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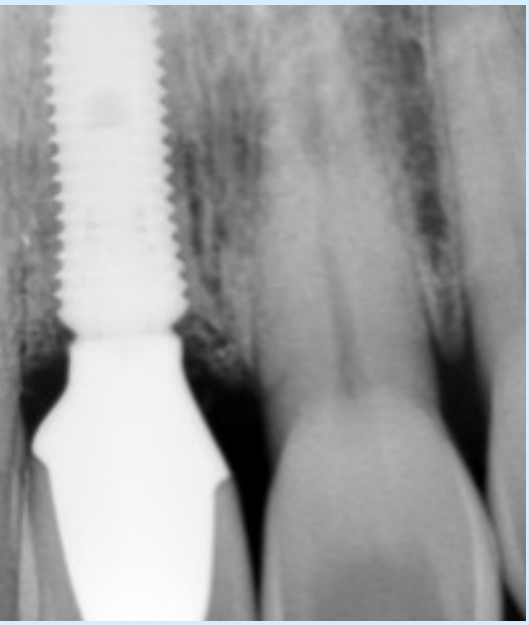



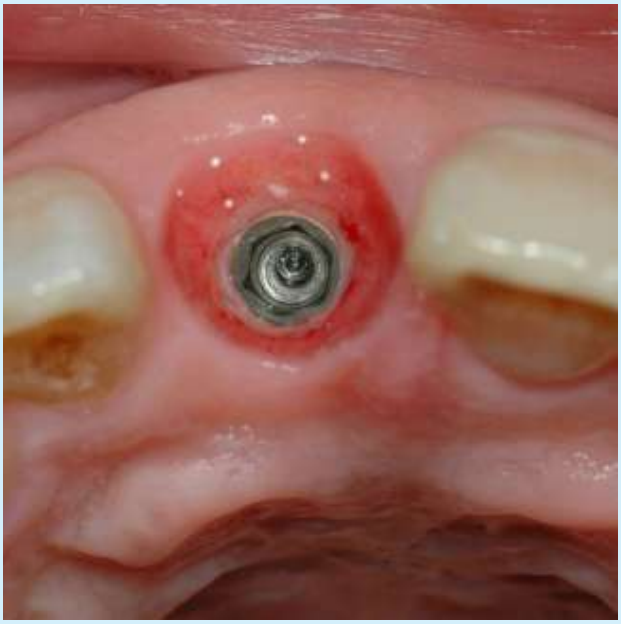


Cover Images from Min KM (J Clin Digit Dent 2020;2(2):6-25)

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About the Journal

The Journal of Clinical and Digital Dentistry are published four times (March, June, September, and December) annually since May 2019. The abbreviated title is "J Clin Digit Dent". In the journal, articles concerning any kind of clinical dentistry such as prosthodontics, orthodontics, periodontics, implant dentistry and digital dentistry are discussed and presented.

Aims and scope

This journal aims to convey scientific and clinical progress in the field of any kind of clinical and digital dentistry.

This journal publishes

- Original research data and high scientific merit in the field of clinical and digital dentistry.
- Review articles.
- Case reports in implant dentistry including GBR, digital dentistry, 3D printing, and prosthodontics.
- Short communications if they provide or document new technique and clinical tips.

About the Journal

Editorial Board

Editorial

Every single dental procedure is critical

Every step in a dental procedure is critical; no step can be taken lightly since it affects long-term prognosis after treatment. Therefore, it is important to study each procedure thoroughly even if it takes time, and try to apply them confidently in clinical practice. There is no dentist who treats patients suboptimally. I think all dentists do their best to provide good treatment; however, sometimes the treatment does not achieve the best results, despite dentists doing their best.

Doing one's best but not seeing good results is often due to the fact that the treatment plan focuses more on solving the current condition than the root cause of the patient's illness, thus resulting in new problems or a recurrence of the same problem. Furthermore, overlooking mistakes or performing insufficient dental procedures can also be another reason for not achieving desirable results.

One must always remember that every step in a dental procedure is critical for long-term prognosis after treatment.

It should be noted that the journal being published by JCDD focuses on explaining the best case for each dental procedure in periodontal treatment and implant surgery prosthetics. Although treatments for all patients seem to be the same, they are essentially different. Thus, dentists are expected to think critically and learn about what they missed in each dental procedure through the newly published journal.

Wongun Chang, DDS MS PhD

DENTIS ScanBody

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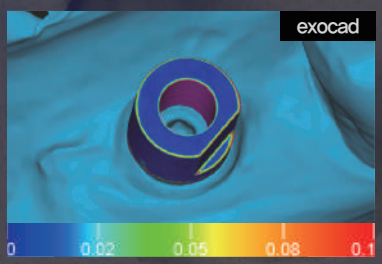

스캔데이터와 라이브러리가 일치하는 모습
(손쉬운 정합으로 보철물의 정확도 향상)

DENTIS

고객센터 1899-2804

Long-term Observations for Subepithelial Connective Tissue Graft (SCTG) in Periodontal and Implant Surgery: Part 2

Kyungman Min, DMD, MSD

In the last serial manuscript , we mentioned two of the problems that can be solved by using a free connective tissue graft, with a brief reference to the development background and purpose of mucogingival surgery, and the type of procedure.
In this series, I will summarize the remaining six problems that can be solved using a free connective tissue graft.

<3> Alveolar ridge augmentation or preservation with a membrane

It has been almost 50 years since the surgical technique for root coverage was developed. Root coverage techniques can be largely divided into four groups depending on their characteristics and period. The first group includes the coronally or laterally positioned mucoperiosteal flaps used by Grupe and Warren 1 and Cohen and Ross et al [2]. The techniques in this category are also called 'single-layer technique' since the exposed root surface is covered with a single layer of full-thickness pedicle flap. On the contrary, the methods of Raetzke or Langer and Langer et al.[3] are called 'two-layer technique' since they mostly use partial-thickness flap in conjunction with SCTG, and thus at least two layers of tissue are placed over the exposed root surface. Ever since the advent of this group of techniques, the predictability of the outcome has improved dramatically. The third group is the guided tissue regeneration (GTR) method which has been reported by Tinti and Vincenzi [4] and Pino Prato et al. [5] since the 1990s. Typically, SCTG tends to show better results in terms of the amount of root coverage and keratinized gingiva, but, as mentioned previously, an animal study by Weng et al. showed that more new bone formation was observed in GTR. Recently, with the advancement of molecular biology, techniques for surface treatment of exposed root and various types of biological mediators[6, 7] are being employed in researches, which comprise the fourth group (This group may in part be thought of as an auxiliary method to the three groups of surgical methods mentioned above.) These four groups of surgical methods can all be used for root coverage, but since the success rate or the degree of success differs by method or case, the clinician must accurately diagnose the characteristics of each case and identify the features of each technique in order to select the appropriate method and obtain the best results. As in the case shown in Figure 1, a bone defect can be interpreted as a hidden recession depending on its morphology and it is resolved using a combination of methods in group 2 and group 3 (or even group 4). We employed the guided periodontal tissue regeneration(GPTR) method using a bone graft and a barrier membrane, combined with SCTG. In this regard, Lekovic et al. [8] reported that grafting connective tissue including periosteum to the furcation defect was more effective in reducing the depth of the periodontal pocket and enhancing the attachment level. As previously mentioned, I harvest the palatal SCTG using a #15 blade only, based on the 'single-incision technique' proposed by Kumar et al. (2013) [9], which ends up being connective tissue including the periosteum of palatal bone, and thus I could expect the effects reported by Lekovic. Michele Paolantonio et al. used an autograft in conjunction with autogenous periosteal barrier membranes and reported a result comparable to that of GTR as well as reduced gingival recession, hinting at long-term stability after treatment of a hidden gingival recession using connective tissue including the periosteum(Figure 2). [10]
If the morphology of the socket after tooth extraction falls into class 3 of the classification scheme developed by Funato A et al. [11], and if you have planned for immediate implant placement, then GBR must be performed

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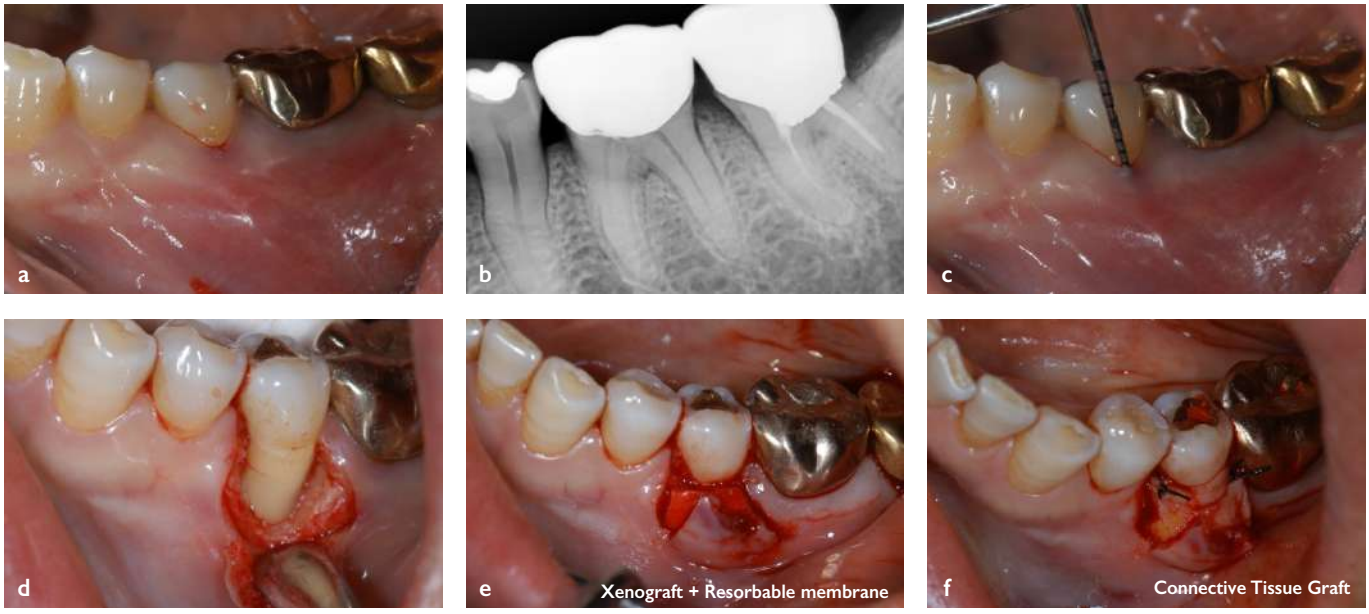

Fig 1a-f. A hidden recession can be interpreted as a type of periodontal pocket. If bone resorption occurred up to the adjacent alveolar bone due to prolonged chronic inflammation, then a combination of periodontal tissue regeneration and SCTG must be performed. SCTG including periosteum retains the graft morphology and thus is easier to deal with during surgery

Fig 2a-i. The flap could be placed coronally to sufficiently cover the connective tissue and the graft was engrafted successfully that the soft-tissue attachment, the so called 'biologic width', was properly formed in the upper region. Later in follow-up, the formation of keratinized gingiva affected by the connective tissue below was observed and the marginal alveolar bone in the bone grafted area was confirmed after 10 years of good maintenance

Fig 3a-i. In the case of immediate implantation, if there is labial bone loss, then sometimes a membrane is placed in-between the flap and bone after implantation and before bone graft. When SCTG is performed to fill the Supra-crestal soft tissue dead space, the graft may not be properly placed within the flap due to graft material overfilling

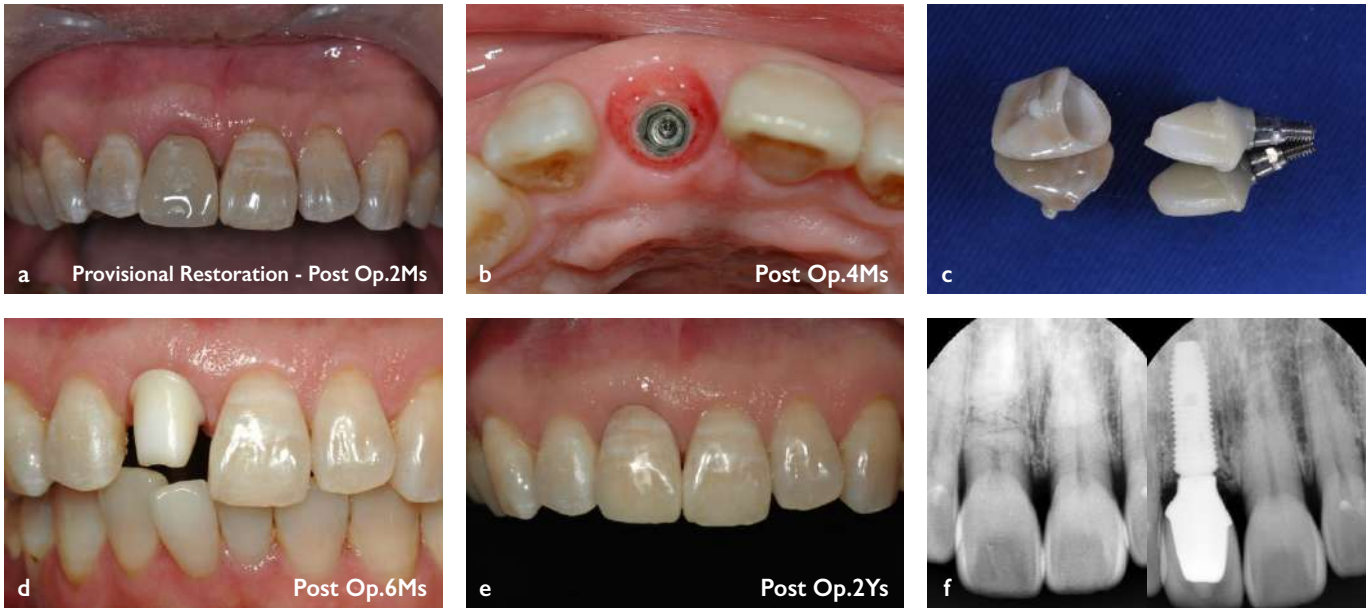

Fig 4a-f. The grafted area had been exposed and undergone necrosis due to insufficient blood supply as it was blocked by the bone graft material and barrier membrane below, but fortunately, the level of gingival margin was properly maintained and at postoperative month 2, a temporary crown was fabricated using a temporary cylinder. There was no esthetic problem at postoperative year 2

simultaneously with implantation and SCTG must be performed either simultaneously or stepwise to form a thick gingival biotype and prevent a gingival recession in the long-term. Since the use of the barrier membrane is expected to reduce the blood supply, SCTG harvesting, immobilization and coverage with the flap must be performed more carefully to avoid graft necrosis (Figure 3,4).

<4> Promoting primary closure of the flap

Personally, I believe that the process of applying bone graft material and a barrier membrane in the patient's mouth for alveolar ridge augmentation is similar to the process of installing a cell incubator in the body and one of the major principles that should be followed during this process is the "PASS principle" presented by Professor HL Wang [12]. They emphasized that an in-depth understanding of the principle of wound healing is as important as highly advanced technology for predictable bone regeneration and based on this assumption they talked about the importance of primary wound closure, angiogenesis, the stability of the wound, and space maintenance and creation. In order to properly install the cell incubator intraorally and create an environment where certain conditions are maintained through healing process based on general principles, primary closure of the flap is of utmost importance. For this purpose, the appropriate soft-tissue management technique for the case must be selected from the various methods including periosteal releasing incision and advanced flap, soft-tissue graft like FGG or SCTG and use of a rotation flap. [13,14,15] As in the case shown in Figure 5, the cases expected class 3 extraction socket as defined by Funato A classification at tooth extraction with severe gingival recession, can be resulted in a severe soft-tissue recession and thus increasing the amount of soft tissue beforehand by applying a root coverage technique prior to extraction is a viable solution. In this case, the tooth must be given root canal treatment in advance and the buccal root contour should be prepped to create the most favorable condition for engraftment of the graft. In addition, depending on the case, root-end resection can be performed in advance to induce healing of the implan-tation area. [16] In this case, since the size of the soft-tissue defect after tooth extraction becomes relatively small, various methods using simultaneous implant placement or GBR alone can be performed (Figure 6,7,8). In the esthetically critical region like the anterior maxilla, we need a strategy that involves minimal soft-tissue treatment such as a releasing incision. As in the case shown in Figure 9, if there is a considerable amount of alveolar bone defect in the palatal bone, then a palatal flap is dissected and an alveolar bone graft is performed on the palatal side at implant placement. Since it is very difficult to perform a releasing incision for primary closure in the palatal, we instead performed SCTG for primary closure. In addition, the graft must be covered by the flap as much as possible given the insufficient blood supply from below.

For this, you must secure adequate space for the graft to be placed, for which you first place the implant fixture at the appropriate depth, perform bone graft and membrane application and then place the SCTG on top of it. Finally, cover the graft with the flap as much as possible without a releasing incision to fix it firmly. [17,18] As previously mentioned, since revascularization is completed by about 2 weeks post-surgery, the suture can be removed between weeks 1–2. At this point, the surgical outcome can be verified, based on which postoperative measures like re-surgery should be determined and explained to the patient. If the graft is too thick and significantly exposed, then the likelihood of failure increases; if the graft is too thin, then circulatory problems may arise due to perforations. Therefore, a graft of about 1-1.5 mm thickness must be harvested. [19,20] The patient has experienced no esthetic problem for

Fig 5a-c. In patients with moderate to advanced periodontitis, a severe local vertical bone defect due to occlusal trauma is sometimes observed, for which restorative treatment becomes highly difficult, especially if accompanied by gingival recession. This is a 31-year-old male patient

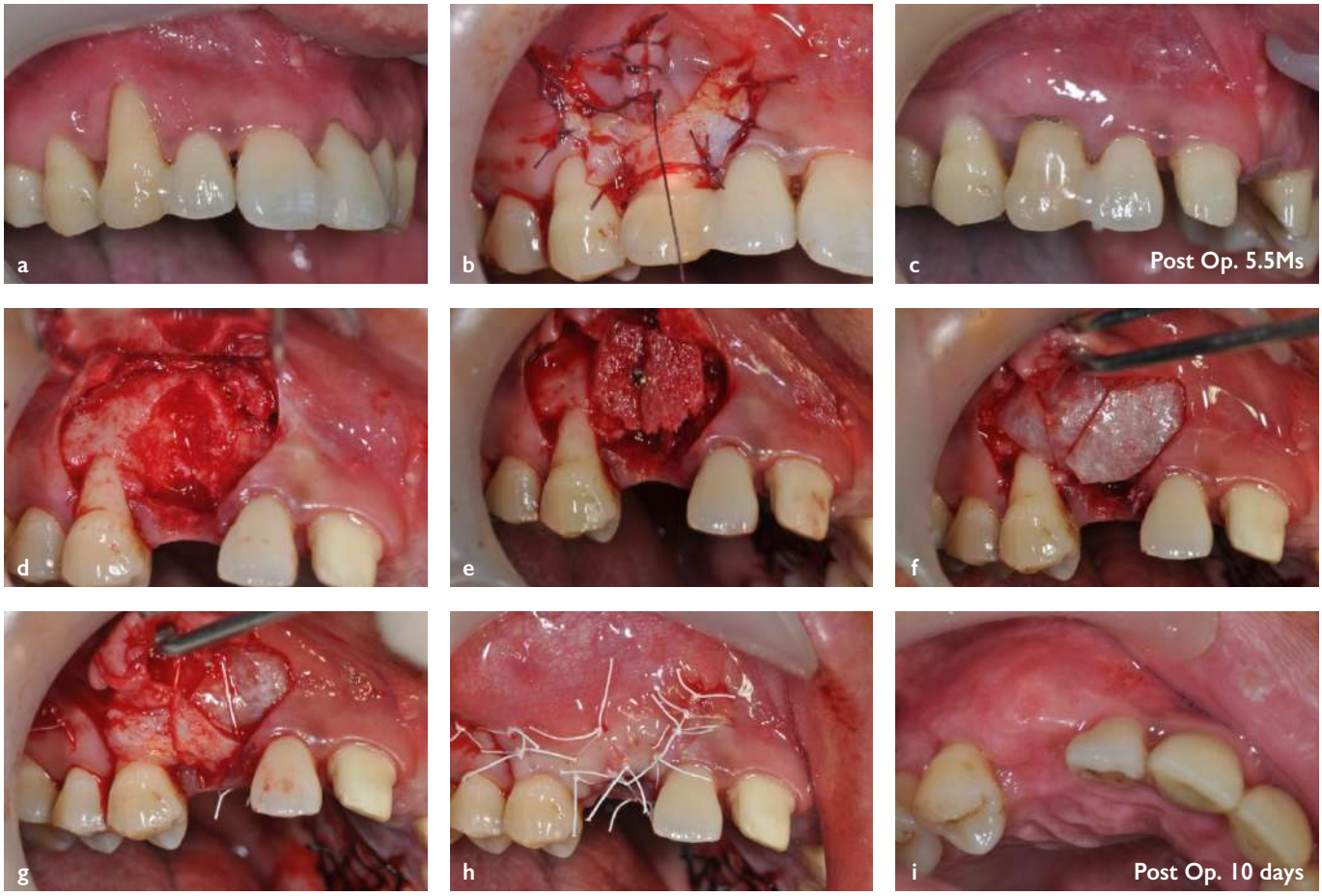

Fig 6a-i. Prior to bone graft, we performed soft-tissue augmentation by SCTG in the labial surface of #13 tooth showing gingival recession and a severe bone defect. After about 5.5 months, we performed bone augmentation using a irradiated allogenic block bone and particulated xenograft and SCTG for primary flap closure at tooth extraction, and good results was obserbed at post 10 days

