

Treatment of Peri-implant Defects with the Vertical Ridge Augmentation Procedure: A Patient Report

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Most clinical patient reports apply the biologic principles of guided bone regeneration, in addition to defect filling with autogenous bone grafts or bone graft substitutes, in peri-implantitis therapy. Not infrequently, sites with membrane coverage have revealed early exposure, with subsequent infections, premature membrane removal, and insufficient bone regeneration. The present patient report demonstrates another surgical approach that uses the clinical principles and soft tissue management of vertical ridge augmentation, strictly following the same surgical protocol, on previously cleaned implant surfaces. The successful outcome of this surgical approach in one patient supports the feasibility of the selected treatment method in maintaining both the implants and the prosthetic reconstruction involved with peri-implantitis. (INT J ORAL MAXILLOFAC IMPLANTS 2001;16:572-577)

Key words: alveolar ridge augmentation, endosseous dental implant, guided tissue regeneration, peri-implantitis

Peri-implantitis is defined as an inflammatory lesion involving the peri-implant soft tissues, yielding breakdown of both the marginal soft tissue and the hard tissue underneath.¹⁻³ Clinically, it is possible to document increased probing depth, clinical loss of attachment, and radiographic evidence of bone loss. A painful and edematous swelling of the surrounding mucosa may be present. Recently, several clinical case reports have been published documenting the possibility of treating peri-implantitis and maintaining clinical implant stability with a variety of therapeutic strategies.^{1,4-17} Resective and regenerative techniques represent the surgical possibilities for treating implant failures. In the past 6 years, experimental and clinical case reports have demonstrated that the application of guided bone regeneration (GBR) principles, in conjunction with technical developments of barrier membrane materials with titanium reinforcement, resulted in verti-

cal bone regeneration of atrophic, flat, edentulous ridges.¹⁸⁻²⁷ In a human histologic evaluation, Parma-Benfenati and associates²⁶ reported a substantial amount of new bone formation underneath the membrane in all cases. A recent multicenter study confirmed that bone augmented vertically with GBR techniques responds to implant placement similar to native, non-regenerated bone.²⁷

Based on these clinical and histologic results, the purpose of this patient report was to propose, as a possibility for treatment of peri-implantitis lesions, a combination of implant surface detoxification with the biologic and clinical principles of the vertical ridge augmentation procedure (VRAP).

MATERIALS AND METHODS

Pretreatment Situation

In January 1998, a 57-year-old non-smoking female patient was referred by her dentist for evaluation of implant treatment. She had been previously treated for periodontal disease and she had not lost any teeth as the result of periodontitis in the previous 8 years. The patient presented with a left mandibular implant-supported fixed prosthesis. After a 30-month loading period, her dentist, during a recall

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Fig 1a Preoperative implants in areas of mandibular left first and second premolars and first molar.

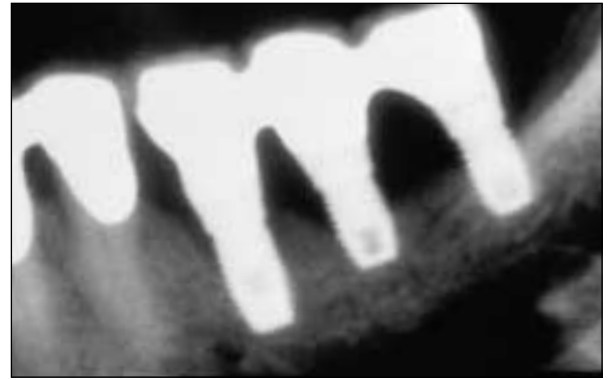


Fig 1b The pretreatment radiograph reveals both vertical and horizontal bone resorption of the 3 implants in the mandibular left sextant.

