

# PROSTHODONTIC

## Insights

A Digest of Recent Trends, Techniques and Clinical Concepts of Dental and Facial Esthetics

## Sinus Augmentation For Implant Reconstruction



*Thomas J. Balshi,  
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Long term success of osseointegrated implants depends on the length of the implant used and the bone quantity and quality surrounding the implant. The atrophic alveolar ridge is inferior to the floor of the maxillary antrum and often precludes the placement of titanium implants. Patients who have been long standing edentulous in the maxillary posterior have additional crestal bone loss which further reduces the amount of available native bone between the antrum and the oral mucosa.

Bone grafting used to augment osseous defects is a well established treatment procedure. Autogenous bone has been shown to be the most effective due to the transfer of living osteogenic cells at the time of the graft procedure. There are, however, disadvantages of using autogenous bone. There is increased morbidity associated with autogenous bone grafting due to the second invasive

surgery often required for bone harvesting. In addition, harvesting autogenous bone is time consuming, adding expense for both the clinician and the patient. Finally, it may be difficult to obtain enough autogenous bone from intraoral sources to completely fill the osseous defect.

An alternative to using autogenous bone grafts is the use of alloplastic (or allogenic) bone. One such grafting material is a processed bovine bone known as Bio-Oss (Osteohealth Co., Shirley NY). One of the distinct advantages of Bio-Oss over freeze dried demineralized human cadaver bone is evident in the processing procedure which maintains the normal structure and chemistry of bone.

Bio-Oss is composed of natural bone mineral derived from specially selected bovine sources. A newly developed process results in a totally biocompatible mineral matrix with extensive interconnecting pores and

a tremendous surface area. In fact, one gram of Bio-Oss is reported to have the approximate surface area of a tennis court. Since Bio-Oss is natural bone, its physical and chemical characteristics are comparable to human bone mineral. These properties make this new material an excellent osteoconductive scaffold for new bone growth. Because the material is natural bone, metal implants can be placed into the Bio-Oss grafted site about six months after graft placement in most cases. This time can be extended for augmenting the maxillary sinus.

The following clinical history illustrates the use of Bio-Oss grafting material for augmenting the maxillary antrum in conjunction with the placement of dental implants. The surgical approach for this procedure begins with a crestal incision followed by full flap elevation of the mucosal tissues. Careful dissection

*(Continued on Page 2.)*



*Figure 1  
Osteotomy created in the buccal plate lateral to the maxillary sinus.*



*Figure 2  
Buccal plate fractured and sinus membrane elevated using the 3 Brånemark titanium implants.*

## Sinus Augmentation . . .

*(Continued from Page 1.)*

of the lateral osseous wall of the sinus (Fig 1) is accomplished followed by infracturing of the lateral bony plate. Osteotomy sites for implant reception are prepared in the native alveolar ridge. The apex of these implants will help hold the infractured lateral bony wall in position forming a new floor for the antrum immediately above the implant apex (Fig 2). Autogenous bone from the implant osteotomy sites can be harvested during the preparation procedure and mixed with the Bio-Oss graft material as a method of seeding viable cells into the graft itself. This mixture can be easily loaded in a disposable delivery syringe (Fig 3).

The bone graft mixture is injected into the interproximal areas between the implants and packed into position using curettes and other blunt surgical instruments (Fig 4). All of the available sinus cavity is filled with densely packed graft material (Fig 5). A resorbable collagen membrane (Bio-Gide, Biomaterials Geistlich, Wolhusen, Switzerland and Osteo-

health Co. Shirley, NY) can be used to cover the sinus lift lateral window. This resorbable membrane can be conveniently held in place using four titanium tacks (IMZ Bone Tacks, Interpore International, Irvine CA) (Fig 6). A water tight closure is essential to an uncomplicated healing. The bone graft is readily visible in the postop radiograph when compared to the preoperative view of the same area (Fig 8,9).

The recommended healing time for a graft placed into the antrum, predominately consisting of porous bone mineral, is 8-10 months. This time can be shortened to 6-8 months if autogenous cancellous bone and marrow is mixed 1:1 with Bio-Oss.

