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CASE REPORT

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Particulate bone grafting with a resorbable collagen membrane and horizontal alveolar ridge augmentation with tenting screws in dental implant placement: A case report

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Key Clinical Message

We used a mixture of particulate bone grafts (xenografts/allografts) with tenting screws to prevent membrane collapse and covered the graft with a resorbable collagen membrane to guide bone regeneration. This strategy can exclude the need for additional procedures, such as non-resorbable membranes and major block grafting surgeries. Although the initial outcomes are promising, continuous follow-up is required to examine the stability of the newly regenerated bone and the long-term success of the implant.

Abstract

This case demonstrates the use of particulate bone grafts covered with a resorbable collagen membrane and supported by tenting screws to correct horizontal alveolar ridge defects. A man in his 40s presented with missing maxillary anterior central and lateral incisors and required a fixed dental prosthesis. One year before, #12, #11, #21, and #22 had been extracted. The area showed horizontal and slight vertical bone loss. We used a mixture of particulate bone grafts (xenografts and allografts) with tenting screws to prevent membrane collapse and covered the graft with a resorbable collagen membrane to guide bone regeneration. After 6 months, complete bone regeneration was achieved, and the dental implants were submerged in the bone. After another 6 months, the patient was administered with a fixed dental prosthesis. This method can be used to correct horizontal alveolar ridge defects and achieve esthetic restoration without the need for more extensive procedures.

KEYWORDS

alveolar ridge augmentation, bone grafting, bone regeneration, dental prosthesis

1 | INTRODUCTION

The long-term success of dental implant therapy requires sufficient bone volume at the site of the implant.[1] Therefore, any bone defect should be treated before or at the time of implant placement. Loss of alveolar bone can cause horizontal and/or vertical bone loss. Several bone grafting techniques have been used to correct alveolar bone defects, such as distraction osteogenesis, guided bone regeneration (GBR), bone splitting, and guided tissue regeneration.[2–4] Alveolar ridge resorption has been efficiently treated using GBR, in which a significant amount of supra-crestal bone is regenerated and combined with autogenous particulate bone grafts,[5] allograft materials,[6] xenografts[7] or a combination of these.[8]

Although GBR allows for both simultaneous and staged approaches to bone regeneration and implant placement, excellent long-term results have been obtained with the staged approach.[9] This case demonstrates the feasibility of using a particulate bone graft mixture composed of allograft and xenograft materials supported by tenting screws covered with a collagen membrane to repair horizontal alveolar ridge defects. This treatment, together with implant placement in the maxillary lateral incisor area, was used to achieve esthetic restoration with no invasive procedures, such as block grafting.

2 | CASE PRESENTATION

A medically fit man in his 40s presented for an implant site evaluation to replace his missing maxillary anterior teeth. The patient had a history of root canal treatment and crowns of the maxillary central and lateral incisors after trauma at the age of 13 years. Eleven years ago, he had recurrent caries around the crowns so he underwent root canal re-treatment, crown lengthening of maxillary anterior teeth (from tooth #13 until #33) and new crowns. Two years ago maxillary central and lateral incisor extraction was performed due to non-restorability of these teeth. Clinical examination revealed missing teeth #12, #11, #21, and #22 with a Siebert class III ridge defect (Figure 1). After prosthodontic consultation and diagnostic wax-up we planned to manage this defect with horizontal GBR if needed and dental implants to be placed in areas #12 and #22 to support a fixed dental prosthesis, replacing #12, #11, #21, and #22. This procedure was explained to the patient, and written informed consent was obtained. Because the patient required a fixed restoration, we adopted a staged surgical approach by first regenerating the bone defect, and then placing the implants in areas #12 and #22.

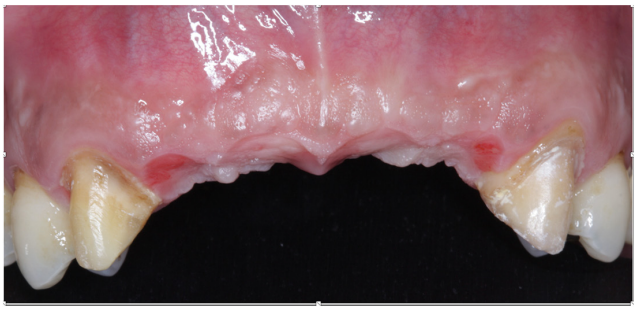

FIGURE 1 Preoperative frontal view.

