RESEARCH PAPER

"Comparative Evaluation of Concentrated Growth Factor versus Bone Graft in Crestal Sinus Lift with Simultaneous Implant Placement in the Posterior Maxilla: A Prospective Case–Control Study"

Dr.Monika Yadav[1], Dr.Himanshu Bhutani[2], Dr.Sanjeev Kumar[3], Dr.Kaushiik Kashyap[4], Dr.Anshika Mittal[5]

[1]MDS; Department of oral and maxillofacial surgery, ITS DENTAL COLLEGE, GREATER NOIDA, UP, INDIA
[2]MDS; Professor and Head, Department of oral and maxillofacial surgery, ITS DENTAL COLLEGE, GREATER NOIDA, UP, INDIA
[3]MDS; Professor, Department of oral and maxillofacial surgery, ITS DENTAL COLLEGE, GREATER NOIDA, UP, INDIA
[4]MDS; Department of oral and maxillofacial surgery, ITS DENTAL COLLEGE, GREATER NOIDA, UP, INDIA
[5]PG 2nd Year,Department of oral and maxillofacial surgery, ITS DENTAL COLLEGE, GREATER NOIDA, UP, INDIA

Abstract

Background: Implant placement in the posterior maxilla is often limited by reduced residual bone height due to sinus pneumatization and ridge resorption. Crestal sinus lift with simultaneous implant placement is a minimally invasive option, but the ideal grafting material remains debated.

Objective: To compare clinical and radiographic outcomes of concentrated growth factor (CGF) versus conventional bone graft in crestal sinus lift with simultaneous implant placement in the posterior maxilla.

Materials and Methods: In this prospective case–control study, 30 ASA I–II patients requiring implant placement in the posterior maxilla with residual bone height ≤5 mm were randomly allocated to two groups (n=15 each): Group A (bone graft) and Group B (CGF). All patients underwent osseodensification-assisted crestal sinus lift with simultaneous implant placement. Outcomes included implant stability (ISQ), insertion torque, radiographic bone gain and density (IOPA and CBCT), marginal bone loss, postoperative pain (VAS), soft-tissue healing (Landry index), and complications over 6 months.

Results: Primary implant stability was comparable between groups. At 4 months, the bone graft group showed significantly higher ISQ (78.2±2.8 vs 75.1±3.3; p=0.008). Bone gain at 3 months was greater with bone graft (3.4±0.6 mm vs 2.9±0.5 mm; p=0.021), while CGF showed significantly higher early bone density at 1 month (110.5±13.6 vs 95.2±12.8 grayscale units; p=0.004). At 6 months, implant stability, bone gain, bone density, marginal bone loss, implant survival, and prosthetic success were comparable. Postoperative pain and morbidity trends favored CGF, though not significantly.

Conclusion: Both CGF and bone graft are effective for crestal sinus lift with simultaneous implant placement. Bone graft provides better early mechanical stability and bone gain, whereas CGF offers advantages in early bone density and biological healing. CGF can be considered a viable autologous alternative in appropriately selected cases.

Keywords: Crestal sinus lift; Concentrated growth factor; Bone graft; Posterior maxilla; Dental implants; Osseodensification.

How to cite this article: Yadav M, Bhutani H, Kumar S, Kashyap K, Mittal A., Comparative Evaluation of Concentrated Growth Factor versus Bone Graft in Crestal Sinus Lift with Simultaneous Implant Placement in the Posterior Maxilla: A Prospective Case–Control Study. Int J Drug Deliv Technol. 2026;16(78s): 105; DOI: 10.25258/ijddt.16.78s.12

Introduction

Implant-supported rehabilitation has become a cornerstone of modern dentistry, offering predictable restoration of function, aesthetics, and phonetics. Long-term success depends on stable osseointegration and healthy peri-implant hard and soft tissues, which in turn require adequate bone volume and quality at the recipient site. The posterior maxilla remains one of the most challenging regions due to progressive alveolar ridge resorption after tooth extraction and inferior pneumatization of the maxillary sinus, often leaving insufficient vertical bone height for standard implant placement.

To overcome these anatomical limitations, maxillary sinus floor elevation (MSFE) techniques have been widely adopted. Among these, the crestal (transcrestal) approach is less invasive than the lateral window technique and is particularly suitable when only limited vertical augmentation is required and simultaneous implant placement is planned. However, maintaining the space created beneath the elevated Schneiderian membrane remains critical to ensure predictable bone formation and implant stability.

Traditionally, particulate bone grafts (xenografts, allografts, alloplasts, or autografts) are used to stabilize the membrane, maintain volume, and act as an osteoconductive scaffold. Despite their success, graft

*Author for Correspondence: Dr.Monika Yadav

materials have drawbacks, including cost, variable resorption, potential donor-site morbidity (for autografts), and risk of complications such as sinusitis or graft migration, especially in cases of membrane perforation.

