Case Report

Vertical Ridge Augmentation with a Titanium-Reinforced ePTFE Membrane And Tenting Screws: A Case Report

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Abstract

The present report demonstrates a clinical procedure to restore an edentulous area with severe bone destruction using ridge augmentation and implant placement. Titanium-reinforced, expanded polytetrafluoroethylene (ePTFE) membrane and tenting screws combined with a mixture of autograft and allograft (rate 50%: 50%) were used for guided bone regeneration (GBR). A two-stage surgery was performed to remove the non-resorbable membrane after 6 months healing period and delayed implants were placed. A vertical bone height of 8.0 mm (from 7.5 mm to 15.5 mm) and 7.0 mm (from 8.5 mm to 15.5 mm) was gained in the edentulous area corresponding to tooth #36 and #37, respectively compared to the radiographic image of the atrophic ridge before GBR. Final superstructures on #36 and #37 were obtained with favorable crown-root ratio. One and half year follow-up examination showed stable marginal bone level and healthy peri-implant mucosa.

Key words:vertical ridge augmentation, GBR, Ti-reinforced ePTFE membrane, dental implant, tenting screws

Introduction

Subsequent horizontal and vertical bone loss is unavoidable and often difficult to restore when teeth are lost due to advanced periodontitis. Vertical bone defect is more complicated to handle because of its high technical sensitivity. Schmid et al. [1] presented in 1991 vertical bone regeneration around the protruded implants covered with an expanded polytetrafluoroethylene (ePTFE) membrane in rabbit skulls. Similar results reported Linde et al [2], Jovanovic et al [3] and Renvert et al [4]. Simion et al [5] reported the first human and histologic study of vertical ridge augmentation using a titanium-reinforced membrane and osseointegrated implants. Guided bone regeneration (GBR) technique has been developed to restore the lost hard tissue from the broken walls where periodontal destruction happens [6, 7]. The composite graft consisting of autogenous bone and freeze-dried bone allograft (FDBA) has osteogenic properties. It maintains space for the created bone volume to improve the treatment outcome and predictability [8]. Regenerated bone provides good implant stability according to long-term follow-up studies [9 - 11]. The present report applied such a technique and obtained a satisfactory result for an edentulous area with severe bone loss.

Patient condition and treatment planning

A medically stable 48-year-old, non-smoking woman suffered from advanced periodontitis of the teeth #36, #37 and #47. The periapical radiographic examination of the lower left mandibular posterior region revealed severe alveolar bone loss around #36 and #37 (Figure 1). The prognosis was hopeless and #36, #37 should be extracted. The reconstruction plan was to restore left side dentition first followed by a right site reconstruction.

Extraction and pre-implant GBR

Teeth #36 and #37 were extracted and soft tissue healing was completed about 8 weeks later. Panoramic X-ray showed severe bone destruction at lower left posterior edentulous ridge (Figure 2). The GBR procedure was performed under local anesthesia with 2% lidocaine and 1:100,000 epinephrine (Figure 3a). A full-thickness midcrestal incision was made on the edentulous area using a sulcular extension to the disto-buccal aspect of tooth #37 (Figure 3b). The flaps were elevated to expose the atrophic ridge and the immature healing sockets (Figure 3c). Evident vertical and horizontal bone defects were found.

Decortication of the ridge was performed using a round bur to expose the medullary spaces and promote the bleeding process. Two tenting screws (7mm and 9mm in length) were positioned at the existed bone peak level of the adjacent tooth (#35) and distal ramus area (Figure 3d). Autogenous bone (Figure 3e) was harvested by disposable Safe-scraperR in situ at the distolateral aspect of the mandibular ramus and mixed with freeze-dried bone allograft (FDBA) particles (Figure 3f), (rate 50%: 50%). The Ti-reinforced ePTFE membrane (TR6Y) was shaped for perfect adaptation and fixed to the lingual and buccal plates with 3 tacks (Screw tack, ACER), (Figure 3g). The membrane was placed 2 mm away from the #35 root surface to keep off bacterial contamination from the sulcus. Safety distance was maintained to the mental nerve while inserting the tacks to fix the membrane and performing periosteal releasing incisions. Tension-free flap was achieved using sufficient periosteal releasing incisions for primary wound closure. The soft tissue was secured with non-resorbable horizontal mattress sutures and interrupted sutures (Figure 3h and 3i). Postoperative panoramic radiograph showed overlying membrane, 2 tenting screws and 3 fixation screws (Figure 3j).

