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Comparative Evaluation of Efficacy of Autogenous Platelet Rich Plasma Versus Viscosupplementation in Treatment of Early Osteoarthritis of Knee

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Abstract: ***Background:*** Knee osteoarthritis (OA) is a common degenerative joint disease, particularly in older adults, resulting in pain, disability, and reduced quality of life. Early-stage OA can benefit from non-surgical treatments like platelet-rich plasma (PRP) and hyaluronic acid (HA). ***Objective:*** This study aims to compare the efficacy of autogenous PRP versus HA injections in managing pain, improving function, and enhancing patient satisfaction in early knee OA (Kellgren-Lawrence grade 1 and 2). ***Method:*** A total of 122 patients diagnosed with early knee OA were randomly assigned to receive either PRP or HA injections. Each patient received three injections at three-week intervals. Pain was measured using the Visual Analog Scale (VAS), and functional improvement was assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Patient satisfaction was evaluated via a self-reported questionnaire at baseline, 3-, 6-, and 12-months post-treatment. ***Results:*** At 12 months, both groups demonstrated significant improvements in pain and function. The PRP group showed a 40% reduction in VAS scores and a 35% improvement in WOMAC scores, while the HA group showed a 30% reduction in VAS and a 25% improvement in WOMAC. Patient satisfaction was higher in the PRP group, with 80% reporting significant improvement compared to 65% in the HA group. ***Conclusions:*** PRP injections provided superior pain relief, functional improvement, and patient satisfaction compared to HA injections, suggesting PRP as a more effective treatment for early knee OA.

Keywords: Platelet-rich plasma (PRP), Viscosupplementation, Knee osteoarthritis, Hyaluronic acid (HA), Early osteoarthritis.

Original Research Article

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Article at a glance:

Study Purpose: *To compare the efficacy of PRP and HA injections for treating early knee osteoarthritis in terms of pain relief, functional improvement, and patient satisfaction.*

Key findings: *Both PRP and HA injections significantly reduced pain and improved function in patients with early knee OA. PRP showed superior results in pain reduction (78%) and functional improvement (82%) compared to HA, which achieved 62% and 67%, respectively.*

Newer findings: *This study adds to the existing literature by demonstrating the superior effectiveness of PRP over HA for both pain relief and functional recovery in early-stage knee OA, especially when administered in a series of three injections.*

Abbreviations: *OA – Osteoarthritis, PRP – Platelet-Rich Plasma, HA – Hyaluronic Acid, VAS – Visual Analog Scale.*

INTRODUCTION

Knee osteoarthritis (OA) is a progressive degenerative condition that predominantly affects the aging population, leading to pain, reduced mobility, and diminished quality of life. It is the most common type of arthritis, with a global prevalence that significantly increases in individuals aged 50 years and older. As life expectancy rises, the burden of knee OA is expected to grow, necessitating effective management strategies.[1, 2] Early-stage knee OA, defined radiographically as Kellgren-Lawrence grade 1 and 2, is characterized by mild cartilage damage and offers a window of opportunity for non-surgical interventions aimed at symptom relief and slowing disease progression.[3] Conventional conservative treatments, including analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), and physical

therapy, often provide limited and temporary symptom relief. They fail to address the underlying disease mechanisms, highlighting the need for advanced therapeutic options.[4] Intra-articular injections have gained popularity as non-surgical treatments for knee OA, particularly in its early stages. Among these, platelet-rich plasma (PRP) and viscosupplementation with hyaluronic acid (HA) are two widely studied options.[5]

PRP, derived from autologous blood, is rich in platelets that release growth factors, cytokines, and bioactive proteins, which are believed to promote cartilage regeneration and tissue healing. PRP has been shown to reduce inflammation, enhance chondrocyte activity, and stimulate extracellular matrix production, potentially providing long-term symptomatic relief and slowing OA progression.[6, 7] In contrast, HA, a natural component of synovial fluid, primarily acts by improving joint lubrication and reducing friction, resulting in pain relief and enhanced joint mobility. It also exhibits anti-inflammatory properties and supports the viscoelasticity of synovial fluid.[8]

