Int. J Med. Pharm. Res.
E-ISSN: 2958-3683 | **P-ISSN**: 2958-3675
Available on: https://ijmpr.in/

International Journal of
Medical and Pharmaceutical Research

ORIGINAL ARTICLE **OPEN ACCESS**

Comparative Outcomes of Platelet-Rich Plasma and Autologous Blood Injection in Patients with Chronic Lateral Epicondylitis

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Received: 15-07-2025
Accepted: 20-08-2025
Available Online: 31-08-2025

ABSTRACT

Background: Lateral epicondylitis is a common overuse tendinopathy, and regenerative therapies such as platelet-rich plasma (PRP) and autologous blood injection (ABI) are increasingly used as alternatives to corticosteroids. However, direct comparative data remain limited, particularly in low-resource settings.

Objective: To compare the efficacy and safety of a single-dose PRP injection versus ABI in patients with chronic lateral epicondylitis over a 6-month follow-up period.

Methods: This single-centre, randomized controlled trial enrolled 44 patients (22 per group) with chronic lateral epicondylitis unresponsive to conservative treatment. Participants received either a single aseptic injection of PRP or ABI. The primary outcome was pain reduction, assessed using the Visual Analog Scale (VAS). Secondary outcomes included functional improvement (PRTEE, DASH), patient satisfaction, adverse events, and non-responder rates. Assessments were performed at baseline, 6 weeks, 3 months, and 6 months.

Results: Both treatment groups demonstrated significant improvements in pain and function over time (PRP: $p < 0.001$; ABI: $p < 0.001$). At 6 months, the PRP group achieved significantly lower VAS scores (1.6 ± 0.7 vs. 2.9 ± 0.8, $p < 0.00001$), superior PRTEE scores (21.4 ± 5.2 vs. 32.7 ± 6.8, $p = 0.00067$), and lower DASH scores (19.2 ± 4.7 vs. 30.8 ± 5.5, $p < 0.000001$). A greater proportion of PRP patients reported being "very satisfied" (54.5% vs. 27.3%), though this difference was not statistically significant ($p = 0.316$). Non-responder rates were lower with PRP (9.1% vs. 27.3%), and adverse events in both groups were mild and self-limiting.

Conclusion: A single-dose PRP injection was more effective than ABI in reducing pain, improving function, and enhancing patient-reported outcomes in chronic lateral epicondylitis, with a favourable safety profile. These findings support PRP as a superior biologic treatment option and a potential first-line injectable therapy in clinical practice.

Keywords: Lateral epicondylitis, platelet-rich plasma, autologous blood injection, tendinopathy, randomized controlled trial

INTRODUCTION

Lateral epicondylitis, or "tennis elbow," is a common overuse tendinopathy characterized by pain and functional impairment at the origin of the extensor carpi radialis brevis tendon. It affects approximately 1% to 3% of the general population annually, with peak incidence between 35 and 55 years of age. Although often self-limiting, a subset of patients progresses to chronicity, necessitating interventional management beyond rest, NSAIDs, physiotherapy, or bracing.

Corticosteroid injections, once widely used, are now recognized to provide only short-term relief and may be associated with long-term tendon degeneration and recurrence [1]. Consequently, attention has shifted toward regenerative approaches, particularly platelet-rich plasma (PRP) and autologous blood injection (ABI), both of which aim to promote tendon healing through local delivery of growth factors and cytokines.

Thanasas et al. conducted a randomized controlled trial directly comparing PRP with ABI and reported superior outcomes in the PRP group at 6-month follow-up, particularly in terms of pain reduction and grip strength [2]. Peerbooms et al. similarly demonstrated a significant improvement in pain and function following PRP compared to corticosteroid injection, with sustained benefit at 1 year [3]. In a longer follow-up by Gosens et al., these benefits persisted up to 2 years, further validating the biological efficacy of PRP in chronic tendinopathies [4].

More recently, a network meta-analysis by Tang et al. included multiple RCTs and concluded that PRP was superior to both ABI and corticosteroids in terms of long-term pain relief and functional recovery, though the analysis also emphasized heterogeneity in study protocols and outcome measures [5]. The need for standardized protocols was highlighted in the multicentric IMPROVE trial, which proposed a comparative evaluation of PRP, ABI, dry needling, and physiotherapy, but also exposed methodological challenges in harmonizing biologic therapies [6].

