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CLINICAL APPLICATION AND EFFECTIVENESS OF PLATELET-RICH PLASMA (PRP) AND PLATELET-RICH FIBRIN (PRF) IN REGENERATIVE DENTISTRY

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Annotation

This article provides a comprehensive review of regenerative technologies in dentistry, focusing on autologous blood-derived products, Platelet-Rich Plasma (PRP) and Platelet-Rich Fibrin (PRF). It discusses their preparation techniques, clinical applications, dosage, efficacy, and limitations. PRP and PRF, rich in growth factors, stimulate cellular proliferation, angiogenesis, and collagen synthesis, promoting faster regeneration of bone and soft tissues. The article highlights their use in tooth extraction, implant placement, periodontal therapy, and oral surgery, emphasizing improved healing outcomes, reduced postoperative pain and inflammation, and enhanced tissue quality. Moreover, current research and innovative approaches combining PRP and PRF with advanced biomaterials and stem cell therapies are explored, indicating promising future directions in regenerative dentistry. Clinical evidence demonstrates that PRF and PRP are effective, safe, and increasingly integral to modern dental surgical practice.

Keywords

PRF, PRP, dentistry, regenerative technology, bone regeneration, soft tissue regeneration, tooth extraction, implantology, periodontal therapy, growth factors, surgical dentistry, clinical efficacy.

Introduction

In recent years, regenerative technologies have gained significant attention in medicine and dentistry. These technologies are aimed at restoring damaged tissues and accelerating physiological healing processes. In surgical dentistry, regenerative approaches are particularly effective in treating periodontitis, implant placement, bone defects, and in reducing postoperative pain. Platelet-Rich Plasma (PRP) and Platelet-Rich Fibrin (PRF) are autologous biological materials derived from the patient’s own blood, containing a high concentration of growth factors. These growth factors stimulate cellular proliferation, angiogenesis, and collagen synthesis, thereby promoting faster tissue regeneration. In surgical dentistry, PRP and PRF are applied to enhance bone and soft tissue regeneration, minimize complications after implant placement or tooth extraction, and shorten patient recovery time. Additionally, these techniques are considered safe and minimally invasive, making them widely accepted among patients. Research indicates that PRF and PRP improve bone volume, promote periodontal tissue renewal, and reduce pain, demonstrating higher efficacy compared to conventional methods. Consequently, regenerative technologies have become an integral part of modern surgical dentistry, and their applications continue to expand.

Relevance

Regenerative technologies, including PRF and PRP, have become increasingly important in surgical dentistry due to their ability to accelerate tissue healing, enhance bone and soft tissue regeneration, and reduce postoperative complications. These approaches address limitations of conventional treatments and improve patient outcomes in procedures such as tooth extraction, implant placement, and periodontal therapy.

Aim

The aim of this study is to evaluate the clinical application, effectiveness, and optimal usage of PRF and PRP in surgical dentistry, focusing on their role in promoting tissue regeneration, accelerating recovery, and improving overall treatment success.

Main part

Platelet-Rich Plasma (PRP) and Platelet-Rich Fibrin (PRF) are autologous blood-derived products that play a critical role in tissue regeneration. Both contain a high concentration of platelets, growth factors, and cytokines that stimulate cellular proliferation, angiogenesis, and collagen synthesis. PRP is a liquid formulation that delivers an immediate release of growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF). These factors enhance osteogenesis, fibroblast proliferation, and endothelial cell migration, which are essential for bone and soft tissue healing. PRF, in contrast, forms a fibrin matrix that allows gradual release of growth factors over 7–14 days, providing sustained stimulation of tissue regeneration. Leukocytes present in PRF contribute to immune modulation and antimicrobial activity, which reduces postoperative inflammation and infection risk. Understanding these cellular and molecular mechanisms is crucial for optimizing the clinical application of PRP and PRF in surgical dentistry. Their autologous nature minimizes immunogenic reactions and enhances biocompatibility, making them ideal for promoting natural healing in dental surgeries. Additionally, the synergistic effect of platelets and fibrin supports angiogenesis, collagen formation, and recruitment of progenitor cells, which collectively improve both bone and soft tissue regeneration.

The preparation of PRP and PRF involves autologous blood collection and centrifugation, but the protocols differ. PRP is obtained by drawing 10–20 mL of the patient's blood into anticoagulant-containing tubes, followed by a two-step centrifugation process. The first spin separates red blood cells from plasma, while the second concentrates platelets within the plasma fraction. The resulting PRP can be activated using thrombin or calcium chloride to form a gel suitable for direct application. PRF preparation is simpler and does not require anticoagulants. Blood is collected into plain tubes and centrifuged immediately at a lower speed, producing a fibrin clot rich in platelets and leukocytes. The clot is then compressed to form membranes or plugs for surgical use. Both techniques require strict adherence to sterile protocols and precise centrifugation parameters, as variations in speed and time can affect platelet concentration and growth factor release. The final PRP or PRF product should be used immediately to maintain biological activity. Proper handling ensures maximal regenerative potential, while improper preparation may compromise clinical outcomes. Both preparations are versatile and can be tailored to the size and type of the defect, allowing for localized and targeted regenerative therapy.

