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# Amelioration by concentrated growth factor on soft and hard tissue around dental implant

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**Conflicts of Interest:** Nil

**Abstract**

Background: Clinical and radiographic effects of concentrated growth factor (CGF) on the tissues around dental implants. Cone-beam computed tomography was used in this investigation to assess the bone volume and density surrounding dental implants with focused growth factors (CBCT).

Materials and methods: three patients with partially edentulous teeth in the posterior region were included in this study, and the diameter and length of the implant were chosen after pre-operative CBCT examination. To assess the effect of CGF on crestal bone levels, bone quality, and quantity around dental implants, CGF is put in the osteotomy site following implant insertion with a cover screw. CBCT scans are performed both immediately and nine months following implant implantation. At three months and nine months after implant insertion, soft tissues are evaluated using the metrics modified plaque index (mPI) and modified sulcus bleeding index (mSBI).

**Results:** After nine months of a baseline measurement, there was an increase in bone volume and density. Crestal bone levels remained stable from the beginning to nine months following implant insertion. Soft tissue metrics including the modified plaque index (mPI) and modified sulcus bleeding index (mSBI) show little variation but are improved when compared to the non CGF group.

**Conclusion:** The regeneration of both soft and hard tissues around dental implants is aided by CGF. A significant impact on maintaining bone volume, density, and crestal bone levels. Soft tissues around the implant

have remained healthy. Additionally, CGF has osteogenic potential, which can improve bone fusion around dental implants.

**Keywords:** Concentrated growth factor (CGF), Cone-beam computed tomography (CBCT), modified plaque index (mPI) and modified sulcus bleeding index (mSBI), Bone density (gv), Bone volume(cc), Crestal bone levels(mm).

**Introduction**

The position of the Implant Abutment Junction (IAJ) in respect to the bone crest and the degree of soft tissue covering determine the peri implant crestal bone level and peri implant bone remodeling[1]. Numerous researches have been conducted to demonstrate ways to stop crestal bone loss. Less than 2 mm of bone loss apical to the IAJ must be anticipated from the implant within the first year. After the first year, a 0.2 mm yearly bone loss is anticipated[2]. Since crestal bone loss is a cumulative effect of numerous causes, recording the bone level at the time of implantation could help identify the function of various factors at various stages[3]. Although several studies have been conducted to analyses the loading effect on implants, none have used CBCT to evaluate the quality and quantity of bone in addition to the levels of crestal bone. Furthermore, no one has examined the impact of CGF on these parameters. Such details could make it easier for a clinician to decide where to place an implant with healthy bone all around.

In the literature, a number of methods have been suggested for preventing the loss of crestal bone, including modifications to the prosthesis texture, surface, and position in relation to the crestal level[4]. There are many biological methods, such as platelet concentrates, to preserve the bone around dental implants. They include Concentrated Growth Factor, which has superior growth factors, a slower rate of release, and improved sustainability[5].

CGF, also known as Sacco's PRF derivatives or Sacco's PRF, was initially mentioned by Sacco in 2005. Fixed centrifugation forces are not as effective at promoting the conversion of fibrinogen into fibrin as controlled alternation between acceleration and deceleration[6]. The high tensile strength of the fibrin network protects growth factors from proteolysis. The alternate centrifugation forces raise the danger of hitting the centrifugation tube, which can cause additional platelet rupturing and growth factor release. Theoretically, the composition and therapeutic potential of CGF appear to be greater[7]. However, there aren't many researches that back this idea. Additional well-designed studies should focus on meaningful comparisons between CGF and other platelet concentrates. In this case series, bone density and volume after implant implantation with CGF after loading of the implant were evaluated and contrasted.

**Materials and methods**

Patients between the ages of 25 and 40 were included in the cases, which were planned and carried out with the ethical clearance (no:D181206003). Patients were selected based on the presence of (i) a partially single edentulous site (ii) in the posterior region, and (iii) good oral and general health. Patients were disqualified if they had a medical history of a systemic disease, drug, or condition that would have an impact on coagulation or healing. 3 months and 9 months following implant implantation, soft tissue parameters such mPI and mSBI were performed. Hard tissues evaluations, including baseline and nine months following implant implantation, were performed on crestal bone levels, bone volume, and bone density.

