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Case Report

Connective Tissue Graft May Compensate for Residual Bone Defect of the Implant in the Esthetic Zone: A Case Report with 7-year Follow-up

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Abstract

The present case report aimed to demonstrate the case using a connective tissue graft (CTG) to compensate for a residual defect after guided bone regeneration (GBR) in the anterior maxillary area. An extensive number of studies have reported successful outcomes of horizontal bone augmentation, but it was also demonstrated that a complete resolution of the defect may not be achieved in all cases. In the present case report, the patient underwent implant placement simultaneously with GBR at the anterior maxillary area. After 4 months, partial regeneration of the initial defect was observed. To compensate for such residual defect, a CTG was applied. Other expectations by the CTG were to enhance tissue volume and phenotype. The final prosthesis was delivered after 3 months. Up to 7 years, favorable radiographic and clinical situations were observed. In conclusion, a CTG may compensate for residual bone defect of the implant in the esthetic zone.

Keywords: connective tissue graft, esthetics, guided bone regeneration

Introduction

The presence of a sufficient amount of peri-implant bone is one of the prerequisites for the long-term stability of the implant.[1,2] Several studies have been performed to decide how much peri-implant bone thickness is required.[3-5] In a retrospective clinical study involving 2,667 implants, it was shown that, at the time of abutment connection, the peri-implant bone loss on the facial surface was related to the facial bone thickness after preparation of implant osteotomy.[5] The study demonstrated a trend that smaller initial facial bone thickness led to greater vertical bone loss on the facial aspect. Moreover, more than 1.8 mm of bone thickness was required to prevent facial loss. In a recent preclinical study by Monje *et al.,*[3] the implant groups with more than and less than 1.5 mm of buccal bone thickness were compared, revealing that more than 1.5 mm of buccal bone thickness prevented physiologic bone resorption and reduced pathologic bone loss.[3]

As mentioned above, an ideal goal for peri-implant bone augmentation would be an establishment of 1.5-2.0 mm of bone thickness upon the implant surface. For this purpose, many approaches are used, such as guided bone regeneration (GBR), ridge splitting, and block bone graft, demonstrating successful outcomes.[6-8] However, one can argue whether a complete resolution of the defect is feasible. In one clinical study, the authors tested two GBR techniques with and without the addition of autogenous bone chips.[9] Interestingly, two GBR groups led to a low frequency of total defect resolution (<25%). This may indicate that residual defects can be encountered more frequently than predicted. If it is true of our everyday clinical practice, clinicians should prepare countermeasures. Residual defects may lead to insufficient tissue profile or vulnerability to mucosal recession.

This case report aimed to demonstrate using a connective tissue graft to compensate for a residual defect after GBR in the anterior maxillary area.

Case report

A 31-year-old woman visited the Department of Periodontology, Kyung Hee University Dental Hospital, Seoul, Korea, for implant treatment in the maxillary anterior region. The patient had an endodontic failure at the maxillary right permanent central incisor. After further discussion on a prognosis of the affected tooth in the Department of Conservative Dentistry, an extraction of the problematic tooth was finally decided.

The tooth was atraumatically extracted with forceps, and then a removal temporary prosthesis was delivered. Implant placement was scheduled at 8 weeks post-extraction. Soft tissue was almost healed with slight coronal depression at this time. Cone-beam computed tomography (CBCT) revealed the presence of thin labial bone residue and insufficient bone tissue in the extraction socket. No residual apical lesion was observed (Figure 1).

Under local anesthesia with 2% lidocaine containing 1:100,000 epinephrine (Yuhan Co., Seoul, Korea), a mucoperiosteal flap was elevated. After sequential drilling, a bone-level implant was placed (Straumann BL Ø 4.1 x 10 mm, Straumann, Basel, Switzerland), and a cover screw (0.5-mm height, Straumann) was connected. The implant was positioned relatively buccally considering "the concept of comfort and danger zone," proposed at the Third ITI Consensus Conference in 2003.[10] On the labial surface of the implant, a long dehiscence-type defect was found, and contour bone augmentation was performed. Deproteinized bovine bone mineral (Bio-Oss, Geilstlich, Wolhusen, Switzerland) was grafted on the exposed implant surface and the adjacent areas, exceeding the neighboring bony envelope. Then, a collagen membrane (Bio-Gdie, Geistlich) was trimmed with scissors and applied to fully cover the grafted bone particles. The coronal end of the membrane was tucked under the palatal flap. No fixation pin was used. Subsequently, another piece of a collagen membrane was horizontally applied to the implant site. Periosteal releasing incision was performed for tension-free flap closure. Primary flap closure was made using 5-0 and 6-0 nylon suture materials (AILEE Co., Seoul, Korea) (Figure 2).