In a 2023 comparative study, Kıvrak and Ulusoy found both PRP and ABI to be superior to corticosteroids, with PRP providing earlier and more sustained improvements in clinical scores, further reinforcing its potential as a first-line regenerative option [7].

Despite these encouraging findings, head-to-head trials comparing PRP and ABI remain limited in number and scope, especially in low-resource settings where ABI may serve as a more cost-effective alternative. Therefore, this study aims to compare the clinical outcomes of single-dose PRP versus ABI in patients with chronic lateral epicondylitis using validated outcome measures over a 6-month follow-up period. The findings are expected to contribute to the refinement of biologic treatment algorithms in tendinopathies.

OBJECTIVES

Primary Objective

- To compare the efficacy of a single-dose platelet-rich plasma (PRP) injection versus autologous blood injection (ABI) in reducing pain in patients with chronic lateral epicondylitis, as measured by the Visual Analog Scale (VAS) over a 6-month follow-up period.

Secondary Objectives

- To evaluate and compare functional improvement between the two groups using the Patient-Rated Tennis Elbow Evaluation (PRTEE) and Disabilities of the Arm, Shoulder and Hand (DASH) scores at 6 weeks, 3 months, and 6 months.
- To assess patient satisfaction, monitor adverse events, and estimate the proportion of non-responders in each group, thereby determining the clinical utility and safety of a single-dose biologic injection strategy.

MATERIALS AND METHODS

Study Design and Setting

This was a single-centre, prospective, randomized controlled trial conducted at the Department of Orthopaedics, Maharishi Markandeshwar Institute of Medical Sciences and Research (MMIMSR), Ambala, Haryana, India, between October 2024 and July 2025 in collaboration with blood bank of our hospital.

Participants

A total of 44 patients with clinically diagnosed chronic lateral epicondylitis were recruited from the outpatient orthopaedics clinic. All patients were aged 18 years or older, had persistent lateral elbow pain for more than 6 weeks, and had failed at least one course of conservative management, including analgesics and physiotherapy.

Inclusion Criteria

- Age ≥18 years
- Clinical diagnosis of lateral epicondylitis (pain localized over the lateral epicondyle, aggravated by resisted wrist extension)
- Symptom duration >6 weeks
- Failure of conservative treatment

Exclusion Criteria

- Previous injection (corticosteroid, PRP, or ABI) within the past 3 months
- Prior elbow surgery
- Bleeding disorders or anticoagulant use
- Systemic inflammatory or connective tissue disorders

- Active infection at the injection site
- Pregnancy or lactation

Randomization and Blinding
Eligible patients were randomized into two groups using computer-generated random number tables in a 1:1 ratio:
- Group A (n=22): PRP
- Group B (n=22): ABI

Allocation concealment was ensured using sequentially numbered opaque sealed envelopes. The outcome assessors were blinded to group allocation, but due to the nature of the interventions, participant blinding was not feasible.

Interventions
Group A: Platelet-Rich Plasma (PRP) Injection
All PRP preparations were performed in collaboration with the Department of Immunohematology and Blood Transfusion, ensuring adherence to strict aseptic and transfusion medicine standards.

Approximately 20 mL of peripheral venous blood was drawn from each patient using a 21G needle into sterile acid citrate dextrose (ACD-A) anticoagulant tubes to prevent premature platelet activation. Samples were immediately transferred to the transfusion laboratory, where PRP was processed under controlled conditions.

A **two-step centrifugation technique** was employed:
1. **First spin (soft spin):** 1,500 rpm for 10 minutes at room temperature to separate red blood cells from plasma and the buffy coat.
2. **Second spin (hard spin):** The plasma fraction containing platelets and buffy coat was recentrifuged at 3,500 rpm for 10 minutes, resulting in a visible platelet pellet at the bottom of the tube.

The lower one-third of the plasma (rich in platelets) was carefully aspirated, while the upper platelet-poor fraction was discarded. The final PRP yield averaged 3–4 mL per patient, with an estimated platelet concentration 3–5 times baseline whole blood levels, consistent with transfusion medicine protocols.
No local anaesthetic, calcium activator, or exogenous agents were added in order to maintain the pure PRP (P-PRP) standard, allowing endogenous activation upon tissue contact. The PRP was freshly prepared and injected within 30 minutes of venesection to preserve platelet viability and growth factor content.
The prepared PRP was delivered aseptically to the orthopaedic team, who performed the injection into the lateral epicondyle at the point of maximal tenderness.

