MANAGEMENT OF THE EXPOSURE OF A DENSE PTFE (d-PTFE) MEMBRANE IN GUIDED BONE REGENERATION (GBR): A CASE REPORT

P. GHENSI[1], W. STABLUM[2], E. BETTIO[3], M.C. SOLDINI[4], T.R. TRIPI[5], C. SOLDINI[6]

[1] *Centre for Integrative Biology (CIBIO), University of Trento, Trento, Italy; IDIS (Institute for Dental & Implant Studies); Department of Neurosciences, University of Padova, Padova, Italy*
[2] *IDIS (Institute for Dental & Implant Studies)*
[3] *Department of Neurosciences, University of Padova, Padova, Italy*
[4] *IDIS (Institute for Dental & Implant Studies); Department of Public Health, Experimental and Forensic Medicine, University of Pavia, Pavia, Italy*
[5] *Department of General Surgery and Medical-Surgical Specialties, University of Catania, Catania, Italy*
[6] *CLC Scientific, Vicenza, Italy; Department of Neurosciences, University of Padova, Padova, Italy; IDIS (Institute for Dental & Implant Studies)*

SUMMARY
Guided bone regeneration (GBR) is a well-established and generally predictable method for repairing alveolar ridge defects and preparing edentulous sites for implant placement. Standard GBR involves filling the space underneath a membrane with autogenous bone or a mixture composed of autogenous bone particles and allogeneic bone tissue or heterologous biomaterials. The use of a barrier membrane for GBR has sometimes been associated with complications, however – reportedly involving exposure, infection, and collapse – and the non-resorbable types of membrane seem to be involved more often than the resorbable solutions. Such complications may be severe enough to defeat the object of the GBR procedure. A non-resorbable high-density polytetrafluoroethylene (d-PTFE) membrane has recently been designed specifically for use in bone-augmentation procedures that seems to assure a good bone regeneration process even when the membrane is exposed to the oral cavity. This case report describes an exposure of a d-PTFE membrane occurring after a maxillary GBR procedure and how it was overcome successfully, enabling implants insertion.

Key words: guided bone regeneration, heterologous biomaterials, vertical bone augmentation, dental implant therapy.

Introduction

In modern dentistry, edentulism is no longer particularly challenging, thanks to dental implant treatments. For implant placement to be successful, however, the patient's alveolar ridge must be substantial enough to retain the implant and ensure adequate aesthetic and functional results – a condition not always met in clinical practice. Tooth extraction, trauma, advanced periodontal disease and failed endodontic therapies can all be responsible for alveolar bone loss (1, 2), making a bone graft necessary before any implants can be installed. Numerous different materials and surgical techniques are now available for the purpose of horizontally or vertically augmenting the jaw bone, such as osteodistraction, inlay and onlay bone grafting, inferior alveolar nerve transposition, and guided bone regeneration (GBR) procedures (3).

GBR has become a well-established approach to the preparation of a site for the placement of im-

plants, with predictable results. The procedure includes using a barrier membrane to keep the space over the bone defect being treated free of any ingrowth of connective tissue (4, 5), thereby enabling osteogenic cells resident in the osseous wound to proliferate and differentiate, and thus restore the bone defect (6, 7).

The factors that are important to the successful outcome of a GBR treatment include: the surgical technique, the occlusion and stability of the barrier, the dimensions of barrier perforations, the tightness of the peripheral seal between the barrier and the host bone, the adequacy of the blood supply and the availability of bone-forming cells (8-10). Several different types of membrane have been considered in recent years that facilitate new bone generation as well as stabilizing the underlying bone graft and minimizing the risks of the newly-formed ridge collapsing or of the space being occupied by ingrowing soft tissue. Experimental and clinical studies have been conducted to test various bioresorbable and non-resorbable membrane materials, such as polytetrafluoroethylene (PTFE), expanded PTFE (e-PTFE), titanium meshes, collagen, polylactic acid, polyglycolic acid, and their copolymers (11-15). Published studies have shown that both resorbable and non-resorbable membranes are effective in preventing soft tissue cells from invading the area of the bone defect and promoting bone regeneration (16-18).

