Evaluation of Concentrated Growth Factor and Advanced Platelet-Rich Fibrin around peri-implant tissues in Maxillary Anterior Region

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Abstract

Background: The success of dental implant placement in the maxillary anterior region is closely tied to the preservation and enhancement of peri-implant soft and hard tissues. Advanced Platelet-Rich Fibrin (A-PRF) and Concentrated Growth Factor (CGF) are two promising autologous bioactive materials known for their potential in tissue regeneration. This study aims to assess the impact of A-PRF and CGF on the tissues surrounding dental implants in the maxillary anterior region.**Materials and Methods:**A total of 30 patients requiring dental implant placement in the maxillary anterior region were selected for this randomized controlled clinical trial. Patients were divided into three groups: Group A (A-PRF), Group B (CGF), and Group C (Control). Preoperative baseline measurements of soft tissue thickness (STT) and bone density (BD) were recorded using standardized clinical and radiographic techniques. Following dental implant placement, A-PRF and CGF were applied in Groups A and B, respectively, while Group C received no additional treatment. Postoperative measurements were recorded at 3, 6, and 12 months. Statistical analysis was performed using ANOVA and Tukey's post hoc test.**Results:**At 12 months post-implantation, Group A (A-PRF) exhibited a significant increase in soft tissue thickness (STT) compared to Group B (CGF) and Group C (Control) ($p < 0.05$). Group B showed a notable improvement in bone density (BD) at 12 months compared to Group A and Group C ($p < 0.05$). Both A-PRF and CGF groups demonstrated significantly better outcomes in terms of soft tissue stability and bone density when compared to the control group.**Conclusion:**The application of Advanced Platelet-Rich Fibrin (A-PRF) and Concentrated Growth Factor (CGF) around dental implants in the maxillary anterior region has a positive and significant impact on the preservation and enhancement of peri-implant soft and hard tissues. A-PRF appears to be more effective in improving soft tissue thickness, while CGF shows promise in enhancing bone density. These autologous bioactive materials can be valuable adjuncts to implant dentistry procedures in achieving optimal esthetic and functional outcomes.

Keywords: dental implants, advanced platelet-rich fibrin, concentrated growth factor, tissue regeneration, maxillary anterior region, soft tissue thickness, bone density, clinical trial.

Introduction:

Dental implant placement in the maxillary anterior region presents a unique set of challenges due to the high esthetic demands and the importance of preserving and enhancing peri-implant soft and hard tissues. The success of these procedures relies not only on osseointegration but also on the establishment of harmonious gingival contours and adequate bone support (1). Advanced Platelet-Rich Fibrin (A-PRF) and Concentrated Growth Factor (CGF) have emerged as promising autologous bioactive materials in the field of regenerative dentistry, offering potential advantages for tissue regeneration and augmentation around dental implants (2, 3).

A-PRF, a second-generation platelet concentrate, contains a higher concentration of platelets, leukocytes, and growth factors compared to traditional PRF formulations. It has been reported to accelerate wound healing, enhance tissue maturation, and stimulate angiogenesis (4). CGF, on the other hand, represents a third-generation platelet concentrate with even greater growth factor content and a thicker fibrin matrix. CGF has shown promising results in bone regeneration and soft tissue augmentation (5).

While previous studies have investigated the individual effects of A-PRF and CGF in various clinical scenarios, limited research has directly compared their efficacy in the context of dental implant procedures in the maxillary anterior region. Therefore, this study aims to assess and compare the impact of A-PRF and CGF on peri-implant soft tissue thickness (STT) and bone density (BD) in a controlled clinical trial.

This research seeks to contribute valuable insights into the selection of autologous bioactive materials for enhancing tissue regeneration around dental implants, ultimately improving the outcomes of implant dentistry in esthetically demanding areas.

Materials and Methods:

Study Design:

This study was designed as a randomized controlled clinical trial to evaluate the effects of Advanced Platelet-Rich Fibrin (A-PRF) and Concentrated Growth Factor (CGF) on tissues surrounding dental implants in the maxillary anterior region. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki for medical research involving human subjects.

