

Guided Bone Regeneration for the Treatment of Peri-Implantitis: Clinical Case Report

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Abstract: Periodontal disease is characterized as an inflammatory process that damages the periodontal lining and/or support tissues. Peri-implantitis is among the periodontal alterations, being caused by bacterial biofilm causing loss of underlying bone insertion, leading to modifications in its architecture that form intraosseous defects of various types. For the treatment of peri-implantitis there are non-surgical, surgical, resective, regenerative, combined techniques and the decision-making will depend on the degree of the bone defect. Therefore, guided bone regeneration (GBR) is an efficient and simple technique for bone augmentation, which is widely used to restructure bone defects that occur in the alveolar ridge and in the peri-implant region. Biomaterials are alternatives to be used in guided bone regeneration due to their excellent biocompatibility, osteoinductive properties, low degradation rate and their hydrophilicity, which collaborates with the absorption of blood cells and proteins that will help in osseointegration. Female, 58-year-old normosystemic patient, attended a private dental office complaining of pain, bad smell, bleeding and bad taste in the peri-implant region referring to element 25, on its distal face to the mesial face of the element tooth 26. After imaging exams, periodontal probing and the patient's past history, extraction of element 26 was performed, decontamination protocol of the implant surface of 25 through mechanical, chemical and physical means performing antimicrobial photodynamic therapy and finally, a guided bone regeneration was performed, using the allogeneic bone grafting technique associated with a polytetrafluoroethylene membrane in its expanded form (e-PTFE) for recovery of the bone defect and alveolar preservation. Thus, guided bone regeneration has shown high success rates and greater predictability when well indicated and performed, making it important for the maintenance of periodontal and peri-implant health.

Keywords: Peri-implantitis; Bone regeneration; Biocompatible material.



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1. Introduction

Periodontal diseases generally present as an inflammatory process affecting the periodontium, characterized by necrosis and/or ulceration of the interdental papilla, gingival bleeding, halitosis, pain, and bone loss [1]. The initiation of this inflammatory alteration can be triggered or not by bacterial biofilm, which forms an organized plaque of microorganisms deposited on the tooth surface [2]. Among the periodontal disorders is peri-implantitis, which can be mediated by bacterial biofilm, leading to loss of bone attachment around dental implants, causing changes in bone architecture and resulting in various types of intraosseous defects [2, 3]. The pathophysiology of periodontitis involves key molecular pathways that activate host-derived proteinases, leading to loss of marginal periodontal ligament fibers, apical migration of the junctional epithelium, and apical spread of bacterial biofilm along the root surface. The pathophysiology of peri-implantitis similarly

involves inflammation of soft tissues, bleeding and/or suppuration, increased probing depth, and clinical and bone attachment loss [1, 4].

However, literature evidence suggests that peri-implantitis lesions exhibit larger inflammatory infiltrates extending apically into bone and do not reside in established sites as seen in periodontitis lesions [5, 6]. The morphology of peri-implant connective tissue is similar to natural dentition, except for the absence of periodontal ligament, cementum, and inserted fibers, and a lower bone level. In natural dentition, the epithelium is more adhered and includes gingival fiber insertion into the tooth surface, whereas in implants, gingival connective tissue fibers are juxtaposed only to the surface of the prosthetic component or implant without insertion [7].

Regarding the clinical consequences of peri-implantitis, periodontal bone destruction manifests as horizontal or vertical bone defects, depending on the direction and extent of apical lesion development caused by plaque accumulation. The primary treatment approach for this condition involves reducing bacterial load below the gingival margin through mechanical means, such as oral hygiene instruction including brushing, or non-surgical periodontal therapy such as scaling and root planing [8]. Various methods have been documented in the literature for peri-implantitis treatment (mechanical, chemical, physical-chemical, among others), but none have been definitively effective in eliminating bacteria from contaminated implant surfaces. Therefore, clinical protocols for treating peri-implantitis have been identified, including non-surgical, surgical, resective, regenerative, and combined techniques [9, 10].

In cases where patient hygiene is challenging or pocket morphology hinders operator visualization and tactile sensation, surgical alternatives are recommended, such as open flap debridement and closure of periodontal pockets, including guided tissue regeneration (GTR) and guided bone regeneration (GBR). GTR involves the regeneration of bone, periodontal ligament, and cementum around natural teeth, while GBR focuses on alveolar ridge growth [11]. Guided bone regeneration (GBR) is a bone grafting technique using a barrier membrane to prevent soft tissue invasion and can be indicated for regenerating periodontal or peri-implant pockets. The surgical precision of this technique depends on the quantity and size of remaining bone walls [12]. The application of this surgical method for vertical and horizontal bone gain is a predictable approach that corrects peri-implant bone defects [13].