**Case 1**

A 25-year-old male presented to the OPD with the primary complaint of missing teeth in both quadrants 36 and 46. Pre-operative radiographic evaluation revealed sufficient quality and quantity of bone to place an implant [Figure 1], implant placement was planned, and the patient was informed about the modality. Clinical evaluations revealed a single edentulous mandibular site with minimal inter occlusal space and distance from adjacent teeth [Figure 1 & 2]. The patient's consent was obtained before the implant with CGF and delayed loading technique was inserted. The surgical phase was planned after Phase I therapy, which included scaling, dental hygiene advice, and standard haematological tests. A full-thickness mucoperiosteal flap was raised to expose the crestal bone in preparation for implant placement. Osteotomy preparation began with a first drill, followed by a sequential drill, until the implant's diameter matched the osteotomy site. The osteotomy site of 46 received CGF [Figure 1]. The cover screw was inserted together with the implants (Figures 1 and 2). To approximate the flaps, interrupted sutures were applied crestally (Figures 1 and 2).

**Case 2**

The main complaint of a 37-year-old male patient who visited the outpatient department (OPD) was that both quadrants of his teeth were missing. A single edentulous mandibular site was identified during a clinical examination with the smallest possible inter occlusal space and distance from neighbouring teeth [Figures 6 and 7]. Pre-operative radiographic analysis revealed sufficient quality and quantity of bone to place an implant [Figure 6], and implant placement was planned after the patient was informed about the modality. The patient's consent was obtained before the implant with CGF and delayed loading technique was inserted. The surgical phase was planned after Phase I therapy, which included scaling, dental hygiene advice, and standard hematological tests. To expose the crestal bone for the implant, a full-thickness mucoperiosteal flap was raised. Osteotomy preparation began with an initial drill and continued with successive frills until the diameter of the implant matched the osteotomy site. In the osteotomy site of patient 46 [Figure 6], CGF was inserted. The cover screw and implant implantation were both completed [Figures 6 a & b]. In order to approximate the flaps, crestally inserted CGF and interrupted sutures were used [Figures 6 a & b].

**Case 3**

With the primary complaint of missing teeth in quadrants 36 and 46, a 30-year-old female presented to the outpatient department (OPD). On clinical examination, there was only one edentulous mandibular site with the smallest inter occlusal space and distance from neighbouring teeth. Pre-operative radiography evaluation revealed sufficient quality and quantity of bone to insert implants. The patient's consent was gained prior to implant placement using the delayed loading approach and CGF. Following scaling, advice on oral hygiene, and routine haematological tests as part of Phase I therapy, the surgical phase was organized. In order to expose the crestal bone for the implant to be placed, a full thickness mucoperiosteal flap was raised. The first drill in the osteotomy preparation process was followed by a series of frills until the implant's diameter matched the osteotomy spot. In the 36-osteotomy site, CGF was inserted. In addition to the cover screw, the implant was placed. To approximate the flaps, crestally CGF was implanted along with interrupted sutures. The entire study flowchart has been mentioned (Table 1).

Three months following implant implantation surgery, the abutment was positioned. With the use of silicon

putty and light body material, impressions were created. After three months of implant insertion, a ceramic crown was delivered for the ultimate restoration. Three months and nine months after implant placement, soft tissue examinations like mPI and mSBI are performed. Utilizing cone beam computed tomography, radiographic bone measures were taken. The CBCT is produced using the Classic i-CAT® apparatus from Imaging Sciences International®, Hatfield, Pennsylvania, USA, with an amorphous silicon flat panel detector type and the following set of parameters: 120kVp, 5mA, 20 seconds scan, and FOV of 16 cm (width), 13 cm (height). After turning on the "Measurement mode" in the CS 3D Imaging Software, two reference points were marked at the implant's apical end and the first contact point with the bone. The distance between the two reference points was then recorded on both the mesial and distal aspects of the implant. This was done again right away and nine months following the installation of the implants, and each time, the amount of bone loss was calculated [figure 3].

