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Case Report

Use of Polypropylene Membrane after Exodontia for Maintaining Bone Thickness: Case Report

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Abstract:

After exodontia, several biological stages are expected to culminate in clot retraction, invagination of the gingiva over the edentulous alveolar space, and bone resorption of the alveolar walls. Generally, the resorption occurs greater in thickness than in the height of the remaining bone. Thus, it is imperative to use milder exodontic techniques that prevent bone loss, thus reducing the need for regenerative grafting techniques and alleviating patient morbidity. The maintenance of the blood clot within the alveolus is essential to promote angiogenesis and chemotaxis of the cells competent for bone formation, as well as to prevent invagination of the epithelial tissue. Subsequently, platelets are primarily responsible for encoding and producing new bone tissue, favoring post-surgical alveolar repair through bone morphogenetic proteins (BMPs). Occlusive membranes are commonly used for bone defect regeneration in guided bone regeneration techniques. However, most of them must remain submerged at the gingival level and should not be exposed to the oral environment. The polypropylene membrane has been widely used in the maintenance and immobility of the clot after exodontia, due to the advantage of being intentionally exposed to the oral environment. The purpose of this article is to present a case of the use of polypropylene membrane after exodontia of a cracked tooth that caused abscess and acute infection. The polypropylene membrane promoted the maintenance of blood clot inside the alveolus, avoiding gingival invagination, and above all, maintaining alveolar thickness, preparing the recipient bed for future rehabilitation with dental implant.

Keywords: *bone regeneration; oral surgery; bioengineering; implant dentistry*

Introduction

Exodontia is still frequent in dental practice, with various reasons, among them caries, periodontal diseases, dental fractures, oral pathologies, and orthodontic indications. After exodontia, there is a rupture of the blood vessels of the vascular-nervous bundle forming the clot inside the alveolus, with intense vascular proliferation (angiogenesis). The genetic information for bone production occurs by chemotaxis, with the attraction of several types of cells and proteins. Bone morphogenetic proteins (BMP) are synthesized by platelets, which indicate and signal the sites of extracellular matrix deposition and the subsequent production and mineralization of the trabecular structure of bone tissue in the alveolus after exodontia. The totipotent or pluripotent cells differentiate into new osteoblasts, which secrete the matrix that will later undergo the process of mineralization and repair of the post-surgical alveolus[1,2].

These initial stages for bone formation are only possible thanks to the maintenance and immobilization of the blood clot after exodontia. Retraction of the blood clot, invagination of the gingival epithelial tissue, and resorption of the alveolar bone walls are naturally predicted. Clinically, the resorption occurs greater in thickness than in the height of the remaining bone. Thus, it is imperative to use milder exodontic techniques that prevent bone loss, thus reducing the need for regenerative grafting techniques and alleviating patient morbidity[3-9].

Guided bone regeneration techniques aim to repair lost bone tissue or preventively reduce possible tissue loss. Physical barriers can be used, which goal to contain cell types that are undesirable for alveolar bone repair, such as gingival epithelial tissue cells. The invasion of these cells inside the alveolus would favor invagination of the epithelial tissue, blood clot retraction, and resorption of the alveolar bone walls. On the other hand, the use of occlusive membranes, by avoiding the invasion of gingival epithelial cells, would favor the maintenance of the blood clot and the immobility of osteoblasts in the alveolus, favoring the maintenance of the bone walls. With the preservation of the bone walls, mainly buccal and palatal/lingual, the alveolar thickness is maintained, which is essential for the future installation of dental implants[1-9].

There are several types of barriers, and they can be absorbable or non-absorbable. Among the absorbable barriers, there are collagen membranes, polylactic acid, polyglycan acid, polyurethane, and acellular dermal matrix. Among the non-absorbable barriers are cellulose, expanded polytetrafluoroethylene, Teflon, latex, titanium and aluminum oxide. However, most of them must remain submerged at the gingival level and should not be exposed to the oral environment. The polypropylene membrane has been widely used in the maintenance and immobility of the clot after exodontia, due to the advantage of being intentionally exposed to the oral environment[3-9].

The purpose of this article is to present a case of the use of polypropylene membrane after exodontia of a cracked tooth that caused abscess and acute infection. The polypropylene membrane promoted the maintenance of blood clot inside the alveolus, avoiding gingival invagination, and above all, maintaining alveolar thickness, preparing the recipient bed for future rehabilitation with dental implant.

Case Report

A Caucasian female patient, 58 years-old, complained of a left sided facial abscess with local pain and swelling in the left maxillary premolar region (Figure 1).

Figure 1: *Patient presenting a left sided facial abscess.*

Prior to the clinical examination, the patient was given antibiotics (amoxicillin) and anti-inflammatory drugs (nimesulide) to contain the infectious process, during 7 days.