The patient was prescribed with antibiotic and analgesic medication (Doxymycin 100 mg/cap, twice a day for 7 days; Ponstan 250 mg/cap, three times a day for 5 days) to prevent postoperative infection and pain. The patient was advised to use mouth rinse with 0.2% chlorhexidine gluconate for postoperative wound care. The sutures were removed after 14 days. Healing was uneventful. There was no soft tissue dehiscence or membrane exposure.

Fig. 1
Periapical radiograph revealed severe bone destruction around tooth #36 and #37.

Fig. 2
Panoramic radiograph showed large vertical defects at the lower left edentulous ridge.

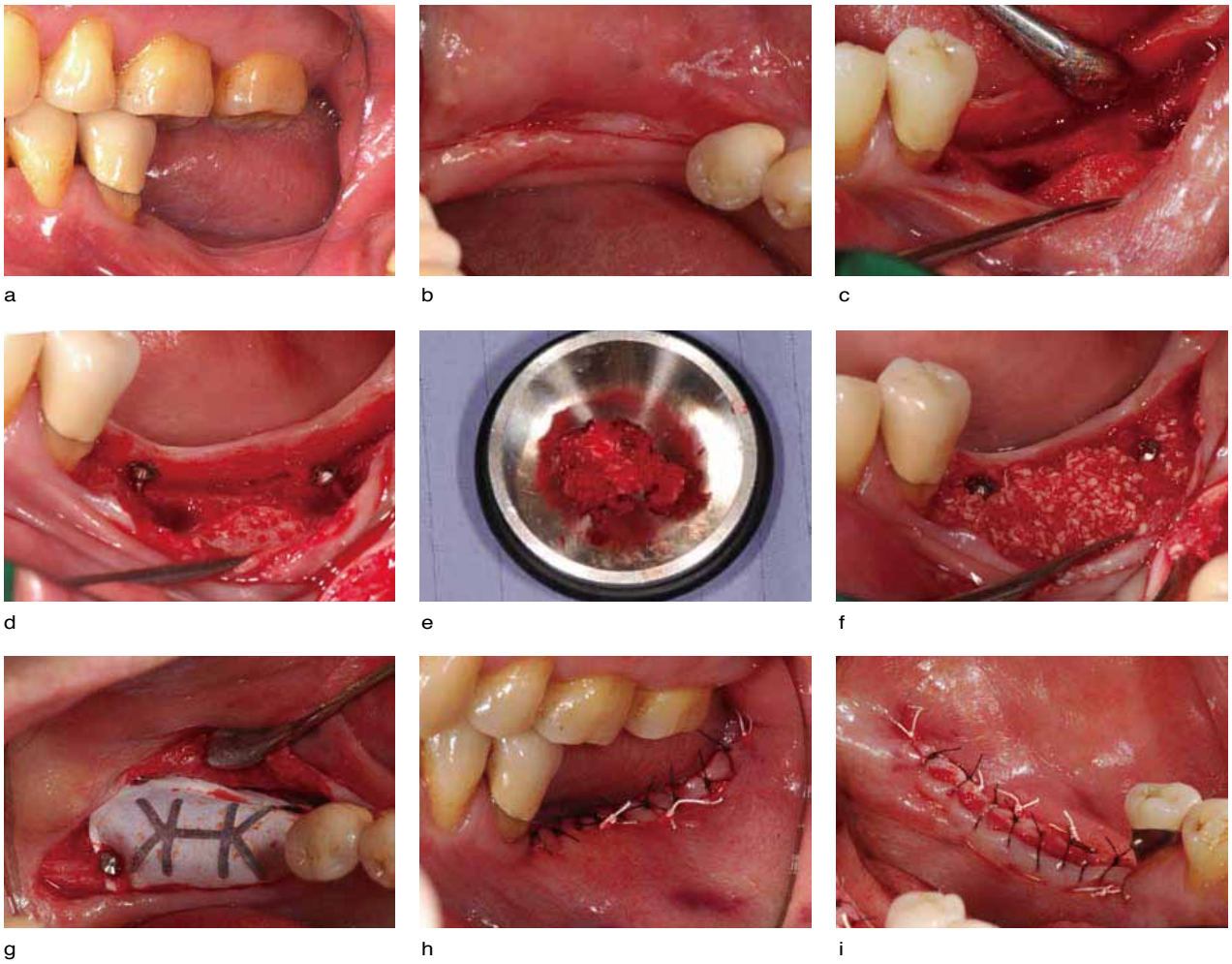

Fig.3 Surgical procedures of bone grafting:
(a)Large interarch distance was shown. (b)One linear and precise midcrestal incision was made. (c) Immature healing sockets and apparent vertical and horizontal defects were inspected. (d) Tenting screws were positioned strategically to create the potential threshold of vertical bone gain. (e,f) Autogenous bone graft was harvested by bone scraper. Autograft combination with allograft (FDBA) was applied to cover the screw heads completely. (g-i) Ti-reinforced ePTFE membrane was secured by 3 fixation tacks. About 2mm of the crestal bone was left uncovered next to the adjacent tooth so as not to interfere with the healing of the periodontal tissues. Primary wound closure was achieved with nonresorbalbe horizontal and interrupted sutures. (j) The postoperative panoramic radiograph displayed the overlying membrane, 2 tenting screws and 3 fixation tacks

