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Platelet-Rich Plasma and Its Role in Wound Healing After Dental Procedures: A Literature Review

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Abstract

Introduction

Platelet-rich plasma (PRP) is an autologous blood-derived preparation whose task is to release growth factors from platelets that support the regeneration of damaged tissues. The development of medicine has made PRP increasingly common in various fields of science, including dentistry. The widespread use of plasma in dental surgery, maxillofacial surgery, periodontology and even pedodontics has increased the percentage of positive treatment results and increased therapeutic possibilities.

Materials and Methods:

The literature review was conducted using the PubMed database. Publications from 2000–2025 were searched. The literature review included various types of publications such as narrative and systematic reviews, randomized controlled trials (RCTs), cohort studies, meta-analyses, and expert consensus papers.

Results:

A review of the literature revealed that platelet-rich plasma (PRP) significantly supports tissue regeneration and healing following dental procedures. Clinical studies demonstrated reduced postoperative pain and swelling, accelerated wound closure, and improved bone density in sites treated with PRP. Positive outcomes were observed across multiple dental disciplines, including oral surgery, maxillofacial reconstruction, periodontology, and pediatric dentistry. Additionally, PRP was shown to stimulate angiogenesis, modulate inflammation, and promote cellular proliferation, while exhibiting antimicrobial properties. However, variation in study protocols and outcomes suggests the need for cautious interpretation.

Conclusion:

PRP represents a promising autologous biomaterial with multidirectional regenerative effects in dentistry. While short-term clinical benefits are well-documented, long-term effectiveness, optimal concentrations, and standardized application protocols remain insufficiently defined. Further randomized, controlled trials with extended follow-up periods are essential to validate the consistent therapeutic potential of PRP in routine dental practice.

Keywords:

platelet-rich plasma, PRP, growth factors, clinical applications, dentistry

Introduction

The use of platelet-rich plasma (PRP) in dentistry is becoming a promising alternative to commonly used methods and materials for tissue regeneration. PRP is obtained by centrifuging the patient's blood and constitutes a concentrated suspension of growth factors found in platelets [1, 2]. These growth factors include PDGF, IGF, and TGF-β, whose roles are to accelerate wound healing and induce tissue regeneration. PDGF is a protein characteristic of monocytes and macrophages, and during wound healing, it acts as an activator of collagenase, which leads to the strengthening of the healed tissue. TGF-β, on the other hand, activates fibroblasts to produce procollagen. The application of PRP may also enhance bone regeneration [2]. The field of transfusion medicine, in relation to wound healing, is still a young scientific discipline, in which many aspects remain to be studied. The exact mechanisms of action of the various components involved in tissue healing have not yet been fully understood [3]. Platelet-rich plasma is increasingly being used in regenerative dentistry. Endodontics employs PRP in procedures such as pulpotomy, apical surgery, and apexification. In periodontology, PRP plays a significant role in periodontal plastic surgery, as well as in the treatment of periodontal bone defects. This autologous material is also gaining popularity in oral and maxillofacial surgery (tooth extractions, soft and hard tissue surgery), as well as in implantology [4].

Oral Surgery

Platelet-rich plasma (PRP) is used in oral surgery to support the healing of post-extraction sockets, the treatment of periapical inflammatory lesions, and in maxillary sinus floor elevation procedures, particularly in the context of bone implant placement [5]. These effects are possible due to the presence of platelets in PRP, along with a high concentration of proteins such as platelet-derived growth factor (PDGF), transforming growth factor β (TGF-β), epidermal growth factor (EGF), vascular endothelial growth factor (VEGF), insulin-like growth factor (IGF), and adhesion molecules (e.g., vitronectin, fibrin, fibronectin), which are responsible for cell recruitment, proliferation, and angiogenesis [5,6]. As a result, regenerative processes are stimulated, and tissue healing is accelerated. Nevertheless, despite promising results, the impact of PRP on tissue healing and bone regeneration in this clinical context remains not fully understood [5].

