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Case Report

Guided Tissue Regeneration (GTR) Using Collagen Membrane with Polylactic Acid Frame (PLA): Case Report

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Abstract

Rehabilitation with implants must seek not only functional repair but also strive for an aesthetically satisfying result. Tooth extraction results in the natural resorption of original hard tissues, with subsequent retraction of the surrounding soft tissues, and this is the surgeon's challenge: to restore function and aesthetics in as few steps as possible. A wide range of techniques and biomaterials are available on the market. It is known that biomaterials must be biocompatible, and among the various alternatives, resorbable biomaterials have the best outcomes with the least number of surgical steps. This clinical case report aimed to present guided tissue regeneration (GTR) with the aid of a collagen membrane with polylactic acid frame (PLA), concomitantly with the installation of two implants. GRT intended to promote new bone formation and guide bone covering with healthy soft tissue. After placing the biomaterials, the implants were positioned at the same surgical time. After 180 days, the osseointegration of the installed implant was in harmony with their surrounding tissues and structures as observed through image examination (panoramic radiography), allowing prosthetic rehabilitation without additional surgical intervention. The use of biomaterials and GTR are extremely valuable for the success and reduction of working time in rehabilitation with implants.

Keywords: Implant; Guided Tissue Regeneration; Membrane; Polylactic Acid

Abbreviations

RGC: Regular General Condition; ePTFE: Non-Resorbable Expanded Polytetrafluoroethylene; PLA: Polylactic Acid; GTR: Guided Tissue Regeneration; GBR: Guided Bone Regeneration

Introduction

Alveolar ridge resorption following teeth extraction is a common issue due to the role of the alveolar process itself, which is to hold the teeth in place. However, the loss of this function leads to gradual resorption. Such resorption causes defects in bone height and thickness, or related problems, that impair the installation of dental implants in the ideal position. In such cases, a tissue graft might be needed. It is known that the treatment of these height defects remains a major challenge for surgeons [1].

Dental implants are the gold standard treatment for contemporary oral rehabilitation. After installation, intimate contact with the peri-implant tissues is necessary to ensure implant success and survival. Peri-implant tissues are divided into hard tissue, supporting the implant; and soft tissues, protecting it [2].

Treatments in the anterior maxilla's region without aesthetic success can lead to terrible clinical situations, which, in turn, can only be corrected with the removal of the implant and subsequent

tissue graft procedures. The surgeon must be attentive to situations that may imply failures or aesthetic inadequacies [3].

Once a dental implant has been diagnosed as poorly positioned, from an aesthetic point of view, the following treatment options are available [3,4]: 1 - leaving the implant in place, not providing support for prosthetic rehabilitation; 2 - removing and replacing the implant surgically or 3 - repositioning the implant using osteotomy [5].

According to the literature, the factors that have the greatest negative effects on tissue reconstruction results include the high level of exposure and the difficulties associated with the nutrition of bone grafts (block or particles), when performed on the alveolar crest in areas with this type of defect [1,6,7].

The stability of the alveolar crest is important for preserving cortical bone, implant longevity, and preventing peri-implant tissue recession, which is usually followed by bone loss from the crest. The thickness of the initial vertical mucous tissue proved to be one of the factors that impact bone stability [8]. In an animal study, it was shown that if the mucosa tissues are 2 mm or less, there is significantly more alveolar bone resorption after healing compared to implants in a thicker mucosa region [9]. Thus, the use of biomaterials becomes essential for successful rehabilitation when there is a need for tissue regeneration [10].

The role of biomaterials

Biomaterials are substances of natural or synthetic origin that are briefly or permanently tolerated by living being's tissues. They can be used as individual units or as part of a more complex system, which treats, repairs, or replaces a tissue, organ, or function [11]. Biomaterials must be biocompatible with the organism; therefore, they cannot be toxic, nor carcinogenic, nor should they be antigenic or mutagenic. In vascular applications, they must be non-thrombogenic [12]. Biomaterials must also have proper mechanical properties for the tissue to be implanted to effectively perform their functions. These substances can be classified according to their physiological behavior as biotolerable, bioinert, bioactive, and resorbable. Resorbable biomaterials are those that, after a certain period, are degraded or absorbed by the body, forming non-toxic compounds that are eliminated by natural metabolic routes, such as the Krebs cycle or excretion via urine [11].

