

Arthroscopic Treatment of Popliteal Cysts with and without Cystectomy: A Systematic Review and Meta-Analysis

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Purpose: To compare the clinical outcomes of the arthroscopic treatments for popliteal cysts with and without cystectomy.

Methods: PubMed/MEDLINE, EMBASE, KoreaMed, and Cochrane Library were searched from the earliest available date of indexing through August 2016. The methodological quality of all articles was assessed according to the Coleman methodology score (CMS). Studies were grouped according to the surgical method, and a meta-analysis was conducted to identify the unsuccessful clinical outcome and complication rates.

Results: Nine studies were included; the mean CMS was 67.33 (standard deviation, 8.75 points). Cystectomy was reported in five studies; cystectomy was not performed in four studies. The odds ratio of unsuccessful clinical outcomes evaluated by Rauschnig and Lindgren score was 122.05 ($p < 0.001$) with cystectomy and 58.12 ($p < 0.001$) without cystectomy. The effect size of complications was 0.16 ($p < 0.001$) with cystectomy and 0.03 ($p < 0.001$) without cystectomy. The recurrence rate was 0% with cystectomy and 6.4% without cystectomy.

Conclusions: All the currently available studies showed satisfactory outcomes in both with and without cystectomy groups. However, arthroscopic cystectomy concurrently performed with management of intra-articular lesions was associated with a relatively low recurrence rate and a relatively high incidence of complications.

Keywords: Knee, Popliteal cyst, Arthroscopy, Cystectomy, Systematic review, Meta-analysis

Introduction

Popliteal cysts (also called Baker's cysts) are most frequently characterized by the enlargement of the gastrocnemius-semi-

membranous bursa in the posteromedial region of the knee. They were first described by Adams¹⁾ in 1840, and Baker²⁾ described the association of popliteal cysts with intra-articular lesions in 1877. The majority of primary popliteal cysts without communication to the joint are found in children without associated knee disorders³⁾. The prevalence of communication between the gastrocnemius-semimembranous bursa and the knee joint cavity in adults varies in relation to the type of study. Handy⁴⁾ reported that a connection was observed in 30%–50% of cadaveric dissections, 55% of open surgical excisions, 37% of knee diagnostic arthroscopies, and 50% of arthrograms of normal knee joints, even without a popliteal cyst. Several studies on the pathogenesis of popliteal cysts have shown that they are associated with intra-articular pathology and valvular mechanism⁵⁻⁷⁾. Thus, popliteal cysts are almost never an isolated pathology in adult knees and are almost always associated with another pathology of the knee

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joint such as a meniscal tear and osteoarthritis⁸⁻¹⁰. Moreover, the presence of a valve and the existence of an effusion create unidirectional flow of synovial fluid from the articular cavity to the cyst, which is one of the fundamental factors responsible for the formation and persistence of cysts⁶. Although incidentally detected asymptomatic popliteal cysts do not require treatment, large cysts can cause popliteal pain or limit the range of motion (ROM), hence the target of surgical intervention¹¹.

Many methods of surgical resection have been suggested. The recurrence rate seems to be high (up to 63%) after a simple open resection^{9,12}. One important reason is the intra-articular pathology that caused the knee effusion is not treated by an open procedure. Also, it is difficult to obtain a tight closure over the opening after open excision, and a large open wound appears necessary¹³. Since Sansone and De Ponti⁶ suggested changes in treatment strategies in 1999, the focus has been shifted toward treatment of the associated intra-articular pathology with use of the least invasive manner possible. An arthroscopic approach to a popliteal cyst could effectively manage not only the cyst by arthroscopic decompression but also the associated intra-articular pathology¹⁴.

Recent advances in arthroscopic techniques make it possible to effectively address the intra-articular pathology, particularly the orifice of the cyst and the cyst itself, which has a valvular mechanism¹⁵. Resecting the inner wall and septa inside the cyst while correcting the valvular mechanism has produced excellent results

in previous papers^{6,16-19}. An arthroscopic procedure without cystectomy also produced satisfactory clinical outcomes without intra- or postoperative complications^{7,11,14,20}. Interestingly, none of the published studies directly compared clinical outcomes of arthroscopic valve debridement with and without cystectomy. There was a previous systematic review reported by Zhou et al.²¹, which investigated open surgical excision procedures without comparison of complication and recurrence rates. The purpose of this systematic review and meta-analysis was to compare clinical outcomes and complication and recurrence rates after arthroscopic treatment of popliteal cysts with and without cystectomy.