The use of such membranes for GBR has sometimes been associated with complications, however - reportedly involving exposure, infection, and collapse – and the non-resorbable types of membrane seem to be involved more often than the resorbable solutions (19, 20). Such complications may be severe enough to defeat the object of the GBR procedure (8, 9). A high-density polytetrafluoroethylene (d-PTFE) membrane has recently been designed specifically for use in bone-augmentation procedures that seems to assure a good bone regeneration process even when the membrane is exposed to the oral cavity (21, 22). This is because the membrane succeeds in keeping bacteria at bay while enabling oxygen diffusion and the transfusion of small molecules.

The present report describes a maxillary GBR procedure involving the exposure of a d-PTFE membrane with a positive outcome thanks to a careful management of the ensuing complication.

Case report

A 50-year-old patient came to Periodontist's attention (W.S.) with mobility of a metal-ceramic bridge and swelling of the adjacent gingiva. The prosthesis was located in the second mouth quadrant (first premolar - first molar) and had been placed 15 years before. Clinical examination revealed periodontal pockets exceeding 10 mm in depth surrounding the two dental abutments.

The patient's medical and dental history was unremarkable. His full-mouth plaque and bleeding scores were both 100%. He reported smoking less than 5 cigarettes a day. Intraoral X-ray was performed to assess the feasibility of periodontal treatment alone, but emergency extraction of the elements was preferred (Figure 1). The patient was given instructions on how to improve his oral hygiene at home, and several scaling and root planing sessions were planned. Three months later, the patient's plaque and bleeding were under control (<20%) and the sites of tooth extraction had healed adequately (Figures 2, 3).

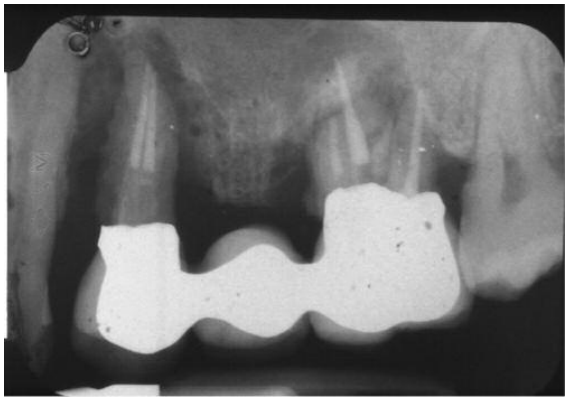

Figure 1
Intraoral X-ray before dental extractions.

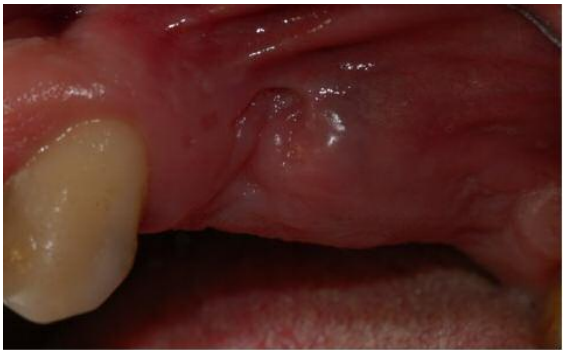

Figure 2
Clinical situation three months after extractions.

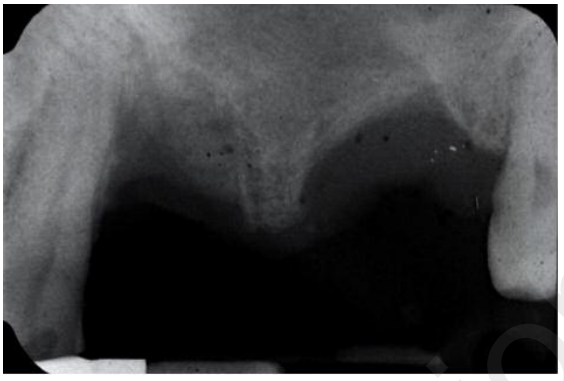

Figure 3
Intraoral X-ray three months after extractions.

