

Bone Regeneration Using Polypropylene Membrane in Peri-implant Bone Loss: Case Report with 4 Years of Follow-up

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Abstract

The polypropylene membrane has been widely used in regenerative and reconstructive procedures, particularly in Implant Dentistry. It is a biocompatible, non-resorbable and impermeable film. It does not present porosity on its surface, conferring total impermeability, hindering the accumulation of debris, food remains and microorganisms on its surface. It was designed to remain intentionally exposed to the oral environment. Originally, it was idealized to be used after exodontia, for the maintenance, permanence and stabilization of the clot inside the alveolus and to avoid the invagination of the epithelial tissue, reducing the possibility of bone loss by remodeling and resorption of bone tissue. The maintenance of the blood clot inside the surgical site is fundamental to promote angiogenesis and chemotaxis of the cells competent for bone formation. Afterwards, the platelets present there are responsible for the production of new bone tissue, favoring the repair of the surgical site, by means of bone morphogenetic proteins (BMPs). Besides the post-exodontic indication, the membrane has been used in other indications, including bone defects caused by bone fenestrations, osteolytic lesions, bucosinusal communications, apicectomies and periapical curettage, and in cases of immediate implants. The purpose of this article is to present the case of a patient who developed peri-implant disease in two implants in the left mandibular premolar region, with bone loss around the screw threads. Peri-implant treatment of decontamination was performed, followed by installation of the polypropylene membrane adjacent to the peri-implant defect. By radiographic control, 6 months after the surgical procedure, bone regeneration adjacent to the screw threads was observed. The case has been followed for 4 years.

Keywords: Bone Regeneration; Oral Surgery; Bioengineering; Implant Dentistry.

Introduction

The polypropylene membrane has been widely used in regenerative and reconstructive procedures, particularly in Implant Dentistry and Oral Surgery¹⁻⁵.

It is a biocompatible, non-resorbable and impermeable film. It does not present porosity on its surface, granting total impermeability, hindering the accumulation of debris, food remains and microorganisms on its outer side. However, on the inner side, it presents the characteristic of adsorption of osteoblasts and osteogenesis precursor cells, in contact with blood clot, promoting its stability¹⁻⁸.

It was designed to remain intentionally exposed to the oral environment. Originally, it was idealized to be used after exodontia, for the maintenance, permanence and stabilization of the clot inside the alveolus and to avoid the invagination of the epithelial tissue, reducing the possibility of bone loss by remodeling and resorption of bone tissue^{1-5,8}. Besides the post-exodontic indication, the membrane has been used in other indications, including bone defects caused by bone fenestrations, osteolytic lesions, bucosinusal communications, apicectomies and periapical curettage, and in cases of immediate implants^{6,7}.

In surgical procedures with bone site exposure (post-exodontic alveoli, cystic cavities, etc), the blood clot formed occurs after rupture of the blood vessels of the vascular-nervous bundle. Angiogenesis (intense vascular proliferation) is observed. Subsequently, by chemotaxis, the attraction of various types of cells and bone morphogenetic proteins (BMP) occurs. The latter are synthesized by platelets, indicating the sites of extracellular matrix deposition and the synthesis and mineralization of trabecular bone tissue. New osteoblasts originate from the differentiation of totipotent or pluripotent cells. Osteoblasts secrete osteoid matrix which will later undergo the process of mineralization and repair of the surgical site¹⁻⁸.

The purpose of this article is to present the case of a patient who presented peri-implant disease in two implants in the left mandibular premolar region, with bone loss around the screw threads. Peri-implant treatment of decontamination was performed, followed by installation of the polypropylene membrane adjacent to the peri-implant defect. By radiographic control, 6 months after the surgical procedure, bone regeneration adjacent to the screw threads was observed.

Case Report

Afrodescendent male patient, 61 years-old, attended to the clinic for periodontal and peri-implant treatment.

The patient presented periodontal and peri-implant disease, in teeth and osseointegrated implants. Tissue growths were observed due to the administration of amlodipine, for the control of arterial hypertension (Figure 1).

