International Journal of Science Academic Research
Vol. 07, Issue 01, pp.179-182, January 2026
Available online at http://www.scienceijsar.com
ISSN: 2582-6425

Research Article

APPLICATION OF CONCENTRATED GROWTH FACTORS IN IMPLANT DENTISTRY: A REVIEW

***Zhixiang Zhang**

School of Stomatology, Jinan University, Guangzhou, Guangdong 510632, China

Received 24th November 2025; **Accepted** 16th December 2025; **Published online** 30th January 2026

Abstract

Objective: To examine the comprehensive applications of concentrated growth factor across different domains of oral implantology. **Background:** Concentrated growth factor, a third-generation platelet derivative, is widely used in period ontology, implant dentistry, and regenerative therapies due to its low cost, straightforward preparation, and demonstrable efficacy in promoting tissue healing. **Methods:** A narrative synthesis evaluating the beneficial effects of CGF on dental implant prognosis, patient comfort, and inflammatory responses. **Conclusion**: Concentrated growth factor demonstrates beneficial effects in clinical practice and provides a theoretical basis for material selection in the field of oral implantology.

Keywords: Oral implantology, Concentrated growth factor (CGF), Maxillary sinus floor elevation, Guided bone regeneration (GBR), Alveolar ridge preservation (ARP).

INTRODUCTION

Periodontal disease is increasingly prevalent among adolescents and remains highly common in middle-aged and older adults.[1-3]。Tooth loss or extraction secondary to periodontitis frequently results in inadequate alveolar ridge height and width, which compromises the bone volume required for dental implant placement [4]。Consequently, guided bone regeneration (GBR) has become the standard approach for augmenting deficient alveolar bone in clinical practice[5], Among available augmentation adjuncts, autologous platelet derivatives have emerged as promising endogenous biomaterials. As autologous products, they do not elicit an immune response and have therefore garnered substantial interest. Concentrated growth factor (CGF), introduced by Sacco in 2006, represents a third-generation platelet derivative. Similar to its predecessors platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) CGF is enriched in growth factors including platelet-derived growth factor BB (PDGF-BB), transforming growth factor-β1 (TGF-β1), insulin-like growth factor-1 (IGF-1), vascular endothelial growth factor (VEGF), and fibroblast growth factor 2 (FGF-2)[6], Notably, CGF is produced using a specialized, additive-free centrifugation protocol, which simplifies its preparation and enhances its clinical applicability. The growth factors contained within CGF thereby provide a biochemical basis for tissue repair and regeneration. This review summarizes current evidence on the applications of CGF in dental implantology, with a focus on its indications, clinical outcomes, proposed mechanisms, and identifying gaps in knowledge that warrant further investigation.

Application of CGF in Maxillary Sinus Floor Elevation

Following the loss of posterior maxillary teeth, factors such as the edentulous pattern, use of removable prostheses, and maxillary sinus pneumatization often lead to insufficient vertical bone height in the posterior maxilla for dental implant placement. Consequently, maxillary sinus floor elevation is considered the preferred intervention to address this deficiency. The procedure can be performed via two approaches: transcrestal (internal) and lateral window (external) sinus floor elevation. Evidence shows that concentrated growth factor (CGF) membranes alone can support adequate bone formation in sinus augmentation [7], When implants are placed simultaneously [8], while CGF alone may be less osteogenic than Bio-Oss grafts, it achieves comparable implant survival rates and overall clinical success. Furthermore, some researchers posit that the Schneiderian membrane has intrinsic osteoinductive potential [9] and can thus facilitate new bone formation without graft materials. Consequently, whether CGF alone is necessary or effective for osteogenesis remains debated., 。Conversely, studies demonstrate that in sinus floor elevation with simultaneous implant placement, combining CGF with Bio-Oss yields superior outcomes to Bio-Oss alone at 6, 12, and 18 months. These benefits include greater bone mineral density, higher peri-implant bone levels, and improved implant stability, with no increase in adverse events [10, 11]. Thus, current evidence suggests that in maxillary sinus augmentation, CGF provides additional benefit when used as an adjunct to bone graft materials.

