original article

Clinical use of Lumina-Porous™ heterologous graft in the maxillary sinus: a preliminary study with two case reports

Abstract / *Oral rehabilitation of edentulous patients with dental implants depends on proper quantity of bone. The posterior maxilla often has an insufficient amount of bone that require sinus augmentation surgery associated with bone graft. There are several types of material available and which can be used as bone grafts. The choice of material should be based on patient's and material's characteristics.* Objective: *The objective of this study is to report two cases in which sinus augmentation bilateral surgery was performed using two bone substitutes: Bio-Oss™ and Lumina-Porous™.* Methods: *Two patients with edentulous maxilla underwent surgery for maxillary sinus augmentation using Bio-Oss™ on the right side and Lumina-Porous™ on the left side. Six months later, after previous implant planning, eight implants were surgically installed for maxillary rehabilitation with fixed denture.* Results: *No differences were found regarding complications during and after surgery or insertion torque of dental implants. Both types of material showed maintenance of the acquired bone volume as a result of surgery. Although the use of Bio-Oss™ is well established in the literature, this is not true for Lumina-Porous™. This heterologous graft does not present the same level of scientific evidence, therefore, additional studies are warranted to further investigate this material.*

Keywords: *Sinus floor augmentation. Biocompatible material. Dental implants.*

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» The authors report no commercial, proprietary or financial interest in the products or companies described in this article.

» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

INTRODUCTION

In Implantodontics, totally or partially edentulous patients rehabilitation success depends on proper bone support.[1] The posterior maxilla usually consists of thin cortical bone and medullary trabeculae of little strength and density.[1,2] The maxillary sinus associated with poor bone quality in this region has been correlated with greater treatment failure rates.[2]

Treatment planning involving the posterior maxilla might include procedures performed to restore bone quality, such as maxillary sinus augmentation surgery.[3,4] The major techniques of maxillary sinus floor augmentation include the procedure initially proposed by Boyne and James[5] and developed by Tatum,[6] in which access is made through the sidewall; and the surgical technique described by Summers,[7] in which access is made through the alveolar bone.

Since maxillary sinus floor procedures were first described, several types of grafting material have been used, namely: autogenous bone, demineralized lyophilized bone (DFDBA), hydroxyapatite, beta-tricalcium phosphate (β-TCP), bovine inorganic bone (deproteinized), or a combination of all the above.[1,8] No consensus has yet been reached in the literature regarding the most appropriate bone substitute for maxillary sinus floor augmentation surgery.[1,2] Thus, the objective of this study is to report two cases in which Bio-Oss™ and Lumina-Porous™were used to restore bone volume in the posterior maxilla, which allowed osseointegrated dental implant placement.

CASE REPORTS

Case 1

A 55-year-old male patient sought the Service of Oral and Maxillofacial Surgery of the School of Dentistry, State University of Campinas (UNICAMP)/Piracicaba with chief complaint of lack of maxillary prosthesis retention. During the first interview, the patient reported tooth loss as a result of periodontal disease five years before. He also reported using maxillary complete denture and mandibular removable partial denture. The patient reported being a smoker for 35 years. Clinical and radiographic examination revealed maxillary complete and mandibular partial edentulism, and pneumatization of the maxillary sinus on both sides (Figs 1 and 2). Treatment planning included maxillary sinus floor augmentation bilateral surgery and placement of eight maxillary dental implants for further implant-supported fixed denture installation.

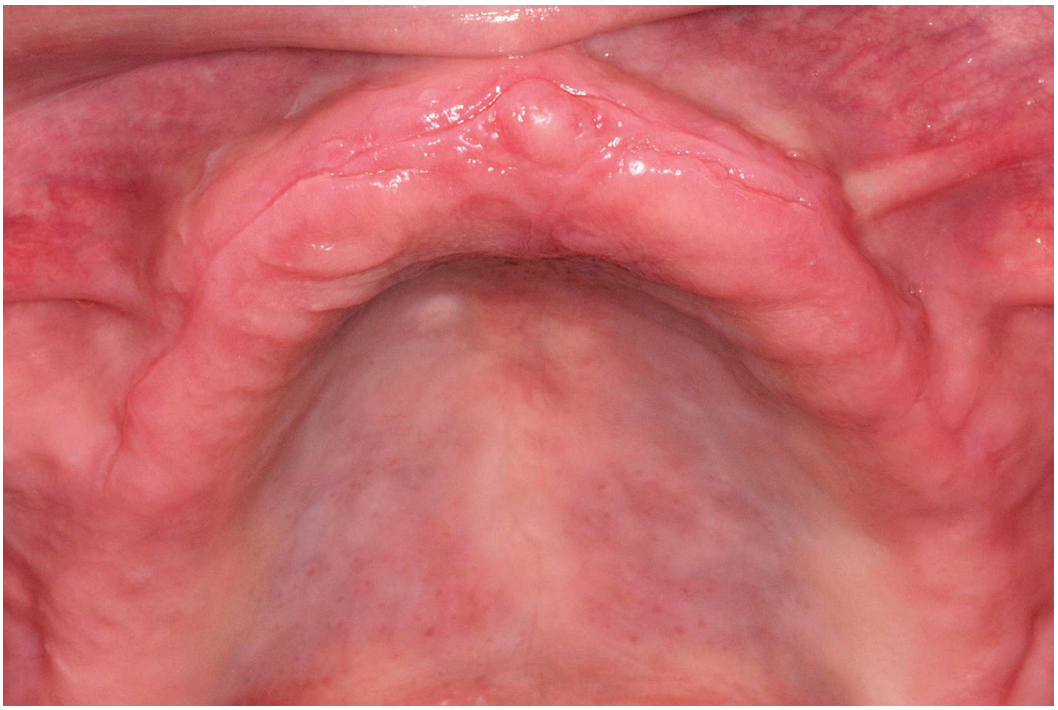

Figure 1. Initial photograph evincing edentulism.