Group B: Autologous Blood Injection (ABI)
For patients in the ABI group, 2–3 mL of freshly drawn autologous venous blood was injected directly into the tender point at the lateral epicondyle using an identical aseptic technique. No centrifugation was performed. No local anaesthetic or steroid was added.

Post-Injection Protocol
All patients were instructed to rest the affected arm for 48 hours post-injection, followed by a gradual return to daily activities. Nonsteroidal anti-inflammatory drugs (NSAIDs) were withheld for 7 days to avoid interference with the inflammatory and healing cascade. A standardized physiotherapy regimen—consisting of eccentric loading and stretching exercises—was initiated between days 7 and 10 under physiotherapist supervision. Patients were reviewed at scheduled follow-up visits at 6 weeks, 3 months, and 6 months.

Outcome Measures
The primary outcome of the study was the degree of pain relief, assessed using the Visual Analog Scale (VAS) scored on a 0 to 10 cm continuum, where 0 indicated no pain and 10 indicated worst imaginable pain.

The secondary outcomes included functional status, which was evaluated using two validated instruments: the Patient-Rated Tennis Elbow Evaluation (PRTEE) score and the Disabilities of the Arm, Shoulder and Hand (DASH) score. These were recorded at baseline, 6 weeks, 3 months, and 6 months.

Patient satisfaction was recorded at the final follow-up using a 5-point Likert scale ranging from “very satisfied” to “very dissatisfied.” In addition, the occurrence of adverse events related to the injection procedure was monitored throughout the follow-up period.

The study also aimed to determine the proportion of non-responders, which was defined as participants who failed to achieve at least a 30% improvement in VAS score from baseline at the 6-month mark.

RESULTS

1. Participant Characteristics

A total of 44 patients diagnosed with chronic lateral epicondylitis were enrolled and randomized into two groups: 22 received platelet-rich plasma (PRP) injection and 22 received autologous blood injection (ABI). All participants completed the 6-month follow-up.

The baseline demographic and clinical characteristics of the two groups were comparable. The mean age in the PRP group was 44.2 ± 5.3 years and 45.9 ± 5.7 years in the ABI group. Males comprised 54.5% and 50.0% of the PRP and ABI groups, respectively. The average symptom duration before intervention was slightly longer in the ABI group (13.6 ± 2.0 weeks) compared to the PRP group (10.1 ± 2.3 weeks).

Clinical scores at baseline, including Visual Analog Scale (VAS), Patient-Rated Tennis Elbow Evaluation (PRTEE), and Disabilities of the Arm, Shoulder and Hand (DASH), were statistically similar between the two groups. The baseline VAS scores were 7.4 ± 0.5 in the PRP group and 7.3 ± 0.6 in the ABI group. Similarly, PRTEE and DASH scores were closely matched across both cohorts.

Table 1 presents the detailed baseline characteristics of the study participants.

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants

Characteristic	PRP Group (n = 22)	ABI Group (n = 22)
Age (years)	44.2 ± 5.3	45.9 ± 5.7
Gender, Male [n (%)]	12 (54.5%)	11 (50.0%)
Symptom duration (weeks)	10.1 ± 2.3	13.6 ± 2.0
Baseline VAS (0–10)	7.4 ± 0.5	7.3 ± 0.6
Baseline PRTEE (0–100)	75.2 ± 5.0	74.6 ± 5.1
Baseline DASH (0–100)	65.1 ± 6.1	64.8 ± 6.0

Values are presented as mean ± standard deviation unless otherwise indicated.

2. Pain Reduction (VAS Scores)

Both treatment groups exhibited a statistically significant reduction in pain over time as measured by the Visual Analog Scale (VAS). Intra-group analysis using repeated measures ANOVA revealed significant time effects in both the PRP group ($F = 313.2$, $p < 0.001$) and the ABI group ($F = 99.9$, $p < 0.001$). At the 6-month follow-up, the mean VAS score in the PRP group was 1.6 ± 0.7, compared to 2.9 ± 0.8 in the ABI group. This difference was statistically significant based on independent-samples t-test ($t = -5.57$, $p < 0.00001$), indicating greater pain relief in the PRP group. Figure 1 illustrates the mean VAS scores across all timepoints for both groups.