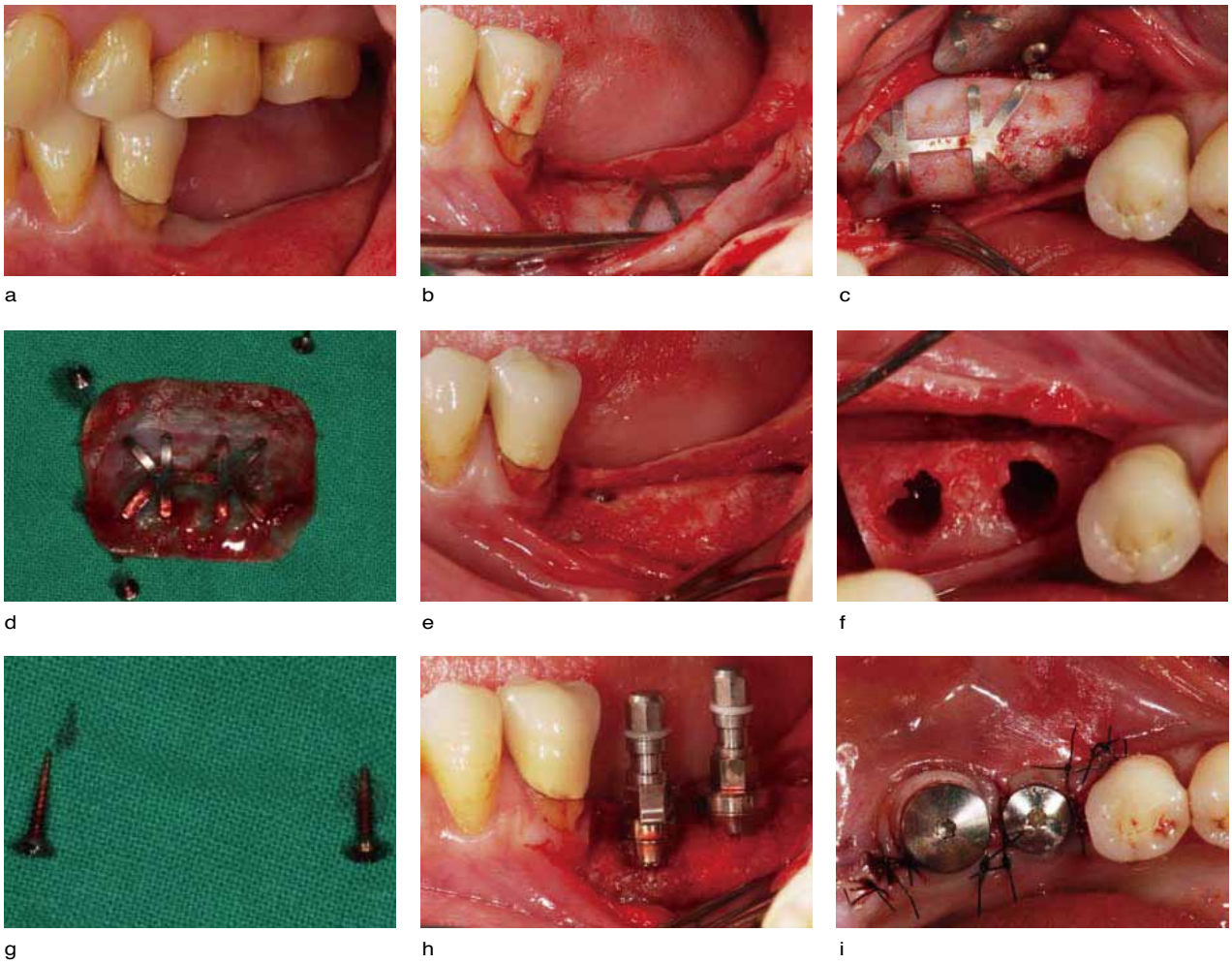

Fig.4
(a-c) After 6 months of healing, re-entry revealed the Ti-reinforced membrane appeared stable with the fixation screws in place. (d-g) Substantial regenerated bone fill of the defect was noted after carefully removing of the membrane and screws. (h,i) Two dental implants were inserted and connected to their healing abutments. (j) The radiograph shows that the implants were surrounded by the augmented bone.

Implant placement

The 2nd stage of the surgery was performed after 6 months to remove the non-resorbable membrane (Figure 4a, 4b, 4c and 4d). A re-entry on the site revealed regenerated hard tissue covering the tenting screws surface (Figure 4e). Two titanium dental implants (Straumann R £ X 4.8 mm X 10 mm, RN, SP; £ X 4.8 mm X 10 mm, WN, SP) were inserted after removal of the tenting screws (Figure 4g). The implant of regular neck type was chosen according to the compromised width of the augmented crest bone at the first molar area (Figure 4f). The implant position of the first molar shifted distally and the shoulder level was in a deeper corono-apical direction for complete bone coverage of the implant surface (Figure 4h). Soft tissue was closed with 5-0 Nylon interrupted sutures (Figure 4i).

Radiography revealed that the two implants were positioned properly and that the surrounding bone tissue was sound three and half months later (Figure 5a). 2 solid abutments (7 mm for RN, 5.5 mm for WN) were placed with 35 N/cm insertion torque value (Figure 5b, 5c).

Two separate crowns were made without splinting because the two implants had different levels of shoulders in the corono-apical dimension (Figure 5d, 5e). The final prostheses had favorable crown-root ratio in the periapical radiograph (Figure 5f).

Follow-up

One and half year follow-up examination showed stable marginal bone level (Figure 6a) and healthy peri-implant mucosa (Figure 6b and 6c).

