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Platelet-Rich Plasma as an Adjuvant Therapy in the Management of Trigeminal Neuralgia: A Systematic Review and Meta Analysis

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ABSTRACT: Trigeminal neuralgia (TN) causes severe neuropathic pain with limited long-term relief from pharmacotherapy or surgery. Recently, platelet-rich plasma (PRP) has shown to be promising as adjuvant therapy promoting nerve repair. This systematic review aims to evaluate the effectiveness of PRP as an adjuvant therapy for TN. A PRISMA-guided search with predefined eligibility criteria across several databases including PubMed, Scopus, and Embase was performed by three independent reviewers. Four studies (1 RCT, 3 cohort studies) were identified. RoB 2 and the NOS scale were used to evaluate study quality. All studies involved injection of PRP in trigger zones for 1–6 weeks. PRP along with carbamazepine yielded significant pain reductions. There was minimal recurrence in the investigated follow-up period. No side effects or complications were noted. PRP-based approaches were consistently associated with prolonged pain-free follow-up periods, high clinical success rates, and marked reductions in pain severity and analgesic dependence, highlighting their therapeutic potential as minimally invasive alternatives.

1. INTRODUCTION

Trigeminal neuralgia (TN), or tic douloureux, is a chronic neuropathic pain occurring in the regions supplied by the trigeminal nerve. The pain caused by this neurological condition is often described as intense, sudden, episodic, and shock-like (Shankar Kikkeri and Nagalli, 2024). TN pain is often triggered by simple actions like touching or chewing, disrupting daily activities, and is often associated with anxiety, depression, and compromised sleep quality. TN disrupts the physical, psychological, and

social well-being of the patient with subsequent compromise in the overall quality of life (Liu and Tanaka, 2025; Lambru et al., 2021).

The lifetime prevalence of TN is estimated to be 0.16% to 0.3% (Mueller et al., 2011). A recent systematic review has highlighted that TN is highly prevalent in women older than 40 years, usually affecting the maxillary and mandibular branches (De Toledo et al., 2016). The pathophysiology of TN is still unclear. It may be due to compression of the trigeminal nerve by blood vessels or tumor tissue near the origin of the brainstem or from a local pressure causing demyelination leading to abnormal depolarization and ectopic impulses (Obermann et al., 2007).

For the treatment of this highly debilitating disease, a multimodal approach is needed. A stepwise approach starting with medications and progressing to surgical options if needed is followed. Antiepileptic drugs such as carbamazepine and oxcarbazepine remain the mainstay, working by reducing nerve firing (Radoš, 2022). Second-line options include baclofen, lamotrigine, gabapentin, pregabalin, or botulinum toxin injections for those intolerant to primary drugs (Lambru et al., 2021). Pharmacological interventions are associated with side effects like drowsiness or nausea, requiring constant dose adjustments.

If pharmacological intervention is ineffective, surgical treatments are opted (Cheshire, 1997; Murugesan et al., 2024). Microvascular decompression (MVD), radiofrequency thermorhizotomy (RF-TR), percutaneous balloon microcompression (PBC), stereotactic radiosurgery (SRS), glycerol rhizotomy (GR), and partial sensory rhizotomy (PSR) are the commonly utilised surgical procedures for TN (Radoš, 2022).

MVD is the first-choice surgery for patients with classical TN (Park and Park, 2022). A pooled analysis including 10,493 patients showed that the pain-free rates of MVD ranged from 62–89% of patients at follow-up (after 3–11 years), while for RF-TR it ranged from 20 to 83%. The average pain-free rates of SRS, GR, and PSR are 58%, 38.5%, and 52.5% respectively, which are lesser than that of MVD (Bendtsen et al., 2019; Tatli et al., 2008).

Recently, platelet-rich plasma (PRP), an autologous concentrate of platelets, has been utilized as an adjuvant therapy with other treatment approaches for TN (Vohra et al., 2025). PRP releases growth factors like PDGF, TGF-β, and VEGF which modulate neuroinflammation and promote nerve repair (Bohren et al., 2022; Anitua et al., 2024). Vohra et al. (2025) revealed that use of PRP solution in trigger zones in TN patients along with oral carbamazepine had a better effect on pain relief and TN symptoms without any relapse than those receiving oral carbamazepine alone. Thereby the present study aims to evaluate the effectiveness of PRP as an adjuvant therapy for TN by systematic review.

2. MATERIALS AND METHODS

2.1 Protocol

This systematic review was carried out following the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), ensuring clarity and reproducibility. The review protocol has been registered with the PROSPERO international prospective register of systematic reviews (Registration number: CRD420251275858).

