨床上有被診斷出來。在54個貝克氏囊腫中，其中有一個破裂。關節積液、滑膜炎、骨刺在膝關節偵測出來的比例分別是59.8%、30.3%及48.8%。貝克氏囊腫的盛行率與關節積液及滑膜炎有高度重要的關連性( $p<0.001$ 及 $p<0.001$ )。而骨刺及X光分級與貝克氏囊腫的盛行率也有重要的關連性( $p<0.01$ 及 $p<0.05$ )。**結論：**貝克氏囊腫在退化性膝關節炎的病患中是常見的，而且它們在臨床檢查中易被忽略，貝克氏囊腫也可能造成併發症。因此，臨床醫師應常用骨骼肌肉超音波來診斷貝克氏囊腫。

**關鍵詞：**貝克氏囊腫、骨骼肌肉超音波、退化性膝關節炎。