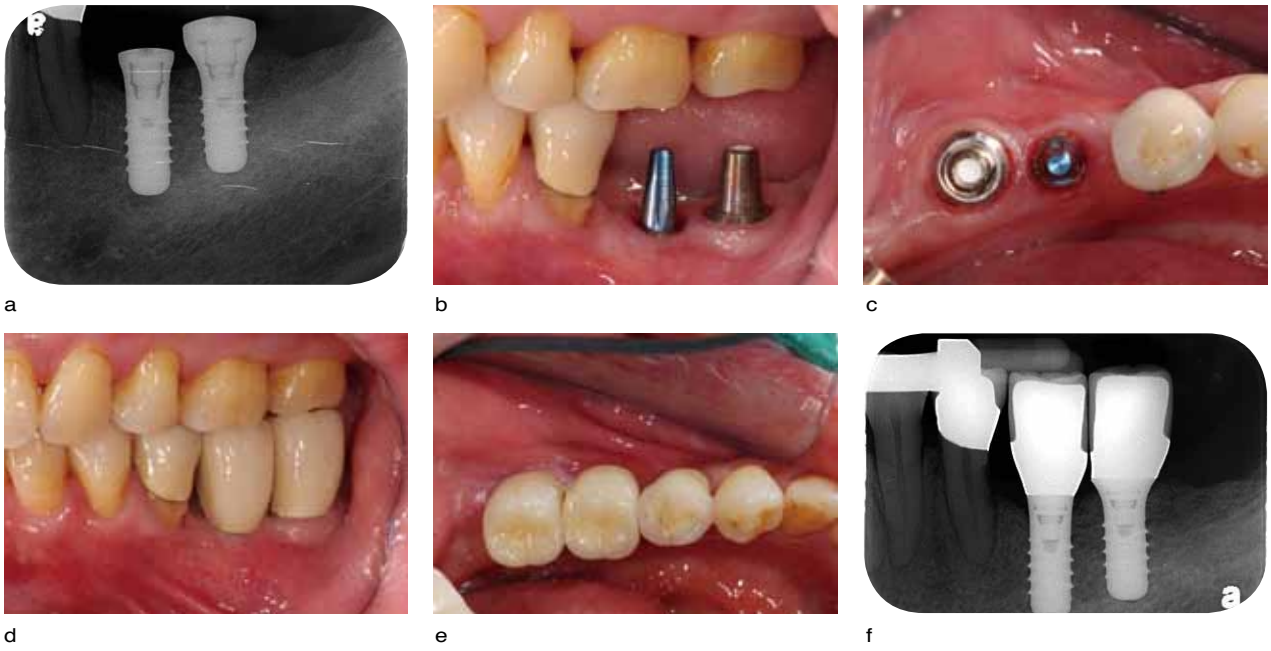

Fig.5 Dental prosthesis after implant placement:
(a) The boundary between augmented and native bone is ambiguous. (b,c) Two solid abutments were placed. (d,e) Two implant supported restorations without splinting were placed with satisfactory clinical