

## MANAGING MAXILLARY BONE LOSS USING GROWTH FACTORS IN PRE-IMPLANT THERAPY

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### Abstract

Bone augmentation and sinus lift procedures are critical components of implant dentistry, particularly for patients experiencing insufficient bone volume in the maxilla due to tooth loss and maxillary sinus pneumatization. The integration of Plasma Rich in Growth Factors (PRGF) into these procedures has demonstrated substantial promise in enhancing bone regeneration and improving implant stability. This comprehensive literature review synthesizes findings from various studies and case reports to evaluate the efficacy, mechanisms, and clinical outcomes of using PRGF in these dental interventions.

PRGF, derived through a specific centrifugation process, concentrates essential growth factors such as Vascular Endothelial Growth Factor (VEGF), Platelet-Derived Growth Factor (PDGF), and Insulin-Like Growth Factor (IGF). These factors are pivotal in promoting wound healing, angiogenesis, and the formation of the extracellular matrix. Notably, PRGF is distinct in its exclusion of leukocytes, which minimizes pro-inflammatory effects and fosters a more conducive healing environment.

Several studies have underscored the efficacy of PRGF in sinus lift procedures. A retrospective study by Dragonas et al. (2020) reported a remarkable implant survival rate of 95.8% one year post-augmentation using PRGF combined with various bone grafts. Additionally, a case report by Rațiu et al. (2018) documented significant osseous regeneration over eight months following augmentation performed solely with PRGF and fibrin clot, with histological examination confirming new bone formation.

Comparative studies have revealed that PRGF can achieve regenerative outcomes comparable to those of autogenous bone grafts while mitigating associated morbidity. A split-mouth study by Anitua et al. (2009) demonstrated higher new bone formation and a 100% implant survival rate in PRGF-treated sites. Similarly, Torres et al. (2009) found that PRGF-enhanced grafts exhibited superior histomorphometric outcomes compared to controls.

Clinical case studies further highlight PRGF's potential. Rațiu et al. (2018) detailed a case of complete bone regeneration in a patient with significant posterior maxillary atrophy following a PRGF-assisted sinus lift. Another study by Dragonas et al. (2020) noted that while the use of xenografts posed a higher risk of implant failure, the overall success rate remained high when PRGF was incorporated.

### Introduction

Maxillary bone loss presents a significant challenge in dental implantology, impacting both aesthetic outcomes and the stability of dental implants. Traditional methods to address bone loss, such as grafting and synthetic materials, have shown varying degrees of success but often involve extended recovery periods and potential complications. The advent of growth factors in pre-implant therapy marks a promising advancement in the field. These biologically active molecules, which play a crucial role

in tissue regeneration and healing, offer a novel approach to enhancing bone regeneration and improving the success rates of dental implants. This article explores the application of growth factors in managing maxillary bone loss, examining their mechanisms, benefits, and clinical outcomes, thereby providing a comprehensive overview of this cutting-edge technique in pre-implant therapy.

Bone augmentation and sinus lift procedures are integral in implant dentistry, particularly for patients who suffer from

insufficient bone volume in the maxilla due to factors such as tooth loss and maxillary sinus pneumatization. The integration of Plasma Rich in Growth Factors (PRGF) into these procedures has shown significant promise in enhancing bone regeneration and improving implant stability. This literature review aims to synthesize findings from various studies and case reports to evaluate the efficacy and outcomes of using PRGF in these dental interventions.

## Background and Mechanism of PRGF

### Understanding PRGF

PRGF is an autologous blood product obtained through a specific centrifugation process that concentrates platelets and growth factors, including Vascular Endothelial Growth Factor (VEGF), Platelet-Derived Growth Factor (PDGF), and Insulin-Like Growth Factor (IGF). These growth factors play pivotal roles in wound healing, angiogenesis, and the formation of the extracellular matrix. PRGF is distinct from other platelet concentrates due to its exclusion of leukocytes, which reduces the pro-inflammatory effects and promotes a more favorable healing environment.

### Mechanisms of Action

The primary mechanism through which PRGF enhances bone regeneration involves the high concentration of growth factors. These factors contribute to several regenerative processes:

1. **Angiogenesis:** VEGF promotes the formation of new blood vessels, ensuring adequate blood supply to the regenerating tissue.
2. **Cell Proliferation and Differentiation:** PDGF stimulates the proliferation and differentiation of osteoprogenitor cells, crucial for new bone formation.
3. **Extracellular Matrix Formation:** IGF facilitates the formation of the

extracellular matrix, providing a scaffold for new bone growth.

These combined effects result in enhanced tissue regeneration, reduced healing time, and improved implant stability.

### PRGF in Sinus Lift Procedures

#### Challenges in Sinus Lift Procedures

Sinus lift procedures are commonly used to augment bone in the posterior maxilla, where bone volume is often compromised. This compromise is typically due to alveolar ridge resorption following tooth loss and maxillary sinus pneumatization. Traditional grafting materials include autologous bone, xenografts, allografts, and alloplasts. Each of these materials has its benefits and drawbacks, with autologous bone being considered the gold standard due to its osteogenic, osteoinductive, and osteoconductive properties. However, the use of autologous bone is limited by donor site morbidity and availability.

#### Efficacy of PRGF in Sinus Lift Procedures

Studies have shown that incorporating PRGF into sinus lift procedures can significantly enhance the regenerative capacity of the graft materials used. Dragonas et al. (2020) conducted a retrospective study assessing the one-year survival rate of implants placed after lateral window sinus augmentation using PRGF combined with various bone grafts. The study reported an implant survival rate of 95.8%, highlighting the efficacy of PRGF in promoting implant stability and bone regeneration.

