Preliminary Clinical and Histologic Evaluation of a Bilateral 3-Dimensional Reconstruction in an Atrophic Mandible: A Case Report

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This article presents the case report of the bilateral 3-dimensional reconstruction of a posterior mandible in a 48-year-old woman. Titanium meshes and Regenaform demineralized freeze-dried bone allograft were used for bone regeneration. After 5 months the titanium mesh was removed, and after another 4 months, 4 Straumann sandblasted, large-grit, acid-etched implants were placed, 2 on each side of the mandible. During implantation a bone specimen was collected and sent for histologic examination. The definitive fixed prosthesis was fabricated after an additional 4 months. The clinical and histologic results are shown. The implants were followed for 18 months after implant loading; no signs of bone loss or infection were observed. Int J Oral Maxillofac Implants 2007;22:478–483

Key words: *bone regeneration, demineralized freeze-dried bone allograft, dental implants, titanium mesh*

In recent years, the development and refinement of bone regeneration techniques has contributed to an increase in dental implants placed and, therefore, to the increased use of fixed prosthetic rehabilitation. These procedures enable a prosthetically guided treatment plan for bone defect repair (ie, guided bone regeneration [GBR]). They make it possible to obtain adequate bone support for implants with a proper implant-crown ratio and an esthetic and functional prosthesis.

Moreover, the new implant surfaces allow the use of implants shorter than 10 mm,[1–3] which in the past was considered the minimum length for successful results.[4,5] In an atrophied mandible (Cawood and Howell class 5)[6] it is possible to place 8-mm implants after limited bone regeneration. Additionally, the use of biomaterials in association with a titanium mesh can eliminate the need for an autologous bone graft. The titanium mesh retains the biomaterial in the right position,[7] protecting it from mechanical trauma and movement.[8–10]

This article presents the case report of a bilateral 3-dimensional reconstruction of the posterior mandible with the use of a demineralized freeze-dried bone allograft (DFDBA) and titanium meshes. The clinical, radiologic, and histologic results are described.

MATERIALS AND METHODS

A 48-year-old woman presented to the office requesting bilateral fixed prosthesis in the posterior mandible. She had no teeth distal to the right first premolar and the left second premolar except for 2 compromised third molars, which were extracted. The clinical and radiologic examination demonstrated inadequate bone for implant placement (Cawood and Howell class 5)[6] (Fig 1). A computerized tomographic (CT) scan showed that the bone height from the crest to the inferior alveolar nerve was approximately 6 mm. The patient, who was in good general health, refused to donate autogenous bone for grafting. Therefore, the use of Regenaform (Regeneration Technologies, Alachua, FL) and titanium mesh was planned. Comprehensive information about this procedure was presented to the patient, and her written consent was obtained.

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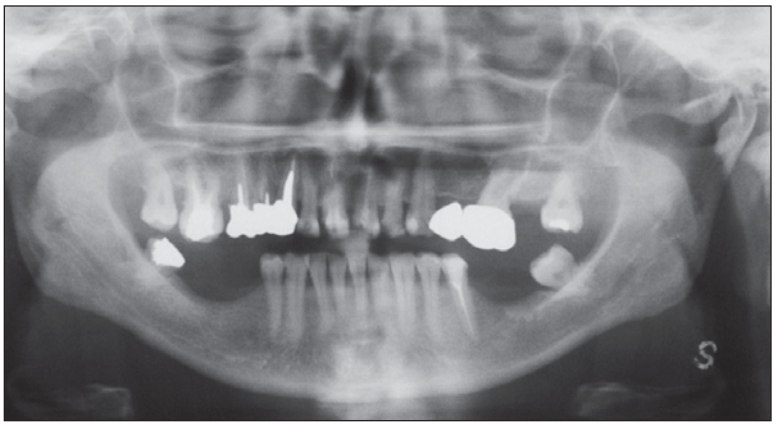


Fig 1 The initial orthopantomogram.