Concentrated Growth Factor (CGF), an autologous platelet concentrate obtained through differential centrifugation of venous blood, forms a dense fibrin matrix enriched with growth factors such as PDGF, TGF-β, and VEGF. CGF is proposed to enhance angiogenesis, cell migration, and early wound stability, potentially improving healing and bone quality in sinus augmentation. Unlike particulate grafts, CGF lacks rigid volumetric structure, raising questions about its ability to maintain space under the membrane in cases with severely reduced residual bone height.

Although systematic reviews suggest that autologous platelet concentrates may improve early healing and reduce postoperative discomfort when combined with grafts, high-quality comparative trials of CGF versus conventional bone grafts in crestal sinus lift with simultaneous implants are limited. This study aims to compare the clinical and radiographic outcomes of CGF versus bone graft in crestal sinus lift with simultaneous implant placement in the posterior maxilla.

Materials and Methods

Study Design and Setting

This prospective case–control study was conducted at the Department of Oral and Maxillofacial Surgery, I.T.S. Dental College, Hospital and Research Centre, Greater Noida, India, between 2023 and 2026. The study protocol was approved by the Institutional Ethical Committee (IEC), and all participants provided written informed consent.

Sample Size and Power Calculation

A total of 30 patients were recruited based on a priori sample size calculation targeting a clinically meaningful difference in implant stability (ISQ) and radiographic bone gain between groups, with $\alpha=0.05$ and power=80%.

Inclusion and Exclusion Criteria

Inclusion criteria:

Adults aged 18–65 years

ASA physical status I or II

Partially edentulous posterior maxilla requiring implant placement

Residual alveolar bone height ≤5 mm and adequate bone width for implant placement

Good general and oral health

Exclusion criteria:

Uncontrolled systemic diseases (e.g., uncontrolled diabetes, bleeding disorders)

History of radiation therapy to the head and neck

Active sinus pathology or severe sinusitis

Heavy smoking (>10 cigarettes/day) or substance abuse

Poor oral hygiene or untreated periodontal disease

Pregnancy or lactation

Randomization and Group Allocation

Eligible patients were randomly allocated into two groups using a computer-generated randomization sequence:

Group A (Bone Graft): Crestal sinus lift with particulate bone graft and simultaneous implant placement

Group B (CGF): Crestal sinus lift with CGF and simultaneous implant placement

Each group comprised 15 patients.

Surgical Protocol

All surgeries were performed under local anesthesia by the same surgeon using a standardized protocol.

Preoperative Preparation:

Clinical examination, OPG, and CBCT to assess residual bone height, width, sinus anatomy, and pathology.

Oral prophylaxis and preoperative instructions.

Crestal Sinus Lift (Osseodensification-Assisted):

A crestal incision with or without releasing incisions was made.

Full-thickness mucoperiosteal flap reflection exposed the alveolar crest.

Osteotomy was performed using Densah burs (osseodensification) in a counter-clockwise direction to compact bone laterally and elevate the sinus floor hydraulically.

The Schneiderian membrane was carefully elevated using specialized instruments.

Graft Placement:

Group A: Particulate bone graft material was placed into the created sub-antral space to maintain elevation and support new bone formation.

Group B: CGF was prepared by drawing 9 mL of venous blood from each patient into special tubes without anticoagulant and centrifuging according to the manufacturer's protocol. The middle CGF layer (fibrin-rich) was harvested and placed into the sub-antral space.

Implant Placement:

Implants were placed immediately after graft/CGF placement.

Primary stability was assessed via insertion torque (Ncm) and Implant Stability Quotient (ISQ) using resonance frequency analysis.

Closure:

Flaps were repositioned and sutured with 3-0 or 4-0 non-resorbable/resorbable sutures to achieve primary closure.

Postoperative Care and Follow-up

All patients received standard postoperative instructions, analgesics, and antibiotics. Sutures were removed at 7–10 days. Clinical and radiographic evaluations were performed at 0, 1, 3, 4, and 6 months. Second-stage surgery and prosthetic loading were performed at approximately 4–6 months, depending on clinical and radiographic evidence of osseointegration.

Outcome Measures

Primary outcomes:

Implant stability (ISQ) at insertion, 4 months, and 6 months

Radiographic bone gain (mm) at 1, 3, and 6 months via IOPA

Secondary outcomes:

Insertion torque (Ncm)

Bone density (grayscale units via IOPA/Image J; HU via CBCT subset)

Marginal bone loss at 6 months
Implant survival and prosthetic success at 6 months
Postoperative pain (VAS scores at days 1, 3, 7, and suture removal)
Soft-tissue healing (Landry index at 1 week)
Complications (sinus perforation, sinusitis, wound dehiscence, graft/CGF exposure, persistent pain)
Operator-assessed handling properties of graft material (ease of placement, containment, adhesion, overall satisfaction)

Radiographic Assessment

IOPA: Standardized intra-oral periapical radiographs were taken at 0, 1, 3, 4, and 6 months. Bone gain was measured from the implant apex to the highest point of new bone formation. Bone density was assessed using Image J software (grayscale analysis).
CBCT: Performed in a subset of 5 patients per group at baseline and 6 months to evaluate 3D bone gain, bone density (HU), and dome formation.