Methods

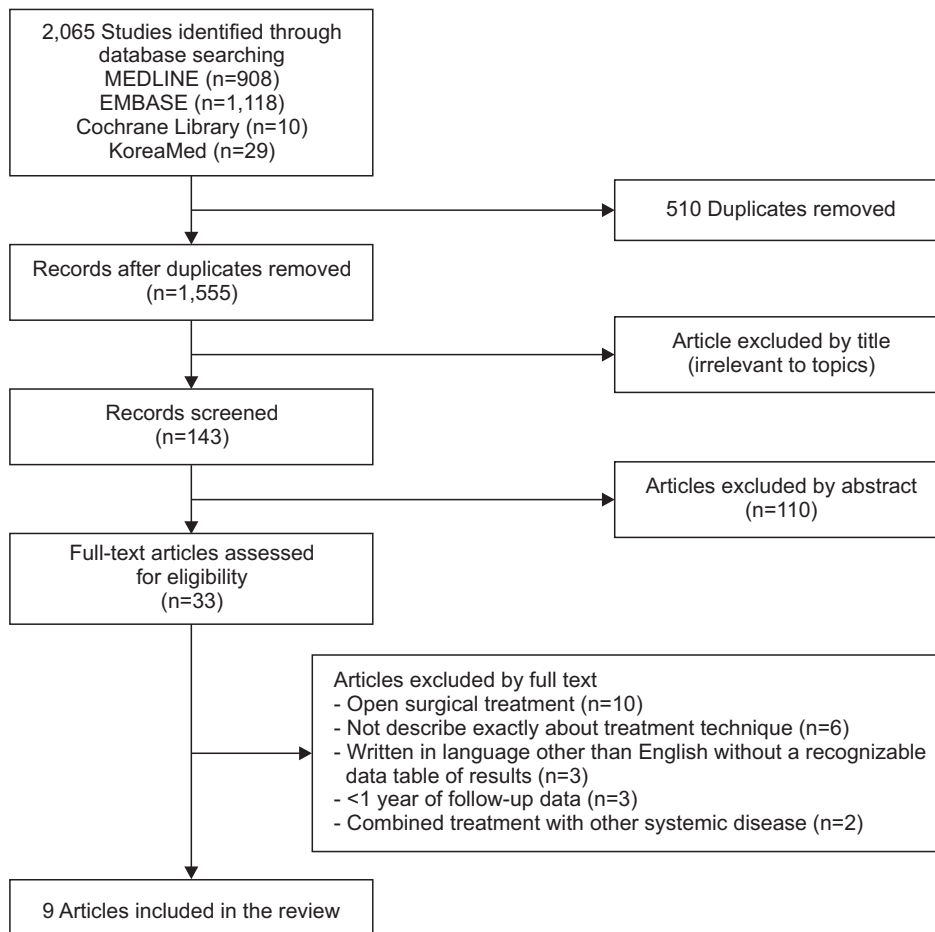
We searched PubMed/MEDLINE, EMBASE, KoreaMed, and Cochrane Library to conduct a systematic review of literature from January 1967 to August 2016. The detailed search strategy is presented in Table 1. This search yielded 2,065 hits: 908 from PubMed/MEDLINE, 1,118 from EMBASE, 10 from Cochrane and 29 from KoreaMed. Duplicated studies, nonhuman studies, studies of extra knee joint cysts, conservative treatment and open surgery studies were excluded, leaving 33 articles for literature review. All the references in the identified studies were manually checked to detect any additional published data, and they were included if they met the inclusion criteria. Table 2 summarizes

Table 1. Search Terms Used in Each Database

Database	Search term	No. of papers retrieved
PubMed/MEDLINE	1. "Baker's Cyst"[tiab] OR "Baker Cyst"[tiab] OR "Baker Cysts"[tiab] OR "Popliteal Cysts"[tiab] OR "Popliteal Cyst"[tiab] OR "Baker's Cysts"[tiab] 742 2. "Popliteal Cyst"[Mesh] 473 3. 1 OR 2 908	908
EMBASE	1. 'Bakers Cyst':ab,ti OR 'Baker Cyst':ab,ti OR 'Baker Cysts':ab,ti OR 'Popliteal Cysts':ab,ti OR 'Popliteal Cyst':ab,ti OR 'Bakers Cysts':ab,ti 573 2. 'popliteal cyst'/exp 10761 3. 1 OR 2 1226 4. 3 NOT 'nonhuman'/de 1212 5. 4 NOT ('article in press'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it OR 'short survey'/it) 1118	1,118
Cochrane	1. "Baker's Cyst" OR "Baker Cyst" OR "Baker Cysts" OR "Popliteal Cysts" OR "Popliteal Cyst" OR "Baker's Cysts":ab,ti,kw 10 2. MeSH descriptor: [Popliteal Cyst] explode all trees 1 3. 1 OR 2 10	10
KoreaMed	1. "Baker's Cyst"[ALL] OR "Baker Cyst"[ALL] OR "Baker Cysts"[ALL] OR "Popliteal Cysts"[ALL] OR "Popliteal Cyst"[ALL] OR "Baker's Cysts"[ALL] 29	29
Total		2,065

Table 2. Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Studies on patients who underwent popliteal cyst treatment not combined with treatment for another disease	Studies on patients who underwent popliteal cyst treatment combined with treatment for rheumatoid arthritis or tuberculosis
Studies on patients who underwent popliteal cyst surgery within the knee area	Studies on patients who underwent popliteal cyst surgery that affected extra knee areas
Studies with an adequate description of the arthroscopic technique used for a popliteal cyst	Studies using conservative treatment or open surgical treatment
Since 1900	Before 1900
Articles written in English	
Article written in language other than English but with a recognizable data table of results	
Human subjects	Nonhuman subjects
Studies reporting a minimum of 1-year follow-up data	Studies reporting <1 year of follow-up data

**Fig. 1.** Flowchart of the article selection process.

the inclusion and exclusion criteria. On the basis of the exclusion criteria (Table 2) and review of the abstracts and full texts, nine studies were ultimately included in the analysis (Fig. 1).