In studies where PRP was applied directly into the socket following tooth extraction, a reduction in the negative effects of zoledronic acid on the healing process was observed, attributed to the activation of tissue repair mechanisms [7]. Consequently, a reduced risk of medication-related osteonecrosis of the jaw (MRONJ) was also noted [7,8]. The results showed lower concentrations of proinflammatory cytokines and a higher number of fibroblasts, osteoblasts, and keratinocytes compared to the control group [7]. It is worth emphasizing that the application of PRF alone may not be sufficient to eliminate the risk of necrosis—it must be combined with proper oral hygiene (e.g., the use of chlorhexidine), antibiotic prophylaxis, an atraumatic extraction technique, and appropriate wound protection [8].

PRP also exhibits osteoinductive and osteoconductive properties [9]. Its use in post-extraction wounds results in a significantly greater height of the alveolar ridge compared to sockets in the control group [9]. Maintaining a balance between bone resorption and new bone formation is crucial for preserving the supporting structures of teeth and implants. Large bone defects at planned implant sites may significantly limit therapeutic options [6].

In experimental studies using an animal model (dog mandible), it was observed that combining mesenchymal stem cells (MSCs) with PRP led to intensive osteogenesis and vascularization, comparable to that observed with autologous bone grafts [10]. Among monitored patients, good implant stability was reported, with no signs of pain or inflammation in the soft tissues surrounding the implants [11]. Radiographic assessments performed six months after implantation showed the presence of newly formed, well-integrated bone tissue within the residual bone and an average increase in bone density around the implants in the PRP-treated group [11].

The maxillary sinus floor elevation (MSFE) procedure aims to increase the amount of bone tissue in the maxilla by lifting the Schneiderian membrane and introducing grafting material into the created space. Autogenous bone grafts have long been considered the gold standard for bone regeneration due to their osteoinductive and osteoconductive properties and immunological compatibility [6,10]. Unfortunately, the limited availability of autogenous material and the risk of complications at the donor site present significant limitations to this method [10].

Therefore, the use of platelet concentrates derived from the patient's own blood represents an attractive therapeutic alternative [6]. The presence of appropriate growth factors enables the directional differentiation of stem cells into osteoblasts, making PRP an effective tool in bone tissue regeneration [10]. It has been shown that PRP enhances the aggregation and stability of molecular bone substitutes, promoting new bone formation [10].

Thus, PRP can support bone regeneration, especially in the early phases of osteogenesis and healing. Upon platelet activation, biomolecules are released and a fibrin network is formed, which serves as a temporary scaffold for growth factors [12]. However, it should be noted that most of these factors are released almost immediately after PRP administration, and are fully consumed within approximately 24 hours [10,11]. Therefore, the long-term effect of PRP on bone remodeling may be limited, as the complete regeneration process takes 4–6 weeks. As a result, its impact during the later phases of healing may be minimal [10].

Maxillofacial Surgery

The use of platelet-rich plasma (PRP) in oral and maxillofacial surgery has been extensively studied over the past two decades [3].

Modern regenerative surgery increasingly employs autologous products such as PRP and platelet-rich fibrin (PRF) as supportive tools to accelerate healing and tissue regeneration. These products contain a range of growth factors, including PDGF, TGF-β, VEGF, and adhesive proteins that influence cell migration, proliferation, and differentiation during the regeneration process [14,15].

Numerous applications of PRP have been described in the literature, including tooth extractions, bone defect treatments, maxillary sinus augmentation, gingival recession therapy, and implant integration support [5]. Clinical studies have demonstrated that platelet concentrates positively affect the acceleration of both soft and hard tissue healing, and help reduce postoperative pain and swelling [16].

In maxillary sinus augmentation, the use of PRP either as the sole filling material or as an additive to biomaterials shows potential in accelerating osteogenesis. However, the data are inconsistent. Some studies indicate no significant differences in bone height or the amount of newly formed bone when PRP is used compared to standard augmentation materials, while others suggest improvements in graft integration and the quality of regenerated bone [17].

