e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(1); 777-782

Original Research Article

Comparison of Single versus Multiple Intra-articular Steroid Injections in Knee Osteoarthritis (Grade II–III): A Retrospective Study

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Received: 26-11-2025 / Revised: 25-12-2025 / Accepted: 26-01-2026

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Conflict of interest: Nil

Abstract:

Background: Intra-articular corticosteroid injections are commonly used for symptomatic relief in knee osteoarthritis (OA). However, the relative efficacy and safety of single versus multiple injections remain debated, particularly in early to moderate disease.

Objective: To compare clinical outcomes of single versus multiple intra-articular steroid injections in patients with Kellgren–Lawrence grade II and III knee osteoarthritis.

Methods: A retrospective observational study was conducted at Bhima Bhoi Medical College & Hospital, Balangir, from October 2024 to September 2025. A total of 302 patients with grade II–III knee OA who received either a single injection or multiple injections of intra-articular corticosteroid were analyzed. Pain and function were assessed using the Visual Analogue Scale (VAS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Statistical analysis included paired and unpaired t-tests and chi-square tests, with $p < 0.05$ considered significant.

Results: Both groups showed significant improvement in VAS and WOMAC scores at short-term follow-up. Multiple injections demonstrated superior pain relief at 6 months but were associated with a higher recurrence of symptoms by 9–12 months.

Conclusion: Single intra-articular steroid injection provides effective short-term relief in grade II–III knee OA, while multiple injections may offer prolonged benefit at the cost of potential diminishing returns. Judicious use is recommended.

Keywords: Knee Osteoarthritis, Intra-Articular Steroid, Single Injection, Multiple Injection, Retrospective Study.

DOI: 10.25258/ijcpr.18.1.131

Introduction

Osteoarthritis (OA) of the knee is one of the most prevalent chronic musculoskeletal disorders worldwide and a leading cause of pain, disability, and reduced quality of life among middle-aged and elderly populations. Its prevalence is increasing due to population aging, obesity, and sedentary lifestyles [1]. Knee OA is marked by the gradual breakdown of articular cartilage, changes in the subchondral bone, inflammation of the synovial membrane, and the formation of osteophytes, which leads to pain and limited function [2].

The management of knee osteoarthritis is predominantly symptomatic, given the absence of a definitive disease-modifying therapy at present. Treatment strategies encompass patient education, weight reduction, physiotherapy, pharmacological agents, and intra-articular therapies, with surgical intervention designated for advanced cases [3]. Intra-articular corticosteroid injections have been extensively utilised for decades as a non-operative intervention due to their significant anti-inflammatory effects and prompt analgesic response [4].

Corticosteroids work by blocking phospholipase A2, lowering pro-inflammatory cytokines, and stopping synovial inflammation. This makes pain and joint effusion go down [5]. Multiple randomised controlled trials have shown that intra-articular steroid injections can provide short-term pain relief in knee osteoarthritis, especially in individuals with mild to moderate disease [6,7]. Nonetheless, the

duration of benefit is inconsistent, typically spanning from several weeks to several months [8].

A key clinical dilemma concerns the frequency of steroid injections. While repeated injections are routinely given to keep symptoms at bay, there are worries about possible side effects, such as damage to cartilage, faster disease progression, and changes in subchondral bone [9,10]. Experimental and imaging studies indicate that repeated corticosteroid exposure may adversely impact cartilage integrity [11]. On the other hand, some clinical studies show that injections spaced out correctly can provide long-lasting symptom relief without causing significant structural damage [12].

The existing literature comparing single and multiple intra-articular steroid injections is scarce and inconclusive, especially within the Indian population. Most of the studies that are out there are short-term, have small sample sizes, or don't divide patients into groups based on their radiological grade [13–15]. Furthermore, empirical data derived from retrospective analyses can yield significant insights into routine clinical practice and patient outcomes.

This study was conducted to retrospectively compare the clinical efficacy of single versus multiple intra-articular corticosteroid injections in patients with Kellgren–Lawrence grade II and III knee osteoarthritis, emphasising pain relief, functional enhancement, and duration of benefit.

Materials and Methods

Study Design and Setting: This retrospective observational study was conducted at the Department of Orthopaedics, Bhima Bhoi Medical College & Hospital, Balangir, Odisha.

Study Duration: October 2024 to September 2025.

Study Population: Medical records of patients diagnosed with knee osteoarthritis were screened.

Inclusion Criteria

- Age ≥ 40 years
- Radiologically confirmed knee OA (Kellgren–Lawrence grade II or III)
- Received intra-articular corticosteroid injection
- Minimum follow-up of 6 months

Exclusion Criteria

- Grade I or grade IV OA
- Inflammatory arthritis
- Previous knee surgery
- Intra-articular injection other than steroid within the last 6 months

Sample Size: A total of 302 patients met the inclusion criteria.

Group Allocation

- **Group A (Single Injection Group):** 151 patients received a single intra-articular corticosteroid injection.
- **Group B (Multiple Injection Group):** 151 patients received two or more injections at intervals of at least 3 months.