appearance. (f) Periapical radiograph shows the implants and the prosthesis with favorable crown-root ratio.

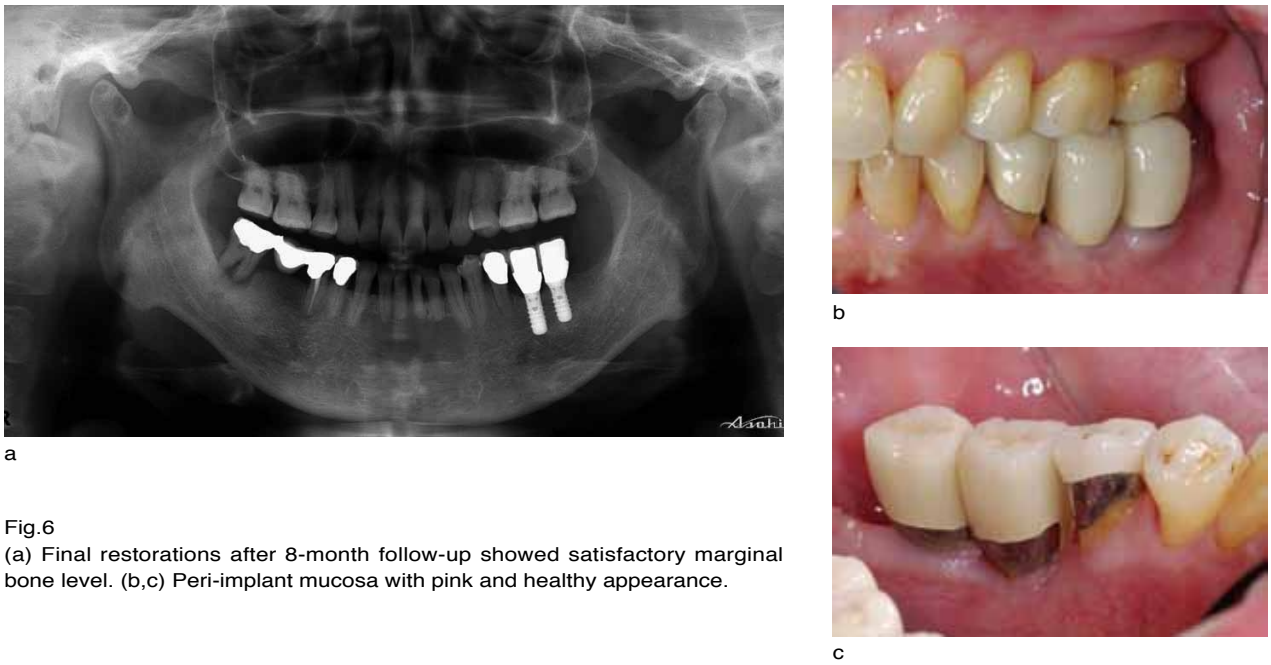

Fig.6
(a) Final restorations after 8-month follow-up showed satisfactory marginal bone level. (b,c) Peri-implant mucosa with pink and healthy appearance.

