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Role of PRF and Interaction of Other Drugs in Implant Prostheses

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Abstract

Implant prosthodontics continues to develop rapidly with expanding treatment possibilities and improved biologic understanding of implant-supported rehabilitation. The long-term predictability of implant therapy depends largely on successful osseointegration, which is influenced by both local healing conditions and systemic pharmacological factors. Various drugs and biologic adjuncts can modify bone remodeling, angiogenesis, and tissue regeneration around implants. Platelet-rich fibrin (PRF) is an autologous platelet- and leukocyte-rich fibrin concentrate derived from blood that has shown regenerative potential because of its ability to release growth factors gradually during healing. In addition to PRF, several pharmacological agents such as antibiotics, anti-inflammatory drugs, bisphosphonates, statins, vitamin D, and bone-regulating molecules have been investigated for their influence on implant integration and peri-implant tissue response. PRF and its modifications, including advanced PRF and injectable PRF, together with platelet-rich plasma, have broadened regenerative applications in implant dentistry by improving wound healing, angiogenesis, and tissue maturation. This review discusses the biologic basis, preparation principles, clinical applications, advantages, limitations, and recent evidence regarding PRF and other pharmacological agents in implant prosthodontics, emphasizing their relevance as adjuncts in regenerative implant therapy and their role in evidence-based clinical practice.

Keywords: Platelet-rich fibrin, dental implants, osseointegration, implant prosthodontics, pharmacological agents

Introduction

Dental implants and implant-supported prostheses are widely accepted for replacing missing teeth because they restore mastication, esthetics, and oral function with high long-term success rates.[1] The clinical success of implant-supported rehabilitation depends primarily on stable osseointegration, which refers to

direct structural contact between the implant surface and surrounding bone without intervening soft tissue. Since this biologic interaction determines implant stability and longevity, both implant surface modifications and biologically active adjuncts have become important research areas.[2]

Among these adjuncts, platelet-rich fibrin has attracted considerable interest because of its autologous origin and regenerative capacity. PRF is produced from centrifuged venous blood without anticoagulants and forms a fibrin matrix enriched with platelets, leukocytes, cytokines, and growth factors. This matrix serves as a temporary biologic scaffold that gradually releases mediators involved in tissue repair.[3] Its clinical appeal lies in simple preparation, low cost, and favorable biologic effects during healing.

Acceleration of osseointegration is particularly important when early or immediate implant loading is planned. Activated platelets within PRF release growth factors that stimulate cellular proliferation, collagen deposition, and early osteoid formation, thereby enhancing both soft and hard tissue healing around implants.[4]

In addition to PRF, numerous systemic medications influence implant healing. Certain agents such as alendronate, zoledronate, teriparatide, insulin, losartan, simvastatin, and vitamin D have shown effects on peri-implant bone metabolism, while other drugs including corticosteroids, cyclosporin A, and cytotoxic agents may negatively influence osseointegration. [5]

Influence of Systemic Drugs on Implant Treatment

Osseointegration is a biologic healing process dependent on coordinated bone formation, resorption, vascular supply, and inflammatory regulation. Systemic medications may alter any of these pathways and thereby affect implant stability and long-term survival.

Bone remodeling around implants requires balanced osteoblastic and osteoclastic activity together with adequate local blood supply. Drugs that support mineral metabolism or reduce bacterial contamination may improve healing, whereas medications that suppress bone turnover or interfere with calcium metabolism may compromise peri-implant bone response. Antibiotics, vitamin D supplementation, and anabolic bone agents may enhance implant healing, while bisphosphonates, proton pump inhibitors, corticosteroids, and selective serotonin reuptake inhibitors have been associated with impaired peri-implant remodeling.[6–8] Therefore, thorough review of systemic drug history is essential before implant placement.

Platelet-Rich Fibrin in Implant Dentistry

Platelet-rich fibrin is classified as a second-generation platelet concentrate because it is prepared without anticoagulants or biochemical additives.[9] Venous blood is centrifuged immediately after collection, producing a fibrin clot rich in platelets, leukocytes, and signaling molecules.

Its regenerative effect is linked to sustained release of platelet-derived growth factor, transforming growth factor beta, vascular endothelial growth factor, and insulin-like growth factor. These mediators stimulate

angiogenesis, fibroblast activity, collagen synthesis, and osteoblastic differentiation, creating favorable conditions for early osseointegration.[10]

The fibrin matrix also supports migration of regenerative cells and neovascularization. Because growth factor release occurs gradually over several days, PRF remains biologically active throughout the early healing phase after implant placement.