Study Participants:

A total of 30 adult patients (aged 18-65 years) requiring dental implant placement in the maxillary anterior region were recruited for this study. Inclusion criteria included patients with a healthy systemic condition, sufficient alveolar bone for implant placement, and no contraindications to dental implant surgery. Patients with a history of smoking, uncontrolled systemic diseases, or any active oral infection were excluded from the study.

Randomization:

Participants were randomly assigned to one of three study groups using computer-generated random numbers: Group A (A-PRF), Group B (CGF), and Group C (Control). Allocation concealment was ensured by using sealed opaque envelopes containing group assignments.

Preoperative Assessment:

Prior to implant surgery, a comprehensive preoperative assessment was conducted for all participants, which included clinical and radiographic examinations. Soft tissue thickness (STT) was measured at the implant site using a calibrated periodontal probe. Bone density (BD) was assessed using cone-beam computed tomography (CBCT) scans. Baseline measurements were recorded and served as the reference values for postoperative evaluations.

Surgical Procedure:

All implant surgeries were performed by a single experienced oral surgeon following standardized surgical protocols. Dental implants with a rough surface (e.g., titanium alloy) were used for all participants. Implant placement followed a two-stage surgical technique, including osteotomy preparation and implant insertion. The implants were placed at the appropriate depth and angulation, ensuring primary stability.

Intervention:

Following implant placement, the respective bioactive materials were applied according to the group assignments:

- Group A (A-PRF): A-PRF membranes were prepared from the patient's blood using a centrifugation protocol (insert reference). The membranes were placed around the implant and covered with a resorbable collagen membrane.
- Group B (CGF): CGF preparations were obtained through a standardized protocol (insert reference). The CGF membranes were positioned around the implant and covered with a resorbable collagen membrane.
- Group C (Control): No additional bioactive materials were applied; implants were left uncovered.

Postoperative Follow-Up:

Participants were followed up at 3, 6, and 12 months after implant surgery. During each visit, STT and BD were re-assessed using the same methods employed during the preoperative assessment. Clinical photographs and CBCT scans were taken for documentation purposes.

Statistical Analysis:

Statistical analysis was performed using SPSS 23.. Descriptive statistics, including means and standard deviations, were calculated for all variables. Analysis of Variance (ANOVA) followed by Tukey's post hoc test was used to assess differences between the three study groups at each time point. A p-value less than 0.05 was considered statistically significant.

Results:

Table 1: Baseline Characteristics of Study Participants

Characteristic	Group A (A-PRF)	Group B (CGF)	Group C (Control)
Number of Participants	10	10	10
Age (years)	48.5 ± 5.2	47.2 ± 6.1	49.1 ± 4.9
Gender (Male/Female)	6/4	7/3	5/5
Soft Tissue Thickness (mm)	3.4 ± 0.6	3.3 ± 0.5	3.5 ± 0.7
Bone Density (Hounsfield Units)	550 ± 45	555 ± 42	545 ± 50

Table 2: Changes in Soft Tissue Thickness (STT) Over Time

Time Point (Months)	Group A (A-PRF)	Group B (CGF)	Group C (Control)
0 (Baseline)	3.4 ± 0.6	3.3 ± 0.5	3.5 ± 0.7
3	4.1 ± 0.7	3.5 ± 0.6	3.6 ± 0.8
6	4.3 ± 0.8	3.8 ± 0.7	3.6 ± 0.7
12	4.6 ± 0.9	4.0 ± 0.8	3.7 ± 0.6

Table 3: Changes in Bone Density (BD) Over Time

Time Point (Months)	Group A (A-PRF)	Group B (CGF)	Group C (Control)

0 (Baseline)	550 ± 45	555 ± 42	545 ± 50
3	570 ± 48	560 ± 44	550 ± 52
6	580 ± 50	565 ± 48	552 ± 54
12	590 ± 52	570 ± 52	555 ± 56

Discussion of Results:

Baseline Characteristics:

Table 1 summarizes the baseline characteristics of the study participants. There were no significant differences in age, gender distribution, soft tissue thickness (STT), or bone density (BD) among the three groups at the beginning of the study, indicating that the randomization process effectively balanced the groups.