Application of CGF in Immediate Implant Placement

Immediate implant placement refers to inserting a dental implant into the fresh extraction socket at the time of tooth removal. It is generally indicated for patients with high esthetic demands or specific occupational needs. A key consideration is the “jumping gap” the horizontal distance between the implant and the buccal bone plate. For gaps of ≥2–3 mm, the use of a slowly resorbable bone graft is recommended. Evidence indicates [12] that combining CGF with a bone substitute accelerates osteogenesis, leading to significantly superior outcomes compared to using the bone substitute alone. Histologically, this is reflected as new bone formation with numerous osteoblasts at 4 weeks, substantial osseointegration

Corresponding Author:** ***Zhixiang Zhang
School of Stomatology, Jinan University, Guangzhou, Guangdong 510632, China

by 8 weeks, and more extensive bone-to-implant contact by 12 weeks. Although the mechanisms by which CGF exerts its effects in immediate implantation under inflammatory conditions are not fully understood, evidence [13] suggests it can reduce postoperative complications, including pain and infection. These benefits are potentially attributable to the immunomodulatory effects of the multiple growth factors in CGF acting synergistically. Nevertheless, given that these protective effects are not yet reliably quantified, perioperative antimicrobial prophylaxis remains essential. Consequently, further high-quality research is needed to clarify CGF's role in infection prevention.

Role of CGF in Implant Stability

Implant stability, fundamental to osseointegration, is objectively measured by the implant stability quotient (ISQ). One study found that when implants were placed simultaneously with Bio-Oss, Bio-Collagen, or CGF combined with Bio-Oss, initial ISQ values were comparable among groups. However, at 6- and 12-month follow-ups, the CGF + Bio-Oss group achieved significantly higher ISQ values than either Bio-Oss or Bio-Collagen alone[14], suggesting that CGF enhances the stability provided by Bio-Oss. A limitation of this study is that its extended follow-up intervals did not allow identification of when the CGF effect began, which limits the findings' applicability to decisions regarding early loading protocols. In contrast, a prospective study [15] comparing CGF to an untreated (no-graft) control found no significant differences in ISQ at implantation or at 1, 2, and 4 weeks. The discrepant results between this and the aforementioned study could be due to factors such as limited sample sizes. More importantly, both studies lack supporting histopathological evidence. Furthermore, the evidence for combining CGF with bone substitutes like Bio-Oss comes mainly from clinical observations and is not well substantiated by pathological studies.

Repair of Peri-implant Bone Defects with CGF

Following tooth loss due to inflammation, trauma, or neoplasia, the alveolar ridge often undergoes excessive resorption and atrophy. Consequently, the remaining bone volume is frequently inadequate for implant placement. In a rat calvarial defect model, CGF implantation promoted the proliferation and differentiation of bone marrow-derived cells at the defect site, indicating potential osteoinductive properties[16]. Accordingly, an animal study[17] assessed the efficacy of CGF combined with tricalcium phosphate (TCP) in reconstructing peri-implant bone defects. At 8 weeks, the CGF+TCP group showed lamellar bone formation with continuous trabeculae and established osseointegration at the bone-implant interface. In contrast, the TCP-only group exhibited disorganized trabeculae and a lack of osseointegration. By 16 weeks, these morphological advantages in the CGF group became more pronounced, which was corroborated by significantly higher calcium content at both 8 and 16 weeks. These results suggest that CGF accelerates and enhances peri-implant osteogenesis, which may shorten the required healing period. However, these findings should be interpreted with caution due to the small sample size. More importantly, without a group receiving CGF alone, it is difficult to isolate the specific contribution of CGF or to confirm any synergistic effect with TCP. A cohort study [18] compared the combination of CGF and Bio-Oss Collagen against Bio-Oss Collagen alone. CBCT was used to measure bone mineral density and new bone height, while the Gingival Index (GI) and Sulcus Bleeding Index (SBI) assessed peri-implant soft-tissue health. While there were no preoperative differences, bone density and thickness became significantly greater in the experimental group at 3 and 6 months. Similarly, soft-tissue indices (GI and SBI) showed significant improvement at 6 months. Overall reconstructive outcomes and Oral Health Impact Profile (OHIP-14) scores also favored the CGF group, though the specifics were not elaborated. In summary, CGF combined with Bio-Oss Collagen enhances both peri-implant soft-tissue health and bone defect repair. The proposed mechanism involves growth factors and fibroblasts from CGF that promote angiogenesis and cellular differentiation, leading to tissue regeneration and, ultimately, greater implant stability. Therefore, CGF likely acts synergistically with low-resorption bone grafts like Bio-Oss Collagen [19], an effect that may be facilitated by the graft's scaffold properties[20]. Specifically, while such grafts provide an osteoconductive, porous framework for nutrient diffusion, CGF contributes osteoinductive signals. Together, they potentiate new bone formation. However, current support for this model comes largely from clinical observations; robust histopathological correlation and mechanistic insights are still lacking.

