

Comparative Efficacy of Intra-Articular Hyaluronic Acid vs. Triamcinolone Acetonide in Knee Osteoarthritis Treatment

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Abstract

Introduction: Osteoarthritis (OA) of the knee is a common degenerative joint disorder affecting the elderly population, characterized by progressive cartilage loss, joint pain, and functional limitation. Intra-articular therapies like Hyaluronic Acid (HA) and Triamcinolone Acetonide (TA) are widely used to relieve symptoms, but their comparative effectiveness remains a subject of clinical interest. This study aimed to evaluate and compare the short- and long-term efficacy of HA and TA in the management of knee OA.

Materials and Methods: A randomized controlled study was conducted over one year at Chengalpattu Medical College, Tamil Nadu, involving 40 patients aged 50–65 years with mild to moderate knee OA. Patients with uncontrolled diabetes or recent steroid injections were excluded. Participants were randomly assigned to two groups: Group A received intra-articular HA, and Group B received intra-articular TA. Pain assessment was carried out using the Visual Analog Scale at 1 week, 1 month, and 6 months post-injection. Additional clinical signs, such as joint tenderness and stiffness, were also evaluated. Statistical analysis was performed using SPSS

Results: At the one-week follow-up, Group B (TA) showed a significantly greater reduction in pain compared to Group A (HA) (VAS 2.55 ± 1.276 vs. 3.25 ± 1.372 ; $p < 0.05$). However, no statistically significant difference was observed between the two groups at 1 month ($p > 0.05$) and 6 months ($p > 0.05$).

Conclusion: Triamcinolone Acetonide demonstrated superior short-term efficacy in pain relief compared to Hyaluronic Acid. However, both agents were equally effective in the long term. While TA may be suitable for rapid symptom control, HA offers a safer profile for extended management. Treatment decisions should be individualized based on patient needs and clinical factors.

Keywords: Knee Osteoarthritis, Hyaluronic Acid, Triamcinolone Acetonide, Intra-Articular Injection, VAS

Introduction

Knee osteoarthritis (OA) is a common degenerative joint disorder, particularly seen in older adults. It is marked by the gradual deterioration of articular cartilage, inflammation of the synovial membrane, the development of bony outgrowths (osteophytes), and changes in the underlying bone structure. This condition is a major contributor to reduced mobility and diminished quality of life, ranking among the top causes of disability across the globe. The disease process in knee OA is driven by a combination of mechanical stress and biochemical alterations, leading to persistent joint pain, stiffness, and restricted movement. (1,2) The management of knee OA is typically multimodal, involving lifestyle modifications, pharmacologic therapy, physical rehabilitation, and in more advanced stages, surgical intervention. Among pharmacological options, intra-articular (IA) injections have emerged as a common intermediate therapy when oral analgesics and physical therapy fail to provide adequate relief [3].

Hyaluronic acid (HA) is a naturally occurring glycosaminoglycan present in synovial fluid and cartilage, playing a vital role in joint lubrication and shock absorption. In osteoarthritis (OA), there is a significant reduction in both the concentration and molecular weight of the body's HA, which diminishes the viscoelastic properties of the synovial fluid. Intra-articular injections of HA, commonly known as Visco supplementation, aim to restore the balance within the joint, enhance lubrication, and alleviate pain by exerting anti-inflammatory effects and promoting chondroprotection. [4,5]

Triamcinolone acetonide (TA), a potent corticosteroid, exerts its effects by suppressing inflammatory mediators and cytokines within the joint space. It offers rapid symptomatic relief, particularly in patients with signs of active synovitis [6]. However, the duration of its efficacy is often limited, and repeated corticosteroid injections have raised concerns regarding potential cartilage damage [7].

Numerous clinical trials and meta-analyses have compared the efficacy of IA HA and corticosteroids. While corticosteroids like TA tend to provide faster relief in the short term, HA is often associated with longer-lasting effects, particularly in terms of functional improvement [8,9]. However, the choice of agent remains controversial, with varying outcomes reported across studies due to differences in patient populations, OA severity, injection protocols, and product formulations. This study aims to provide a comparative assessment of the efficacy of intra-articular hyaluronic acid and triamcinolone acetonide in the treatment of knee osteoarthritis, focusing on pain relief, functional improvement, and duration of therapeutic effect.

Materials & Methods

Study Design and Setting: A randomized controlled trial was conducted in the Department of Orthopaedics, Chengalpattu Medical College and Hospital, Tamil Nadu, over a period of one year. The study aimed to evaluate the effectiveness of intra-articular therapies in the management of knee osteoarthritis (OA).

Study Population: A total of 40 participants aged 50 to 65 years, diagnosed with mild to moderate knee osteoarthritis based on the Kellgren-Lawrence radiographic grading system, were recruited for the study.