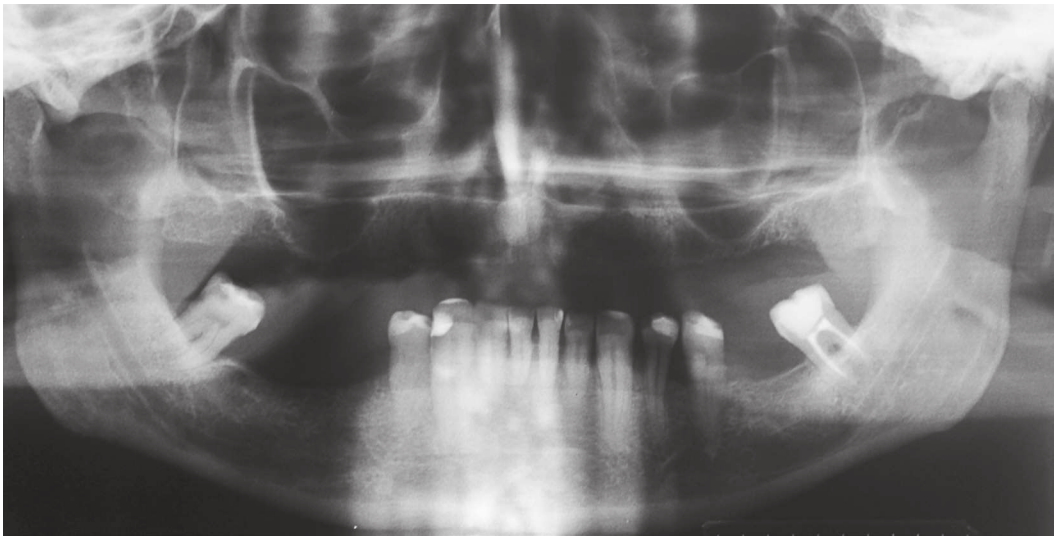

Figure 2. Panoramic radiograph evincing pneumatization of the maxillary sinus on both sides.

Case 2

A 45-year-old female patient sought the Service of Oral and Maxillofacial Surgery of the School of Dentistry, State University of Campinas (UNICAMP)/Piracicaba for rehabilitation with implant-supported denture after extraction of maxillary teeth due to severe periodontal disease. During the first interview, she reported having controlled hypertension. The patient had been using maxillary complete denture for three months. Clinical and radiographic examination revealed maxillary complete and mandibular partial edentulism associated with pneumatization of the maxillary sinus on both sides (Figs 3 and 4).

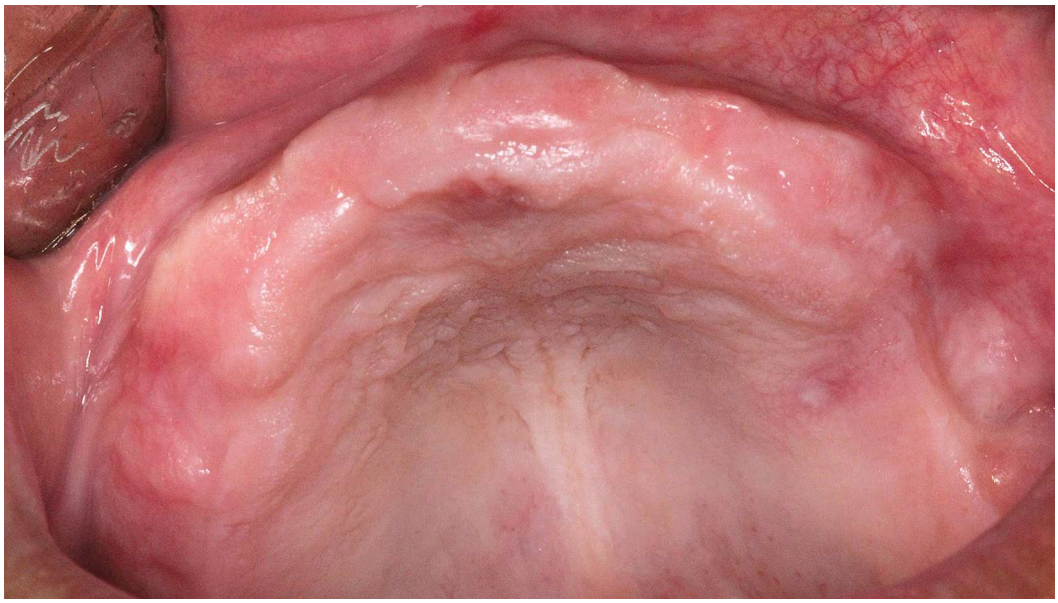

Figure 3. Initial photograph evincing edentulism.

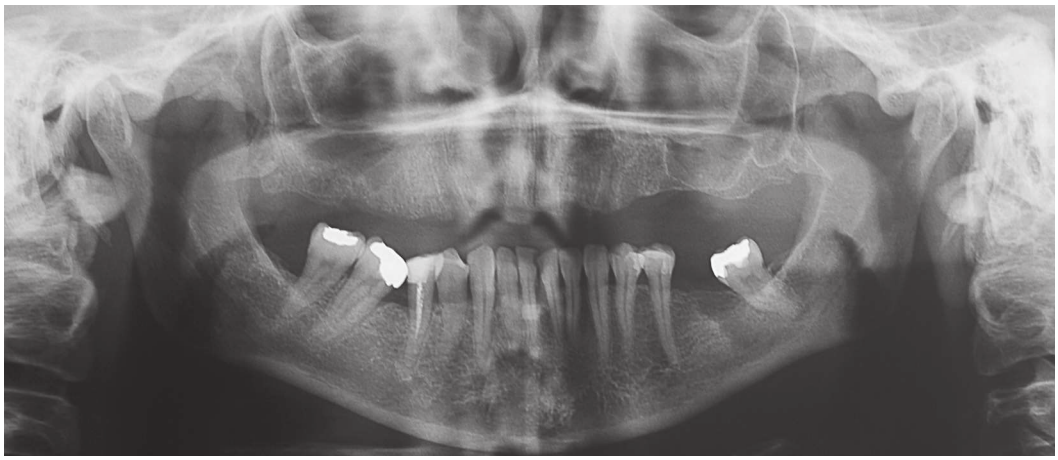

Figure 4. Panoramic radiograph evincing pneumatization of the maxillary sinus on both sides.