Different types of guided tissue regeneration barriers (GTR) are available, including non-resorbable and resorbable membranes. A wide range of materials is used to manufacture these membranes. The first commercial GTR membranes were made of non-resorbable expanded polytetrafluoroethylene (ePTFE) (Gore-Tex). As this kind of barrier must be removed by surgical reintervention, resorbable membranes have increasing clinical interest. Such membranes are produced with polylactic acid, polyglactin, collagen types I and III, or other biocompatible components. When using these membranes/barriers, several authors [8,9,12] observed new connective tissue fixation, as well as new alveolar bone formation, depending on the guided tissue regeneration technique (GTR) used [12].

There is a growing emphasis on the use of resorbable membranes that are biocompatible with the host and that do not require surgical reintervention for removal. The biological barrier composed of polylactic acid (PLA) has proven to be safe and biocompatible and maintains tissue integrity [12].

The lactic acid present in the polylactic acid (PLA) is derived from renewable material obtained in the process of sugars' fermentation from natural sources such as sugarcane or corn [8]. The PLA has excellent physical characteristics, such as mechanical resistance and thermal plasticity, in addition to having good processability, and PLA hydrolysis results in the breakdown of the polymer chains. These process results in oligomers and then in monomeric units of lactic acid that can undergo enzymatic attacks. These products are completely resorbable and naturally eliminated from the human body via metabolic pathways [8].

Polylactic acid has been suggested as a possible substitute for metallic devices due to its resorption capacity, making unnecessary a second surgery to remove the material after the recovery of the affected tissue. This fact would decrease the costs of surgery, the patient's recovery time, as well as reduce the risks of surgical complications [11].

One of the most complain in procedures for bone gain is the necessity of a second surgery to remove the scaffold used on first attempt at the placement of dental implant, most of the time, with the need of a great incision as large as at the first procedure. A biomaterial that is resorbable will facilitate the case conduction without the need of a great second procedure, because the no need of any material removal. By the explained before the Purpose of this case report is to shown a new approach to vertical bone regeneration using GBR principles associated with resorbable material.

Case Report

A 50-year-old patient, with RGC, normotensive and reactive, attended the dental office reporting functional impairment in the region of 13 and 14 due to the absence of early lost elements, leading to the aesthetic instability of the region. The protocol for requesting complementary tests was carried out and no changes were ob-

served. After initial analysis using cone-beam computed tomography, several treatment plan options were proposed, among which the patient opted for tissue regeneration and immediate implant installation.

Figure 1: Initial radiograph aspect.

Among the many possibilities in the planning of dental implants, we decided to use individualized implants. Two dental implants were installed equidistant from each other for better dissipation of masticatory loading forces. A total of 2g of amoxicillin and 4 mg of dexamethasone were prescribed 1h before the surgical procedure. Extraoral antisepsis was performed with 2% chlorhexidine and 0.12% chlorhexidine mouth rinse. An infiltrative anesthetic technique was used in the entire maxillary region, with 4% articaine anesthetic salt (100,000: 1 dilution). Incisions were made at the height of element 12 extending to the 15, with a crest incision, followed by divulsion and detachment of the vestibular and palatal tissue, respecting anatomical structures.

Implants were installed at nearby 13, 14, irrigating with 0.9% sodium chloride solution. The entire bone structure was curetted, removing adjacent soft tissue. After the structure readjustment, the tissue regeneration process began, creating micro-perforations in the vestibular wall to increase nutrition. The entire area was covered using particulate bone graft Lumina Bone Porous Large granulation (Biomaterials Criteria) with platelet-rich fibrin membrane (L-PRF).

Following the procedure, 1 x 20 x 30 Lumina Coat collagen membranes reinforced with printed frames of structured and porous polylactic acid were inserted. This membrane presentation

Figure 2: Association of biomaterial used to GBR (guided Bone regeneration).

was modeled after plasticization by heating, carried out by placing the modified membrane with PLA in a bucket filled with 0.9% sodium chloride saline solution, which was heated and measured at 700ºC using a digital thermometer. The new membrane was modeled and conditioned manually according to the conformation of the anatomical defect of the affected region, fixing the membranes using tenting screws inserted in the buccal and crestal bone walls.