Radiographically, generalized bone loss was observed adjacent to the dental roots and to the implant screws (Figure 2). Specifically in the implants of the mandibular premolar region on the left side, bone loss adjacent to the implant threads was noted (Figure 3). Table 1 shows the quantity of the screw threads exposed by bone loss, but submerged (submucous).



Figure 1: Initial clinical aspects of periodontal and peri-implant disease: right side (A); frontal view (B); left side (C).



Figure 2: Panoramic radiography showing initial aspects of generalized bone loss.



Figure 3: Bone loss adjacent to the implant threads of the mandibular premolar region on the left side.

Table 1: Quantity of the screw threads exposed by bone loss, before and after the surgical procedure.

Region / Tooth	Exposed screw threads before the procedure	Exposed screw threads after the procedure
Mesial / 34	3	3
Distal / 34	6	3
Mesial /35	6	5
Distal / 35	8	3

Oral hygiene orientation was performed. Periodontal and peri-implant treatment consisted of scaling and root planing procedures, every 3 dental elements or implants per session, under local anesthesia. In the implant scaling procedure, a teflon curette was used so as not to cause grooves on the implant surface.

Under local anesthesia, the implants in the region of the mandibular premolars on the left side were scraped (Figure 4), favored by an intrasulcular incision (Figure 5). Complementarily, a 1% pH 1 citric acid solution was employed for chemical decontamination. The polypropylene membrane (Bone Heal, São Paulo, Brazil) was introduced inside the gingival sulcus, without the need of relaxing and secondary incisions. Suspender sutures were performed (Figure 6). The patient received analgesic, anti-inflammatory and antibiotic drugs.



Figure 4: Scaling and planing of the implant surfaces in the region of the mandibular premolars on the left side.



Figure 5: Intrasulcular incision.



Figure 6: Polypropylene membrane introduced and suspender sutures.

After 15 days (Figure 7), the polypropylene membrane and sutures were removed (Figure 8). After 30 days, the patient was evaluated again. Gingival tissue dehiscence was noted (Figure 9), caused by bone loss and the anti-inflammatory action of periodontal and pharmacological therapy. No complaints or complications were reported.

After 6 months of treatment, the patient was assessed clinically and radiographically (Figures 10 and 11, respectively). Bone regeneration was observed around the implant threads, which were summarized in Table 1.



Figure 7: Post-surgical aspects after 15 days.



Figure 8: Removal of the polypropylene membrane and sutures.



Figure 9: Dehiscence of the gingival tissue.



Figure 10: Final clinical aspects after 6 months of treatment: right side (A); frontal view (B); left side (C).

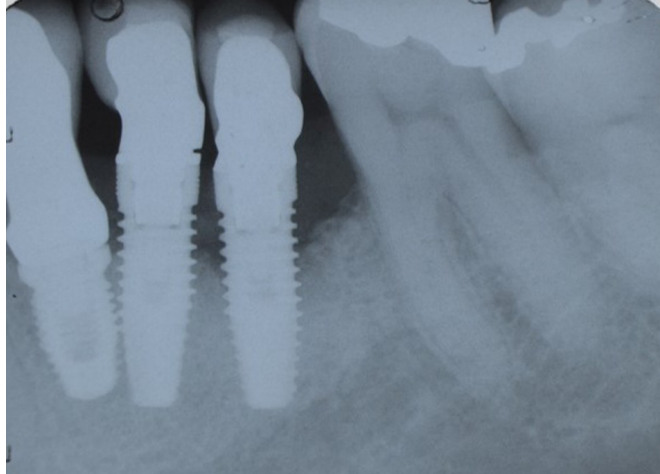


Figure 11: Final radiographic aspect showing bone regeneration around the implant threads.

