Section: Anaesthesia

Original Research Article

PERIARTICULAR PROLOTHERAPY WITH DEXTROSE VS INTRA-ARTICULAR PLATELET-RICH PLASMA WITH DEXTROSE FOR THE TREATMENT OF BAKER'S CYST: A COMPARATIVE STUDY

***Kruti Sundar Mandal*[1], *Jagannath Tripathy*[2]**

[1]*Department of Anesthesiology, Gouridevi Medical College, Durgapur, West Bengal, India.*
[2]*Department of Anaesthesia, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, India*

Received *: 12/08/2025*
Received in revised form *: 05/10/2025*
Accepted *: 20/10/2025*

Corresponding Author:
Dr. Kruti Sundar Mandal,
Department of Anesthesiology, Gouridevi Medical College, Durgapur, West Bengal, India.
Email: krutimandal@gmail.com

DOI: 10.70034/ijmedph.2025.4.138

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 771-775

ABSTRACT

Background: Baker's cysts arise from intra-articular knee pathology through a valve-like connection between the joint and the gastrocnemius–semimembranosus bursa, causing synovial outflow, pain, and swelling. Conventional measures (observation, aspiration ± steroid, or arthroscopic procedures) often provide temporary relief with recurrence. Regenerative options such as dextrose prolotherapy (DPT) and platelet-rich plasma (PRP) are increasingly used, but comparative evidence is limited. This study compared periarticular DPT versus intra-articular PRP (both with low-concentration dextrose) in adults with symptomatic Baker's cysts, assessing pain (Visual Analogue Scale, VAS 0–10) at 24 weeks, cyst size, KOOS, recurrence, patient global impression of change, and adverse events.

Materials and Methods: In an open-label, randomized, parallel-group study, 80 patients (40 in each group) with sonographically diagnosed Baker's cysts were randomly assigned to (1) periarticular DPT plus 15% dextrose buffered (3 sessions at weeks 0, 4, 8 on capsuloligamentous insertions posteromedially) or (2) PRP-IA (6–8 mL leukocyte-depleted PRP obtained by single-spin technique, activated by 5% dextrose; 2 sessions at weeks 0 and 4). Standardized co-interventions. Outcomes were measured at baseline, weeks 4, 12, and 24 by a blinded evaluator. Primary analysis was done using ANCOVA (adjusted for baseline). Safety was observed continuously.

Results: Seventy-six participants had completed 24 weeks. At week 24, mean VAS improved −3.1 (SD 2.0) with DPT vs −3.6 (SD 2.1) with PRP-IA; adjusted between-group difference −0.4 (95% CI −1.1 to 0.3), p=0.24. Cyst maximal diameter decreased −8.4 mm (SD 6.9) vs −10.2 mm (SD 7.4), difference −1.5 mm (95% CI −4.2 to 1.2), p=0.27. KOOS-Pain/ADL/Symptoms improved comparably. Recurrence by week 24 was 17.5% (DPT) versus 12.5% (PRP-IA), p=0.52. PGIC "much/very much improved" was 62% vs 68% (p=0.54). The side effects were minor (transient post-injection soreness; no infections or neurovascular trauma).

Conclusion: Periarticular dextrose prolotherapy and intra-articular PRP with dextrose were equally effective at 24 weeks regarding pain, cyst size, and function for Baker's cysts, with low adverse events; DPT is a less expensive, more convenient option than PRP. Multicenter trials of larger size and longer duration are required.

Keywords: Baker's Cyst, prolotherapy, platelet-rich plasma.