The advantages and disadvantages of the treatment options available were explained to the patient, who opted for fixed prosthetics involving the placement of two dental implants after reconstruction of the alveolar ridge with the aid of a non-resorbable membrane.
The patient received a prophylactic preoperative dose of oral antibiotic (2 g amoxicillin/clavulanic acid 1 hour before surgery) (Augmentin; GlaxoSmithKline, Verona, Italy) and a mouth rinse with 15 mL of 0.2% chlorhexidine solution (Dentosan; Pfizer Consumer Healthcare, Rome, Italy) was used before surgery for 1 minute. Local anesthesia was induced with mepivacaine 2% + epinephrine 1:100.000 (2% Carbocaine; AstraZeneca, Milan, Italy) injections along the plane of the bone to ensure deeper pain control and contain bleeding. One crestal incision was made and another release incision was made about two teeth away from the surgical site. The full-thickness flap was elevated following the bone plane and removing any granulation tissue (Figures 4, 5).
Since the aim was a healing by primary intention, periosteal incisions were performed to make the flap passive. Some autologous bone was harvested with a safescraper (Safescraper curve, Meta, Reggio Emilia, Italy) and combined with bovine-derived deproteinized bone (Bio-Oss, Geistlich Pharma, Wolhausen, Switzerland) (Figure 6).
A d-PTFE (Cytoplast® Ti-250, Deore Materials, Osteohealth, USA) membrane was attached to the palate with pins, the particulate bone graft was placed in position, and the membrane was

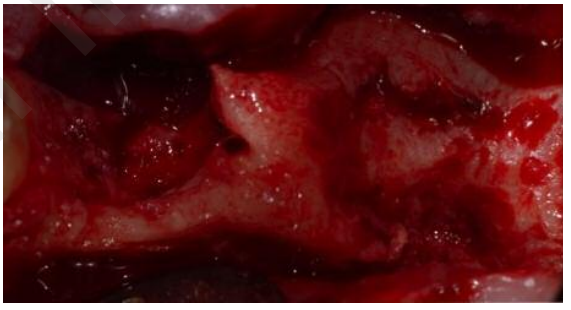

Figure 4
Clinical situation after elevation of a full-thickness flap.

Figure 5
Site preparation for GBR procedure.

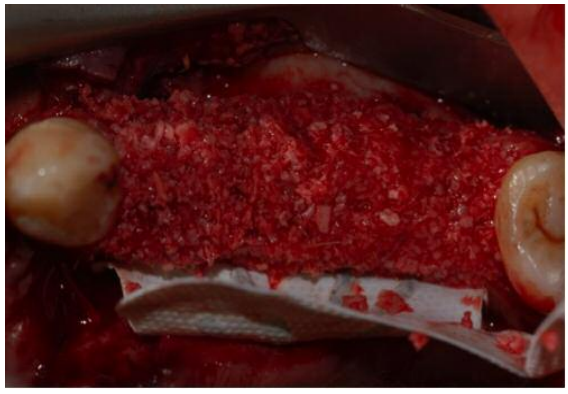

Figure 6
Particulate bone graft in position.

then stabilized on the vestibular side. The flap was then sutured using mattress stitches on the inside and simple sutures on the occlusal margin (Figures 7, 8, 9).
After the procedure, the patient was told to continue the antibiotic therapy for 6 days (1g every 8h), to use a 0.2% chlorhexidine mouthwash 3 times a day for two weeks, and to take an anti-inflammatory drug (Brufen 600, Abbott Laboratories) every 12 hours.
When the patient's sutures were removed 14 days later, it was found that the membrane was exposed (Figure 10). This was probably due to

Figure 7
Stabilization of the d-PTFE membrane on the vestibular side.

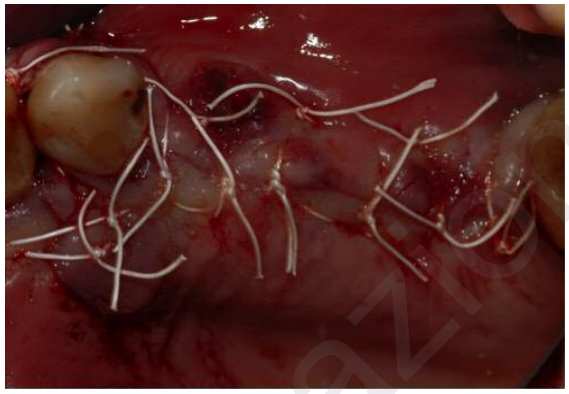

Figure 8
Suture using mattress stitches on the inside and simple sutures on the occlusal margin.

