Soft-Tissue Enhancement Combined With Biologically Oriented Preparation Technique to Correct Volumetric Bone Defects: A Clinical Case Report

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The aim of the present case report was to illustrate how to obtain an ideal alveolar ridge contour by means of peri-implant soft-tissue management combined with the prosthetic approach of the biologically oriented preparation technique (BOPT). A patient presenting a moderate vertical and horizontal bone loss in the posterior maxilla was treated with sinus floor elevation and simultaneous implant placement. During the reentry procedure, the horizontal defect was corrected with an apically repositioned flap combined with a connective tissue graft. To increase the volume of the interimplant papillae, a pedunculated flap originating from the primary flap was turned within the interimplant space. BOPT one-time abutments have been employed to maximize the space available for the papilla-like tissues. A focused and combined surgical and prosthetic procedure has permitted enhancement of both peri-implant esthetics and function without the need for further invasive and costly bone regeneration techniques.

Key Words: soft tissue, bone defects, BOPT

INTRODUCTION

In cases of implant-supported rehabilitation, an adequate state of peri-implant tissue health is the essential criterion of restorative success.[1] Modern implantology often requires reconstructive procedures to satisfy both esthetic and functional demands of the patients. Traditionally, horizontal bone defects are treated with bone augmentation techniques, including guided bone regeneration, appositional bone blocks, and ridge-splitting osteotomies. Beyond functional reasons such as food impaction, interimplant airflow, and speech problems, the esthetic necessities for implant rehabilitations often require thickening of soft tissues to correct volumetric bone defects to achieve a proper ridge contour. In the case of limited horizontal bone resorption, proper soft-tissue management may be an alternative choice that reduces time, cost, and risk of complications related to bone augmentation procedures.[1–5] At the same time, to increase gingival thickness and the esthetic appearance, the abutment morphology, among several other prosthetic factors, may play an important role, but it has never been thoroughly analyzed. Recently, a prosthetic technique called biologically oriented preparation technique (BOPT) has been proposed, which uses a feather-edge preparation on natural abutments. The vertical preparation allows for positioning the final finish line at different levels, either more coronally or more apically, within the gingival sulcus without affecting the quality of marginal adaptation of the restoration. Furthermore, it has been claimed that applying the concepts of this technique to implant abutments could improve long-term gingival margin stability.[1–5]

The purpose of the present case report was to illustrate the surgical-prosthetic approach for the treatment of moderate horizontal bone loss in the posterior maxilla, analyzing the remodeling of the soft tissues while considering aspects of both height and thickness.

CASE PRESENTATION

A 56-year-old male patient presented in good general health status, reported at the Centre for Edentulism and Jawbone Atrophies (Figure 1), Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico, Milan, Italy. The patient was asking for rehabilitation of the upper right partially edentulous maxilla

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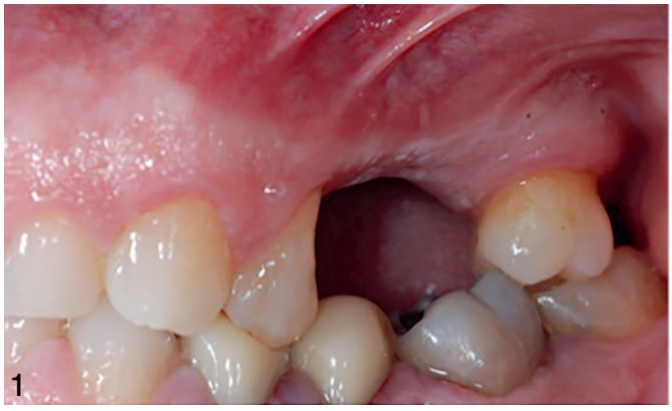
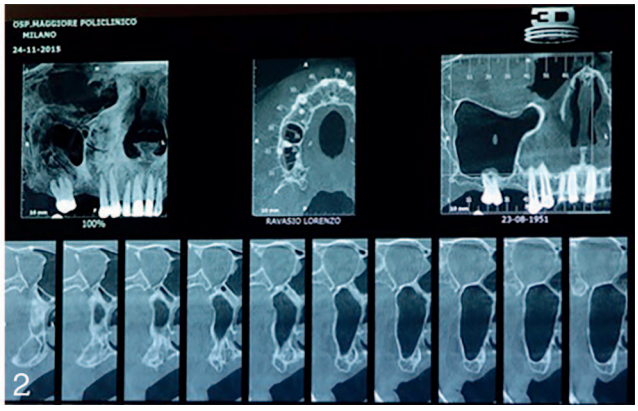