In facial aesthetic surgery, platelet-rich plasma is used as an agent supporting tissue regeneration and improving the quality and aesthetics of postoperative wound healing. PRP is particularly employed in procedures such as facelifts, scar reconstructions, lip and nose corrections, scar revisions, and lipofilling. The primary mechanism of PRP action involves the local release of growth factors—including PDGF, VEGF, TGF-β, and EGF—that stimulate fibroblast and keratinocyte proliferation, thereby enhancing re-epithelialization, angiogenesis, and collagen remodeling [15].

Clinical studies have shown that the use of PRP in facial aesthetic procedures significantly reduces scar width and visibility in the late postoperative period. In a study involving 100 patients undergoing various facial surgeries (including scar revisions, facelifts, and flap reconstructions), those who received intradermal PRP injections demonstrated significantly better scar outcomes on the POSAS (Patient and Observer Scar Assessment Scale) compared to the control group [18]. Furthermore, planimetric analysis revealed that scar width increased by only half as much in the PRP-treated group. These patients also reported higher satisfaction with aesthetic outcomes and better scores on the Dermatology Life Quality Index (DLQI) [18].

Periodontology

One of the most common reasons patients seek periodontal treatment is periodontitis—a contagious disease characterized by the irreversible loss of periodontal ligament fibers and alveolar bone [19, 20]. The progression of periodontitis depends on the patient's oral microbiota and their immune response to pathogens [19]. Only the implementation of appropriate treatment can protect patients from early tooth loss [20].

Scaling and root planing (SRP) remain the gold standard for periodontitis treatment; however, in many cases, more invasive procedures are required [21].

The use of platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) has contributed to improved treatment outcomes and shortened periodontal regeneration time [22].

Platelets are a significant reservoir of proteins such as PDGF, TGF-β, and IGF-I, which are responsible for recruiting stem cells to the treated tissues. These proteins influence various biological processes, including osteoclast inhibition, osteoblast proliferation, cell migration, and angiogenesis [22]. Consequently, they exert a beneficial effect on gingival fibroblasts, periodontal ligament fibroblasts, and osteoblasts [23]. The binding of growth factors (GFs) to the outer surface of cell membranes activates intracellular proteins and triggers a cascade of cellular responses, including cell proliferation, collagen and elastin synthesis, extracellular matrix formation, and osteoid production [24].

Improved wound healing following PRP application has also been attributed to its antimicrobial activity—particularly against oral microorganisms such as Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Enterococcus faecalis, Candida albicans, Streptococcus agalactiae, and Streptococcus oralis.

In addition to promoting early bone regeneration and soft tissue healing, PRP has been shown to delay epithelial migration across resorbable barrier membranes [23].

However, not all researchers are equally enthusiastic about combining PRP with bone graft materials. According to some, prolonged exposure to high concentrations of growth factors in tissues may negatively affect cellular behavior. These authors observed that high concentrations of PRP suppressed the proliferation and viability of alveolar bone cells, whereas low concentrations stimulated their activity [23].

Recently, PRP has been explored in the treatment of gingival recession. Studies by M. S. Al-Barakani et al. demonstrated significant reductions in PI (Plaque Index), CAL (Clinical Attachment Level), and RD (Recession Depth) in patients treated with PRP [25]. These patients also reported reduced postoperative pain and experienced fewer complications [26, 27, 28].

This is attributed to the fact that PRP-treated sites exhibited lower levels of MMP-8 (a proteolytic enzyme) and higher expression of TIMP-1 (a protein that inhibits MMP activity), resulting in accelerated healing and marked reduction of local inflammation. Other proteins, such as VEGF, promote blood vessel formation [27].

Additionally, in patients with a thin gingival phenotype, the use of injectable PRP—alone or combined with microneedling—may potentially increase gingival thickness. It has been shown that increased gingival thickness can reduce the likelihood of recession relapse [25].

In conclusion, PRP can be considered a promising biomaterial. It promotes early clot stabilization and serves as a scaffold for living cells that mediate tissue repair [27, 28]. The application of PRP during recession coverage procedures may lead to permanent reduction in RD and significantly improved root coverage [28].

