Original Research

COMPARATIVE EFFICACY OF INTRA-ARTICULAR HYALURONIC ACID ALONE VERSUS COMBINED HYALURONIC ACID AND TRIAMCINOLONE ACETONIDE IN PATIENTS WITH KNEE OSTEOARTHRITIS: A PROSPECTIVE STUDY FROM A TERTIARY CARE CENTER

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ABSTRACT

Background: Knee osteoarthritis is a leading cause of pain and disability worldwide. Intra-articular hyaluronic acid (HA) is widely used for symptomatic relief, while corticosteroids such as triamcinolone acetonide provide rapid anti-inflammatory effects. The present study was conducted to compare the efficacy and safety of intra-articular HA alone versus HA combined with triamcinolone acetonide in patients with knee osteoarthritis**.**

Methods: This prospective comparative study was conducted at the Bone and Joint Hospital, Barzulla, Government Medical College Srinagar, from November 2024 to November 2025. A total of 200 patients aged 30–50 years with knee osteoarthritis were enrolled and divided into two groups: Group A (n=100) received intra-articular HA alone, while Group B (n=100) received HA combined with triamcinolone acetonide. Pain and functional outcomes were assessed using Visual Analog Scale (VAS) and WOMAC scores at baseline, 2 weeks, 6 weeks, 12 weeks, and 24 weeks. Statistical analysis was performed using appropriate tests with $p < 0.05$ considered significant.

Results: Both groups were comparable at baseline ($p > 0.05$). Significant reduction in VAS scores was observed in both groups; however, Group B showed greater improvement at all follow-up intervals. Mean VAS scores in Group A decreased from 7.18 ± 0.71 to 4.42 ± 0.68, whereas in Group B they decreased from 7.12 ± 0.69 to 3.98 ± 0.61 at 24 weeks ($p < 0.001$). Similarly, WOMAC scores improved significantly in both groups, with greater reduction in Group B (from 66.9 ± 6.5 to 43.3 ± 5.8) compared to Group A (from 67.4 ± 6.8 to 47.6 ± 6.1) ($p < 0.001$). A higher proportion of patients in Group B achieved ≥30% reduction in VAS (82% vs 66%, $p = 0.01$) and ≥20% improvement in WOMAC scores (79% vs 61%, $p = 0.006$). Adverse events were mild and comparable between the groups, with no serious complications reported.

Conclusion: Both intra-articular HA alone and HA combined with triamcinolone acetonide are effective in managing knee osteoarthritis. However, the combination therapy provides superior pain relief, particularly in the early period, and results in better overall functional outcomeswithout increasing adverse effects. The addition of triamcinolone to HA may be considered a more effective therapeutic option in selected patients.

Keywords: Knee Osteoarthritis, Hyaluronic Acid, Triamcinolone Acetonide, Intra-Articular Injection,Vas Score, Womac Score, Combination Therapy.

INTRODUCTION

Osteoarthritis (OA) is a chronic, progressive joint disorder characterized by the gradual degeneration of articular cartilage, leading to pain, stiffness, and functional limitation [1]. Among the various joints affected, the knee is one of the most commonly involved, making knee osteoarthritis a significant cause of morbidity and impaired quality of life [2]. It represents a major global health burden and is a leading cause of disability, with its prevalence rising steadily, particularly during midlife and advancing age [3–5]. Epidemiological projections suggest that nearly one in two individuals may develop symptomatic knee osteoarthritis by the age of 85

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years [4]. Consequently, the primary goals of management are focused on alleviating pain, improving joint function, and enhancing overall quality of life [6,7].

Knee osteoarthritis (OA) is one of the most prevalent chronic musculoskeletal disorders and a leading cause of pain, disability, and reduced functional capacity worldwide. Recent epidemiological data indicate that the global prevalence of knee OA continues to rise, with a significant burden observed in middle-aged and elderly populations [7]. This increasing prevalence poses a substantial socioeconomic challenge due to its impact on mobility, independence, and quality of life.

Osteoarthritis is now recognized as a whole-joint disease involving not only progressive degeneration of articular cartilage but also subchondral bone remodeling, synovial inflammation, and changes in periarticular structures. These pathological processes contribute to pain, stiffness, and functional limitation, which are the hallmark clinical features of the disease [5]. The multifactorial nature of OA necessitates a comprehensive approach to management.