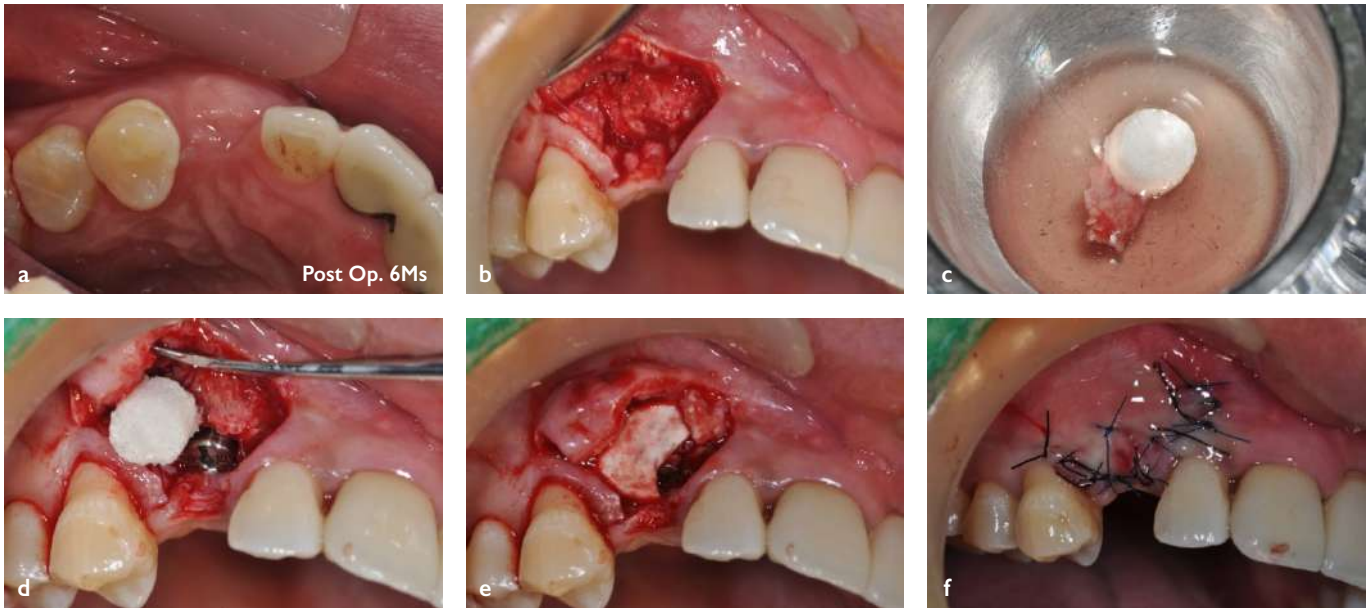

Fig 7a-f. The implant was installed after about 6 months and, to increase the labial volume, a low profile healing abutment was connected to secure the vertical space, and collagenated alloplastic material was applied together. SCTG harvested from palate was also used

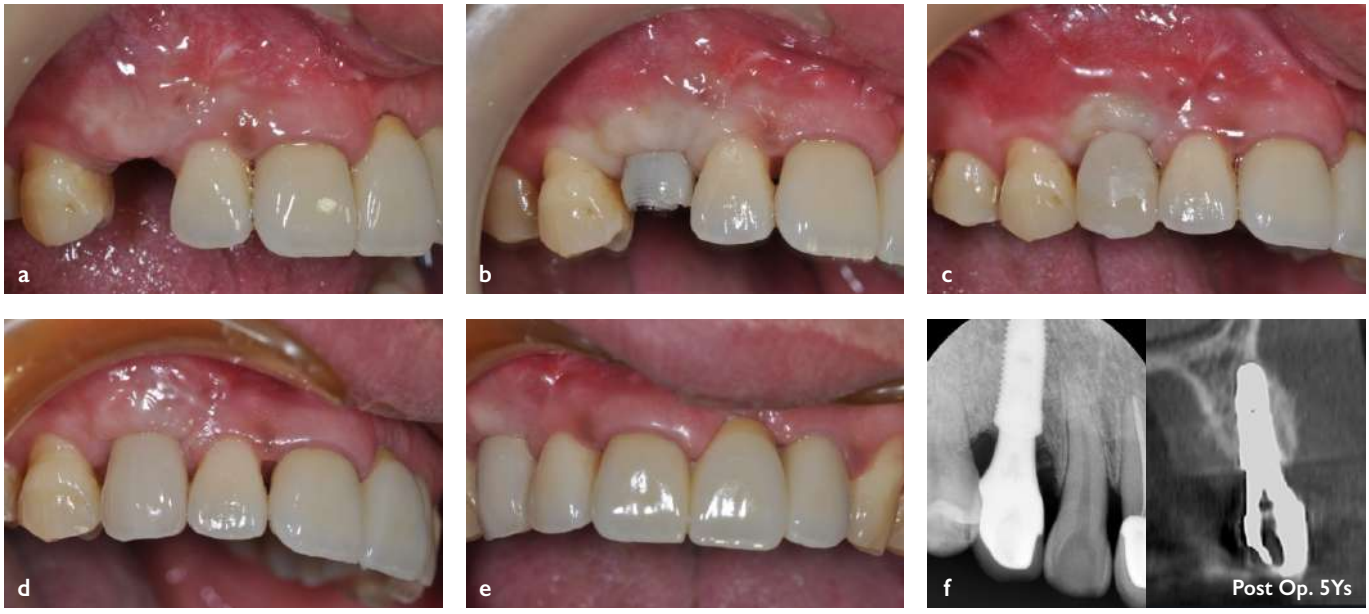

Fig 8a-f. For gingival recontouring, a temporary crown was made using composite resin after connecting the resin core temporary cylinder which had been made before second stage surgery. Gingival margin of the labial side of tooth #13 is well-maintained at postoperative year 5

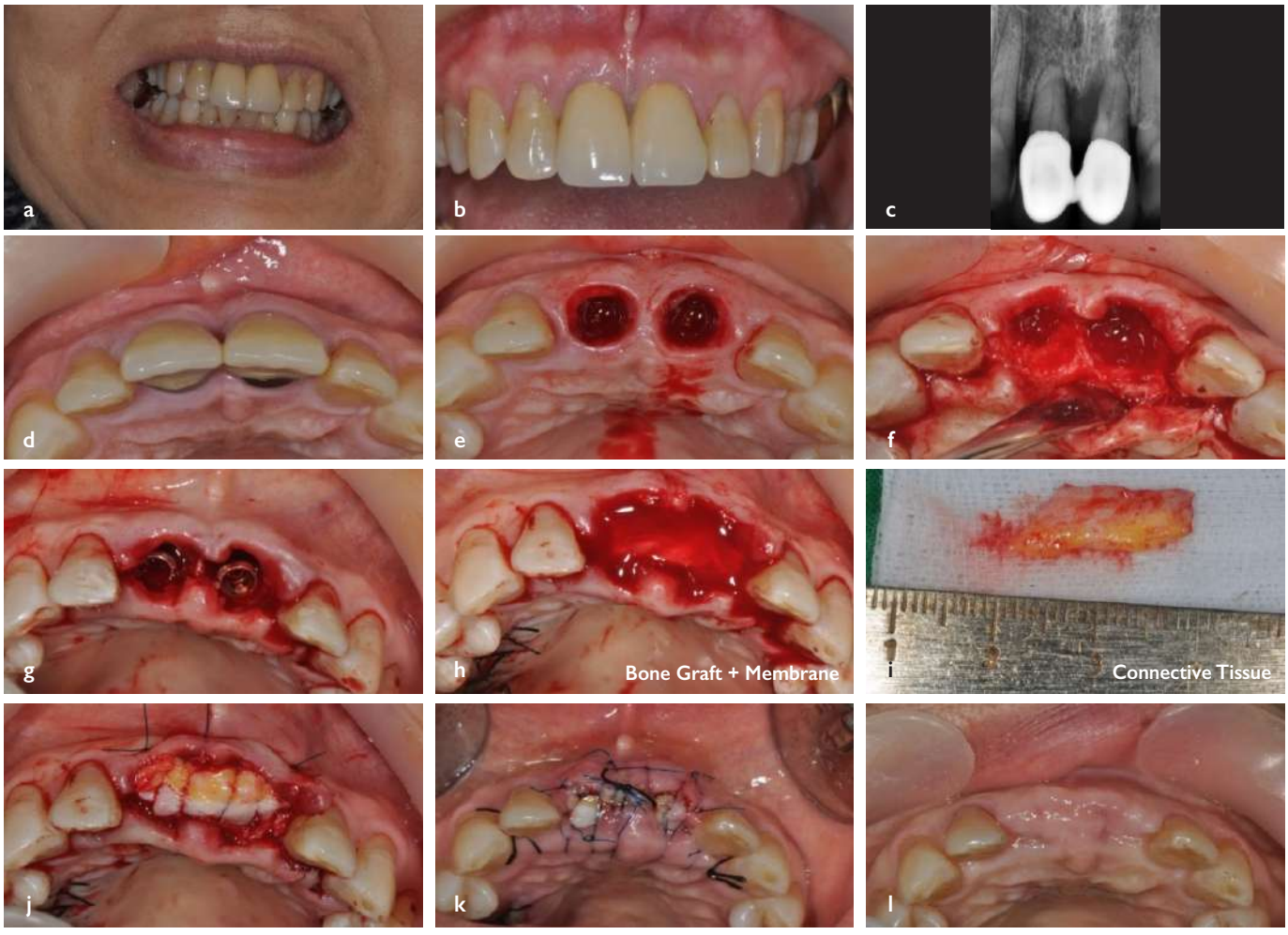

Fig 9a-i. A 72-year-old female with a severe bone defect in the palatal bone of maxillary central incisor area showed severe occlusal trauma in the splinted prosthesis with an anterior deep-bite. After palatal reflection of the flap, I installed implant fixture with a bone graft and SCTG was perfored to attemp a primary flap closure. Here, the graft must be covered by the flap as much as possible with minimum tension

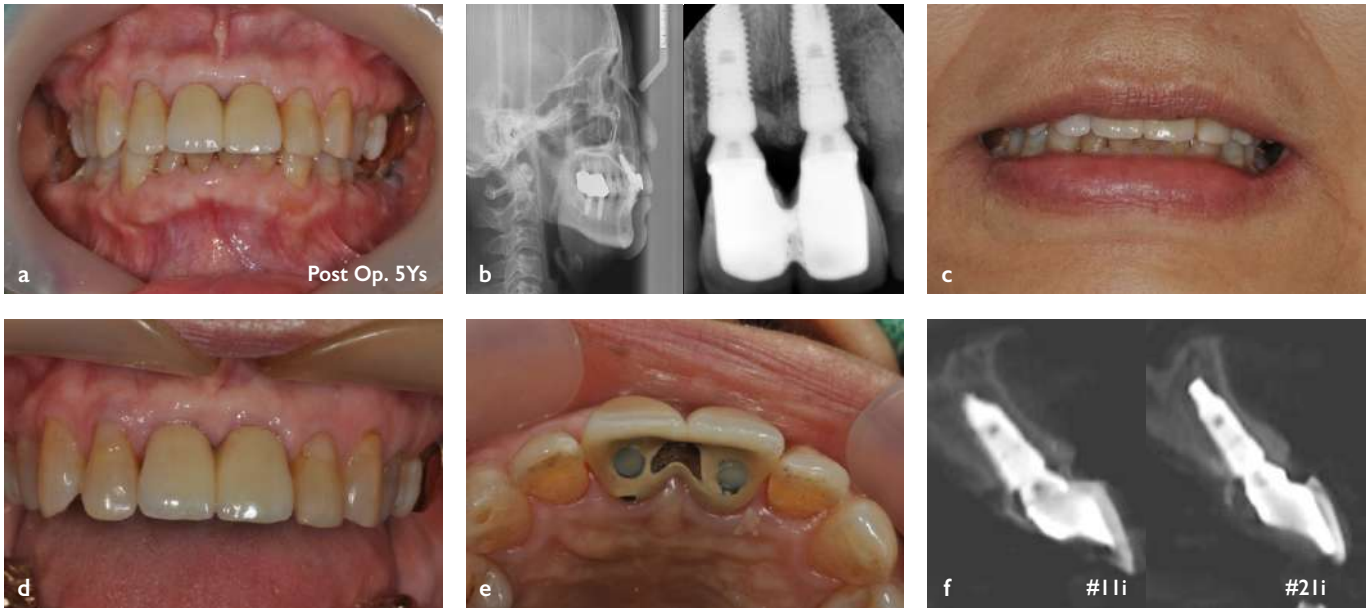

Fig 10a-f. A screw-retained prosthesis was fabricated to prevent occlusal trauma due to insufficient intermaxillary space. To date, there is no sign of screw loosening. It has the advantage of no excess cement. At postoperative year 5, an appropriate amount of interdental papilla is maintained and CBCT also confirms that appropriate thickness of lingual alveolar bone is retained

about 5 years now and CBCT also confirms that a sufficient amount of alveolar bone has been formed and maintained (Figure 10).

<5> Constructing the interdental papilla in the esthetic zone

The 1992 paper by Dr. Tarnow21 on the interdental papilla has served as an important guideline for many clinicians in selecting the treatment strategy regarding esthetics in the anterior maxilla area and, along with the 2000 paper by the same author22, is considered integral to establishing a prosthetic treatment plan including implants. However, these papers show, by experimental design, a mere probabilistic correlation between the distance from interdental contact point to interdental alveolar crest and presence of interdental papilla, not a causal relationship. More importantly, they indirectly mentioned the amount of soft tissue relative to interdental space and I believe that, in theory, increasing the amount of interdental soft-tissue is a priority to obtain a successful esthetic outcome in a restorative treatment case. Since it is usually difficult to surgically over contour the soft-tissue in the limited interdental space, the predictable surgical procedure has been restricted. However, patients who need orthodontic treatment for diastema or prosthetic restoration using implants have relatively less spatial restriction for surgical procedures and thus adequate space can be secured via tooth migration or prosthetic restoration after a soft-tissue graft to recover the proper interdental papilla morphology between the teeth.

The case shown in Figure 11,12 was a 37-year-old male patient who had received, but not completed, a long-term orthodontic treatment when he visited our clinic. We decided to restart the orthodontic treatment after basic periodontal treatment. Re-evaluation after periodontal treatment revealed a distal alveolar bone defect, diastema and labial gingival recession in tooth #12. In this case, we formed a full-thickness flap including the distal interdental papilla of tooth #12 and performed a bone graft followed by subepithelial connective tissue graft for root coverage. Orthodontic treatment started after 3 months to ultimately achieve spatial closure and interdental papilla of adequate size and shape was formed in the new interdental space. In this regard, Cardaropoli 23 claimed that if preceded by proper periodontal treatment, orthodontic treatment for malocclusion due to pathologic tooth migration can be reliable and, in particular, starting orthodontic treatment after surgical periodontal treatment will yield good esthetic outcome by promoting root coverage and interdental papilla regeneration.

Constructing interdental papilla around implants in the anterior maxilla follows a similar process. The patient in Figure 13 visited our clinic with a severe case of bone defect around the abutment of a maxillary anterior 6-unit fixed prosthesis and tooth mobility.