Discussion

Vertical ridge augmentation can be achieved by other techniques such as alveolar distraction osteogenesis (ADO), [12-14] and inlay/onlay grafting [15, 16]. ADO can produce consistent bone regeneration [17], and autograft is commonly thought to be the gold standard of graft selection [18]. GBR, however, has better control over the undesired axis of regenerated bone compared to ADO [14] and little space limitation as a distractor application at the mandibular area [19]. GBR can minimize the usage of precious and rare autogenous bone block from the oral cavity [20, 21].

An insufficiency of vertical bone height for implant placement or a large distance often requires changes of coronal length and form resulting in an unfavorable crown-root ratio of dental prosthesis. This is the main indication for vertical ridge augmentation. Nissan et al [22] reported recently that the crown height space of unsplinted implant supports prosthesis over 15 mm high but that it has a higher rate of implant failure. In the present case, successful vertical ridge augmentation via GBR instead of implantation on the native bone height reduced the consequent crown height space to less than 15 mm. Establishment of the adequate vertical crown space was believed to have better long-term prognosis and stability.

Urban et al [23] demonstrated that the mean vertical augmentation was 5.5 to 2.29 mm. The existing periodontium of the adjacent teeth should be the main consideration in predicting the volume of the bone that can be regenerated. Bone peaks of adjacent teeth show the effect of space making and maintenance, which is the key for bone regeneration [24]. Support can be obtained using tenting screws that can enhance the effect of propping up the overlying barrier and enhance space maintenance for the severe atrophic edentulous ridge. Hence, two tenting screws were used in this case. A vertical bone height of 8 mm and 7 mm in the edentulous ridge was gained corresponding to the tooth #36 and #37, respectively. Le et al [25] reported even thicker vertical augmentation of 9.7 mm mean value. Using tenting screws in large vertical defects can be regarded as a better protocol for ridge augmentation according to Le et al and our experience.

Premature membrane exposure resulting in postoperative infection is the major and most frequent complication even though ePTFE membrane is advantageous in GBR [26, 27]. Therefore, correct membrane placement and stabilization with fixation screws and primary passive closure are mandatory. To avoid bacterial contamination from the adjacent tooth and potential damage to the mental nerve, the membrane was placed more distally to the adjacent root surface and mental foramen in this case. Thus, compromised horizontal volume of crest morphology at the first molar was unavoidable. High technical sensitivity of the ePTFE membrane is important compared to the bioresorbable barrier membrane, which is easier to handle during surgery [28]. Hence, ePTFE membrane application has a limited popularity.

Conclusion

GBR with Ti-reinforced ePTFE membrane, tenting screws and bone grafts offers predictable functional reconstruction of large vertical defects. Long-term success and survival rates can be predicted. This technique is also a feasible and successful way to create a desirable crown/root ratio for implant prosthesis.

摘要

本報告說明如何利用階段性骨脊增進術(staged approach of ridge augmentation)以及人工植體置入，重建一個有嚴重骨破壞的左下第一及第二大臼齒缺牙區。本案例於引導骨再生(guided bone regeneration)手術中，使用不可吸收性再生膜（Ti-reinforced ePTFE membrane）及支撐釘（tenting screws）以支撐混合的自體骨(autograft)與異質移植骨(allograft)填充物。經過六個月的癒合期後，第二次手術時將不可吸收性的再生膜移除，並同時置入人工植體。術後X光片顯示的齒槽骨高度，與未施行引導骨再生術前的萎縮齒槽骨脊做比較，可見在左下第一大臼齒的齒位區，骨脊高度從7.5mm增加至15.5mm，共增加了8.0mm，以及在左下第二大臼齒的齒位區，骨脊高度從8.5mm增加至15.5mm，共增加了7.0mm的垂直高度；而後以固定式義齒重建，也獲得理想的冠-根比，經過一年半的追蹤，目前植體周圍的齒槽骨依然保持穩定的高度。

關鍵詞： 垂直骨脊增進術、引導骨再生術、不可吸收性再生膜、人工植體、骨釘

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