The primary goal of treatment in knee OA is symptomatic relief and improvement in joint function. Current guidelines recommend a stepwise approach, beginning with conservative measures such as lifestyle modification, physiotherapy, and pharmacological therapy, followed by intra-articular interventions in patients with persistent symptoms [9]. Among these, intra-articular corticosteroids are known to provide rapid short-term pain relief by reducing synovial inflammation, whereas hyaluronic acid acts as a viscosupplement, improving joint lubrication and potentially offering longer-term benefits [10,11].

However, the individual limitations of these therapies have led to increasing interest in combination intra-articular treatments. The addition of corticosteroids to hyaluronic acid is hypothesized to provide both immediate anti-inflammatory effects and sustained symptomatic improvement. Several randomized controlled trials have evaluated this combined approach and have demonstrated improved early pain relief and functional outcomes compared to hyaluronic acid alone **[12,13]**.

MATERIALS AND METHODS

Study Design and Setting: This prospective comparative study was conducted at the Bone and Joint Hospital, Barzulla, Government Medical College Srinagar, over a period of one year from November 2024 to November 2025. The study was carried out after obtaining approval from the Institutional Ethics Committee, and informed written consent was obtained from all participants prior to inclusion in the study.

Study Population: A total of 200 patients diagnosed with knee osteoarthritis were enrolled in the study. Patients were recruited from the outpatient and inpatient departments of the institution. All participants were within the age group of 30–50 years and included both males and females.

Inclusion Criteria

- Patients aged between 30 and 50 years
- Clinical diagnosis of knee osteoarthritis based on symptoms (pain, stiffness, reduced mobility)
- Radiological confirmation of osteoarthritis (Kellgren–Lawrence Grade II or III)
- Willingness to participate and provide informed consent

Exclusion Criteria

- Advanced osteoarthritis (Kellgren–Lawrence Grade IV)
- Previous intra-articular injection within the last 6 months
- History of inflammatory arthritis (e.g., rheumatoid arthritis, gout)
- Active infection in or around the knee joint
- History of knee surgery
- Known hypersensitivity to hyaluronic acid or corticosteroids
- Coagulopathy or ongoing anticoagulant therapy

Sample Size and Group Allocation: A total of 200 eligible patients were included and allocated into two groups of equal size (n = 100 each):

- **Group A:** Received intra-articular hyaluronic acid alone
- **Group B:** Received intra-articular hyaluronic acid combined with triamcinolone acetonide

Allocation was performed using a simple randomization technique.

Intervention Protocol: All injections were administered under strict aseptic conditions by an experienced orthopedic surgeon.

- **Group A (HA group):** Patients received intra-articular injection of hyaluronic acid as per standard dosing protocol.
- **Group B (Combination group):** Patients received intra-articular hyaluronic acid along with triamcinolone acetonide in the same sitting.

The injections were administered via a standard anterolateral approach to the knee joint. Patients were observed briefly post-procedure and advised to limit strenuous activities for 24–48 hours.

Outcome Measures

Primary Outcomes

- **Pain assessment:** Measured using the Visual Analog Scale (VAS)
- **Functional outcome:** Assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)

Secondary Outcomes

- Requirement of rescue analgesics
- Incidence of adverse events (injection site pain, swelling, post-injection flare, infection)

Follow-up Protocol

Patients were evaluated at the following time intervals:

- Baseline (pre-injection)
- 2 weeks
- 6 weeks
- 12 weeks
- 24 weeks

At each follow-up visit, VAS and WOMAC scores were recorded, and patients were assessed for any complications or adverse effects.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage. Student's t-test was used for comparison of continuous variables between groups. Paired t-test was used for within-group comparisons. Chi-square test was applied for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: The study adhered to the principles of the Declaration of Helsinki. Confidentiality of patient data was maintained throughout the study, and participants were free to withdraw at any stage without any impact on their treatment.

RESULTS

Both groups were comparable at baseline with respect to demographic and clinical parameters. There was no statistically significant difference between the groups in terms of age, sex distribution, body mass index, duration of symptoms, Kellgren–Lawrence grading, baseline VAS score, and baseline WOMAC score ($p > 0.05$), indicating homogeneity between the groups [Table 1].