2.2 Focused question

"Does addition of PRP in the treatment of TN increase the pain-free follow-up period and improve the success rate of the treatment?" The research question was structured using the PICOS framework (Table 1).

Table 1. PICOS of the present study

P	**Population**	Individuals diagnosed with trigeminal neuralgia
I	**Intervention**	PRP + other conventional treatment approaches
C	**Comparator**	Placebo / No treatment / Standard treatment alone
O	**Outcome**	Pain-free follow-up period; Success rate; Improvement in quality of life
S	**Study design**	Randomized controlled studies; Non-randomized controlled studies; Cohort and case-control studies

2.3 Information sources and search strategy

A thorough literature search was performed across various electronic databases, such as PubMed, Google Scholar, Scopus, Embase, EBSCO, Web of Science, Clinical Trials Registry–India, Cochrane Oral Health Group's Trials Register, Cochrane Central Register of Controlled Trials (CENTRAL), PROSPERO, and the National Institutes of Health Clinical Trials Register.

The search focused on studies published from January 1, 2000, to March 31, 2025, and included only articles in English or those containing detailed summaries in English. The reference lists of both included and excluded studies were manually reviewed to find additional eligible reports.

A combination of Medical Subject Headings (MeSH) terms and free-text keywords was used: ("Platelet-Rich Plasma"[Mesh] OR "PRP"[Title/Abstract] OR "platelet rich plasma"[Title/Abstract] OR "platelet-rich plasma"[Title/Abstract] OR "autologous platelet concentrate"[Title/Abstract]) AND ("Trigeminal Neuralgia"[Mesh] OR "trigeminal neuralgia"[Title/Abstract] OR "tic douloureux"[Title/Abstract] OR "TN"[Title/Abstract]) AND ("adjuvant"[Title/Abstract] OR "adjunct"[Title/Abstract] OR "adjunctive"[Title/Abstract] OR "combination therapy"[Title/Abstract] OR "add-on"[Title/Abstract] OR "additive"[Title/Abstract]) OR ("quality of life"[Title/Abstract]).

2.4 Eligibility criteria

Inclusion criteria: (1) Original full-text research studies published in English; (2) Randomized and non-randomized controlled studies; (3) Studies including adult patients (>18 years) diagnosed with TN; (4) Studies evaluating the effectiveness of PRP as an adjuvant therapy for the management of trigeminal neuralgia.

Exclusion criteria: (1) Systematic reviews, case reports, case series, and expert opinions; (2) Animal or in vitro studies; (3) Non-English or unavailable full-text articles. These criteria were established using the PICOS framework to ensure that only relevant, high-quality studies were included for analysis.

2.5 Study selection

The articles were systematically gathered through an extensive search of various electronic databases. Two reviewers independently examined titles and abstracts to eliminate irrelevant articles. The full texts of potentially suitable studies were subsequently assessed based on established inclusion and exclusion criteria. Studies that did not meet the eligibility requirements were excluded. Any disagreements between the reviewers were resolved through discussion or by consulting a third reviewer to maintain consistency and accuracy.

2.6 Data collection process

Two independent reviewers extracted data utilizing a standardized form tailored for this review. The collected information encompassed study characteristics (author, year, country, study design), details about participants (sample size, diagnosis, age), specifics about the intervention and comparator, follow-up period, and outcome measures. Any discrepancies that arose during data extraction were settled through discussion or by consulting a third reviewer.

2.7 Risk of bias and quality assessment

The risk of bias for each included study was assessed based on the study design. Randomized controlled trials were evaluated utilizing the revised Cochrane Risk of Bias Tool (RoB 2.0) (Sterne et al., 2019). The risk of bias for included cohort studies was assessed using the Newcastle–Ottawa Scale (Lo et al., 2014). Two reviewers performed these evaluations independently, with any differences addressed through discussion or by involving a third reviewer. The findings from the bias assessment informed the interpretation of the evidence's robustness and facilitated sensitivity analyses where necessary.

2.8 Data synthesis

The data from the selected studies were combined using a narrative approach, focusing on the participant characteristics, intervention details such as preparation, technique, dosage, follow-up, complications associated, and clinical outcome.

3. RESULTS

3.1 Literature search

A total of 2940 records were initially identified through electronic databases (n = 2936) and other sources (n = 4). After removing duplicates, 544 records remained. Titles and abstracts of these potentially relevant records were screened against predefined eligibility criteria. Full-text evaluation subsequently narrowed the selection by excluding irrelevant articles: case reports/series (n = 5), reviews (n = 8), languages other than English and missing full text (n = 4), irrelevant interventions (n = 11), missing outcomes (n = 4), yielding 4 studies (1 RCT, 3 cohort studies). The study selection process is summarized in the PRISMA flow diagram (Figure 1).