Cone Beam Computed Tomography was used to take volumetric radiography measures surrounding the implant using defined reference locations such as the cemento-enamel junction, the apex of the implant, and the root apex of neighbouring teeth. With the help of the volumetric analysis function in the INVIVO 5.3 Software, the bone volume around the implant was measured. Prior to surgery, immediately following implant implantation, and nine months later, radiographic evaluations were performed [figure 4]. Bone density measured in three areas with different shades of grey: apical (1), middle (2), and cervical (3). The readings were recorded in a location with a 1 mm diameter that was 2 mm away from the implant. (a) Coronal view of the measurements at the mesial and distal ends. The area of the reference value at the lip/cheek area is indicated by the arrow. Figure 5 shows the vestibular and palatal measurements in sagittal perspective (b).

**Results**

Comparison of the research groups' gender distributions two males and one female taken in the study.

From baseline to nine months, it was seen that the volumetric bone levels were higher in the CGF group than the NON CGF group (Table2).

Crestal bone levels were maintained even after 9 months of implant placement in the CGF group; however, crestal bone levels were decreased in the NON CGF group, according to a comparison of baseline to 9-month crestal bone levels on mesial and distal surfaces. (Table 3).

mSBI revealed no difference from 3 to 9 months of implant placement in the CGF group, whereas difference was seen in the NON CGF group when mPI was increased from 3 to 9 months; the difference was not clinically significant in either group (Table 4).

Significant variations between the CGF group and the baseline group were found in the bone density from the baseline to 9 months at various sites and surfaces. Nonetheless, in the NON CGF group, bone density increased surrounding the implant that was implanted (Table5 & 6).

**Discussion**

Different etiological factors, such as periodontal disease, the development of an abscess, trauma, or vertical tooth fracture, might harm a tooth. Progressive resorption of the alveolar bone and a decline in masticatory function are two common effects of tooth loss. Modern clinical dentistry has undergone a significant change as a result of tooth replacement with dental implants. To enable secure attachment of titanium implant screws into living

bone, a technique known as osseointegration, Branemark first developed Osseointegrated dental implants.

The use of implant-based procedures is expanding in contemporary dentistry. In 5–10% of patients, bone loss surrounding dental implants is found. If a dental implant is lost, becomes mobile, or experiences peri-implant bone loss of more than 1.0 millimetres in the first year and more than 0.2 millimetres in the second year, it is deemed to have failed8.

Increased chances of implant failure are frequently a result of bone loss. Localized inflammation or infection and mechanical forces placed on the crestal bone near the implant crest module or collar are two potential causes of crestal bone loss. Patients undergoing dental rehabilitation may employ a variety of dental implants with various surface patterns. A large number of them have a two-stage, submerged implant design with a smooth, 2 mm coronal collar/crest module.

In order to determine the prognosis and long-term survival of dental implants, the measurement of crestal bone loss around implants has been the focus of substantial research.

Early research has indicated that a CBL of 1.5 mm during the first year of function, followed by less than 0.2 mm in the next years, is typical and was thought to be a key factor in effective implant therapy. Recent investigations that came after have demonstrated that, regardless of the implant surface or design, the total interproximal, clinical and radiographic bone loss was estimated to be < 0.5 mm after 3 years in function9.

Blood is centrifuged to produce platelet concentrates (also known as platelet-rich fibrin), a procedure that was first explained by Choukroun and colleagues. High concentrations of growth factors (PDGF, TGF-, IGF, and VEGF) as well as inflammatory molecules (IL-1, IL-4, IL-6, and TNF-) are present in these materials, which may speed up the healing process and improve bone repair and regeneration.

Platelet-rich fibrin (PRF) and platelet-rich plasma (PRP) are known to have lower tensile strength, lower concentrations of growth factors, and lower viscosities than compressed CGFs. As a result, compressed CGF can be used as a barrier membrane with growth factors acting as an alternative to collagen membrane. This barrier membrane promotes rapid tissue development and repair.

It is generally known that CGF quickens the growth of new bone. PRP and other blood derivatives are prepared using intricate processes and chemical additions. CGFs get around these drawbacks. CGF is free from viral transmission diseases since it doesn't need any chemical or allergic additions, such as bovine thrombin or anticoagulants. 100% of CGF is autologous fibrin. Both CGF and a bone transplant can be applied. Fast new bone formation is induced by CGF with fibrin-rich blocks10. According to our research, CGF hastens implant recovery. How CGF impacts the crestal bone volume and density levels around dental implants during the healing phase and after prosthesis is not known. So, in this study, we investigated the effects of CGF on the bone volume, bone density, and crestal bone levels of dental implants. We further proposed that administration of CGF accelerates the full course of recovery. Alveolar grafting with CGF and post-extraction implants have both been linked to similar increases in bone density, which may be explained by the osteopromotive properties of CGF11. The current study's strength was a 9-month CBCT follow-up, and only the mandibular lower posterior edentulous location was included to gauge the bone's quality. In this split mouth trial, the lower posterior portion of one quadrant with no teeth received CGF whereas the other quadrant did not. Only

three patients' responses to CGF were analyzed for this study, which has certain limitations.