Fig11a-i. Prior to re-treatment for incomplete orthodontic treatment, we first treated the bone defect on the distal surface of tooth #12 and then, performed bone graft and SCTG and coronally positioned a double papillary flap to regenerate the receded labial gingiva and interdental papilla

Fig 12a-i. Orthodontic treatment started at postoperative month 3 to perform spatial closure on the distal surface of tooth #12. After treatment, the amount of soft tissue increased while the interdental space decreased to reproduce a proper interdental papilla morphology

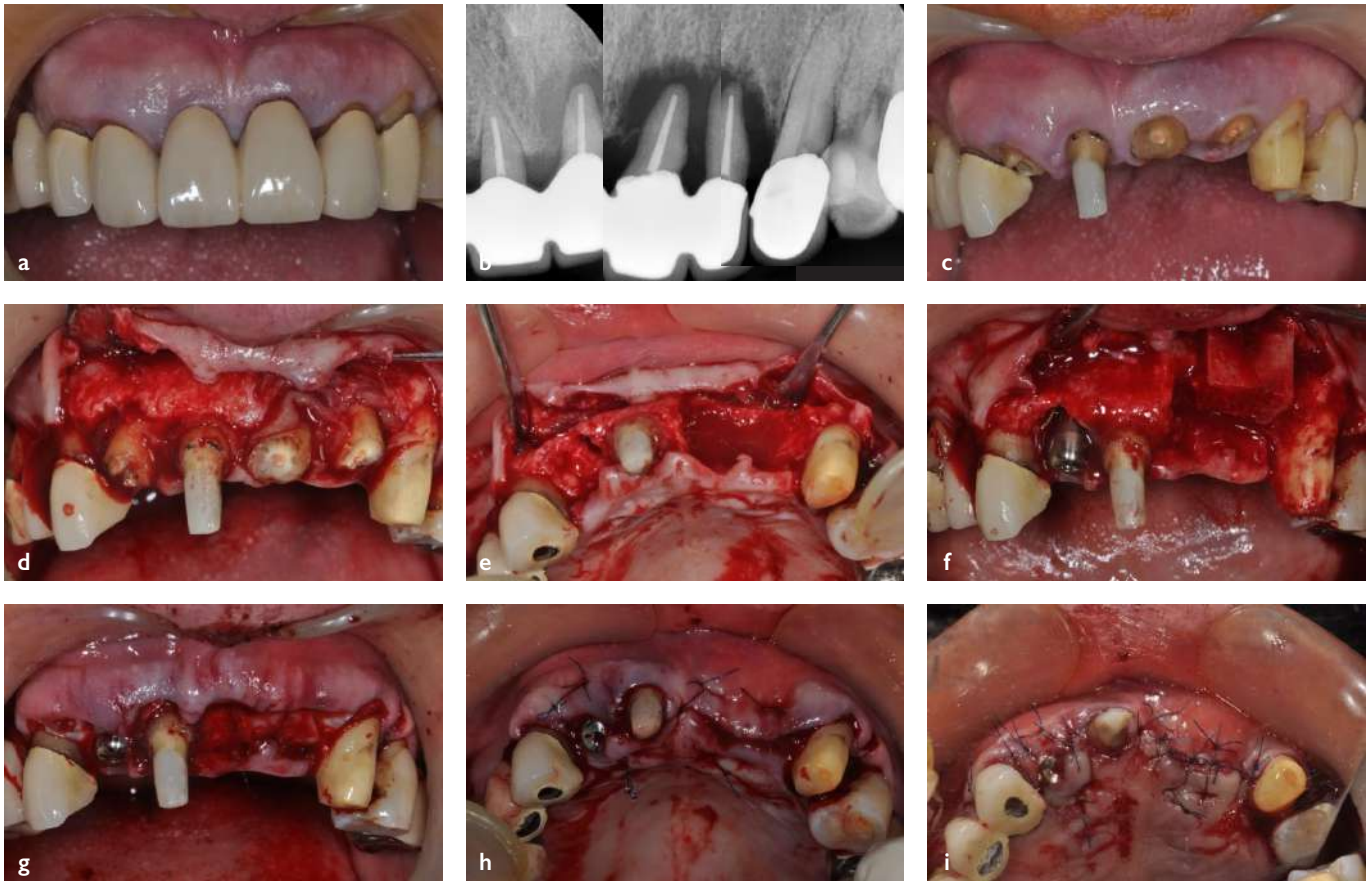

Fig 13a-i. A 63-year-old male showing severe bone defect around the abutment of an old prosthesis in the maxillary anterior area visited my clinic for tooth mobility and pain. We sufficiently cut off the tooth before extraction and performed in situ gingival augmentation to facilitate the primary closure when performing alveolar ridge augmentation simultaneously with tooth extraction. We used an irradiated allogenic block bone and particulated xenograft

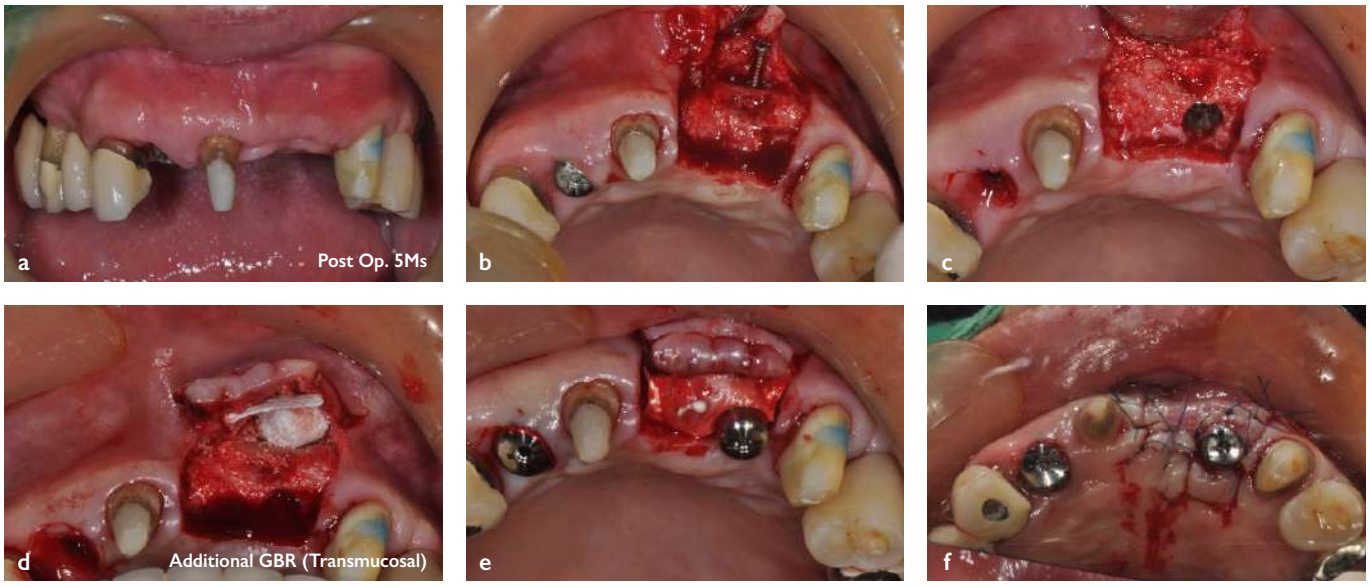

Fig 14a-i. After about 5 months, I installed implant fixture and performed transmucosal GBR. I used collagenated alloplastic material with membrane to augment the labial volume of alveolar bone

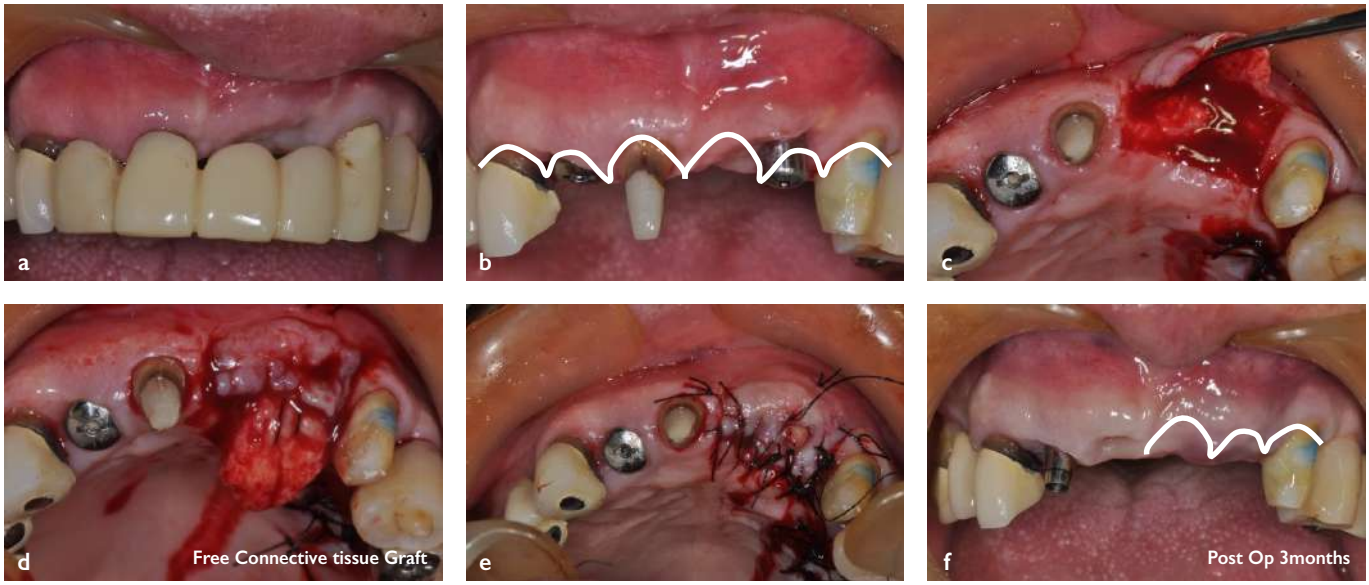

Fig 15a-f. Before prosthetic restoration, loss of interdental papilla was predicted around the implant in #22 region and so we first connected a low-profile healing abutment and performed SCTG (Guided Soft Tissue Augmentation). At postoperative 3 months, a relatively sound gingival margin was expected with prosthetic restoration

We decided to fabricate a final prosthesis using the implant, but the severe alveolar bone defect was predicted after tooth extraction, so I decided to approach it in a stepwise manner. First, I used allogenic block bone and a particulated xenograft to perform a local alveolar ridge augmentation. Before doing this, I cut off the tooth sufficiently before extraction for in situ gingival augmentation to facilitate the primary closure when performing alveolar ridge augmentation simultaneously with tooth extraction. After 5 months, we placed the implant using the transmucosal GBR method for an additional bone graft (Figure 14). However, after healing, loss of interdental papilla around #22 was observed and a Guided Soft Tissue Augmentation [24] was performed using a low-profile healing screw and SCTG (Figure 15). About after 3 months, a second surgery was performed with the gingival re-contouring concept [25]. During the gingival healing period, a temporary crown was prepped and the final prosthesis was fabricated with a customized abutment (Figure 16).

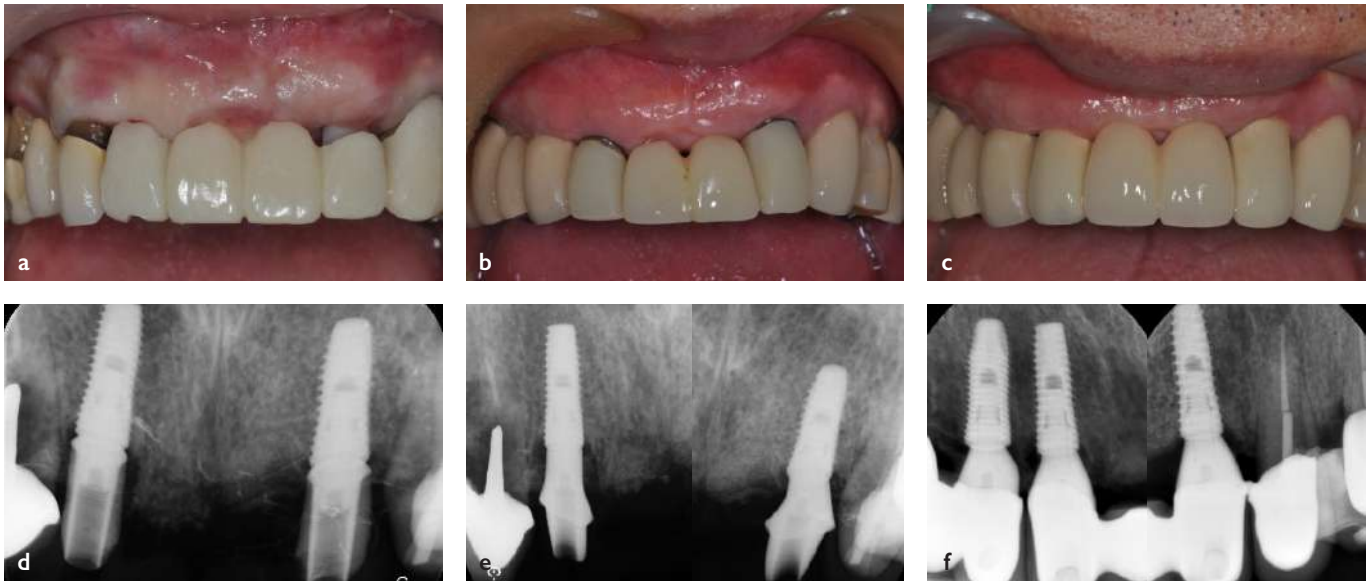

Fig 16a-f. A Temporary prosthesis was made using composite resin after connecting the resin core temporary cylinder which had been made before 2nd stage surgery to perform the gingival sculpturing. To reproduce the morphology of the sculptured gingiva, I fabricated a gum model using temporary prosthesis as a customized impression coping and SCRP-type final prosthesis with a custom abutment

<6> Supplementary treatment of small alveolar bone defects

Although Guided Bone Regeneration (GBR) is useful for site preparation in implant placement,[26,27,28] it is not always successful and thus the decision to perform this procedure must be made through various considerations such as the morphology of the bone defect, the patient's condition, and cost-effectiveness. Especially, if the amount of graft material or apparatus needed for bone graft procedure is small, instability of materials and increased possibility of failure of primary wound closure may bring worse results than without surgery. There is no mention of specific standards in the literature, but it seems that bone grafts are usually unnecessary or must be chosen carefully in dehiscence defects < 2 mm , especially formed outside bone housing. Instead it may be reasonable to choose a method that enhances prognosis by thickening the peri-implant soft tissue.
The patient in Figure 17 was transferred to our clinic to prevent gingival recession around the implant fixture shown through a thin mucosa around the implant inserted in #43 tooth area after the second surgery. This a case of dehiscence defect occurring in an implant inserted into a narrow alveolar ridge. The defect was located outside bone housing and the patient was planning for an overdenture, so I performed free gingival graft by harvesting thick palatal mucosa instead of guided bone regeneration.
Of course, we could have used subepithelial connective tissue graft to increase the thickness of the buccal gingiva and prevent gingival recession at the dehiscence bone defect, but in order to resist the frictional force exerted on the overdenture abutment and deepen the oral vestibule, we left the periosteum and fixed the graft firmly to the recipient site including the exposed implant surface using the Holbrook's Suture.[29] Normally, horizontal anastomosis is formed up to day 5 after the plasmatic circulation and epithelial cell loss from the surface is observed. Blood vessels are reconstructed at week 2 and most of the healing occurs from 4 weeks to 2 months.[30,31,32] Although the implant collar region was slightly exposed, there was no problem for about 5 years and especially 1 year after surgery, a dense fibrotic tissue was formed to resist friction (Figure 18).
The patient in Figure 19is a 50-year-old male who visited our clinic for treatment of advanced periodontitis about 15 years ago. At that time, he had been in the maintenance phase after a periodontal treatment including resective osseous surgery, but in recent years, further maintenance became difficult and so we extracted all teeth with a bad prognosis and started the implant treatment.
Thus far, due to severe destruction of the alveolar ridge by periodontitis, we could only use short implants and had to leave a slight bone defect between #46 and #47 fixtures. Considering the healing time, difficulty of flap management, and the cost-effectiveness, we filled the bone defect

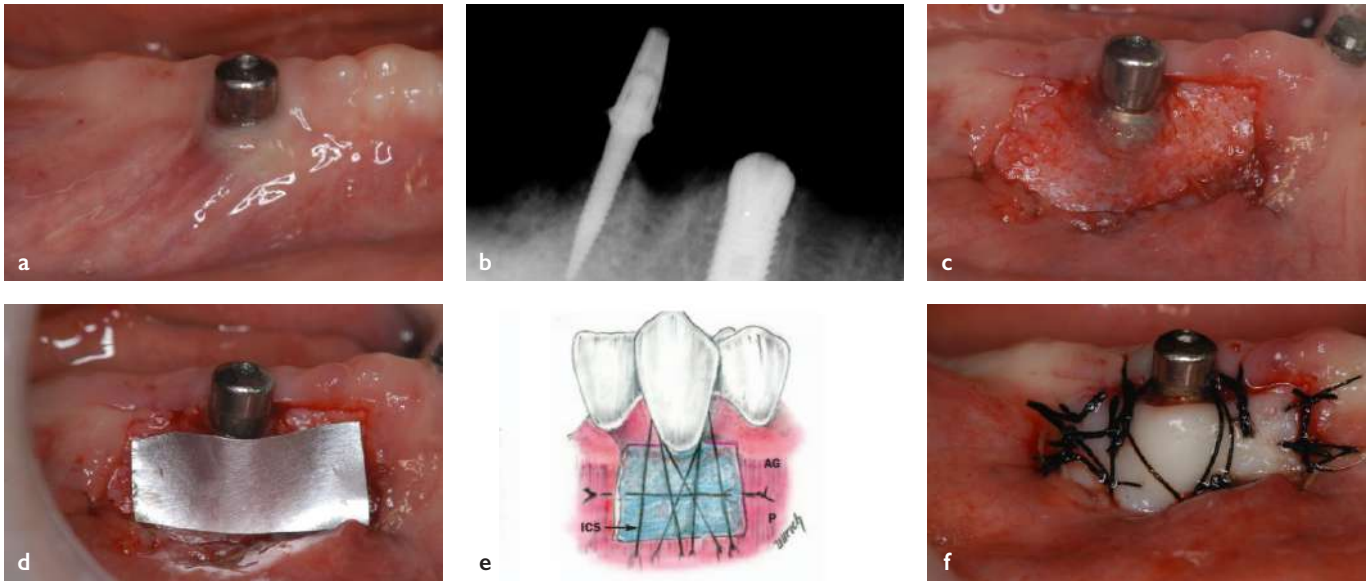

Fig 17a-f. To prevent the pulling of the marginal gingiva by mobile peri-implant mucosa and to reduce the effect of trauma during denture insertion/removal, I grafted a thick keratinized gingiva from the palate. Since it is usually difficult to anticipate the soft-tissue attachment around implants to be as firm as that of natural dentition, it is helpful to form a rigidly attached gingiva on the surrounding alveolar bone

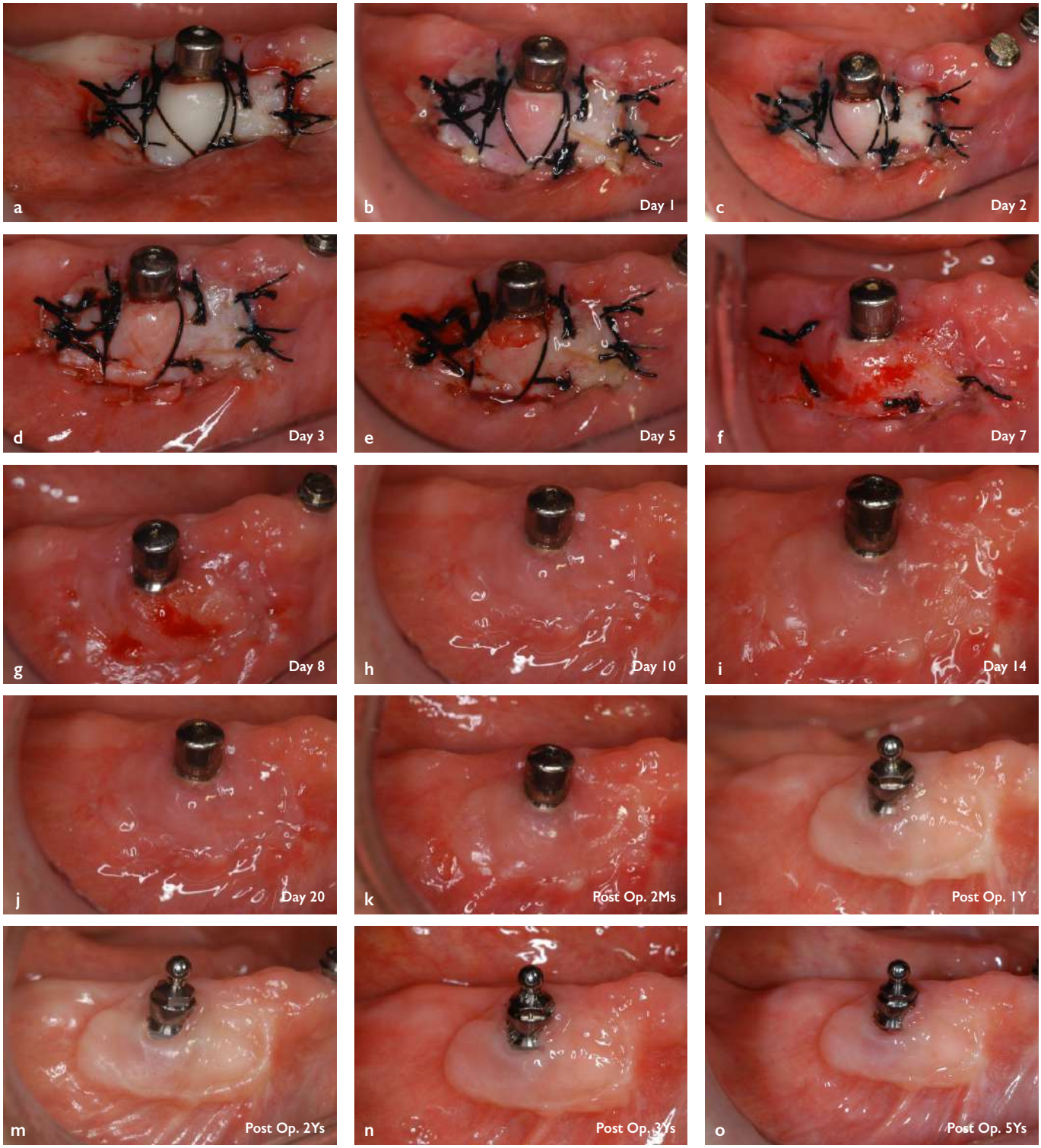

Fig 18a-o. Nutrition is supplied by plasmatic circulation up to the first 48 hours (critical healing period) and the capillary network starts to form at day 2-3, which occupies the center of the graft by postoperative day 10, allowing for the sutures to be removed. In microscopic terms, the time required for a thick graft to be healed is known to be about 16 weeks and in this case I started to make a final prosthesis 2 months after surgery and the mucosa was loaded 3 months after surgery

