Mandibular Reconstruction With Fibula Bone Graft Followed by Particulate Cancellous Bone and Marrow Graft With Titanium Mesh Tray

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INTRODUCTION

Patients with mandibular tumor sometimes undergo extensive bony resection with mandibular reconstruction. Although there are many methods available for mandibular reconstruction, no consensus on a definitive method has been reached.[1] Currently, mandibular reconstruction with vascularized free fibula flap technique has become a routine procedure for the functional reconstruction of the mandible.[2] In addition, with the advent of endosseous dental implants, dental prosthetic rehabilitation has been considered the final goal of the treatment.[3] However, because the vertical height of the reconstructed mandible by fibula is insufficient to compare with the native mandible, occlusal reconstruction with dental implants is often disturbed. Therefore, the reconstruction of alveolar ridge is essential to provide a better prosthetic rehabilitation with dental implants. With regard to bone augmentation, it is important not only to increase bone volume but also to form proper alveolar ridge being well-harmonized with opposing or adjacent teeth. To accomplish such augmentation, the particulate cancellous bone and marrow (PCBM) graft in combination with custom-made titanium mesh (Ti-mesh) tray is now a reliable method for reconstruction of the alveolar ridge.[1]

This report describes the 2-staged approach of mandibular reconstruction with fibula graft followed by iliac PCBM with a custom-made Ti-mesh tray. This reconstruction procedure enables favorable occlusal reconstruction with dental implants for the patients with large mandibular defect.

CASE PRESENTATION

A 40-year-old man was referred to our facility with a request of reconstruction for mandibular defect arising from tumor resection. Four months before, under the diagnosis of keratocystic odontogenic tumor of the left mandible, he underwent hemi-mandibular resection. The resected mandible was reconstructed with a titanium plate. Three months after the surgery, the titanium plate was fractured, and the patient's occlusion was disturbed because of the deviation of the mandible. We performed the mandibular reconstruction by a 2-staged approach. At first, the reconstructive titanium plate was removed and the mandibular defect was reconstructed with free vascularlized fibula bone graft. Six months later, the alveolar ridge was reconstructed by using the PCBM harvested from the unilateral posterior ilia and the custom-made Ti-mesh tray (Figure 1). The custom-made Ti-mesh tray was fabricated preoperatively with the use of a 3-dimensional (3D) life-sized skull model. The ideal alveolar ridge for occlusal reconstruction was built up with dental wax on the fibula bone of the 3D model. Then, a Ti-mesh sheet (OsteoMed, Addison, Tex) was cut and formed according to this model (Figure 2). After another 6 months, the custom-made Ti-mesh tray was removed and 2 dental implants (Brånemark system MK-III TiUnite, Nobel Biocare, Zurich, Switzerland) were installed in the reconstructed mandible. Second-stage surgery was performed after 6 months of submerged healing. The healing abutments were hand tightened on the 2 implants. One month later, the definitive cement-retained prosthesis was fabricated, and the abutment screw was tightened to the torque of 35 Ncm (Figures 3, 4a and b). The patient has been followed up for 8 months after functional loading. Cone-beam computed tomography revealed that the bone of peri-implants was not resorbed (Figure 5a and b). The implants and the prosthesis have remained stable without any trouble.

DISCUSSION

The most common problem encountered with free fibula bone graft for prosthetic treatment is the insufficient bone