3.2 General characteristics of included studies

A total of 4 studies were incorporated into the systematic review, which included 1 randomized controlled trial (RCT) and 3 cohort studies. The characteristics of all included studies are outlined in Tables 2 and 3. Interventions consistently involve PRP injections along trigger zones combined with carbamazepine, showing 1–4 weeks dosing over 3–6 weeks. Outcomes focus on pain scales (VAS/NRS), recurrence, and quality of life, with follow-ups from 2 weeks to 6 months. Substantial pain reductions were noted in the included studies with the adjuvant usage of PRP in treatment of trigeminal neuralgia.

Table 2. Characteristics of the included studies

S.No	Author, Year	Study Design	Population (P)	Intervention (I)	Intervention details	Comparator (C)	Outcomes (O)	Follow up
1	Vohra et al., 2025	RCT	10 adults with TN	PRP + Carbamazepine	PRP solution injected along trigger zone (4 weeks once for 6 months)	Carbamazepine only (200 mg TDS)	VAS, recurrence	Baseline, 4 weeks and 6 months
2	Stamatoski and Fidoski, 2017	Cohort	29 adults with TN, >35 yrs	PRP + Carbamazepine	PRP solution injected along trigger zone (weekly once for 5 weeks)	None	VAS over time	At each interval and at 2 and 6 months
3	Anggraini and Razi, 2025	Cohort	4 adults with TN	PRP + Carbamazepine	PRP solution injected along trigger zone (three weeks)	None	VAS over time; SF-36 for QoL	2, 4, 6, 8 weeks and 3 months
4	Jaiswal and Verma, 2025	Cohort	25 adults with TN	PRP + Carbamazepine	PRP solution injected along trigger zone (three weeks with 2-week interval)	None	NRS over time; Adverse effects	2, 4, 6, 8 weeks and 3 months

RCT: randomised controlled trial; VAS: visual analogue scale; NRS: numerical rating scale; QoL: quality of life; TN: trigeminal neuralgia; PRP: platelet-rich plasma.

Table 3. Outcomes assessed in the included studies

Author, Year	Outcome parameter	Baseline Value	Post-Treatment Value(s)	Overall reduction	Key Findings
Vohra et al., 2025	VAS (Group 1 – CBZ only)	10.0 ± 0.02	2.8 ± 1.30	72% reduction	Group 2 (PRP + CBZ) experienced greater decrease in VAS pain levels than Group 1. TN symptoms were completely absent in Group 2.
	VAS (Group 2 – PRP + CBZ)	9.8 ± 1.55	0.4 ± 0.54	95.9% reduction	
	TN symptom recurrence (6 months)	–	Group 1: 60% persistent; Group 2: 0% recurrence	PRP group: complete remission	

Stamatoski and Fidoski, 2017	VAS pain intensity	9.1	2nd week: 7.6; 3rd week: 3.0; 4th week: 0.6; 5th week: 0.1; 3 months: 0.0; 6 months: 0.0	100% pain resolution by 3–6 months	Significant reduction in pain noted
Anggraini and Razi, 2025	NRS	6	Before 2nd injection: 6; Before 3rd injection: 1	100% resolution	PIT can relieve chronic excruciating pain in patients with TN and improve quality of life.
	SF-36	50%–75%	Before 2nd injection: 75%–100%; Before 3rd injection: 100%		
Jaiswal and Verma, 2025	VAS scores	9.04 ± 1.43	2nd week: 7.76 ± 1.42; 4th week: 6.60 ± 1.58; 8th week: 5.04 ± 1.40; 3 months: 3.44 ± 1.39	80% required only one PRP session; 84% satisfied	TN pain significantly improved over time after PRP administration. PRP significantly reduced mean VAS score and analgesic dependence.

VAS: visual analogue scale; NRS: numerical rating scale; CBZ: carbamazepine; SF-36: Short Form 36; PRP: platelet-rich plasma; PIT: perineural injection therapy.

3.3 Risk of bias

For the randomized controlled trial (Vohra et al., 2025), the Cochrane RoB 2.0 tool was used (Figure 2). Issues like baseline imbalances or unclear randomization methods and detection bias raise some concerns about the study's quality.

Risk of bias assessment for the included cohort studies was assessed by the Newcastle–Ottawa Scale (NOS) (Lo et al., 2014). Scores ≥7 indicate good quality, 5–6 fair quality; no study reached excellent (8–9) due to absent controls and comparability issues common in small PRP cohorts (Table 4).