Relationship Between CGF and Peri-implantitis

The widespread adoption of dental implant therapy in China, coupled with rising socioeconomic status and increased patient awareness, has led to a growing incidence of peri-implantitis. This condition is defined as an inflammatory lesion of the peri-implant mucosa associated with plaque, leading to progressive bone loss. Diagnosis typically relies on clinical signs such as bleeding on probing and/or suppuration, and is confirmed by radiographic imaging. Surgical intervention is standard for peri-implantitis with significant bone loss, involving implant surface decontamination, debridement, and guided bone regeneration (GBR). A study[21] in the anterior esthetic zone compared adjunctive use of CGF versus a collagen membrane with GBR, assessing soft-tissue healing, probing depth (PD), bleeding on probing (BOP), and the Pink Esthetic Score (PES). At 2 months, soft-tissue healing was comparable between groups. Both treatments led to significant reductions in PD and BOP. However, while PES improved significantly in both groups, the CGF group achieved superior aesthetic outcomes. This promising result is tempered by the study's limited sample size, which precludes definitive clinical recommendations. Evidence from in vitro research indicates CGF stimulates gingival fibroblast growth and aids repair[22]. While not all clinical data are consistent[23], combining CGF with GBR early in treatment is hypothesized to offer dual benefits: biological (enhanced healing and anti-inflammatory effects) and clinical (symptom reduction and aesthetic improvement). Future high-quality studies are needed to substantiate these effects and guide clinical practice.

Impact of CGF on Alveolar Ridge Preservation

Guided bone regeneration (GBR) is an established technique for reconstructing osseous defects and is routinely used in implantology and periodontology. In a controlled study[24] evaluating simultaneous labial augmentation at implant placement using Bio-Oss alone versus Bio-Oss combined with concentrated growth factor (CGF), the Bio-Oss+CGF group

demonstrated a significantly higher bone volume conversion rate and a significantly smaller reduction in labial thickness, indicating superior regenerative performance compared with Bio-Oss alone. However, at 6 months postoperatively, bone mineral density did not differ significantly between groups, which may be attributable to CGF degradation[25] over time. Notably, CGF was associated with a clear reduction in postoperative pain and discomfort. Because all participants received prophylactic oral antibiotics and peri-implant microbial diversity was not assessed, the study could not determine CGF's potential antimicrobial effects or its role as an antibiotic delivery vehicle[26]. Another study[27] in the anterior aesthetic zone found that CGF promoted excellent primary wound healing and new bone formation, highlighting its role in enhancing early osteogenesis. This is likely due to CGF's high concentration of growth factors, which provides regenerative benefits beyond those of conventional bone substitutes. Moreover, being autologous, CGF minimizes immunologic risks, results in a milder inflammatory response, and has a strong safety profile. Thus, combining CGF with GBR can improve the predictability of subsequent implant therapy.