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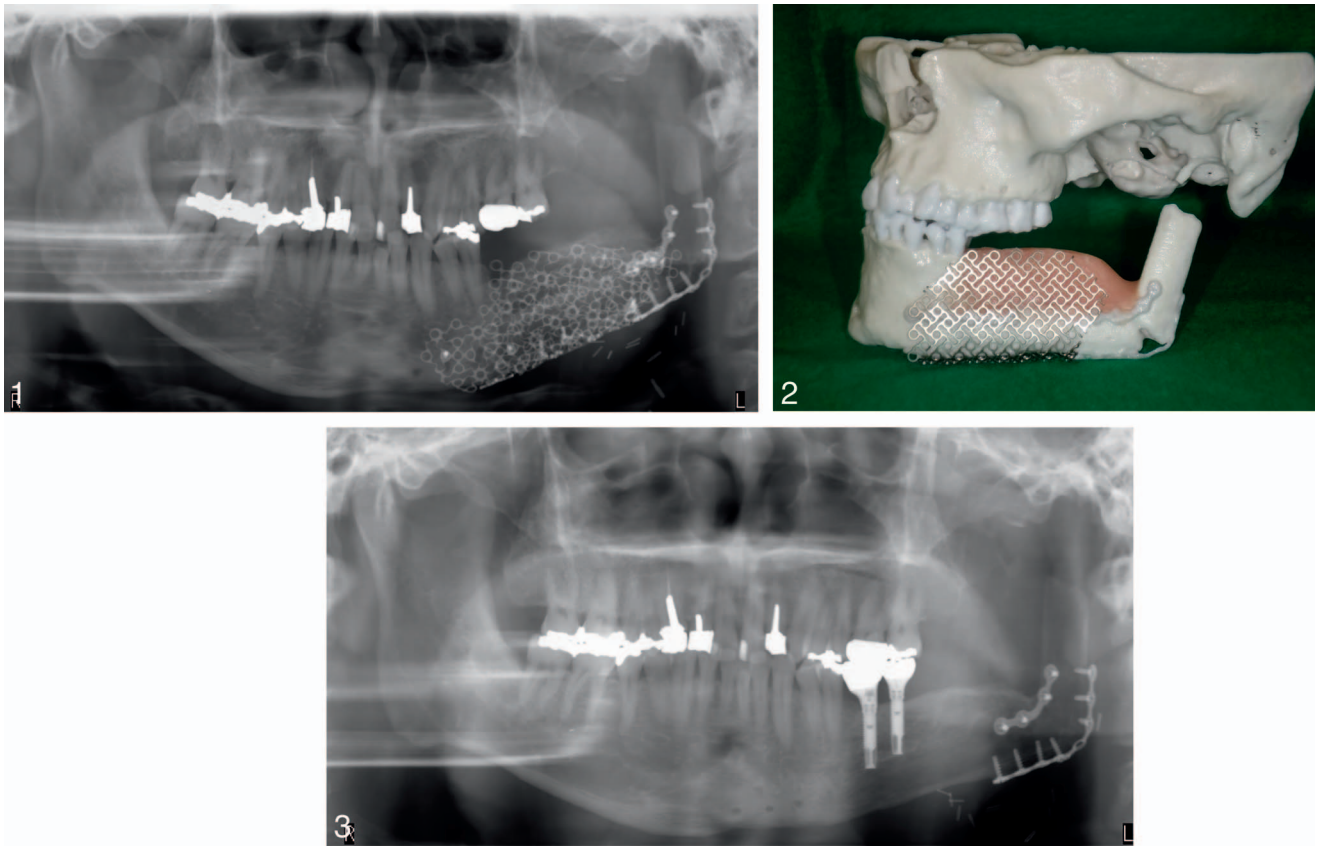