3 | TREATMENT

A 0.12% chlorhexidine oral rinse was carried out for 1 min, followed by infiltration of local anesthesia into the anterior maxilla, both buccal and palatal, using 2% lidocaine (1:80,000 epinephrine). A sulcular incision was made with a #15 blade around teeth #13 and #23, which were then connected by a mid-crestal incision through the edentulous area of the missing teeth #12, #11, #21, and #22. Two buccal vertical-releasing incisions were made distal to teeth #13 and #23. Next, the full-thickness buccal and palatal flaps were reflected. The buccal flap was reflected past the mucogingival junction using periosteal elevators to expose the bone. We attempted to drill for implant placement; however, as the bone was too thin (3–4 mm width), we decided to perform GBR. The buccal bone areas of the missing teeth #12 and #21 were decorticated. The holes for the tenting screws were prepared using a spiral drill. Two titanium screws 8 mm in length and 1.5 mm in diameter were used as tenting screws to prevent membrane collapse (Figure 2).

Two 20 × 30-mm collagen membranes (BioMend Extend, Zimmer, Carlsbad, CA, USA) were prepared and adjusted to cover the required sites (#12 and #21). The composite particulate graft comprised a 1:1 mixture of bovine-derived xenografts (Geistlich Bio-Oss; Geistlich Pharma AG, Switzerland) and allografts (Puros Cortical-Cancellous Particulate Allograft; Zimmer, Carlsbad, CA, USA). The graft was prepared and placed in the desired area. The collagen membrane was draped over the graft and tucked under the palatal flap (Figure 3). A periosteal-releasing incision was made to allow closure of the primary flap.

The flap was sutured in two layers using a resorbable suture material. First, a horizontal mattress suture was used to stabilize the membrane, followed by continuous

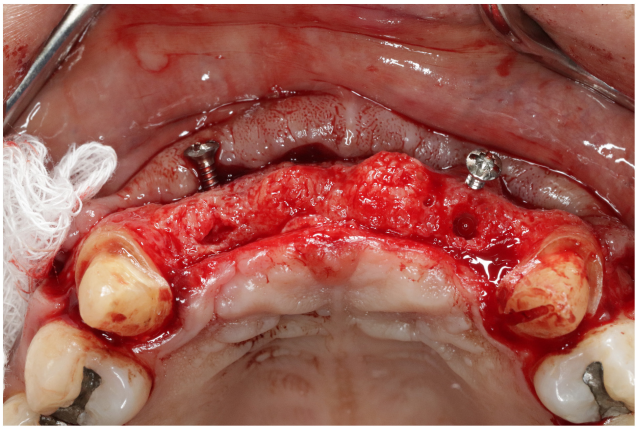

FIGURE 2 Incision, flap reflection, decortication, and placement of tenting screws.

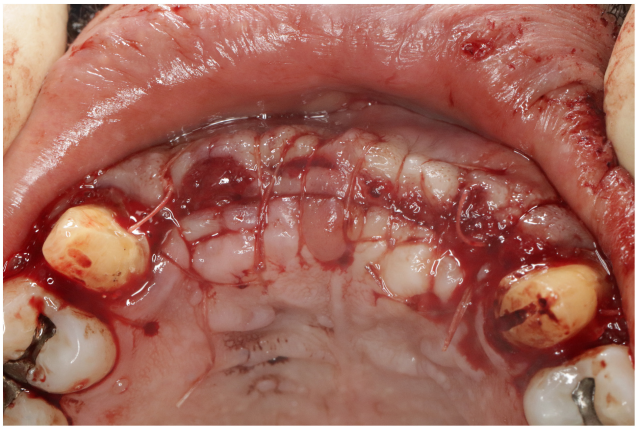

FIGURE 4 Flap sutured by a horizontal mattress suture, followed by continuous suturing.

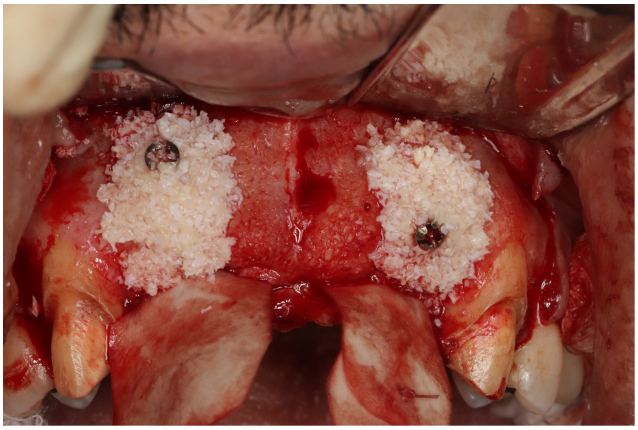

FIGURE 3 Bone graft mixture placed in areas of 12 and 22. Collagen membrane was trimmed to the required size and tucked under the palatal flap.

suturing to achieve a tension-free primary closure (Figure 4).