INTRODUCTION

Baker's cysts are collections of synovial fluid within the gastrocnemius–semimembranosus bursa that often communicate with the knee joint by a one-way, valvular opening. The cyst is often a reflection of underlying intra-articular disease like osteoarthritis or meniscal tear, and symptoms are generated by

posterior knee fullness, pain, and limited flexion or extension, complicated by neurovascular irritation at times.[1-3] Traditional treatment varies from watchful waiting to ultrasound-guided aspiration with corticosteroid and surgical or arthroscopic interventions designed to expand the communication or treat intra-articular drivers, but recurrence remains a clinical nemesis.[4-7] Over the last few decades, regenerative and irritant-based injection treatments—more notably dextrose prolotherapy (DPT) and platelet-rich plasma (PRP)—promised to treat knee osteoarthritis and periarticular pain by modulating nociception, stimulating extracellular matrix synthesis, and capsuloligamentous stabilization.[8-12] Case-based literature also indicates that PRP can possibly reduce Baker's cysts when given under ultrasound guidance, though controlled data are still scarce.[13-15] In spite of these new findings, few prospective trials have directly contrasted periarticular DPT with intra-articular PRP (PRP-IA) in treating symptomatic Baker's cysts. Evidence derived from studies of knee osteoarthritis suggests that both modalities decrease pain and enhance function, but head-to-head trials have provided inconsistent data on relative effectiveness.[8,16-18] The study was thus designed to directly compare mean change in pain (VAS, 0–10) at 24 weeks between periarticular DPT and PRP-IA in symptomatic adults with Baker's cysts, in addition to secondary outcomes such as ultrasound-assessed cyst size, Knee Injury and Osteoarthritis Outcome Score (KOOS) subscales, recurrence rate, patient global impression of change (PGIC), and adverse events. The null hypothesis was that there would be no difference between DPT and PRP-IA regarding 24-week changes in pain scores, cyst size, KOOS scores, recurrence, PGIC, or rates of adverse events.

MATERIALS AND METHODS

This one-center, prospective, randomized, parallel-group study compared periarticular dextrose prolotherapy (DPT) with intra-articular platelet-rich plasma activated with dextrose (PRP-IA) for symptomatic Baker's cyst. The study protocol was approved by the Institutional Ethics Committee, consistent with the Declaration of Helsinki, and prospectively registered. Written informed consent from all participants was taken following extensive explanation of study procedures, possible benefits, and hazards.

Adults 35–80 years old with posterior knee pain or fullness and Baker's cysts of a minimum maximal diameter of 15 mm detected by ultrasound and communicating with the knee joint were selected for screening. Eligibility criteria were >6 weeks' duration of symptoms, pain with activity ≥4/10 VAS, and previous failure of conservative management involving physiotherapy, activity modification, and oral analgesics. Exclusion criteria included active infection, inflammatory arthropathy, anticoagulation preventing injection, uncontrolled diabetes mellitus (HbA1c > 9%), history of cyst surgery, pregnancy, severe valgus or varus deformity (>10°), and intra-articular injection in the last 3 months.

Participants were allocated in a 1:1 ratio to DPT or PRP-IA by a computer-generated random sequence of variable block sizes. Concealment of allocation was achieved with sequentially numbered, opaque, sealed envelopes. Injectors were unblinded by necessity owing to differing procedures, but participants were told that both were active regenerative therapies. All clinical and imaging evaluations were performed by a blinded assessor, and statistical analysis by an independent, blinded statistician.

In the DPT group, under ultrasound guidance at weeks 0, 4, and 8, a buffered 15% dextrose solution (15% D-glucose in normal saline with 1% lidocaine) was injected. Injection sites involved periarticular and para-articular structures that were involved in posteromedial capsular laxity and nociception, which included the capsuloligamentous insertions of the posteromedial capsule, semimembranosus tendon insertion, and posterior fibers of the medial collateral ligament. With a peppering technique using 25–27 G needles, about 12–16 mL of solution was divided among these sites each session.

In the PRP-IA group, autologous PRP was prepared from a standardized single-spin centrifugation protocol (1800 rpm, 8 min) that yielded leukocyte-poor PRP with a 3–4 times baseline platelet concentration. Intra-articular injection of 6–8 mL of PRP was performed at weeks 0 and 4 via a superolateral approach in strict asepsis. Immediately before injection, 5% dextrose was employed as an activator and vehicle according to institutional routine. Local anaesthetic was avoided to avoid platelet inhibition.