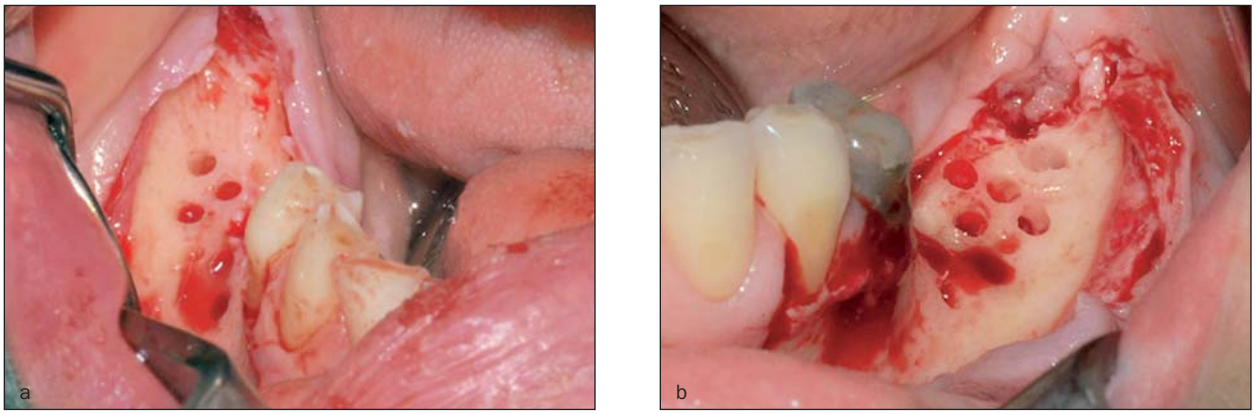


Fig 2 Receiving sites on *(a)* the right and *(b)* the left sides of the mandible were prepared by perforating the mandible with a round bur reaching the spongiosa.

After midazolam sedation (intravenous administration) and local anesthesia with articaine 4% plus adrenaline 1:100,000 (Ubistesin; 3M ESPE, Seefeld, Germany), a bilateral full-thickness flap was raised in the edentulous mandible using mesial and distal relaxing incisions. The bone crest was smoothed using a pear-shaped bur at 20,000 rpm. Two titanium meshes were molded directly on the bone defects. The GBR Straumann Dental System (Straumann, Basel, Switzerland) was used. This system includes quadrangular (55 × 55 mm) 0.2-mm-thick mesh made of grade 1 anodized titanium with hexagonal 1.2-mm holes and is affixed with 1.5-mm grade 4 titanium screws. The receiving sites were prepared by perforating the bone with a round bur to reach the spongiosa (Figs 2a and 2b). Regenaform was chosen as the graft material. It is an osteoinductive and osteoconductive material available in malleable bars made from corticomedullary human bone dehydrated, frozen, and demineralized (DFDBA) and immersed in a thermoplastic insoluble gel. It is rigid at body temperature and softens when heated to 43 to 49° C. It was prepared following the manufacturer's instructions and placed in the meshes. Care was taken to leave the margins free. Subsequently, the meshes were positioned on the bone defects with the graft material with gentle compression and secured by means of screws. The margins of the meshes were checked and, if necessary, burnished to avoid soft tissue lesions (Figs 3a and 3b). The mucoperiosteal flap was closed without any tension using Vicryl 4-0 (Johnson & Johnson, Somerville, NJ), and the patient was dismissed with the usual postoperative recommendations. At the 3-week follow-up, a 4 mm^2 exposure of the left mesh was seen (Fig 4). It was treated with 0.2% chlorhexidine gel and remained unchanged until the second surgery, which was performed 5 months after the first surgery.

For the second surgery, the same intravenous sedation and local anesthesia were used. A bilateral full-thickness flap was raised, and the 2 meshes were removed. As the regenerated bone seemed clinically immature, the surgery was concluded by suturing the flap. After another 4 months (9 months from the first surgery), a new CT scan was made to evaluate the new bone height (Figs 5 to 7). A bilateral full-