In this particular case, stage II abutment connection surgery was completed 5 1/2 months following stage I implant placement surgery. The implants were loaded at that visit with a fixed acrylic provisional restoration. Nine days later the final porcelain fused to gold implant restoration supported by the four Brånemark osseointegrated implants was delivered (Fig 10). Follow-up



Figure 3  
Mixture of BIO-OSS and autogenous bone packed into disposable delivery syringe.



Figure 4  
Mixture of autogenous bone and BIO-OSS firmly packed into site behind the threads of the implant.



Figure 5  
Sinus elevation site completely packed using the mixture of BIO-OSS and autogenous bone.



Figure 7  
Occlusal view immediately following surgical procedure showing the tightly sutured area.



Figure 9  
Radiographic view immediately following surgical procedure involving sinus elevation, bone grafting, and implant placement.



Figure 6  
Bio-Gide resorbable membrane held in place using four titanium tacks.



Figure 8  
Preoperative radiographic view of sinus area.



Figure 10  
Occlusal view six months following stage I surgery showing final porcelain fused to gold crowns on four osseointegrated dental implants.

periapical radiographs taken ten weeks after stage II surgery show excellent osseous response (Fig 11 & 12).

### Summary

In light of the invasive nature of autogenous grafting and the potential morbidity risks associated with a second surgical donor site, the use of an alternative material such as porous bone mineral is advantageous when ridge augmentation procedures are considered. This article describes a clinical procedure using porous bone material, Bio-Oss, in conjunction with a resorbable collagen membrane, Bio-Gide, to internally augment the maxillary sinus while titanium implants are placed simultaneously.

### Acknowledgements:

Fort Washington Dental Lab, Fort Washington, PA.

## In Vitro Osteoblastic Cell Attachment and Proliferation on Bio-Oss

*Stephan EB, Kendrick J, Dziak R*

Bio-Oss is an organic, bovine, bone matrix material used in bone regeneration procedures. This material is an alternative to autogenous bone grafts and demineralized cadaver bone. It was the aim of these studies to examine the ability of Bio-Oss, compared to demineralized freeze dried bone allograft (DFDBA), to support the attachment and proliferation of isolated osteoblastic cells. Primary culture osteoblastic cells were isolated from neonatal rat calvaria.

This study showed that DFDBA and Bio-Oss had a time dependent

increase in attachment with no significant difference between the two materials. Also both materials supported osteoblastic cell proliferation. All experiments were performed in triplicate and statistical analysis was done by factorial ANOVA at a 95% confidence limit. These results suggest that attachment and proliferation of primary culture osteoblastic cells is similar for Bio-Oss and DFDBA..

*Accepted for Presentation: International Association For Dental Research Annual Meeting, Orlando FL 1997*



Figure 11



Figure 11 & 12  
Follow-up periapical radiographs 8 months postop showing excellent osseous response around implants in both the native and grafted bone.

## Titanium Bone Interface

*Boyne PJ*

Various materials such as allogenic, alloplastic, or xenogenic grafts can be used to reconstruct the host bone site for reception of an implant. The proper selection of these materials can greatly effect the interface and the type of bone formation around the implant initially, and also the reaction of the bone and its status over the long term service of the implant and function.

Bio-Oss is a porous bone mineral (Xenogenic bone) which is derived of bovine bone by a chemical process that removes all of the organic material, leaving the inorganic matrix. The residual bone matrix (Bio-Oss) is composed of all of the elements and structures of bone mineral; secondly, the porosity of this product is exactly that of natural bone, thus profusion by neoangiogenesis is facilitated by this product. Further, it invites osteoclastic resorption which produces the histologic cell synchronization that is necessary for normal

repair. The large surface area of this porous bone mineral also makes it an excellent carrier for antimicrobials and other agents such as growth factors. The use of bone inductor materials and bone growth factors offer possible future surgical applications in enhancing the initial and long term character of the metal to bone interface.

This chapter presents examples of the various types of interfaces and the prognosis in terms of these interfaces responding to changes and functional load on a long term basis. Excellent slides are presented showing the histologic response at the implant to bone interface following loading in sites grafted with Bio-Oss and other bone grafting materials.