Antibiotics (Amoxicillin 500 mg, Yuhan, Seoul, Korea) and an analgesic (Loxoprofen 60 mg, Dongwha Pharm, Seoul, Korea) were administered per os 3 times a day for 7 days. The patient was advised to rinse the mouth with 0.12% chlorhexidine solution (Hexamedine, Bukwang, Seoul, Korea) twice a day for 2 weeks. No specific adverse event was observed during the healing.

At 4 months post-implant placement, uncover surgery was planned. The soft tissue appeared sufficiently mature, but some depression was observed at the labiocrestal area. A small flap was reflected to connect a healing abutment, and it was found that unintegrated bone substitute particles and residual bone defect were present at

the labial surface of the implant. The remaining height of the defect was roughly 2 mm. Considering the patient's gingival phenotype, the residual defect should be compensated. Among several options, soft tissue augmentation using a connective tissue graft (CTG) was applied. The CTG was harvested from the right side of the hard palate using a single incision approach. The size of the CTG was approximately 6 mm long, 4 mm high, and 1-1.5 mm thick. After connecting a healing abutment (RC Ø5x4 mm, Straumann), the CTG was applied to the residual defect. The coronal end of the CTG was slightly extended on the labial side of the abutment. Due to the small reflection of the flap, the CTG was stably positioned without additional fixation. The flap was then sutured around the healing abutment to protect the CTG from the oral environment (Figure 3).

The healing was pleasant. After 3 months, a final prosthesis (customized titanium abutment and porcelain-fused-zirconia implant crown) was delivered. The patient was recalled twice a year. Up to 7 years of follow-up, stable soft tissue level was observed (Figure 4). Marginal bone level change during the follow-up period was minimal (Figure 5). Other peri-implant indices did not show inflammatory signs (probing pocket depth < 4 mm, bleeding on probing ≤ 1 spot out of 6).

Discussion

In the present study, we demonstrated that CTG may compensate for residual bone defects following GBR in the esthetic zone. The patient underwent standardized bone augmentation surgery, but the defect was not completely resolved. CTG was applied to the residual defect for long-term tissue stability, leading to favorable tissue conditions for up to 7 years.

Among peri-implant defects, the dehiscence-type defect is probably the most-encountered one and horizontal (or lateral) bone augmentation is performed not only for establishing bone structure around implants but also for obtaining sufficient thickness of peri-implant hard tissue. Extensive literature has demonstrated successful outcomes of bone-regenerative treatment for dehiscence-type defects.[8,11] However, one should contemplate specifically whether the defect can be resolved completely, considering the study results showing incomplete bone supply at the defect and shrinkage of the initially augmented dimension.[9,12,13] A recent systematic review based on 28 publications presented that defect resolution was 81.2% on average (4.2 mm defect fill from initial 5.1 mm defect, in height).[8] This indicates that horizontal augmentation may occasionally leave some defects.

For residual defects, several options may be available: 1) leave it as it is, 2) additional bone augmentation, and 3) soft tissue augmentation. If the soft tissue phenotype is thick, the residual defect may be left without augmentation. Jung *et al*.,[14] investigated the effect of small bony dehiscence defect left on the implant without bone augmentation and augmented defect, demonstrating that healthy and stable soft tissue can be established even with bony dehiscence. However, it led to more vertical bone loss compared to the sites with bone augmentation.[14] In a study by Benic *et al.*,[15] they showed more mucosal recession at the immediately placed implant without visible buccal bone (based on CBCT findings).[15] Soft tissue phenotype was not evaluated in those two studies, but one can suspect the phenotype may play a role.