Figures 1 and 2. Figure 1. Clinical view before surgery of patients who showed edentulism and jawbone atrophies. **Figure 2.** Computed tomography dental scan showed moderate vertical and horizontal bone loss in the posterior maxilla.

with a fixed implant-supported prosthesis. The clinical and radiologic aspects of the edentulous ridge showed a vertical and horizontal bone resorption associated with a pneumatized sinus.

The treatment plan was decided according to the intraoral examination, the analysis of the cast models, and the radiographic examination consisting of cone-beam computed tomography (Figure 2) and an orthopantomograph. Before the surgical phase, the patient underwent a full-mouth disinfection session with chlorhexidine 0.2% rinse for 30 seconds, and then proper domiciliary oral hygiene instructions were given.[6,7]

A signed informed consent was obtained from the patient. The protocol was conducted according to the principles embodied in the Helsinki Declaration.

Surgical procedure

With respect to the vertical defect, a sinus floor elevation with simultaneous implant placement was performed, whereas the horizontal defect was treated during the second-stage surgery with an apically repositioned flap (ARF) associated with a connective tissue graft (CTG).

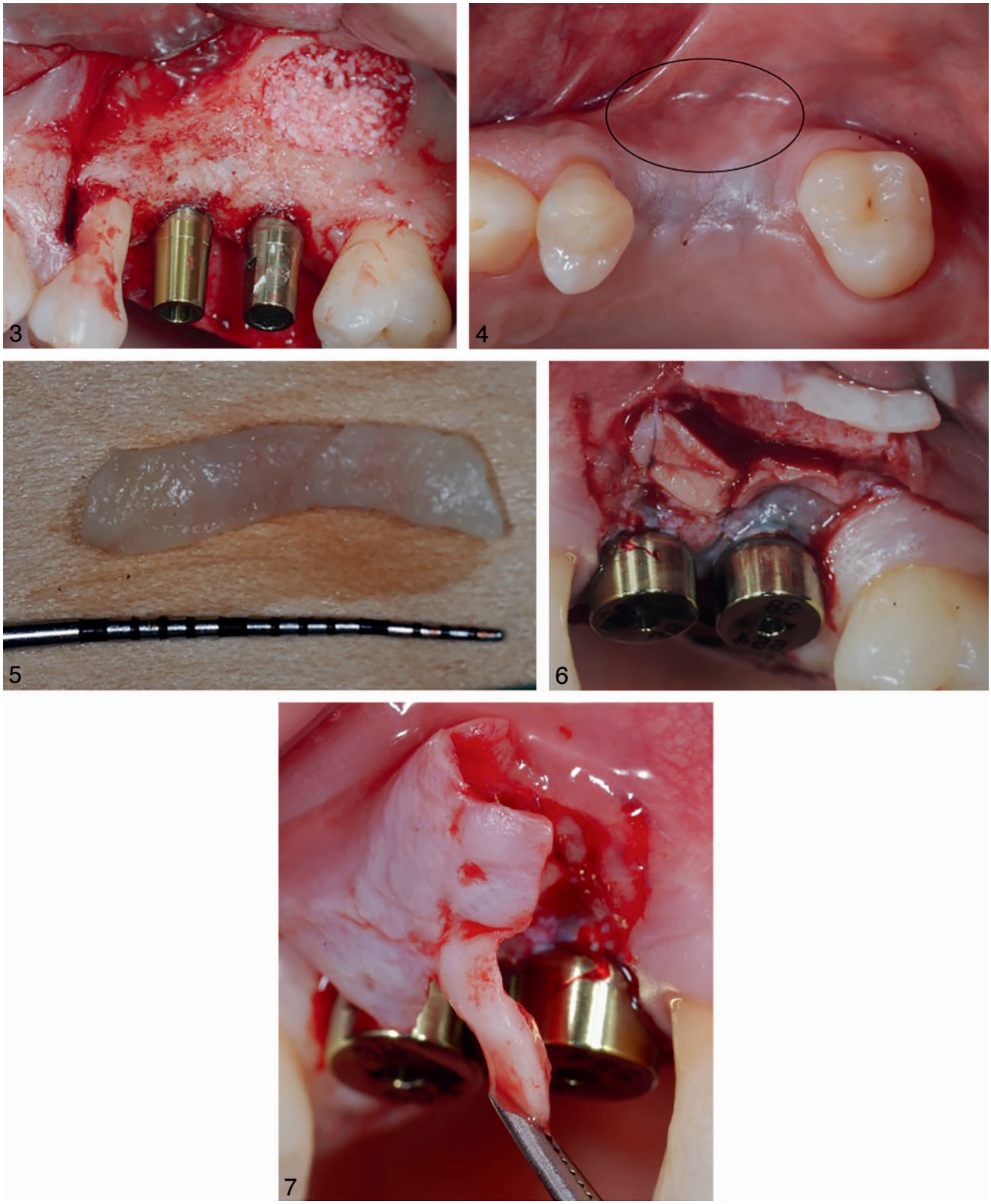
During the first surgical session, local anesthesia was administrated by infiltration of articaine with epinephrine 1:100 000. A full-thickness flap was elevated from the first upper right premolar to the second upper right molar, with mesial and distal releasing incisions. A lateral antrostomy was prepared with rotary cutting instruments, and the Schneiderian membrane was then elevated. Implant sites were then prepared, and the sinus was grafted with demineralized bovine bone mineral (Bio-Oss, Geistlich, Wolhusen, Switzerland). Once the implant sites were prepared, 2 implants (Global, Sweden & Martina, Padua, Italy) were inserted in a prosthetically driven position for teeth 15 and 16 (Figure 3). Only the implant in position 16 was partially enclosed in the grafted sinus. Finally, a resorbable collagen membrane (Bio-Gide, Geistlich) was placed to cover the graft and the bony window. Primary wound closure was accomplished with a 4/0 silk suture.