Table 1: Baseline Demographic and Clinical Profile

Parameter	Group A (HA) (N=100)	Group B (HA + Triamcinolone) (N=100)	P-Value
Age (years, mean ± SD)	43.6 ± 5.8	44.1 ± 5.6	0.54
Male/Female (n)	42/58	39/61	0.66
BMI (kg/m²)	27.4 ± 3.1	27.6 ± 3.0	0.63
Duration of symptoms (months)	18.9 ± 8.4	19.3 ± 8.1	0.72
KL Grade II/III	62/38	64/36	0.77
Baseline VAS	7.18 ± 0.71	7.12 ± 0.69	0.54
Baseline WOMAC	67.4 ± 6.8	66.9 ± 6.5	0.59

A progressive reduction in pain scores was observed in both groups over the study period. However, Group B (HA + Triamcinolone) demonstrated a significantly greater reduction in VAS scores at all follow-up intervals compared to Group A [Table 2].

Table 2: Comparison of VAS Scores over Time

Time Interval	Group A (Ha)	Group B (Ha + Triamcinolone)	P-Value
Baseline	7.18 ± 0.71	7.12 ± 0.69	0.54
2 weeks	5.91 ± 0.76	4.98 ± 0.73	<0.001
6 weeks	5.36 ± 0.74	4.62 ± 0.69	<0.001
12 weeks	4.88 ± 0.70	4.21 ± 0.65	<0.001
24 weeks	4.42 ± 0.68	3.98 ± 0.61	<0.001

Significant improvement in WOMAC scores was observed in both groups during follow-up, reflecting improvement in pain, stiffness, and functional capacity. Group B demonstrated superior improvement compared to Group A [Table 3].

Table 3: Comparison of WOMAC Scores

Time Interval	Group A (Ha)	Group B (Ha + Triamcinolone)	P-Value

Baseline	67.4 ± 6.8	66.9 ± 6.5	0.59
12 weeks	52.8 ± 6.4	48.7 ± 6.0	<0.001
24 weeks	47.6 ± 6.1	43.3 ± 5.8	<0.001

A higher proportion of patients in Group B achieved clinically significant improvement compared to Group A. The requirement for rescue analgesics was lower in the combination group. Both treatments were well tolerated with minimal adverse effects [Fig 1].

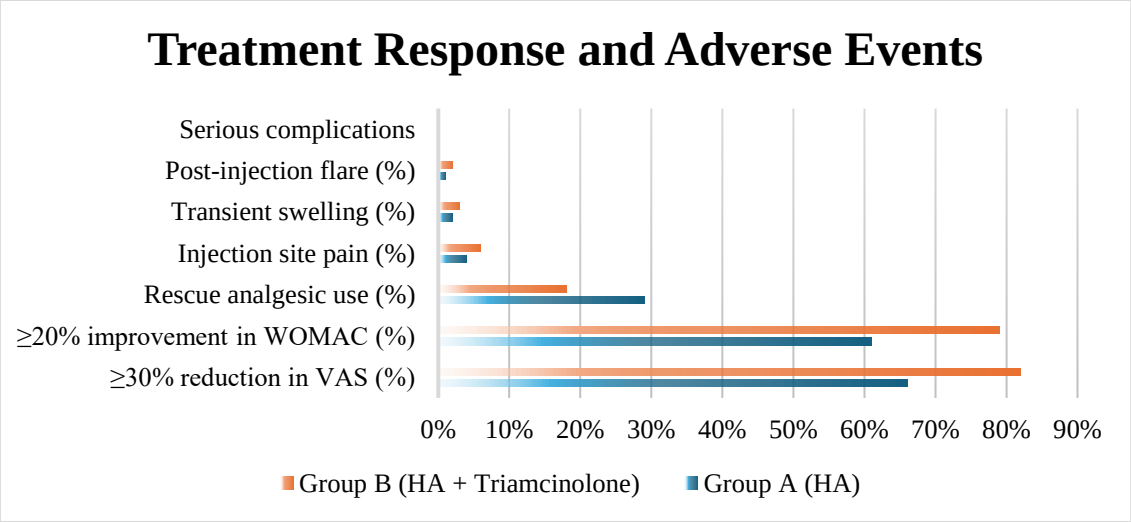

Fig 1.Treatment Response and Adverse Events

Overall Observation: The findings of the present study indicate that both intra-articular hyaluronic acid alone and in combination with triamcinolone acetonide are effective in reducing pain and improving function in patients with knee osteoarthritis. However, the combination therapy demonstrated superior efficacy, particularly in terms of early pain relief and overall clinical improvement, while maintaining a comparable safety profile.

DISCUSSION

The present study showed that both intra-articular hyaluronic acid alone and the combination of hyaluronic acid with triamcinolone acetonide produced meaningful improvement in patients with knee osteoarthritis; however, the combination group demonstrated greater reduction in pain and better functional recovery at every follow-up point up to 24 weeks. The most prominent difference was seen early after injection, and the advantage remained evident throughout the follow-up period in our cohort. This pattern suggests that the addition of triamcinolone may enhance the clinical response to hyaluronic acid rather than merely producing a transient early effect.