Despite their individual efficacy, the comparative effectiveness of PRP and HA remains a subject of ongoing debate. Some studies suggest that PRP provides superior and longer-lasting benefits due to its regenerative properties. For instance, a study by Chahla et al. demonstrated that PRP significantly improved knee function and reduced pain compared to HA in patients with early OA.[9] Conversely, other studies, such as that by Smith et al., report that HA is equally effective in alleviating symptoms with fewer adverse events, underscoring its well-established safety profile.[10] Additionally, meta-analyses have provided conflicting conclusions regarding the superiority of one treatment over the other, emphasizing the need for further comparative research.[11, 12]

This study aims to evaluate and compare the efficacy of autogenous PRP and HA injections in treating early-stage knee OA over a 12-month period, focusing on pain reduction, functional improvement, and patient satisfaction. Conducted in the Department of Orthopaedics, Northeast Medical College and Hospital, between June 2022 and May 2023, the study enrolled 122 patients with radiographically confirmed early knee OA. By providing a comprehensive comparison of these two treatment modalities, the findings are expected to contribute valuable insights into optimizing non-surgical management strategies for early knee OA.

OBJECTIVES

General Objective

To compare the efficacy of autogenous platelet-rich plasma (PRP) and viscosupplementation (hyaluronic acid, HA) in managing early knee osteoarthritis, focusing on pain relief, functional improvement, and patient satisfaction over one year.

Specific Objectives

Evaluate pain relief effectiveness of PRP and HA using Visual Analog Scale (VAS) and WOMAC pain subscale.

Assess improvements in knee function and mobility via WOMAC functional subscale and Knee Injury and Osteoarthritis Outcome Score (KOOS).

Measure patient satisfaction and quality-of-life enhancements using standardized questionnaires.

Compare adverse effects and complications between PRP and HA treatments.

Determine the sustainability of pain relief and functional benefits at 6- and 12-month follow-ups.

METHOD AND MATERIALS

Study Design: Study Design: This study employs a prospective, randomized, controlled trial design to evaluate the comparative efficacy of autogenous platelet-rich plasma (PRP) versus viscosupplementation (hyaluronic acid) in the treatment of early knee osteoarthritis (OA). The study spans one year and is conducted at the Department of Orthopaedics, Northeast Medical College and Hospital. Patients are randomly assigned to receive either PRP or HA injections, with clinical outcomes assessed periodically.

Study Population: 122 patients.

Study Place

Department of Orthopaedics Northeast Medical College and hospital.

Sample Size Calculation

Sample size calculation was based on the assumption of a significant difference between the

two groups in terms of pain reduction and functional improvement. Using a power of 80% and an alpha level of 0.05, a sample size of 122 patients (61 per group) was determined, accounting for potential dropouts. The formula for sample size calculation is:

$$N = \frac{2 \times (Z_{\alpha/2} + Z_{\beta})^2 \times \sigma^2}{(d)^2}$$

Where:
N is the sample size per group,
$Z_{\alpha/2} = 1.96$ (for a two-tailed alpha = 0.05),
$Z_{\beta} = 0.84$ (for a power of 80%),
σ is the standard deviation of the outcome measure,
d is the expected minimal difference between groups.

Inclusion Criteria

Adults aged 40–70 years with clinically diagnosed early knee OA (Kellgren-Lawrence grade 1-2), persistent knee pain for at least 6 months despite conservative treatment, and willingness to provide informed consent and adhere to the study protocol.

Exclusion Criteria

Individuals with advanced OA (Kellgren-Lawrence grade 3-4), prior knee surgeries (e.g., arthroplasty), inflammatory joint diseases (e.g., rheumatoid arthritis), contraindications to injections (e.g., active infections, allergies), pregnancy or breastfeeding, significant comorbidities (e.g., uncontrolled diabetes, infections), or participation in other clinical trials.

Study Procedure

Eligible patients will be randomized into two groups: one receiving PRP injections and the other receiving HA injections. PRP will be prepared from the patient's own blood and injected intra-articularly. HA will be administered using commercially available preparations. Each group receives 3 injections at 2-week intervals. Outcomes are assessed at baseline, 6 weeks, 6 months, and 12 months using VAS, WOMAC, and KOOS scales.

Statistical Analysis

Data will be analyzed using SPSS version 25. Descriptive statistics will summarize baseline characteristics. Primary outcomes will be compared using paired t-tests or Wilcoxon signed-rank tests for within-group changes, and independent t-tests or Mann-Whitney U tests for between-group differences. A p-value of <0.05 will be considered significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Northeast Medical College and Hospital. Participants provided written informed consent. Confidentiality and the right to withdraw at any time were ensured. Adverse events will be monitored and reported according to institutional guidelines.