Surgical planning

Treatment planning proposed for both cases was maxillary sinus floor augmentation bilateral surgery using Lumina-Porous™ (0.3 – 1 mm granulation; Criteria Indústria e Comércio de Produtos Medicinais e Odontológicos Ltda, São Carlos; Brazilian Health Surveillance Agency (ANVISA) register #80522420001) and Bio-Oss™ (0.25 – 1 mm granulation, Geistlich Pharma AG, Wolhusen — Switzerland; Brazilian Health Surveillance Agency (ANVISA) register #25351301282) as bone substitutes, and further placement of eight maxillary dental implants. Both procedures were performed by the same dental surgeon.

Maxillary sinus augmentation bilateral surgery

Patients received pre-operative medication given orally one hour before the surgical procedure: 1 g of amoxicillin, 4 mg of dexamethasone, 500 mg of dipyrone and 7.5 mg of midazolam. Patients used 0.12% chlorhexidine digluconate as mouthwash immediately before surgery, followed by skin antisepsis with 2% chlorhexidine digluconate. After local anesthesia (2% lidocaine associated with epinephrine 1:100.000), a linear incision was made on the alveolar ridge. The latter was associated with relaxing incisions for surgical site exposure followed by mucoperiosteal detachment. Maxillary sinus sidewall was progressively worn in oval shape, 1 cm in diameter. To this end, a round diamond bur #8 inserted into a handpiece was used (Fig 5). Once the maxillary sinus membrane was visually detected and the bone wall presented mobility, the former was detached with the aid of non-cutting angulated curettes so as to obtain the surgical cavity necessary to receive the bone substitute (Fig 5). Right and left maxillary sinus were randomly filled with 0.5 g of Bio-Oss™ or Lumina-Porous™ (Figs 7 and 8). Surgical wounds were closed by first intention healing with 4-0 silk wire.

Implant placement

Six months later, new imaging examinations were taken. They revealed proper bone

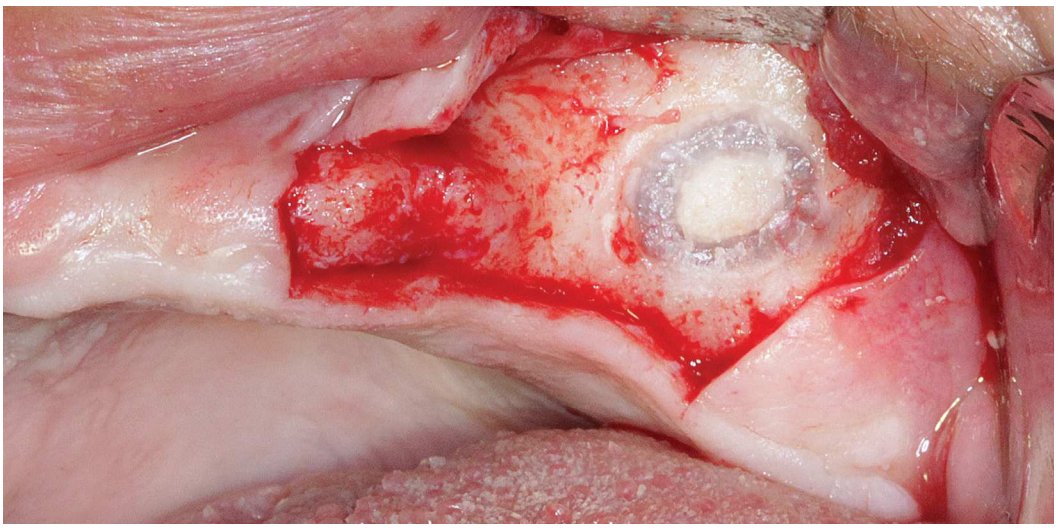

Figure 5. Left maxillary sinus sidewall wear (Case 2).

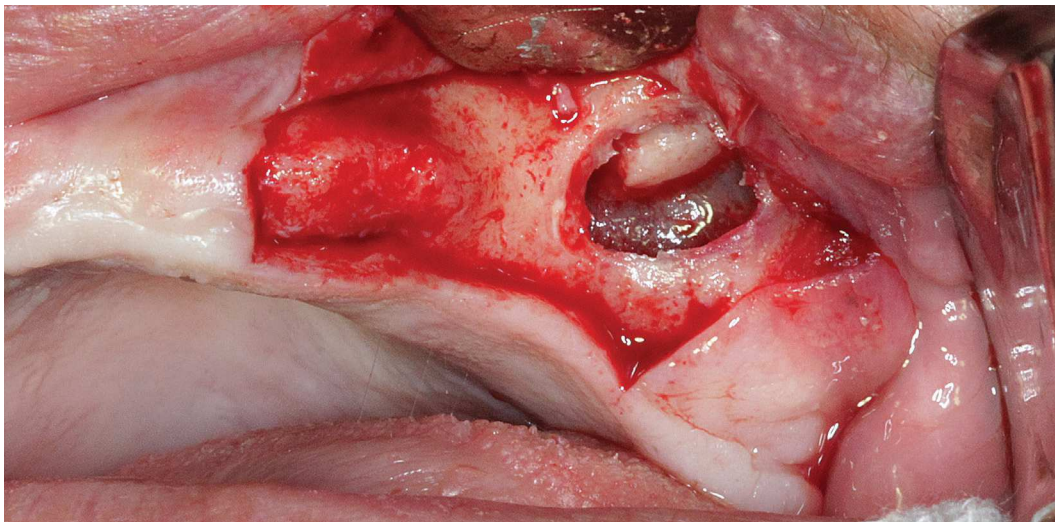

Figure 6. Maxillary sinus cavity after membrane detachment (Case 2, right side).