Two authors independently reviewed the full text of the nine articles. The methodological quality of each study included in the

analysis was evaluated using the Coleman methodology score (CMS)²², which contains 10 criteria and produces a final score ranging from 0 to 100 points. Each author scored the methodological quality of the studies twice; disagreement was resolved by consensus among the authors. All data were extracted into an

Table 3. Characteristics of the Included Studies

Study	Publication year	Type of study	Level of evidence	No. of patients	No. of follow-up (mo)	Treatment	Functional outcomes, (RL score)		Recurrence	Complication	Type of complication
							Before surgery	Final follow-up			
Ahn et al. ¹⁴⁾	2010	Case series	IV	31	36.1	A/S valve debridement with cystectomy and A/S treatment of concomitant lesions	Grade 1: 6 Grade 2: 19 Grade 3: 6	Grade 0: 25 Grade 1: 5 Grade 2: 1	0 (0)	0 (0)	None
Cho ⁷⁾	2012	Case series	IV	111	24	A/S valve debridement with cystectomy and A/S treatment of concomitant lesions	Grade 1: 96 Grade 2: 10 Grade 3: 5	Grade 0: 98 Grade 1: 13	0 (0)	5 (4.5)	Hematoma: 4 Discomfort: 1
Ko and Ahn ²⁵⁾	2004	Case series	IV	14	29.7	A/S valve debridement with cystectomy and A/S treatment of concomitant lesions	Grade 1: 3 Grade 2: 10 Grade 3: 1	Grade 0: 14	0 (0)	5 (35.7)	Hematoma: 1 Pain & swelling: 2 Technical error: 2
Lie and Ng ¹³⁾	2011	Case series	IV	10	13	A/S valve debridement with cystectomy and A/S treatment of concomitant lesions	Grade 2: 6 Grade 3: 4	Grade 0: 7 Grade 1: 3	0 (0)	2 (20.0)	Infection: 1 Discomfort: 1
Wang et al. ²⁶⁾	2014	Case series	IV	20	16	A/S valve debridement with cystectomy and A/S treatment of concomitant lesions	Grade 1: 2 Grade 2: 6 Grade 3: 12	Grade 0: 14 Grade 1: 6	0 (0)	0 (0)	None
Calvisi et al. ²⁸⁾	2007	Case series	IV	22	24	A/S valve closure without cystectomy and A/S treatment of concomitant lesions	Grade 1: 2 Grade 2: 15 Grade 3: 5	Grade 0: 14 Grade 1: 5 Grade 2: 2 Grade 3: 1	2 (9)	0 (0)	None
Ji et al. ²⁷⁾	2009	Case series	IV	44	36	A/S valve debridement without cystectomy and A/S treatment of concomitant lesions	Grade 0: 4 Grade 1: 22 Grade 2: 14 Grade 3: 4	Grade 0: 28 Grade 1: 12 Grade 2: 3 Grade 3: 1	6 (13.6)	1 (2.2)	Discomfort: 1
Ohishi et al. ¹¹⁾	2015	Case series	IV	29	22.9	A/S valve debridement without cystectomy and A/S treatment of concomitant lesions	Grade 1: 2 Grade 2: 16 Grade 3: 11	Grade 0: 26 Grade 1: 1 Grade 2: 1 Grade 3: 1	1 (3.4)	0 (0)	None
Sansone and De Pont ⁶⁾	1999	Case series	IV	30	32	A/S valve debridement without cystectomy and A/S treatment of concomitant lesions	Grade 1: 3 Grade 2: 18 Grade 3: 9	Grade 0: 19 Grade 1: 10 Grade 2: 1	1 (3.3)	1 (3.3)	Pain & swelling: 1

Values are presented as number only or number (%).
RL: Rauschning and Lindgren, A/S: arthroscopic.

Excel spreadsheet ver. 2016 (Microsoft, Redmond, WA, USA). The extracted data included details of the study design, study period, patient demographics (sex, mean age, and mean duration of follow-up), pre- and postoperative functional scores, surgical technique, and complication rate. All statistical analyses were performed with RevMan version 5.3 software (The Cochrane Collaboration, Copenhagen, Denmark) and Stata version 14.2 static software (StataCorp., College Station, TX, USA).

The Rauschning and Lindgren (RL) knee score²³⁾ was used to evaluate the treatment outcome and efficacy in all nine studies. The parameters considered in the RL criteria are subjective symptomatology related to the presence of a popliteal cyst (pain and a posterior sense of tension in the popliteal fossa) and the clinical importance of posterior swelling or reduction in the ROM. All included studies were evaluated by using the following scale⁶⁾:

grade 0, absence of swelling and pain, no limitation in ROM; grade 1, light swelling or sense of posterior tension after intense activity, minimal limitation of ROM; grade 2, swelling and pain after normal activity, ROM limitation less than 20°; and grade 3, swelling and pain even when resting, ROM limitation more than 20°.