The healing proceeded uneventfully, and the sutures were removed after 15 days.

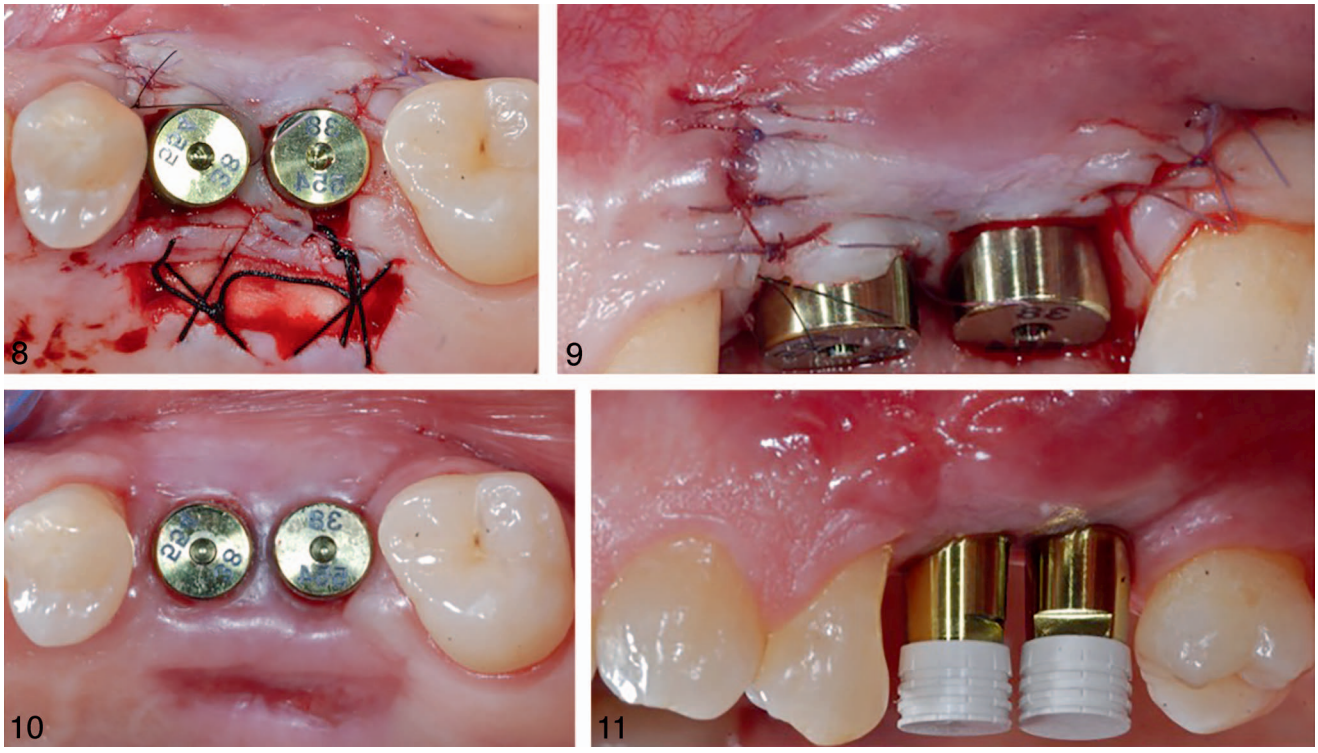
After 4 months (Figure 4), the reentry procedure was performed to connect the healing abutments. The second-stage surgery consisted of a split-thickness ARF combined with a subepithelial connective tissue graft. A crestal incision displaced palatally associated with mesial and distal releasing incisions without involving the sulcus of the neighboring teeth was designed. The rationale was to have a proper amount of keratinized tissue to be dislocated in the interimplant space to recreate a papilla-like tissue. Once the split-thickness flap has been raised, the healing screws with the same emergence profile of the abutments were screwed to the fixtures. A free gingival graft was harvested from the homolateral palatal side and extraorally deepithelialized (Figure 5). This allowed us to obtain a graft of uniform thickness of about 1.5 mm, reducing the postoperative patient morbidity and increasing the quality of the connective tissue according to Zucchelli et al.[8] Collagen sponges were positioned in the donor site and sutured with cross-stitches to stabilize the blood clot. The CTG was anchored to the periosteum 2 mm submarginally in the area of greatest resorption with 6-0 resorbable single stitches (Resorb, Sweden & Martina, Due Carrare, Italy; Figure 6). Thanks to the large amount of keratinized tissue obtained from the ARF, reconstruction of the interimplant papilla was performed according to Palacci et al.[2] Briefly, the excess buccal tissue allowed for a dissection and rotation of a pedicle flap that contains the blood supply (Figure 7). The pedicle was finally fixed to the palatal side with a 6-0 mattress suture to fill the space between the healing abutments (Figures 8 and 9).

Prosthetic procedure