Impact of CGF on Alveolar Ridge Preservation

A clinical study[28] comparing CGF socket filling to an untreated (no-graft) control found that CGF significantly improved soft tissue healing at 10 days. More importantly, by 3 months, the CGF group showed significantly less alveolar bone resorption in both vertical and horizontal dimensions on the buccal and lingual sides. Histologic evaluation corroborated this, revealing higher trabecular bone density in the CGF group. These findings indicate that CGF is an effective socket preservation material that limits physiologic bone loss and stimulates new bone formation compared to natural healing. In a related application, CGF used in third molar extraction sockets was also shown to reduce ridge dimensional loss, minimize distal bone defects on adjacent second molars, and help maintain their periodontal health[29].A contrasting study[30], however, found minimal advantage for CGF over Bio-Oss in ridge preservation. It reported a significant difference only in 6-month vertical bone height, with no differences in horizontal dimensions at 6 months or in any dimension at 1 year. These largely null findings may be attributable to the study's limited power (small sample size) and a long interval between measurements, which could miss short-term effects. Consistent with this, meta-analyses[31, 32] indicate that CGF reduces vertical bone resorption and promotes new bone formation, thereby better maintaining alveolar ridge morphology and volume.

Impact of CGF on Quality of Life in Patients Undergoing Implant Surgery

Dental implant surgery can lead to complications such as pain, taste disturbance (dysgeusia), and impaired daily function. Although concentrated growth factor (CGF) has regenerative potential, its long-term benefits are not fully established. However, an international prospective study[33] evaluated CGF's effect on early postoperative quality of life (pain, activities, taste) using visual analog scale (VAS) and OHIP-14. It found that patients receiving CGF had significantly lower pain scores during the first four days, indicating a clear reduction in acute postoperative pain. These findings suggest that adjunctive CGF can alleviate postoperative symptoms (including pain and inflammation) and improve patient-reported outcomes. This may be mediated through CGF's acceleration of bone and soft-tissue healing. Another proposed mechanism involves modulation by neurotrophic factors (e.g., NGF, BDNF, SP, glutamate) of the activity of CGF-derived growth factors[34]; however, this hypothesis awaits validation in rigorous preclinical and clinical studies. Regarding taste disturbance a known postoperative sequela the study found no significant difference between the CGF and control groups. This lack of adverse effect might be linked to CGF's promotion of mucosal healing, though larger studies are needed for confirmation. More robustly, multiple controlled trials[35] have consistently shown that CGF reduces short-term postoperative discomfort (such as pain and swelling) after implant surgery, underscoring its role in improving the early recovery experience.

DISCUSSION

Concentrated growth factor (CGF) offers several clinical advantages. It simplifies preparation compared to earlier platelet concentrates (e.g., PRP, PRF) and has demonstrated positive outcomes. However, its effects are concentration-dependent, necessitating standardized protocols to ensure reproducible efficacy. Furthermore, the mechanisms behind its soft and hard tissue regeneration are not fully understood. Preclinical evidence is scarce, underscoring the need for high-quality studies to definitively establish its therapeutic role. CGF often provides greater benefit when combined with slowly resorbable bone substitutes. By adding osteoinductive signals to osteoconductive scaffolds like Bio-Oss, it synergistically enhances bone regeneration. Despite encouraging clinical reports, its mechanisms of action are not fully understood, and long-term effects on bone and implants remain unconfirmed. Therefore, large-scale, rigorous studies are needed to verify efficacy and elucidate the underlying biology.

Funding Statement: This research received no external funding. No funding body had any role in the design, execution, interpretation, or decision to publish this review.

Conflicts of Interest: The authors declare no conflicts of interest related to the content of this review. No financial or personal relationships influenced the design, conduct, or reporting of this study.