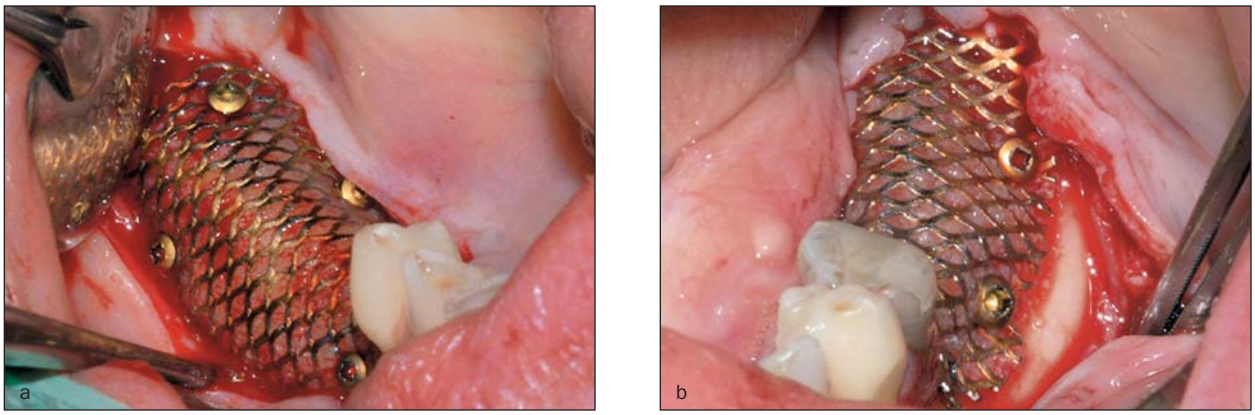


Fig 3 Placement of the titanium mesh and DFDBA on the *(a)* right and *(b)* left sides of the mandible.

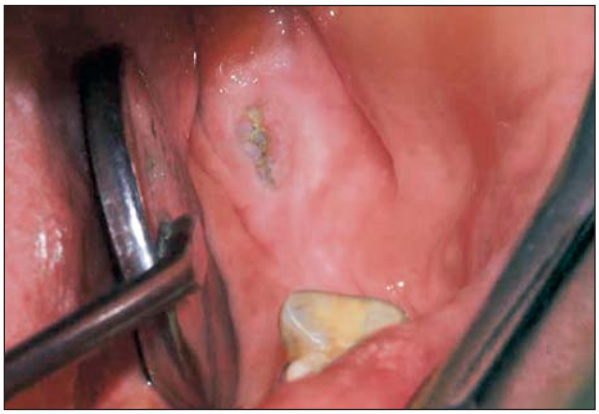


Fig 4 At the 3-week follow-up, a 4-mm^2 exposure of the left mesh was noticed. The area was treated with 0.2% chlorhexidine gel.

thickness flap was raised, and the regenerated bone was mature enough for implant placement (Figs 8a and 8b). Four Straumann implants were placed: a 4.1 × 10-mm implant for the right second premolar site; a 4.8 × 8-mm implant for the right first molar site; a 4.1 × 8-mm implant for the left first molar site; and a 4.8 × 8-mm implant for the left second molar site. Bone specimens were obtained from the implant sites, fixed in 4% formalin, and sent for histologic examination.

The prosthesis was fabricated after an additional 4 months.

RESULTS

Clinical Results

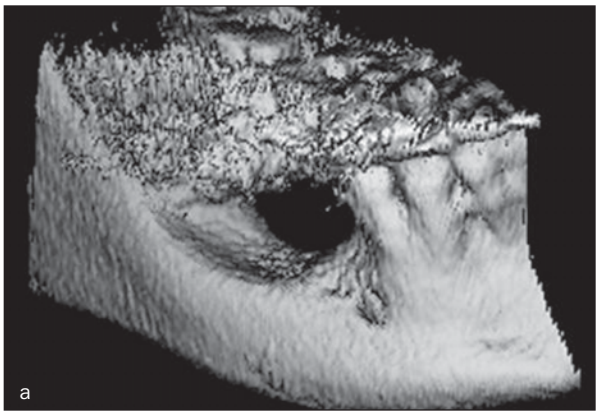
As shown by the pre- and postreconstruction CT scans, the mean vertical regeneration was 4 mm. The bone height was slightly lower where the mesh had been exposed. After 9 months, the regenerated bone appeared clinically compact and similar to native bone. The 18-month follow-up demonstrated the 4 implants to be clinically and radiologically in good condition (Fig 9). No signs of bone loss or infection were observed.