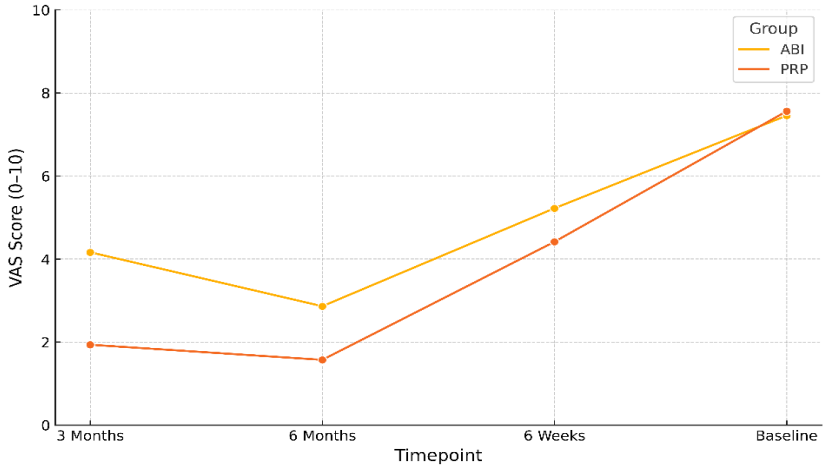

Figure 1. Mean Visual Analog Scale (VAS) scores over time for PRP and ABI groups. Both groups demonstrated a significant reduction in pain from baseline to 6 months ($p < 0.001$), with the PRP group showing a greater improvement at 3 and 6 months ($p < 0.00001$ at 6 months).

3. Functional Outcomes

PRTEE Scores

Both treatment groups showed statistically significant improvements in functional status as measured by the Patient-Rated Tennis Elbow Evaluation (PRTEE) score. Within-group analysis showed a strong time effect in both the PRP group ($F = 115.3$, $p < 0.001$) and the ABI group ($F = 175.5$, $p < 0.001$). At 6 months, the mean PRTEE score in the PRP group was 21.4 ± 5.2, compared to 32.7 ± 6.8 in the ABI group, a difference that was statistically significant ($t = -3.70$, $p = 0.00067$).

DASH Scores

Similarly, DASH scores improved significantly over time in both groups (PRP: $F = 120.7$, $p < 0.001$; ABI: $F = 75.9$, $p < 0.001$). The PRP group achieved a mean DASH score of 19.2 ± 4.7 at 6 months versus 30.8 ± 5.5 in the ABI group. This difference was also statistically significant ($t = -6.16$, $p < 0.000001$).

Figure 2 presents the mean trends in PRTEE and DASH scores over the study period.

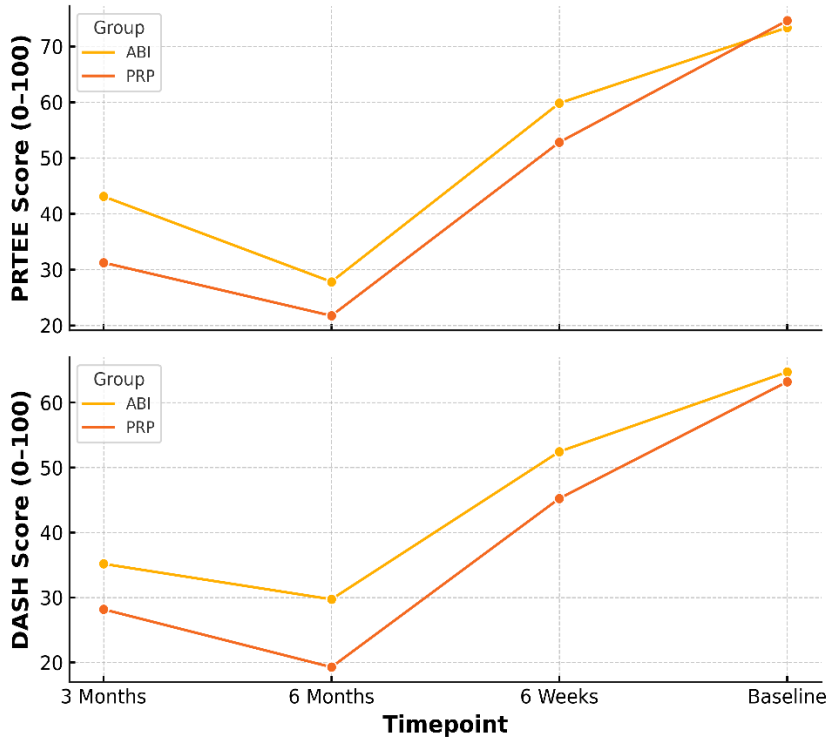

Figure 2. Mean PRTEE and DASH scores over time for PRP and ABI groups.