After 3 weeks (Figure 10), abutments with the same emergence profile of the healing caps were screwed with a torque of 30 Ncm to the implants and used for the subsequent snap-fit impression with polyether material (Figures 11 and 12). Definitive abutments with a feather-edge preparation and the related metal framework were prepared by the dental technician, positioning the finishing line subgingivally (Figure 13). After 4 weeks from the reentry procedure, temporary crowns were cemented to the definitive abutments (Figure 14). After a 6-month period of soft-tissue maturation (Figure 15), a second impression was taken to assess the relation between peri-implant soft tissues and the metal framework. This allowed us to check the invasion of the gingival sulcus by the finishing



Figures 3–7. Figure 3. Sinus floor elevation and contextual implant placement. **Figure 4.** Clinical view of the upper maxilla soft-tissue defect after implant placement. **Figure 5.** Connective tissue graft. **Figure 6.** Second-stage surgery consisted of a split-thickness apically repositioned flap combined with a subepithelial connective tissue graft. **Figure 7.** Semilunar incisions were made in the flap, and the tissue was then rotated toward the palate to create a papilla between the implant.



Figures 8–11. Figure 8. Occlusal soft-tissue view of the 2 healing screws. A horizontal augmentation is evidenced because of the connective tissue graft placed. **Figure 9.** Mesial and distal releasing incisions and the pedicle flap were fixed with a 6-0 suture. Collagen sponges were positioned in the donor site and sutured with cross-stitches. **Figure 10.** Occlusal view 3 weeks from the reentry procedure. **Figure 11.** A particular view of the reentry procedure. The abutments were screwed to the implants and used for impression.

line of the prosthetic crowns. Finally, gold-ceramic definitive crowns were cemented with a temporary luting agent (TempBond, Kerr Dental, Scafati, Italy; Figure 16).