Discussion

The local haemostasis process of physiological repair is initiated by cellular and tissue phenomena. The connection between the fibrin network and the walls of the surgical site forms the blood clot. Initially it presents a gelatinous and yellowish appearance. The invasion of microorganisms from the oral cavity into the surgical site is prevented by salivary neutrophils and immunoglobulins. Additionally, the presence of salivary enzymes and microorganisms inside the surgical site causes physiological retraction of the clot. As from 3 days after the surgical procedure, there is an activation of angiogenesis in the granulation tissue that fills the surgical site. Differentiated and undifferentiated cells that compose the granulation tissue are supplied by the periodontal ligament and endosteum. From the fourth day on, osteoprogenitor cells (osteoblasts) migrate to the region, initiating the process of filling the surgical site defect. After 7 days, the secretion and deposition of osteoid matrix by the osteoblasts starts, and later on, they will form the bone tissue. The bone formation occurs centripetally, from the periphery to the centre of the surgical site, interposing itself to the granulation tissue¹⁻⁸.

The mature bone tissue is permeated by irregular trabeculae after 45 days. At this stage, the incorporation and binding of osteocytes to the mature bone tissue, formed earlier, occurs. After the formation of concentric lamellae, in a few months, with Havers and Volkmann channels and adequate nutrition, the maturation of the osteoid tissue will take place. In Implant Dentistry, this maturation is sufficient for the newly formed bone tissue to become suitable to receive the osseointegrated implant and possible maintenance of the functional activities resulting from masticatory loads (4 and 6 months for the mandible and maxilla, respectively)^{1-5,8}.

From the gingival perspective, the covering of the wound by the epithelial tissue occurs after 21 days, gradually promoting isolation between the surgical site and the oral cavity¹⁻⁸.

These biological steps are fundamental for the maintenance and immobility of the blood clot within the surgical site. In this perspective, gentle maneuvers are necessary during the surgical procedure and care with the maintenance and management of the blood clot inside the surgical site. Carelessness or untimely maneuvers may delay or annul the bone repair process¹⁻⁸.

Autogenous bone grafts are considered the gold standard for filling bone defects. However, they have some disadvantages, such as the need for a donor area, increased surgical time and amount of bone tissue to be transplanted, causing discomfort and morbidity to patients. When there are extensive bone defects, there is also the need for membranes to help closing the mucoperiosteal flap, making the procedure more expensive.

Most occlusive membranes used for guided bone regeneration techniques should remain submerged at the gingival level and should not be exposed to the oral environment. From this perspective, the polypropylene membrane is chosen as ideal in these procedures, as it reserves only the blood clot and takes advantage of all the benefits of this autogenous factor. Several characteristics can also be considered: malleability; easy cutting, modeling and adaptation to the region; resistance to applied loads; no need for relaxing incisions and other fixation resources; exposure to the oral environment without contamination and infection; low cost. In the present report, the polypropylene membrane met these characteristics in the guided bone regeneration technique¹⁻⁸.

In addition to the possibility of exposure to the oral environment, the polypropylene membrane does not undergo dimensional changes, hydration or waterlogging, being a stable and impermeable material. It is indicated to be removed between 7 to 14 days¹⁻⁸.

Its external surface (convex side) is smooth, showing no accumulation of dental biofilm and food debris, and not allowing adherence to scar tissue. However, on its inner surface (in contact with the blood clot, concave side), the adsorption of osteoblasts and osteogenesis precursor cells is promoted¹⁻⁸.

The polypropylene membrane potentiates chemotaxis and angiogenesis, favoring the own nature of the organism in the synthesis and endogenous maturation of the newly-formed bone¹⁻⁸. Although there is no bone cavity in the present report, we chose to use the polypropylene membrane because we believe that guided tissue regeneration and re-covering of the implant threads by new bone tissue would be possible.

Conclusions

In the current regenerative techniques in Implant Dentistry, Periodontics and Oral Surgery, the maintenance of bone tissue or the reduction of bone resorption is essential. More conservative or minimally invasive procedures gain prominence. The use of polypropylene membrane provides osteopromotion and osteogenesis in guided bone regeneration techniques. The polypropylene membrane promotes the protection of the surgical site against invagination of the epithelial tissue, favors the maintenance and immobilization of the blood clot, enhancing the local physiology, through chemotaxis and angiogenesis, and stimulates the own response of the body in the synthesis and endogenous maturation of the newly formed bone.

Conflict of Interest

The authors declare no conflict of interest.

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