We used a forest plot for the heterogeneity evaluation performed using the p-values and I² values. Then, on the basis of the heterogeneity evaluation and the number of studies included, we investigated the odds ratio (OR) of the presence of a grade 2 or higher RL functional evaluation, which indicates an unsuccessful clinical score²⁴⁾, in each arthroscopic treatment group.

Results

Characteristics of the included studies, such as pathology associated with popliteal cysts and demographic/baseline charac-

Table 4. Intra-articular Knee Pathologies Associated with Popliteal Cysts in All Included Studies (n=311)

Associated pathology	No. of cases (%)
Medial meniscus tear	164 (52.7)
Degenerative change	102 (32.8)
Synovitis and synovial hypertrophy	73 (23.5)
Chondromalacia and chondral defect	61 (19.6)
Lateral meniscus tear	22 (7.1)
Plica syndrome	9 (2.9)
Loose body (intra-articular)	3 (1.0)
Anterior cruciate ligament rupture	3 (1.0)

Table 5. Demographic and Baseline Characteristics of the Study Patients

	Cystectomy ^{7,13,15,26,27)}	Without cystectomy ^{6,11,28,29)}	Total
No. of studies	5	4	9
Total no. of patients	186	125	311
Mean age (yr)	52.4	56.2	54.1
Mean follow-up (mo)	23.8	28.7	26.1
Total no. of functional outcome scores used	1	1	1

Table 6. Overall Coleman Methodology Score for Each Criterion

Criterion (maximum score)	Coleman methodology score		
	Cystectomy ^{7,13,15,26,27)}	Without cystectomy ^{6,11,28,29)}	Total
Part A			
Study size (10 points)	3.6±4.10 (0–10)	4.75±1.5 (4–7)	4.11±3.10 (0–10)
Mean follow-up (5 points)	3.8±1.64 (2–5)	4.25±1.5 (2–5)	4±1.5 (2–5)
No. of procedures (10 points)	10±0 (10)	10±0 (10)	10±0 (10)
Type of study (15 points)	0±0 (0)	0±0 (0)	0±0 (0)
Diagnostic certainty (5 points)	5±0 (5)	5±0 (5)	5±0 (5)
Surgery description (5 points)	5±0 (5)	5±0 (5)	5±0 (5)
Rehabilitation description (10 points)	4±5.48 (0–10)	7.5±5 (0–10)	5.55±5.27 (0–10)
Part B			
Outcome criteria (10 points)	7±0 (7)	8.5±1.73 (7–10)	7.67±1.32 (7–10)
Procedure for outcome (15 points)	11±0 (11)	11±0 (11)	11±0 (11)
Selection process (15 points)	15±0 (15)	15±0 (15)	15±0 (15)
Total score	64.4±10.01 (55–78)	71±6.16 (62–75)	67.33±8.75 (55–78)

Values are presented as mean±standard deviation (range).

teristics of patients are summarized in Tables 3–5. In five of the nine studies, arthroscopic cystectomy was performed after debridement of communicating valves^{7,13,14,25,26}; overall, 186 patients underwent arthroscopic cystectomy after valve debridement, and the minimum follow-up was 13 months. Three studies reported the outcomes of arthroscopic valve debridement without cystectomy^{6,11,27}; overall, 103 patients underwent that procedure, and the minimum follow-up was 22.9 months. In one study, the communicating valve was closed arthroscopically without cystectomy²⁸ in 22 patients, and the mean follow-up was 2 years.

The mean CMS score of the included studies was 67.33 points (range, 55 to 78 points). The part A mean CMS scores were 4.11 points for study size, 4 points for mean follow-up, 10 points for the number of different surgical procedures, 0 point for the type of study, 5 points for diagnostic certainty, 5 points for the description of surgical procedures, and 5.55 points for the description of postoperative rehabilitation. The part B mean scores of the CMS were 7.67 points for outcome criteria, 11 points for the procedure for assessing outcomes, and 15 points for the description of the patient selection process. The mean CMS score for each criterion and the detailed CMS score for each study are shown in Tables 6 and 7, respectively.

According to the RL functional evaluation criteria, RL grade 0 or 1 at final follow-up was used to define successful treatment²⁹. Most patients in all nine studies showed improvement in the RL grade after arthroscopic treatment. At final follow-up, the knees were rated as normal or nearly normal in 99.5% of patients (185 out of 186) who underwent combined arthroscopic valve debridement with cystectomy and in 92.0% of patients (115 out of 125) who underwent arthroscopic treatment without cystectomy. We evaluated the OR of RL grade 2 or higher (indicating an unsuccessful clinical outcome)²⁴ after pooling the data from studies with cystectomy and those without cystectomy. The forest plot shows that the OR was 122.05 in the cystectomy group (95% confidence interval [CI], 33.84–440.23, $p < 0.001$; heterogeneity $I^2 = 0\%$, $p = 0.81$) and 58.12 in the non-cystectomy group (95% CI, 9.00–375.26, $p < 0.001$; heterogeneity $I^2 = 77\%$, $p = 0.005$) (Fig. 2). The OR for all included studies (cystectomy and non-cystectomy groups together) was 78.31 (95% CI, 25.29–242.43, $p < 0.001$; heterogeneity $I^2 = 54\%$, $p = 0.03$). The results of the test for subgroup differences of the total studies were $I^2 = 0\%$ and $p = 0.52$.