Evaluation method of the soft tissue

The peri-implant soft-tissue changes were monitored both vertically and horizontally.

Vertical Changes

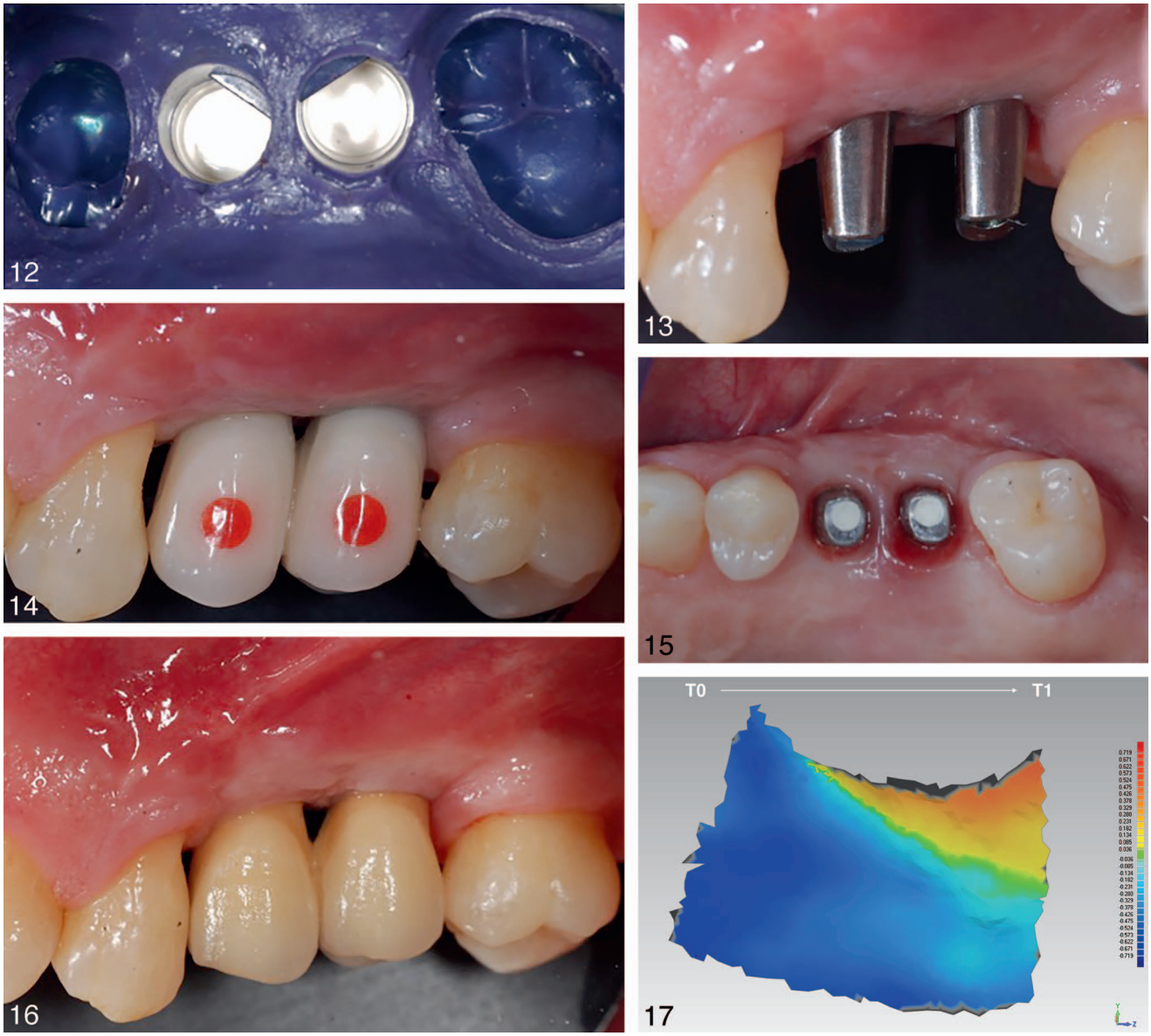
Apico-coronal gingival modification was monitored using intraoral photographs combined with dedicated software (IMAGEJ 1.43, National Institutes of Health, Bethesda, Md). An intraoral photograph was taken at the time of temporary crown cementation (T0) and before the delivery of the final prosthesis (T1). The provisional crown enclosed a circular landmark with a previously determined diameter. On the intraoral photograph, the distance between the most apical point of the landmark to the zenith of the gingiva was measured with the software. Intraoral photographs were taken with a digital single lens reflex camera (Nikon D90, Nikon Corp, Shinjuku, Japan). At each evaluation, the prosthetic landmark was calibrated with the software to transform the pixel of the photograph in millimeters.