Additional bone augmentation may be considered, but there was no substantial evidence to support it at the insufficiently augmented sites. Such an additional augmentation may require an additional healing period for another submerged healing, which increases total treat-

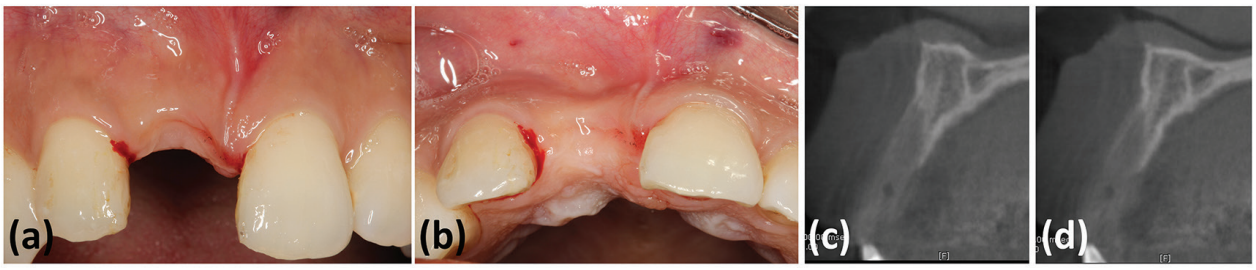

Figure 1: Pre-operative clinical and radiographic situations: (a), facial view of clinical photograph; (b), occlusal view of clinical photograph; (c, d), sagittal view of conebeam computed tomographic scan.

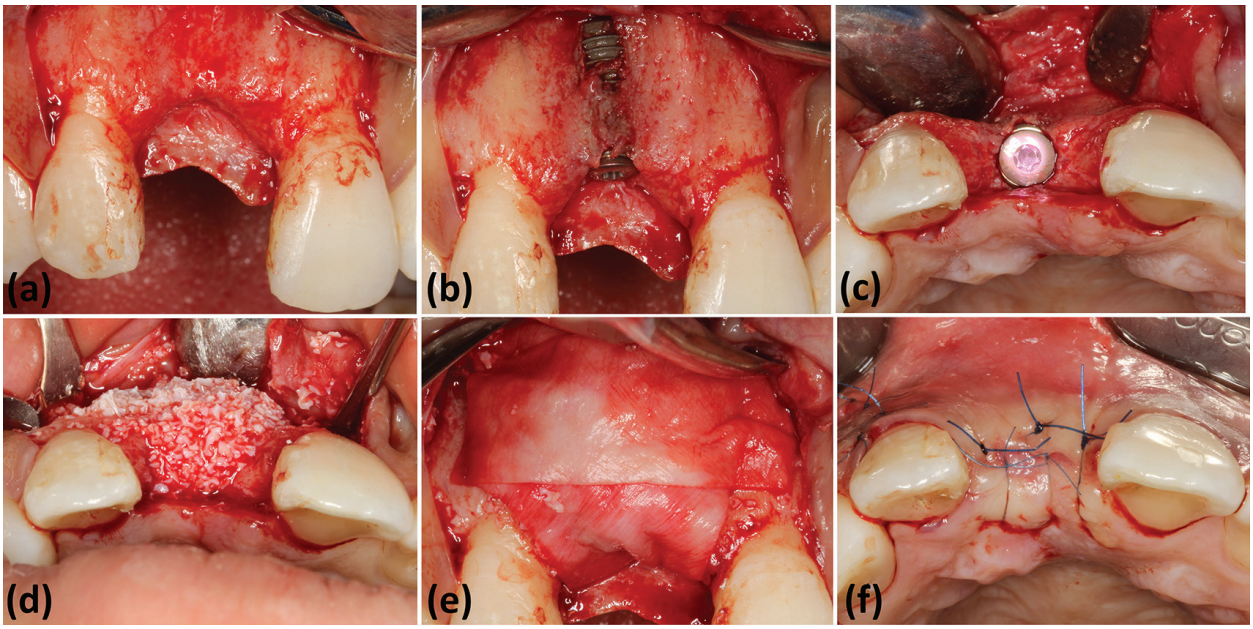

Figure 2: Implant placement and guided bone regeneration: (a), after flap reflection; (b), after implant placement, long dehiscence defect was observed; (c), bucco-oral implant position was not ideal; (d), deproteinized bovine bone mineral was applied; (e), collagen membranes were applied in a double layer manner; (f), primary flap closure.

