Peri-implant plastic surgery techniques to hard and soft tissue augmentation in implant rehabilitation

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Abstract: This report presents the clinical results of peri-implant plastic surgical approaches for hard and soft tissues before and during the implant placement in a patient with vertical ridge deformation and a shallow vestibule sulcus, and the subsequently performed prosthetic rehabilitation. The surgical approaches used in this case reduced the crown-height space and crown-to-implant ratio and ensured that the implants were placed in their ideal positions, and peri-implant tissue health was maintained. In conclusion, developments in the peri-implant plastic surgery enable the successful augmentation of hard and soft tissue defects and provide the implant-supported fixed prosthetic rehabilitation.

Key words: Guided bone regeneration, implant, peri-implant plastic surgery

INTRODUCTION

Dental implantology is considered to be the ideal approach to replacing missing teeth and has received attention in the recent scientific developments. Nevertheless, the long-term success of dental implants depends on a balance between hard structures and soft tissues. Adequate bone volume, optimal implant position, esthetic soft tissue contours, and stable and healthy soft tissue are required for the ideal dental implant rehabilitation.[1-3] Furthermore, peri-implant hard tissue defects related to alveolar bone loss complicate or prevent the placement of a dental implant in an ideal position, and lead to soft tissue problems.[4] Crown height space (CHS) may also increase due to severe bone destruction.[5] The increase in CHS causes intense load over restorations and implants. The intense stress caused by this intense load leads to several complications such as implant failure, crestal bone loss, implant breakage, screw loosening, occlusal material breakage, and prosthetic restoration breakage.

To minimize the stress, it is suggested to increase the number of the implants in the cases where implant crown proportion is not ideal.[6] In such cases, optimal implant rehabilitation can be improved by correctly classifying the alveolar ridge defects, adhering to proper techniques for alveolar ridge and soft tissue augmentation, and ensuring the appropriate crown-to-implant ratio (C/I) as well as the most appropriate mode of implant placement in each patient.[14] Peri-implant plastic surgical approaches facilitate the development of healthy peri-implant structures, provide satisfactory functional and esthetic results in both hard and soft tissues, and include bone augmentation, soft tissue augmentation, precision in implant placement, and quality of the prosthetic restoration.[1-3,7,8] Although it is regarded as a new concept in the implantology literature, peri-implant plastic surgery is actually a version of periodontal plastic surgery adapted for implantology.[1,2]

In the cases where hard and soft tissue defects are observed together, peri-implant plastic surgical approaches in different combinations applied considering the diagnosis and treatment planning, will help physicians achieve an ideal result. Particularly, the combined peri-implant plastic surgery treatment will increase the short- and long-term success of the implant rehabilitation when applied to the patients with severe alveolar bone loss due to various endodontic and periodontal reasons under the development of healthy peri-implant structures, provide satisfactory functional and esthetic results in both hard and soft tissues, and include bone augmentation, soft tissue augmentation, precision in implant placement, and quality of the prosthetic restoration.[1-3,7,8] Although it is regarded as a new concept in the implantology literature, peri-implant plastic surgery is actually a version of periodontal plastic surgery adapted for implantology.[1,2]
guidance of a patient-specific treatment protocol. This report presents the clinical results of hard and soft tissue peri-implant plastic surgical procedures, and the techniques used before and during the implant process for the patient’s oral rehabilitation, and the results of a 1-year follow-up.

CASE REPORT

The 45-year-old male patient referred to the periodontology clinic due to severe pain in the fixed prosthesis region including the teeth 23, 24, and 26, and difficulty in chewing. Intraoral examination indicated severe inflammation along with mobility, deep periodontal pockets reaching to the apex (10 mm on average), and pus formation in the region. The periapical and panoramic radiographic analysis showed a radiolucency image on the related teeth which were previously applied endodontic treatment [Figure 1]. The clinical and radiographic diagnosis showed that the severe inflammation on the teeth 23, 24, and 26 in the left maxillary region occurred due to the endodontic-periodontal lesion. The teeth with lesion were extracted after the antibiotic treatment, and the infected area was curetted. Implant indication was placed on this region upon the patient’s approval. A treatment protocol including implant rehabilitation and peri-implant plastic surgeries was prepared based on the patient’s clinical and radiographic measurements. According to the protocol, this region was decided to be suitable for peri-implant plastic surgical approaches since it had a shallow vestibule due to heavy inflammation and a vertical bone defect before the implant placement. Upon the patient’s approval, it was decided that the peri-implant plastic surgery procedures were carried out in multiple stages to minimize the possible complications in this complicated case. Peri-implant plastic surgeries were applied pre and during implantation.