Statistical Analysis

Data were analyzed using SPSS. Normality was assessed using Shapiro–Wilk test. Continuous variables were compared using unpaired t-test, and categorical variables using Chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Results

Baseline Characteristics

A total of 30 patients (15 per group) were included. Mean age was 48.7±6.2 years in Group A and 50.1±5.8 years in Group B (p=0.524). Gender distribution, ASA status, residual bone height, and residual bone width were comparable between groups (all p>0.05), confirming baseline homogeneity.

Implant Stability (ISQ)

At insertion: ISQ was 68.4±3.1 (Group A) vs 67.9±3.4 (Group B); p=0.682.
At 4 months: ISQ increased to 78.2±2.8 (Group A) vs 75.1±3.3 (Group B); p=0.008 (significant).
At 6 months: ISQ was 82.6±1.9 (Group A) vs 81.8±2.1 (Group B); p=0.285.
Primary stability was comparable, but bone graft showed significantly higher secondary stability at 4 months.

Insertion Torque and Prosthetic Outcomes

Mean insertion torque was 33.5±2.1 Ncm (Group A) vs 32.8±2.4 Ncm (Group B); p=0.401.
Implant survival at 6 months was 100% (15/15) in Group A and 93.3% (14/15) in Group B (p=0.500). Prosthetic success at 1 month post-loading was 100% in Group A and 93.3% in Group B (p=0.500). Time to prosthesis loading was 126.3±4.5 days (Group A) vs 124.8±5.2 days (Group B); p=0.391.

Radiographic Bone Gain (IOPA)

Baseline: 0.0 mm in both groups.
1 month: 2.1±0.5 mm (Group A) vs 1.8±0.4 mm (Group B); p=0.092.
3 months: 3.4±0.6 mm (Group A) vs 2.9±0.5 mm (Group B); p=0.021 (significant).
6 months: 3.8±0.5 mm (Group A) vs 3.5±0.6 mm (Group B); p=0.143.
Bone graft showed significantly greater bone gain at 3 months, but differences were not significant at 6 months.

Bone Density (Grayscale via IOPA/Image J)

Baseline (adjacent bone): 142.3±15.1 (Group A) vs 138.7±14.3 (Group B); p=0.521.
0 month: 95.2±12.8 (Group A) vs 110.5±13.6 (Group B); p=0.004 (significant).
4 months: 125.7±11.4 (Group A) vs 130.8±12.1 (Group B); p=0.253.
6 months: 140.1±10.2 (Group A) vs 142.9±9.8 (Group B); p=0.445.
CGF demonstrated significantly higher early bone density at 0 month, but values converged by 6 months.

CBCT Analysis (Subset: n=5 per group)

Bone gain at 6 months: 4.1±0.7 mm (Group A) vs 3.7±0.6 mm (Group B); p=0.328.
Bone density at baseline: 762.4±125.3 HU (Group A) vs 745.8±118.7 HU (Group B); p=0.823.
Bone density at 6 months: 1125.6±156.4 HU (Group A) vs 1210.3±143.9 HU (Group B); p=0.394.
Dome formation at 6 months: 100% in both groups.
CBCT confirmed comparable 3D bone gain and density at 6 months.

Postoperative Healing and Complications

Intra-op sinus perforation: 1 case (6.7%) in Group A; none in Group B (p=1.000).
Post-op sinusitis: 1 case (6.7%) in Group A; none in Group B (p=1.000).
Wound dehiscence: 2 cases (13.3%) in Group A; 1 case (6.7%) in Group B (p=1.000).
Persistent pain (>1 week): 3 cases (20.0%) in Group A; 1 case (6.7%) in Group B (p=0.598).
Graft/CGF exposure: 1 case (6.7%) in Group A; none in Group B (p=1.000).
No statistically significant differences were observed, though complication trends favored CGF.

Postoperative Pain (VAS)

Day 1: 6.5±1.3 (Group A) vs 5.8±1.4 (Group B); p=0.167.
Day 3: 4.2±1.1 (Group A) vs 3.5±1.0 (Group B); p=0.083.
Day 7: 1.3±0.8 (Group A) vs 1.0±0.7 (Group B); p=0.291.
At suture removal: 0.5±0.6 (Group A) vs 0.3±0.5 (Group B); p=0.337.
Pain scores were consistently lower in the CGF group but not significantly.

Soft-Tissue Healing (Landry Index at 1 Week)

Very poor/poor: 1 case (6.7%) in Group A; none in Group B.
Fair: 3 cases (20.0%) in Group A; 1 case (6.7%) in Group B.
Good: 7 cases (46.7%) in Group A; 9 cases (60.0%) in Group B.
Excellent: 4 cases (26.7%) in Group A; 5 cases (33.3%) in Group B.
No significant differences were observed (p>0.05).