Clinical Applications of PRF Around Implants

PRF has been applied in immediate implant placement, sinus augmentation, ridge preservation, guided bone regeneration, and management of extraction sockets. It improves cell migration, adhesion, proliferation, and osteogenic differentiation while also modulating local inflammatory responses.[10]

When mixed with bone graft materials, PRF improves graft handling and cohesion while supporting vascular penetration within grafted areas. In sinus floor elevation procedures, leukocyte-rich PRF has shown positive effects on graft maturation and reduced postoperative discomfort.

Because PRF contains leukocytes, it may also contribute antimicrobial and anti-inflammatory effects by regulating early inflammatory reactions and limiting postoperative edema.

Recent Evidence on PRF and Implant Stability

Recent systematic reviews indicate measurable improvement in early implant stability when PRF is used during implant placement. A 2023 meta-analysis reported significantly higher implant stability quotient values during early healing when compared with control groups.[11]

Another pooled analysis demonstrated improved secondary stability at 1, 4, 8, and 12 weeks following implant placement. These findings suggest that PRF contributes mainly during the early osseointegration phase, although long-term survival rates remain comparable.

Platelet-Rich Plasma in Implant Dentistry

Platelet-rich plasma represents a first-generation autologous platelet concentrate prepared from anticoagulated blood. It contains high platelet concentrations and multiple growth factors that stimulate angiogenesis, fibroblast proliferation, and tissue repair.

PRP has been used to improve graft maturation, enhance early soft tissue healing, and stimulate bone formation around implants. Although early regenerative benefits are reported, long-term implant survival outcomes remain less consistent than PRF because PRP requires anticoagulants and external activation during preparation.[12]

Antibiotics Used in Implant Dentistry

Antibiotics are commonly prescribed during implant surgery to reduce bacterial contamination that may interfere with clot stability and osseointegration. Amoxicillin remains the most frequently used

prophylactic agent because of broad-spectrum activity and effective tissue penetration. Evidence supports a single preoperative dose rather than prolonged postoperative administration.[13]

Clindamycin is commonly used in penicillin-allergic individuals, although some studies report less favorable implant outcomes compared with amoxicillin. Chlorhexidine mouth rinses are also frequently recommended to reduce local bacterial load.

Anti-inflammatory Drugs

NSAIDs such as ibuprofen are routinely prescribed for postoperative pain control. These agents reduce inflammation by inhibiting cyclooxygenase enzymes and lowering prostaglandin production.

Short-term administration is generally considered safe, but prolonged use may suppress early bone remodeling because prostaglandins participate in osteoblast differentiation and vascular responses during healing.[15]

Corticosteroids such as dexamethasone may be useful in extensive implant surgeries to reduce edema and improve patient comfort, although long-term corticosteroid exposure may impair bone healing.

Drugs That May Improve Osseointegration

1. Statins

Statins such as simvastatin stimulate bone morphogenetic protein expression and promote osteoblastic differentiation. Experimental studies report improved bone-to-implant contact after local application.

2. Vitamin D

Vitamin D supports calcium homeostasis and mineralization. Deficiency has been associated with delayed osseointegration and early implant complications.

3. Teriparatide

Teriparatide enhances osteoblastic activity and may improve implant healing in osteoporotic bone.

Drugs That May Hinder Osseointegration

1. Bisphosphonates

These agents suppress osteoclastic activity and reduce bone turnover. Long-term use may increase risk of medication-related osteonecrosis of the jaw.[14]

2. Proton Pump Inhibitors

Long-term proton pump inhibitor therapy may impair calcium absorption and bone metabolism.

3. SSRIs

Selective serotonin reuptake inhibitors may alter osteoblast and osteoclast regulation.

4. Corticosteroids

Chronic corticosteroid therapy reduces collagen formation and osteoblastic function.

5. Chemotherapeutic Agents

Antineoplastic drugs impair cellular proliferation and may compromise healing when implant placement coincides with treatment.

Clinical Significance

Biologic adjuncts and pharmacologic agents directly affect peri-implant healing and long-term treatment predictability. PRF and PRP improve early wound healing and tissue maturation, particularly in regenerative procedures and immediate implant protocols.

Systemic medications require individualized evaluation because some improve bone response while others increase risk of implant complications. Comprehensive pharmacologic assessment therefore remains essential for predictable implant outcomes.

Conclusion

Platelet-rich fibrin has become an important biologic adjunct in implant dentistry because it enhances soft tissue healing and early osseointegration through sustained growth factor release. Current evidence supports its beneficial role in improving secondary implant stability during early healing.[11]

Alongside PRF, pharmacological agents significantly influence implant success. Antibiotics and short-term anti-inflammatory drugs support early healing, whereas anabolic agents such as statins and vitamin D may improve bone response. In contrast, drugs that suppress bone turnover or alter mineral metabolism may compromise osseointegration and require careful treatment planning.

Future long-term randomized clinical studies are needed to establish standardized clinical protocols for biologic adjuncts and medication-related implant management.

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