Horizontal Changes

The tridimensional changes of the soft tissues were compared at T0 and T1. The soft tissues were scanned using an intraoral scanner (TRIOS Pod system, 3Shape, Copenhagen, Denmark), and the optical impressions were matched using a dedicated software (Geomagic, 3diemme, Cantù, Italy). This allowed the selection of a specific area at the peri-implant site (both buccally and palatally) in which the changes in terms of thickness of the graft were calculated. Data were expressed as mean ± standard deviation and the maximum gain and shrinkage of the selected peri-implant area. The software elaborated a colorimetric map in which the color varied from blue, where the gingival thickness was decreased, to red, where the thickness was augmented. The color green was present when the variation was similar to 0. Gray represented the areas not read by the scanner and consequently not included in the elaboration of the data (Figure 17).

Results

The healing proceeded uneventfully. Clinically, 3 weeks after the CTG, soft tissues presented a good improvement of the missing volume of the ridge contour (Figure 10). Furthermore, the interim peri-implant space was apparently filled by the pedicled flap in ongoing maturation. From the evaluation of the soft-tissue margin, negligible modifications were detected. In particular, a slight apical remodeling of the zenith of the mesial implant was noted (0.24 mm), together with a creeping on the distal implant (0.16 mm). As inferred from the colorimetric map, a shrinkage of the soft tissues was observed between T0 and T1. Conversely, a soft-tissue gain in the papilla area was found. This was probably linked to the conditioning of the temporary crowns (Figure 17).



Figures 12–17. Figure 12. Snap-fit impression with polyether material. **Figure 13.** Definitive abutments were prepared by the dental technician with the same emergency profile as the healing screw.They have been left in position during all the subsequent phases up to the delivery of the final crowns. **Figure 14.** Provisional resin crowns were prepared by the dental technician and enclosed a circular landmark with a previously determined diameter. **Figure 15.** Occlusal view after a 6-month period of soft-tissue maturation. **Figure 16.** Clinical view of the finished case with gold-ceramic definitive crowns. **Figure 17.** A colorimetric map elaborated by the software in which the color varied from blue, where the gingival thickness was decreased, to red, where the thickness was augmented.

After 6 months from the reentry surgery, the volumetric gain obtained with the bilaminar technique appeared clinically stable (Figure 17), with a healthy texture of the restored papilla. Moreover, the gingival adaptation to the prosthetic crowns reduced the black triangles with the neighboring teeth caused by the absence of the bone peaks.

Discussion

The present case report illustrates the management of a buccal bone defect with soft-tissue augmentation techniques associated with a recently developed prosthetic approach.

According to Cosyn et al,[3] a deficient alveolar process may lead to challenging esthetic complications irrespective of the treatment modality. Moreover, a defect in the ridge contour over an implant-supported prosthesis could represent a site for food impaction and consequent patient discomfort.[9] Interestingly, if the horizontal and vertical ridge resorption is within 3 mm of its original contour, acceptable results might be achieved by soft-tissue augmentation procedures with no need of further guided bone regeneration.[4] Thus, according to Palacci and Nowzari,[5] in the case of a moderate horizontal bone loss, mucogingival surgery associated with a CTG could results in a stable soft-tissue augmentation around dental implants.

For this reason, in the present report, an ARF combined with a CTG has been used to augment the buccal soft-tissue volume concealing at the same time the bone defect. Moreover, the attached masticatory mucosa has been displaced from the palatal to the buccal side dissecting and rotating a pedunculated flap, in order to fill the interimplant space and to increase the vestibular tissue volume as well. The final aim was also to increase the keratinized tissue circumferentially around the prosthetic crowns. Indeed, the absence of keratinized mucosa around dental implants negatively affects patients' ability to maintain effective oral hygiene control, resulting in plaque accumulation, gingival inflammation, and gingival recession.[10–12] As in the present case, when implants are surrounded by alveolar mucosa, the lining mucosa with a movable soft-tissue border may impede proper oral hygiene performance, especially in sites with severe bone atrophy and soft-tissue resorption. Hence, the increase of soft-tissue quantity and quality was mandatory to maintain an adequate status of health and esthetics during long-term follow-up.