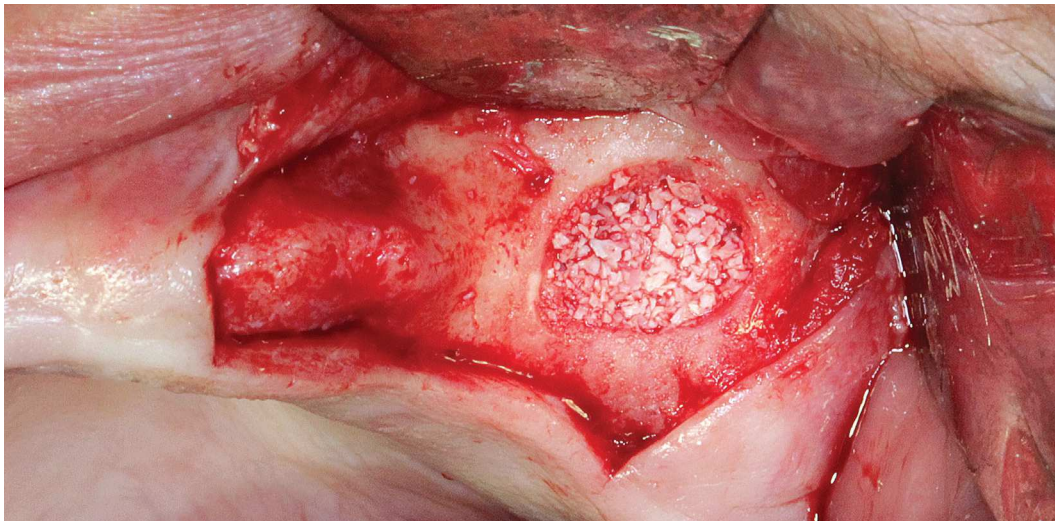

Figure 7. Maxillary sinus cavity filled with Lumina-Porous™ (Case 2, left side).

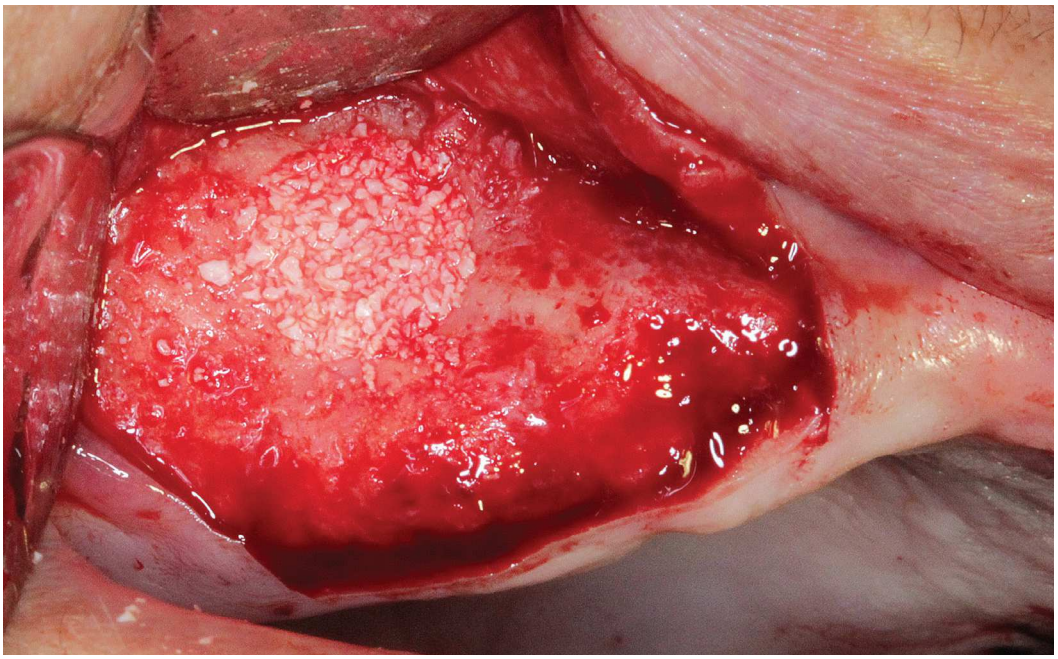

Figure 8. Maxillary sinus cavity filled with Bio-Oss™ (Case 2, right side).

volume augmentation for implant placement (Figs 9 and 10).

Both patients underwent prosthetic planning with the manufacture of a surgical guide before implant placement. Subsequently, eight implants were installed: In Case 1, eight implants were installed following the manufacturer's instructions. A specific sequence of drills was used in six implants, followed by placement of Titamax TI implants with external hexagon (EH) connection 3.75 x 11 mm (Neodent Ind. e Com. de Material Dentários - Curitiba, PR, Brazil) (Figs 11 and 12). Grafted sites had samples removed with a trephine bur 2 mm in diameter (SIN, Sistema de Implante Nacional Ltda., São Paulo, Brazil), with subsequent placement of two Titamax TI implants with EH 4.0 x 11 mm.

In Case 2, eight implants were also installed following the manufacturer's instructions. A specific sequence of drills was used in six implants, followed by placement of Titamax TI implants with external hexagon (EH) connection, three of them being 3.75 x 11 mm, whereas the other three were 3.75 x 13 mm (Neodent Ind. e Com. de Material Dentários - Curitiba, PR, Brazil). Grafted sites had samples removed with a trephine bur 2 mm in diameter, with subsequent placement of two Titamax TI implants with EH 4.0 x 11 mm on the right side and 4.0 x 13 mm on the left side (Figs 13, 14, 15). All implants received an initial average torque of 32 N.