Operator-Assessed Handling Properties

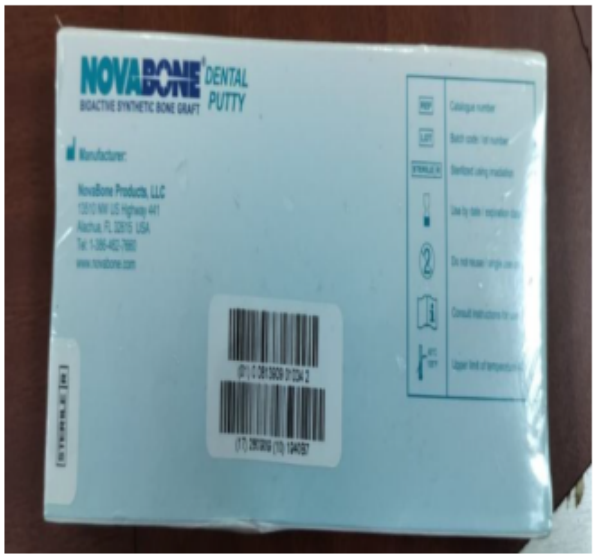
Ease of placement: 4.1±0.7 (Group A) vs 3.5±0.9 (Group B); p=0.048 (significant).

Containment in site: 4.4±0.6 (Group A) vs 3.0±0.8 (Group B); p=0.001 (significant).
Adhesion to implant: 2.2±0.8 (Group A) vs 4.6±0.5 (Group B); p=0.001 (significant).
Overall satisfaction: 3.9±0.7 (Group A) vs 3.7±0.8 (Group B); p=0.482.
Bone graft was easier to place and contain, while CGF showed superior adhesion to the implant surface.