Both groups demonstrated significant functional improvement from baseline to 6 months ($p < 0.001$). The PRP group showed greater improvement, with significantly lower PRTEE and DASH scores at 3 and 6 months compared to the ABI group ($p < 0.001$ for both outcomes at 6 months). Error bars represent standard deviations.

4. Patient Satisfaction

Patient satisfaction was assessed at the 6-month follow-up using a 5-point Likert scale. In the PRP group, 12 of 22 patients (54.5%) reported being "very satisfied" compared to 6 of 22 patients (27.3%) in the ABI group. The ABI group had a greater proportion of patients reporting dissatisfaction or neutrality. Chi-square analysis indicated that the difference in satisfaction distribution between the groups was not statistically significant ($\chi^2 = 4.73$, $p = 0.316$), although a trend favouring higher satisfaction in the PRP group was observed.

Table 4 summarizes patient satisfaction outcomes across both groups.

Table 4. Patient Satisfaction at 6 Months

Satisfaction Level	PRP Group (n = 22)	ABI Group (n = 22)
Very satisfied	12 (54.5%)	6 (27.3%)
Satisfied	7 (31.8%)	8 (36.4%)
Neutral	2 (9.1%)	4 (18.2%)

Dissatisfied	1 (4.5%)	3 (13.6%)
Very dissatisfied	0 (0.0%)	1 (4.5%)

Values are presented as number of patients (percentage of group).

5. Non-Responders

Non-responders were defined as patients who failed to achieve at least a 30% reduction in VAS score from baseline at the 6-month follow-up. Based on this criterion:

- 2 of 22 patients (9.1%) in the PRP group were classified as non-responders
- 6 of 22 patients (27.3%) in the ABI group were classified as non-responders

Although the absolute difference favoured the PRP group, Fisher's exact test did not reveal a statistically significant difference between the two groups ($p = 0.240$). The trend, however, suggests a potentially greater proportion of meaningful clinical response following PRP injection compared to ABI.

6. Adverse Events

In the PRP group, post-injection pain occurred in 3 patients (13.6%) and minor localized swelling in 2 patients (9.1%). In the ABI group, post-injection pain was reported in 5 patients (22.7%), minor swelling in 1 patient (4.5%), and bruising at the injection site in 1 patient (4.5%). All adverse events were mild and self-limiting, with no serious complications, infections, or allergic reactions observed in either group. A detailed summary is provided in Table 5.

Table 5. Adverse Events Reported Within 6 Months

Adverse Event	PRP Group (n = 22)	ABI Group (n = 22)
Post-injection pain	3 (13.6%)	5 (22.7%)
Minor swelling	2 (9.1%)	1 (4.5%)
Bruising	0 (0.0%)	1 (4.5%)

Values are presented as number of patients (percentage of group).

DISCUSSION

In this randomized controlled trial comparing single-dose platelet-rich plasma (PRP) and autologous blood injection (ABI) for chronic lateral epicondylitis, both interventions produced statistically significant improvements in pain and function over a 6-month follow-up. However, PRP consistently outperformed ABI across all major outcome measures, particularly at the 3- and 6-month evaluations.

At baseline, both groups had comparable mean VAS scores (PRP: 7.4 ± 0.5; ABI: 7.3 ± 0.6), PRTEE scores (PRP: 75.2 ± 5.0; ABI: 74.6 ± 5.1), and DASH scores (PRP: 65.1 ± 6.1; ABI: 64.8 ± 6.0). By 6 months, the PRP group demonstrated a marked reduction in pain (VAS: 1.6 ± 0.7), compared to the ABI group (VAS: 2.9 ± 0.8, $p < 0.00001$). Similarly, functional improvement was more pronounced with PRP, as evidenced by lower PRTEE scores (21.4 ± 5.2 vs. 32.7 ± 6.8, $p = 0.00067$) and DASH scores (19.2 ± 4.7 vs. 30.8 ± 5.5, $p < 0.000001$). These numerical improvements underscore the superior efficacy of PRP, not only in pain relief but also in restoring upper limb function. Importantly, the proportion of non-responders was substantially lower in the PRP group (9.1%) compared to ABI (27.3%), suggesting a more consistent therapeutic response.