**Conclusion**

When it comes to anterior teeth extractions and quick implant insertion, many implantologists place a high priority on aesthetics and ridge preservation. A breakthrough in personalized medicine is CGF, an autologous biomaterial used in facial reconstructive and regenerative medicine. CGF has a consistent release of growth factors and a solid fibrin scaffold. In comparison to non-CGF groups, the study's findings show that CGF considerably improves bone regeneration surrounding implants. Despite the fact that CGF improved bone production, there were few variations between the two groups' crestal bone level alterations on the implants' mesial and distal sides. In order to promote osseous regeneration, CGF proved to be a better and much more straightforward platelet concentrate. Additionally, CGF helped to raise the baseline bone density around the implant to a considerably greater degree. In circumstances where bone mineralization is impaired, this characteristic might be useful. More research is necessary to determine the precise mechanism through which CGF affects bone mineralization. By mixing CGF with other biomaterials, a continuous drug delivery system is created, potentially extending the bioactive half-life of CGF. The primary goal is to enhance CGF's superiority in composition and therapeutic efficacy. However, there isn't enough evidence to support this yet. The majority of the available information on the usage of CGF originates from nonrandomized studies, basic sciences, animal studies, and experimental research, which is why there is currently a severe lack of evidence. Until clinical trials relevant to effectiveness and safety are planned and validated algorithms are available, clinicians should exercise care when considering employing CGF treatment. The aforementioned case studies can clarify socket shielding techniques and facilitate rapid Osseo integration of these implants employing this cutting-edge method. Before this method for quick implant insertion in the anterior region can be widely employed, more controlled trials and radiographic evaluations are required.

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**Legend Figures**

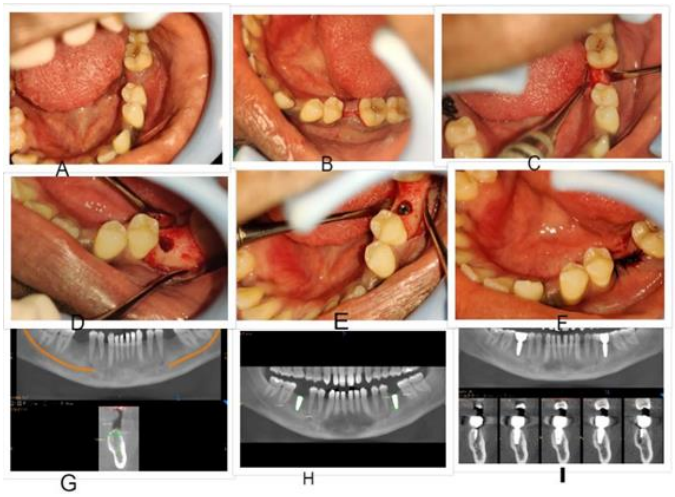


Figure 1: **A:** -Pre-Operative, **B:** -Incision, C**:** -Reflection of Muco Periosteal Flap, **D:** -Osteotomy Site, **E:** -Implant with Cover Screw Placed, **F:** -Sutures Placed, **G:** -Pre-Operative CBCT, **H:** -Immediate Post Operative CBCT After Implant Placement, **I:** -9 Month Post Operative CBCT After Implant Placement.