4 | OUTCOME AND FOLLOW-UP

Postoperatively, amoxicillin, 500 mg oral antibiotics (thrice daily for 1 week), ibuprofen, 400 mg anti-inflammatory medication (thrice daily for 1 week), and a tapering dose of prednisolone was prescribed. At 24 h postoperatively, a 0.12% chlorhexidine oral rinse was applied daily until the sutures were removed for plaque control. At 48 h postoperatively, the swelling was most prominent and then subsided gradually and disappeared completely after 10 days. During the postoperative period, mild discomfort was present, mostly caused by swelling; this pain was controlled by prescribed medications. Follow-up was performed weekly for the first 3 weeks, then once every 2 weeks for the next 2 months to ensure complete healing; no complications occurred in the early stage. At the 11-week follow-up, the soft tissue covering the tenting screw on the left side had thinned (Figure 5). We decided to remove the tissue to prevent spontaneous exposure, which could affect the quality of the regenerated bone.[10]

Buccal infiltration local anesthesia was applied to # the missing area of #22 using 2% lidocaine (1:80,000 epinephrine). A small horizontal incision was made over the screw, which was then removed (Figure 6). Simple sutures were made using Vicryl suture material (Vicryl, Ethicon, Boston, MA, USA; Figure 7). The sutures were removed 1 week later.

After 6 months (Figure 8), the repaired area was opened again using the same incision design and a full-thickness flap to show bone growth (Figure 9). Horizontal bone regeneration was also achieved (bone width around 7–8 mm). We removed the right tenting screw, performed implant osteotomy in the #12 and #21 areas (Figures 10 and 11), placed the implants (Straumann Bone Level NC, 3.3-mm diameter Roxolid implant material, Straumann, Andover, MA, USA) according to the manufacturer's protocol; and submerged the implants in the bone (Figures 12–14). Horizontal mattress sutures, followed by simple interrupted sutures, were used to suture the flaps (Figure 15).

Implant exposure was performed after 4 months, and healing abutments were placed. The implants were then restored using fixed dental prostheses cemented from #12 to #22 (Figures 16–18). We also changed the crowns of teeth #13 and #23. To ensure the long-term success of implant therapy the patient was enrolled in a periodontal and peri-implant maintenance program every year. This visit includes professional tooth cleaning followed by polishing using polishing brushes and polishing paste. This will control the inflammatory factors which are responsible

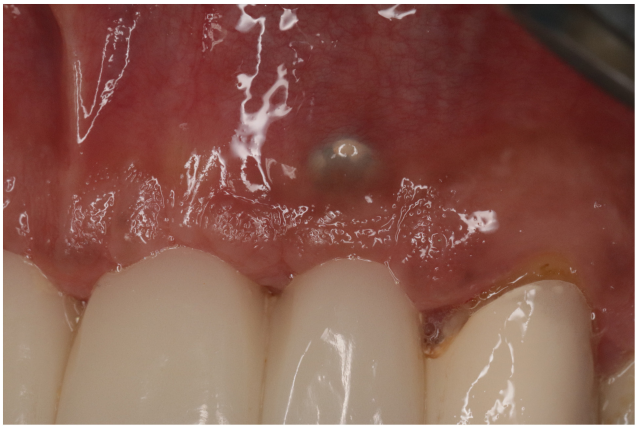

FIGURE 5 Thinning of the soft tissue covering tenting screw area of 22.

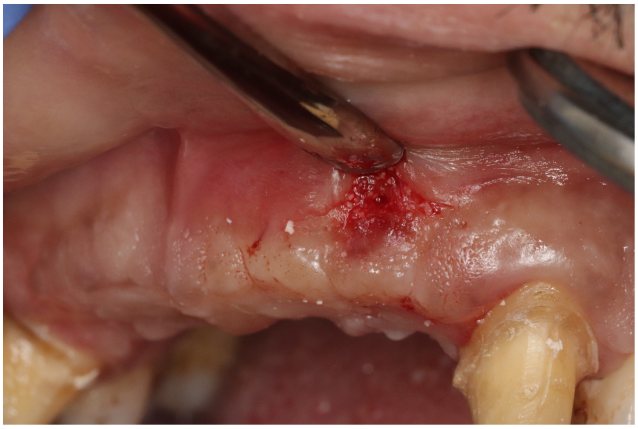

FIGURE 6 Horizontal incision and removal of the tenting screw.

for gingival health, especially at the level of the regenerated bone.[11] The patient was satisfied with the esthetics (Figure 19). Follow-up was conducted after 1 year, and the patient was stable.