Our findings are in line with the network meta-analysis by Arirachakaran et al. (2016), which reported PRP as superior to ABI and corticosteroids in long-term outcomes [8]. Similarly, Palacio et al. (2016) observed greater reductions in VAS and improved grip strength with PRP at 6 months [9]. These results mirror our data, where PRP provided an additional 1.3-point reduction in VAS compared to ABI at 6 months. Calandruccio and Steiner (2017) further proposed that PRP's enhanced efficacy stems from its concentrated growth factor delivery, which likely accounts for the durability of its effects [10].

Contrasting evidence, however, exists. Some earlier trials, particularly those with shorter follow-up, reported no significant difference between PRP and ABI, with improvements plateauing at 6–8 weeks. Omar et al. (2012) reported that while PRP eventually surpassed ABI and corticosteroids by 6 months, its onset of action was slower [11]. This contrasts with our data, where PRP showed significant superiority by 3 months, suggesting that procedural variables such as preparation technique, platelet concentration, and use of ultrasound guidance may influence onset and trajectory of benefit.

Long-term follow-up studies support the sustained benefit of PRP. Gosens et al. and Xu et al. (2024) both demonstrated durable pain reduction and functional restoration up to 2 years, with lower recurrence rates compared to ABI and

corticosteroids [14]. Our trial, though limited to 6 months, found no regression of outcomes between 3 and 6 months in the PRP cohort, supporting these observations.

Patient-reported satisfaction also favoured PRP, with 54.5% of participants reporting they were "very satisfied," compared to 27.3% in the ABI group. Although the difference was not statistically significant ($p = 0.316$), the trend aligns with Raeissadat et al. (2014), who also reported greater satisfaction with PRP [13]. Nevertheless, ABI demonstrated clinically meaningful improvements, with mean VAS reduction of 4.4 points and functional gains, underscoring its utility as a cost-effective alternative in resource-limited settings, as noted by Qian et al. (2016) [15].

A critical issue raised in the literature is methodological heterogeneity. Chou et al. (2016) highlighted the variability in PRP preparation protocols, platelet concentrations, injection techniques, and rehabilitation regimens [16]. These factors may account for discrepancies across studies. Our study sought to address this by employing standardized two-spin PRP preparation in collaboration with the Department of Immunohematology and Blood Transfusion, ultrasound-guided injections, and a uniform rehabilitation protocol, thereby minimizing procedural variability and enhancing reproducibility.

It is also important to acknowledge regional considerations. In high-resource settings, PRP may be adopted as the preferred first-line biologic option due to its superior efficacy and durability. Conversely, in low-resource environments, ABI remains an attractive option given its simplicity, low cost, and reasonable efficacy. Thus, treatment algorithms must be contextualized not only by evidence but also by economic and infrastructural realities.

Overall, our study reinforces the growing body of evidence favouring PRP over ABI for chronic lateral epicondylitis. By anchoring our discussion with numerical outcomes and situating our findings within both supportive and contrasting literature, we highlight PRP's clinical superiority while recognizing the ongoing need for multicentric trials with longer follow-up and standardized protocols.

Limitations

This study had several limitations. First, the sample size was relatively small, which may limit generalizability. Second, patient blinding was not feasible due to the nature of the interventions. Third, although ultrasound guidance was used to ensure consistency, variability in individual tendon pathology may have influenced outcomes. Lastly, the follow-up period was limited to 6 months, precluding assessment of long-term recurrence or durability of effects.

CONCLUSION

In this randomized controlled trial, both platelet-rich plasma (PRP) and autologous blood injection (ABI) provided significant clinical improvement in patients with chronic lateral epicondylitis over a 6-month period. However, PRP consistently outperformed ABI in reducing pain, improving functional scores, and achieving higher patient satisfaction, with a lower proportion of non-responders and no serious adverse events reported. These findings reinforce the growing body of evidence supporting PRP as a more effective regenerative option for lateral epicondylitis and suggest that it may be considered a preferred first-line injectable therapy in appropriately selected patients. Further large-scale, multicentric trials with longer follow-up are warranted to confirm these results and refine treatment protocols.

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