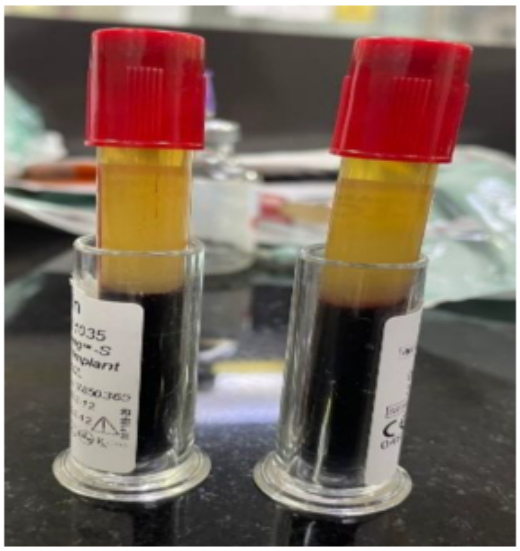
Armamaterium

Minor oral surgical instruments

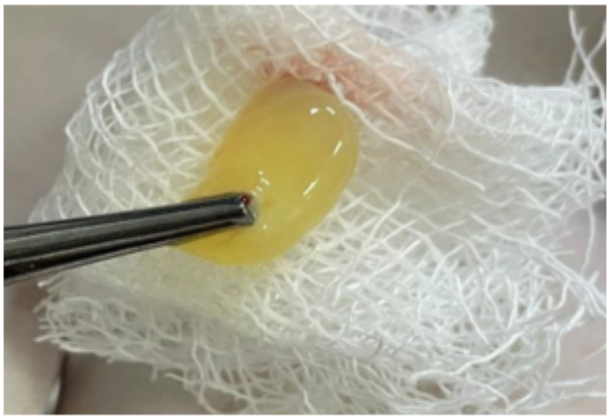
densah bur kit



bone graft



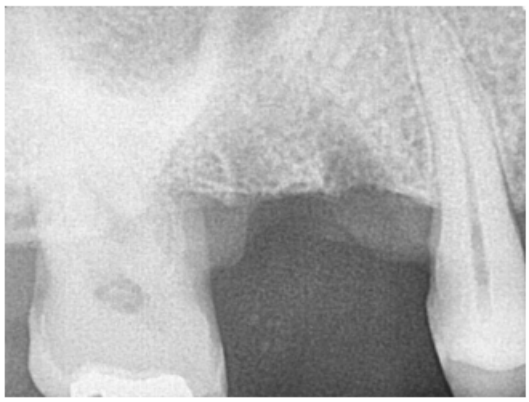
CGF

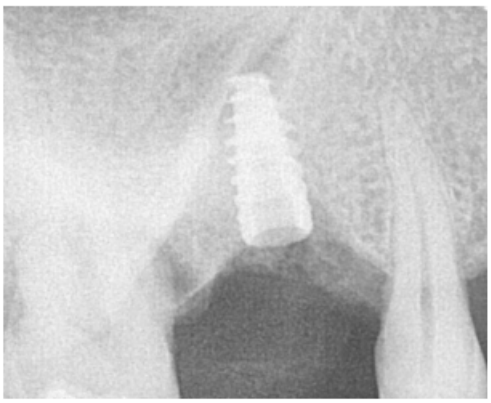


CGF CLOT

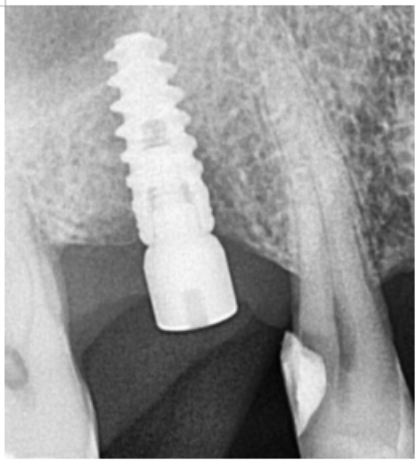
MEMBRANE

Group A- Crestal Sinus Lift And Implant With Bone Graft
Intraoral Periapical Radiograph Of Group A