Our findings are broadly consistent with the recent comparative study by Tammachote N et al. [12], who reported a synergistic effect of hyaluronic acid and triamcinolone acetonide compared with hyaluronic acid alone in Kellgren–Lawrence grade 2 and 3 knee osteoarthritis, with better pain relief and physical function over 12 weeks. Similarly, de Campos et al. [13] found that adding triamcinolone improved the first-week symptom and functional scores of viscosupplementation, although the difference was not maintained beyond the early period. In contrast to that shorter-lived benefit, our data suggest that the combined regimen may offer a more durable clinical advantage in a slightly different patient population and with a longer follow-up window.

The early superiority of the combination arm in our study also aligns with the work of Wang et al. [4], who demonstrated that co-injection of hyaluronic acid and corticosteroid produced rapid improvement in pain relief, knee function, and range of motion, although later follow-up did not show a major difference compared with hyaluronic acid alone. An earlier randomized study by Ozturk et al. [15] had already explored hyaluronic acid with and without corticosteroid over one year, supporting the feasibility of this combined intra-articular approach in knee osteoarthritis. Taken together, these studies support the concept that corticosteroids may accelerate symptom relief, while hyaluronic acid contributes to ongoing joint symptom control.

The time course of response observed in the present study is also in line with the broader literature on the therapeutic trajectory of intra-articular agents. Bannuru et al. [9] reported that corticosteroids are

relatively more effective than hyaluronic acid during the first four weeks, whereas hyaluronic acid tends to show greater benefit from four to 26 weeks. Likewise, He et al. [14], in a meta-analysis of 12 randomized trials involving 1,794 patients, found that corticosteroids provided better short-term pain relief up to one month, while hyaluronic acid became more effective by six months; they also reported similar functional improvement between the two treatments. Our results extend this trajectory by suggesting that combining the two agents may capture the early benefit of corticosteroids and the sustained benefit associated with hyaluronic acid, thereby producing a more consistent improvement across the full follow-up period.

The functional outcomes in our study, as reflected by WOMAC scores, improved in both groups but more markedly in the combination arm. This is clinically important because pain reduction alone does not necessarily translate into meaningful improvement in daily activity; the parallel reduction in WOMAC scores indicates that the better pain control observed with the combined injection strategy was accompanied by better function. The absence of serious adverse events and the low frequency of mild local reactions in our series are also reassuring and are consistent with the safety profile reported in prior studies evaluating hyaluronic acid, corticosteroids, or their combination. de Campos et al. [13], Hangody L et al. [4], and He et al. [14] all reported acceptable tolerability, without a clear signal of excess serious harm from the combined approach.

A possible explanation for the more sustained benefit seen in our cohort is that the study population was relatively young, restricted to the 30–50-year age group, and included mainly Kellgren–Lawrence grade II and III disease. Patients at this stage may retain enough joint reserve to respond better to symptom-modifying intra-articular treatment than those with more advanced osteoarthritis. The present study therefore supports the use of hyaluronic acid plus triamcinolone acetonide as a practical option in selected patients with symptomatic early to moderate knee osteoarthritis, especially when faster pain relief is desired without compromising short-term safety. The findings should, however, be interpreted within the limits of a single-center study and a 24-week follow-up period.

CONCLUSION

The present study demonstrates that both intra-articular hyaluronic acid alone and its combination with triamcinolone acetonide are effective modalities in the management of knee osteoarthritis, resulting in significant reduction in pain and improvement in functional outcomes over a 24-week follow-up period. However, the addition of triamcinolone acetonide to hyaluronic acid was associated with superior clinical efficacy, particularly in terms of faster onset of pain relief and greater overall improvement in VAS and WOMAC scores.

The combination therapy also showed a higher proportion of responders and a reduced requirement for rescue analgesics, without any increase in adverse effects, thereby maintaining a favorable safety profile. These findings suggest that intra-articular hyaluronic acid combined with triamcinolone acetonide offers a more effective therapeutic option compared to hyaluronic acid alone, especially in patients requiring rapid symptomatic relief.

In conclusion, the use of combination intra-articular therapy may be considered a valuable and practical approach in the management of early to moderate knee osteoarthritis. Further large-scale, multicentric studies with longer follow-up are recommended to validate these findings and assess long-term outcomes.

Conflict of Interest: None

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