During the surgical procedures and the postoperative phase, no complications were observed. Presently, patients are in the prosthetic rehabilitation phase. Postoperative panoramic radiographs (Figs 16, 17) reveal implants in place.

DISCUSSION

Rehabilitation of the posterior maxilla is oftentimes limited by alveolar ridge atrophy and

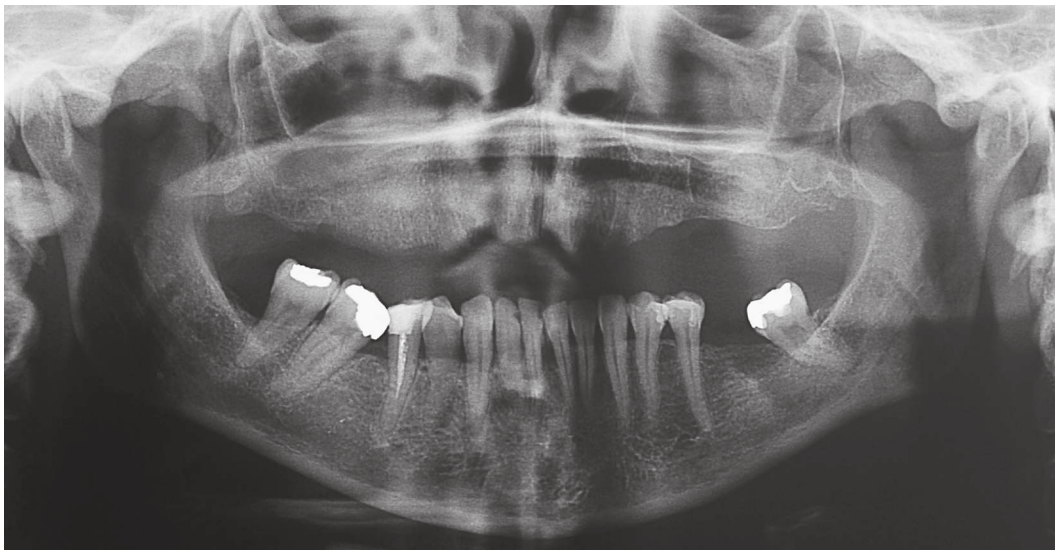

Figure 9. Panoramic radiograph six months after maxillary sinus augmentation bilateral surgery (Case 1).

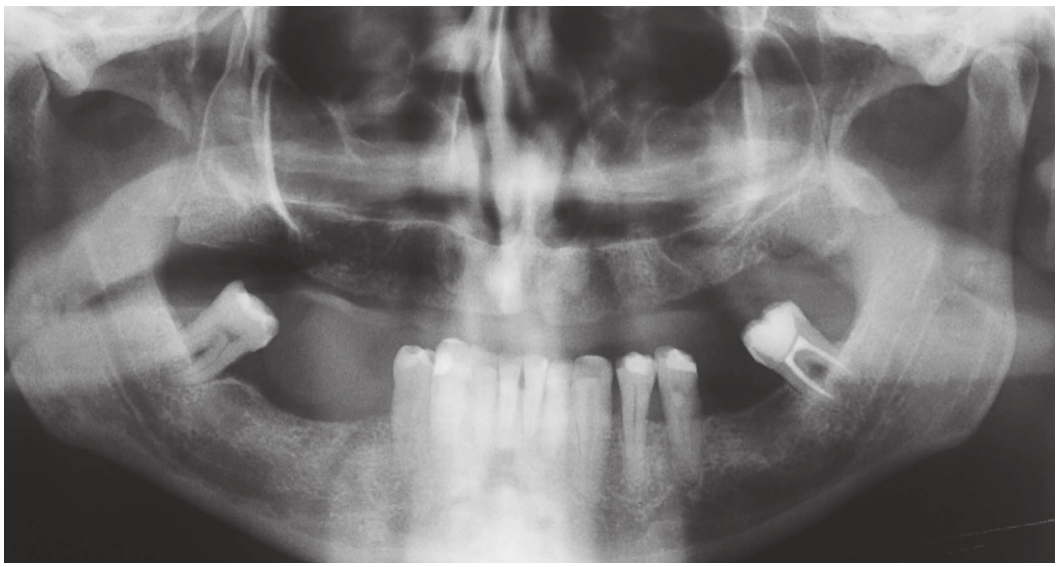

Figure 10. Panoramic radiograph six months after maxillary sinus augmentation bilateral surgery (Case 2).