5 | DISCUSSION

The GBR technique has become a major treatment option for ridge augmentation, as it provides optimal bone support for dental implants. Implants placed in native bone using GBR have success rates comparable to those of implants placed in grafted bone.[12] In contrast, Albrektsson et al. reported positive results with alveolar ridge augmentation, leading to 100% implant success and survival over 1 year.[13] Lateral ridge augmentation can be achieved using the GBR technique with particulate graft materials and resorbable collagen membranes.[10]

Autogenous bone grafts have osteogenic, osteoinductive, and osteoconductive properties,[14] making them

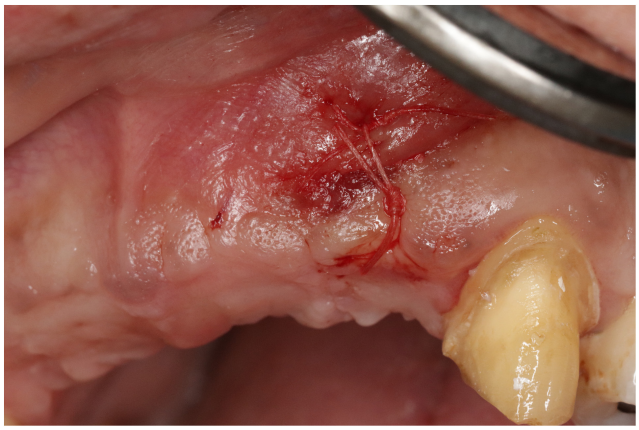

FIGURE 7 Suturing of horizontal incision.

FIGURE 8 Surgical site 6 months post bone grafting surgery.

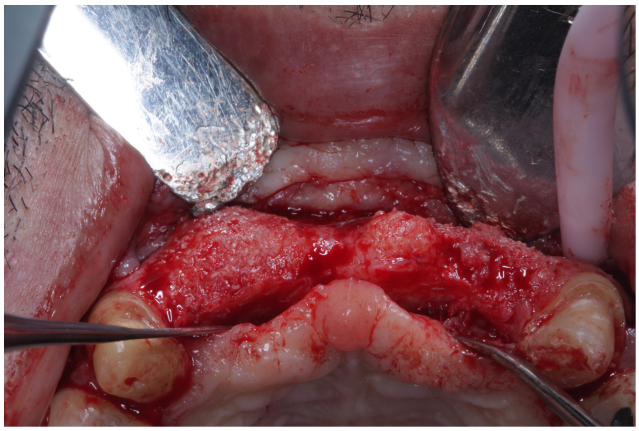

FIGURE 9 Incision and flap reflection showing regenerated bone.

the gold standard for GBR. However, their use is associated with a high morbidity rate owing to the need for a second surgical site. This can cause pain, discomfort, and other complications related to the invasiveness of the procedure.[14] Therefore, to minimize patient morbidity,

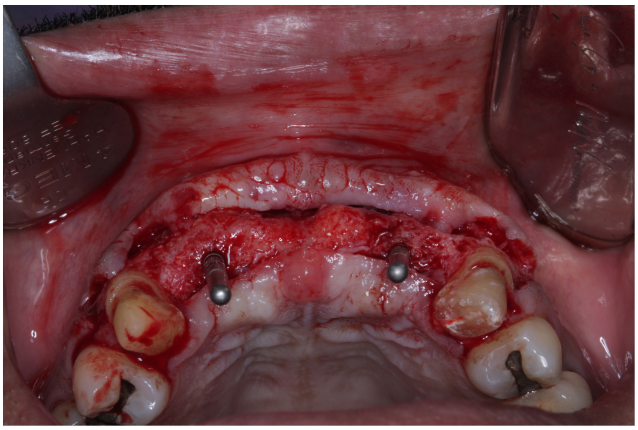

FIGURE 10 Implant osteotomy and placement of direction indicator.