appointment, diagnosed a peri-implant infection both clinically and radiographically (Figs 1a and 1b). The fixed prosthesis was anchored by 3 standard Nobel Biocare implants (Nobel Biocare, Göteborg, Sweden), with dimensions 3.75×10 mm, 3.75×7 mm, and 3.75×7 mm replacing, respectively, the mandibular second premolar and first and second molars. The patient did not report any problems or symptoms. After removal of the prosthesis, probing depth measurements were made (to the nearest mm) at the buccal, lingual, mesial, and distal surfaces of the implants with a 15-mm calibrated periodontal probe (15UNCP, Hu-Friedy, Chicago, IL). Clinical evaluation revealed slight redness of both buccal and lingual mucosa, bleeding on probing, and a generalized 5 to 6 mm pocket depth at the implant sites. The quantity of keratinized tissue averaged between 3 to 4 mm. Because the implant-supported prosthesis had been cemented with a temporary luting agent, it was possible to evaluate each implant for mobility. All 3 implants were immobile and not tender to percussion. Radiographic evidence of bone loss involving a combination of vertical and horizontal bone loss was demonstrated with standard periapical dental radiography and by computed tomographic scans before definitive treatment planning.

All procedures to be performed were thoroughly explained to the patient, emphasizing the impossibility to functionally utilize the left mandibular sextant for a 12-month healing period. The patient gave her written consent.

Surgical Procedure

Local administration of 2% xylocaine (1:50,000 epinephrine) was given. A crestal incision within the keratinized tissue, circumscribing the cervical

aspects, was extended intrasulcularly to the mesial line-angle of the first premolar buccally. Two "hockey stick" vertical releasing incisions were made on the buccal site: mesially, at the mesial line angle of the mesial tooth; and distally, approximately 7 to 8 mm distal to the proposed most distal extension of the membrane. A buccal mucoperiosteal full-thickness flap was raised. The intrasulcular lingual incision continued with the previously executed crestal incision and was extended mesially to include at least 3 teeth. Two vertical releasing incisions (mesial and distal) that terminated no more than 1 mm beyond the mucogingival junction were made on both sides. A full-thickness lingual flap was raised that went beyond the insertion of the mylohyoid muscle. A mesiodistal incision was made to release both the periosteum and the muscle fibers immediately underneath the periosteal layer. This was done to enhance elasticity and obtain coronally accentuated dislodgment of the lingual flap facilitating tension-free closure. A periosteal incision of the buccal raised full-thickness flap was made starting from the distal releasing incision, progressing mesially, until it reached the mesial releasing incision. The simultaneous coronal extension of both flaps was then clinically evaluated.

The inflammatory granulomatous tissue was removed from the inner aspects of both mucoperiosteal flaps and from the peri-implant bony defects using hand curettes. Abundant sterile saline rinses were delivered to the defects. All 3 standard implants (mesial, intermediate, and distal) presented bone resorption that was morphologically differentiated in horizontal and vertical components (Fig 2). The mesial implant presented mainly a moat-type infrabony lesion of approximately 3 mm depth, with 3 exposed threads; the intermediate

implant presented mainly a horizontal component (5 mm) in combination with a 2-mm vertical component, with 5 exposed threads; and the distal implant presented mainly a horizontal component (3 mm) in combination with a 1-mm vertical component, with 2 exposed threads (Fig 2). The exposed implant threads were cleaned using an air-powder abrasive unit (Cavitron Jet, Dentsply, Milan, Italy) with sodium carbonate solution for 3 minutes, with the spray vector directed perpendicular to the implant surface. A solution of tetracycline hydrochloride (Ambramicina, 250 mg, Scharper S.R.L, Milano, Italy) was rubbed on the exposed threads for 5 minutes and then washed off with abundant sterile physiologic saline.^{28,29}

The cortical bone was perforated with the smallest carbide round bur to open the cancellous bone and create a bleeding bone surface. Autogenous



Fig 2 The intraoperative view after curettage of all granulation tissue clearly demonstrates the vertical and the horizontal components of the defects around all 3 implants.



Fig 3a An Oval TR9 e-PTFE membrane was bent to obtain close adaptation to the underlying bone and to cover the heads of the implants prior to fixation.

bone dust, accumulated by using bone filter aspiration (Quality Aspirators, Duncanville, TX), and/or autogenous bone chips in addition to human demineralized freeze-dried bone (DFDB) were positioned around the exposed threads to completely cover them.