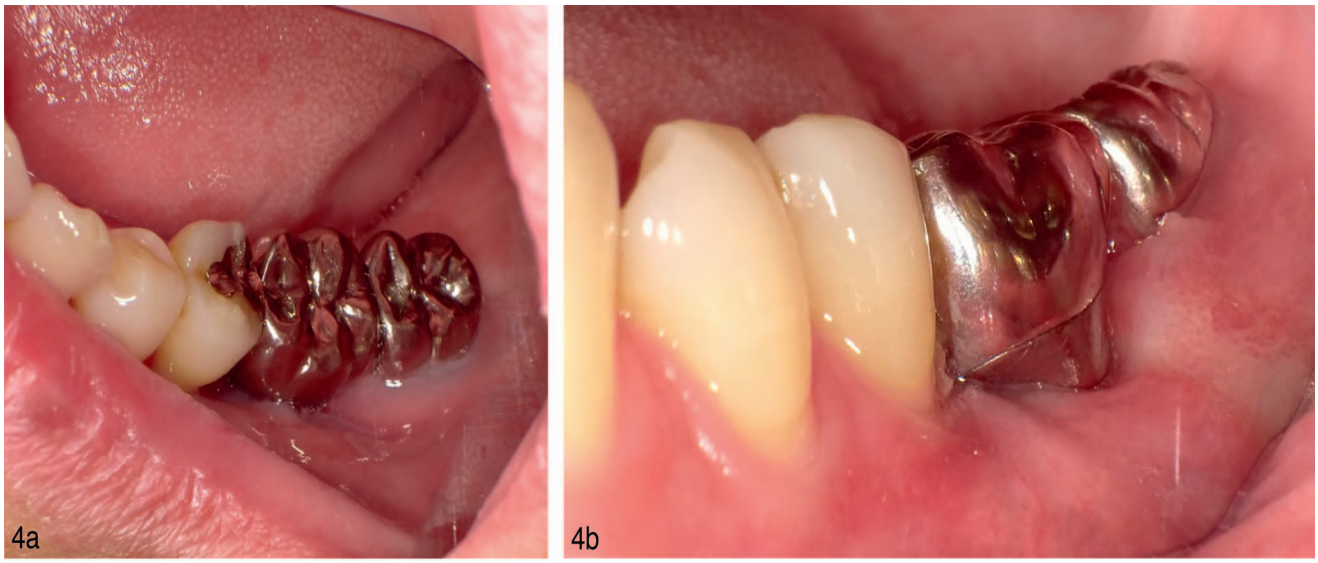
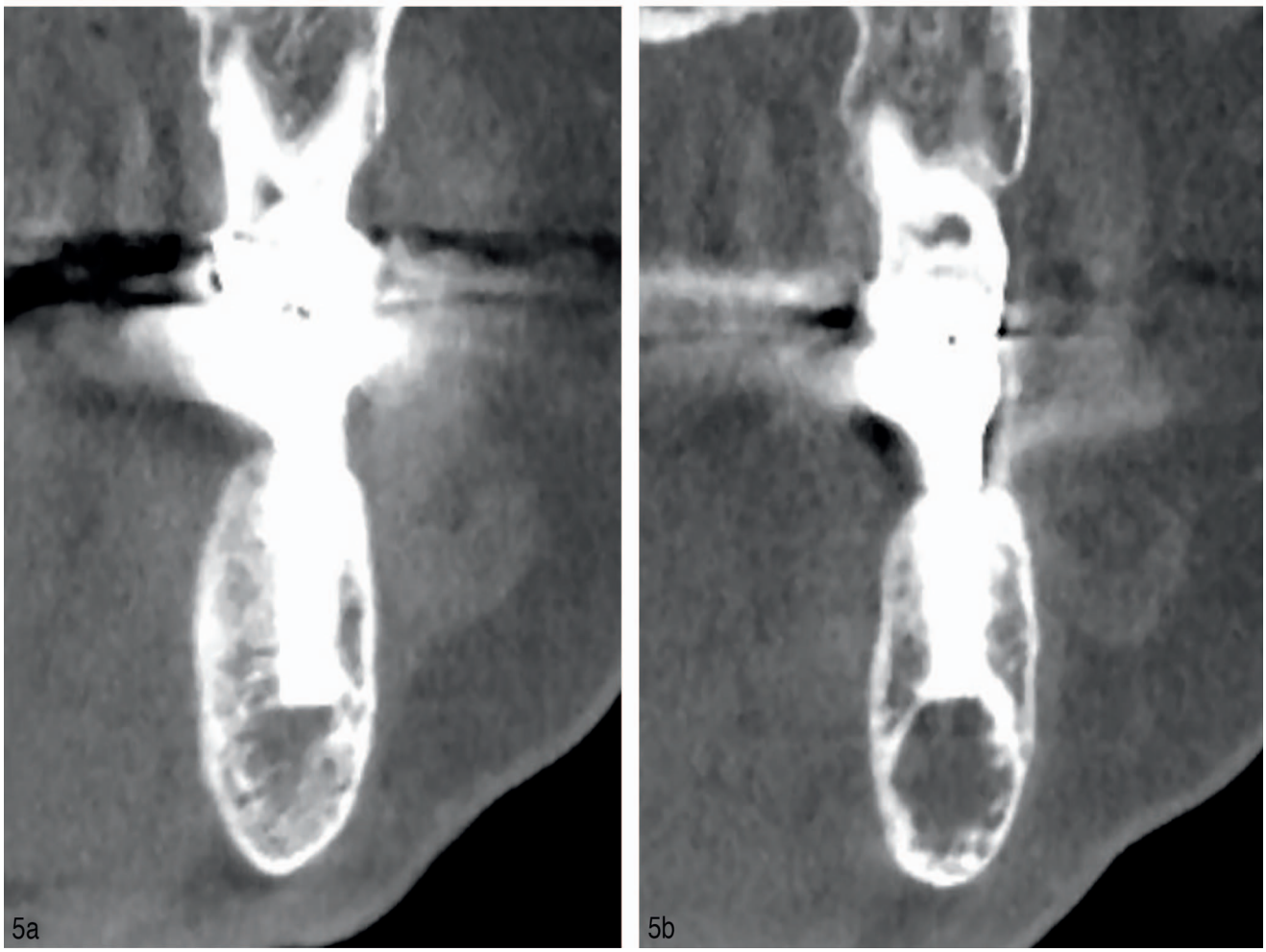