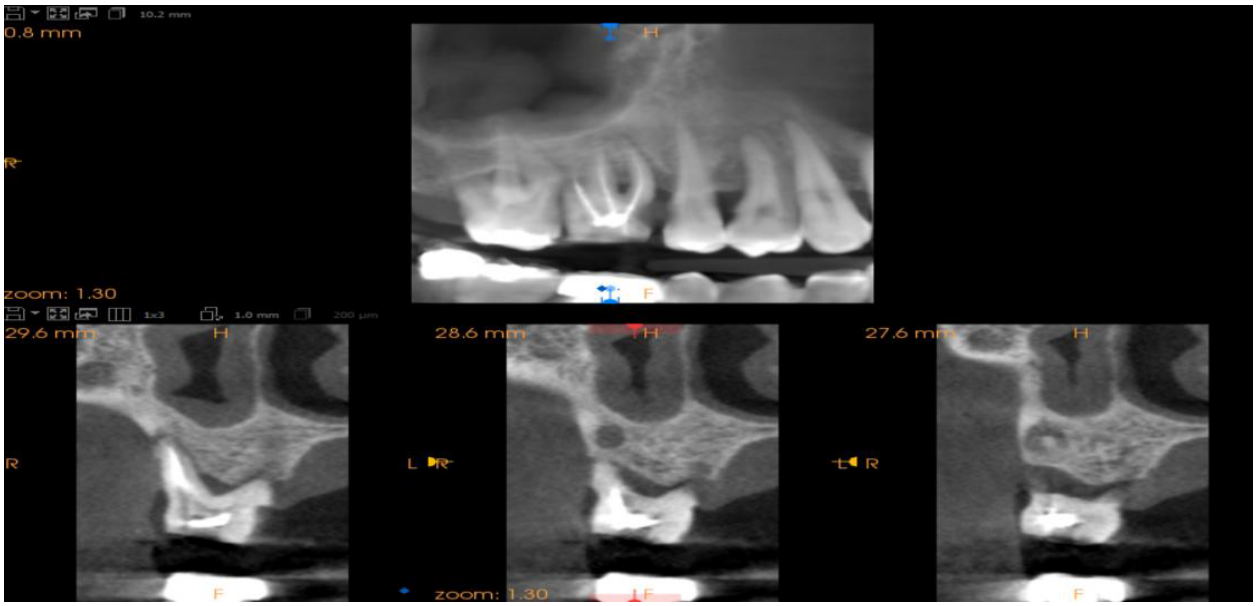
Pre Operative 0 Month



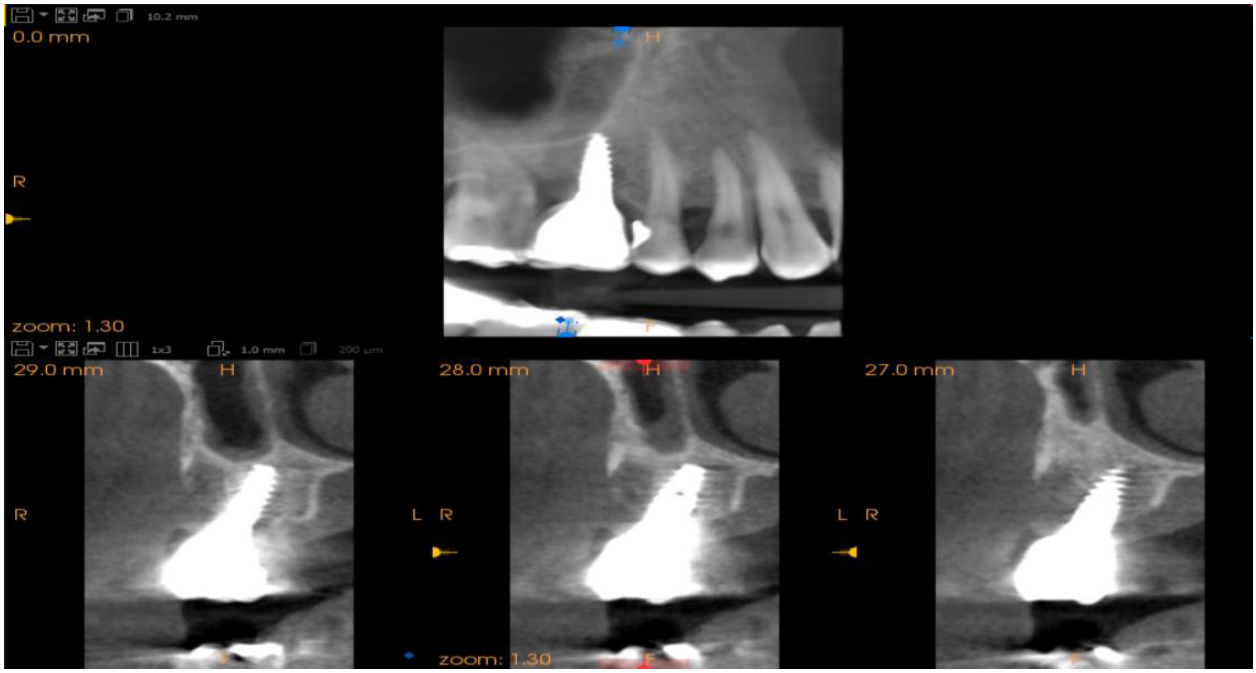
4 MONTH

6 MONTH

CBCT



PRE OPERATIVE



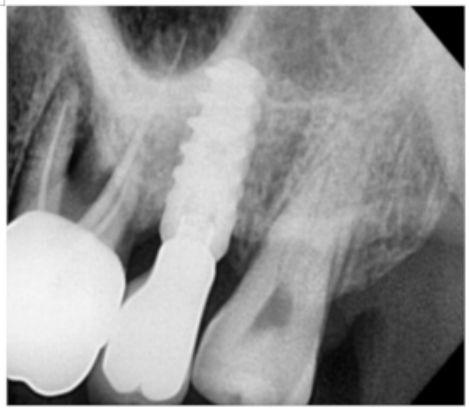
6 MONTHS POST OPERATIVE

Group B - Indirect Sinus Lift With Cgf

Intraoral Periapical Radiograph Group B

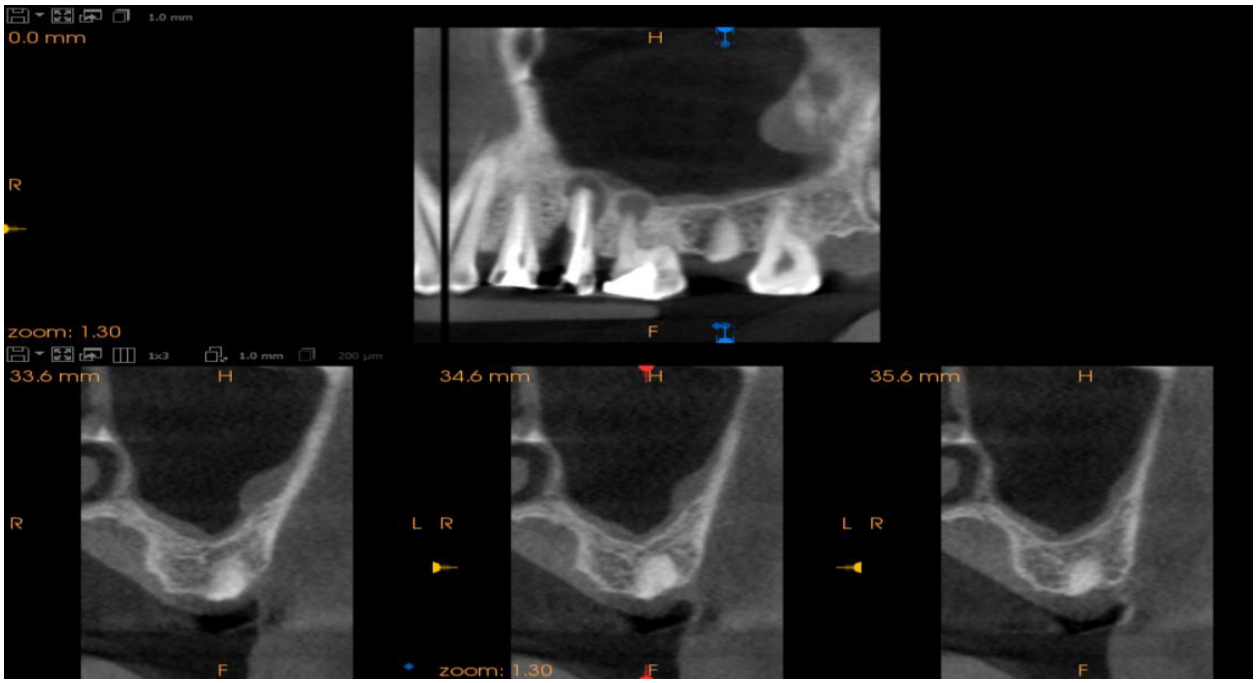
0 MONTH

4 MONTH

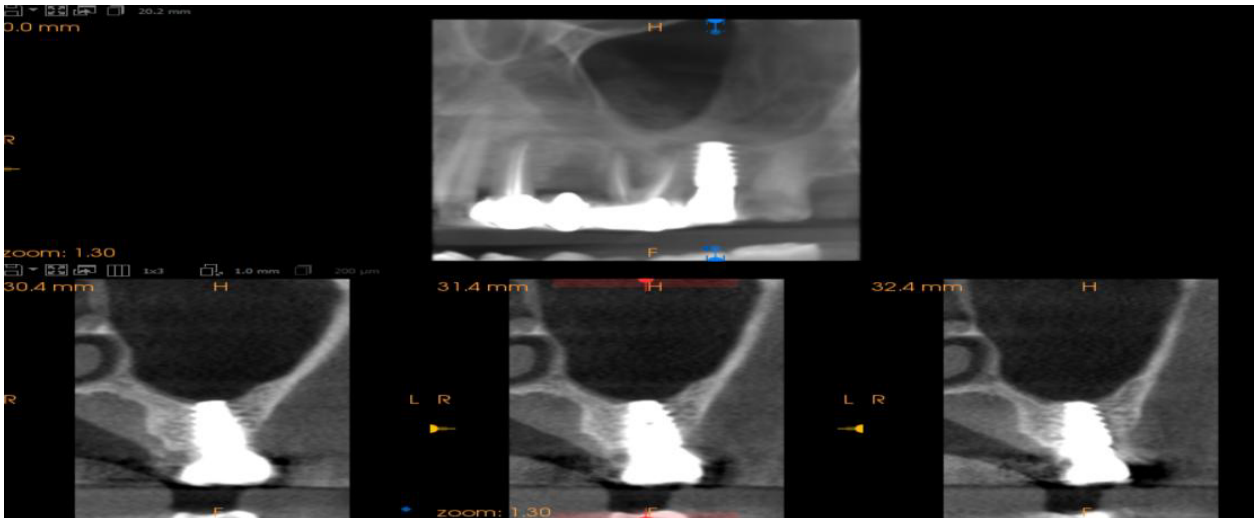


6 MONTH

CBCT



PRE OPERATIVE



POST OPERATIVE

References

1. Zitzmann NU, Schärer P. Sinus elevation procedures in the resorbed posterior maxilla: comparison of the crestal and lateral approaches. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998;85(1):8 17.
2. Al Dajani M. Incidence, risk factors, and complications of Schneiderian membrane perforation in sinus lift surgery: a meta analysis. Implant Dent. 2016;25(3):409 15.
3. Mazor Z, Horowitz RA, Del Corso M, Prasad HS, Rohrer MD, Dohan Ehrenfest DM. Sinus floor augmentation with simultaneous implant placement using Choukroun's platelet rich fibrin as the sole grafting material: a radiologic and histologic study at 6 months. J Periodontol. 2009;80(12):2056 64.
4. Chen L, Cheng J, Cai Y, Zhang J, Yin X, Luan Q. Efficacy of concentrated growth factor (CGF) in the surgical treatment of oral diseases: a systematic review and meta analysis. BMC Oral Health. 2023;23(1):712.
5. Lokwani BV, Gupta D, Agrawal RS, Mehta S, Nirmal NJ. The use of concentrated growth factor in dental implantology: a systematic review. J Indian Prosthodont Soc. 2020;20(1):3 10.
6. Woo I, Le B. Maxillary sinus floor elevation: review of anatomy and two techniques. Implant Dent. 2004;13(1):28 32.
7. Qin J, Wang L, Sun Y, Sun X, Wen C, Shahmoradi M, Zhou Y. Concentrated growth factor increases Schwann cell proliferation and neurotrophic factor secretion and promotes functional nerve recovery in vivo. Int J Mol Med. 2016;37(2):493 500.