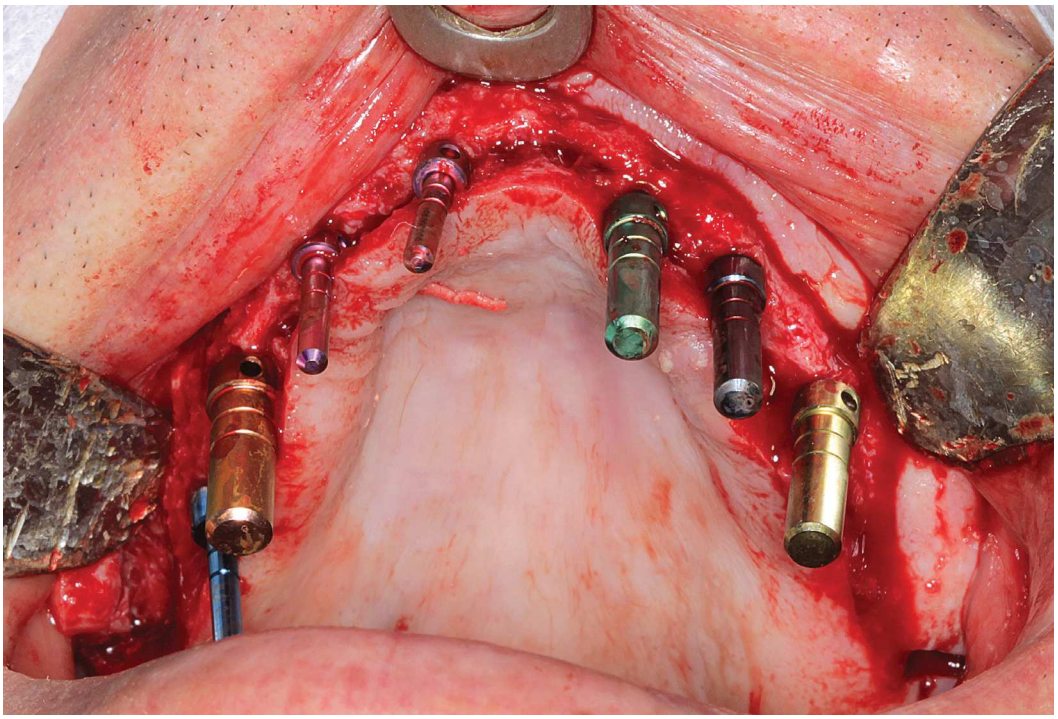

Figure 11. Surgical guide in place, with parallelism posts (Case 1).

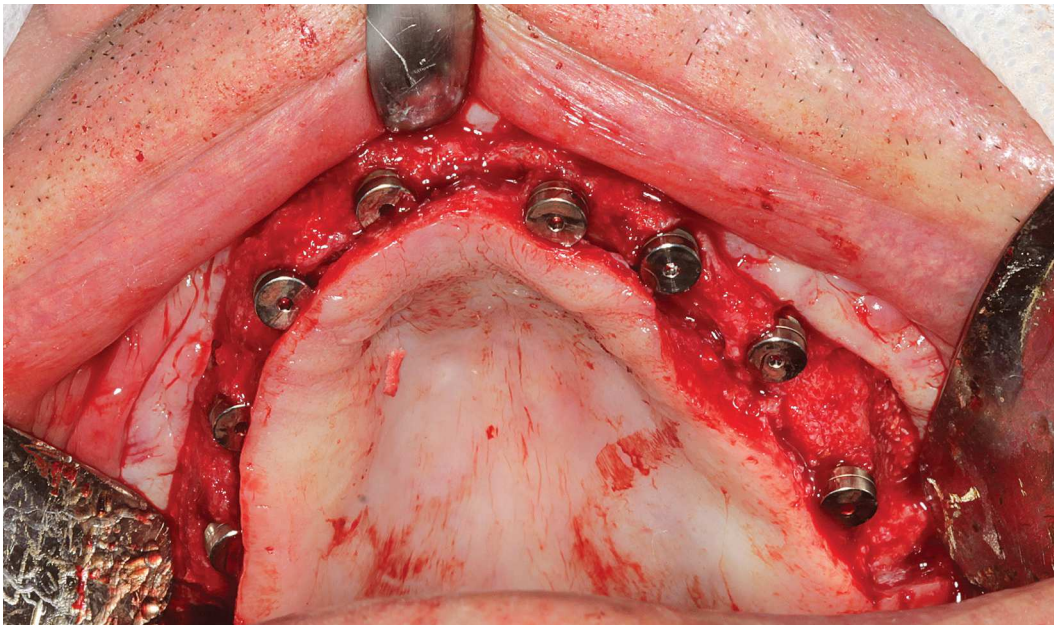

Figure 12. Implants placed after cover screw installation (Case 1).

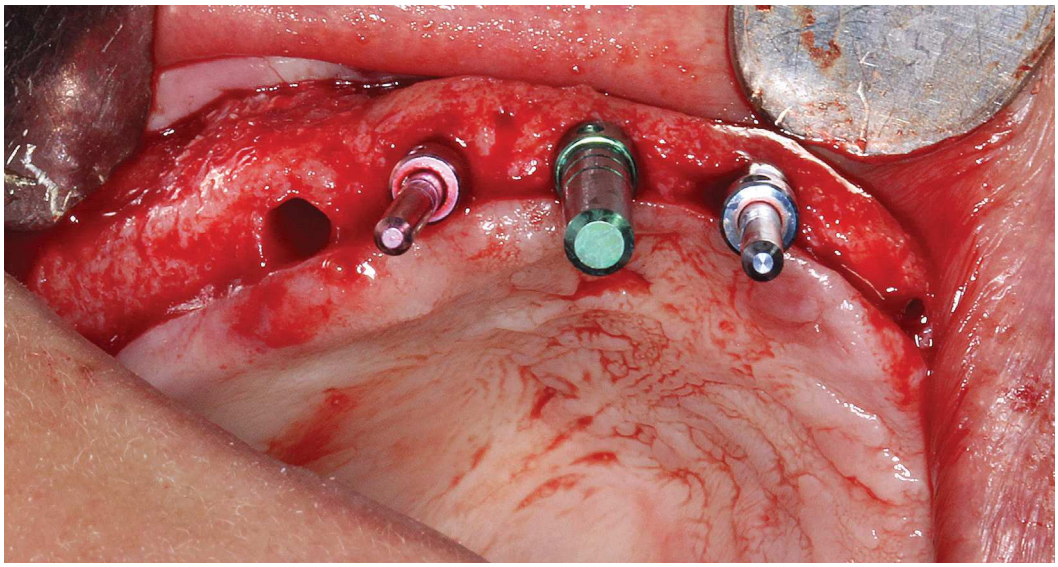

Figure 13. Perforation with a trephine bur 2 mm in diameter at the grafted site (Case 2, right side).