Figures 1–3. Figure 1. Panoramic radiograph of the reconstructed mandibular by the particulate cancellous bone and marrow (PCBM) and custom-made Ti-mesh tray. Bone augmentation was performed to increase the height of the PCBM-reconstructed mandible to match that of the remaining native mandible. **Figure 2.** Ti-mesh tray used for reconstruction of alveolar ridge. **Figure 3.** Panoramic radiograph 6 months after the placement of dental implants.

height,[4] which results in a gap between the bone margin and the occlusal plane, in particular in patients treated by partial resection of the mandible with residual dentition on the healthy side.[5] If this problem remains unsolved, various troubles will occur in the occlusal reconstruction with dental implants such as inappropriate tooth contour and crown-root ratio, overloading, deficiency of rip support, and difficulty of brushing. Therefore, the bone augmentation for the optimal alveolar ridge is quite important. To reproduce the alveolar ridge with a complicated 3D form, the PCBM and custom-made Ti-mesh tray technique is effective from functional and esthetic points of view.[6] Recently, some reports describe the good results of the double-barrel fibula technique for the mandibular reconstruction including occlusal reconstruction with dental implants.[7–9] However, this surgical technique is complicated, and the indication is limited. Therefore, it is thought that it requires a great deal of skill to obtain the good result. On the other hand, although 2 surgeries are needed, our present technique is the combination with 2 basic conventional procedures. In our technique, it is important that the PCBM and Ti-mesh tray are covered by well-vascularized oral soft tissue to prevent them from being exposed to the oral cavity. Therefore, the cases that underwent resection of tumor including surrounding soft tissue without soft tissue and/or radiation therapy are sometimes inappropriate for the present technique. With regard to the management of peri-implant mucosa, we did not perform the free gingival graft. Traditionally, the sufficient keratinized gingiva has been recognized to maintain healthy gingival tissues and to prevent gingival recession. In particular, it has been believed that the success of implants is dependent on the ability of the mucosa to endow the appropriate biologic protective role between the oral environment and implants.[10] However, controversy exists over the role of keratinized gingiva in the long-term success of implants.[10] We thoroughly performed tooth blushing instruction instead. Therefore, plaque control is good in the oral cavity, and there is no inflammation in the peri-implant mucosa regardless of movable mucosa.

To the best of our knowledge, no cases of mandibular and occlusal reconstruction with fibula bone flap and PCBM with A custom-made Ti-mesh tray have previously been reported for patients with mandibular defect. This approach, we believe, offers advantages for occlusal reconstruction with dental implants.





Figures 4 and 5. Figure 4. Definitive prosthesis. (a) Occlusal view. (b) Lateral view. **Figure 5.** Images of cone-beam computerized tomography after 8 months from functional loading. (a) The site of first molar in the mandible. (b) The site of second molar in the mandible.

Abbreviations

3D: 3-dimensional

PCBM: particulate cancellous bone and marrow

Ti-mesh: titanium mesh

References

1. Goh BT, Lee S, Tiedman H, Stoelinga PJ. Mandbular reconstruction in adults: a review. *Int J Oral Maxillofac Surg*. 2008;37:597–605.

2. Sieg P, Zieron JO, Bieworlf S, Hakim SG. Defect-related variations in mandibular reconstruction using fibula grafts: a review of 96 cases. *Br J Oral Maxillofac Surg*. 2002;40:322–329.

3. Moscoso JF, Keller J, Genden E, et al. Vascularized bone flaps in oromandibular reconstruction: a comparative anatomic study of bone stock from various donor sites to assess suitability for endosseous dental implants. *Arch Otolayngol Head Neck Surg*. 1994;120:36–43.

4. Shah JP, Gil Z. Current concepts in management of oral cancer—surgery. *Oral Oncol*. 2009;45:394–401.

5. Wang F, Huang W, Zhang C, Sun J, Kaigler D, Wu Y. Comparative analysis of dental implant treatment outcomes following mandibular reconstruction with double-barrel fibula bone grafting or vertical distraction osteogenesis fibula: a retrospective study. *Clin Oral Implants Res*. 2015;26: 157–165.

6. Miyamoto I, Yamashita Y, Yamamoto N, et al. Evaluation of mandibular reconstruction with particulate cancellous bone marrow and titanium mesh after mandibular resection due to tumor surgery. *Implant Dent*. 2014;23:108–115.

7. Bahr W, Stoll P, Wachter R. Use of the "double barrel" free vascularized fibula in mandibular reconstruction. *J Oral Maxillofac Surg*. 1998;56:38–44.

8. Chang YM, Tsai CY, Wei FC. One-stage, double-barrel fibula osteoseptocutaneous flap and immediate dental implants for functional and aesthetic reconstruction of segmental mandibular defect. *Plast Reconstr Surg*. 2008;122:143–145.

9. Wang WH, Zhu J, Deng JY, Xia B, Xu B. Three-dimensional virtual technology in fibula flap. *J Craniomaxillofac Surg*. 2013;41:417–422.

10. Kim BS, Kim YK, Yun PY, et al. Evaluation of peri-implant tissue response according to the presence of keratinized mucosa. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2009;l107:e24–e28.