Advancements in biomaterials in dentistry and surgical techniques have enabled the integration of guided bone regeneration (GBR) as an effective alternative for challenging cases. GBR, proposed in the late 1970s, involves hindering the migration of undesired cells by adapting a barrier membrane to the area requiring reconstruction [14]. The barrier membrane ensures stability of the bone graft, preventing soft tissue collapse into the defect and inhibiting migration of non-osteogenic cells while concentrating growth factors [14]. Mechanical protection of the clot is achieved through a barrier membrane, promoting migration and proliferation of osteoprogenitor cells and preventing colonization of soft tissues within the defect [15, 16].

Wound dehiscence and membrane exposure are the most common complications following guided bone regeneration, potentially leading to postoperative infection, inadequate bone healing, and graft material loss. Factors contributing to wound dehiscence include improper flap design, soft tissue tension, excessive graft material, trauma from provisional prostheses, and traumatic chewing or tooth brushing [12]. Therefore, tension-free flap closure is crucial for ensuring the technique's efficacy [14].

Guided bone regeneration also ensures three-dimensional repair, essential for precise implant placement and final aesthetics, with fewer disadvantages compared to other techniques [17]. This surgical procedure is an effective means for reconstructing atrophic ridges and is currently considered a standard therapeutic technique for bone defect regeneration in implantology, oral, and maxillofacial surgery [18]. Thus, the reported case involves guided bone regeneration (GBR) for a two-wall peri-implant bone defect, demonstrating complete defect reconstruction and peri-implant bone gain.

2. Methodology

This study is a case report with descriptive, exploratory, and qualitative approaches, lacking a narrative control group, aimed at demonstrating its clinical relevance and facilitating further research and reports on the same theme, always based on evidence. It should be noted that the study received approval from the Ethics and Research Committee on Human Subjects of the Centro Universitário INTA - UNINTA, under opinion number 5.631.129. The study was conducted at the Dental Clinic DENTAL-CLINIC in Sobral, Ceará, where the responsible clinician signed the Custodian Agreement Form (CAF), authorizing researchers to access data from the patient's medical records involved in this research. Additionally, a letter of consent was obtained from the institution where the research was conducted.

Researchers committed to maintaining ethical conduct while handling and accessing the data in question alongside the Research Ethics Committee (CEP) of Centro Universitário INTA - UNINTA, ensuring confidentiality of collected data and privacy of its contents, as prescribed by Resolutions 466/12 of the National Health Council (CNS), through the Data Use Commitment Agreement (DUCA). The study received informed consent from the patient after signing the Informed Consent Form (ICF) for participation and use of her images. Ethical and legal principles were respected in the patient's treatment in accordance with Resolutions No. 196/96 and 466/12 of the National Health Council (CNS).

3. Case Report

Female, 58-year-old, without systemic abnormalities, presented to a private dental office in Sobral, CE, complaining of pain, bad odor, bleeding, and a bad taste around the peri-implant region related to tooth #25. During the clinical examination, a dental implant associated with tooth #25 was observed with probing depth >5mm in the distal and mesial regions of tooth #26 (Figure 1A). The patient also exhibited local mucosal swelling, redness, and bleeding upon probing. Tomographic examination revealed diffuse bone loss in the inter-proximal region of the implant related to tooth #25 and tooth #26 with features consistent with periapical bone resorption (Figure 1B).

During the clinical examination, an extensive amalgam restoration was observed in tooth #26, which did not respond to thermal tests, leading to a diagnosis of combined endoperio lesion. Based on clinical and imaging findings, the patient was recommended for extraction of tooth #26 and guided bone regeneration of the bone defect during the same surgical session, aiming for future dental implant rehabilitation. A peri-implant decontamination protocol was proposed for the implant related to tooth #25 (Figure 1C).

The surgical procedure commenced with patient preparation and setup of the surgical table, followed by intraoral disinfection using a 0.12% Chlorhexidine Di-gluconate mouth rinse (Periogard®, Colgate Palmolive Ltda – Osasco – SP) for 1 minute. Iodopovidone 2% (Riodeine®, Rioquímica – São José do Rio Preto – SP) was applied to the facial region with sterile gauze for perioral skin disinfection. Local anesthesia was then administered using 4% Articaine with 1:200,000 Epinephrine (Articaine®, DFL – Rio de Janeiro – RJ), targeting blockage of the middle and posterior superior alveolar nerves, along with infiltrative technique in the vestibular and palatal mucosa. A total of 2 cartridges of anesthetic were used for the procedure.