The 2 filling materials were not mixed together with the aim of positioning the autogenous bone first, in intimate contact with the cortical layer of the ridge, and on top of it the DFDB. A titanium-reinforced e-PTFE membrane (TR9, W.L. Gore & Associates, Flagstaff, AZ) was bent with fine tweezers to obtain close adaptation to the underlying bone and to the implants (Fig 3a). The lateral portions were trimmed with scissors in such a way that the outer portion overlapped the edge of the bone beyond the defect margins by approximately 4 mm. The titanium-reinforced membrane was stabilized to the bone with a Frioss fixation screw (Friatec, Afi-Apollonia, Italy). The augmentation material was relieved from the natural tooth. Horizontal mattress sutures with U stitches were used to create 2 contact surfaces at least 3 mm thick (first line of closure) and were alternated with simple interrupted sutures (second line of closure) (Fig 3b). No pressure was applied to the surgical area.

The patient was premedicated with an antibiotic (2 g of amoxicillin 2 hours prior to surgery) and received 1 g of amoxicillin per day for 1 week postoperatively. The patient was given appropriate analgesics and examined at the end of the first week for material/membrane exposure. Healing was uneventful. Sutures were removed after 15 days and the patient was examined monthly. Use of her previous implant-supported fixed prosthesis and any type of removable prosthesis was avoided on the surgical site until stage 2 surgery to prevent any trauma to the augmented site.

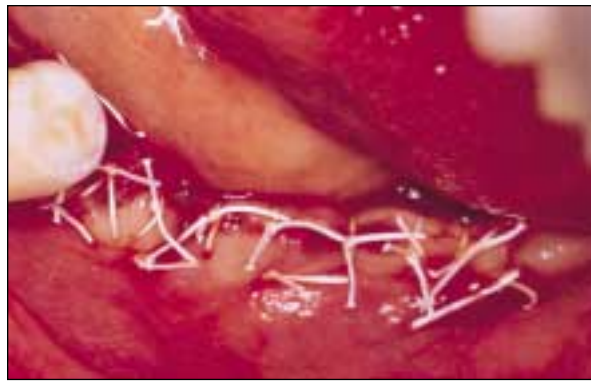


Fig 3b Flaps were sutured with horizontal mattress sutures using U suturing to create 2 contact surfaces (first line of closure) and alternated with simple interrupted sutures (second line of closure).

Second-Stage Surgery and Membrane Removal

The patient's oral hygiene and compliance to recall intervals was optimal. Despite a prolonged healing period, the barrier membrane remained completely submerged and the surrounding tissues were completely healthy, without any sign of inflammation (Fig 4).

At re-entry for abutment connection, after a 12-month healing period, the titanium-reinforced membrane was removed. A crestal incision was made in a mesiodistal direction to raise a flap just beyond the most apical margins of the augmentation material. After the fixation screw was removed, the membrane was raised with small surgical pliers from its most apical portion. Regenerated tissue could be clinically measured and compared to the initial peri-implant destruction. All space underneath the barrier membrane was completely filled with regenerated, hard, bone-like tissue (Fig 5). Clinically, this regenerated tissue was hard and appeared to consist of calcified tissue. The newly formed tissue reached the uppermost part of the implant system, partially covering the cover screws. After replacing the cover screws with the previous components of the implant-supported 3-unit prosthesis, the flaps were sutured back to their original positions. A periodontal dressing was applied and chlorhexidine digluconate gel was prescribed for 2 weeks. The sutures and dressing were removed after 1 week.

The patient was recalled monthly for professional oral hygiene instruction and prophylaxis. Nine months after membrane removal, clinical probing depth measurements were made. These did not exceed 2 mm, and a healthy and firm peri-implant mucosa had been established. After a 12-month loading period, a periapical radiograph showed a

radiographic bone fill within the infrabony defects and around the previously exposed threads, reaching the neck of the implants (Fig 6).

DISCUSSION

Peri-implantitis does not seem to be a common occurrence.^{30,31} For the GBR technique used with peri-implantitis therapy, premature membrane exposure ranging from 30%¹⁰ to 87%⁸ is the most frequently reported cause of subsequent infections and compromised bone fill within the space isolated by the membrane. Additionally, some clinicians have been prompted to use a bioresorbable barrier membrane to avoid these complications and the need to reopen the site for membrane removal¹⁴ without completely reaching their objectives.