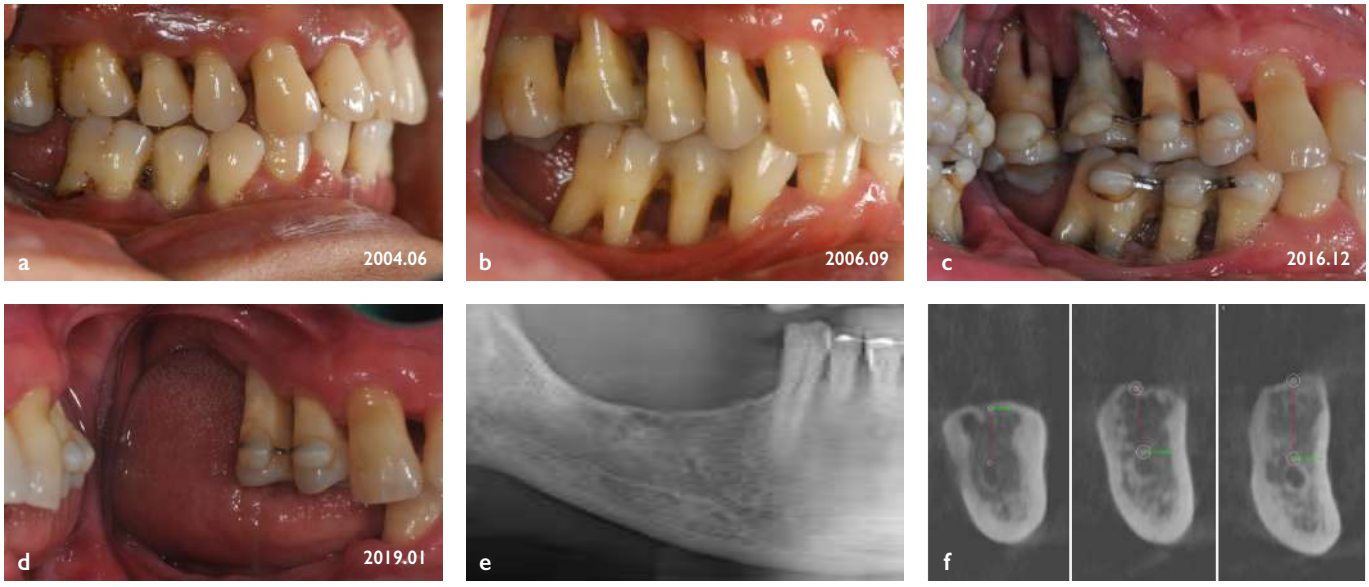

Fig 19a-f. In patients with moderate to advanced periodontitis, severe bone defect after tooth extraction occasionally occurs despite continuous maintenance treatment. A 47-year-old male patient suffered severe vertical bone defect along with tooth loss 15 years after periodontal treatment and wished to get an implant restoration despite the lack of residual alveolar ridge. I decided to fabricate the prosthesis by connecting short implants

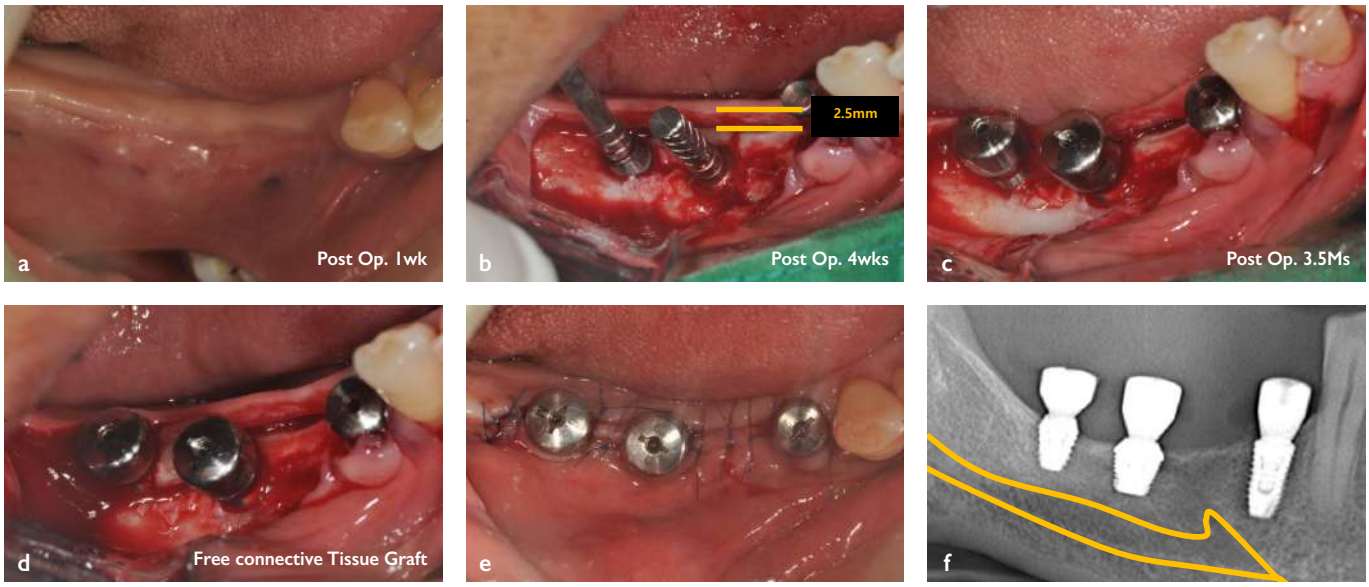

Fig 20a-f. After implantation, a slight bone defect was observed between #46i and #47i, but instead of a hard-tissue graft I placed the connective tissue graft from the palatal mucosa between the healing abutment and then performed a primary flap closure. I may install the implant more deeply, but in this case there was already not enough residual alveolar bone to adjust the insertion depth

between #46 and #47 with Subepithelial connective tissue graft and closed the case. [33,34], This approach has the effect of increasing the thickness of the vertical mucosal thickness when the implant cannot be deeply installed, so that it can lower the emergence angle to less than 30° and concave the subgingival contour of the prosthesis. [35] I think it works positively in terms of the peri-implant biological width.

<7> Facilitating the formation of the biologic width around the teeth or implants

The technique of free autogenous gingival grafts, proposed in the late 1960s, received much attention after NP. Lang and H Löe demonstrated the relationship between the width of keratinized gingiva and gingival health in 1972, and it was revealed later by many researchers like Maynard [36] that

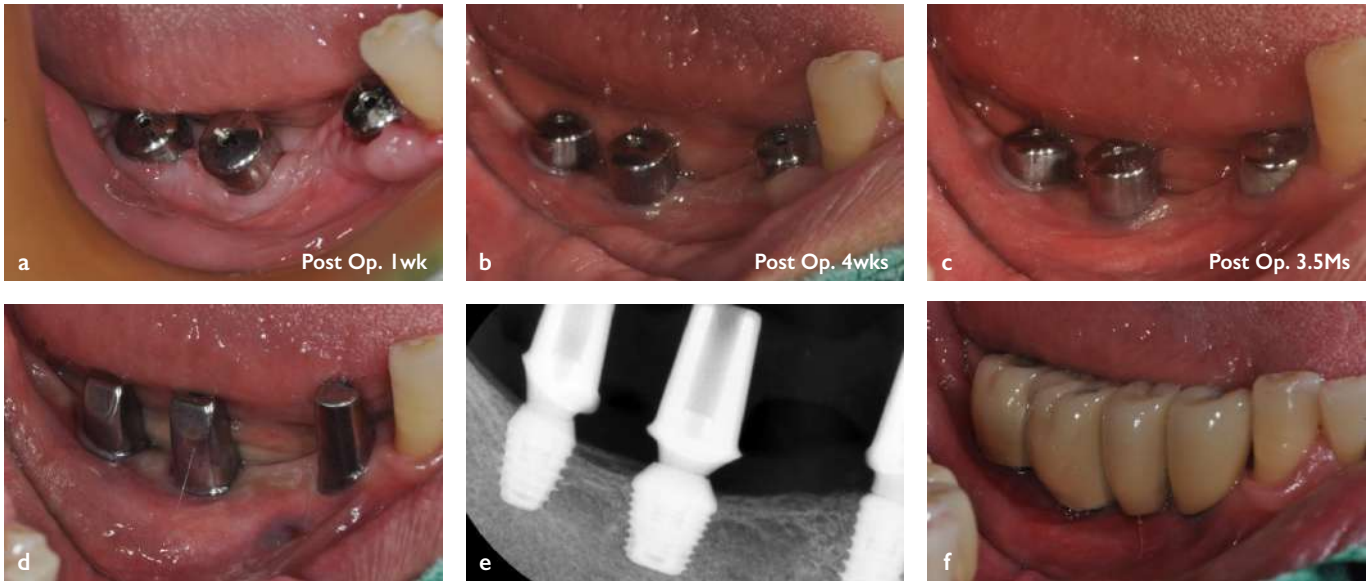

Fig 21a-f. After installing the final prosthesis, I can minimize the emergence angle of the suprastructure to minimize marginal bone resorption. In addition, to overcome the problems of severe bone resorption including insufficient depth of vestibule and difficulty with securing attached gingiva, I assigned a sufficient embrasure space and had the patient use an interdental brush to prevent peri-implant mucositis in this area

that the width of keratinized gingiva is crucial for maintaining the attachment level. However, in the 1980s, Dorfman, Kennedy [37] and Bissada et al. [38] started emphasizing that the advantage of free gingival graft stems from the thickness rather than the width of the attached gingiva, and thus plaque control is much more important, while Wennström [39] concluded from a 5-year follow-up after surgical removal of all keratinized gingiva that the width of keratinized gingiva is not related to gingival recession. Afterward, it has been acknowledged that the thickness of the marginal gingiva, rather than the width of the attached gingiva, is linked to gingival recession and that the decrease in the width of the attached gingiva is the consequence. In other words, patients with thin marginal gingiva can suffer discomfort from stimulation during mastication, direct mechanical trauma during tooth preparation, plaque accumulation, and orthodontic tooth movement toward thin gingiva resulting in accelerated gingival recession, so they must be treated carefully.

Furthermore, the ideal goal in the process of solving the 'gingival recession' problem is to regenerate the periodontal attachment apparatus histologically. In other words, a treatment strategy for regenerating the new cementum, periodontal ligament, and new bone around the root must be determined and, according to the research findings thus far (there are only a few papers that studied the histology in actual patients), subepithelial connective tissue graft suits this purpose. [40,41]

The case shown in Figure 22 is a male patient in his early 30s who visited our clinic for a persistent gingival recession following orthodontic treatment. He had a thin-biotype and dehiscence defects of alveolar bone was observed in CBCT, which were predictive of a buccal attachment loss due to continuous gingival recession, and thus I performed SCTG procedure around the maxillary and mandibular premolar areas on both sides in order to increase the gingival thickness via biotype conversion. In the right posterior region of the maxilla, we applied the Tunneling technique reported by Allen (Figure 23). [42,43] In the donor site, I obtained sufficient connective tissue graft as in the langer & langer method 3 and in the recipient site, I connected the envelope formed around the buccal side of each tooth, which is similar to the Bruno's technique but has the advantage of preserving the interdental papilla. Enough buccal gingival thickness was attained after surgery.

T Linkevicius [44] argued that the thickness of peri-implant soft tissue is related to bone resorption, which is related ,to the reconstruction of peri-implant biologic width, and thus a soft tissue graft is necessary. The 2014 clinical report by the same author [45] reported that in the case of a thin gingiva ≤ 2 mm, bone resorption could not be prevented even if the thickness of the surrounding soft tissue was compensated for by platform-switching during the implant surgery. In practice, we may meet

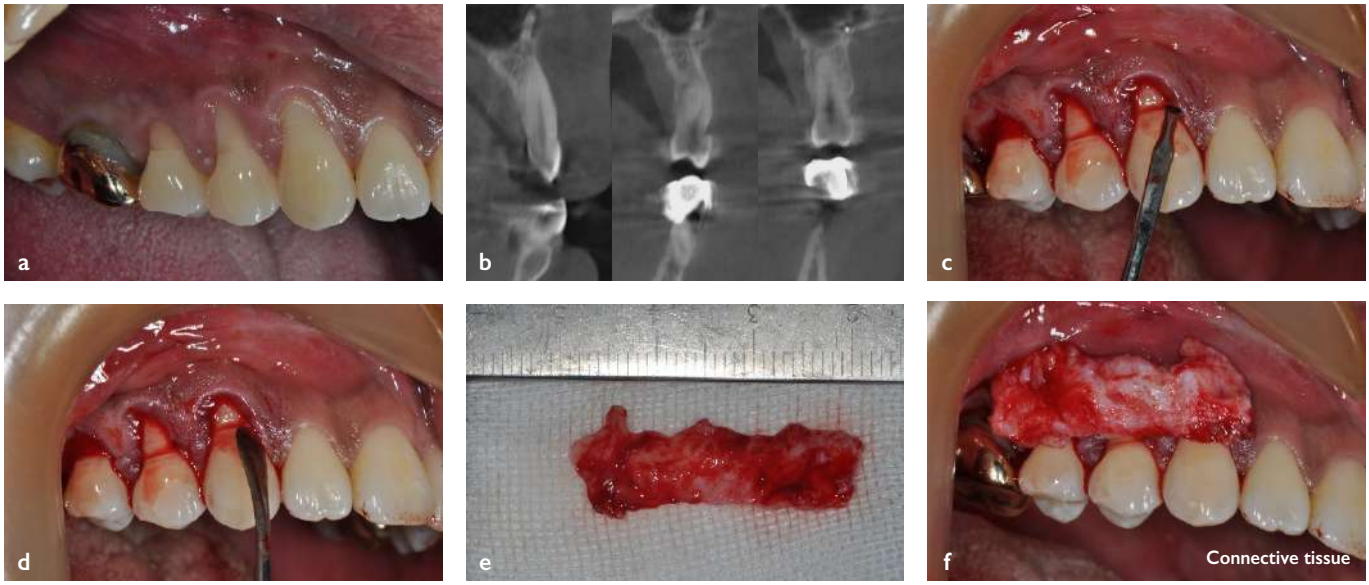

Fig 22a-f. For a simultaneous root coverage procedure on successive three teeth, I believe the appropriate method would be the 'Tunneling technique'. Since recipient site preparation is a type of blind technique, so an exact dissection may be difficult. During this procedure, you have to make sure there are no problems on the flap even when there is perforation in the periosteum. You need to dissect more than expected to place the required amount of CTG. You should be very careful about the mental nerve in the mandible

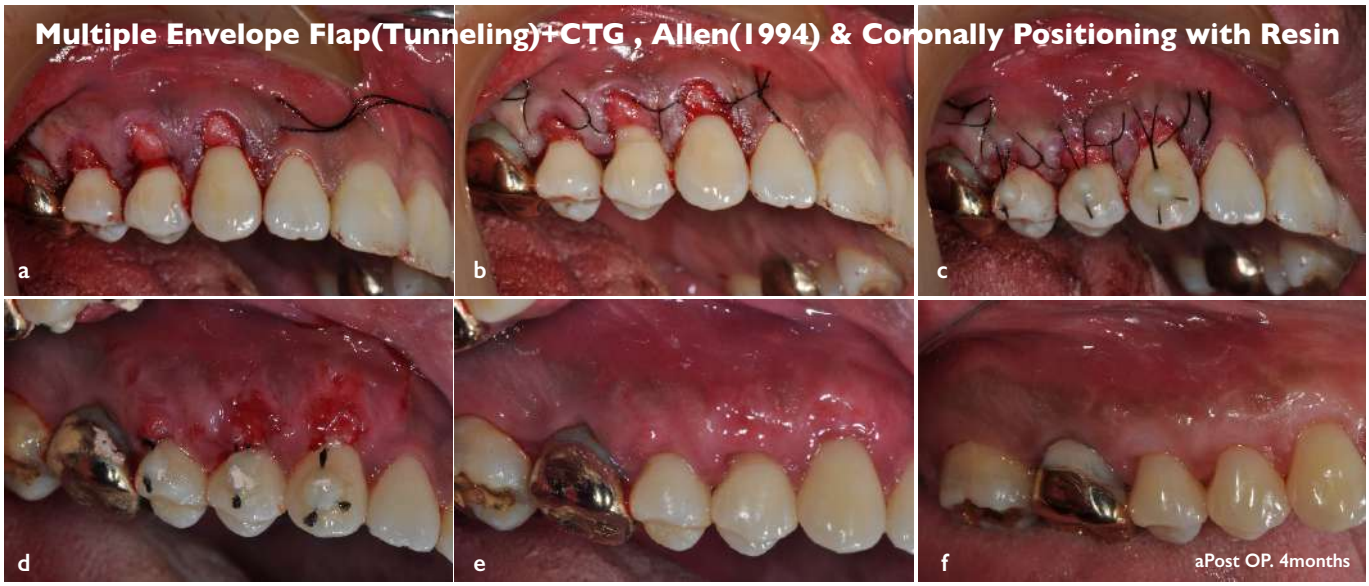

Fig 23a-f. A coronally positioned flap may be performed using sutures and resin if necessary. Typically, the graft can be immobilized with tissue adhesive alone. After surgery, a thick enough marginal gingiva is observed

some patients with thin-biotype gingiva during implant surgery, especially those who have been using removable partial dentures for a long time that the gingival thickness was considerably reduced (Figure 24). In such cases, we have to insert the fixture deeply into the alveolar bone in anticipation of bone resorption. However, because the height of the residual alveolar bone was not enough and thus the fixture could not be deeply inserted, even with short implants, I performed subepithelial connective tissue graft procedure around the implant during first surgery to thicken the surrounding soft tissue. During fixture-level impression in the same patient, a gingival thickness of about 2 mm was observed, which was greater than it was before surgery, and bone resorption is expected to be prevented as reported by T Linkevicius (Figure 25).