*Boyne, PJ. Evaluation of titanium/bone interface of dental alveolar implants. In : Wise, RF et al: Encyclopedic Handbook of Biomaterials and Bioengineering, Part B: Applications; Vol 2. Marcel Dekker Inc, New York NY 1995;1698-1711.*

# An Advanced System For Bone Augmentation Combining A Slowly Resorbing Barrier Membrane and Novel Bone Graft

*Kay SA, Wisner-Lynch L, Marxer M, Lynch SE*

Guided bone regeneration utilizing nonresorbable e-PTFE membranes is a proven technique that can result in reconstruction of defects in the oral maxillofacial region. Guided bone regeneration (GBR) relies primarily on four principles: exclusion of unwanted tissues and cells; space creation and maintenance; protection of underlying blood clot; and wound stabilization. The main disadvantage with GBR techniques, using nonresorbable membranes, is the need for a second invasive surgical procedure to retrieve the membrane. In addition, nonresorbable membranes often require premature removal secondary to overlying soft tissue dehiscence and wound infection. A resorbable cell-occlusive, non-antigenic, biocompatible membrane would solve the above problems.

However, until now resorbable membranes resorbed too quickly for successful GBR to occur. Bio-Gide, a bilayered, slowly resorbing collagen membrane appears well-suited for GBR procedures and has thus been used extensively in Europe for regeneration of bony defects.

Large bony defects require not only a cell-occlusive membrane, but an underlying graft material in order to maintain adequate space for regeneration to occur. NBM-Ih (Bio-Oss) a highly osteoconductive bone mineral matrix appears, not only to adequately support the collagen membrane throughout the time required for successful GBR, but also appears to enhance the regenerative process by serving as an excellent matrix for angiogenesis and osteogenesis. In addition, it appears that this bone matrix may

be able to serve as an ideal carrier for recombinantly produced growth factors that are currently under investigation for clinical use.

Reconstruction of large bony defects through guided bone regeneration is now a clinical reality. The combined therapy of a slowly resorbable, bilayer collagen membrane (Bio-Gide) with an underlying, highly biocompatible and osteoconductive natural bone mineral matrix (Bio-Oss) appears to allow GBR to occur predictably and without the necessity of a second invasive procedure. This article reviews the major principles and procedural details of GBR as well as presenting illustrative case reports.

*In Press: Practical Periodontics & Esthetic Dentistry*

## Osseous Restoration of the Maxilla and the Mandible for Implant-Supported Prosthesis Using Titanium Mesh and Bone Mineral

*Philip J. Boyne DMD, MS.*

*Quintessence Publishing Co., Carol Stream IL 1996*



**Book Review**

This textbook describes in detail biologically sound bone grafting techniques for reconstructing deficient edentulous and partially edentulous maxillae and mandibles for conventional and implant supported prostheses. The author's experience utilizing composite grafts of porous bone mineral (Bio-Oss, Osteohealth, Shirley NY) and autogenous bone within a titanium mesh (TiMesh) framework is discussed and illustrated in detail.

The author has spent the last 30+ years devoting much of his professional life to maxillofacial reconstruction and bone grafting. This text represents a synthesis of this lifetime experience, especially as it relates to qualitatively and quantitatively deficient maxillae and mandibles.

Dr. Boyne, through text, illustrations, and detailed descriptions of clinical cases, describes current surgical techniques for harvesting bone, mechanisms of action of bone grafts including bone conduction and induction, the role of growth factors and BMP's in current and future grafting systems, and a detailed technique of augmenting deficient ridges utilizing composite grafts of autogenous bone and porous bone mineral (Bio-Oss) in conjunction with titanium mesh frameworks. In addition, Dr. Boyne addresses issues such as increasing bone density through slowly resorbing grafting materials (i.e. Bio-Oss) for optimal implant placement in the posterior maxilla and when to use barrier membranes in bone regenerative procedures.

A detailed and descriptive chapter by Dr. Michael Peetz reviews the biology of bone graft substitutes in general and then looks closely at the chemical, morphologic and physical properties of porous bone mineral, relating these characteristics to its biologic behavior. Dr. Peetz also addresses the issues of safety and discusses the rigorous production requirements that ensure the lack of infectivity and antigenicity with porous bone mineral.