Figure 3: Manipulation of the PLA (Polylactic Acid) barrier and conformation of scaffold.

In the prepared bone bed, drilling was initiated following the protocol recommended by the manufacturer of the selected implants (Nobel Biocare, USA), aiming at the best three-dimensional positioning of each implant, and following a good distribution. The drilling protocol started using a 2.0 milling bur at 1200 RPM in the regions where the future implant installations were determined, followed by a 2.0 crosscut bur and an 11.5 x 3 carbide bur (5 mm) at 750RPM, at a depth of 11.5 mm. Finally, two Replace Conical Connection implants (Nobel Biocare implants, USA) of 11.5 x 3.5 mm were installed in the anterior region of 13 and 14 at 35 Ncm torque in all installed implants.

Figure 4: Dental implant used and biomaterial covering defect to promote vertical bone gain.

Excessive gum tissue was readjusted in the anterior region to better condition the suture, ending with simple sutures for better tissue fixation using 5-0 Micropoly polypropylene sutures (Microsuture, São Paulo - SP, Brazil).

After 180 days, a new panoramic radiographic control was taken. We may indeed observe the stability of the reconstructed structures and a satisfactory clinical aspect, making it possible to refer the patient to clinical care for manufacturing adequate prostheses.

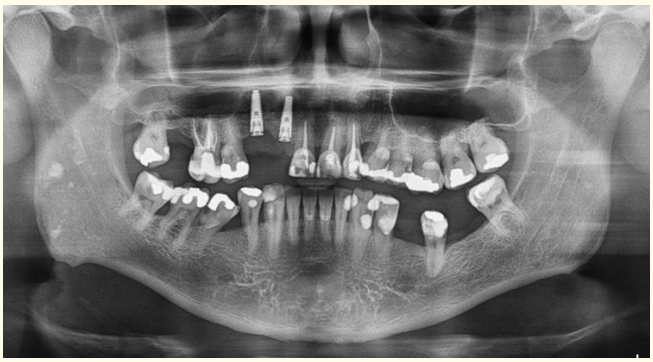

Figure 5: Dental implant used and biomaterial covering defect to promote vertical bone gain.

Discussion

Usually, dental implants that are poorly positioned or at an excessive angle are caused by failures in the diagnosis and planning process, loss of orientation during surgery or poor judgment in the case [13,14]. To avoid these errors, it is ideal to associate Guided Tissue Regeneration (GTR) with the treatment plan [5].

The current implantology seeks to improve techniques that aim to gain hard and soft tissue concomitantly with implant installation in order to reduce the number of surgical steps with the best possible aesthetic and functional result [5].

GTR's role is to optimize the thickness and quality of peri-implant tissues, as well as to allow health and longevity to the implant under load [12]. The quality of the soft tissues surrounding the implant is extremely important for its aesthetic result [3] and reconstruction; therefore, biomaterials should be used [12].

Currently, several types of membranes with different characteristics are available on the market [15]. Thus, studies that evaluate the morphological and composition characteristics of these membranes are relevant and helpful in choosing the most adequate membrane type for each case [15].

The polylactic acid membrane (PLA) is composed of a polymer of a glycide and a lactide. The polymeric components of the barrier are hydrolyzed and eliminated from the body through the Krebs cycle as carbon dioxide and water [15]. Studies have shown that the PLA membrane is effective in cases where tissue regeneration is required, with good results in cases of GTR concurrent with the installation of implants [16].

Therefore, the use of GTR with several membranes and biomaterials has become the gold standard for treatments aiming at dental rehabilitation associated with the gain of hard and/or soft tissue [2].

Conclusion

The use of Guided Tissue Regeneration with biocompatible resorbable membranes from polylactic acid is effective for aesthetic success in the rehabilitation of peri-implant tissues, and its use concomitant with the installation of implants should be considered whenever possible.

Conflict of Interest

The authors declare no conflict of interest.

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Volume 4 Issue 8 August 2021