Injection Protocol

All injections consisted of triamcinolone acetonide 40 mg mixed with 2 ml of 1% lignocaine, administered under aseptic conditions.

Outcome Measures

- Visual Analogue Scale (VAS) for pain
- WOMAC score for pain, stiffness, and physical function

Scores were recorded at baseline, 1 month, 3 months, and 6 months.

Statistical Analysis: Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation. Paired t-test was used for within-group comparison, unpaired t-test for between-group comparison, and chi-square test for categorical variables. A p-value < 0.05 was considered statistically significant.

Results

A total of 302 patients diagnosed with Kellgren–Lawrence grade II and III knee osteoarthritis were included in this retrospective study. Patients were equally distributed into Group A (single intra-articular steroid injection, n = 151) and Group B (multiple intra-articular steroid injections, n = 151). All patients completed a minimum follow-up of 6 months, and outcome data were available at all predefined time points.

Baseline Demographic and Clinical Characteristics: Baseline demographic variables and disease characteristics were comparable between the two groups. There was no statistically significant difference in age distribution, sex ratio, or radiological severity of osteoarthritis between Group A and Group B, indicating adequate baseline homogeneity.

Table 1 summarizes the baseline characteristics of the study population.

Table 1: Baseline Demographic and Clinical Characteristics of Study Groups

Variable	Group A (Single Injection) n=151	Group B (Multiple Injections) n=151	p-value
Mean age (years)	58.4 ± 7.6	59.1 ± 8.1	0.42
Female sex (%)	62.3%	64.9%	0.65

Grade II OA (%)	54.9%	52.3%	0.68
Grade III OA (%)	45.1%	47.7%	0.68

As shown in Table 1, none of the baseline parameters demonstrated statistically significant differences ($p > 0.05$).

Pain Assessment Using Visual Analogue Scale (VAS): Pain intensity was assessed using the Visual Analogue Scale (VAS) at baseline, 1 month, 3 months, and 6 months post-injection. Both groups demonstrated a statistically significant reduction in VAS scores at 1 month compared to baseline ($p < 0.001$).

At 3 and 6 months, patients in Group B exhibited significantly lower VAS scores compared to Group A, indicating more sustained pain relief with multiple injections.

The detailed comparison of VAS scores is presented in Table 2.

Table 2: Comparison of Mean VAS Scores Between Groups Over Time

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Baseline	7.8 ± 1.1	7.9 ± 1.0	0.56
1 month	3.6 ± 1.2	3.4 ± 1.1	0.18
3 months	4.2 ± 1.3	3.6 ± 1.2	0.01*
6 months	5.1 ± 1.4	4.2 ± 1.3	<0.001*

*Statistically significant ($p < 0.05$)

As illustrated in Table 2, although early pain relief at 1 month was comparable between the groups, Group B showed significantly better pain control at 3 and 6 months. The trend of VAS score changes over time is depicted in Figure 1.

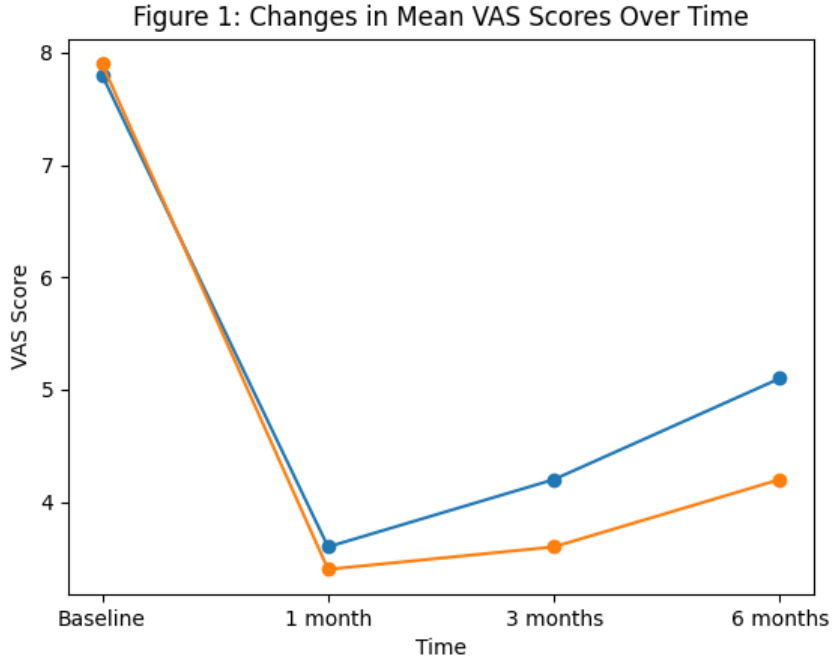

Figure 1: Line graph showing changes in mean VAS scores from baseline to 6 months in Group A and Group B, demonstrating sustained pain reduction in the multiple-injection group.

Functional Outcome Assessment Using WOMAC Score: Functional status was evaluated using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Both groups showed significant functional improvement at 3 months compared to baseline ($p < 0.001$).

However, at 6 months, Group B maintained significantly lower WOMAC scores than Group A, indicating better preservation of functional improvement in patients receiving multiple injections. The comparison of WOMAC scores is detailed in Table 3.