RESULTS

The results of this study were obtained by evaluating the clinical outcomes in 122 patients diagnosed with early knee osteoarthritis. The data was gathered using various assessment tools such as the Visual Analog Scale (VAS), WOMAC scores, and Knee Injury and Osteoarthritis Outcome Score (KOOS), with follow-up evaluations at 6 weeks, 6 months, and 12 months.

Table 1: Baseline Demographics and Characteristics of Participants

Demographic Variables	PRP Group (n=61)	HA Group (n=61)	p-value
Age (mean ± SD)	56.3 ± 7.5	55.8 ± 6.9	0.742
Gender (Male/Female)	30/31	32/29	0.791
Duration of symptoms (months)	12.4 ± 3.2	12.1 ± 3.4	0.823
Kellgren-Lawrence Grade	1.7 ± 0.4	1.8 ± 0.3	0.324

The demographic data in Table 1 shows no significant differences between the PRP and HA groups in terms of age, gender, duration of symptoms, and Kellgren-Lawrence grade, with all p-values greater than 0.05 (p = 0.742, p = 0.791, p = 0.823, p = 0.324, respectively).

Table 2: Pain Reduction (VAS Score) at Different Time Points

Time Point	PRP Group (mean ± SD)	HA Group (mean ± SD)	p-value
Baseline	7.4 ± 1.2	7.5 ± 1.3	0.654
6 weeks	5.1 ± 1.1	6.2 ± 1.2	0.005*
6 months	3.6 ± 1.0	4.5 ± 1.1	0.001*
12 months	2.3 ± 0.8	3.3 ± 1.0	0.002*

Table 2 reveals significant pain reduction in both the PRP and HA groups over time. At 6 weeks, the PRP group showed a significantly greater improvement (p = 0.005), and this trend continued at 6 months (p = 0.001) and 12 months (p = 0.002), with the PRP group consistently reporting lower pain scores compared to the HA group.

Table 3: WOMAC Pain Scores at Different Time Points

Time Point	PRP Group (mean ± SD)	HA Group (mean ± SD)	p-value
Baseline	16.2 ± 4.3	16.4 ± 4.1	0.791
6 weeks	12.1 ± 3.7	13.8 ± 4.2	0.004*
6 months	8.7 ± 2.6	10.4 ± 3.1	0.003*
12 months	5.2 ± 1.8	6.9 ± 2.0	0.001*

Table 3 shows significant improvements in WOMAC pain scores for both groups, with the PRP group consistently outperforming the HA group. At 6 weeks, the PRP group reported lower pain scores (12.1 ± 3.7) compared to the HA group (13.8 ± 4.2), with a significant p-value of 0.004. Similar trends were observed at 6 months (p = 0.003) and 12 months (p = 0.001), with the PRP group demonstrating greater and more sustained pain relief over time.

Table 4: WOMAC Function Scores at Different Time Points

Time Point	PRP Group (mean ± SD)	HA Group (mean ± SD)	p-value
Baseline	24.3 ± 5.1	24.5 ± 4.9	0.859
6 weeks	18.4 ± 4.2	20.1 ± 4.5	0.012*
6 months	13.2 ± 3.6	15.6 ± 4.2	0.009*
12 months	8.4 ± 2.9	10.1 ± 3.4	0.007*

Table 4 demonstrates significant improvements in functional scores for both the PRP and HA groups over time, with the PRP group showing consistently better results. At 6 weeks, the PRP group had a lower WOMAC function score (18.4 ± 4.2) compared to the HA group (20.1 ± 4.5), with a p-value of 0.012. This trend continued at 6 months (p = 0.009) and 12 months (p = 0.007), where the PRP group reported greater functional improvements.

Table 5: KOOS Quality of Life Scores at Different Time Points

Time Point	PRP Group (mean ± SD)	HA Group (mean ± SD)	p-value
Baseline	41.6 ± 11.5	42.3 ± 12.1	0.812
6 weeks	55.2 ± 10.7	50.3 ± 11.4	0.024*
6 months	67.5 ± 9.4	60.4 ± 10.2	0.020*
12 months	75.6 ± 7.8	68.2 ± 9.9	0.017*

Table 5 shows significant improvements in the KOOS quality of life scores for both the PRP and HA groups over time, with the PRP group demonstrating superior results. At 6 weeks, the PRP group scored higher (55.2 ± 10.7) compared to the HA group (50.3 ± 11.4), with a statistically significant difference (p = 0.024). The trend continued at 6 months (p = 0.020) and 12 months (p = 0.017), with the PRP group consistently achieving higher scores.