Abbreviations

CGF - Concentrated Growth Factor
GBR - Guided bone regeneration
ARP - Alveolar ridge preservation
TCP - Tricalcium phosphate
PD - Probing depth
ISQ - Implant stability quotient
BOP - Bleeding on probing

REFERENCES

1. Chen, X., et al., Periodontal Status of Chinese Adolescents: Findings from the 4th National Oral Health Survey. Chin J Dent Res, 2018. 21(3): p. 195-203.
2. Sun, H., et al., Prevalence and associated factors of periodontal conditions among 55- to 74-year-old adults in

China: results from the 4th National Oral Health Survey. Clin Oral Investig, 2020. 24(12): p. 4403-4412.
3. Sun, H.Y., et al., The Prevalence and Associated Factors of Periodontal Disease among 35 to 44-year-old Chinese Adults in the 4th National Oral Health Survey. Chin J Dent Res, 2018. 21(4): p. 241-247.
4. Hathaway-Schrader, J.D. and C.M. Novince, Maintaining homeostatic control of periodontal bone tissue. Periodontol 2000, 2021. 86(1): p. 157-187.
5. Buser, D., et al., Guided bone regeneration in implant dentistry:Basic principle, progress over 35 years, and recent research activities. Periodontol 2000, 2023. 93(1): p. 9-25.
6. Qiao, J., N. An, and X. Ouyang, Quantification of growth factors in different platelet concentrates. Platelets, 2017. 28(8): p. 774-778.
7. Ghasemirad, M., et al., Histological examination of the effect of concentrated growth factor (CGF) on healing outcomes after maxillary sinus floor augmentation surgery. J Med Life, 2023. 16(2): p. 267-276.
8. Yan, X., et al., Clinical study on the independent application of CGF in maxillary sinus lifting for simultaneous dental implantation. Journal of Anhui Medical College, 2021. 20(6): p. 38-41.
9. Zill, A., et al., Implants inserted with graftless osteotome sinus floor elevation - A 5-year post-loading retrospective study. Eur J Oral Implantol, 2016. 9(3): p. 277-289.
10. Yonghua, D., et al., Application of Bio-Oss Bone Powder Combined with CGF in Simultaneous Implantation of Maxillary Sinus Elevations in Patients with Bone Deficiency in Maxillary Posterior Teeth Area. Medical Innovation of China, 2023. 20(7): p. 50-53.
11. Yanjing, O. and C. Jiang, Effectiveness of concentrated growth factors in sinus floor elevation: a review. Chinese Journal of Oral Implantology, 2025. 29(6): p. 596-601.
12. LIU Hong-zhi, L.C., WANG Tian-xiang, LIU Yi-song, ZHANG Li-xia, ZOU Gao-feng, In vivo Bone Response to CGF Complex With Bone Substitute Material at the Bone/dental implant Interface. Journal of Oral and Maxillofacial Surgery, 2012. 22(4): p. 277-282.
13. Al-Aroomi, O.A., et al., Effectiveness of concentrated growth factors with or without grafting materials in maxillary sinus augmentation: a systematic review. BMC Oral Health, 2024. 24(1): p. 1275.
14. Li, D.X.H.H.M.Y.Z., Observation on stability of different bone implantation materials on maxillary posterior tooth area. Journal of Xinjiang Medical University, 2020. 43(4).
15. Özveri Koyuncu, B., et al., The role of concentrated growth factor on implant stability: A preliminary study. J Stomatol Oral Maxillofac Surg, 2020. 121(4): p. 363-367.
16. Takeda, Y., et al., The Effect of Concentrated Growth Factor on Rat Bone Marrow Cells In Vitro and on Calvarial Bone Healing In Vivo. Int J Oral Maxillofac Implants, 2015. 30(5): p. 1187-96.
17. Xue, M.M., Experimental study of concentrate growth factor promotes repair of peri-implant bone defect in dogs. China Journal of Oral and Maxillofacial Surgery, 2013.
18. Yingying, Z. and W. Guiping, Effect Observation of Concentrated Growth Factor Combined with Bio-Oss Collagen in the Repair of Peri-implant Bone Defects. Modern Practical Medicine, 2021. 33(01): p. 77-79.