Preimplant peri-implant procedures

Surgical procedures were carried out in two stages: First, the vestibule sulcus depth and the keratinized mucosa width (KMW) were increased through free gingival graft (FGG) on the area with shallow vestibule, and then, sinus augmentation was applied for the vertical ridge augmentation.

Vestibular depth increase through free gingival graft

The FGG technique was used to increase the shallow vestibule and to simplify the primer closure of the flap after the augmentations. Thus, the implant site was prepared for the augmentations. The site to which the bone augmentations and implants would be applied was prepared by a horizontal incision from the mucogingival junction line. The 25 mm × 5 mm FGG obtained from hard palate was placed in the site. The vestibular depth and adequate KMW were formed after 3 weeks.

Sinus augmentation application

Sinus augmentation was applied in the 3rd month after the FGG, which reduced to 22 mm × 4 mm in the 3rd month [Figure 2]. Due to the absence of an intraoral component of the vertical ridge deficiency in the implant region, augmentation was performed on the maxillary sinus floor through a modified posterior Caldwell-Luc procedure. The maxillary sinus floor was filled with freeze-dried bone allograft (FDBA) MinerOss, BioHorizons, Birmingham, AL, USA and a collagen barrier membrane BioMend, Zimmer, CA, USA [Figure 3a-c]. The incision margins were closed with 3–0 silk sutures to allow healing by first intention.

Implant surgeries and peri-implant procedures

In the 4th month after the sinus augmentation, new bone formation of 10 mm. In height was observed in computed tomography (CT), and then, vertical ridge augmentation was used together with the guided bone regeneration (GBR) in the same session as the implant surgery to decrease the CHS and the C/I ratio. In addition, the number and the size of the implants were maximized in this case to decrease the stress on the implants. For this reason, implants with 4.1 diameter were used in this case.

Implant surgeries

Under local anesthesia, the full-thickness flap was lifted from the most distal part of tuber maxilla, the region of the tooth 27, to the canine tooth region, and 4 subperiosteal implants Zimmer Dental, Tapered Screw-Vent, 4.1 diameter, and 10 mm length were placed in the augmentation region based on the prosthetic planning [Figures 4 and 5].

Guided bone regeneration techniques

Implants were inserted in the suitable position from the alveolar crest for the planned vertical regeneration. Dense polytetrafluoroethylene (d-PTFE) membrane Cytoplast, Osteogenics Biomedical Inc., Lubbock, TX, USA were fixed to the bone with pin on the lingual, and multiple cortical perforations were performed. FDBA was positioned around the implants, filling completely in the defect [Figure 4b and d]. Finally, the d-PTFE membranes were completely fixed with buccal pin [Figure 4e]. During the membrane removal after 6 months, vertical defects around the implants were satisfactorily filled with newly formed hard tissue [Figure 6a and b].

Prosthetic restorations

Prosthetic restorations were performed in the 1st month following the phase 2 surgery (membranes were also removed during this process) [Figure 7a and b]. These prostheses solved the patient’s functional, psychological, esthetic, and phonation problems. Despite not being ideal, the C/I ratio was close to 1/1, the optimum value. The patient had no functional, psychological, esthetic, or phonation problems during the 12 month follow-up [Figures 8 and 9].