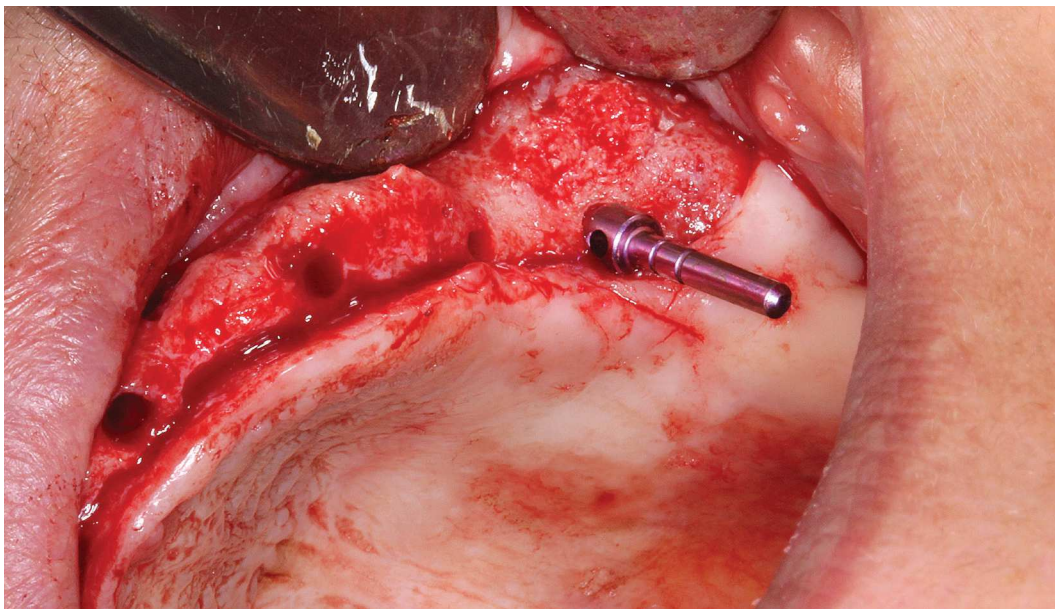

Figure 14. Parallelism post at the grafted site (Case 2, left side).

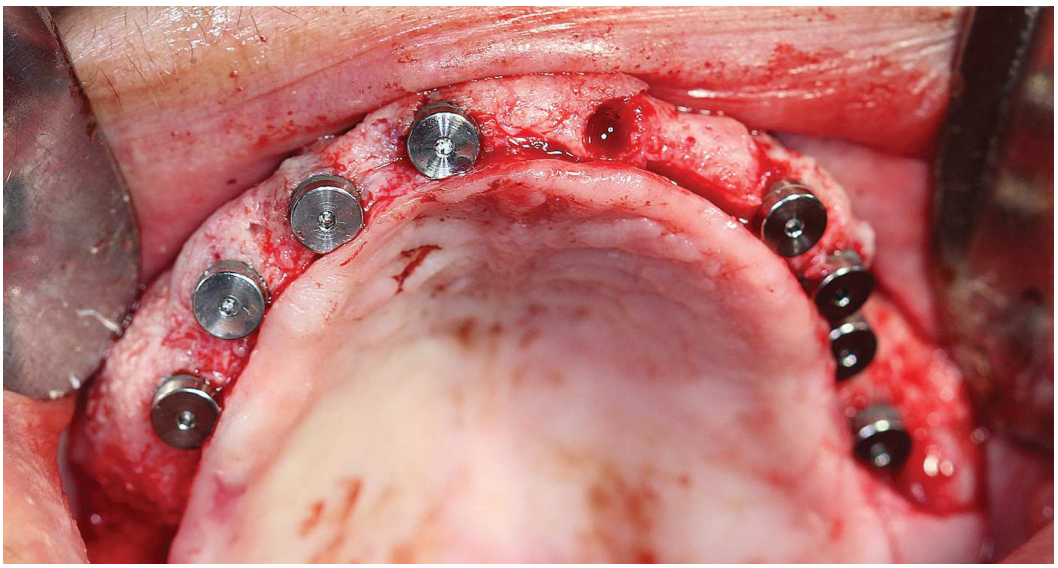

Figure 15. Implants placed after cover screw installation (Case 2).

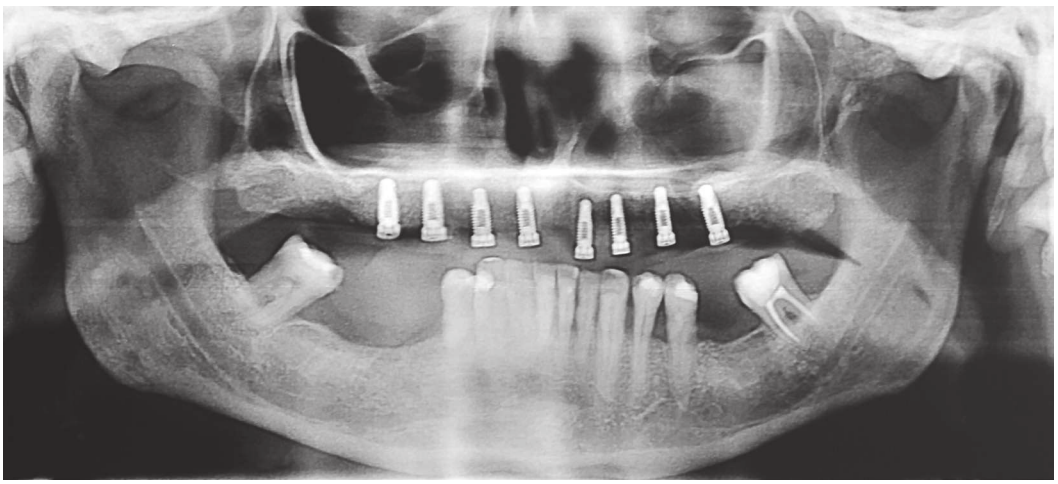

Figure 16. Panoramic radiograph after implant placement surgery (Case 1).