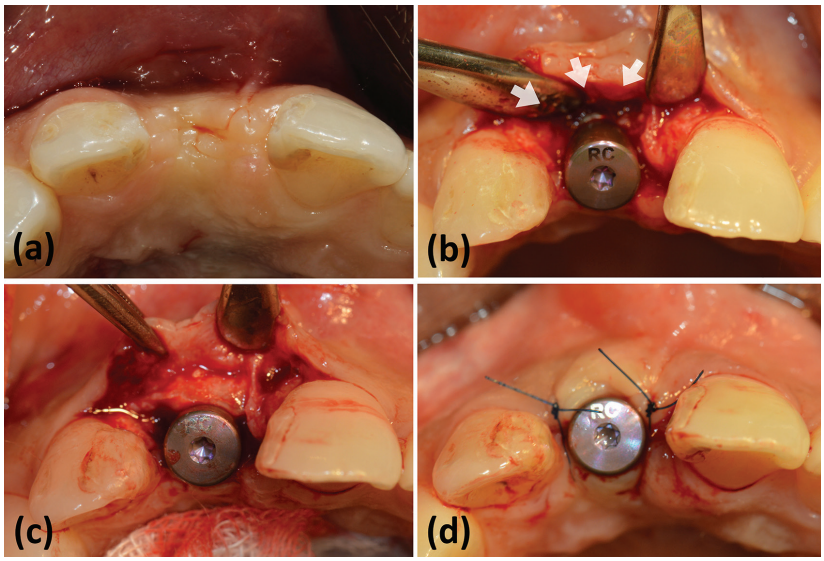

Figure 3: Situation at 4 months post-implant placement: (a), healing was normal, but tissue depression at labio-crestal area was noted; (b), complete defect resolution was not achieved (arrows); (c), connective tissue graft was applied to the residual defect; (d), The flap was sutured around healing abutment.

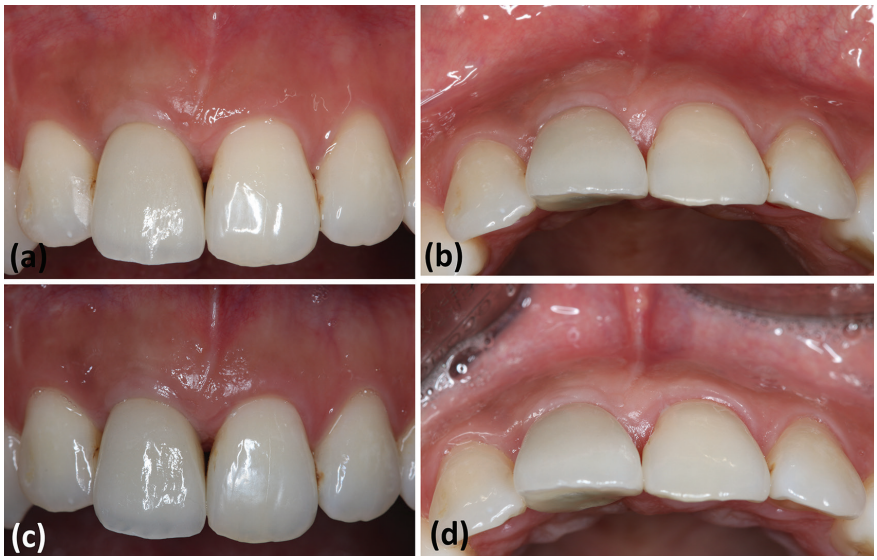

Figure 4: Clinical situation after final prosthesis delivery: (a), facial view at 3 years; (b), occlusal view at 3 years; (c), facial view at 7 years; (d), occlusal view at 7 years.

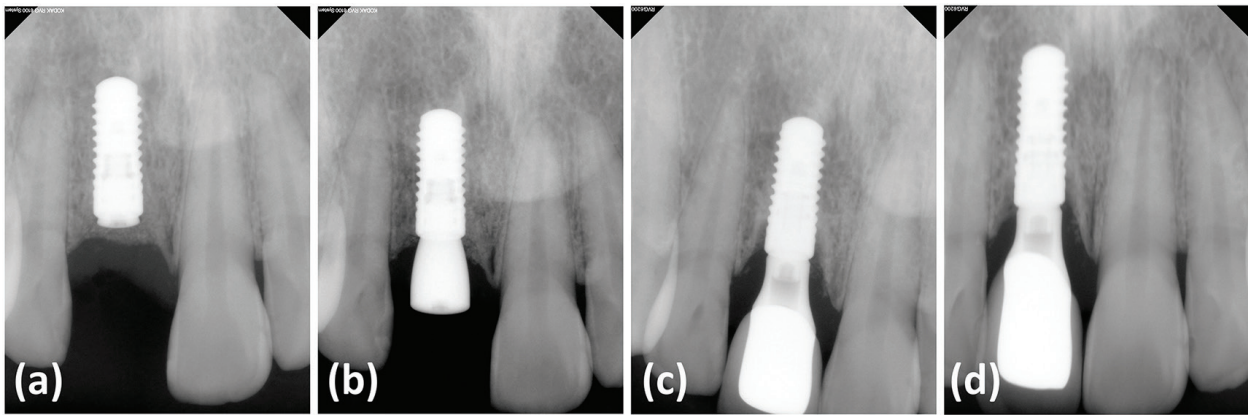

Figure 5: Intraoral radiographic view: (a), immediately after implant placement; (b), after healing abutment connection; (c), at 5 years; (d), at 7 years.

ment time and cost.