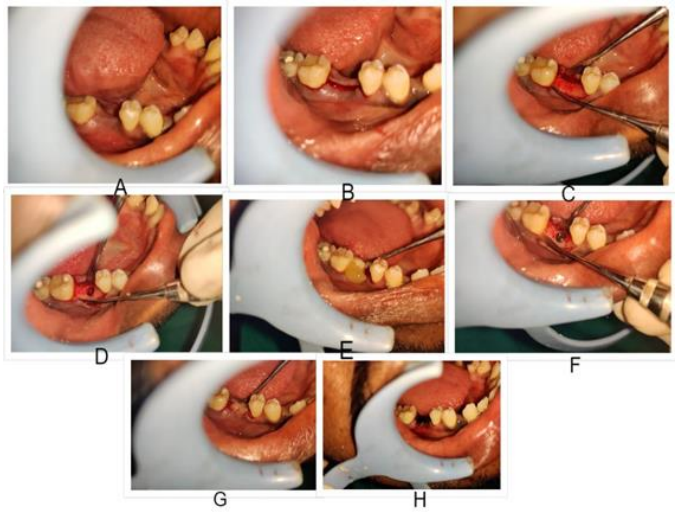


Figure 2: **A:** -Pre-Operative, **B:** -Incision, C**:** -Reflection of Muco Periosteal Flap, **D:** -Osteotomy Site, **E:** -CGF Placed in Osteotomy Site**, F:** - Implant with Cover Screw Placed, **G:** -CGF Is Placed on Crestal Bone After Implant Placement Along with Cover screw **H:** -Sutures Placed.

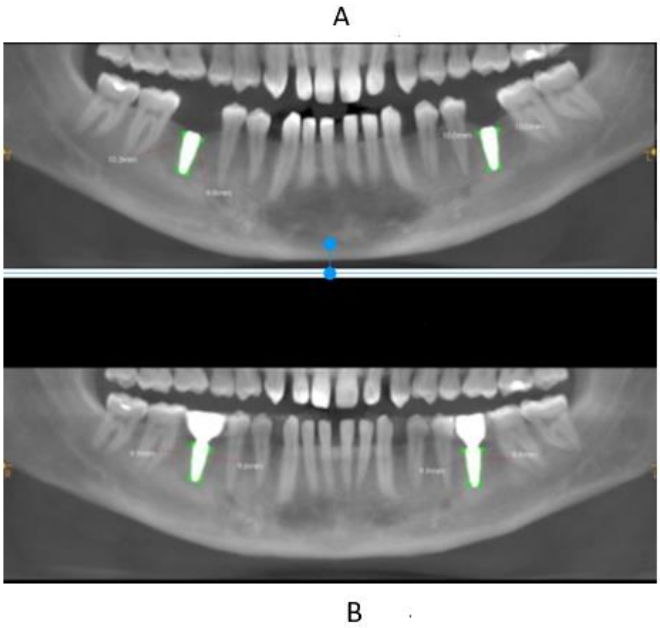


Figure 3: Two reference points were marked at the implant's apical end and the first contact point with the bone. The distance between the two reference points was then recorded on both the mesial and distal aspects of the implant A: - Crestal Bone Levels Measuring Immediate After Implant Placement, B: - Crestal Bone Levels Measuring 9 Months After Implant Placement

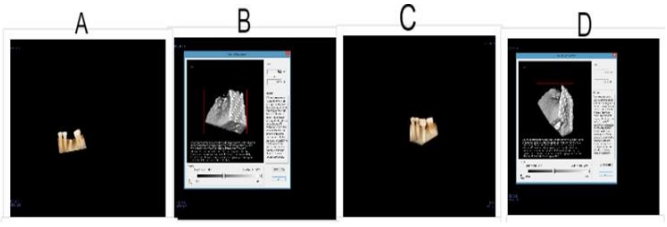


Figure 4: Volumetric radiography measures surrounding the implant using defined reference locations such as the cemento-enamel junction, the apex of the implant, and the root apex of neighbouring teeth. With the help of the volumetric analysis function in the INVIVO 5.3 Software, the bone volume around the implant was measured. A: -Bone Volume Rendering Immediately After Implant Placement, B: - Bone Volume Rendering Immediately After Implant Placement CGF Group C: - Bone Volume Rendering 9 Months After Implant Placement Non CGF Group D: - Bone Volume Measurement 9 Months After Implant Placement CGF group.