The rates of recurrence and complications are shown in Table 3. Overall, 0% (0 out of 186) of the cystectomy group and 8.0% (10 out of 125) of the non-cystectomy group had a recurrent cyst after treatment. The postoperative complication rate was 6.5% (12 out of 186) in the cystectomy group and 1.6% (2 out of 125) in

Table 7. Detailed Coleman Methodology Scores for the included Studies

Study	Publication year	Coleman methodology score											Total score
		Study size	Mean follow-up	No. of procedures	Type of study	Diagnostic certainty	Surgery description	Rehabilitation description	Outcome criteria	Procedure for outcome	Selection process		
Ahn et al. ¹⁴	2010	4	5	10	0	5	5	10	7	11	15	72	
Cho ⁷	2012	10	5	10	0	5	5	10	7	11	15	78	
Ko and Ahn ²⁵	2004	0	5	10	0	5	5	0	7	11	15	58	
Lie and Ng ¹³	2011	0	2	10	0	5	5	0	7	11	15	55	
Wang et al. ²⁶	2014	4	2	10	0	5	5	0	7	11	15	59	
Calvisi et al. ²⁸	2007	4	5	10	0	5	5	10	10	11	15	75	
Ji et al. ²⁷	2009	7	5	10	0	5	5	10	7	11	15	75	
Ohishi et al. ¹¹	2015	4	2	10	0	5	5	10	10	11	15	72	
Sansone and De Ponti ⁶	1999	4	5	10	0	5	5	0	7	11	15	62	

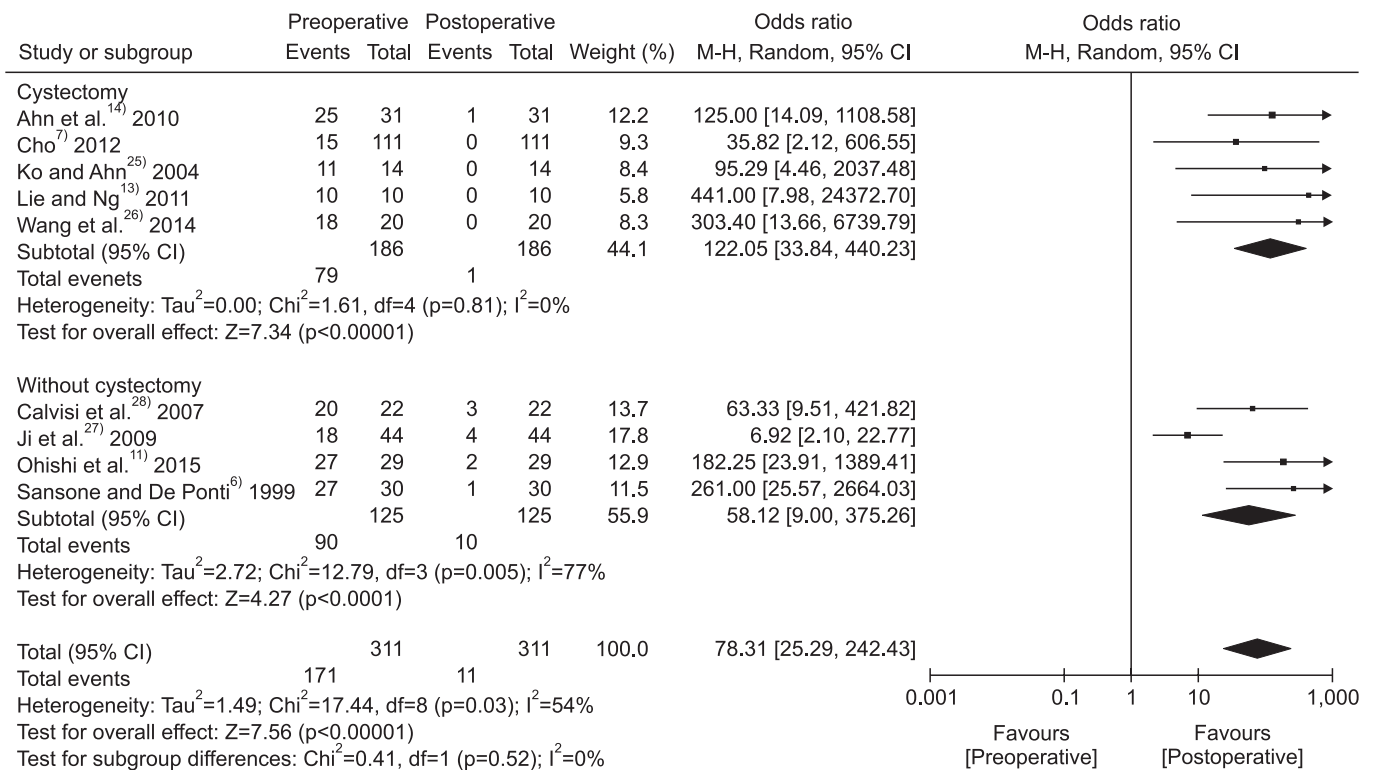


Fig. 2. Forest plot of the odds ratios in the cystectomy and non-cystectomy groups for unsuccessful preoperative and postoperative clinical outcomes. M-H: Mantel-Haenszel method, CI: confidence interval, df: degree of freedom.