The final option is soft tissue augmentation. Recent studies indicate that soft tissue augmentation utillizing autogenous CTGs can produce tissue volume increases equivalent to those achieved with conventional GBR for buccal concavity defects, without necessitating implant surface exposure.[16,17] Furthermore, Stefanini *et al.,*[18] applied a de-epithelized CTG for a small buccal dehiscence defect at implant placement site. They exhibited favorable peri-implant soft tissue conditions and stable marginal bone levels.[18] Even though the number of studies regarding this issue is limited, those studies suggest that soft tissue augmentation may replace GBR for specific situations. In the present case report, the defect was a residue from the prior augmentation. Although the present defect may exhibit distinct characteristics compared to those reported in prior research, the fundamental principle may still be relevant. Moreover, the soft tissue phenotype of the present patient was thin, which might have caused esthetic problems if left unimproved.[19]

The bucco-oral implant position in the present study should be critically appraised. Given the present case, in which some augmented protions were located outside the bony envelope, buccal implant positioning could poten-

tially destabilize the augmented bone. Prior studies have highlighted the critical role of the bony envelope in bone regeneration.[20,21] Thus, more prudent approach for this case might be a more palatal correction of the osteotomy, based on "the concept of comfort and danger zone".[10] Furthermore, it might be advisable to apply more bone substitute material to compensate for resorption.

To prevent insufficient bone regeneration around peri-implant defect, the following strategies may be considered: 1) Employing a healing abutment instead of a cover screw during.[22] Submerged healing can counteract pressure on the implant platform and provide additional space for tissue regeneration. 2) non-resorbable membranes offer greater dimensional stability compared to resorbable membranes.[7] 3) additional bone grafts or collagen-incorporated bone substitutes, placed on top of the implant platform, can prevent displacement of bone graft material.[23,24]

The patient was followed up for a duration of 7 years. Despite no adverse clinical signs or symptoms, the patient should be monitored regularly, considering buccal implant positioning and residual bone defect.

Conclusions

Within the limitations of the present case report, it was shown that 1) simultaneous bone augmentation with implant placement may leave a minor defect, and 2) a CTG can compensate for the residual defect, preventing potential esthetic and biological complications.

Acknowledgments

None

Conflicts of Interest

The authors declare no conflict of interest.