Fig 4 Uneventful soft tissue healing after a 12-month healing period. No membrane exposure occurred.



Fig 5 Intraoperative view immediately after membrane removal. All the space underneath the membrane is completely filled with newly formed tissue. At the most distal implant, newly formed tissue reached the uppermost part of the implant system, partially covering the cover screw.



Fig 6 Periapical radiograph after a 12-month loading period showing complete bone fill around the previously exposed threads and stabilization of the vertical bone loss process.

A major disadvantage to the current proposed procedure (VRAP) is the presence of swollen and edematous mucosa, which can jeopardize the soft tissue healing process. Therefore, after elevation of buccal and lingual mucoperiosteal flaps, all granulosomatous tissue was carefully curetted on both aspects to obtain an ideal healing surface.

A retrospective analysis demonstrated that the VRAP is predictable only when a strict surgical protocol is followed, paying attention to all details.²⁴ As substantiated in a previous article, it is the authors' opinion that the predictability of this new technique is strictly related to respect of the clinical protocol and is highly technique-sensitive.²⁴ A very important step is to obtain tension-free flaps at the barrier membrane, so that the regenerative material can be kept completely covered for a 12-month healing period. The buccal and lingual periosteum must be released in such a way that elasticity is greatly enhanced and a coronal dislodgment of both flaps is achieved. For the buccal flap, the major precaution is to stay as far away as possible from the mental foramen, while for the lingual aspect it is extremely important that the full-thickness flap be raised beyond the insertion of the mylohyoid muscle. The muscle must be raised to protect important anatomic structures, including the lingual nerve, lingual artery, and sublingual gland.

Combined mechanical-antimicrobial treatment aimed at suppressing the anaerobic bacteria involved in peri-implantitis pathology must be performed prior to the attempt to surgically regenerate peri-implant bone lost as a result of infection.^{4,32} The present patient report examined the effects of combining decontamination of exposed threads and VRAP on a peri-implant lesion after a 12-month healing and loading period. The bone filling material, as well as the barrier membrane, remained completely covered. Although both factors may explain the positive clinical outcome, the latter seems to be especially crucial for effectiveness of the therapy. One of the major advantages of such a surgical procedure is that it spares the patient considerable biologic cost. Other advantages are that this procedure can be performed in an office setting without hospitalization when a standard surgical protocol is followed, and patient morbidity is the same as that associated with single-stage implant placement. Furthermore, the autogenous bone grafting material is collected from the same surgical site, eliminating the need for either another intraoral or extraoral donor site.

Since GBR is a simultaneous approach, it is an advantageous alternative to a multistep procedure or staged approach, avoiding additional surgery for

the patient. Treatment success has been documented by clinical parameters such as a healthy periodontal condition, a re-entry procedure and periapical radiograph after 12 months, as well as subsequent radiographic documentation following a 12-month re-loading period with the original prosthesis. This is in disagreement with a previous clinical study by Jovanovic and coworkers,¹⁰ which reported radiographic bone fill at the base of defects but no gain in bone tissue coronal to the infrabony component of the defects. This divergence in results could be explained by different soft tissue management in the present investigation, as well as by a prolonged and uneventful healing period. On the other hand, the clinical result in this patient report is in conformity with a study of Meraw and coworkers,¹⁶ in which bone growth was induced beyond the cover screw of a few test implants with combination growth factor cement.

An important factor for achieving predictable results is a sufficiently long healing period. It has been demonstrated that sites of early membrane removal achieve less gain in bone height.³³ In this patient report, as in other human cases reported in the dental literature, close bone-to-metal contact histologically defined as osseointegration³⁴ has not been documented, although clinical results were deemed highly satisfactory both by the patient and by clinicians. In the authors' opinion, the patients' periodontal health must be completely re-established before undertaking such a procedure. A further and important objective is the maintenance of this newly hard bone-like tissue over the subsequent re-loading period. In this patient report, the 3 implants were immediately loaded after the 12-month healing period with the original prosthesis and followed over a period of 12 months. All the clinical parameters were satisfactory, and repeated radiographic examinations revealed stable vertical bone levels (Fig 6).

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