Both cohorts received the same co-interventions. All patients completed a standardized home exercise program with a focus on strengthening of the quadriceps and hamstrings, activity modification counselling, and use of acetaminophen (≤3 g/day) as rescue analgesia. Use of nonsteroidal anti-inflammatory medications was avoided except for unavoidable breakthrough pain, and all such use was recorded. To avoid confounding, aspiration or injection of the cyst or knee with corticosteroids were not allowed during follow-up.

Outcome measures were determined a priori. The main outcome was the difference of VAS pain (0–10) on activity from baseline to 24 weeks. Secondary outcomes comprised ultrasound-determined cyst size (maximum anteroposterior diameter, in mm, in the prone position with extended knee), KOOS subscales (Pain, Symptoms, and Activities of Daily Living), recurrence (reappearance or > 20% increase from smallest recorded cyst size with posterior knee symptoms or requirement for additional treatment), patient global impression of change (PGIC; "much improved" or "very much improved" at weeks 12 and 24), and all adverse or serious adverse events.

Assessment was made at baseline and 4, 12, and 24 weeks by the same blinded sonographer with identical ultrasound equipment and settings.

Sample size calculation was based on an assumed minimum clinically important difference of 1.5 points in VAS pain (SD 2.2), two-sided $\alpha = 0.05$, and 80% power, which necessitated 36 patients in each group. To accommodate 10% loss to follow-up, target recruitment was 80 patients (40 per arm).

Statistical analysis was according to the intention-to-treat principle, and multiple imputation for missing data and sensitivity analyses were performed per protocol. The main endpoint was analyzed by analysis of covariance (ANCOVA) with the independent factor of treatment group and covariate baseline VAS. Adjusted mean differences (aMDs) with 95% confidence intervals were estimated. Longitudinal outcomes were analyzed using repeated-measures mixed-effects models to evaluate time × group interactions. Secondary. continuous variables were compared by ANCOVA, whereas categorical data were analyzed by chi-square or Fisher's exact test. Statistical significance was established at two-sided $p < 0.05$. Prespecified subgroup analyses were carried out on age (<60 vs ≥60 years) and radiographic osteoarthritis severity (Kellgren–Lawrence grade I–II vs III). Statistical analysis was done with SPSS version 16.

RESULTS

Between January and November 2024, 112 patients were screened; 80 were randomized (DPT, n=40; PRP-IA, n=40). Four were lost to follow-up (2 per arm) by week 24; no serious AEs. Baseline characteristics were similar [Table 1].

Table 1: Baseline characteristics

Characteristic	DPT (n=40)	PRP-IA (n=40)
Age, years (mean ± SD)	57.7 ± 9.5	58.3 ± 8.7
Female, n (%)	23 (57.4)	22 (55.1)
BMI, kg/m² (mean ± SD)	28.1 ± 3.8	28.0 ± 4.0
Kellgren-Lawrence KOA grade I/II/III, n	8 / 21 / 11	7 / 22 / 11
VAS pain (0–10)	6.7 ± 1.2	6.7 ± 1.3
KOOS-Pain (0–100)	52.2 ± 12.4	52.7 ± 11.9
Cyst AP diameter, mm	24.2 ± 6.0	24.7 ± 6.2
Symptom duration, months	7.6 ± 4.1	7.4 ± 4.0

At week 24, VAS decreased −3.1 (SD 2.0) with DPT and −3.6 (SD 2.1) with PRP-IA. The baseline-adjusted between-group difference favoured PRP-IA by −0.4 (95% CI −1.1 to 0.3), p=0.23, was not statistically significant. [Table 2]

Cyst size (mm): Mean reduction at week 24 was −8.4 (SD 6.9) for DPT versus −10.2 (SD 7.4) for PRP-IA; aMD −1.5 mm (95% CI −4.2 to 1.2), p=0.27. [Table 2]

KOOS subscales: At week 24, adjusted improvements were similar across Pain (aMD +2.6; 95% CI −2.3 to +7.5), Symptoms (+2.0; −2.5 to +6.4), and ADL (+3.1; −1.9 to +8.1); all p>0.05. [Table 2]

Recurrence: By week 24, 7/40 (17.5%) in DPT and 5/40 (12.5%) in PRP-IA met recurrence criteria; RR 0.71 (95% CI 0.25–2.02), p=0.52.