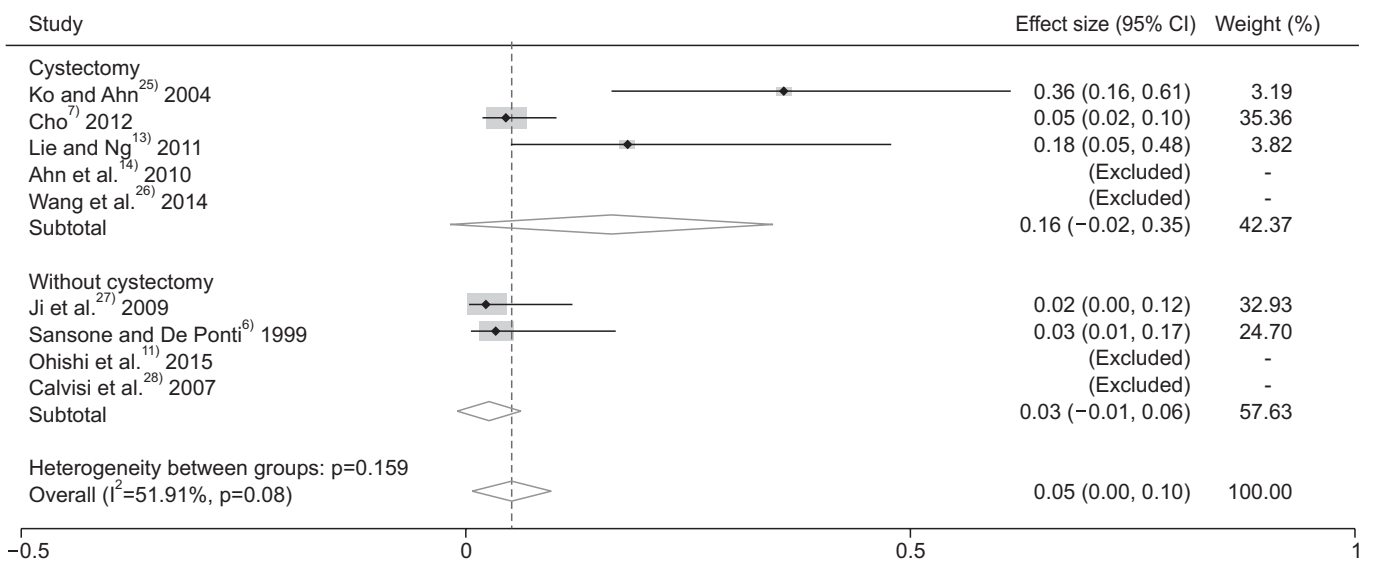


Fig. 3. Forest plot of the effect size of complications in the cystectomy and non-cystectomy groups.

the non-cystectomy group. The reported complications included hematoma formation (cystectomy group, 2.7%; non-cystectomy group, 0%), portal site infection and discomfort (cystectomy group, 1.6%; non-cystectomy group, 0%), persistent pain and swelling (cystectomy group, 1.0%; non-cystectomy group, 1.6%),

and technical error during cyst debridement (cystectomy group, 1.0%; non-cystectomy group, 0%). The effect size for complications was 0.16 with cystectomy (95% CI, -0.02-0.35, I²=0%, p<0.001) and 0.03 without cystectomy (95% CI, -0.01-0.06, I²=0%, p<0.001) (Fig. 3). The heterogeneity of complications be-

tween the groups was $p=0.159$, and the overall effect size was 0.05 (95% CI, 0.00–0.10, $I^2=51.91\%$, $p=0.08$).

Discussion

Many studies have reported that conservative management of popliteal cysts results in a high rate of cyst persistence³⁰; however, an open surgical excision cannot be considered as a definitive solution in most patients because of the high rate of recurrence^{8,23}. Therefore, treatments for popliteal cysts focus on the management of intra-articular lesions and communication between the cyst and the articular cavity, as well as cystectomy, although the operative techniques differ from study to study.

The current literature on the treatment of popliteal cysts does not support one therapeutic method over another because of the lack of high-quality studies. Several papers showed superior outcome scores for arthroscopic valve debridement with or without cystectomy, but those findings are not consistent across papers. Our aim in this study was to review the available literature to compare clinical outcomes and complication and recurrence rates after arthroscopic treatment of popliteal cysts with and without cystectomy. Two important facts emerged from this systematic review and meta-analysis. First, no direct comparative study has been done between arthroscopic valve debridement and the use of cystectomy as a surgical intervention for popliteal cysts. Second, the total recurrence rate was lower, although the total complication rate was higher, in the cystectomy group than in the non-cystectomy group.