DISCUSSION

This report presents the results of the multiple-stage peri-implant plastic surgery practices, and the prosthetic treatment in a case where implant placement was complicated, because of the severe alveolar bone loss due to the endodontic-periodontal lesion in the left maxillary region, and the results of the 1-year follow-up. No complications were observed during the peri-implant plastic surgery practices, and the peri-implant tissue health was seen to be maintained in the 1st year of the prosthetic treatment. Gradual surgical procedures can minimize potential risks and complications even if they might extend treatment period. In this case, peri-implant plastic surgeries and implant surgery were performed in two stages: Preimplantation and during implantation.
Figure 1: Preimplant panoramic radiography (severe alveolar bone loss is observed due to endodontic-periodontal lesion)

Figure 2: Preimplant panoramic radiography (before sinus augmentation)

Figure 3: (a-c) Sinus augmentation

Figure 4: (a-e) Implant application and guided bone regeneration (with titanium-reinforced membrane)

Figure 5: Postimplant panoramic radiography (immediately after the surgery)

Figure 6: (a and b) Removal of titanium-reinforced membrane

Figure 7: (a and b) Placement abutments

Figure 8: Prosthetic rehabilitation
The aim of the preimplantation procedures was to generate sufficient bone and KMW before the implants are applied. First, the vestibular depth was increased through the FGG, which was also used for flap closure during the sinus augmentation and the GBR, and to enhance healing. FGG is an alternative method to the “controlled tissue expansion” technique, in which the soft tissue is made expand in volume by being progressively stretched. Thus, the flap in the surgery site is prevented from being ruptured, and primary wound healing is ensured. FGG also leads to an increase in the soft tissue and the primary closure of the surgery site, as in this technique. However, FGG is more advantageous than the “controlled tissue expansion” technique since it creates keratinized mucosa. Increasing the vestibule depth and the KMW using the FGG also helps protection of the peri-implant tissue health. Three months after the FGG, sinus augmentation was performed before implant surgery, due to the inadequate vertical crestal height (≤1 mm) in the implant area. Sinus augmentation is the internal augmentation of the maxillary sinus, which is intended to increase the vertical bony dimension in the lateral maxilla to enable the placement of dental implants.

In this case, the implants were not applied in the same session as the sinus augmentation upon the patient’s approval to minimize the possible complications such as buccal bone fracture, nonstabilization of the implants, or sinus membrane rupturation since the vertical bone height was ≤1 mm in the augmentation region, and the number and diameters of the implants were high. A controlled treatment process was ensured by implementing the two-stage approach. On the new bone formation of about 10 mm observed in CT in the 4th month after augmentation, it was decided to initiate the implant placement for the case.

The CHS and the C/I rate played a significant role in the vertical bone augmentation during the implant surgery. The ideal CHS required for a fixed implant prosthesis should range between 8 mm and 12 mm. The C/I ratio means the relationship between the lengths of the restoration and the implant embedded in the bone. Although the C/I ratio may not affect peri-implant crestal bone loss, it has been hypothesized that implant restorations with low C/I ratios may cause less overload on prosthetic components, reducing the risk of technical complications such as screw loosening, cement failure, and framework fracture. The CHS was higher than 12 mm in this case, and GBR technique was applied to decrease the CHS, and the C/I rate as much as possible and to increase the vertical crestal height. Implant prognosis was improved by decreasing the CHS, and the C/I ratio by the approximate 3 mm bone gain achieved during the GBR. Besides, a greater number of implant is usually required for the prosthesis as the CHS increases, especially in the presence of force factors. Therefore, the negative effects of the pressure coming over the implants were reduced by placing four implants into the region; in other words, by increasing the number of implants. Titanium-reinforced membrane (d-PTFE) was applied together with the FDBA in the GBR technique. These membranes have recently been widely used especially in vertical bone augmentation and yielded successful results as an alternative to the blocked bone augmentation.

In this study, a multiple-stage surgical treatment was applied based on a well-planned peri-implant plastic surgery protocol in a case with severe bone destruction and inflammation due to endodontic complications, and successful results were achieved. Surgical treatments were intended to maintain a certain harmony between hard and soft tissues and to regain the functioning and esthetics in long-term by decreasing the CHS and the C/I ratio as much as possible. In conclusion, peri-implant plastic surgical attempts involving the suitable treatment protocols, right planning, and interdisciplinary approaches were found to play a significant role in optimal implant rehabilitation.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patients understand that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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