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**REVIEW ARTICLE**

# Efficacy of platelet-rich plasma in the regeneration of periodontal tissues

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## ABSTRACT

**Introduction:** periodontitis causes loss of dental supporting tissues and represents a clinical challenge for regenerative dentistry, where safe and effective biological alternatives are sought.
**Objective:** to analyze the effectiveness of platelet-rich plasma (PRP) in periodontal regeneration, describing its clinical applications and its impact on healing and revascularization.
**Methods:** a systematic review of the scientific literature was conducted across multiple databases. The search employed an algorithm combining keywords and Boolean operators to identify relevant sources. Selected studies, after applying inclusion and exclusion criteria, were critically analyzed considering recency, methodological quality, and thematic relevance, and integrated into the final synthesis of the review.
**Development:** reviewed studies demonstrate that PRP acts as a reservoir of growth factors, promoting angiogenesis, cell proliferation, and bone regeneration. Benefits have been reported in regenerative endodontics, oral surgery, and periodontics, including pain reduction, accelerated healing, and improved graft integration. Its safety and low incidence of adverse effects are also highlighted. However, challenges remain regarding standardization of preparation protocols and evaluation of long-term outcomes.
**Conclusions:** platelet-rich plasma constitutes a promising biomaterial in periodontal regeneration, with clinical advantages in healing and revascularization. Its efficacy is supported by multiple studies, although comparative and longitudinal research is needed to consolidate standardized protocols and assess its sustained impact in dental practice.

**Keywords:** Periodontics; Platelet-Rich Plasma; Guided Tissue Regeneration.

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## INTRODUCTION

The translational branch of regenerative medicine encompasses various fields, including gene therapy, stem cell transplantation, use of soluble molecules, cellular reprogramming, and tissue engineering. In endodontics, degradation of periodontal tissues—gingiva, cementum, periodontal ligament, and alveolar bone—leads to tooth mobility and eventual tooth loss.[1]

Thus arises the research problem: current periodontal treatments such as scaling and root planing or surgical interventions cannot restore the original attachment of periodontal tissues to teeth or regenerate native periodontal structures. Consequently, regenerative approaches—such as guided tissue regeneration and bone grafts—are increasingly adopted to achieve periodontal tissue formation. Therefore, this study focuses on describing the applications of PRP in regenerative dental medicine.[2]

Regeneration is defined as the reconstitution of lost tissues in such a way that the original architecture and function of destroyed structures are fully restored. The primary goal of regenerative periodontal therapy is to reestablish the anatomy and function of periodontium damaged by periodontitis—including alveolar bone, root cementum, and periodontal ligament.[3]

Polypeptide growth factors—such as platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), insulin-like growth factor (IGF), and transforming growth factor (TGF)—improve clinical and radiological outcomes, particularly in surgical treatment of periodontal intrabony defects. As these factors promote wound healing and epithelialization, they may also aid in early resolution of chronic inflammatory lesions—such as periodontal pockets—and benefit non-surgical periodontal therapy.[4]

Autologous platelet concentrates (APCs) are gaining popularity in numerous clinical settings, acting as reservoirs of various growth factors—including PDGF, VEGF, TGF, and IGF. Platelets contribute to soft and hard tissue regeneration through multiple growth factors stored in alpha granules and released upon physiological activation.[5]

Platelet-rich plasma (PRP) has recently been considered an orthobiologic adjuvant therapy, currently used across medical fields such as dermatology—for tissue regeneration, wound healing, scar revision, skin rejuvenation, and alopecia. PRP also demonstrates potential to enhance periodontal regeneration through several mechanisms, including localized acceleration of tooth movement by influencing bone quality and improving tooth movement rates.[6,7]

PRP is defined as an autologous concentration of platelets in a small plasma volume and is regarded as a rich source of autologous growth factors (GFs). GFs are natural biological mediators that regulate key cellular events in tissue repair and regeneration. Upon binding to specific cell membrane receptors on target cells, GFs trigger intracellular signaling pathways that typically activate genes capable of altering cellular activity and phenotype.[4] Recent advances in cellular and molecular biology have enhanced understanding of GF functions. In vitro and in vivo studies confirm that GFs can improve tissue regenerative capacity by regulating chemotaxis, differentiation, and cell proliferation. Moreover, PRP components interact with cells involved in immune response, inflammation, angiogenesis, cell migration and differentiation, and extracellular matrix anabolism and catabolism.[8]

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Therefore, PRP application has gained unprecedented attention in regenerative medicine as a biomaterial for delivering critical growth factors and cytokines from platelet granules to target areas, thereby promoting regeneration across various tissues. In conclusion, the significance of this study lies in PRP's role as a transformative advance in healthcare, establishing a broad precedent for future innovations—potentially supported by artificial intelligence—to yield superior clinical and radiological outcomes in periodontal treatments, including accelerated healing and enhanced tissue regeneration. Given these considerations, this review was conducted to analyze the efficacy of platelet-rich plasma in periodontal regeneration, describing its clinical applications and its impact on healing and revascularization.