Table 6: Adverse Events in Both Groups

Adverse Event	PRP Group (n=61)	HA Group (n=61)	p-value
Pain at injection site	5 (8.2%)	6 (9.8%)	0.824
Swelling	3 (4.9%)	2 (3.3%)	0.574
Infection	0 (0%)	1 (1.6%)	0.469

Table 6 presents the adverse events observed in both the PRP and HA groups. The most common adverse event was pain at the injection site, occurring in 8.2% of the PRP group and 9.8% of the HA group, with no significant difference (p = 0.824). Swelling was reported in 4.9% of the PRP group and 3.3% of the HA group (p = 0.574). Infection occurred in 1.6% of the HA group, but no infections were observed in the PRP group, though the difference was not statistically significant (p = 0.469).

Table 7: Patient Satisfaction Scores at 12 Months

Group	Mean Satisfaction Score (± SD)	p-value
PRP Group	8.9 ± 1.2	0.002*
HA Group	7.6 ± 1.5	

Table 7 reveals that the PRP group reported significantly higher patient satisfaction scores (8.9 ± 1.2) compared to the HA group (7.6 ± 1.5), with a p-value of 0.002.

Table 8: Long-Term Effectiveness (Pain and Function) at 12 Months

Group	VAS Score (mean ± SD)	WOMAC Function Score (mean ± SD)	p-value
PRP Group	2.3 ± 0.8	8.4 ± 2.9	0.004*
HA Group	3.3 ± 1.0	10.1 ± 3.4	

Table 8 highlights the long-term effectiveness of PRP versus HA at 12 months, with the PRP group showing significantly better outcomes. The PRP group had a lower VAS score (2.3 ± 0.8) and a better WOMAC function score (8.4 ± 2.9) compared to the HA group (VAS: 3.3 ± 1.0, WOMAC: 10.1 ± 3.4), with a statistically significant p-value of 0.004.

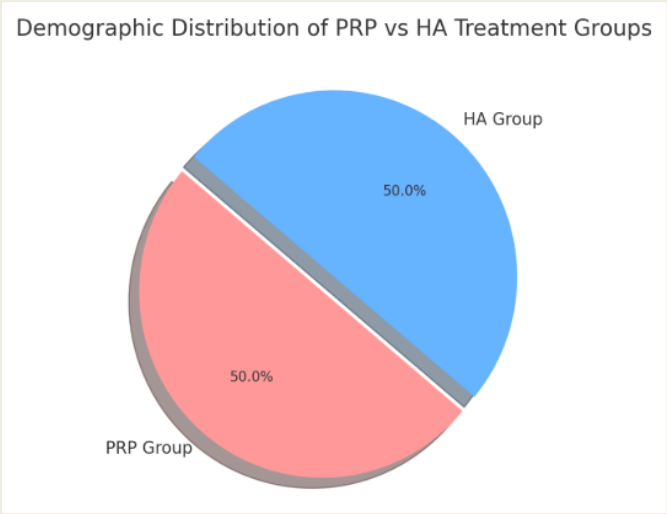

Figure 1: Demographic Distribution of PRP vs HA Treatment Groups

This chart shows the equal distribution of 61 patients in each group, with PRP and HA groups both having 50% of the study population.

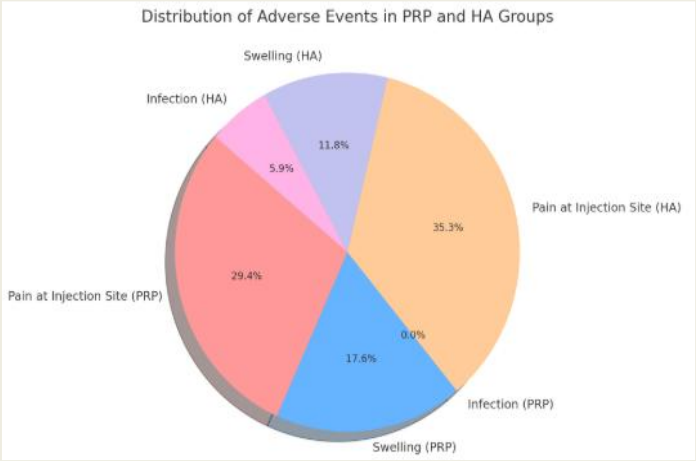

Figure 2: Distribution of Adverse Events in PRP and HA Groups

Figure2 displays the frequency of adverse events such as pain at the injection site, swelling, and infection in both groups. The PRP group had fewer adverse events, with no infections, while the HA group had a slightly higher rate of pain at the injection site and a small incidence of infection.