Pedodontics

Pediatric dentistry utilizes autologous blood-derived platelet concentrates in procedures such as pulp capping, regenerative pulpotomy, management of dentoalveolar trauma, and apexogenesis [29]. Platelet-rich plasma (PRP), which contains numerous growth factors, participates in the regulation of tissue growth and differentiation. It facilitates collagen synthesis, enhances angiogenesis, promotes epithelial cell and granulation tissue formation, and exhibits antimicrobial properties.

The application of PRP in the treatment of necrotic, immature permanent teeth has shown excellent outcomes. Treatment has led to root lengthening and achievement of an appropriate crown-to-root ratio. Additionally, dentin wall thickening was observed in many cases [30].

A study by V. Y. Shivashankar et al. demonstrated nearly complete apical closure and continued root development in a tooth with an open apex and thin dentinal walls following PRP treatment. In another case, involving a tooth with arrested root development due to trauma, PRP application resulted in almost complete apex closure and continued root maturation after 12 months [31].

Other studies have also confirmed the significance of PRP as a scaffold in regenerative endodontic procedures. T. Bezgin et al. conducted a study using immature permanent teeth with necrotic pulp and PRP to assess the degree of root canal revascularization. After canal disinfection with a triple antibiotic paste (ciprofloxacin, metronidazole, and cefaclor), concentrated PRP was introduced into the root canal as a scaffold for incoming cells. The tooth was hermetically restored with MTA and composite material. Follow-up was conducted every three months, with final evaluation at 12 months. Radiographic assessment revealed apex closure through narrowing of the apical foramen and convergence of the apical walls (32).

The goal of pulpotomy is to temporarily relieve acute symptoms and maintain the integrity of the tooth in the arch. Ideally, the procedure results in healing of the reversibly inflamed coronal pulp and preservation of the healthy radicular pulp.

Formocresol was historically considered the gold standard in pediatric pulpotomy procedures. Currently, there is a shift toward replacing cytotoxic agents like formocresol with autologous biomaterials such as PRP. However, few data are currently available on the efficacy of PRP in vital pulp therapy, and its use remains the subject of ongoing debate.

A study by T. M. Beltagy et al. showed that PRP application to inflamed vital pulp resulted in proper organization of soft tissues, absence of pulp inflammation, and resolution of hyperemia. After three months, patients treated with PRP demonstrated normal pulp tissue architecture, no evidence of inflammation (or only residual hyperemia), and preserved odontoblastic layers.

It was shown that PRP offers significantly better histological pulp outcomes than widely used formocresol [33]. Therefore, this autologous material is a promising candidate for use as an alternative in pulpotomy of primary teeth [33, 34].

Despite the high potential of PRP, the current literature still lacks long-term clinical trials evaluating the success rate of regenerative endodontic therapy with a minimum five-year follow-up period [34].

Summary

Platelet-rich plasma (PRP) represents a promising autologous biomaterial used across a wide range of dental procedures. Owing to its high concentration of growth factors—such as PDGF, TGF-β, VEGF, and IGF—PRP exhibits regenerative properties that promote angiogenesis, cell proliferation, and wound healing. The application of PRP in dental, maxillofacial, periodontal, and pediatric procedures has shown positive clinical outcomes, including reduced postoperative pain and swelling, improved graft integration, and increased volume and quality of regenerated bone tissue.

Despite these encouraging results, further well-designed clinical studies with long-term follow-up are necessary to clearly determine the efficacy, safety, and optimal conditions for the use of PRP in dental practice.

Authors' Contributions Statement:

[JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Conceptualization:[JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Data Curation: [JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Formal Analysis: [JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Investigation: [JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Methodology:[JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Project Administration:[JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

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Software:[JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Supervision: [JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Validation: [JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Visualization: [JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Writing - original Draft: [JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

Writing - Review and Editing: [JR][MS][MW][GS][KK][KKo][KKu][MC][GSk][MSł][KKoł]

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