## METHODS

This study was designed as a systematic bibliographic review to analyze the efficacy of platelet-rich plasma (PRP) in periodontal tissue regeneration. The search period spanned from 2010 to 2024 to include recent and relevant research. High-impact databases consulted included PubMed, ScienceDirect, SciELO, and Google Scholar, along with grey literature and secondary references from previously selected articles.

The search strategy employed keywords and Boolean operators such as "platelet-rich plasma" OR "plasma rico en plaquetas" AND "periodontal regeneration," combined with related terms like "dentistry," "healing," "revascularization," and "regenerative medicine." Articles in Spanish, English, and Portuguese were included to ensure a broad, multilingual perspective.

Inclusion criteria encompassed studies published within the defined timeframe, original research (clinical, in vitro, or in vivo trials), and full-text articles directly addressing PRP application in periodontics. Duplicates, articles without full access, narrative reviews lacking methodological support, and irrelevant studies were excluded.

The selection process occurred in several phases: initial record identification via database searches, followed by title and abstract screening, and full-text review. Initially, 26 records were obtained; 7 were removed due to duplication, and 19 underwent in-depth analysis. After applying exclusion criteria, 12 articles were finally included in the qualitative synthesis. The procedure was represented using a modified PRISMA flow diagram (Figure 1), illustrating identification, screening, eligibility, and inclusion stages.

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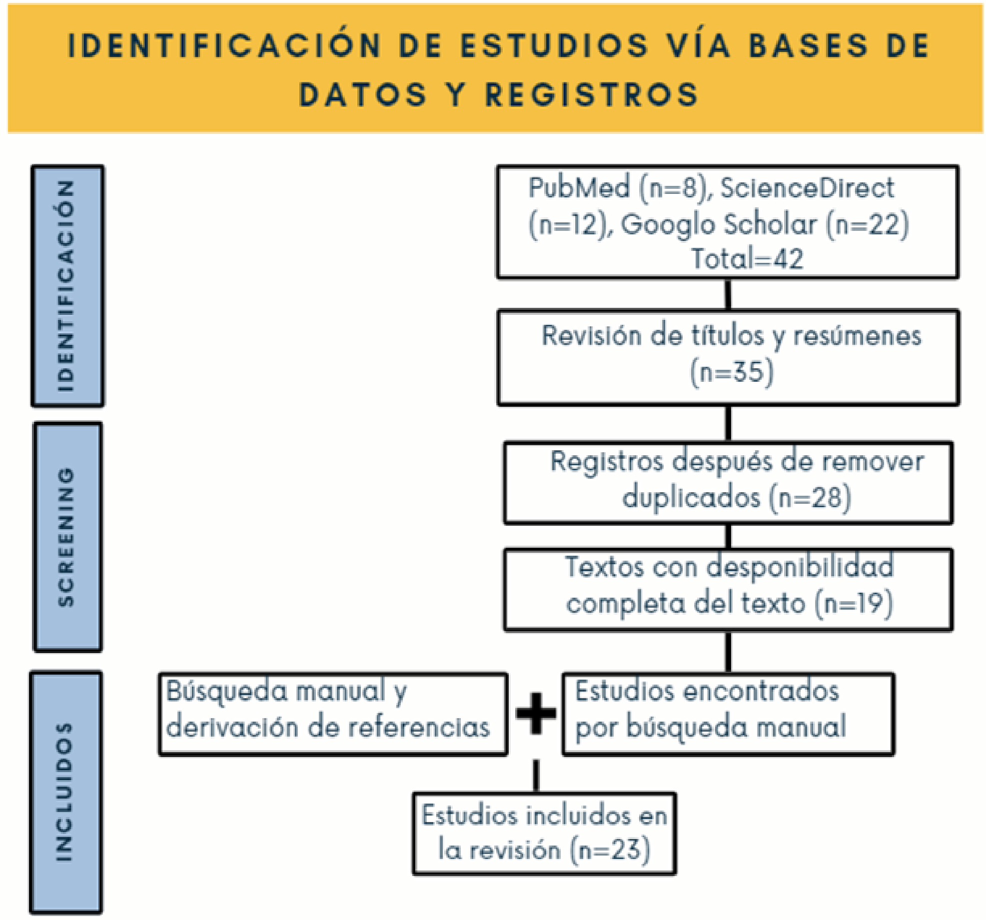


**Fig. 1** Modified PRISMA flowchart of the bibliographic search process and results.

Data extraction and analysis focused on key variables such as author, publication year, methodological design, sample size, intervention type, and main outcomes. Synthesis was qualitative, integrating findings on healing, revascularization, and periodontal regeneration. No meta-analysis was performed due to heterogeneity in designs and results, although consistent trends emerged supporting PRP's efficacy as a regenerative biomaterial.