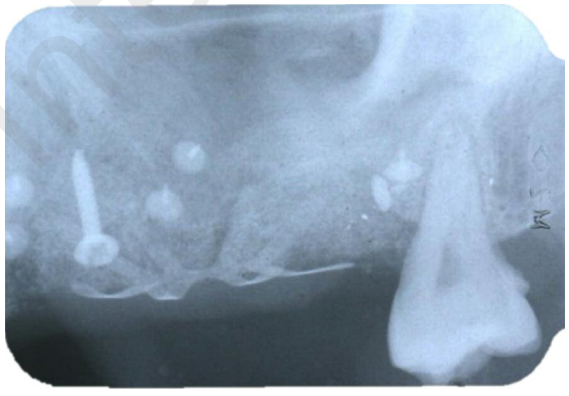

Figure 9
Intraoral X-ray immediately after GBR procedure.

the lack of an additional mesial internal stitch near the left superior second molar. There was nonetheless evidence of an epithelial seal at the site involved, with no detachment on probing or suppuration. The problem was managed by continuing chlorhexidine mouthwashes (0.12%) for 30 days, applying 1% chlorexidine gel twice a day until the re-opening procedure and removing any plaque once a week at the office.
The patient was thus monitored closely for plaque and it was decided to remove the membrane after 4 months (Figure 11). When the site was reopened the original defect appeared to have been filled, so two fixtures (CLC Conic; CLC Scientific, Vicenza, Italy), respectively of 4x10 mm

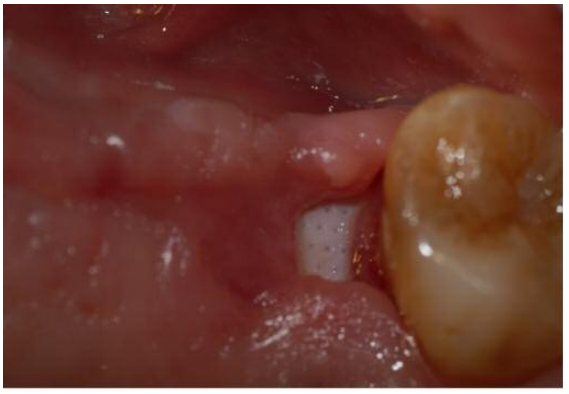

Figure 10
Exposure of the d-PTFE membrane 14 days after GBR procedure.

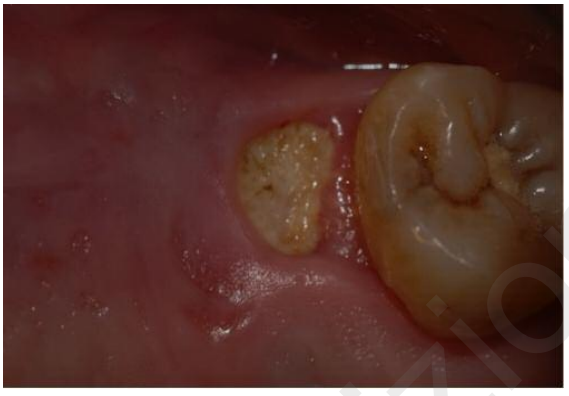

Figure 11
Exposure of the d-PTFE membrane after 4 months.

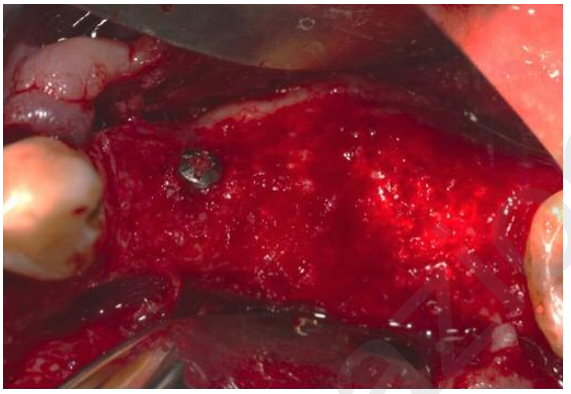

Figure 12
Site re-opening 4 months after GBR procedure.