Inclusion Criteria

- Adults aged 50–65 years
- Clinically and radiologically confirmed mild to moderate knee OA
- Willingness to provide informed consent and adhere to follow-up schedule

Exclusion Criteria

- Uncontrolled diabetes mellitus
- History of intra-articular steroid or hyaluronic acid injection within the previous six months
- Secondary osteoarthritis due to trauma, inflammatory arthritis, or infection
- Severe OA requiring surgical intervention
- Known hypersensitivity to study medications

Randomization and Group Allocation: Eligible subjects were randomly assigned into two groups (Group A and Group B) using a simple randomization technique. A shuffled card method was employed to ensure unbiased allocation - each card contained a group label, and participants picked one card to determine their group.

- **Group A:** Received intra-articular corticosteroid injection
- **Group B:** Received intra-articular platelet-rich plasma (PRP) injection

Each group comprised 20 participants.

Intervention Procedure: All procedures were performed under aseptic precautions in the outpatient procedure room. Patients were positioned comfortably, and the affected knee was flexed at 90 degrees. The injection site was identified using anatomical landmarks and confirmed by palpation. Following the injection, patients were advised to rest the joint for 24 hours and avoid strenuous activities for at least one week. No additional NSAIDs or analgesics were prescribed during the follow-up period unless deemed clinically necessary.

Follow-Up and Outcome Assessment: All participants were followed up at 1 week, 1 month, and 6 months post-injection. The primary outcome measure was pain intensity, assessed using the Visual Analog Scale (VAS), a 10-point scale where 0 indicates no pain and 10 indicates the worst possible pain. Secondary outcomes included assessment of joint tenderness, stiffness, and functional improvement, recorded during each follow-up visit.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics such as mean, standard deviation, and percentage were used to summarize demographic and baseline variables.

- Paired t-test was applied to compare pre- and post-intervention VAS scores within each group.
- An independent t-test was used to compare the mean differences between Group A and Group B at each follow-up interval.
- Chi-square test was employed to analyze categorical variables such as joint tenderness and stiffness improvement.
- A p-value < 0.05 was considered statistically significant.

Results were presented as mean $\pm$ standard deviation (SD) and illustrated in tabular and graphical formats for clarity.

Ethical Considerations: The study protocol was reviewed and approved by the Institutional Ethics Committee (IEC) of Chengalpattu Medical College. All participants were thoroughly informed about the nature and purpose of the study, potential benefits, and possible risks involved. Written informed consent was obtained from each participant before enrolment. Confidentiality of personal data was maintained throughout the study, and all procedures adhered to the principles outlined in the Declaration of Helsinki (2013 revision).

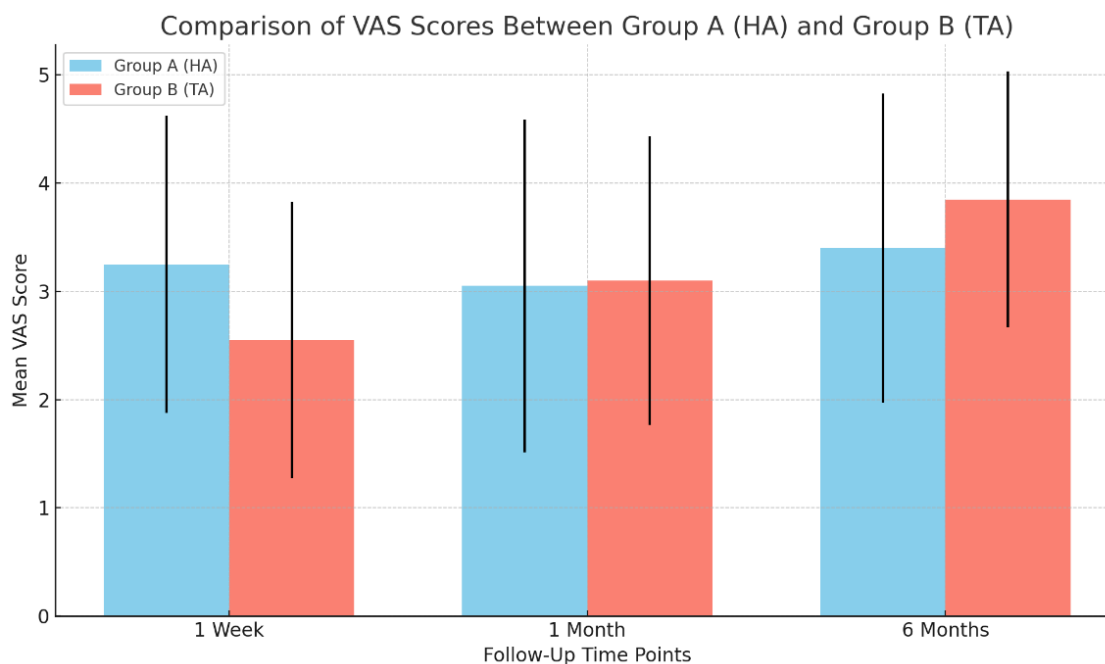
Results

The study included 40 patients, divided equally into two groups: Group A received intra-articular injections of Hyaluronic Acid (HA), while Group B was administered Triamcinolone Acetonide (TA). The participants had a mean age of 57.4 years (± 8 years), with ages ranging from 50 to 65 years. Pain intensity was monitored using the Visual Analog Scale (VAS) at three key time points: 1 week, 1 month, and 6 months following the injection.