After 10 days, the patient returned with no extraoral (Figure 2) or intraoral signs of infection. On intraoral clinical examination, chronic periodontitis, missing teeth, presence of single crowns on teeth and implants were observed. Tooth 24 was identified as the region of origin of the abscess (Figure 3). Radiographically, bone loss due to periodontal disease, radiopaque images alluding to dental calculus, edentulous area, presence of teeth with endodontic treatment, prosthetic and dental implants were observed (Figure 4). Additionally, CT sections showed a hypodense line compatible with a palatal root fracture of tooth 24 (Figure 5).

Initially, periodontal treatment was proposed. After its completion, the exodontia of tooth 24 was indicated and, prior to future dental implant installation in the region, the use of polypropylene membrane was suggested, with the purpose of maintaining alveolar bone walls and bone thickness. The patient was properly instructed, and after her signed consent, the procedure was performed.

Figure 2: *Ausence of left sided facial abscess.*

Figure 3: *Initial clinic aspects: tooth 24 was identified as the region of origin of the abscess.*

Figure 4: *Initial radiographic aspects.*

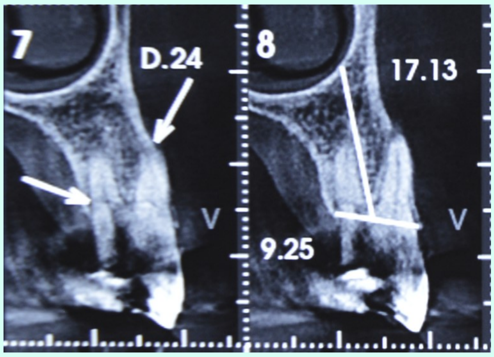

Figure 5: *CT sections showed a hypodense line compatible with a palatal root fracture of tooth 24.*

After local anesthesia, an intrasulcular incision was made between teeth 23, 24 and 25, promoting periosteal detachment, without relaxants, in order to perform the exodontia, which was easily done. However, due to the root fracture, it was necessary to grasp and pull the remaining root with an endodontic file (Figure 6). The alveolus was curetted and washed thoroughly with saline solution, promoting bleeding and clot formation (Figure 7). A polypropylene membrane (BoneHeal™, INP, São Paulo, Brazil) was cut and adapted, covering the entire alveolus in the buccal-palatal direction. The region was sutured and the membrane was intentionally exposed to the oral environment (Figure 8). The natural crown of tooth 24 was cut, adapted and cemented with composite resin in the edentulous region, remaining as a temporary prosthesis (Figure 9). Analgesic, anti-inflammatory and antibiotic drugs were administered to the patient.

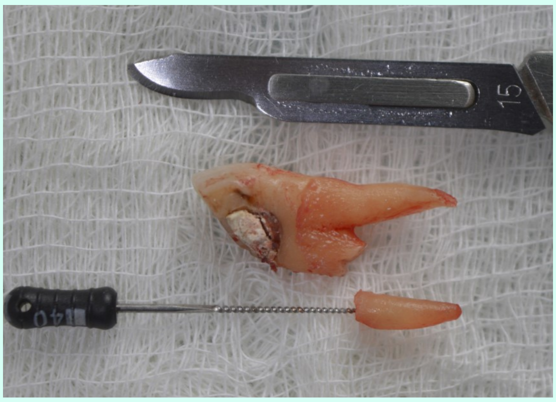

Figure 6: *Removal of the tooth and of the radicular fragment with an endodontic file.*

Figure 7: *Bleeding and clot formation*

Figure 8: *Polypropylene membrane was adapted and the region was sutured.*

Figure 9: *Temporary prosthesis with natural crown of tooth 24, adapted and cemented with composite resin in the edentulous region*

After 7 days of surgery, the sutures and membrane were removed (Figures 10, 11 and 12). Maintenance and immobilization of the clot was observed, as well as maintenance of the alveolar ridge thickness (Figures 13 and 14). The patient had no complaints or complications.

At 21 days after exodontia, the patient was evaluated, showing partial but satisfactory gingival repair (Figures 15 and 16). After 30 days, the patient was evaluated again, showing satisfactory gingival repair (Figures 17, 18 and 19). The patient was instructed to wait 6 months and was referred to implant surgery.

Figure 10: *Evaluation post-surgical (7 days): buccal view*

Figure 11: *Evaluation post-surgical (7 days): occlusal view*

Figure 12: *Removal of sutures and membrane*

Figure 13: *Surgical site after membrane removed: occlusal view*

Figure 14: *Surgical site after temporary*

Figure 15: *Evaluation post-surgical (21 days): buccal view*

Figure 16: *Evaluation post-surgical (21 days): occlusal view*

Figure 17: *Evaluation post-surgical (30 days): anterior view. Observe the maintenance of bone thickness at the root level.*

Figure 18: *Evaluation post-surgical (30 days): buccal view. Observe the initial conformation of the gingival papillae*

Figure 19: *Evaluation post-surgical (30 days): occlusal view. Observe the maintenance of the alveolar bone walls, particularly the vestibular wall.*

Discussion

In physiological repair, cellular and tissue phenomena initiate local hemostasis. The blood clot is formed by the connection between the fibrin network and the walls of the alveolus. The clot has a gelatinous and yellowish appearance. Neutrophils prevent the invasion of microorganisms from the oral cavity, as well as salivary immunoglobulins. Generally, the physiological retraction of the clot after exodontia is caused by salivary enzymes and microorganisms[3-9].