Rațiu et al. (2018) presented a case report where sinus lift augmentation was performed exclusively with PRGF and fibrin clot, followed by significant osseous regeneration over eight months. Histological examination confirmed new bone formation, demonstrating the potent regenerative

properties of PRGF. The patient exhibited complete bone regeneration, underscoring PRGF's effectiveness even in complex clinical scenarios.

### **Comparative Studies and Outcomes**

#### **Comparative Studies with Autogenous Bone**

While autogenous bone remains the preferred grafting material due to its comprehensive regenerative properties, comparative studies have demonstrated that PRGF can achieve similar outcomes with reduced morbidity. In a split-mouth study by Anitua et al. (2009), treatment outcomes of sinus elevation using bovine anorganic bone and PRGF were evaluated in 48 patients. The study found higher new bone formation and a 100% implant survival rate in PRGF-treated sites, demonstrating its effectiveness in enhancing bone regeneration.

#### **Histomorphometric Outcomes**

Torres et al. (2009) conducted a study on sinus floor augmentation using anorganic bovine bone (ABB) and PRGF. Histomorphometric analysis revealed a higher percentage of newly formed bone in PRGF-treated sites compared to control sites, indicating improved bone regeneration. This study supports the hypothesis that PRGF enhances the osteoconductive properties of bone graft materials.

### **Clinical Case Studies**

#### **Case Report by Rațiu et al. (2018)**

Rațiu et al. (2018) detailed a case involving a patient with significant bone atrophy in the posterior maxilla. The patient underwent sinus lift augmentation using PRGF and fibrin clot. Over eight months, the patient exhibited marked osseous regeneration. Histological examination confirmed the formation of new bone, demonstrating PRGF's potent regenerative capabilities. The case highlights the potential

of PRGF to enhance bone formation and implant stability in challenging clinical scenarios.

#### **Dragonas et al. (2020)**

Dragonas et al. (2020) reported that among various factors assessed, the use of xenograft alone or in combination with other grafts was associated with an increased risk of implant failure. This finding suggests that PRGF's benefits might be influenced by the type of graft material used. Nonetheless, the overall implant survival rate was high, indicating the effectiveness of PRGF in enhancing implant outcomes.

### **Additional Findings and Studies**

#### **Study by Cricchio and Lundgren (2003)**

Cricchio and Lundgren (2003) investigated sinus bone formation and implant survival after sinus membrane elevation and implant placement. Their findings indicated that PRGF significantly enhanced bone formation and reduced postoperative swelling and pain, contributing to improved patient outcomes. This study further supports the integration of PRGF in sinus lift procedures to enhance clinical outcomes.

#### **Case Study by Rațiu et al. (2018)**

In another detailed case report by Rațiu et al. (2018), a patient experienced significant bone regeneration following a sinus lift procedure using PRGF and fibrin clot. The patient's panoramic radiography and cone-beam computed tomography (CBCT) scans confirmed bone regeneration and implant osseointegration, demonstrating PRGF's efficacy in promoting bone healing in compromised sites.

### **Discussion**

The integration of PRGF in bone augmentation and sinus lift procedures

offers several benefits:

1. **Enhanced Bone Regeneration:** PRGF enhances the osteogenic potential of graft materials, leading to increased new bone formation and improved implant stability.
2. **Reduced Postoperative Complications:** The use of PRGF reduces inflammation and promotes a more favorable healing environment, leading to fewer postoperative complications.
3. **Improved Patient Outcomes:** Clinical studies and case reports indicate that PRGF improves patient outcomes by enhancing bone regeneration and reducing healing times.

Despite the positive outcomes reported in various studies, more randomized controlled trials are needed to establish standardized protocols and further validate these findings. The variability in study designs, graft materials used, and patient populations necessitates a more comprehensive understanding of PRGF's role in different clinical scenarios.

Despite these positive findings, the variability in study designs, graft materials, and patient populations calls for more randomized controlled trials to establish standardized protocols and validate PRGF's efficacy across different clinical scenarios. Nonetheless, the current evidence underscores PRGF's significant potential in enhancing bone regeneration and improving clinical outcomes in sinus lift and bone augmentation procedures.

This review concludes that PRGF is a promising adjunct in implant dentistry, offering benefits such as enhanced bone regeneration, reduced postoperative

complications, and improved patient outcomes. Future research should focus on long-term clinical outcomes, comparative studies, and standardized application protocols to optimize the use of PRGF in various clinical settings.

### **Conclusion**

PRGF has demonstrated significant potential in enhancing the outcomes of sinus lift and bone augmentation procedures. Its ability to promote rapid and effective bone regeneration makes it a promising adjunct in implant dentistry. Future research should focus on long-term clinical outcomes, comparative studies, and standardized protocols to optimize the use of PRGF in various clinical settings.

In conclusion, the utilization of growth factors in pre-implant therapy for managing maxillary bone loss represents a significant leap forward in dental implantology. By harnessing the body's natural healing mechanisms, growth factors offer a more effective and biologically harmonious method for promoting bone regeneration. This approach not only enhances the structural integrity and aesthetic outcomes of dental implants but also reduces recovery time and the risk of complications associated with traditional bone grafting techniques. As clinical research continues to advance, the integration of growth factors into routine pre-implant therapy holds the promise of transforming the standard of care for patients experiencing maxillary bone loss, ultimately leading to more predictable and successful implant outcomes.

This review highlights the potential and efficacy of PRGF in enhancing bone regeneration in dental procedures, making it a valuable consideration for practitioners in the field.

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