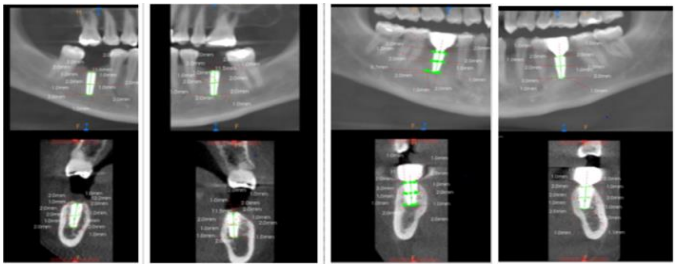

Figure 5: Bone density measured in three areas with different shades of grey: apical (1), middle (2), and cervical (3). The readings were recorded in a location with a 1 mm diameter that was 2 mm away from the implant. (a) Coronal view of the measurements at the mesial and distal ends. The area of the reference value at the lip/cheek area is indicated by the arrow. A: - Bone Density of Immediate Post Operative After Implant Placement B: - Bone Density of Immediate Post Operative After Implant Placement.

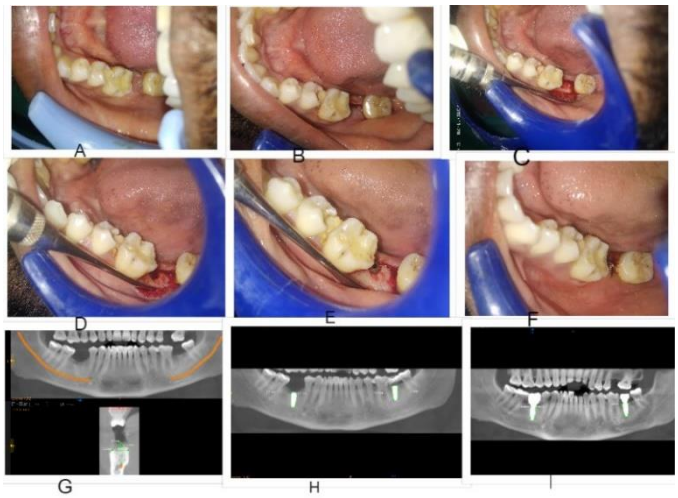


Figure 6: **A:** -Pre-Operative, **B:** -Incision, C**:** -Reflection of Muco Periosteal Flap, **D:** -Osteotomy Site, **E:** -Implant with Cover Screw Placed, **F:** -Sutures Placed, **G:** -Pre-Operative CBCT, **H:** -Immediate Post Operative CBCT After Implant Placement, **I:** -9 Month Post Operative CBCT After Implant Placement.

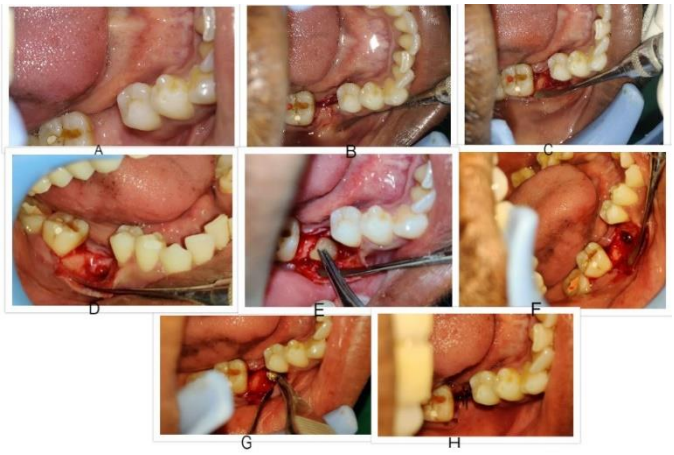

Figure 7: **A:** Pre-Operative, **B:** -Incision, C**:** -Reflection of Muco Periosteal Flap, **D:** -Osteotomy Site, **E:** -CGF Placed in Osteotomy Site**, F:** - Implant with Cover Screw Placed, **G:** -CGF Is Placed on Crestal Bone After Implant Placement Along with Cover screw **H:** -Sutures Placed.