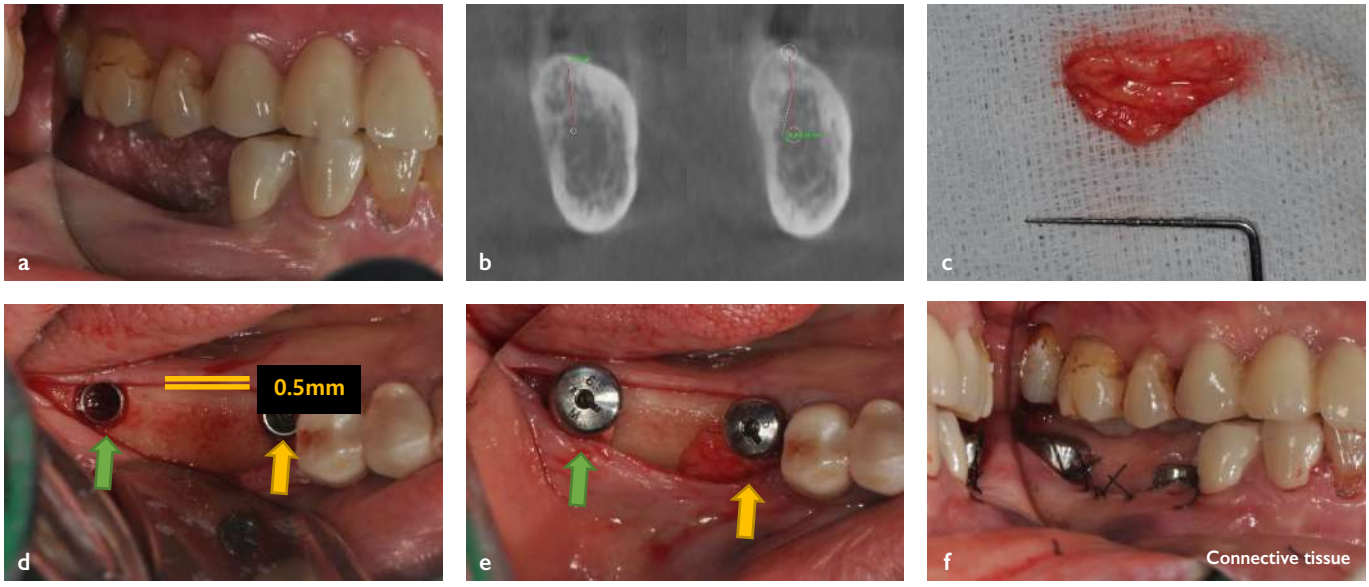

Fig 24a-f. During surgery, by measuring the thickness of the reflected flap and adjusting the fixture insertion depth, you can prevent exposure of the fixture surface that can lead to bone resorption, which is critically implicated in the formation of the peri-implant biologic width. If insertion depth is limited by a critical anatomical structure, then you can try Bio-type conversion via SCTG

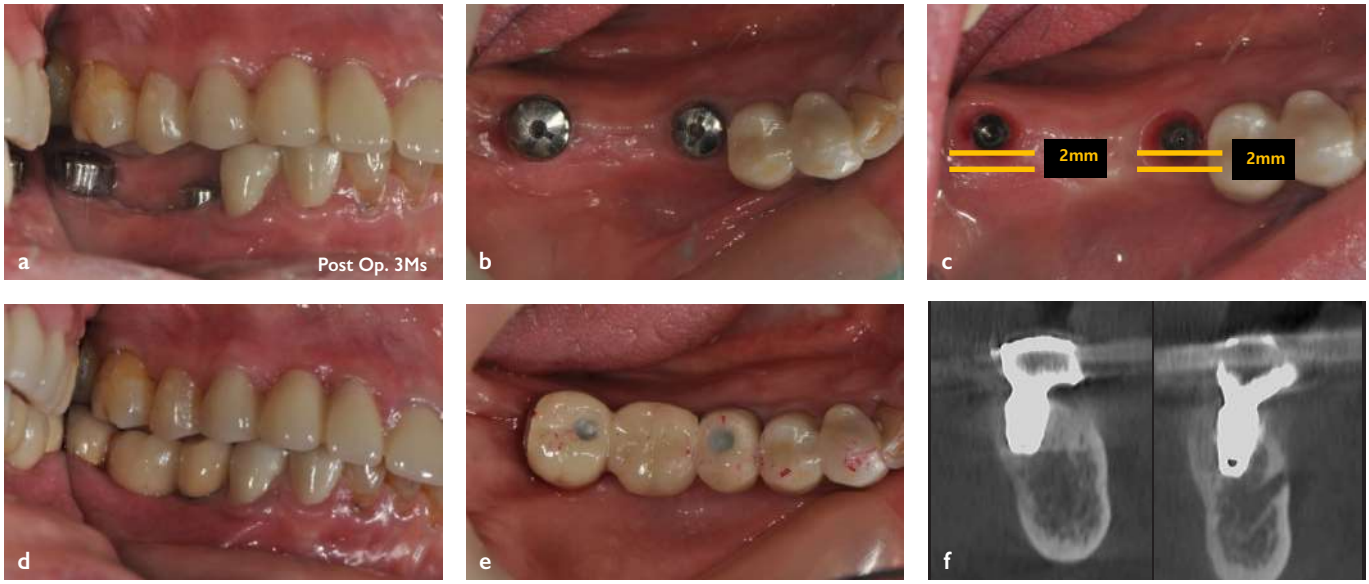

Fig 25a-f. 3 months after surgery, the soft-tissue thickness observed during primary impression-taking was confirmed to be greater than it had been initially. We then fabricated a customized abutment with an optimized emergence angle and subgingival contour and then installed the final prosthesis. Long-term monitoring of marginal bone resorption is necessary

<8> Research for developing soft-tissue graft substitute

Despite the many clinical uses of subepithelial connective tissue graft, in the clinician's perspective, it is a burden to create a second surgical site and cause pain and discomfort to patients, especially the elderly in today's aging society. These concerns have been shared by many researchers in the past 10 years. In recent years, we have come across many products in the field of soft-tissue regeneration that replace autogenous soft-tissue including allogenic [46,47], xenogenic, [48] and synthetic soft-tissue, as in alveolar bone regeneration. Although these materials are not yet demonstrating results comparable to autogenous soft-tissue in terms of volume expansion and stability, with the recent advances in bioengineering technology and development of novel methods that increase the cellular components in the graft material by culturing cells on scaffolds 49 [49,50] or that involve a combination of various growth factors [51,52] or equivalent substances (ex> Aptamer), [53] a product that can substitute SCTG, the "golden standard" today, will emerge in the

near future. In the case shown in Figure 26, we performed a one-stage implant placement in the alveolar bone in a patient with a thin gingiva and applied a combination of collagen material and epithelial growth factor between the healing abutment. During impression-taking after about 2.5 months, we confirmed a enough thickness and condition of the soft-tissue corresponding to the peri-implant biologic width (Figure 27).

In the case of immediate implantation after tooth extraction in the anterior maxillary area, soft-tissue substitutes are being used to construct a healthy biologic width and soft-tissue thickness, but the predictable indications, materials, and procedure shave not yet been established. In some cases, the thickness of the marginal gingiva was maintained and no gingival recession occurred in the long-term (Figure 28), but in other cases, gingival recession occurred in the same period to yield esthetic problems (Figure 29).

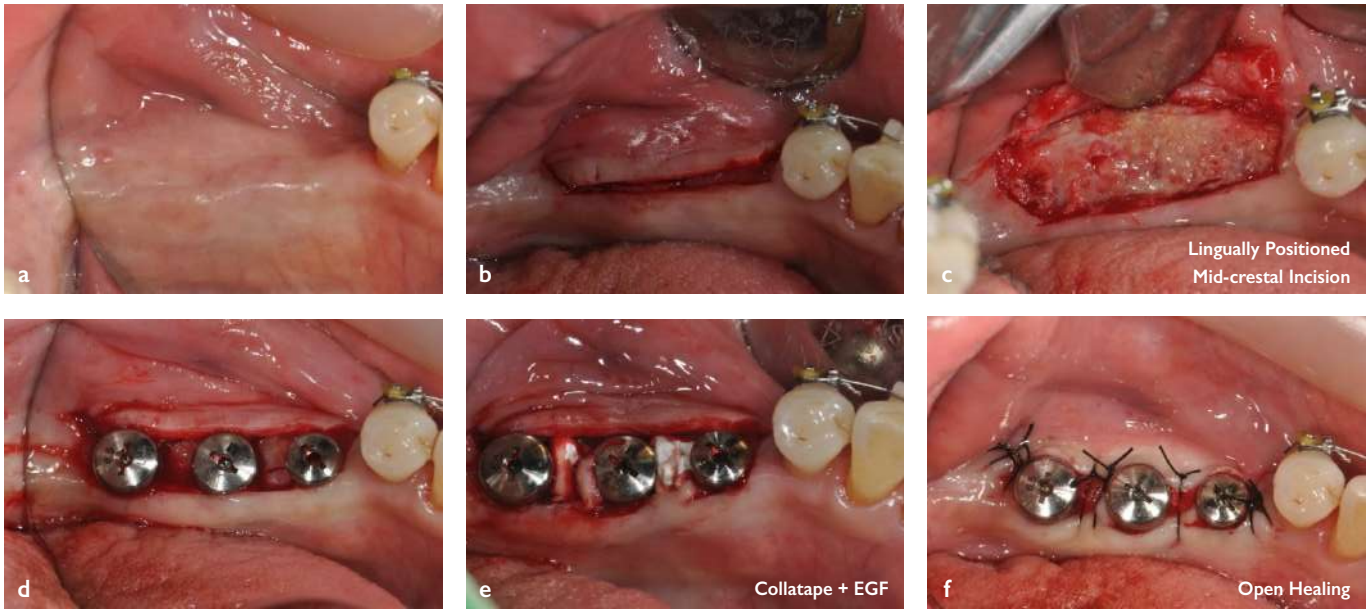

Fig 26a-f. When connecting the healing abutment after implant placement, you can decide on how to deal with the gap between the healing abutment depending on the amount of surrounding keratinized gingiva. If there is minimal keratinized gingiva, and thus the Palacci technique cannot be used, you can either perform a palatal soft-tissue graft or wait for secondary healing without doing anything. In the case of regenerated bone, however, soft-tissue coverage is advantageous. In this case, I closed the interdental space by applying a combination of collagen material and epithelial growth factor(EGF)

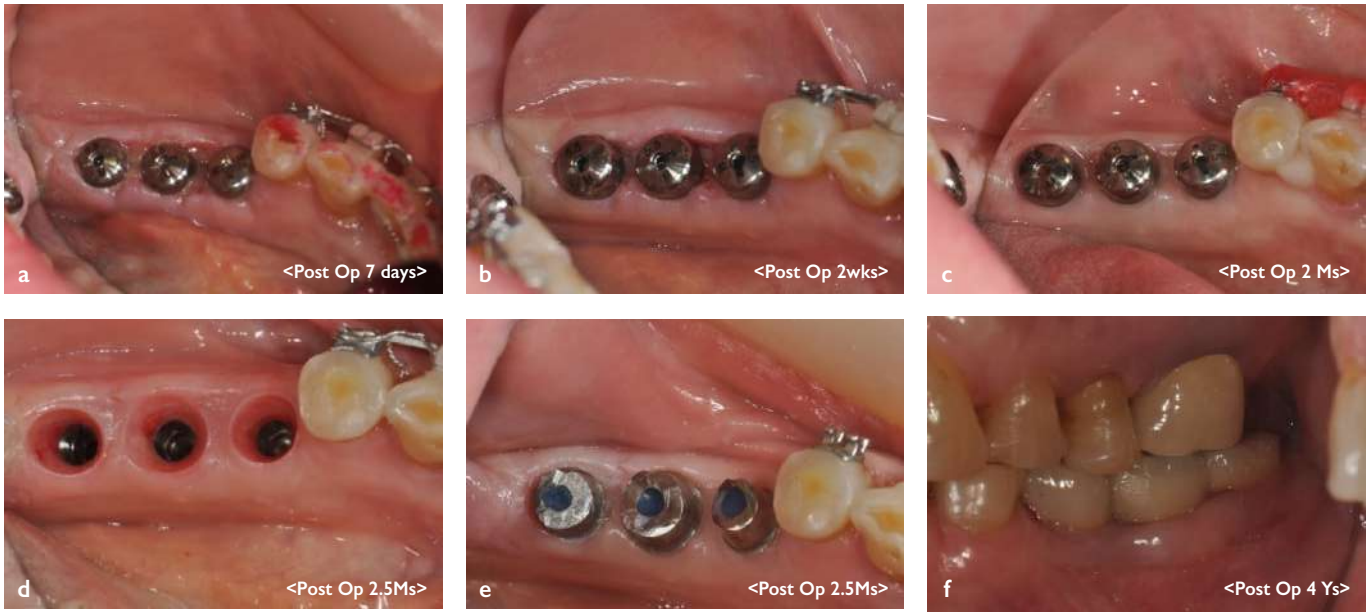

Fig 27a-f. When I removed the healing abutment to take the 1st impression 2.5 months after the second stage surgery, we observed that the interdental area was healed with a sufficient amount of soft tissue. We then fabricated a customized abutment and zirconia final prosthesis. The soft tissue in this area remained healthy during the 4 years of postoperative follow-up

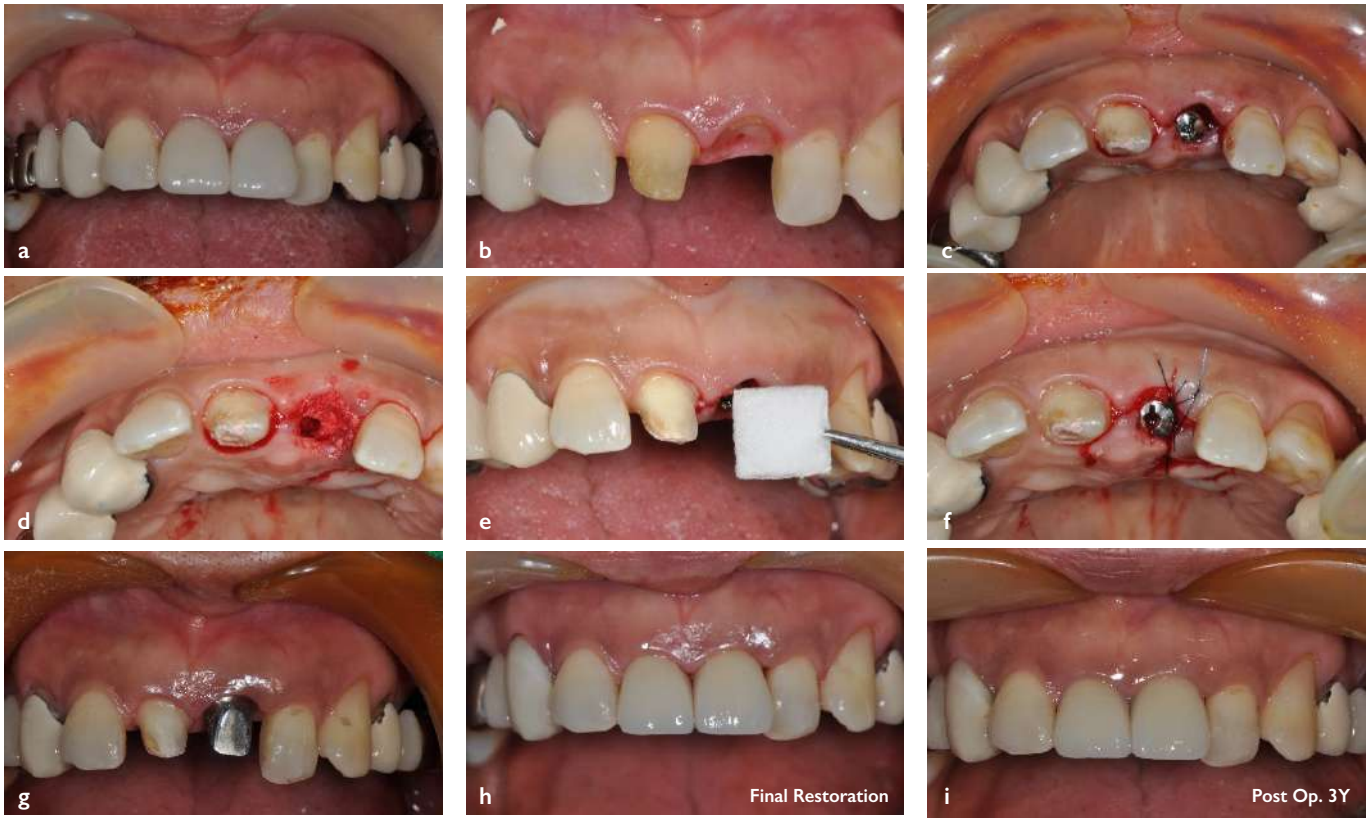

Fig 28a-f. In this case of immediate implantation after tooth extraction, an increase in the labial soft tissue is anticipated. I applied a combination of slightly thick collagen material and Epithelial Growth Factor.The soft tissue was in a good condition after 3 years.

Fig 29a-f. This is a case of immediate implantation after tooth extraction and an increase in labial soft tissue is required. I applied a combination of synthetic bone graft and slightly thin collagen material with epithelial growth factor(EGF). A slight gingival recession was observed at postoperative year 3, the cause of which should be further discussed

Many scientific research studies must be conducted in the future to investigate whether this was caused by the thin-biotype of the original soft-tissue in the area or the use of the thin collagen material and whether different results can be obtained by subepithelial connective tissue graft.

Conclusion

As the internal and external environment of clinical practice in dentistry changes rapidly, we have now come to the point where patients demand implant treatment as the first choice of treatment once tooth extraction has been decided. In the past 20 years or so, dentists have accumulated a lot of experience with implant surgery, and today, they agree that the health status of peri-implant soft tissue is critically implicated in the long-term prognosis of implants.

Traditionally, subepithelial connective tissue harvested from the palatal side has been used for root coverage around natural dentition. Recently, with the increase and advancement of implant surgery, it has been used extensively for various purposes in peri-implant soft tissue management. In other words, although it had started from the single purpose of root coverage, it is now being used for not only esthetic purposes like interdental papilla restoration but also enhancing the long-term prognosis of the implant by preventing peri-implant bone loss. In line with this, many soft-tissue substitutes based on bioengineering are being developed, which is expected to help somewhat reduce the postoperative discomfort of patients.

Since subepithelial connective tissue graft has various indications and respective modifications in periodontal treatment and implant surgery, clinicians must choose the appropriate method through a detailed diagnosis of each case. At the same time, we must strive to avoid unnecessary procedures by fully considering the contraindications and precautions.

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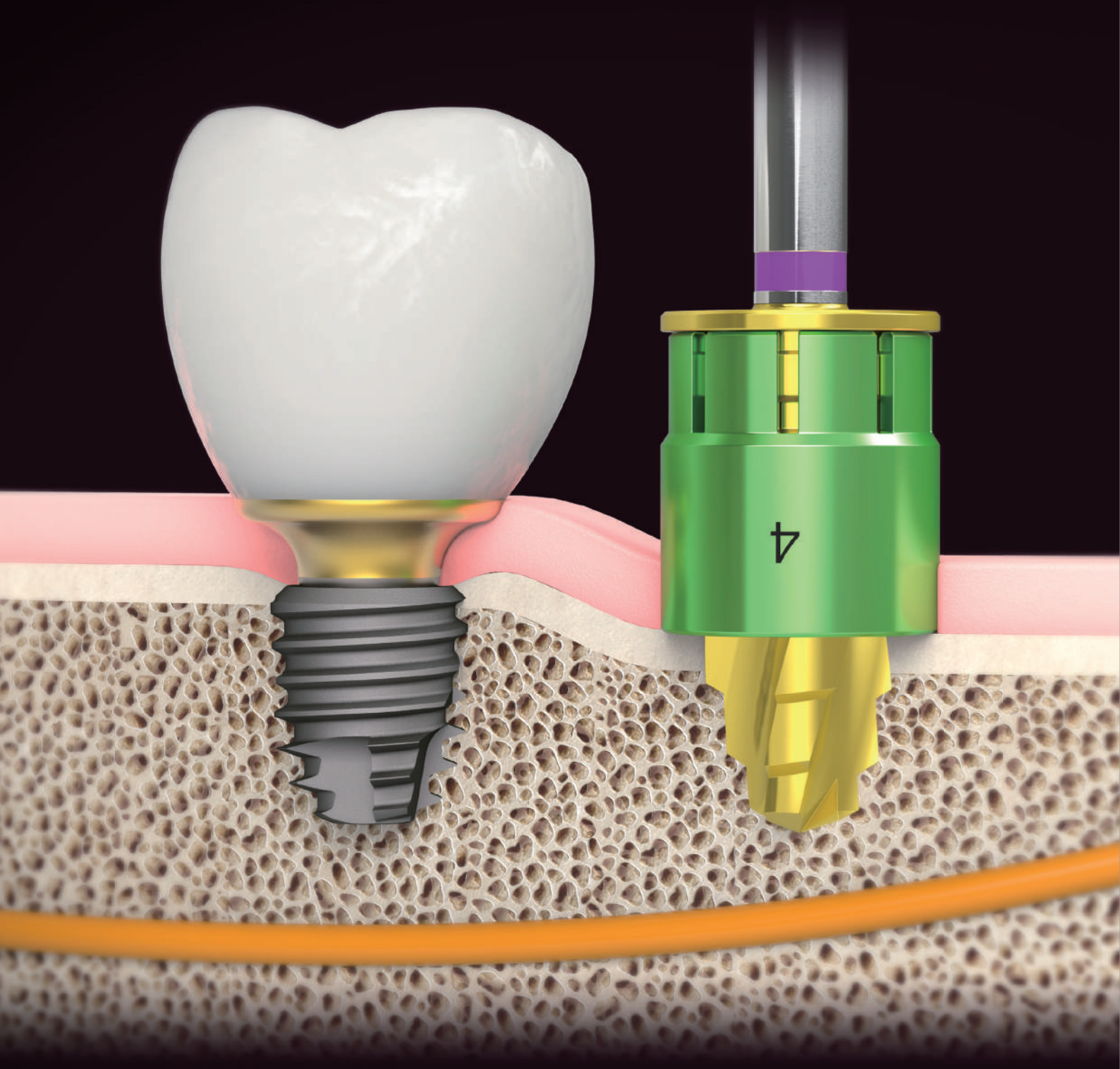

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Lateral ridge augmentation with guided bone regeneration in mandibular posterior area : A clinical case report

Pil Lim, DMD, MSD, PhD

Introduction

Dental implant treatment has become a widespread and predictable modality for the restoration of the missing teeth. Presence of sufficient bone volume around the implant is a prerequisite for predictable, long-term prognosis in implant dentistry. Deficient bone volume can be augmented by several techniques such as autogenous block bone grafting, ridge splitting, distraction osteogenesis, and guided bone regeneration (GBR). Several ridge augmentation techniques are utilized in implant dentistry, of which GBR is the most common procedure. The basic concept of GBR involves placement of mechanical barriers to protect the blood clots and isolate the bone defect site from the surrounding soft tissue, thereby providing a secluded space to the osteogenic cells for bone regeneration. GBR can be achieved with the use of particulate autogenous bone grafts, allografts, xenografts, or alloplastic grafting materials, as well as resorbable or non-resorbable barrier membranes.