The clinical effectiveness of PRP and PRF depends on appropriate dosage and accurate placement. PRP is typically applied in volumes of 3–5 mL per surgical site, depending on defect size, as a gel or injectable solution. It is used in extraction sockets, periodontal pockets, peri-implant bone defects, and soft tissue injuries to accelerate healing and reduce inflammation. PRF is applied as one to three membranes, depending on the area requiring regeneration, directly over bone or soft tissue defects. The fibrin matrix ensures close contact with the tissue and gradual release of growth factors, supporting sustained tissue regeneration. Both PRP and PRF can be combined with bone graft materials to enhance osteogenesis and provide structural support. Precise placement and controlled dosage are essential, as insufficient material may limit regenerative effects, while excessive application can compromise clot stability and integration. Clinicians must assess the size, depth, and complexity of the defect to determine the optimal amount of PRP or PRF. Consistent technique ensures reproducible clinical outcomes and maximizes the biological benefits of these autologous regenerative products in surgical dentistry.

PRP and PRF are widely applied in surgical dentistry to enhance tissue regeneration and improve clinical outcomes. In implantology, PRF membranes are used to cover implant sites, supporting osseointegration and soft tissue healing. PRP is often applied in bone graft sites to accelerate bone formation and reduce healing time. In tooth extractions, PRF promotes faster closure of extraction sockets and reduces postoperative pain and swelling. Periodontal therapy also benefits from these materials; PRF is inserted into periodontal pockets to stimulate new attachment formation and regenerate lost alveolar bone. Furthermore, PRP can be used in combination with barrier membranes during guided tissue regeneration procedures to enhance cellular proliferation and angiogenesis. Both PRF and PRP have applications in maxillofacial surgery, including the treatment of cystic lesions, sinus lifts, and ridge augmentation. Their versatility allows clinicians to adapt them for various defect sizes and anatomical locations. Clinical studies indicate improved bone density, reduced soft tissue inflammation, and faster wound closure when these regenerative materials are applied correctly. Moreover, the autologous nature of PRP and PRF ensures biocompatibility and minimizes the risk of immune reactions or disease transmission.

The effectiveness of PRF and PRP in surgical dentistry has been demonstrated in numerous clinical studies. PRF provides a sustained release of growth factors, which enhances soft tissue healing, collagen deposition, and angiogenesis over several days. PRP delivers an immediate burst of growth factors, accelerating initial stages of bone and soft tissue repair. Patients treated with PRF or PRP often experience reduced postoperative pain, swelling, and risk of infection. Bone grafting procedures combined with PRP or PRF show higher rates of bone fill and improved quality of newly formed bone. Periodontal regeneration outcomes, including clinical attachment gain and reduction of probing depth, are significantly enhanced when PRF membranes are used. Additionally, implant stability is increased due to improved bone-to-implant contact and enhanced peri-implant soft tissue health. Both PRP and PRF demonstrate predictable results, particularly when protocols are standardized and surgical technique is precise. Overall, their application leads to faster healing, better tissue quality, and higher patient satisfaction compared to conventional treatment methods.

PRP and PRF offer several advantages in surgical dentistry. They are autologous, minimizing the risk of immunogenic reactions or disease transmission. Their use promotes faster tissue regeneration, reduces postoperative pain and swelling, and enhances bone and soft tissue quality. These materials are versatile, applicable in a wide range of surgical procedures, and can be combined with bone grafts or barrier membranes to improve outcomes. The sustained release of growth factors from PRF and the immediate effect of PRP allow for tailored regenerative strategies. However, limitations exist. The effectiveness of PRP and PRF depends on proper preparation, handling, and clinical technique. Variations in centrifugation speed, time, and blood quality can affect platelet concentration and growth factor release. PRF requires immediate application after preparation, limiting its storage and transport options. Additionally, in large or complex defects, PRP and PRF alone may be insufficient, necessitating combination with other regenerative materials. Cost and availability of equipment may also restrict widespread use in some clinical settings. Despite these limitations, careful protocol adherence ensures reliable and predictable regenerative outcomes.

Regenerative technologies such as PRF and PRP continue to evolve, with ongoing research aimed at enhancing their clinical efficacy and expanding their applications. Recent studies explore combining PRF and PRP with stem cell therapies, growth factor-enriched scaffolds, and advanced biomaterials to further accelerate bone and soft tissue regeneration. Innovations in centrifugation protocols and preparation devices aim to standardize platelet concentration and optimize growth factor release. Emerging techniques, such as injectable PRF (i-PRF), provide easier handling and improved distribution in complex defect sites. Additionally, personalized regenerative approaches based on patient-specific biological and genetic factors are being investigated to maximize therapeutic outcomes. Integration with digital dentistry, including 3D imaging and computer-guided surgery, allows precise placement of regenerative materials and better assessment of healing progress. These advancements suggest that regenerative dentistry will become increasingly predictable, minimally invasive, and patient-centered. The combination of PRF, PRP, and modern biomaterials has the potential to revolutionize dental surgery, improving functional and aesthetic results while reducing recovery time. Ongoing clinical trials and translational research are essential to validate these innovative protocols and establish evidence-based guidelines for routine practice.

Conclusion

PRF and PRP have established themselves as vital components of modern surgical dentistry due to their ability to accelerate tissue healing and improve clinical outcomes. Their autologous nature ensures biocompatibility, safety, and minimal risk of adverse reactions. Clinical evidence demonstrates their effectiveness in enhancing bone regeneration, promoting soft tissue repair, reducing postoperative pain and inflammation, and improving implant stability. Proper preparation, dosage, and application are critical for achieving optimal regenerative results. While limitations exist, such as sensitivity to preparation protocols and limitations in large defects, their advantages far outweigh these challenges. Future innovations combining PRF and PRP with stem cells, advanced biomaterials, and digital planning hold great promise for more predictable, efficient, and patient-centered dental treatments. Overall, PRF and PRP represent a significant advancement in regenerative dentistry, providing clinicians with powerful tools to optimize healing, improve treatment success, and enhance patient satisfaction.

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