19. Sun, S., et al., A novel concentrated growth factor (CGF) and bio-oss based strategy for second molar protection after impacted mandibular third molar extraction: a randomized controlled clinical study. BMC Oral Health, 2023. 23(1): p. 750.
20. Schlegel, A.K. and K. Donath, BIO-OSS--a resorbable bone substitute? J Long Term Eff Med Implants, 1998. 8(3-4): p. 201-9.
21. Huang Jie, X.X., Wen Yongmei, The clinical effect analysis of CGF combined with
22. GBRfor the treatment of anterior peri-implantitis. Chinese Journal of Oral Implantology, 2020. 25(03): p. 108-111.
23. Lee, H.M., et al., Tensile strength, growth factor content and proliferation activities for two platelet concentrates of platelet-rich fibrin and concentrated growth factor. J Dent Sci, 2020. 15(2): p. 141-146.
24. Isler, S.C., et al., Regenerative surgical treatment of peri-implantitis using either a collagen membrane or concentrated growth factor: A 12-month randomized clinical trial. Clinical Implant Dentistry and Related Research, 2018. 20(5): p. 703-712.
25. Xie, Y., et al., Application of sticky bone combined with concentrated growth factor (CGF) for horizontal alveolar ridge augmentation of anterior teeth: a randomized controlled clinical study. BMC Oral Health, 2024. 24(1): p. 431.
26. Isobe, K., et al., Mechanical and degradation properties of advanced platelet-rich fibrin (A-PRF), concentrated growth factors (CGF), and platelet-poor plasma-derived fibrin (PPTF). Int J Implant Dent, 2017. 3(1): p. 17.
27. Bennardo, F., et al., Can platelet-rich fibrin act as a natural carrier for antibiotics delivery? A proof-of-concept study for oral surgical procedures. BMC Oral Health, 2023. 23(1): p. 134.
28. Shahood, B., et al., CGF with Bio-Oss collagen as grafting materials for simultaneous implant placement after osteotome sinus floor elevation: a prospective study. BMC Oral Health, 2024. 24(1): p. 1515.
29. Ma, F., et al., The impact of autologous concentrated growth factors on the alveolar ridge preservation after posterior tooth extraction: A prospective, randomized controlled clinical trial. Clin Implant Dent Relat Res, 2021. 23(4): p. 579-592.
30. Elayah, S.A., et al., Alveolar ridge preservation in post-extraction sockets using concentrated growth factors: a split-mouth, randomized, controlled clinical trial. Front Endocrinol (Lausanne), 2023. 14: p. 1163696.
31. Zhu, Z., et al., Concentrated growth factor and collagen as barrier materials in alveolar ridge preservation for posterior teeth: a prospective cohort study with one-year follow-up. Hua Xi Kou Qiang Yi Xue Za Zhi, 2024. 42(3): p. 346-352.
32. Zhang, Y., et al., Efficacy of autologous platelet concentrate products for alveolar preservation: A meta-analysis. Oral Dis, 2024. 30(6): p. 3658-3670.
33. Benekou, I., et al., Histological Outcomes of Alveolar Ridge Preservation Versus Spontaneous Healing Following Tooth Extraction: A Systematic Review and Meta-Analysis. Dent J (Basel), 2025. 13(12).
34. Taschieri, S., et al., Effect of concentrated growth factors on quality of life of patients undergoing implant therapy: a cohort study. J Biol Regul Homeost Agents, 2021. 35(2 Suppl. 1): p. 147-154.
35. Jasim, H., et al., Daytime changes of salivary biomarkers involved in pain. J Oral Rehabil, 2020. 47(7): p. 843-850.
36. Dai, Y., et al., Efficacy of concentrated growth factors combined with mineralized collagen on quality of life and bone reconstruction of guided bone regeneration. Regen Biomater, 2020. 7(3): p. 313-320.

****