At the one-week follow-up, Group B (TA) demonstrated a more pronounced reduction in pain, with a mean VAS score of 2.55 ± 1.276 , compared to 3.25 ± 1.372 in Group A (HA). This difference was statistically significant ($p < 0.05$). However, by the one-month mark, the average VAS scores were 3.05 ± 1.538 for Group A and 3.10 ± 1.334 for Group B, showing no meaningful difference between the groups ($p > 0.05$). At six months, pain scores showed a slight upward trend in both groups 3.40 ± 1.429 in Group A and 3.85 ± 1.182 in Group B - but the variation remained statistically insignificant ($p > 0.05$).

Table 1: VAS Pain Scores at Follow-Up Intervals

Time Point	Group A (HA) Mean $\pm$ SD	Group B (TA) Mean $\pm$ SD	p-Value	Interpretation
1 Week	3.25 $\pm$ 1.372	2.55 $\pm$ 1.276	< 0.05	Significant reduction in TA group
1 Month	3.05 $\pm$ 1.538	3.10 $\pm$ 1.334	> 0.05	No significant difference
6 Months	3.40 $\pm$ 1.429	3.85 $\pm$ 1.182	> 0.05	No significant difference



These results suggest that Triamcinolone Acetonide provides a quicker onset of pain relief in the short term (1 week), whereas both treatments show similar outcomes at 1 and 6 months post-injection.

Discussion

This study demonstrated that intra-articular Triamcinolone Acetonide (TA) provided a more significant reduction in pain after one week compared to Hyaluronic Acid (HA), as reflected by lower VAS scores (2.55 ± 1.276 vs 3.25 ± 1.372 ; $p < 0.05$). However, at one month and six months following injection, no statistically significant difference in pain reduction was observed between the two groups, indicating comparable long-term efficacy.

These findings are consistent with previously published literature. Pelletier et al. reported that intra-articular corticosteroid injections resulted in significant short-term pain relief but failed to show sustained superiority over HA beyond one month of follow-up [11]. Similarly, Migliorini et al. demonstrated through a meta-analysis that both TA and HA were effective in reducing pain in patients with early-stage osteoarthritis, with no significant difference in long-term outcomes between the two treatments [10].

Bowman et al. highlighted the anti-inflammatory properties of HA and its role in stimulating cartilage synthesis and preserving joint structure, suggesting that HA may be better suited for long-term use, particularly in younger patients or those with early osteoarthritis [8]. Nevertheless, the rapid pain relief associated with TA, as observed in the present study, supports its use in patients requiring immediate symptom control, such as those experiencing acute exacerbations.

Concerns regarding the potential catabolic effects of repeated corticosteroid injections on articular cartilage have been raised in multiple studies. Wernecke et al. reported that intra-articular corticosteroids could

adversely affect cartilage integrity when used repeatedly [7]. In addition, Utamawatin et al. found that although a higher dose of TA (40 mg) was more effective than a lower dose (10 mg) in reducing pain, repeated administration did not improve structural outcomes and may increase the risk of cartilage thinning [12]. Furthermore, McAlindon et al. observed a reduction in knee cartilage volume following repeated intra-articular triamcinolone injections, despite modest pain relief [9].

Overall, the findings of the present study suggest that TA is more effective for short-term pain relief, whereas HA represents a safer option for long-term management of mild to moderate osteoarthritis. Therefore, treatment selection should be individualized based on symptom severity, desired duration of relief, patient age, and associated comorbidities.

Conclusion

In this randomized controlled study, intra-articular Triamcinolone Acetonide demonstrated superior short-term pain relief compared to Hyaluronic Acid in patients with mild to moderate osteoarthritis of the knee. However, both treatment modalities showed comparable effectiveness at one- and six-month post-injection, with no statistically significant difference in long-term outcomes. While Triamcinolone Acetonide may be preferred for immediate symptom control, Hyaluronic Acid presents a safer alternative for sustained management without the potential cartilage-related adverse effects associated with corticosteroids. Treatment choice should be individualized based on clinical presentation, patient preference, and risk profile.

Conflict of Interest: Nil

Reference

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