Autogenous bone is considered as the gold standard of grafting materials. Autogenous bone possesses osteoconductive, osteoinductive, and osteogenetic properties; however, it has several disadvantages. The need for additional surgery may be associated with corresponding risks, complications, and higher morbidity. In addition, the duration of surgery is longer, and the amount of autogenous bone obtained is usually limited.

Allografts are the tissues obtained from the individuals of the same species. The use of allogeneic bone, i.e., the bone from human donors, can overcome the disadvantages of autogenous bone grafts. The benefits of allogeneic bone grafting are the avoidance of a secondary donor site, reduced duration of surgery, decreased blood loss and host morbidity, and an unlimited supply of graft material.

A barrier membrane should satisfy the following conditions: (1) biocompatibility, which refers to the absence of the interactions between the material and the host tissue, (2) cell occlusivity, which means the prevention of soft tissue in-growth, (3) tissue integration by the host tissues, (4) clinical manageability, and (5) space creation. Currently available barrier membranes are of two types, namely non-resorbable and resorbable.

Non-resorbable membranes require a second surgery for their removal. Moreover, exposure to these membranes may lead to the complete failure of the regeneration process. These disadvantages led to the development of resorbable membranes.

Resorbable collagen membranes are most commonly used for GBR in dentistry. The chief advantage of resorbable membranes is that a second surgery is not required for their removal. The unique manufacturing process of the membranes creates a longer resorption profile suited to GBR procedures.

The present report describes a clinical case of GBR using allogeneic bone grafts and a resorbable collagen membrane for lateral ridge augmentation.

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Case Report

A 52-year-old woman presented with a need for posterior implantation instead of old fixed partial denture. Her medical history was non-specific. The old fixed partial denture was removed and the mandibular second molar (#47) was extracted before implant surgery. Six weeks after the extraction, implant surgery with GBR was performed under local anesthesia in the right mandibular posterior region (Fig. 2a).

The mucosa was opened with a paracrestal incision approximately 2 mm toward the lingual aspect and extended through the sulcus of the adjacent teeth to the buccal aspect of the alveolar crest (Fig. 2b). This incision is known to allow for tension-free primary closure with the periosteal releasing incision and coronal advancement of the flap in patients who need ridge augmentation procedures. Implants were placed (Fig. 2c; SQ Implant, DENTIS, Daegu, Korea) after optimal site preparation following the manufacturer's guidelines. Minor buccal dehiscence defects were observed after the placement of the implants. This exposure of the implant surfaces resided within the envelope of bone and lateral ridge augmentation in such defects can be predictably obtained with the GBR technique. Cortical perforation was done for the activation of bone regeneration (Fig. 2c), following which an allogeneic bone material (Freeze Dried Bone Allograft [FDBA], mixture of cortical and cancellous bone) was grafted (Fig. 2d; Ovis Allo 0.3 g, DENTIS, Daegu, Korea). The grafted bone materials were covered with a resorbable collagen wqmbrane (Fig. 2e; Ovis BCP/Collagen Membrane 15x20 mm, Daegu, Korea). This membrane consisted of type I atelocollagen derived from porcine skin and biphasic calcium phosphate. Stabilization of the barrier membrane during GBR is the key to success of the procedure. In this case, the horizontal mattress suturing technique was used to immobilize the barrier membrane (Fig. 2e).

Primary wound closure of the surgical flap must be obtained to achieve good results of bone regeneration. The surgeon must ensure precise and tension-free wound closure. A periosteal incision is often necessary to achieve this, in order to advance the flap in a coronal direction (Fig. 2f). Monofilament suture material is recommended and 4-0 non-resorbable suture was used in this case (Fig. 2g). The sutures were removed after 7–14 days.

Fig 1. Pre-operative panoramic X-ray

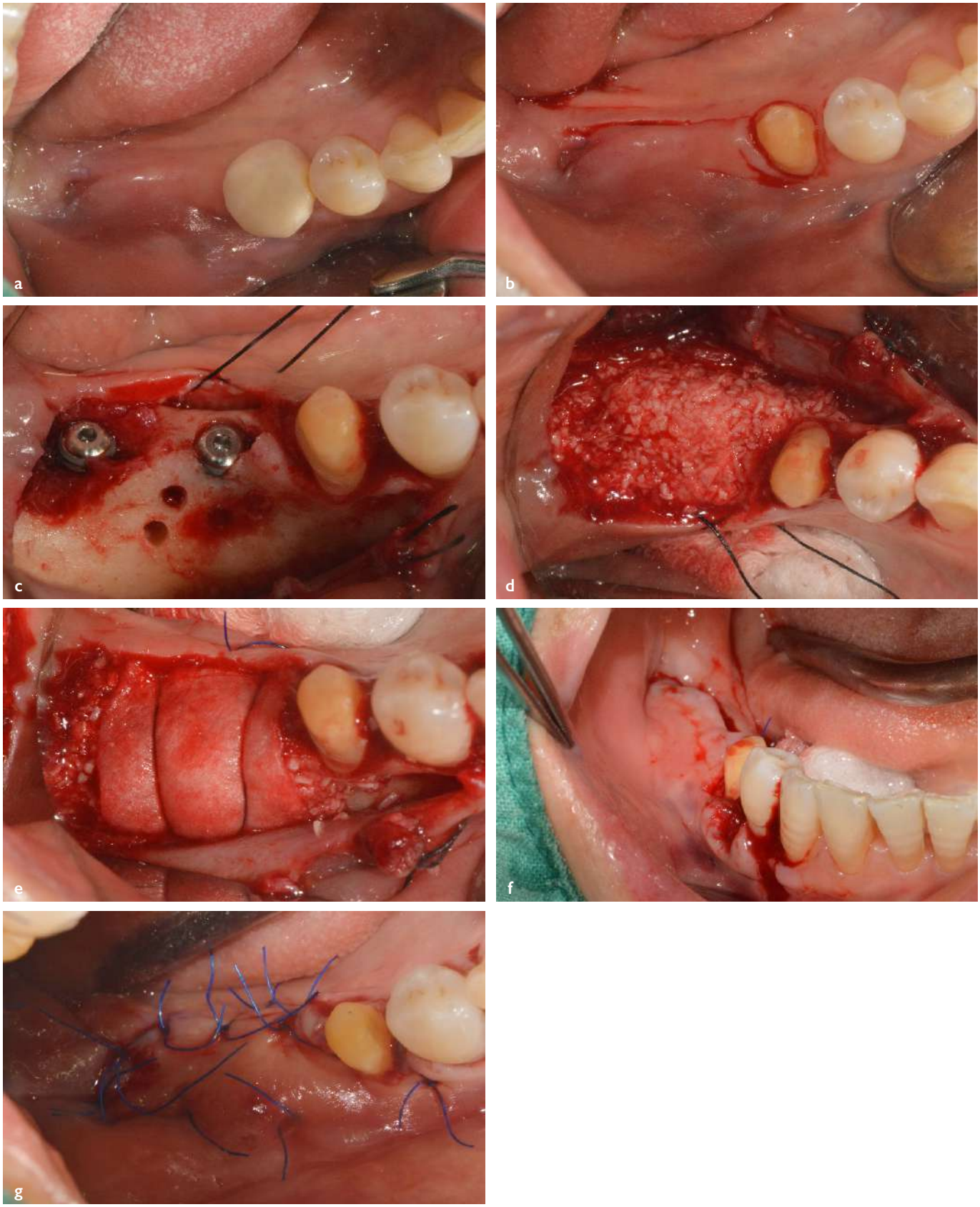

Fig 2a-g. (a)Before implant surgery (b)Incision (c)Flap elevation and implant placement (d)Application of allograft (FDBA) (e)Covering with resorbable collagen membrane (f)Checking for tension-free primary closure (g)Suturing

Sufficient time is required for healing to ensure successful outcomes of the GBR procedure. A second surgery was performed after 4 months because allografts were used in this case (Fig. 3a). An extended healing period of 6 months or more may be required in cases where xenografts or alloplasts are used.

A free gingival graft procedure was performed during the re-opening stage to increase the width of the keratinized gingiva in the implant area. First, a partial thickness flap was raised on the buccal side (Fig. 3b), and the cover screws were exposed and connected to the transmucosal healing abutment (Fig. 3c). The recipient site was prepared for placement of the graft. The graft was harvested from the maxillary premolar area of the palate and sutured to the periosteum of the recipient site to avoid displacement during wound closure (Fig. 3d).

There is ongoing controversy in the literature regarding the importance of keratinized gingiva around the implants. However, it is clear that keratinized gingiva is not a prerequisite for peri-implant health but is helpful in maintaining the implant. An impression was made and the final restoration was fabricated after 4 to 6 weeks following the healing of the soft tissue (Figs. 3e and 3f).

Ultimately, excellent ridge width and soft tissue dimensions were achieved, which assisted in implant placement and restoration as shown in Fig. 3f.

The dimensions of the buccal bone can be examined by three-dimensional radiographic imaging. Cone beam computed tomography (CBCT) offers excellent image quality with reduced exposure to radiation as compared to the conventional dental CTs.

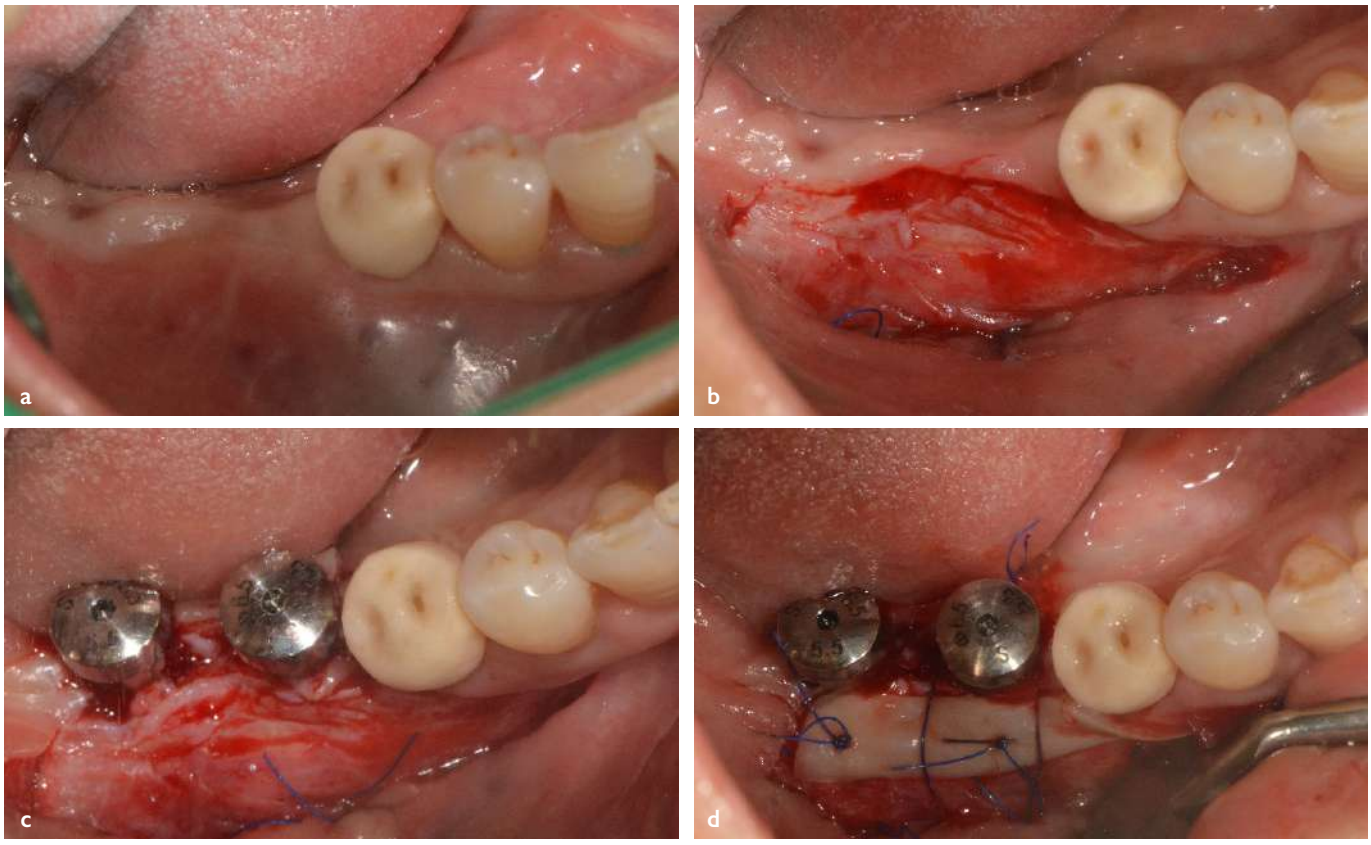

Fig 3a-d. (a)4 months post-operative (during second surgery) (b)Recipient bed preparation for free gingival graft (c)Uncovering and connection of healing abutment (d)Gingival graft secured with sutures

Fig 3e-f. (e)6 weeks after the surgery (f)Final delivery of the restoration(Note the buccal bone volume and keratinized gingiva)

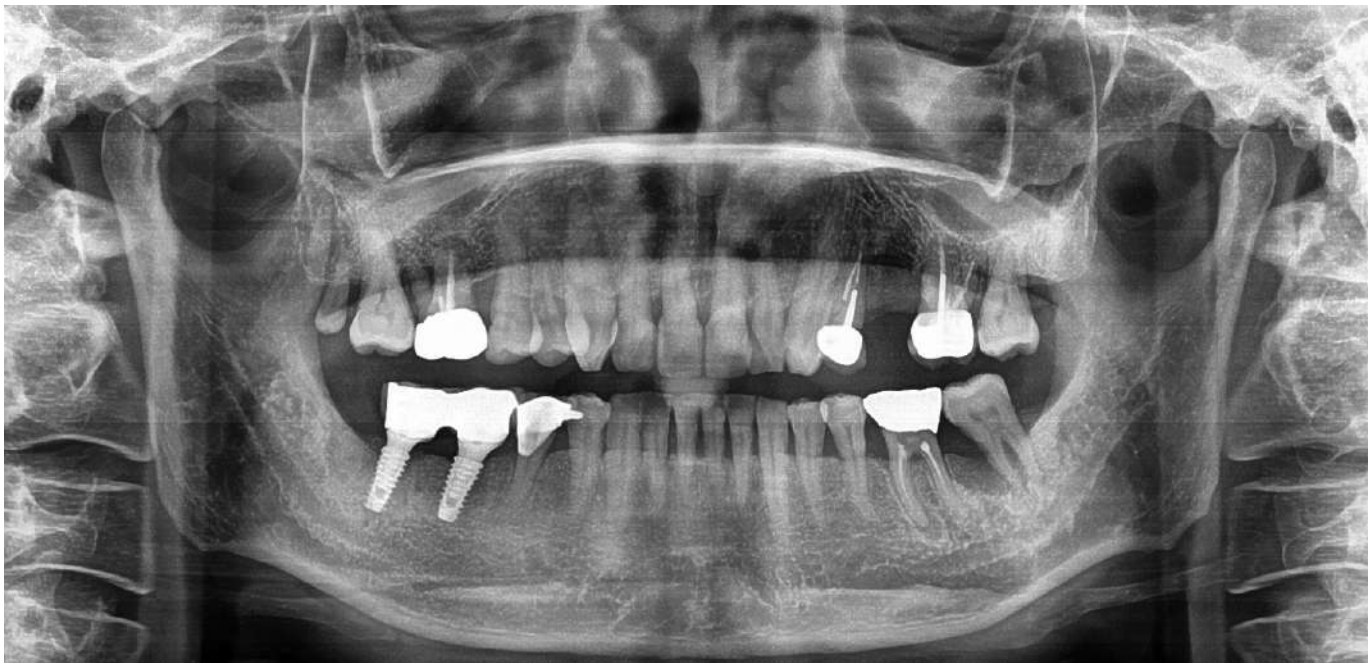

Fig 4. Post-operative panoramic X-ray

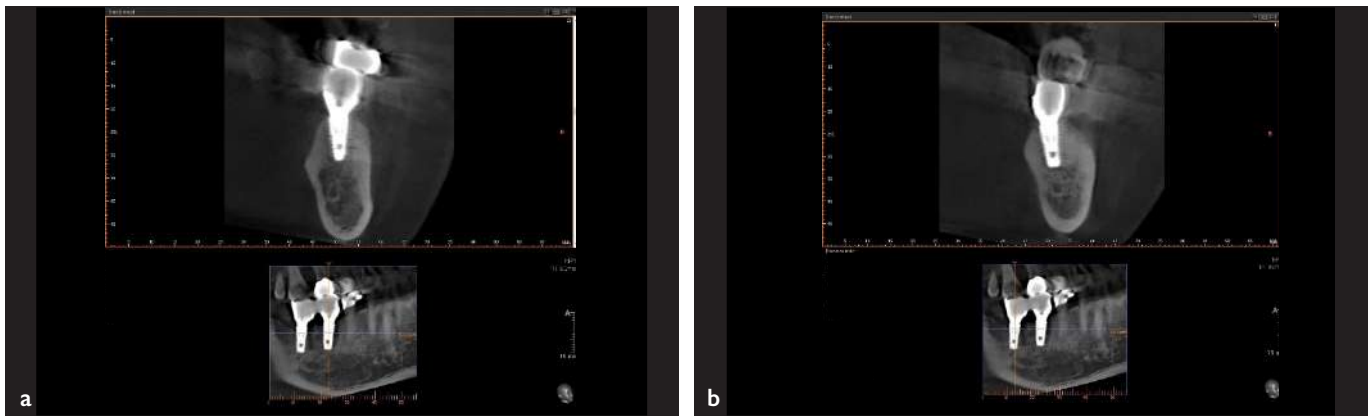

Fig 5a-b. CBCT image of #46 and #47 site after bone augmentation(Note the successful buccal augmentation)

Discussion

GBR is commonly performed in combination with dental implant rehabilitation. It is a technique that enhances bone growth by maintaining the space and preventing soft tissue ingrowth, utilizing either a resorbable or non-resorbable barrier membrane. GBR may be performed in conjunction with or by a surgical intervention prior to the implant placement. Various materials have been used as membranes in experimental and clinical studies on GBR.