Within 3 days of exodontia, there is activation of angiogenesis in the central and peripheral parts throughout the granulation tissue that fills the alveolus. The endosteum and periodontal ligament provide the differentiated and undifferentiated cells that compose the granulation tissue formed within the alveolus. Four days after the surgical procedure, the osteoprogenitor cells - osteoblasts - migrate to the region and begin to fill the defect (surgical site). Gradually, after one week, the secretion and deposition of osteoid matrix by the osteoblasts begins, which later on will form the bone tissue. Secondary bone formation occurs from the periphery to the center of the alveolus, interposing itself in the granulation tissue. After 45 days, mature bone tissue permeated by irregular trabeculae is formed. The osteocytes are embedded and attached to the mature bone tissue that has formed. In a few months, from the formation of concentric lamellae, with Havers and Volkmann canals and adequate nutrition, the maturation of osteoid tissue will culminate, which makes the tissue susceptible to the maintenance of functional activities resulting from masticatory loads[3-9]. Externally, the epithelial tissue covers the wound after 21 days, promoting isolation between the alveolus and the oral cavity[10]. The bone tissue becomes compatible with the installation of osseointegrated implants for prosthetic rehabilitation only after 4 and 6 months, for mandible and maxilla, respectively[11]. Dental implant installation surgeries, even based on reverse planning, require the most advanced bone maturation[12,13].

Considering these biological stages, the maintenance and immobility of the blood clot inside the alveolus is fundamental. Therefore, gentle maneuvers during the dental extraction procedure and care of the blood clot inside the alveolus is necessary. The lack of attention to these requirements can delay or annul the process of alveolus repair[14].

Autogenous bone grafts are considered the gold standard for the purpose of filling bone defects. The reduction of surgical time, avoiding the need for a second surgical stage with greater morbidity for the patient is one of the advantages[14]. They are indicated in maxillary sinus surgeries and, by the use of block grafts, in bone defects in which there is loss or resorption of bone walls. Adjuvantly, membranes and meshes are indicated to assist in closing the mucoperiosteal flap in extensive bone defects[15,16]. However, when block grafts are performed, two procedures should be considered at the same surgical moment, for both donor and recipient areas. In this perspective, the use of polypropylene membrane is indicated[3-9].

Several types of materials have been used in the manufacture of membranes and meshes in the technique of guided bone regeneration. However, other characteristics should be considered in their use, such as the ease of adaptation, cutting and modeling to the region; malleability; resistance compatible with applied loads; unnecessary relaxing incisions; unnecessary fixation resources (screws or tacks), favoring the low cost; possible exposure to the oral environment without suffering contamination and infection[17]. The polypropylene membrane attended, as observed in the present case, most of these characteristics for osteopromotion purposes.

Developed to be intentionally exposed to the oral environment, the polypropylene membrane does not require the use of other biomaterials, reserving only the blood clot. Polypropylene is a stable and impermeable material, which does not undergo hydration or soaking, and therefore does not suffer dimensional changes. The polypropylene membrane is indicated to be removed in 7 to 14 days. It does not show adherence to scar tissue, as well as the accumulation of dental biofilm and food debris. However, the internal surface (in contact with the blood clot) promotes adsorption of osteoblasts and precursor cells of the osteogenesis[1-9].

After exodontia, the alveolar bone resorption is greater in thickness (buccal-palatal/lingual distance) than in height. The Figures 17 and 19 illustrate the maintenance of bone thickness thanks to the permanence of the blood clot inside the alveolus, by the use of the polypropylene membrane. The Figure 18 presents the new gingival architecture and conformation, besides of maintenance of the gingival papillae. This membrane enhances the local physiology (chemotaxis and angiogenesis) and favors the organism's own nature in the synthesis and endogenous maturation of the newly-formed bone[14,15].

Conclusions

In current Implant Dentistry, one of the precepts is the maintenance of soft and hard tissues or the reduction of bone resorption, particularly after exodontia. From this perspective, more conservative procedures during exodontia and the advent of guided bone regeneration techniques, using membranes, seek maximum preservation and, through concepts of osteopromotion and osteogenesis. The polypropylene membrane after exodontia offers protection, maintenance and immobilization of the blood clot, enhancing the local physiology (chemotaxis and angiogenesis) and favoring the organism's own nature 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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