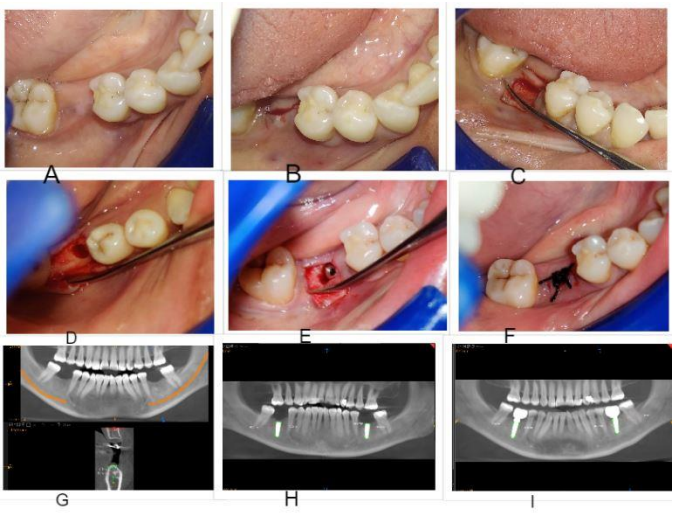

Figure 8 **A:** Pre-Operative, **B:** -Incision, C**:** -Reflection of Muco Periosteal Flap, **D:** -Osteotomy Site, **E:** -Implant with Cover Screw Placed, **F:** -Sutures Placed, **G:** -Pre-Operative CBCT, **H:** -Immediate Post Operative CBCT After Implant Placement, **I:** -9 Month Post Operative CBCT After Implant Placement.

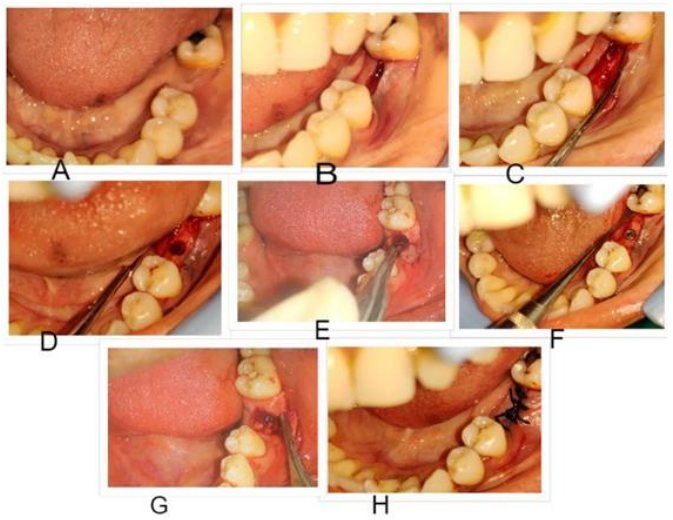

Figure 9: **A:** -Pre-Operative, **B:** -Incision, C**:** -Reflection of Muco Periosteal Flap, **D:** -Osteotomy Site, **E:** -CGF Placed in Osteotomy Site**, F:** - Implant with Cover Screw Placed, **G:** -CGF Is Placed on Crestal Bone After Implant Placement Along with Cover screw **H:** -Sutures Placed.

Table 1: Study design flow chart

| | | |
|---|---|---|
| Visit I | Presurgical Visit | Modified plaque index<br>Modified sulcular bleeding index<br>Scaling and root planning<br>Oral hygiene instructions<br>Pre-operative CBCT |
| Visit II | Baseline (0) | Surgical procedure<br>Oral hygiene instructions<br>Immediate post-operative CBCT |
| Visit III | 1 Week After Implant Placement | Suture removal at surgical site<br>Record any adverse event<br>Oral hygiene instructions |
| Visit IV | 3 Months After Implant Placement | Modified plaque index<br>Modified sulcular bleeding index<br>Scaling and root planning<br>Prosthesis placement<br>Record any adverse event<br>Oral hygiene instructions |
| Visit V | 9 Months After Implant Placement | Modified plaque index<br>Modified sulcular bleeding index<br>Record any adverse event<br>Scaling and root planning<br>Oral hygiene instructions<br>Post-operative CBCT |

Table 2: Comparison of gender distribution between the study groups

| Group | Gender | N (%) |
|---|---|---|
| CGF group | Male | 2 |
| | Female | 1 |
| NON CGF group | Male | 2 |
| | Female | 1 |

Table 3: Volumetric bone level comparison between the study groups at different time points (in cc)

| Group | Time point | mean | Mean ±SD Difference |
|---|---|---|---|
| CGF SITE | Immediate | 1.8671cc | 0.06±0.28cc |
| NON CGF SITE | | 1.8043cc | |
| CGF SITE | 9 months | 1.8709cc | 0.11±0.51cc |
| NON CGF SITE | | 1.7666cc | |