This clinical case report demonstrates the feasibility of an allogeneic bone material and resorbable collagen membrane for lateral ridge augmentation. Remarkable lateral bone augmentation was achieved without the need for a non-resorbable membrane.

Use of a resorbable collagen membrane eliminates the need for a second membrane removal surgery and requires less manipulation, thereby reducing the time needed to perform the procedure, and decreasing postsurgical trauma and patient morbidity.

This clinical report illustrates the restoration of a partially edentulous posterior mandibular ridge with dental implants. The lateral ridge defect area was grafted with FDBA and covered with a resorbable collagen membrane, which was chosen considering its excellent handling characteristics and optimal resorption profile (4 to 6 months) This augmentation procedure resulted in clinical and radiographic (CBCT) gains in horizontal components of the osseous defects, thereby facilitating subsequent placement of dental implants.

Generally, allogeneic bone grafts show histological characteristics analogous to those of the autogenous bone. Allogeneic bone completely transforms into the recipient's own bony tissue after the completion of healing. However, further studies should be carried out to assess the long-term success of dental implants following the use of allogeneic grafts.

Conclusion

This clinical case report suggests that the use of an allogeneic bone material (FDBA) and resorbable collagen membrane in GBR is an effective means of achieving horizontal ridge augmentation.

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Maxillary posterior implant restoration using socket preservation for site developement: a case study

Jeongcheol Park, DMD, MSD

Introduction

Clinicians meet many challenges while performing an implant on a patient with severe periodontal disease following tooth extraction due to widespread alveolar bone resorption. The first challenge is placing the implant in the absence of sufficient bone. Clinicians must determine how to restore the alveolar ridge where severe resorption occurred after tooth extraction. Restoring the alveolar ridge is an especially important problem when the ridge is close to anatomical structures such as the maxillary sinus and the inferior alveolar nerve.

The second challenge is managing the implant/crown ratio. The ratio between the crown length and the length of the dental root supported by the alveolar bone is an important issue for teeth. This ratio is comparatively less important for implants.1 However, the longer the crown, the more difficult self-cleansing, and maintenance become, especially since there is a lack of keratinized gingiva around dental implants.[2]

This paper reports a case of socket preservation for site development overcoming these challenges.

Clinical case

A 63-year-old man C.C: The patient had difficulty eating due to loose teeth. The patient had lost tooth #17 a long time before and had difficulty chewing due to alveolar bone loss at tooth #16, #24, and bridegs #25~27 resulting in loose teeth.

Treatment Plan

1. Extract bridges #16, #24, #25~27 and restore implants #16, #17, #24~26, #27.
2. Restore crowns #36, 37, 46, 47.

Based on Elian's socket classification, tooth #24 was deemed Type 3, and teeth #16, and #25~27 were deemed Type 2. Implant placement immediately after extraction was considered difficult due to alveolar ridge resorption. It was also predicted that delayed implant placement would lead to further bone resorption and soft tissue recession, hindering alveolar bone restoration. Thus, socket preservation was planned in order to secure sufficient alveolar bone for implant placement and prevent soft tissue recession.3 After securing approximately 4-5 mm of alveolar bone through socket preservation, implants could be placed via maxillary sinus elevation using the transalveolar approach.

A crown restoration was planned in the mandibular posterior teeth since these teeth had dental caries, extrusion, and fracture. Restoration could not be performed for the maxillary and mandibular anterior teeth even though the teeth required periodontal and orthodontic treatments. The mandibular molar crown restoration was thus planned to secure posterior support and to protect the anterior teeth.

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Fig 1. Panoramic image taken during the first examination

Fig 2a-c. Front and lateral (left and right) views of the teeth during the first examination

Fig 3. Tooth #16

Fig 4. Bridges #24, #25-27

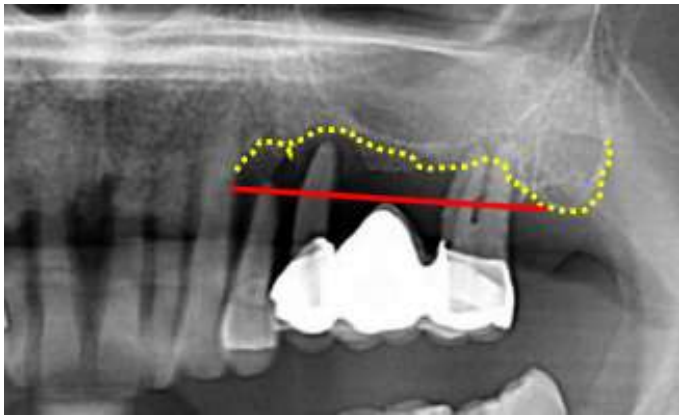

Fig 5. A preoperative panoramic image of teeth #24~27. Yellow dotted line – current position of the alveolar ridge, red line – the expected position of the alveolar ridge after socket preservation

Fig 6. Tooth #24 and bridges #25~27 before extraction

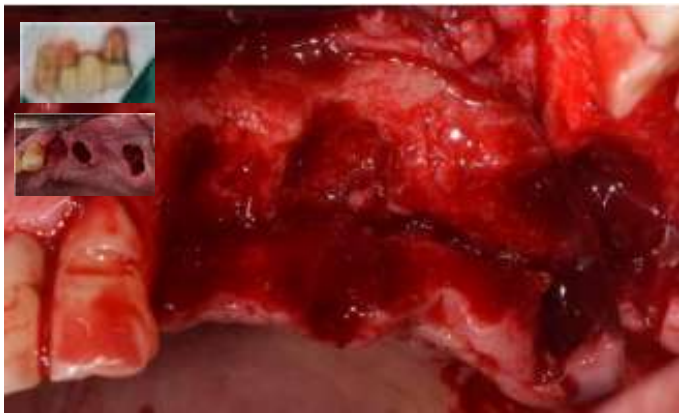

Fig 7. Flap elevation for socket preservation

Fig 8. Socket preservation with horizontal and vertical bone augmentation had to be performed. However, the site of bone loss was in an unfavorable condition for securing sufficient space for socket preservation. Therefore, a titanium-reinforced d-PTEF membrane was used

Fig 9. Ovis XENO-P bone graft was used

Fig 10. Sutures were performed. (PTFE sutures)

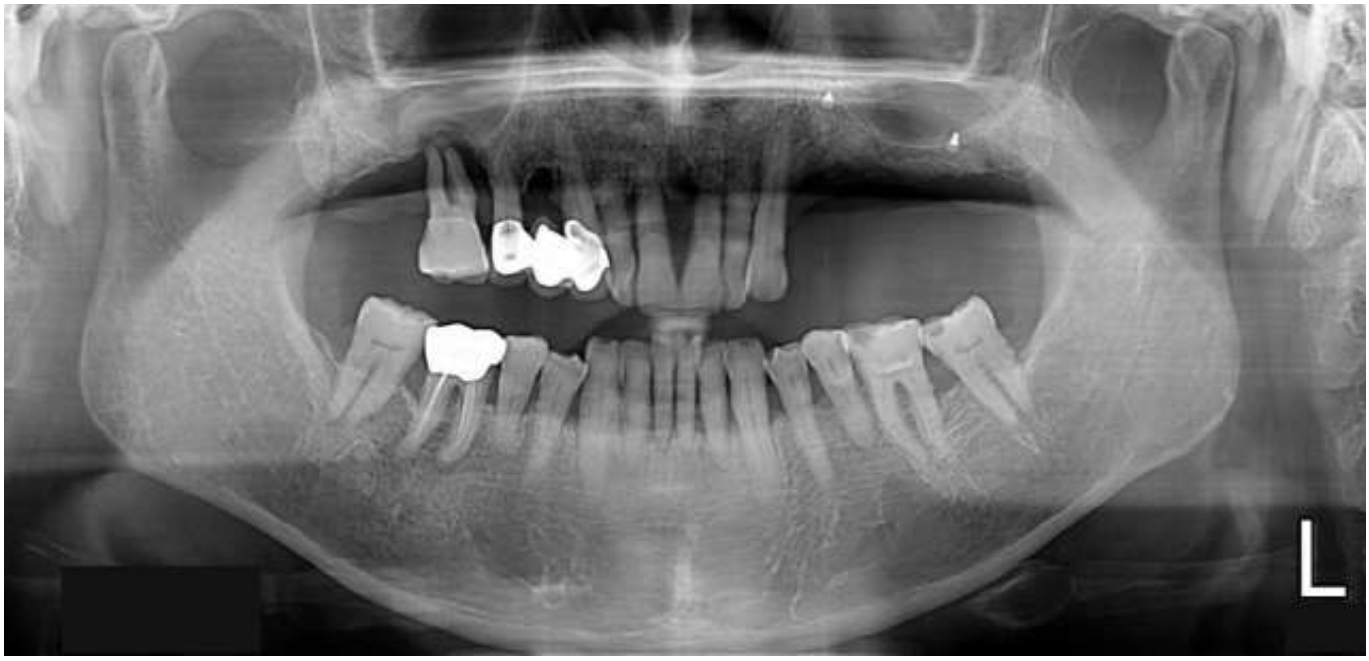

Fig 11. Panoramic image taken after socket preservation on teeth #24~#27

Fig 12. Partial removal of suture. (POD 10days)

Fig13. Before membrane removal (POD 5 weeks)

Fig 14. #Membrane removed.(POD 5weeks)

Fig 15. 5months and 10days after socket preservation

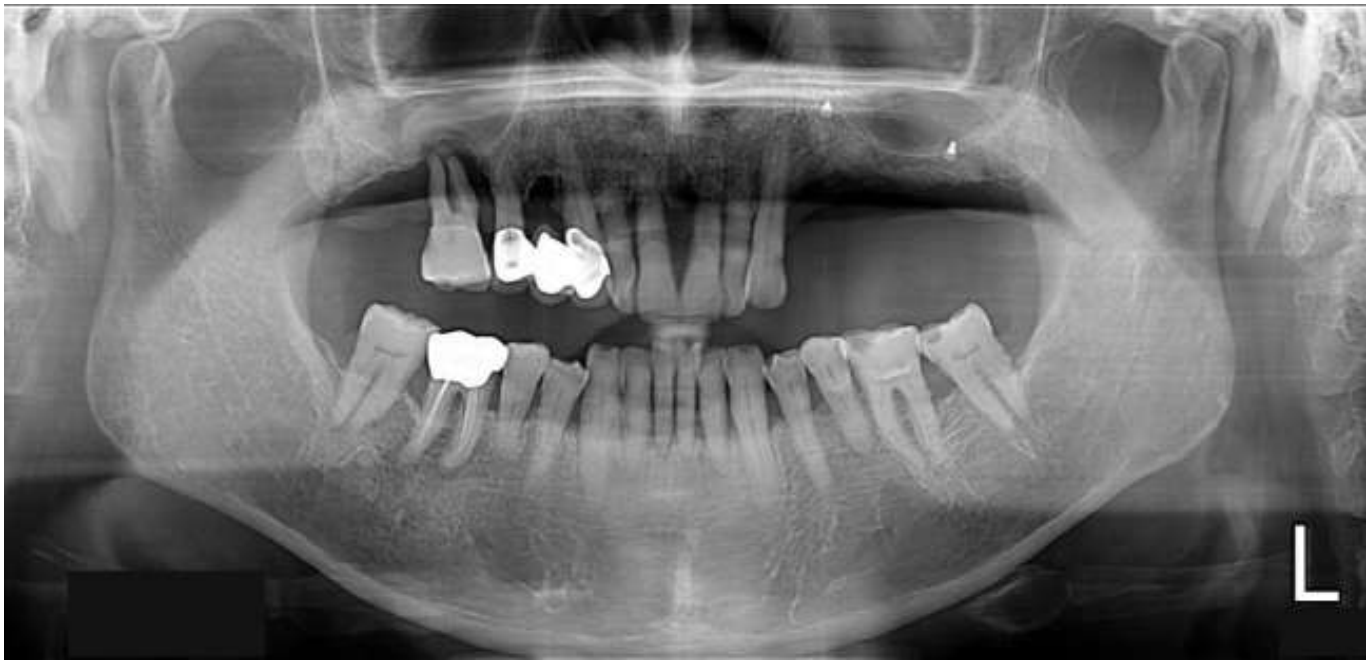

Fig 16. Panoramic image taken before implant placement. Implant placement on teeth #24, 26, and 27 was planned

Fig 17. Flap elevation for implant placement. Membrane screws were removed

Fig18. After placing implant #24, implant #26 was placed by transalveolar sinus floor elevation . A hole was drilled on the sinus floor using a 6 mm stopper drill. Approximately 5 mm of residual bone height was measured

Fig 19. #27 implant was also placed by transalveolar maxillary sinus elevation. A hole was drilled on the maxillary sinus floor using a 6 mm stopper drill. Approximately 5 mm of residual bone height was measured

Fig 15. Sinus membrane was elevated using water pressure at tooth #26,27. No bubbles were observed during aspiration; thus, no sinus membrane perforation was suspected

Fig 21. #24, 26, 27 implants were placed

Fig 22. All three implants were fixed with a force of 30 N. The operation was concluded 1stage surgery

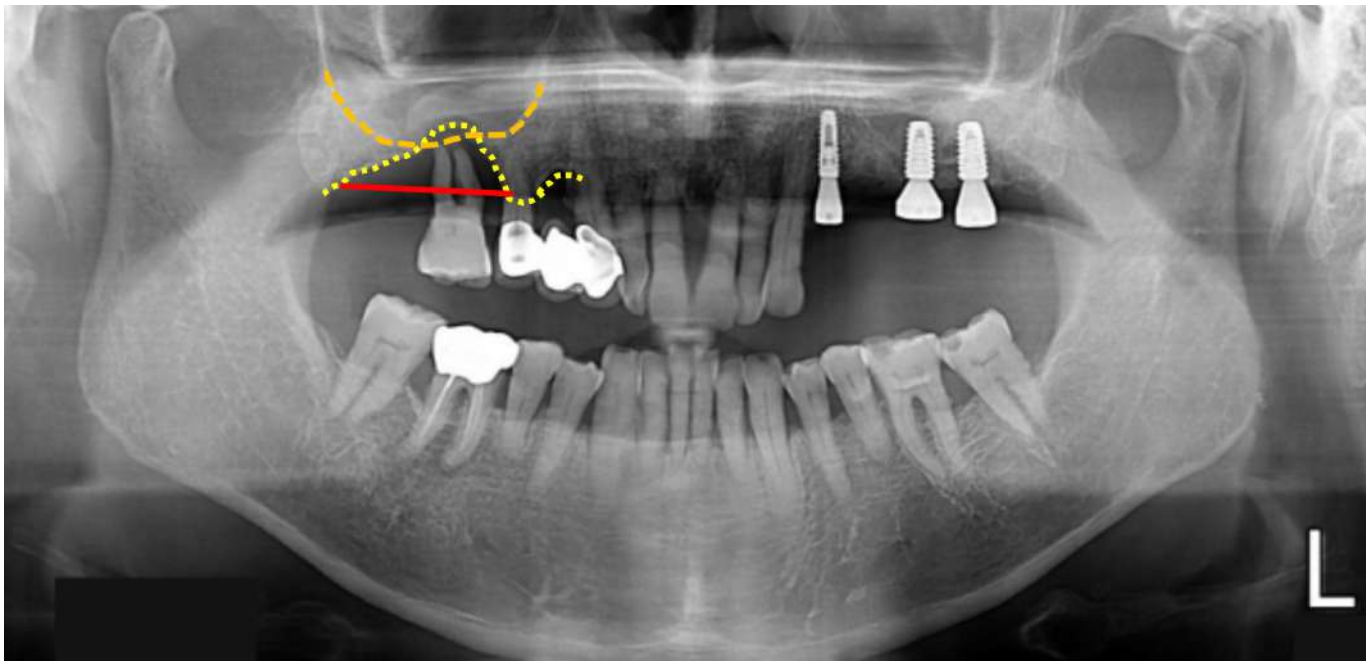

Fig 23. Panoramic image obtained following implant #24, 26, 27 placement. #24- 3.5 × 10 mm, #26- 5.0 × 8.5, #27- 5.0 × 8.5 A preoperative panoramic image of teeth #16,17. Yellow dotted line – current position of the alveolar ridge, Orange line – Sinus floor, Red line – the expected position of the alveolar ridge after socket preservation

Fig 24. #The patient complained of discomfort at tooth #16 following the left implant placement. Tooth extraction was planned

Fig 25. Tooth #16 was extracted

Fig 26. 3 days after the extraction of tooth #16, socket preservation for site development was performed

Fig 27. #16 Site of bone loss. Buccal and palatal walls were completely lost. Securing sufficient space for GBR was important

Fig 28. A space was secured using a titanium mesh on the buccal side. On the palatal side, palatal flap thinning was performed, and a bioresorbable membrane was placed

Fig 29. FDBA was placed in the socket

Fig 30. Ovis XENO-P bone graft was placed outside the socket

Fig 31. The site of the lesion was covered with a bioresorbable collagen membrane

Fig 32. The suture was performed after socket preservation at tooth #16

Fig 33. The suture was removed 15 days later

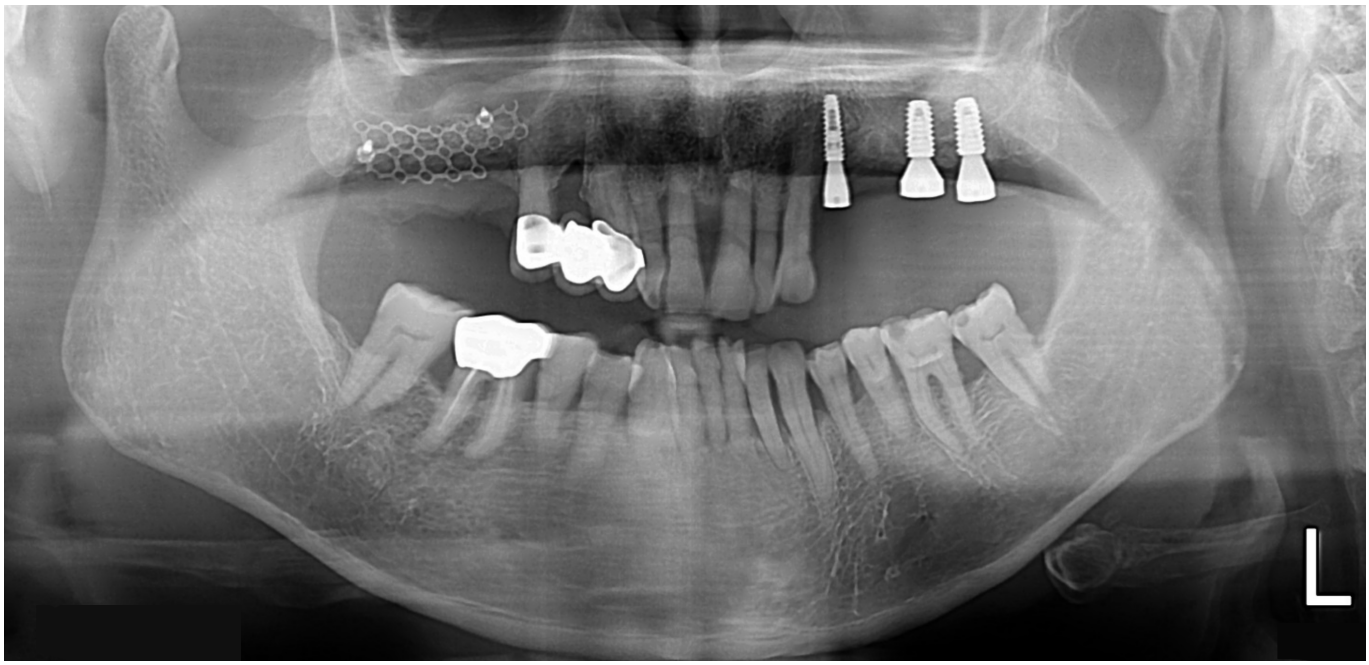

Fig 34. Panoramic image obtained following after socket preservation at tooth #16