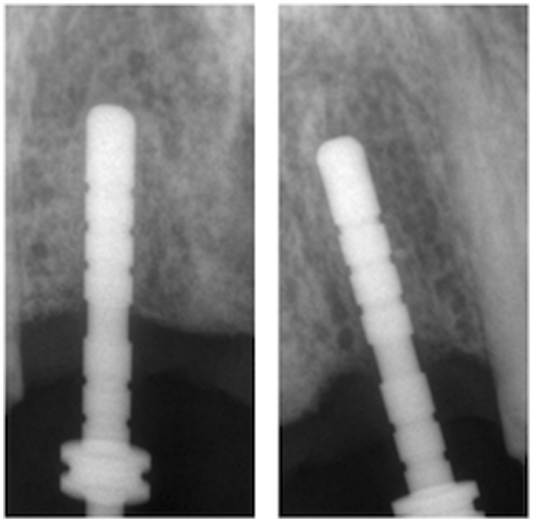

FIGURE 11 Periapical radiograph showing the direction indicator.

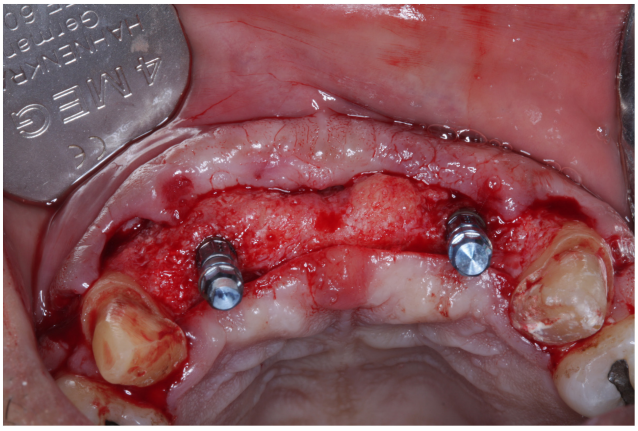

FIGURE 12 Occlusal view showing implant placement.

various bone substitutes have been used in GBR, such as xenografts, allografts, alloplastic grafts, and mixtures of these graft types.[15–17]

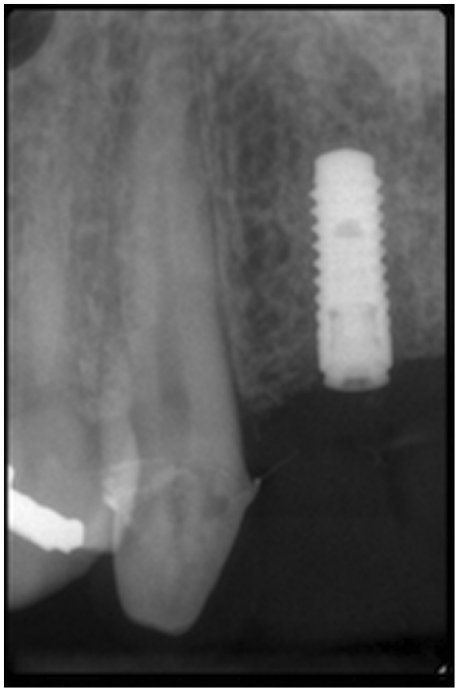

FIGURE 13 Periapical radiograph showing implant # 12.

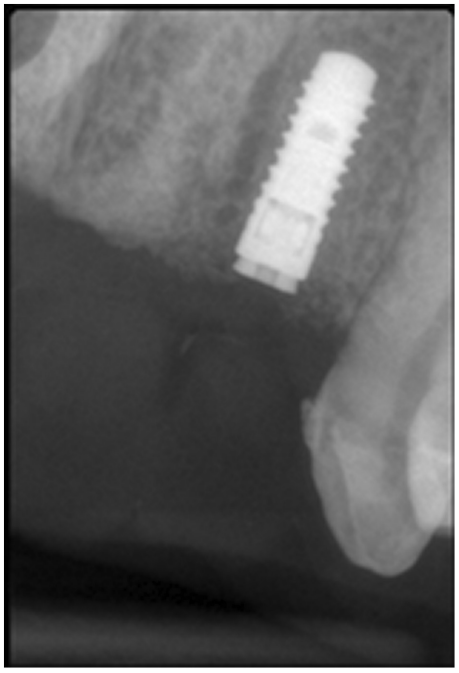

FIGURE 14 Periapical radiograph showing implant # 22.

In this case, a mixture of biocompatible allografts with osteo-inductive and osteoconductive properties[18] acts as a scaffold with slow resorption rates, thereby maintaining the volume of bone gain.[19] A resorbable collagen membrane was used to cover bone grafts. The barrier membrane protects the treated site and prevents unwanted cell migration. Collagen membranes are preferred because they are biocompatible with oral tissues and

FIGURE 15 Occlusal view showing suturing of the flap.