Another issue associated with implant restorations, particularly in the esthetic zone, is the apical migration of the buccal gingiva over time. Most clinical studies[11,13,14] showed that the amount of recession was significantly increased at implant sites with narrow keratinized mucosa. Furthermore, abutment morphology, among several other prosthetic factors, may play a pivotal role in the stability of the gingival margin in esthetically sensitive areas. Considering these factors, in the present case, the BOPT has been used. This procedure consists of a feather-edge preparation on natural abutments applied to implant abutments to improve long-term gingival margin stability.[15] The BOPT contemplates the guided modification of the gingival contour by the provisional restoration. Once the ideal gingival contour has been achieved, the gingival contour is replicated in the final restorations precisely. The idea was also to mirror the convexity of the final restoration with that of the natural tooth and to finish the abutment preparation without a defined shoulder, so that the closure can be modified according to the gingival margin adaptation in ongoing maturation.

This concept was developed from the observation of natural teeth prepared with feather-edge preparation, suggesting that if the emergence profile of the anatomical crown is specular to the gingival contour, the marginal gingiva might be able to adapt to the profile of the prosthetic crown. The gingival profile, together with the crown profile, draws a typical line that forms an angle that is more open in subjects with a thin periodontium and more closed in subjects with a thick periodontium. Therefore, flat emergence crown profiles will determine flat gingival profiles, whereas in the presence of convex emergence crown profiles, the marginal gingiva will tend to increase its volume, assuming a thicker and rounder profile. In this way, soft tissues will adapt to the crown profiles on the basis of esthetic parameters. As shown in natural teeth, equally to other parameters responsible for the clinical success, this type of design seems to augment the stability of the soft tissues around the prosthetic restoration, reducing at the same time the incidence of gingival recession on the buccal aspect.

According to some authors,[2] this behavior might depend only partially on the better quality of the marginal closure between crown and abutment after cementation. In fact, according to Canullo et al,[16] an abutment with horizontal preparation has a diameter that increases in the apico-coronal direction while reaching the profile of the prosthetic crown. This divergent abutment morphology tends to push the tissues in an apical direction, determining a recession of the soft-tissue margin, which could cause the exposition of the abutment margin. Conversely, as shown in the present report, feather-edge abutment has a convergent abutment profile so that the soft-tissue margin tends to be located more coronally, leaving the tissue ingrowing. In particular, the reduction of the abutment obtained by removing the abutment shoulders or chamfers allowed the interdental soft tissues to occupy the space previously occupied by the metal.

After 3 weeks from the uncovering procedure, the definitive abutments were connected to the implants and left in position during all subsequent phases up to the delivery of the final crowns. This factor is of relevance if considering that disconnections and subsequent reconnections of the abutment components has shown to compromise the peri-implant mucosal barrier, resulting in a more apically positioned zone of connective tissue.[17] Moreover, the risk of bacterial toxins pumping in the peri-implant tissues is further enhanced by the continuous prosthetic operations that could promote bone resorption.[18] Hence, to avoid any disturbance to tissue maturation, a "1 abutment/2-time technique" was applied. After taking polyether impressions, definitive abutments with the same emergency profile as the healing screw and provisional resin crowns were immediately positioned, minimizing repeated abutment disconnections and reconnections. Furthermore, an additional advantage of this technique was that the prosthetic margin of the temporary crowns on the definitive abutments was shifted coronally to exploit any migration of soft tissues before the definitive crowns were made.

Conclusion

Mucogingival surgery might be considered a less invasive alternative to bone regeneration in patients with a moderate horizontal bone defect in the esthetic area. The reestablishment of an ideal contour of the alveolar process provided both esthetic and functional improvements. The choice of the BOPT associated with the direct insertion of the definitive abutment at the time of impressions allowed maximizing the peri-implant tissue maturation, reducing tissue trauma to prevent gingival recessions over time.

Abbreviations

ARF: apically repositioned flap
BOPT: biologically oriented preparation technique
CTG: connective tissue graft

Note

The authors declare no conflict of interest.

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