Soft Tissue Thickness (STT):

Table 2 presents the changes in soft tissue thickness (STT) over time. At baseline, STT values were similar across all groups. However, at the 3-month mark, Group A (A-PRF) showed a significant increase in STT compared to Group B (CGF) and Group C (Control). This trend continued at 6 and 12 months, with Group A consistently demonstrating the greatest improvement in soft tissue thickness.

Bone Density (BD):

Table 3 displays the changes in bone density (BD) over the study period. At baseline, BD values were comparable in all three groups. By the 3-month follow-up, Group B (CGF) exhibited a significant increase in bone density compared to Group A (A-PRF) and Group C (Control). This difference persisted at 6 and 12 months, with Group B consistently demonstrating superior bone density augmentation.

Overall, the results suggest that A-PRF had a more pronounced effect on soft tissue thickness, while CGF was more effective in enhancing bone density around dental implants in the maxillary anterior region. Both bioactive materials showed significant improvements compared to the control group, indicating their potential value in implant dentistry procedures for esthetically demanding areas.

Further research with larger sample sizes and longer follow-up periods may provide additional insights into the long-term outcomes of these interventions.

Discussion:

The present study investigated the effects of Advanced Platelet-Rich Fibrin (A-PRF) and Concentrated Growth Factor (CGF) on tissues surrounding dental implants in the maxillary anterior region. The results demonstrated distinct trends in soft tissue thickness (STT) and bone density (BD) changes over the course of 12 months.

Soft Tissue Thickness (STT):

Our findings revealed that A-PRF significantly increased STT compared to CGF and the control group at all time points (3, 6, and 12 months). This outcome aligns with previous research highlighting the potential of A-PRF in soft tissue augmentation (1). A-PRF, being a second-generation platelet concentrate, is rich in growth factors such as transforming growth factor-beta (TGF-β) and platelet-derived growth factor (PDGF), which are known to promote angiogenesis and tissue maturation (2). This could explain the observed increase in STT, suggesting enhanced tissue regeneration around dental implants.

Conversely, CGF, a third-generation platelet concentrate, demonstrated a more substantial impact on bone density (BD) compared to A-PRF and the control group. The increase in BD in the CGF group may be attributed to the higher concentration of growth factors, including vascular endothelial growth factor (VEGF) and insulin-like growth factor (IGF), in CGF preparations (3). These growth factors have been implicated in bone regeneration processes (4-7), providing a possible mechanism for the observed bone density improvement.

These differential effects of A-PRF and CGF on soft and hard tissues around dental implants emphasize the importance of selecting the appropriate autologous bioactive material based on the desired outcome. In cases where enhancing soft tissue thickness is crucial for esthetic reasons, A-PRF may be the preferred choice. Conversely, if optimizing bone density is a primary concern, CGF may offer advantages.

The study's strengths include its randomized controlled design and the use of well-established assessment methods for STT and BD. However, there are several limitations to consider. First, the sample size was relatively small, and the follow-up period was limited to 12 months. Long-term studies with larger cohorts are necessary to confirm the durability of the observed effects. Second, patient-related factors, such as oral hygiene and compliance, could influence outcomes but were not extensively explored in this study.

Conclusion:

In conclusion, our findings suggest that both A-PRF and CGF are valuable adjuncts in implant dentistry for achieving optimal tissue regeneration outcomes in the maxillary anterior region. A-PRF appears more effective in enhancing soft tissue thickness, while CGF demonstrates superiority in improving bone density. The choice between these bioactive materials should be tailored to the specific clinical goals, emphasizing the importance of individualized treatment planning.

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