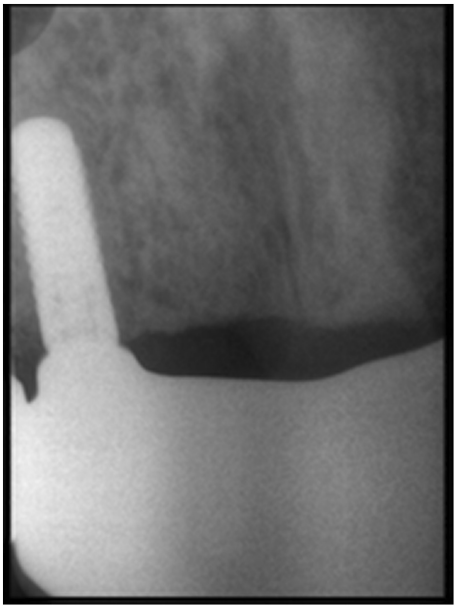

FIGURE 16 Periapical radiograph showing the final loading of the fixed dental prosthesis on the implant # 12.

physiologically absorbed. Moreover, collagen is considered a hemostatic agent that promotes platelet aggregation and subsequently initiates clot formation.[18] A study comparing resorbable and non-resorbable membranes showed similar histological and histomorphometric results when used in GBR[20] However, the use of non-resorbable membranes requires precise adjustment and stabilization. In addition, these membranes have a higher risk of exposure, are time-consuming, and require additional surgeries for membrane removal. Using resorbable collagen membranes eliminates the need for another surgery to remove the membrane; additionally, it requires minimal adjustment, thus decreasing the time required to complete surgery and minimizing patient morbidity and postsurgical trauma.[21]

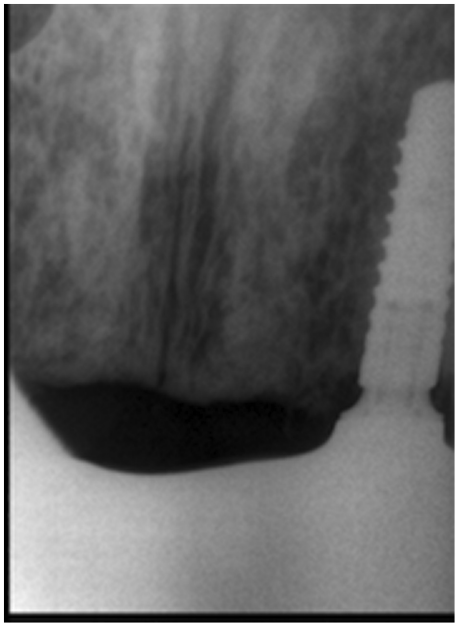

FIGURE 17 Periapical radiograph showing the final loading of the fixed dental prosthesis on the implant # 22.

FIGURE 18 Final insertion of the fixed dental prosthesis supported by 2 implants #12 and # 22.

FIGURE 19 Patient smile shows a good esthetic outcome of the treatment.

Tenting screws were used to prevent membrane collapse. This technique positively affects staged GBR, with greater bone gain and consistent bone augmentation[22] Once horizontal bone regeneration is achieved, the implant can be placed in the proper position without requiring a non-resorbable membrane or more invasive surgical procedure, such as autogenous block grafting.

In conclusion, the horizontal GBR strategy using a mixture of allograft and xenograft bone supported by tenting screws and covered with a resorbable collagen membrane can exclude the need for additional surgeries, such as non-resorbable membranes and major block grafting surgeries. Although the initial outcomes are promising, continuous follow-up is required to examine the stability of the newly regenerated bone and the long-term success of the implant. Additional controlled, long-term, randomized clinical, and histological studies are required to determine the superiority of this approach over other conventional techniques.

AUTHOR CONTRIBUTIONS

Amani Mirdad: Formal analysis; investigation; methodology; resources; writing – original draft; writing – review and editing.

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FUNDING INFORMATION

Non-applicable.

CONFLICT OF INTEREST STATEMENT

No grants from any funding agency in the public, commercial, or not-for-profit sectors were provided to support this case report.

DATA AVAILABILITY STATEMENT

The data that supports this case are available with the corresponding author upon reasonable request.

ETHICS STATEMENT

The patient has signed a written informed consent.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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