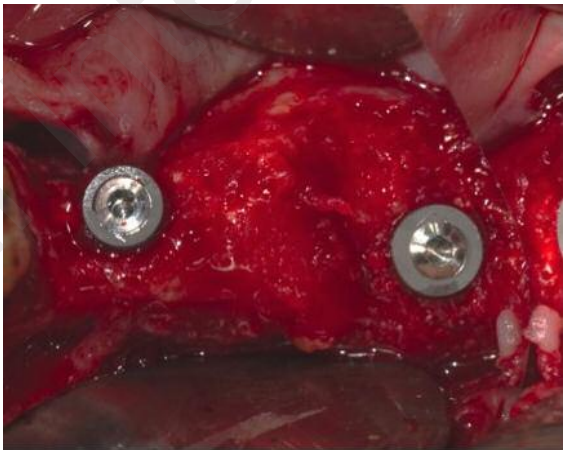

Figure 13
Implants insertion in regenerated bone.

and 5x6 mm in size, were inserted in first premolar and fist molar position (Figures 12, 13). Some minor dehiscences were filled with deproteinized bovine bone (Bio-Oss, Geistlich Pharma, Wolhausen, Switzerland) and covered with a resorbable collagen membrane (BioGide, Geistlich Pharma, Wolhausen, Switzerland) (Figures 14, 15).

The fixtures were exposed 6 months later (Figure 16). After one month, conical abutments were screwed to the fixtures and dental impressions were obtained (Figure 17). The patient opted for an alloy-resin prosthesis, the metal structure of which was cemented to the cylindrical abutments to ensure the best passivation. After two weeks, the final bridge was screwed and regular oral hygiene was scheduled (Figure 18). Intraoral X-ray at two year confirmed the stability of the prosthetic reconstruction and the success of the GBR procedure (Figure 19).

Discussion

During the lengthy healing process after GBR, membrane exposure and infection is one of the

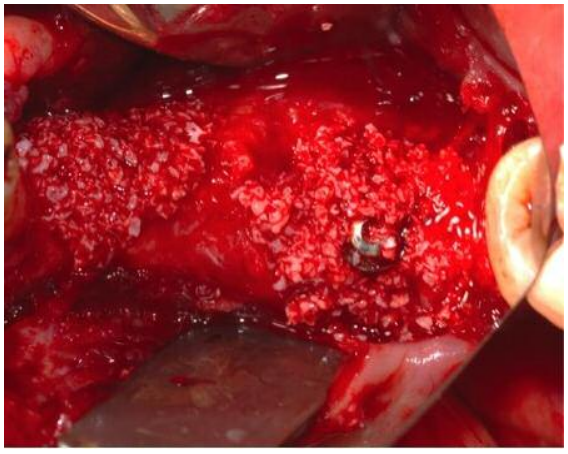

Figure 14
Filling of some minor dehiscences with deproteinized bovine bone.

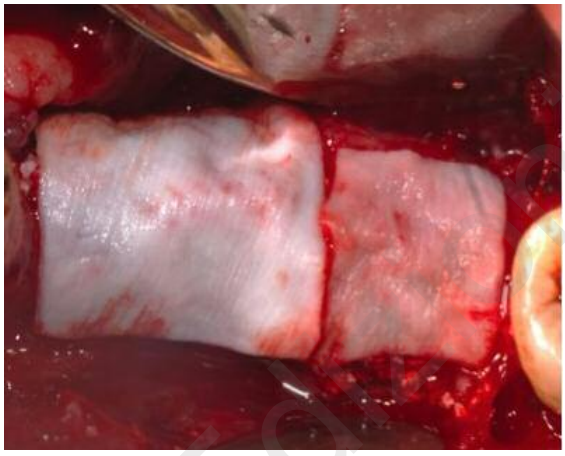

Figure 15
Covering of particulate bone graft with a resorbable collagen membrane.

most commonly reported complications (13). Non-resorbable and resorbable membranes need to be covered with soft tissue primary closure to prevent bacterial contamination and inflammatory reactions, which would place the success of the treatment at risk (8, 9, 23). In the event of inflammation, e-PTFE membranes have often to be removed immediately, while resorbable membranes may undergo degradation as a result of the enzymatic activity of macrophages and neu-

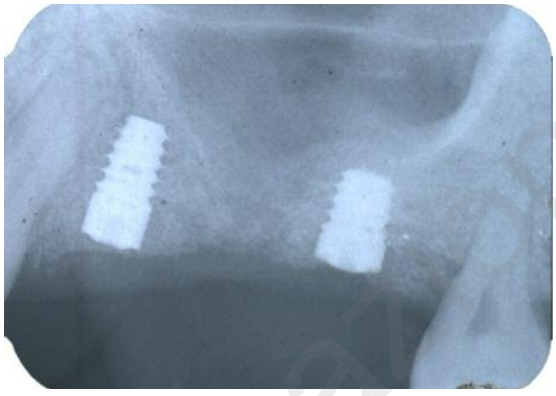

Figure 16
Intraoral X-ray 6 months after implants insertion.