Cystectomy was performed in five of the studies discussed in this report^{7,13,14,25,26}; patients in the other four studies did not undergo cystectomy^{6,11,27,28}. We assessed RL scores before and after surgery, and our statistical analyses found $I^2=0\%$ and $Z=7.56$. The pooled results showed that the OR of unsuccessful clinical outcomes (RL grade ≥ 2) was greater in the cystectomy group than in the non-cystectomy group with 122.05 ($p<0.001$) and 58.12 ($p<0.001$), respectively. Similar results were shown in a previous systematic review/meta-analysis by Zhou et al.²¹. They found a success rate of 98.2% after cyst wall resection and the rate was 94.7% without cyst wall resection; however, their review included open surgical excision procedures.

In the studies reviewed here, the recurrence rate was 0% in the cystectomy group and 8.0% in the non-cystectomy group. Despite the homogeneity and low recurrence rate of the cystectomy group, for now, we can only infer that cystectomy might benefit patients with popliteal cysts because of the small number of patients recruited and the presence of heterogeneity in the non-

cystectomy group. Furthermore, the OR in the non-cystectomy group was as high as 58.12. Therefore, cystectomy might not significantly increase the chance of achieving a good clinical result. The cystectomy group also had a relatively high rate of complications (6.5% vs. 1.6%); however, there was no severe or permanent complication (Table 3) and it is difficult to conclude that the accompanying cystectomy was entirely responsible for such complications. It is necessary to investigate whether the complications are truly related to the resection of the inner wall and septa inside the cyst because the procedure accompanied correction of the valvular mechanism.

In all nine studies, the investigators reported on the incidence of concomitant intra-articular lesions in patients with popliteal cysts, and injuries to the medial meniscus and articular cartilage were the most common concomitant lesions in the joint (Table 4). These results indicate that more effective treatment methods for medial meniscal injuries and articular cartilage injuries are needed to further improve the therapeutic efficacy of treatments for popliteal cysts. In addition, some of the reviewed studies described reasons for treatment failure^{6,11,14,28}: knee arthritis, chondromalacia of the posterior tibial plateau, and severe chondral defects. These data not only confirm the importance of managing intra-articular lesions during surgery but also indicate that the currently available methods used to treat severe arthritis and cartilage defects are unsatisfactory.

This systematic review and meta-analysis has several limitations. First, it is based on low quality studies. Studies with only level IV evidence were included in our analysis because our literature search did not return any high quality studies. The current literature on the treatment of popliteal cysts was limited to retrospective case series where the superiority of one treatment strategy over another could not be evaluated. Second, one study²⁸ performed communication valve closure surgery in the non-cystectomy group; the decreased homogeneity of the treatment procedure in the non-cystectomy group might have affected the results of the study. Therefore, high quality studies are needed to confirm the efficacy of various arthroscopic surgical interventions regardless of concurrent cystectomy in the treatment of popliteal cysts. Third, some sources of selection bias, including different follow-up periods and different intervals from injury to surgery, were present in the reviewed studies. Further research needs to be conducted, particularly studies that directly compare the cystectomy group and non-cystectomy group, to draw a definitive conclusion.

Conclusions

All the currently available studies on the arthroscopic management of popliteal cysts showed satisfactory outcomes in both the cystectomy and non-cystectomy groups. Neither procedure showed clear superiority to the other. Arthroscopic cystectomy after management of intra-articular lesions was associated with a low recurrence rate but a relatively high incidence of complications. However, it is unclear whether the cystectomy procedure alone was responsible for the high complication rate. It is necessary to evaluate whether such complications are truly related to the resection of the inner wall and septa inside the cyst, not to the correction of the valvular mechanism.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