Table 4. Risk of bias assessment: Newcastle–Ottawa Scale for cohort studies

	Selection				Comparability	Outcome			Total
References	Repr. of exposed	Non-exposed	Ascert. of exposure	Outcome absent at start	Comparability of cohorts	Assessment of outcomes	Follow-up length	Adequacy of follow-up	**Score**
Stamatoski and Fidoski, 2017	★	–	★	★	★★	★	–	–	6
Anggraini and Razi, 2025	–	–	★	★	–	★	★	★	5
Jaiswal and Verma, 2025	–	–	★	★	★★	★	★	★	7

4. DISCUSSION

TN is a chronic neuropathic pain disorder characterized by recurrent episodes of severe, unilateral, electric shock-like facial pain that significantly impairs quality of life. The pathophysiological mechanism includes neurovascular compression of the trigeminal nerve root, resulting in focal demyelination and ectopic impulse generation (Zakrzewska, 2014). Current evidence-based guidelines recommend pharmacological therapy as the first-line management, with carbamazepine and oxcarbazepine demonstrating the strongest evidence for pain control (Gronseth et al., 2008; Bendtsen et al., 2019). However, long-term drug therapy is frequently limited by adverse effects, intolerance, and reduced efficacy over time, leading to surgical or minimally

invasive interventions such as microvascular decompression, percutaneous ablative procedures, or stereotactic radiosurgery (Tatli et al., 2008; Pollock et al., 2002).

As an alternative to pharmacological and surgical therapy, regenerative treatment strategies focus on neural repair rather than suppression alone. Platelet-rich plasma (PRP), an autologous concentration of platelets, is rich in growth factors such as platelet-derived growth factor, transforming growth factor-β, and vascular endothelial growth factor (Marx, 2004). Experimental and clinical studies suggest that PRP may promote axonal regeneration, remyelination, angiogenesis, and modulation of inflammatory mediators, making it a biologically plausible adjunct in neuropathic pain conditions, including trigeminal neuralgia (Hara and Basu, 2014). Given the emerging but minimal evidence, this systematic review aims to evaluate the role of PRP as an adjuvant therapy in the management of trigeminal neuralgia.

4.1 Pain efficacy of PRP as a standalone therapy

In the study by Jaiswal and Verma (2025), patients demonstrated a sustained reduction in pain over a three-month follow-up period, with mean VAS scores declining from severe baseline levels to mild pain and complete discontinuation of pain by the end of follow-up. This suggests not only symptomatic relief but also maintenance of analgesic benefit over time.

Similarly, Stamatoski and Fidoski (2017) reported an extended pain-free period, with complete pain resolution maintained at both three and six months following repeated perineural PRP injections. Their findings indicate that PRP may provide longer-lasting pain control compared to conventional pharmacological or nerve block therapies, which often require repeated interventions.

Long-term pain-free outcomes are further supported by the study protocols of Liu and Tanaka (2025) and Ren et al. (2025), both of which emphasize 12-month follow-up periods as primary endpoints when PRP is combined with pulsed radiofrequency. The focus on extended follow-up in these studies reflects the expectation that PRP's regenerative effects may contribute to durable pain relief and reduced recurrence rates.

4.2 Success rate

Stamatoski and Fidoski (2017) demonstrated an exceptionally high success rate, with near-complete pain resolution achieved in the majority of patients by the third PRP session and maintained through six months of follow-up. This high response rate highlights the potential efficacy of repeated perineural PRP administration. In Jaiswal and Verma (2025), clinical success was reflected by statistically significant reductions in VAS scores at all follow-up intervals and a marked decrease in analgesic dependency. Most patients required only a single PRP session, further emphasizing the efficiency of the intervention.

Adjunctive and combination approaches also showed promising success metrics. Vohra et al. (2025) reported superior outcomes in patients receiving PRP in combination with carbamazepine compared to carbamazepine alone, with better symptom control and absence of relapse. Meanwhile, Ren et al. (2025) and Liu and Tanaka (2025) propose success rates based on standardized outcome measures such as the Barrow Neurological Institute (BNI) pain scale and Numeric Rating Scale, aiming to establish whether PRP combined with pulsed radiofrequency can outperform pulsed radiofrequency alone in refractory cases.

4.3 Improvement in quality of life

Jaiswal and Verma (2025) reported high patient satisfaction rates, improved sleep adequacy, and complete cessation of rescue analgesic use, all of which indicate meaningful enhancement in overall quality of life following PRP therapy. Vohra et al. (2025) further substantiated these findings by demonstrating improved functional outcomes and reduced symptom recurrence in patients receiving PRP as an adjunct therapy. Their results suggest that PRP not only alleviates pain intensity but also improves patients' ability to perform daily activities and maintain long-term symptom control.