Subsequently, extraction of tooth #26 was performed (Figure 1D), beginning with flap reflection to visualize the bone defect using a Molt periosteal elevator (Quinelato® - Rio Claro – SP). After gingival detachment, a forceps 18L (Quinelato® - Rio Claro – SP) was adapted and luxation movements were performed vestibulo-palatally. Subsequently, curettage and inspection of the socket were carried out using a Lucas curette (Quinelato® - Rio Claro – SP) to stimulate bleeding, followed by chemical decontamination with 0.12% chlorhexidine digluconate solution soaked in gauze for 2 minutes on the bone defect surface (Figure 1E).

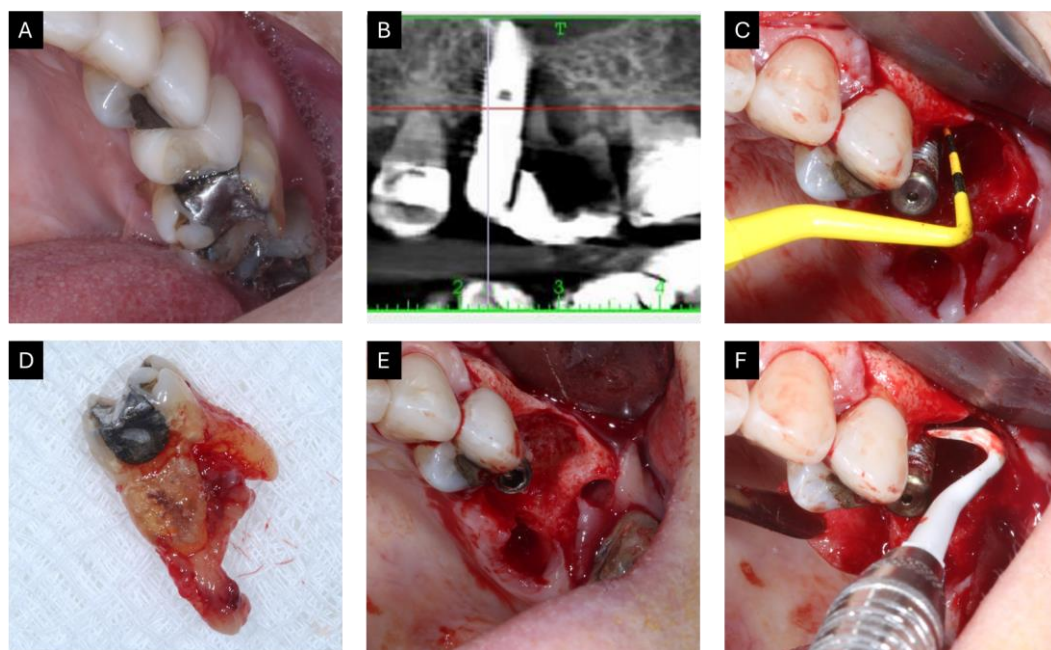


Figure 1: A. Intraoral clinical appearance. B. Computed tomography. C. Probing of the peri-implant region. D. Tooth #26 with periapical lesion. E. Mechanical decontamination using Teflon curette. F. Visualization of the bone defect and tooth socket after flap reflection.

The implant surface of tooth #25 was also decontaminated through mechanical debridement using Teflon curettes (Millenium® - Maringá - PR) (Figure 1F), followed by chemical decontamination with 0.12% chlorhexidine digluconate and then physical decontamination with antimicrobial photodynamic therapy using low-power laser associated with methylene blue (Figure 2A). Subsequently, guided bone regeneration (GBR) was initiated by hydrating particulate bovine bone substitute (Bio Oss® - Geistlich Pharma, Wolhusen, Switzerland) with saline solution (Sorimax, Farmax® - Divinópolis - MG). The biomaterial was then placed over the bone defect, in the socket of tooth #26, and covering the entire implant of tooth #25 to correct the vertical bone loss caused by the peri-implant lesion (Figure 2B). After filling with the bone substitute biomaterial, a non-resorbable expanded polytetrafluoroethylene (e-PTFE) barrier membrane (Surgitime ePTFE® - Bionno-vation Biomedical, São Paulo - SP) was adapted, as primary wound closure was not feasible, and healing was intended to occur by secondary intention.

Finally, suturing was performed using 6-0 blue polypropylene suture (Techsuture® - Bauru - SP) to reposition the reflected flap with simple interrupted stitches passing through the entire vestibular and palatal mucosa to stabilize the membrane (Figure 2C). At the end of the procedure, the patient was instructed on post-operative care, including avoiding vigorous rinsing for the first three days, consuming liquid, soft, cold, and/or natural foods within the first 24 hours, careful brushing around the operated area, applying extra-oral cold compresses for the first 24 hours, removing the sutures after 7 days, and removing the Teflon membrane after 21 days (Figure 2D).