Table 4: Comparison of crestal bone levels between the study groups based on area and time (in mm)

| Time point | Area | Group | mean |
|---|---|---|---|
| Immediate | Mesial | CGF SITE | 9.6mm |
| | | NON CGF SITE | 9.1mm |
| | Distal | CGF SITE | 9.5mm |
| | | NON CGF SITE | 9.0mm |
| 9 months | Mesial | CGF SITE | 9.6mm |
| | | NON CGF SITE | 8.9mm |
| | Distal | CGF SITE | 9.5mm |
| | | NON CGF SITE | 8.9mm |

Table 5: Comparison of modified Plaque Index (mPI) and modified Sulcular Bleeding Index (mSBI) scores between the study groups at different time points

| Parameter | Group | Time points | Mean |
|---|---|---|---|
| modified Plaque Index(mPI) | 3 months | CGF SITE | 0.7 |
| | | NON CGF SITE | 0.8 |
| | 9 months | CGF SITE | 0.8 |
| | | NON CGF SITE | 0.9 |
| modified Sulcular Bleeding Index (mSBI) | 3 months | CGF SITE | 0.6 |
| | | NON CGF SITE | 0.7 |
| | 9 months | CGF SITE | 0.6 |
| | | NON CGF SITE | 0.8 |

Table 6: Comparison of bone density between the study groups based on the area of recording at baseline

| Area | Point | Time point | Mean in grey value (gv) |
|---|---|---|---|
| Mesial | A | CGF SITE | 841.1000gv |
| | | NON CGF SITE | 801.6000gv |
| | B | CGF SITE | 914.1000gv |
| | | NON CGF SITE | 903.0000gv |
| | C | CGF SITE | 1012.1000gv |
| | | NON CGF SITE | 1002.7000gv |
| Distal | A | CGF SITE | 848.4000gv |
| | | NON CGF SITE | 767.2000gv |
| | B | CGF SITE | 972.9000gv |
| | | NON CGF SITE | 891.7000gv |
| | C | CGF SITE | 994.0000gv |
| | | NON CGF SITE | 981.7000gv |
| Buccal | A | CGF SITE | 815.0000gv |
| | | NON CGF SITE | 789.2000gv |
| | B | CGF SITE | 916.0000gv |
| | | NON CGF SITE | 910.1000gv |
| | C | CGF SITE | 999.0000gv |
| | | NON CGF SITE | 1006.9000gv |
| Lingual | A | CGF SITE | 851.7000gv |
| | | NON CGF SITE | 764.1000gv |
| | B | CGF SITE | 1071.7000gv |
| | | NON CGF SITE | 886.5000gv |
| | C | CGF SITE | 993.2000gv |
| | | NON CGF SITE | 960.8000gv |

Table 7: Comparison of bone density between the study groups based on the area of recording at 9 months

| Area | Point | Time point | Mean |
|---|---|---|---|
| Mesial | A | CGF SITE | 855.6000gv |
| | | NON CGF SITE | 779.5000gv |
| | B | CGF SITE | 990.6000gv |
| | | NON CGF SITE | 875.8000gv |
| | C | CGF SITE | 1050.3000gv |
| | | NON CGF SITE | 987.1000gv |
| Distal | A | CGF SITE | 850.5000gv |
| | | NON CGF SITE | 760.9000gv |
| | B | CGF SITE | 980.9000gv |
| | | NON CGF SITE | 885.6000gv |
| | C | CGF SITE | 1000.4000gv |
| | | NON CGF SITE | 955.9000gv |
| Buccal | A | CGF SITE | 850.5000gv |
| | | NON CGF SITE | 731.9000gv |
| | B | CGF SITE | 990.0000gv |
| | | NON CGF SITE | 834.9000gv |
| | C | CGF SITE | 1000.7000gv |
| | | NON CGF SITE | 925.8000gv |
| Lingual | A | CGF SITE | 890.4000gv |
| | | NON CGF SITE | 707.4000gv |
| | B | CGF SITE | 1091.8000gv |
| | | NON CGF SITE | 846.0000gv |
| | C | CGF SITE | 1000.7000gv |
| | | NON CGF SITE | 918.0000gv |