PGIC: "Much/very much improved" at week 24: 62% (DPT) vs 68% (PRP-IA), p=0.53. [Table 2]

- Adverse events: Transient post-injection soreness and short-lived knee fullness noted. No infections, hemarthroses, or neurovascular complications. [Table 3]

Table 2: Primary and key secondary outcomes at 24 week

Outcome	DPT (mean change)	PRP-IA (mean change)	aMD (PRP-IA − DPT)	95% CI	p-value
VAS pain (0–10)	−3.1	−3.6	−0.4	−1.1, +0.3	0.23
Cyst AP diameter (mm)	−8.4	−10.2	−1.5	−4.2, +1.2	0.27
KOOS-Pain (0–100)	+18.7	+21.2	+2.6	−2.3, +7.5	0.29
KOOS-ADL (0–100)	+15.4	+18.1	+3.1	−1.9, +8.1	0.24
PGIC "much/very much improved", %	62	68	—	—	0.53
aMD - adjusted mean difference					

Table 3: Adverse events through 24 weeks

Adverse event	DPT (n, %)	PRP-IA (n, %)
Local soreness ≤72 h	11 (27.5)	10 (25.0)
Transient knee fullness	2 (5.0)	5 (12.5)
Vasovagal episode (self-limited)	1 (2.5)	1 (2.5)
Infection / hemarthrosis / neurovascular injury	0	0

Sensitivity and subgroup analyses Per-protocol results (n=76) were consistent. No significant interactions were observed by age or KOA grade.

DISCUSSION

In this randomized comparison of two regenerative approaches to symptomatic Baker's cysts, periarticular dextrose prolotherapy (DPT) and intra-articular platelet-rich plasma with dextrose (PRP-IA) had equivalent 24-week changes in pain, cyst size, and function, with few adverse events. The lack of statistically significant between-group differences indicates that both modalities are appropriate treatment alternatives, and choice may hinge upon availability of resources, cost, and clinician experience.

These results are consistent with the valve-like communication mechanism between the knee joint and gastrocnemius–semimembranosus bursa that is the basis of cyst formation. By decreasing ,therapies can correct joint–bursal homeostasis and decrease cyst distension.[1-3] Traditional methods like aspiration with corticosteroid injection provide temporary relief but high recurrence when the steroid effect is lost, whereas arthroscopic communication expansion or treatment of intra-articular pathology decreases recurrence but at the expense of invasiveness and cost.[4-7] The rate of recurrence seen here (12–18% at 24 weeks) is comparable to results after minimally invasive treatment, lending support to the potential longevity of regenerative interventions when conservative treatment fails.

The evidence base for PRP is rich in degenerative knee conditions. Several systematic reviews and meta-analyses have demonstrated that PRP has greater improvement of pain and function compared to hyaluronic acid or placebo for up to 6–12 months, although heterogeneity in preparation, platelet concentration, and dosing hinders interpretation.[16-20] Case series and reports also demonstrate that PRP, when ultrasound-guided to treat intra-articular pathology, can reduce or eliminate Baker's cysts.[13-15] Mechanistically, PRP is likely to dampen synovial inflammation and induce anabolic tissue repair, reducing intra-articular effusion and consequently secondary cyst filling.

Dextrose prolotherapy has also shown utility across musculoskeletal disorders. Systematic reviews in knee osteoarthritis document clinically significant pain and function gains compared to baseline and, in some comparisons, similar outcomes to PRP at intermediate follow-up.[8,11,17] One meta-analysis saw no significant difference between prolotherapy and PRP on 6-month pain outcomes, with only minor, non-clinically relevant inferiority in reduction of stiffness.[11] Our non-inferential trial, set up for superiority, produced directionally similar results—comparable efficacy and safety for both treatments.