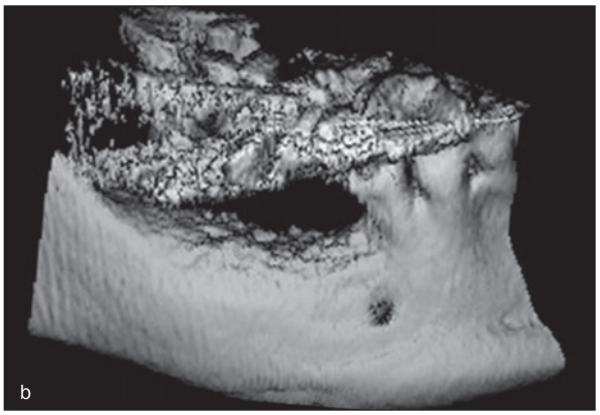
Histologic Results

With toluidine blue staining, new bone was clearly prevalent, with some native old bone. DFDBA particles were scarce and enclosed in medullary bone in an active remodeling phase, without inflammatory cells or fibrous encapsulation (Figs 10a and 10b).

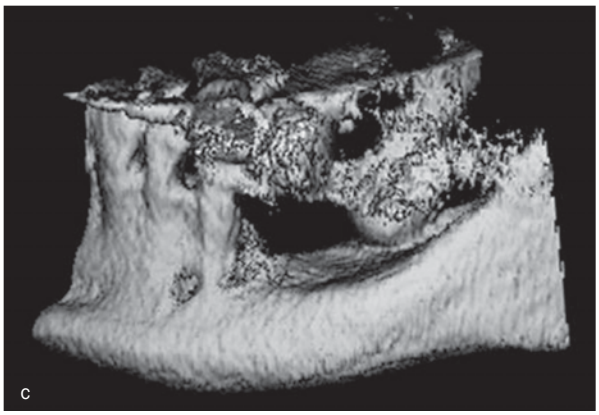
DISCUSSION

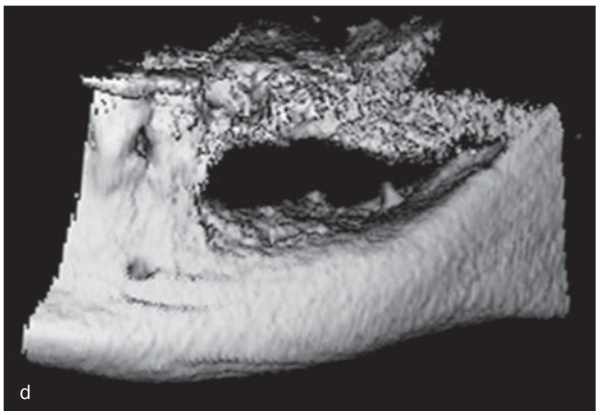
In this clinical case, titanium meshes and DFDBA were effective therapeutic choices. It is possible to shape the mesh and the graft material exactly to the bone defect. Regenaform was particularly appropriate because when softened it is very malleable and not conditioned by blood for its hydrophobic status. At body temperature, it hardens and remains in position. Moreover, it made it possible to augment the bone without the use of autologous bone, which made the procedure less invasive and eliminated the risk of donor site morbidity.





Figs 5a and 5b A CT scan (3D reconstruction) of the right side of the mandible *(a)* before bone regeneration and *(b)* 9 months later.





Figs 5c and 5d A CT scan (3D reconstruction) of the left side of the mandible *(c)* before bone regeneration and *(d)* 9 months later.