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# First Results of a Clinical Study Using Bio-Oss and a New Resorbable Membrane for GBR in Dental Implantology

*Zitzmann N, Raeff R, Schärer P*

The purpose of this study was to compare the new resorbable collagen membrane, Bio-Gide, to the conventional ePTFE- material (Gore-Tex) for GBR in cases of exposed implant surfaces with respect to handling, efficacy, and biocompatibility.

Eighteen patients were treated over a 12 month period with Bio-Gide and Gore-Tex membranes using a split-mouth design (Group A). Thirty-two patients with a single defect were treated with Bio-Gide alone (Group B). All defects were grafted with Bio-Oss (Osteohealth Co., Shirley NY) bone grafting material and then covered with the respective membranes. In all, 166 implants were placed, 112 having defects. The defect type and

dimensions, as well as the surface area of the exposed portion of the implant, were recorded in detail both initially and at re-entry during abutment connection.

Abutment connection was performed in the lower jaws after 4 months and in the upper jaws after 6 months. In the first 12 months, 86 of 166 fixtures have undergone re-entry, 56 initially presenting with defects.

A gain in regenerated bone was noted in 93% of the defects. Full coverage of the initially exposed implant surface was noted in 55% of the Bio-Gide and 57% of the Gore-Tex membrane sites. A partial reduction of the defect size was noted in 40.5% of the Bio-Gide and 28.5% of the Gore-Tex sites. No

reduction in defect size was observed in 4.5% of the Bio-Gide sites and 14.5% of the Gore-Tex sites. Significant amounts of new bone were gained over exposed implant surfaces using Bio-Oss in combination with Bio-Gide or Gore-Tex membranes. Bio-Gide resorbed without inflammation, thereby avoiding some of the complications associated with non-resorbable membranes (i.e. early removal due to inflammation or the need of an extensive flap procedure during abutment connection).

*First Prize, Research Award; Academy of Osseointegration, 11th Annual Meeting; New York, NY, March 1996*

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## Guided Bone Regeneration Around Exposed Implants: A New Bioresorbable Device and Bioresorbable Membrane Pins

*Hurzeler MB, Strub JR*

The purpose of this study was to demonstrate the clinical applications of a new bioresorbable collagen membrane in combination with an organic bone mineral for guided bone regeneration around exposed implants, using bioresorbable pins for barrier membrane stabilization.

In three clinical cases, the authors demonstrate the techniques involved in regenerating bone around exposed implant threads during immediate titanium implant placement following tooth extraction. In each surgical procedure, anterior maxillary teeth were removed and pure titanium root form implants were placed. When necessary, bleeding was initiated within surrounding bone. All defects around

implants were grafted with Bio-Oss porous bone mineral. Bio-Gide resorbable membranes were then placed over the implants and grafted sites and fixated with bioresorbable pins. Eight months later, abutment connection surgery was performed. At this time the amounts of newly formed hard tissue covering previously dehiscid implant surfaces was evaluated and biopsies of this newly formed tissue obtained.

Successful regeneration of newly formed bone around previously exposed implant threads was achieved in all three cases using a new bone substitute (Bio-Oss), new resorbable collagen membrane (Bio-Gide) and resorbable pins. With the use of the new bioresorbable colla-

gen barrier the healing pattern appears favorable when compared to nonresorbable e-PTFE membranes. It is recommended to combine the use of bioresorbable membranes and pins with a space maintaining material since the collagen membrane lacks space maintaining properties.

Bio-Oss, the grafting material used, appears to have a high osteoconductive potential. Histologic evaluations confirmed viable new bone surrounding the implants and integrated with slowly resorbing Bio-Oss particles.

*Practical Periodontics and Esthetic Dentistry 1995;7(9):37-45*

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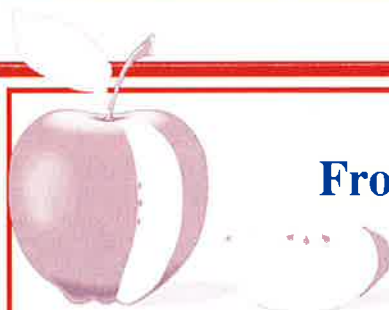
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