- Adams R. Chronic rheumatic arthritis of the knee joint. *Dublin J Med Sci.* 1840;17:520-2.
- Baker WM. The formation of synovial cysts in the leg in connection with disease of the knee joint. *St. Bartholomew's Hosp Rep.* 1877;13:245-61.
- Seil R, Rupp S, Jochum P, Schofer O, Mischo B, Kohn D. Prevalence of popliteal cysts in children. A sonographic study and review of the literature. *Arch Orthop Trauma Surg.* 1999;119:73-5.
- Handy JR. Popliteal cysts in adults: a review. *Seminars in Arthritis and Rheumatism*; Elsevier; 2001. p108-18.
- Lindgren PG. Gastrocnemio-semimembranosus bursa and its relation to the knee joint. III. Pressure measurements in joint and bursa. *Acta Radiol Diagn (Stockh).* 1978;19:377-88.
- Sansone V, De Ponti A. Arthroscopic treatment of popliteal cyst and associated intra-articular knee disorders in adults. *Arthroscopy.* 1999;15:368-72.
- Cho JH. Clinical results of direct arthroscopic excision of popliteal cyst using a posteromedial portal. *Knee Surg Relat Res.* 2012;24:235-40.
- Childress HM. Popliteal cysts associated with undiagnosed posterior lesions of the medial meniscus. The significance of age in diagnosis and treatment. *J Bone Joint Surg Am.* 1970;52:1487-92.
- Jayson MI, Dixon AS. Valvular mechanisms in juxta-articular cysts. *Ann Rheum Dis.* 1970;29:415-20.
- Johnson LL, van Dyk GE, Johnson CA, Bays BM, Gully SM. The popliteal bursa (Baker's cyst): an arthroscopic perspective and the epidemiology. *Arthroscopy.* 1997;13:66-72.
- Ohishi T, Takahashi M, Suzuki D, Fujita T, Yamamoto K, Ushirozako H, Banno T, Matsuyama Y. Treatment of popliteal cysts via arthroscopic enlargement of unidirectional valvular slits. *Mod Rheumatol.* 2015;25:772-8.
- Rauschnig W, Lindgren PG. The clinical significance of the valve mechanism in communicating popliteal cysts. *Arch Orthop Trauma Surg.* 1979;95:251-6.
- Lie CW, Ng TP. Arthroscopic treatment of popliteal cyst. *Hong Kong Med J.* 2011;17:180-3.
- Ahn JH, Lee SH, Yoo JC, Chang MJ, Park YS. Arthroscopic treatment of popliteal cysts: clinical and magnetic resonance imaging results. *Arthroscopy.* 2010;26:1340-7.
- Kongmalai P, Chernchujit B. Arthroscopic treatment of popliteal cyst: a direct posterior portal by inside-out technique for intracystic debridement. *Arthrosc Tech.* 2015;4:e143-8.
- Kanekasu K, Nagashima K, Yamauchi D, Yamakado K. [A clinical study of arthroscopic cystectomy on popliteal cysts associated with rheumatoid arthritis]. *Ryumachi.* 1997;37:761-9. Japanese.
- Takahashi M, Nagano A. Arthroscopic treatment of popliteal cyst and visualization of its cavity through the posterior portal of the knee. *Arthroscopy.* 2005;21:638.
- Ahn JH, Yoo JC, Lee SH, Lee YS. Arthroscopic cystectomy for popliteal cysts through the posteromedial cystic portal. *Arthroscopy.* 2007;23:559.e1-4.
- Malinowski K, Synder M, Sibiński M. Selected cases of arthroscopic treatment of popliteal cyst with associated intra-articular knee disorders primary report. *Ortop Traumatol Rehabil.* 2011;13:573-82.
- He R, Guo L, Yang L, Chen GX, Duan XJ, Luo CF. [Knee arthroscopic resection of articular capsule valvular treat popliteal cysts]. *Zhonghua Wai Ke Za Zhi.* 2013;51:417-20. Chinese.
- Zhou XN, Li B, Wang JS, Bai LH. Surgical treatment of popliteal cyst: a systematic review and meta-analysis. *J Orthop Surg Res.* 2016;11:22.
- Coleman BD, Khan KM, Maffulli N, Cook JL, Wark JD. Studies of surgical outcome after patellar tendinopathy: clinical significance of methodological deficiencies and guidelines for future studies. Victorian Institute of Sport Tendon Study Group. *Scand J Med Sci Sports.* 2000;10:2-11.

23. Rauschnig W, Lindgren PG. Popliteal cysts (Baker's cysts) in adults. I. Clinical and roentgenological results of operative excision. *Acta Orthop Scand.* 1979;50:583-91.
24. Sansone V, de Ponti A, Paluello GM, del Maschio A. Popliteal cysts and associated disorders of the knee. Critical review with MR imaging. *Int Orthop.* 1995;19:275-9.
25. Ko S, Ahn J. Popliteal cystoscopic excisional debridement and removal of capsular fold of valvular mechanism of large recurrent popliteal cyst. *Arthroscopy.* 2004;20:37-44.
26. Wang L, Xia BJ, Ruan WM, Tong PJ, Xiao LW, Jin HT. [Extracapsular arthroscopic excision of popliteal cysts through anterior combined with posterior approach]. *Zhongguo Gu Shang.* 2014;27:635-7. Chinese.
27. Ji JH, Kim WY, Park SE, Shin ES, Moon CY. Arthroscopic treatment of popliteal cysts using the trans-septal approach. *J Korean Knee Soc.* 2009;21:158-64.
28. Calvisi V, Lupporelli S, Giuliani P. Arthroscopic all-inside suture of symptomatic Baker's cysts: a technical option for surgical treatment in adults. *Knee Surg Sports Traumatol Arthrosc.* 2007;15:1452-60.
29. Rupp S, Seil R, Jochum P, Kohn D. Popliteal cysts in adults. Prevalence, associated intraarticular lesions, and results after arthroscopic treatment. *Am J Sports Med.* 2002;30:112-5.
30. Malinowski K, Koniarski A, Synder M. Popliteal cyst: comparison of complete endoscopic to intensive nonoperative treatment (SS-51). *Arthroscopy.* 2009;25:e28.