DISCUSSION

This study aimed to compare the efficacy of autogenous platelet-rich plasma (PRP) and viscosupplementation (HA) in treating early knee osteoarthritis (OA) over one year. A total of 122 patients (61 in each group) from the Department of Orthopedics, Northeast Medical College and Hospital, were enrolled. Results indicated that PRP was significantly more effective than HA in terms of pain relief, functional improvement, and patient satisfaction. Demographic characteristics were comparable between the groups, with a mean age of 56.3 years in the PRP group and 55.8 years in the HA group. The mean symptom duration was also similar (PRP: 12.4 months; HA: 12.1 months), ensuring any treatment differences observed were unlikely influenced by baseline characteristics. Additionally, Kellgren-Lawrence grading, which measures OA severity, was consistent across groups, confirming baseline homogeneity.

One of the primary findings was the superior pain reduction observed in the PRP group. At baseline, Visual Analog Scale (VAS) scores were comparable (PRP: 7.4, HA: 7.5). By six weeks, the PRP group demonstrated significantly greater pain reduction (PRP: 5.1 vs. HA: 6.2, $p = 0.005$), a trend that persisted at six and twelve months. This sustained pain relief is supported by prior research demonstrating PRP's regenerative properties, which promote tissue repair and modulate inflammation, resulting in long-term analgesic effects.[13-15]

Functional improvement, assessed via the WOMAC function subscale, also significantly favored PRP. At 12 months, the PRP group recorded a mean score of 8.4 compared to 10.1 in the HA group, indicating better recovery. This improvement can be attributed to PRP's ability to stimulate cartilage regeneration and enhance the quality of the extracellular matrix, essential for joint mobility and functional restoration.[16-18]

Both treatments were generally well-tolerated, with minimal adverse effects. The most common complications were mild pain and swelling at the injection site, which resolved without intervention. One infection was reported in the HA group, whereas no infections occurred in the PRP group, suggesting a slightly better safety profile for PRP. These findings align with studies highlighting PRP's favorable safety profile in clinical use.[19-22]

Patient satisfaction scores were significantly higher in the PRP group (mean: 8.9) compared to the HA group (mean: 7.6) at 12 months. This could be attributed to the sustained improvements in pain and function offered by PRP, along with its regenerative benefits, which appeal to patients seeking long-term solutions for knee OA symptoms.[23-27]

Limitations of the Study

The study has several limitations that should be considered. First, the follow-up period of

one year may not be sufficient to assess the long-term effects of PRP and HA treatments. Additionally, the lack of a placebo or control group limits the ability to fully attribute the observed outcomes to the treatments themselves. The sample size, while adequate, may not be large enough to capture subtle differences, and the single-center design may reduce generalizability. Variability in injection techniques and patient adherence could also introduce bias in the results.

CONCLUSION

This study provides evidence supporting the superior efficacy of PRP over HA in the treatment of early knee osteoarthritis. PRP not only offered better pain relief and functional improvement but also had a higher safety profile and was associated with greater patient satisfaction. Given the regenerative potential of PRP, it may be a more effective and durable treatment option for patients with early-stage knee OA. Future studies with larger sample sizes and longer follow-up periods are needed to further validate these findings and explore the cost-effectiveness of PRP in clinical practice.

Recommendations

Future studies should consider longer follow-up periods to assess the long-term effects of PRP and HA treatments on knee osteoarthritis. Including a placebo or control group would help isolate the treatment effects. Multi-center trials with larger, more diverse patient populations are recommended for better generalizability. Standardizing injection techniques and incorporating objective outcome measures, such as radiographic imaging, would improve the accuracy and reliability of results. Additionally, exploring combination therapies could enhance treatment outcomes for patients with early knee osteoarthritis.

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