## DEVELOPMENT

Regenerative medicine aims to replace and regenerate human cells, tissues, or organs. Deficiencies in dental, oral, and craniofacial (DOC) structures may result from numerous diseases, disorders, and injuries—including infections, genetic disorders, cancers, and trauma.(1) Recent advances in biomaterials and fabrication techniques have enabled development of various materials—including natural and synthetic polymeric scaffolds—for clinical applications in repairing and regenerating diverse deficiencies and deformities.(7)



 

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Clinical use of polymeric scaffolds focuses on regenerative endodontics (REP) to provide a suitable physiological environment that biologically replaces damaged dentin-pulp complexes and root structures. The most commonly used scaffold in REP is the blood clot, involving canal preparation and disinfection to induce periapical blood clot formation.(5) An increasing number of bio-scaffolds have demonstrated success—including platelet-rich plasma (PRP), platelet-rich fibrin (PRF), collagen membranes, collagen-hydroxyapatite scaffolds, collagen-gelatin hydrogels (with or without fibronectin), chitosan hydrogels (with or without particulate dentin), angiogenic hydrogels, and many others.(9)

One application of PRP is as a revascularization scaffold, showing successful revascularization/revitalization of necrotic immature permanent teeth at 12 months.(10,11,12) PRP-based procedures also succeed in treating mature permanent teeth, maintaining periapical integrity and healing while preserving tooth longevity in the oral cavity.(13)

These outcomes are explained by PRP's release of abundant growth factors with strong pro-angiogenic effects, acting on endothelial cells via paracrine signaling from extravascular mesenchymal cells to generate blood vessels. PRP also provides a fibrous network facilitating endothelial cell and fibroblast migration, thereby promoting angiogenesis.(14)

Another safe and successful application was reported by Arango et al.,(15) where calcified tissue healing was induced in two horizontal root fractures of maxillary central incisors using a revascularization protocol applied at fracture sites. This technique has also regenerated immature permanent teeth—fractured or carious—in children and young adults (6–28 years) with restorable crowns but thin dentin walls, through revascularization procedures that introduce blood and stem cells into disinfected root canal spaces.(16)

PRP also alleviates symptoms such as pain and swelling when combined with collagen scaffolds. It enhances reparative responses in terms of periapical healing and reduces treatment time for non-vital immature teeth with open apices.(17) PRP has also been used in surgical procedures—including pre-prosthetic surgery, apical surgery, extraction sockets, bone augmentation, and sinus lift procedures—reducing infection risk, recovery time, pain, and inflammation while inducing new bone formation at surgical sites.(18)

Regarding healing, PRP has been applied in gingival recession using coronally advanced flaps, showing initial reduction in matrix metalloproteinase-8 (MMP-8) and IL-1β levels, followed by increased MMP-1 levels at day 10—promoting early-phase periodontal wound healing.(19) PRP contains numerous growth factors that influence wound healing, enhance tissue regeneration, and prevent local complications by increasing collagen content, promoting angiogenesis, and improving initial wound strength.(20)

Currently, PRP has also been used as a submucosal injection targeting systemic inflammatory markers to reduce retraction time after maxillary premolar extraction in bimaxillary protrusion patients. Success is attributed to systemic alterations in blood parameters—including ALP, gamma-GT, serum albumin, and total serum protein (linked to liver function)—alongside increased PDWa and serum calcium levels.(8)

PRF is also used in periodontal regeneration due to its enrichment with soluble growth factors and cytokines that primarily aid tissue regeneration and accelerate wound healing. Multiple studies report notable clinical improvement and radiographic reduction in intrabony defect depth when bone grafts or pharmacological agents (e.g., metformin gel) are combined with PRF—or when PRF is used alone.(21,22,23)

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PRF can also serve as a therapeutic drug delivery system, functioning as a three-dimensional matrix for sustained release of small biomolecules.[24] This physiological scaffold offers advantages over synthetic materials—including controllable degradation, non-toxic byproducts, and excellent biocompatibility. Combining drugs or stem cells with biomimetic scaffolds and signaling factors would complete the triad of tissue engineering approaches.[25]

Today, numerous commercially available PRP preparation systems claim to produce consistent liquid end-products and higher platelet counts than manual laboratory preparation. However, challenges persist—including integration of mechanical signals in biomaterial design, evaluation of regenerative effects, and restoration of horizontal alveolar bone loss with long-term stability of regenerated periodontal tissues. Despite these challenges, periodontal tissue regeneration is a rapidly growing field, and all advances hold promising potential to improve dental patient health in the near future.[26]

## CONCLUSIONS

This qualitative study—based on an exhaustive bibliographic review of high-impact dental literature—demonstrates that platelet-rich plasma (PRP) is a widely used and effective biomaterial in periodontal regeneration and various clinical areas, including oral and maxillofacial surgery, implantology, and bone remodeling. Its effectiveness stems from autologous platelet and growth factor concentration in a small plasma volume, promoting essential biological processes for tissue repair—reducing healing time, enhancing revascularization, mitigating pain, and improving graft integration—thus establishing PRP as a safe and promising alternative in dental practice.

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