The two treatments act through distinct yet convergent biological mechanisms. DPT induces osmotic and inflammatory stimulation of fibroblasts, enhancing collagen deposition and tightening capsuloligamentous insertions. These effects tighten the posteromedial capsule, that can lessening the one-way valve phenomenon that sustains cyst growth.[8,17] PRP, by contrast, introduces concentrated growth factors and anti-inflammatory cytokines into the joint, restoring cartilage metabolism and lowering effusion pressures driving cyst distension.[16,18-20] The analogous clinical benefits imply both methods ultimately normalize joint–bursal biomechanics and diminish nociception through overlapping mechanisms.

Various methodologic features increase the reliability of the study. Randomized allocation eliminated selection bias, and treatment protocols mirrored customary clinical practice (three DPT compared with two PRP sessions). Blinded assessment of outcomes, standardized ultrasound cyst measurements, and application of multidimensional endpoints—pain, function, and patient satisfaction—enhance internal validity. Sample size was large enough to detect a clinically significant VAS difference, and adherence to an intention-to-treat analysis helped maintain comparability between arms.

However, some limitations need to be noted. This was a single-center study with a 24-week time frame, too short to assess long-term recurrence or durability. Blinding of injectors was not feasible due to procedural variation, although assessors and analysts were masked. Leukocyte-poor, single-spin preparation in the PRP protocol may not be generalizable to leukocyte-rich or double-spin systems in other centers. Lack of sham or aspiration-only control did not allow for an estimation of placebo or decompression effect. Arthroscopic evaluation of concomitant intra-articular pathology was not performed, and economic analysis was beyond the study's scope. Furthermore, variability in global PRP preparation (platelet yield, activation, frequency) and uncertainty regarding optimal dextrose concentration or injection targeting for prolotherapy limit generalizability.[16]

Clinically, periarticular DPT and intra-articular PRP are both safe, well-tolerated, and equally effective in six months for symptomatic Baker's cysts related to degenerative knee disease. DPT provides a convenient, office-based modality where PRP capabilities are not available, without centrifugation and increased procedural expense. The equivalent effectiveness seen reaffirms the worth of prolotherapy as a cost-efficient regenerative therapy. Subsequent studies should validate these results using multicenter, powered non-inferiority trials with longer 12- to 24-month follow-up. These studies should incorporate imaging biomarkers such as MRI-based cyst volumetry, evaluate combined aspiration-plus-PRP protocols for potentially synergistic benefit, and measure cost-utility endpoints.[5,8,16] Elongation of the evidence base to diverse populations, cyst etiologies, and regenerative preparations will continue to define optimal patient selection and establish standard protocols for this prevalent yet problematic disease.

CONCLUSION

In adult patients with symptomatic, ultrasound-verified Baker's cysts, intra-articular PRP with dextrose and periarticular dextrose prolotherapy both improved pain, cyst size, and function equally at 24 weeks, with minimal occurrence of minor, self-limited adverse events. DPT could be a cost-effective, access-enhancing adjunct in the absence of PRP availability. Larger, longer-term studies are needed to establish durability, optimize protocols, and determine recurrence prevention.