8. Emmerich D, Att W, Stappert C. Sinus floor elevation using osteotomes: a systematic review and meta--analysis. J Periodontol. 2005;76(8):1237—51.
9. Stacchi C, Spinato S, Lombardi T, et al. Minimally invasive management of implant--supported rehabilitation in the posterior maxilla, Part II. Int J Periodontics Restorative Dent. 2020;40(3):e95—e102.
10. Stacchi C, Spinato S, Lombardi T, et al. Minimally invasive management of implant--supported rehabilitation in the posterior maxilla, Part I: sinus floor elevation—— biologic principles and materials. Int J Periodontics Restorative Dent. 2020;40(3):e85—e93.
11. Mazor Z, Horowitz RA, Del Corso M, Prasad HS, Rohrer MD, Dohan Ehrenfest DM. Sinus floor augmentation with simultaneous implant placement using Choukroun's platelet-rich fibrin as the sole grafting material: a radiologic and histologic study at 6 months. J Periodontol. 2009;80(12):2056–2064.
12. Johansson LÅ, Isaksson S, Lindh C, Becktor JP, Sennerby L. Maxillary sinus floor augmentation and simultaneous implant placement using locally harvested autogenous bone chips and bone debris: a prospective clinical study. J Oral Maxillofac Surg. 2010;68(4):837–844.
13. Fornell J, Johansson LÅ, Bolin A, Isaksson S, Sennerby L. Flapless, CBCT-guided osteotome sinus floor elevation with simultaneousimplant installation: radiographic examination and surgical technique—1-year follow-up. Clin Oral Implants Res. 2012;23(1):28–34.
14. Nedir R, Nurdin N, Khoury P, Perneger T, Hage ME, Bernard JP, Bischof M. Osteotome sinus floor elevation with and without grafting material in the severely atrophic maxilla: a 1-year prospective randomized controlled study. Clin Oral Implants Res. 2013;24(11):1257–1264.
15. Kumar DS, Jayakumar ND, Padmalatha O, Sankari M, Varghese SS. Effect of maxillary sinus floor augmentation without bone grafts. J Pharm Bioallied Sci. 2013;5(3):176–183.