References

1. Berglundh T, Lindhe J. Dimension of the periimplant mucosa. Biological width revisited. J Clin Periodontol. 1996;23(10): 971-3.
2. Merheb J, Quirynen M, Teughels W. Critical buccal bone dimensions along implants. Periodontol 2000.1014; 66(1): 97-105.
3. Monje A, Chappuis V, Monje F, Muñoz F, Wang HL, Urban IA, *et al.*The critical peri-implant buccal bone wall thickness revisited: an experimental study in the Beagle dog. Int J Oral Maxillofac Implants. 2019;34(6):1328-36.
4. Qahash M, Susin C, Polimeni G, Hall J, Wikesjö UM. Bone healing dynamics at buccal peri-implant sites. Clin Oral Implants Res. 2008; 19(2): 166-72.
5. Spray JR, Black CG, Morris HF, Ochi S. The influence of bone thickness on facial marginal bone response: stage 1 placement through stage 2 uncovering. Ann Periodontol. 2000;5(1):119-28.
6. Devina AA, Halim FC, Sulijaya B, Sumaringsih PR, Dewi RS. Simultaneous implant and guided bone regeneration using bovine-derived xenograft and acellular dermal matrix in aesthetic zone. Dent J (Basel). 2024; 12(3):52.
7. Naenni N, Lim HC, Papageorgiou SN, Hämmerle CHF. Efficacy of lateral bone augmentation prior to implant placement: a systematic review and meta-analysis. J Clin Periodontol. 2019;46(Suppl 21):287-306.
8. Thoma DS, Bienz SP, Figuero E, Jung RE, Sanz-Martín I. Efficacy of lateral bone augmentation performed simultaneously with dental implant placement: a systematic review and meta-analysis. J Clin Periodontol. 2019;46 (Suppl 21):257-76.
9. Temmerman A, Cortellini S, Van Dessel J, De Greef A, Jacobs R, Dhondt R, *et al*. Bovine-derived xenograft in combination with autogenous bone chips versus xenograft alone for the augmentation of bony dehiscences around oral implants: a randomized, controlled, split-mouth clinical trial. J Clin Periodontol. 2020; 47(1):110-9.
10. Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations in the anterior maxilla: anatomic and surgical considerations. Int J Oral Maxillofac Implants. 2004;19:43-61.
11. Calciolari E, Corbella S, Gkranias N, Viganó M, Sculean A, Donos N. Efficacy of biomaterials for lateral bone augmentation performed with guided bone regeneration. A network meta-analysis. Periodontol 2000. 2023;93(1):77-106.
12. Elnayef B, Porta C, Suárez-López Del Amo F, Mordini L, Gargallo-Albiol J, Hernández-Alfaro F. The fate of lateral ridge augmentation: a systematic review and meta-analysis. Int J Oral Maxillofac Implants. 2018; 33(3):622-35.
13. Naenni N, Schneider D, Jung RE, Hüsler J, Hämmerle CHF, Thoma DS. Randomized clinical study assessing two membranes for guided bone regeneration of peri-implant bone defects: clinical and histological outcomes at 6 months. Clin Oral Implants Res. 2017;28(1):1309-17.
14. Jung RE, Herzog M, Wolleb K, Ramel CF, Thoma DS, Hämmerle CH. A randomized controlled clinical trial comparing small buccal dehiscence defects around dental implants treated with guided bone regeneration or left for spontaneous healing. Clin Oral Implants Res. 2017;28(3):348-54.
15. Benic GI, Mokti M, Chen CJ, Weber HP, Hämmerle CH, Gallucci GO. Dimensions of buccal bone and mucosa at immediately placed implants after 7 years: a clinical and cone beam computed tomography study. Clin Oral Implants Res. 2012; 23(5): 560-6.

16. Bouckaert E, De Bruyckere T, Eghbali A, Younes F, Wessels R, Cosyn J. A randomized controlled trial comparing guided bone regeneration to connective tissue graft to re-establish buccal convexity at dental implant sites: three-year results. Clin Oral Implants Res. 2022;33(5):461-71.
17. De Bruyckere T, Cosyn J, Younes F, Hellyn J, Bekx J, Cleymaet R, *et al*. A randomized controlled study comparing guided bone regeneration with connective tissue graft to re-establish buccal convexity: one-year aesthetic and patient-reported outcomes. Clin Oral Implants Res. 2020;31(6):507-16.
18. Stefanini M, Felice P, Mazzotti C, Marzadori M, Gherlone EF, Zucchelli G. Transmucosal implant placement with submarginal connective tissue graft in area of shallow buccal bone dehiscence: a three-year follow-up case series. Int J Periodontics Restorative Dent. 2016;36(5):621-30.
19. Romandini M, Pedrinaci I, Lima C, Soldini MC, Araoz A, Sanz M. Prevalence and risk/protective indicators of buccal soft tissue dehiscence around dental implants. J Clin Periodontol. 2021; 48(3):455-63.
20. Tinti C, Parma-Benfenati S. Clinical classification of bone defects concerning the placement of dental implants. Int J Periodontics Restorative Dent. 2003; 23(2):147-55.
21. Yu SH, Saleh MHA, Wang HL. Simultaneous or staged lateral ridge augmentation: a clinical guideline on the decision-making process. Periodontol 2000. 2023;93(1):107-28.
22. Buser D, Chappuis V, Belser UC, Chen S. Implant placement post extraction in esthetic single tooth sites: when immediate, when early, when late?. Periodontol 2000. 2017;73(1):84-102.
23. Mir-Mari J, Benic GI, Valmaseda-Castellón E, Hämmerle CHF, Jung RE. Influence of wound closure on the volume stability of particulate and non-particulate GBR materials: an *in vitro* cone-beam computed tomographic examination. Part II. Clin Oral Implants Res. 2017; 28(6):631-9.
24. Mir-Mari J, Wui H, Jung RE, Hämmerle CH, Benic GI. Influence of blinded wound closure on the volume stability of different GBR materials: an *in vitro* cone-beam computed tomographic examination. Clin Oral Implants Res. 2016;27(2):258-65.

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