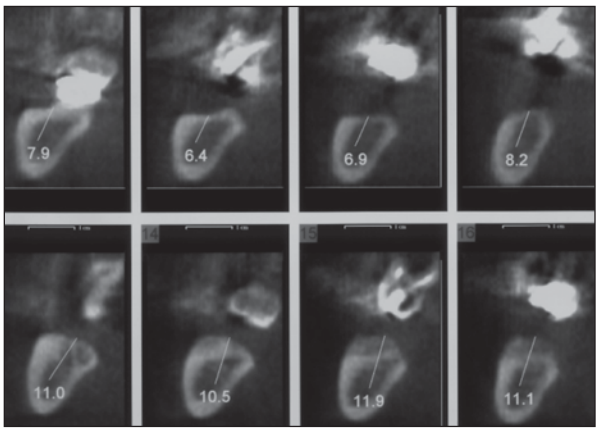


Fig 6 A CT scan of the right side of the mandible showing sections of the mandible before bone regeneration (upper row) and 9 months later (lower row).

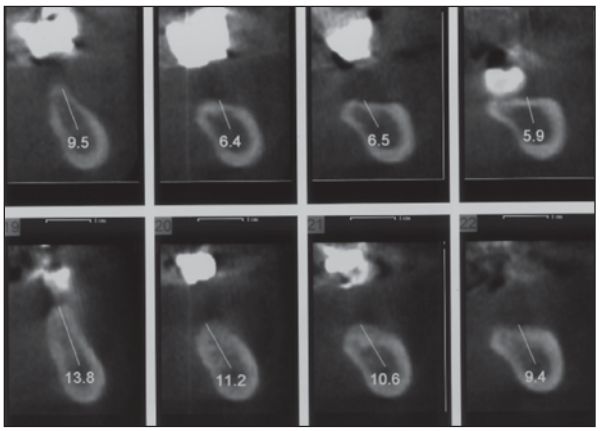
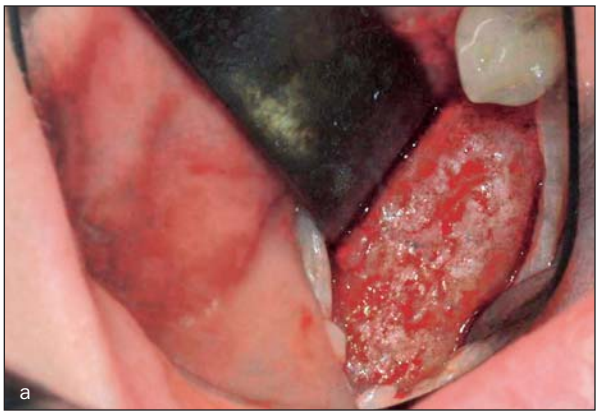


Fig 7 A CT scan of the left side of the mandible showing sections of the mandible before bone regeneration (upper row) and 9 months later (lower row).