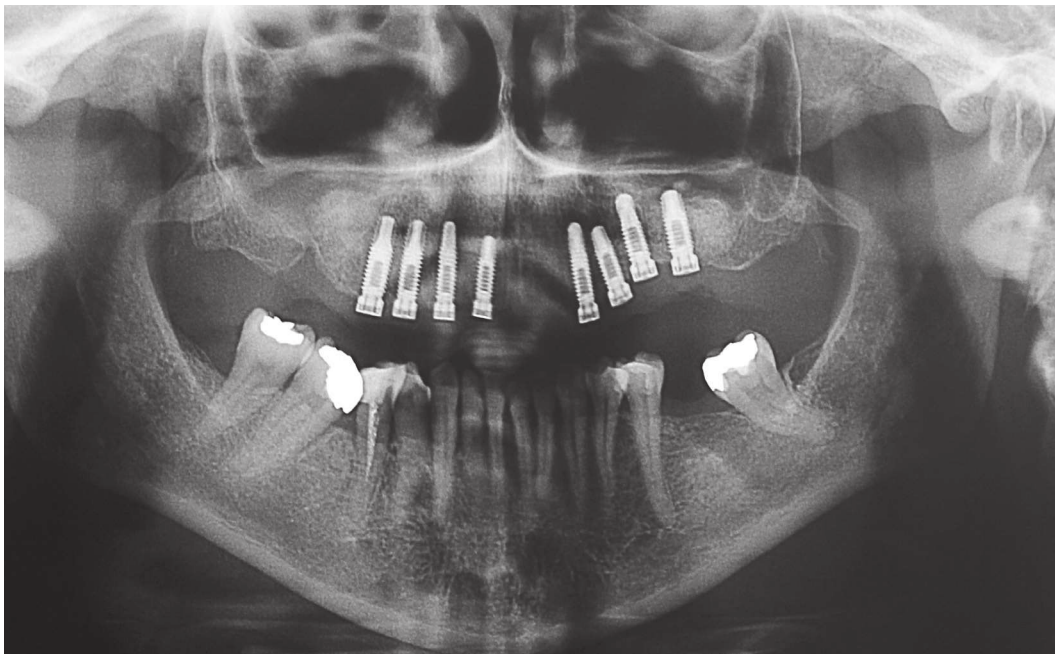

Figure 17. Panoramic radiograph after implant placement surgery (Case 2).

pneumatization of the maxillary sinus. Thus, dental implant placement requires bone augmentation procedures, including maxillary sinus augmentation surgery. Several types of material have been recommended so as to favor bone neoformation; therefore, in order to choose which type of biomaterial will be used, the following must be taken into account: the purpose of intervention, patient's individual characteristics, bone defect anatomic position and morphology, and the characteristics of the material.[9] Presently, no scientific evidence gives more advantage to a bone substitute in relation to others, particularly in terms of implant survival and lack of complications.[10,11] Long-term clinical success depends on vital, functional bone-graft formation.[12]

The present study used two types of biomaterial. One of them was Bio-Oss™, a natural bone substitute gleaned from the mineral portion of bovine bone. During the manufacturing process, the organic structure of bovine bone is removed; resulting in an intercrystalline structure of microtunnels and microcapillaries between the crystals of apatite.[1] The resulting matrix resembles human bone chemical composition, morphology and ultrastructure.[8] Histological analysis was carried out after maxillary sinus augmentation surgery and revealed bone tissue formation with osteocytes, Havers canals and blood capillaries.[8,13,14,15] This type of material presents good biocompatibility without inflammatory infiltrate or foreign body reaction.[8,16] Moreover, Bio-Oss™ presents excellent osteoconductive properties and implant clinical survival rates.[9] Its use in maxillary sinus augmentation surgery yields predictable and safe outcomes.[15,17]

Lumina-Porous™ is a bone substitute similar to Bio-Oss™. Both of them are of bovine origin, but the former is produced in Brazilian territory.[18] It is osteoconductive and contributes to bone tissue and blood vessels formation. Its chemical composition is as follows: CaO 58%, P_2O_5 40%, MgO 1% and Na_2O 1%. Lumina-Porous™ biocompatibility is associated with its physiological pH value (pH = 6). Furthermore, sterilization by irradiation with gamma rays (25 kGy) and the manufacturing process establish the crystallographic profile of hydroxyapatite.[1] The cases reported herein presented no differences in terms of implant initial torque or complications associated with the use of biomaterial.

For the patients reported in this study, biomaterial was used alone, although other authors advocate its association with autogenous bone.[1,10,12,16] Results yielded by a combination of autogenous bone and inorganic bovine bone are contradictory, and no conclusions have been drawn about the advantages of such combination.[15] Present scientific evidence is not enough to support or refute the hypothesis that pure inorganic bovine bone (Bio-Oss™) yields better results in comparison to a combination of autogenous bone and inorganic bovine bone during maxillary sinus augmentation procedures.

No trans or postoperative complications were found in the present study. Maxillary sinus augmentation surgery was considered a predictable procedure, with rare complications associated with grafting.[17,19] Nevertheless, should they occur, the major complications are as follows: sinus membrane perforation, excess bleeding, infected grafted site and failure in bone formation;[19] none of which were found in any cases.

Maxillary sinus augmentation surgery with access made through the sidewall is ideal to histologically assess bone substitutes, since it facilitates biopsy without additional morbidity.[10] The samples collected from the cases reported herein are part of a broader study conducted with a higher number of patients.

Both cases are limited in terms of follow-up, since biomaterial might behave differently in the long term and after prosthetic rehabilitation. Nevertheless, since both types of biomaterial are available on the market, discussing and reporting their clinical use contribute to the development of further studies. To date, it is reasonable to assert that similarly to the cases reported in this study, other clinical cases also show good initial dental implant stability. Additionally, bone substitutes seem to provide proper support for implant initial torque during maxillary sinus augmentation surgery.

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