Fig 35. Six weeks after the surgery. The titanium mesh could be seen through the soft tissue

Fig 36. 10 weeks after the surgery. Titanium mesh removal was planned since the titanium mesh could be seen through the soft tissue, and there was a risk of soft tissue perforation

Fig 37. Following the titanium mesh removal, the buccal lesion site was well-restored. The mesh and screws were removed

Fig 38. Sutures were performed after mesh removal

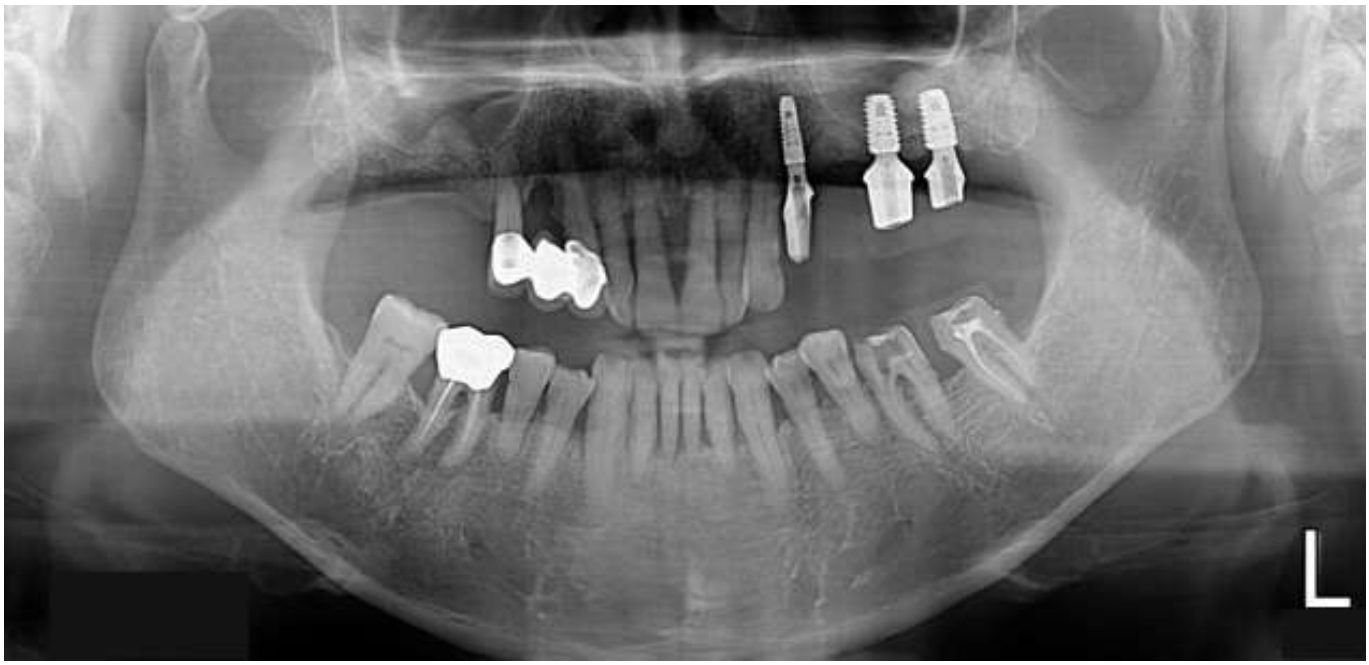

Fig 39. About 6months after socket preservation at tooth #16. Implant placement on teeth #16,17 was planned. Progressive loading was applied to the left maxillary teeth, starting 4 months after the implant placement

Fig 40. The oral cavity six months after socket preservation of tooth #16 and before implant placement for teeth #16 and 17

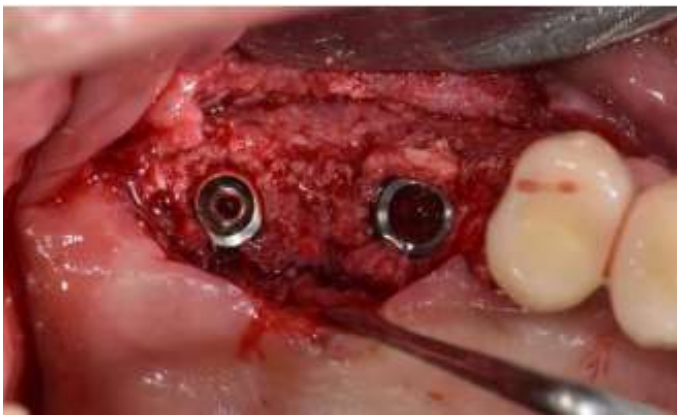

Fig 41. The transalveolar condition following the implant placement. The alveolar bone, which was damaged at the first examination, was well-restored

Fig 42. The damaged buccal alveolar bone was well-restored

Fig 43. The initial fixation was achieved with a force of approximately 30N. Implant placement was performed as a one-stage operation

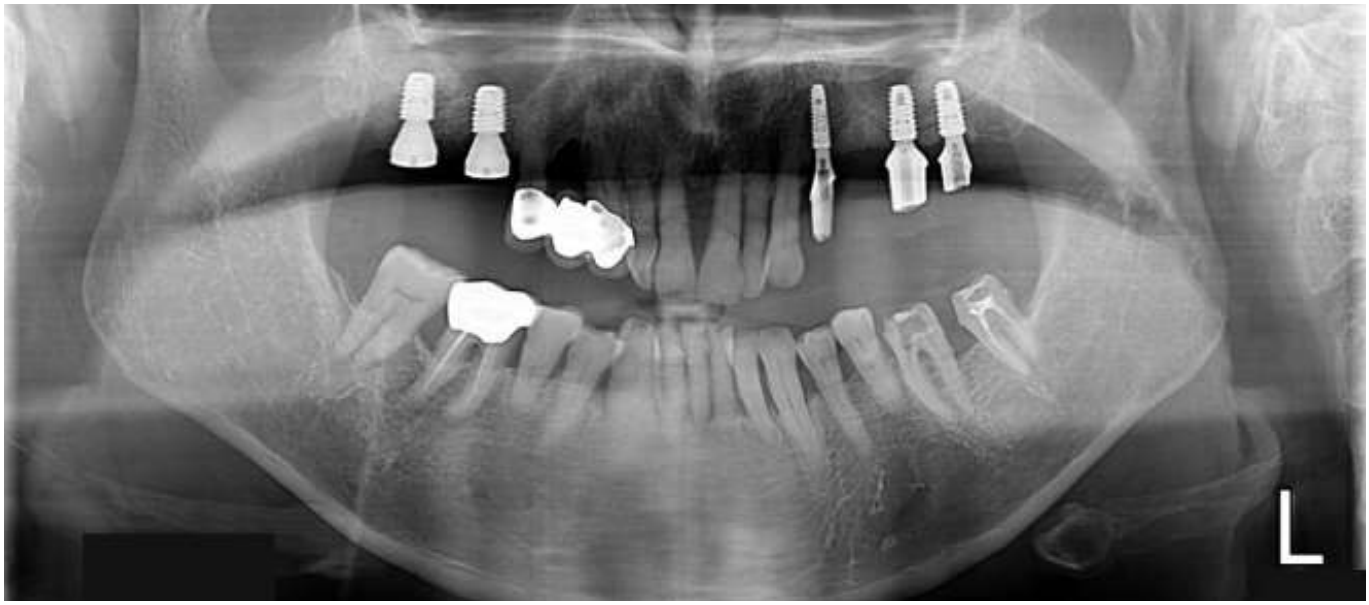

Fig 44. 5.0 × 7 mm implants were placed in teeth #16, 17. Maxillary sinus elevation was performed using the transalveolar approach. FDBA was used as a maxillary sinus bone graft

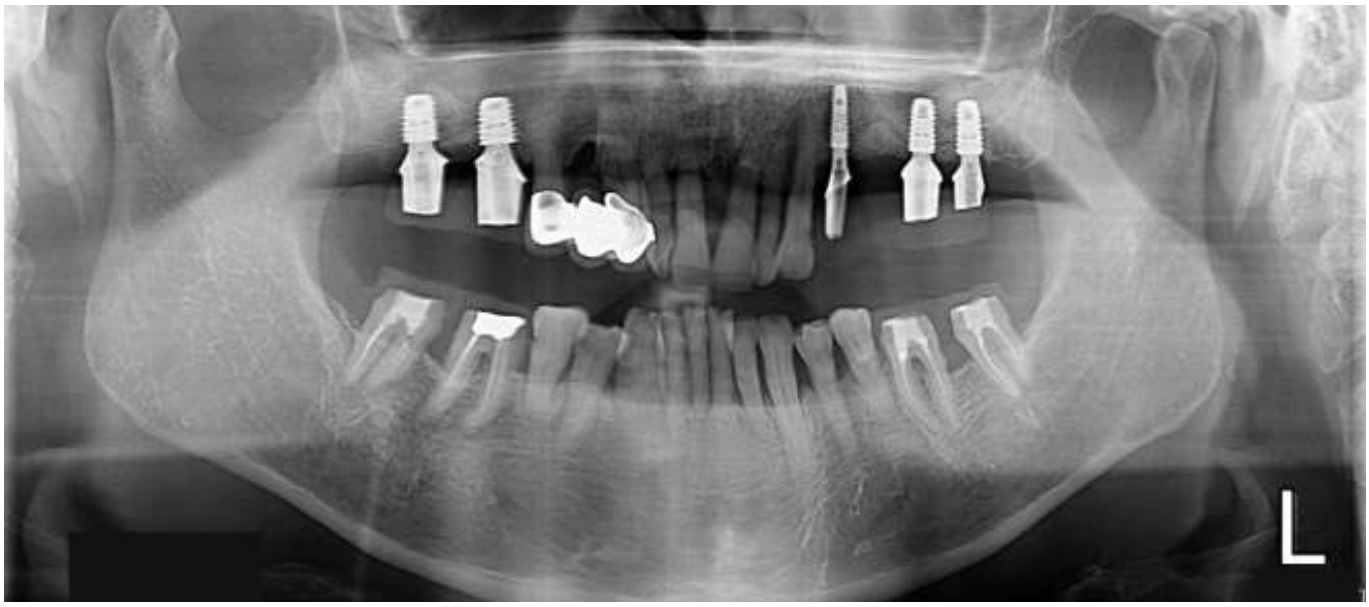

Fig 45. Progressive loading was applied three months and three weeks after the #16 and 17 implant placement. Temporary teeth were placed on the left and right mandibular first and second molars

Fig 46a-e. The oral cavity after the first provisional restoration. The periodontal stability of the maxillary implant and the mandibular molar tooth to be restored with a crown was examined during the first provisional restoration. Next, it was checked whether the shim stock was stably held between occluded teeth and whether the closure stopper and equalizer on the molar teeth were well-maintained. Weak occlusion was observed at the right second molar; accordingly, the resin was added. The periodontal stability was seeme satisfactory. The second provisional restoration was begun to achieve occlusal stability

Fig 47a-h. The oral cavity after the second provisional restoration. The second provisional restoration had the same design as the final restoration. Periodontal stability, food retention, self- cleansing, and occlusal stability were assessed for one month. The final restoration was then planned

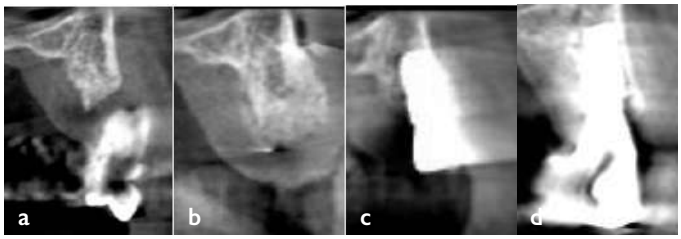

Fig 48a-d. CT scans taken before extraction of tooth #24, after socket preservation, after implant placement, and after completing the final restoration, respectively

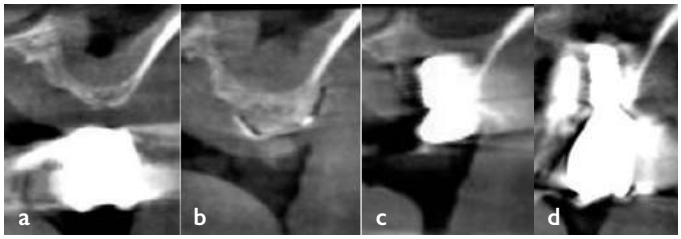

Fig 49a-d. CT scans taken before ponic removal, after GBR, after implant placement, and after completing the final restoration at tooth #26, respectively

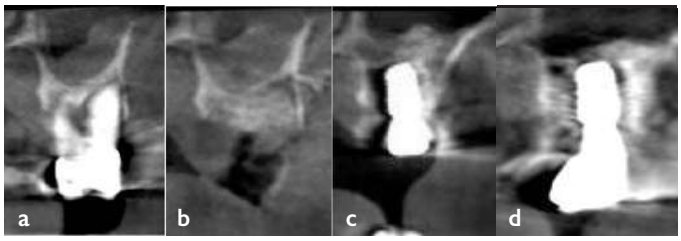

Fig 50a-d. CT scans taken before extraction of tooth #27, after socket preservation, after implant placement, and after completing the final restoration, respectively

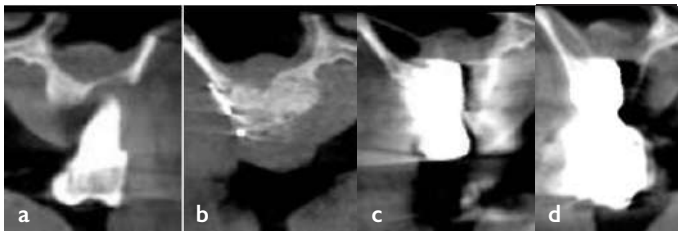

Fig 51a-d. CT scans taken before extraction of tooth #16, after socket preservation, after implant placement, and after completing the final restoration, respectively

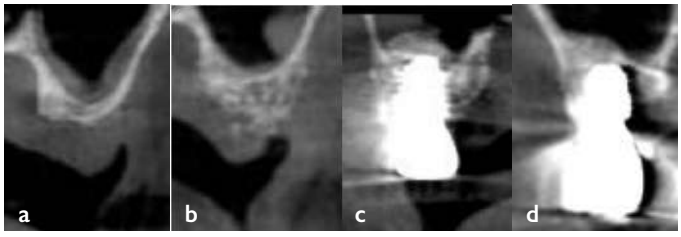

Fig 52a-d. CT scans taken before bone grafting, after bone grafting, after implant placement, and after completing the finalrestoration of tooth #17, respectively

Discussion

Alveolar ridge resorption cannot be prevented following tooth extraction since the alveolar ridge structurally depends on teeth.[4] Socket preservation for site development can significantly reduce alveolar ridge resorption.[5] The patient in this case report had severe alveolar bone resorption. For this reason, horizontal and vertical alveolar ridge augmentation and maxillary sinus graft placement using the lateral approach were inevitable following teeth extraction and delayed implant placement. Socket preservation for site development allowed for the recovery of alveolar bone that had been severely resorbed and secured a sufficient width of the alveolar ridge for implant placement.

Furthermore, a sufficient height of the alveolar ridge was secured for transalveolar implant placement. Thus, socket preservation helped create a more favorable condition for maxillary sinus bone grafting.

There are various opinions on the technical methods of socket preservation and the graft and barrier membranes that can be used.[6]

I believe socket preservation should be performed using the concept of GBR, more specifically, immediate GBR. When choosing a technique for socket preservation, it is important to select a bone graft material appropriate for the bone lesion according to GBR standards and choose an appropriate membrane in case cell migration must be inhibited and space must be secured.

I recommend following an implant treatment protocol for soft bones when performing implant restoration following socket preservation. While the timing of loading can be determined based on the initial fixation force, I recommend progressive loading.

Although this is a case report on a single patient only, socket preservation secured a sufficient amount of alveolar bone for implant placement and reduced soft tissue recession, in a patient who underwent implant treatment after extraction of teeth around which severe alveolar bone resorption was observed. Socket preservation produced highly satisfactory clinical outcomes.

Fig 52a-i. Panoramic image of the oral cavity obtained after completing the final restoration. The final restorations matched the shape and occlusion of the second provisional restoration.

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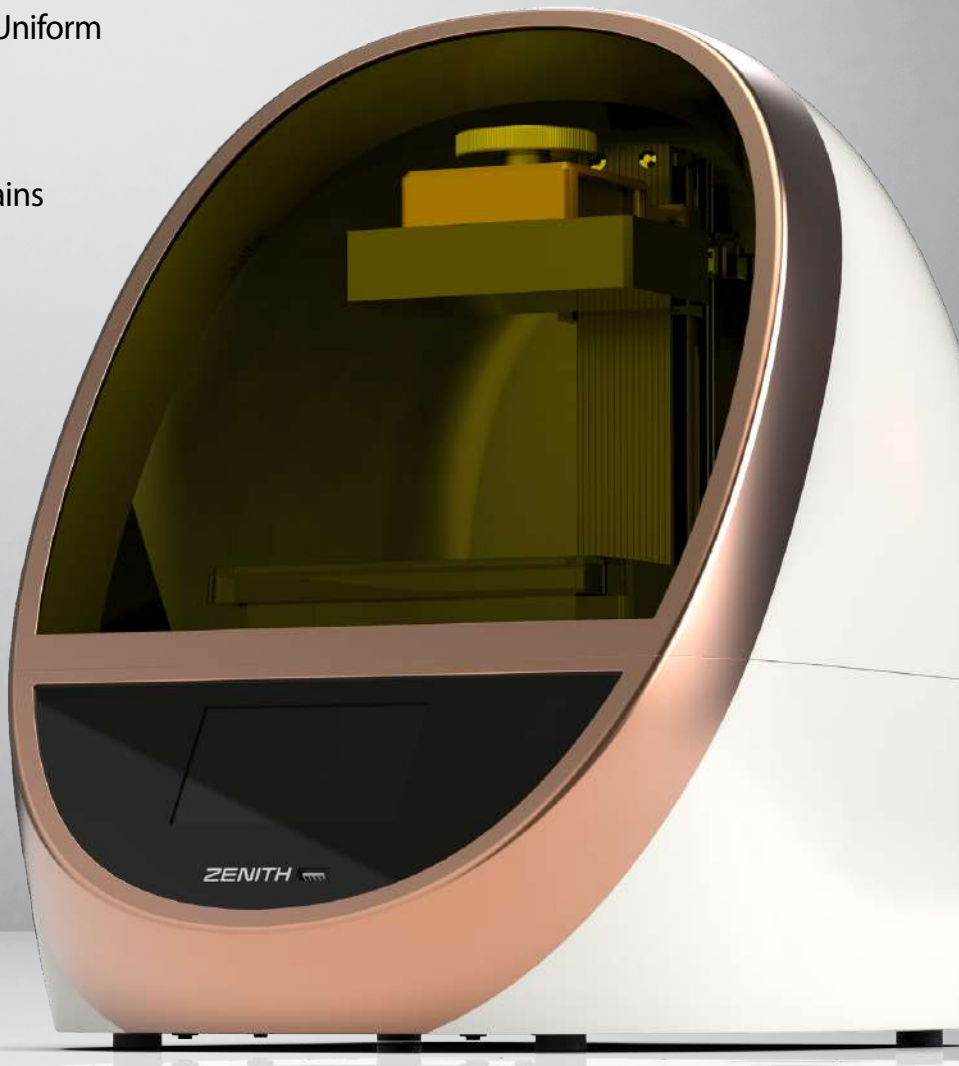

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