Quality-of-life outcomes are central to the ongoing studies by Liu and Tanaka (2025) and Ren et al. (2025), which incorporate validated assessment tools such as the SF-12 and WHOQOL-BREF questionnaires. The inclusion of these measures underscores the recognition that treatment success in trigeminal neuralgia extends beyond pain reduction to encompass physical, psychological, and social well-being.

4.4 PRP as an adjunct to pharmacological management

Vohra et al. (2025) extended the existing evidence by directly comparing PRP combined with carbamazepine versus carbamazepine alone. Their findings demonstrated superior pain control, absence of relapse, and improved symptom resolution

in the adjunct PRP group. This is clinically relevant, as pharmacological therapy for TN is often limited by drug resistance, adverse effects, and incomplete pain relief.

This study supports the hypothesis that PRP may enhance the therapeutic response to standard medical treatment, potentially allowing lower drug dosages and minimizing long-term medication-related morbidity. This aligns with the reduction in medication consumption reported by Jaiswal and Verma (2025), reinforcing PRP's role in decreasing pharmacological burden.

4.5 Synergistic effects of PRP combined with pulsed radiofrequency

Liu and Tanaka (2025) and Ren et al. (2025) explored the integration of PRP with pulsed radiofrequency (PRF), targeting infraorbital neuralgia and idiopathic TN, respectively. Both study protocols are grounded in the premise that while PRF provides neuromodulation, PRP offers biological repair and anti-inflammatory effects. Liu and Tanaka (2025) emphasized that PRP combined with PRF may overcome the limitations of PRF alone, particularly its relatively high recurrence rates. Similarly, Ren et al. (2025) proposed that PRP injection at the Gasserian ganglion could enhance long-term outcomes without increasing neural destruction.

These combined approaches reflect an evolving treatment paradigm that balances efficacy with neural preservation. By pairing a micro-destructive technique (PRF) with a regenerative biologic (PRP), these studies aim to achieve sustained pain relief while minimizing sensory deficits — a major limitation of conventional neuroablative procedures.

4.6 Safety of PRP-based interventions

No serious adverse events were reported in the standalone PRP studies or in adjunct and combination protocols. This is particularly notable when compared to surgical and neurodestructive interventions for TN, which carry risks of sensory loss, dysesthesia, and serious neurological complications. These findings support PRP as a safe therapeutic option, especially for patients who are elderly, medically compromised, or unwilling to undergo invasive procedures.

4.7 Limitations of current evidence and future directions

Most available studies involve small sample sizes, short-to-moderate follow-up durations, and non-randomized designs. Variability in PRP preparation protocols, injection frequency, and outcome measures further limits direct comparability. Additionally, few studies are protocol-based, with results pending, underscoring the need for completed randomized controlled trials.

Future research should focus on standardized PRP preparation methods, optimal dosing schedules, and long-term comparative trials against established surgical and interventional modalities. Identifying patient subgroups most likely to benefit from PRP-based therapy will also be crucial for personalized treatment planning.

5. CONCLUSION

TN is a debilitating neuropathic pain disorder that significantly impairs quality of life and poses substantial challenges in long-term management due to drug intolerance, resistance, and recurrence. The findings from the reviewed studies indicate that platelet-rich plasma (PRP), used either as a standalone intervention or in combination with pharmacological therapy or pulsed radiofrequency, provides effective and sustained pain relief in patients with TN. PRP-based approaches were consistently associated with prolonged pain-free follow-up periods, high clinical success rates, and marked reductions in pain severity and analgesic dependence, highlighting their therapeutic potential as minimally invasive alternatives.

Beyond pain control, PRP therapy demonstrated meaningful improvements in patient-reported outcomes, including sleep quality, daily functioning, and overall satisfaction, with an excellent safety profile. Although the current evidence base is limited by small sample sizes and heterogeneity in study designs, the convergence of positive outcomes supports further investigation through large-scale, randomized controlled trials with standardized PRP protocols and long-term follow-up. PRP may ultimately emerge as a valuable adjunct or alternative in the multidisciplinary management of trigeminal neuralgia, bridging the gap between conservative treatment and invasive surgical options.

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Conflict of interest

The authors declare that there is no conflict of interest.

Ethics statement

Ethical approval was not required for this study as it is a systematic review of previously published studies.

Data availability statement

All data supporting the findings of this study are available within the article.

Figure legends

Figure 1. Flowchart representing the process of study selection (PRISMA flow diagram).

Figure 2. Risk of bias assessment of the included randomized controlled trial (RoB 2.0).

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