16. Sohn DS, Huang B, Kim J, Park WE, Park CC. Utilization of autologous concentrated growth factors (CGF)-enriched bone graft matrix (sticky bone) and CGF-enriched fibrin membrane in implant dentistry. J Implant Adv Clin Dent. 2015;7(10):11–18.
17. Ali S, Bakry SA, Abd-Elhakam H. Platelet-rich fibrin in maxillary sinus augmentation: a systematic review. J Oral Implantol. 2015;41(6):746–753.
18. Al-Dajani M. Incidence, risk factors, and complications of Schneiderian membrane perforation in sinus lift surgery: a meta-analysis. Implant Dent. 2016;25(3):409–415.
19. 58. Zhou X, Hu XL, Li JH, Lin Y. Minimally invasive crestal sinus lift technique and simultaneous implant placement. Chin J Dent Res. 2017;20(4):211–218.
20. Tallarico M, Cochran DL, Xhanari E, Dellavia C, Canciani E, Mijiritsky E, et al. Crestal sinus lift using an implant with an internal L-shapedchannel: 1-year after loading results from a prospective cohort study. Eur J Oral Implantol. 2017;10(3):325–336.
21. Romero-Millán J, Aizcorbe-Vicente J, Peñarrocha-Diago M, Galindo-Moreno P, Canullo L, Peñarrocha-Oltra D. Implants in the posterior maxilla: open sinus lift versus conventional implant placement. A systematic review. Int J Oral Maxillofac Implants. 2019;34(4):e231–e244.
22. Ntontoulos V, Inchingolo F, Tsantis S, Salvaridou E, Kotsavasiliadis T, Gazioni D, et al. Innovative ―IPG-DET technique‖ combined with autologous CGF with stem cells CD34+ for the rehabilitation of the posterior atrophic maxilla. Open Dent J. 2020;19(9):119–126.
23. Lokwani BV, Gupta D, Agrawal RS, Mehta S, Nirmal NJ. The use of concentrated growth factor in dental implantology: a systematic review. J Indian Prosthodont Soc. 2020;20(1):3–10.
24. Abou-Ellill R, Ismail R, Elsharkawy A. Posterior maxillary ridge augmentation with sinus lift using mineralized plasmatic matrix versus autogenous bone graft. Egypt Dent J. 2021;67(2):1157–1164.
25. Simis C, Inchingolo F, Georgakopoulos IP, Kosmetatou G, Katechi V. Minimal invasive and innovative ―IPG-DET technique‖ combined with autologous CGF with stem cells CD34+ for the rehabilitation of the posterior atrophic maxilla. Med Clin Dent Sci. 2022;1:023.
26. Elsaid MGAH, Aboelhasan MF, Shuman MA, Alashmawy MMM, Abdelrahman AOA, Elwaseef S. Transcrestal sinus lift with simultaneous implant placement using osseodensification in posterior maxilla with residual bone height of 4–6 mm. Braz Dent Sci. 2022;25(4):e3403.
27. Hashem AH, Khedr MF, Hosny MM, El-Destawy MT, Hashem MI. Effect of different crestal sinus lift techniques for implant placement in the posterior maxilla of deficient height: a randomized clinical trial. Appl Sci. 2023;13(11):6668.
28. Al-Aroomi OA, Ou Y, Sakran KA, Chen H, Lin Y, Gao Y, et al. Effectiveness of concentrated growth factors with or without grafting materials in maxillary sinus augmentation: a systematic review. BMC Oral Health. 2024;24:Article number.
29. Speroni S, Polizzi E, Giuffrè M, Antonelli L, Coccoluto L, Gherlone EF. Crestal sinus lift with the hydrodynamic technique: a prospective clinical study with 3-year follow-up. Appl Sci. 2024;14(14):6204.
30. Mattar H, Nasr TA, Keraa K, El Sholkamy M. Implant outcomes in crestal versus open sinus elevation: a randomized clinical trial. Int J Oral Maxillofac Implants. 2025; Ahead of print.