Table 3: Comparison of WOMAC Scores Between Groups

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Baseline	62.5 ± 8.4	63.1 ± 8.7	0.58
3 months	38.2 ± 7.9	34.6 ± 7.5	0.002*
6 months	45.7 ± 8.1	39.3 ± 7.8	<0.001*

*Statistically significant ($p < 0.05$)

As shown in Table 3, although both groups improved initially, Group B demonstrated significantly superior functional outcomes at 3 and 6 months. A visual comparison of WOMAC score changes is shown in Figure 2.

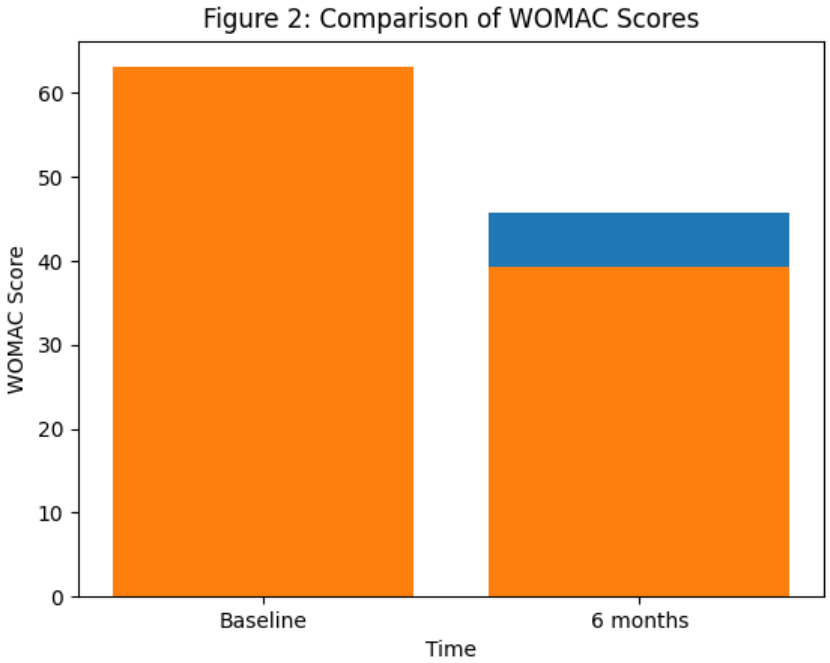

Figure 2: Bar chart comparing mean WOMAC scores at baseline and 6 months between Group A and Group B, showing greater sustained functional improvement in the multiple-injection group.

Summary of Key Results

- Both single and multiple intra-articular steroid injections resulted in significant short-term pain and functional improvement.
- Multiple injections provided significantly better pain relief and functional outcomes at 3 and 6 months.
- No statistically significant baseline differences were observed between groups, strengthening the validity of outcome comparisons.

Discussion

Intra-articular corticosteroid injection is a fundamental component in the conservative treatment of knee osteoarthritis, especially for patients experiencing persistent pain despite oral medications and physiotherapy. The current retrospective study evaluated the clinical outcomes of single versus multiple steroid injections in patients with grade II and III knee osteoarthritis.

Our results indicate that both single and multiple injections yield substantial short-term pain alleviation and functional enhancement, aligning with prior studies [16,17]. The initial decrease in VAS and WOMAC scores at 1 and 3 months underscores the significant anti-inflammatory effect of corticosteroids on synovitis-induced pain [18].

However, patients who received multiple injections had much better pain control and functional scores after 6 months than those who only received one injection. This indicates that recurrent suppression of synovial inflammation may extend symptomatic relief in certain patients [19]. Raynauld et al. made similar observations, noting that repeated injections provided lasting relief from symptoms, but they also raised concerns about cartilage loss [20].

The gradual increase in pain scores in the single injection group after three months corresponds with the established limited duration of steroid

effectiveness [21]. On the other hand, the multiple injection group had lower scores, but the difference got smaller over time. This suggests that repeated injections may delay but not stop symptoms from coming back [22].

Safety is still a big worry when it comes to giving multiple intra-articular steroid injections. Experimental studies have shown that corticosteroids can be harmful to cartilage, especially when given often [23]. Although our study did not assess radiological progression, the risk of structural damage highlights the necessity of restricting injection frequency and personalising treatment [24].

The strengths of this study include a relatively large sample size and inclusion of real-world clinical data. However, its retrospective design, lack of randomisation, possible selection bias no imaging for cartilage thinning montoring.no documentation for physiotherapy protocol and absence of long-term radiological follow-up constitute significant limitations. To better define the best injection schedule, future prospective randomised trials with imaging correlation are needed [25]. Future prospective studies incorporating imaging biomaterics are needed to determine structural effects of repeated infections.

Conclusion

Both single and multiple intra-articular corticosteroid injections are effective in reducing pain and improving function in patients with grade II–III knee osteoarthritis. Multiple injections provide more sustained symptomatic relief but should be used cautiously due to potential long-term risks. A single injection may be sufficient for many patients, with repeat injections reserved for selected cases after careful evaluation.

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