REFERENCES

1. Leib AD, Miller TT. Baker's cyst. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK430774/
2. Demange MK. Baker's cyst. Rev Bras Ortop. 2015;50(6):580–7.
3. Radiopaedia. Baker cyst [Internet]. Updated 2025 Feb 8. Available from: https://radiopaedia.org/articles/baker-cyst
4. Smith MK, Lesniak B, Baraga MG, Kaplan L, Jose J.Treatment of popliteal (Baker) cysts with ultrasound-guided aspiration and intra-articular corticosteroid injection. Orthopedics. 2015;38(11):e1067–73.
5. Mortada M, AA Yomna, S Z Rabab. Efficacy and safety of musculoskeletal ultrasound-guided aspiration with corticosteroid for Baker's cysts. J Inflamm Res. 2020;13:1173–80.
6. Goto K, S Isaku. Ultrasound-guided arthroscopic communication enlargement for popliteal cysts. J Exp Orthop. 2020;7(1):76–83.
7. Fredericksen K, K John. Bedside ultrasound-guided aspiration and corticosteroid injection of Baker's cysts. CJEM. 2021;23(3):332–5.
8. Wee TC, J R N Edmund, L T Yeow. Dextrose prolotherapy in knee osteoarthritis: a systematic review and meta-analysis. J Clin Orthop Trauma. 2021;20:101464.
9. Waluyo Y, Artika SR, Insani Nanda Wahyuni, Gunawan AMAK, Zainal ATF. Efficacy of prolotherapy for osteoarthritis: a systematic review. J Rehabil Med. 2023;55:jrm00370 (1–9).
10. Rabago D, Patterson JJ, Mundt M, Kijowski R, Grettie J, Segal NA, Zgierska A. Dextrose prolotherapy for knee osteoarthritis: a randomized controlled trial. Ann Fam Med. 2013;11(3):229–37.
11. Wee TC, Hassan MR, Chee W. Prolotherapy versus platelet-rich plasma at 6 months in knee osteoarthritis: a meta-analytic comparison. J Clin Orthop Trauma. 2021;20:101464.
12. Sistani N, Beletsky A, Khoshbin A, Ogilvie R, Dwyer T, Chahal J, et al. A systematic review on the high variability in study design and outcome reporting in randomized controlled trials examining intra-articular platelet-rich plasma injection for knee osteoarthritis. J Cartilage Joint Preserv. 2022;2(1):100041.
13. Song B, Li H, Wang Q, Zhang Y, Zhang W. Leukocyte-rich platelet-rich plasma for Baker's cyst in post-traumatic osteoarthritis: a case report. Regen Med. 2020;15(12):2341–7
14. El Zouhbi A, Yammine J, Hemdanieh M, Korbani ET, Nassereddine M. Utility of Platelet-Rich Plasma Therapy in the Management of Meniscus Injuries: A narrative review. Orthop Rev (Pavia). 2024 Mar 17;16:94240. doi: 10.52965/001c.94240. PMID: 38505136; PMCID: PMC10950196.
15. UpToDate. Popliteal (Baker's) cyst—clinical features and management [Internet]. Updated 2025 Feb 17. Available from: https://www.uptodate.com
16. Yi L, Qiu F, Song H, Huang H, Zhang G. Platelet rich plasma injections for knee osteoarthritis: an overview of systematic reviews. Front Physiol. 2025;16:1598514.
17. Zhao AT, Caballero CJ, Nguyen LT, Vienne HC, Lee C, Kaye AD. A Comprehensive Update of Prolotherapy in the Management of Osteoarthritis of the Knee. Orthop Rev (Pavia). 2022;14(4):33921.
18. Glinkowski WM, Gut G, Śladowski D. Platelet-Rich Plasma for Knee Osteoarthritis: A Comprehensive Narrative Review of the Mechanisms, Preparation Protocols, and Clinical Evidence. J Clin Med. 2025;14(11):3983.
19. Zeng W, Liu W, Wang J, Xiao J, Zheng Z, Li Z, et al. Intra-articular PRP combined with mesenchymal stem cells in knee osteoarthritis: preclinical and clinical synthesis. J Orthop Surg Res. 2022;17(1):246–58.
20. Diaz Haaz DI, Rizo Castro O. Efficacy and Safety of Intra-articular Platelet-Rich Plasma (PRP) Versus Corticosteroid Injections in the Treatment of Knee Osteoarthritis: A Systematic Review of Randomized Clinical Trials. Cureus. 2025;17(3):e80948.
21. Nawaz H, Jawwad M, Khan M. Efficacy of Platelet-Rich Plasma Injections in Knee Osteoarthritis: A Systematic Review and Meta-Analysis. Cureus 2025;17(10): e94288.
22. Hasan M, Berkovich Y, Sarhan B, Steinfeld Y, Ginesin E, Hijaze S et al. Comprehensive analysis of knee cysts: diagnosis and treatment. Knee Surg Relat Res. 2025;37(1):23.