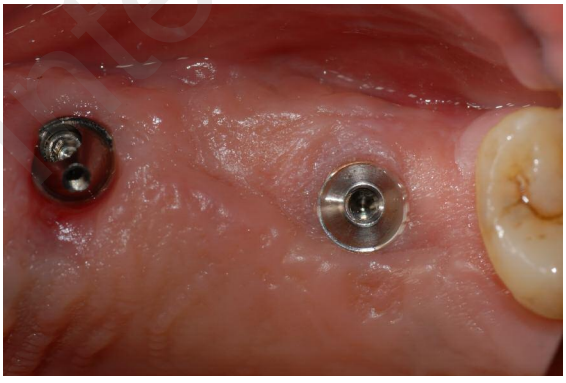

Figure 17
Conical abutments screwed on the fixtures and surrounding soft tissues.

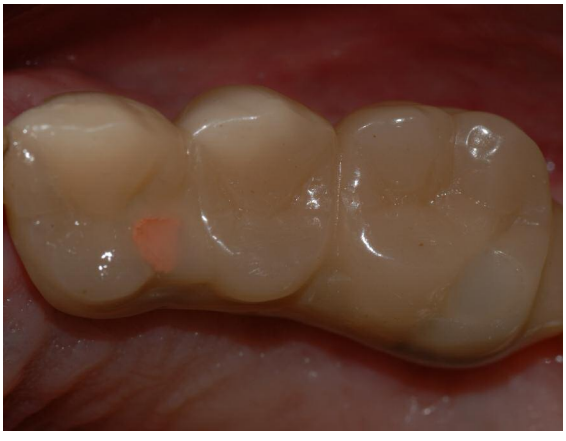

Figure 18
Final alloy-resin restoration in function.

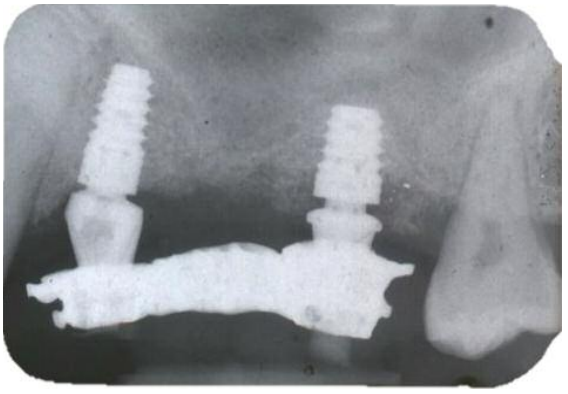

Figure 19
Intraoral X-ray after 2 year of occlusal loading.

trophils if adjacent tissues develop an inflammatory reaction (15, 23, 24). Either way, the membrane is unlikely to provide an adequate barrier for the purpose of keeping the underlying space free to allow for bone growth (although it is unnecessary to remove an exposed bioresorbable membrane) (15, 24, 25).

Non-resorbable d-PTFE membranes feature pores 0.2 mm in diameter that prevent bacterial infiltration and, even if the membrane is exposed, the risk of complications and infections is much lower than with e-PTFE membranes. This makes primary soft tissue closure important but no strictly needed because the membrane suffices as an impenetrable barrier to food and bacteria (26).

In our case, a d-PTFE membrane was not removed after its exposure. A careful protocol was adopted instead, which consisted in repeated 0.12% chlorhexidine mouthwashes, 1% chlorexidine gel applications and weekly oral hygiene monitoring appointments. The validity of this approach was demonstrated by the successful bone augmentation achieved, which enabled dental implants to be inserted. This case goes to show that membrane exposure can be managed with a thorough knowledge of the materials involved and an adequate oral hygiene.

Conflicts of interests

Dr. Claudio Soldini declares a conflict or interest with the implant brand used in this case report as co-owner for the company CLC Scientific.

All the other Authors declare no conflict of interest.

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Correspondence to:
Paolo Ghensi, DDS
Oral Surg MClin Dent, Clin Msc
Via Chini 101/2,
38123 Trento (TN), Italy
Phone: +390461910569
E-mail: dr.ghensi@gmail.com