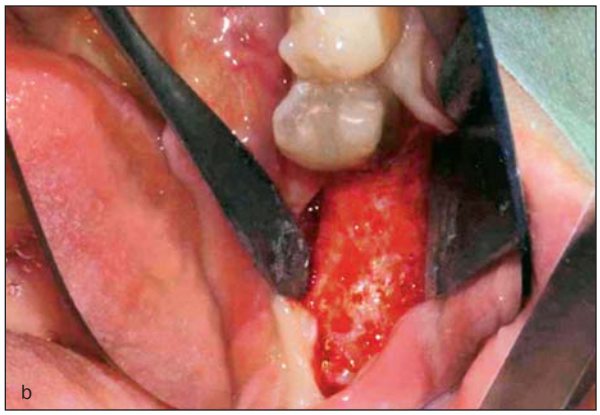
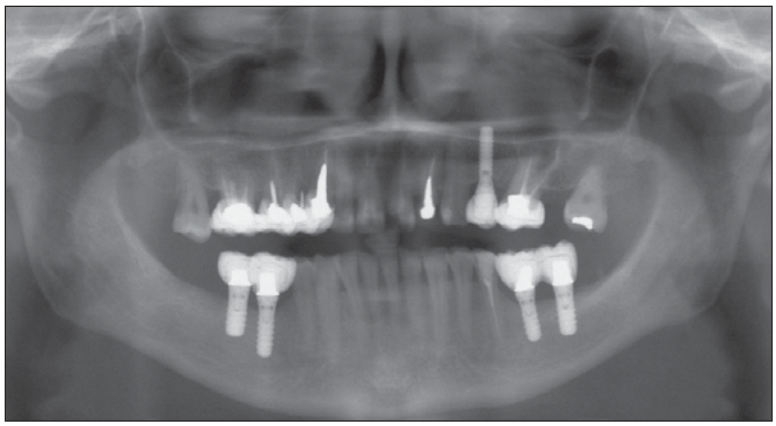
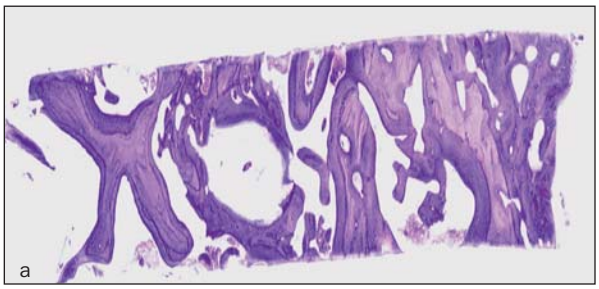
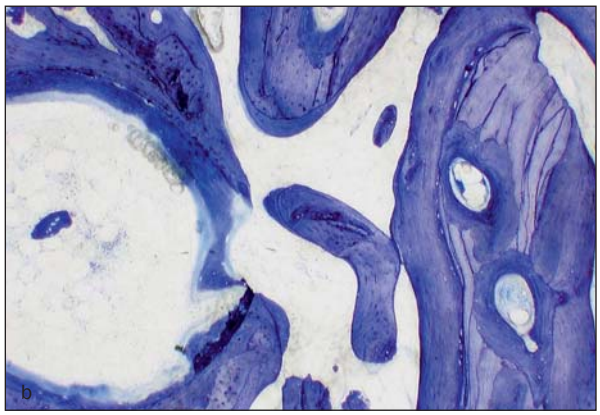


Fig 8 The regenerated bone on *(a)* the right and *(b)* the left sides of the mandible before implant placement, 9 months after the first surgery.

Fig 9 An orthopantomogram of the definitive prostheses at a follow-up visit 18 months after implant loading.







Figs 10a and 10b With toluidine blue staining, new bone was clearly prevalent. DFDBA particles were scarce and enclosed in medullary bone in an active remodeling phase, without inflammatory cells or fibrous encapsulation.

As has been discussed in the literature, one of the fundamental requisites for bone regeneration is space maintenance.[11,12] The more regeneration required, the more difficult it is to obtain space, especially for vertical defects. Titanium mesh has a mechanical resistance greatly superior to any membrane and can achieve a good stability for graft materials, which is very important for their success.[8–10] In addition, when a mesh becomes exposed it is possible to leave it in situ, although there will be less regenerated bone in the exposed area.[13,14] On the contrary, exposed expanded polytetrafluoroethylene (e-PTFE) membranes have to be removed.[15,16] As a membrane, titanium mesh is capable of protecting the bone graft during the healing phase,[17,18] and it is conceivable that it can provide the same protection to other graft materials. In this case the mesh was removed after 5 months. Various times have been reported in the literature: from 4 to 7 months for autologous bone,[17–19] up to 6 months for composite autogenous/xenogenous grafts,[20] and up to 9 months for xenogenous grafts.[21] The choice to surgi-

cally stage the mesh removal and implant placement has been successfully used by various authors.[19,20] This 2-stage procedure results in a more steady bone conformation; in the time between the 2 surgeries the regenerated bone can recover from the trauma of mesh removal and mature into a stable medullary-cortical bone pattern. In accordance with previous studies,[22–24] histologic analysis of the tissue in the present study showed a great amount of remodeling bone with limited enclosure of DFDBA particles. At the 18-month follow-up, the implants were clinically and radiologically successful. Their stability and the lack of any bone loss are strongly believed to be related to the graft maturity obtained by means of this technique.

CONCLUSION

The use of titanium mesh associated with a malleable graft material resulted in a good vertical and horizontal bone gain for implant placement. Within the limitations of a single case, the clinical and histologic results seem to support the use of Regenaform DFDBA as an alternative to an autologous bone graft in regenerative surgery in association with the use of a titanium mesh.

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