Post-operative medication included Amoxicillin 500 mg every 8 hours for 7 days, Nimesulide 100 mg every 12 hours for 5 days, and Dipyrrone 1g every 12 hours for 3 days. After 6 months, new imaging exams were performed (Figure 2E). The patient remains under follow-up and is awaiting dental implant placement in the area of tooth 26.

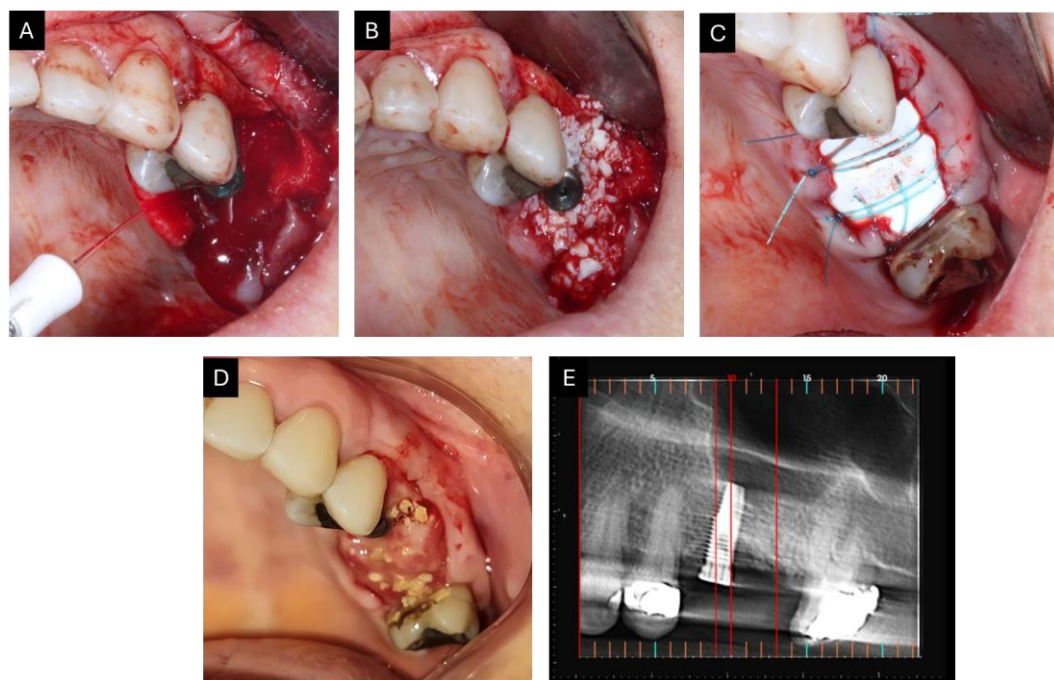


Figure 2: A. Physical decontamination using low-power laser associated with methylene blue. B. Adaptation of the bone graft (Bio Oss®). C. Placement of expanded polytetrafluoroethylene (e-PTFE) barrier membrane and suturing. D. Removal of the Teflon membrane after 21 days. E. Computed tomography after 6 months.

4. Discussion

Peri-implant health is closely tied to a set of factors that determine the long-term success of implants, making regular follow-up with a dentist essential. Patient awareness of maintenance visits is crucial for preventing peri-implant diseases [19]. According to Andrade (2017), imaging exams are crucial for diagnosis and monitoring of peri-implantitis. Recommended radiographic intervals are 1, 3, and 5 years to track implant status, with advanced methods like computed tomography indicated when disease is suspected, providing three-dimensional images of the bone around dental implants [20]. Radiographic exams typically show bone loss of 2 to 4 mm since implantation, with increased probing depths due to pseudo-pockets in such cases. Treatment involves reducing occlusal stress, gingivectomy, routine visits, and improved oral hygiene. Parameters for assessing peri-implant health include absence of mobility, pain, or notable sensitivity during palpation or percussion, and functional stability [21].

In the reported clinical case, computed tomography played a crucial role from diagnosis to bone regeneration planning, offering the advantage of three-dimensional images that aided in surgical planning. The longevity and success of implants hinge on maintaining periodontal health, preventing peri-implant diseases, and ensuring proper surgical procedures during implant installation to avoid contamination and ensure initial stability [22]. Despite high success rates, dental implants can still face inflammatory and chronic complications, with mucositis and peri-implantitis affecting 1 to 32% of cases [20].

Sun, Cao, and Li [23] noted that while peri-implantitis has little impact on dental implant loss, it significantly affects treatment outcomes and post-operative quality of life [21]. Patients with a history of untreated or incompletely treated periodontal disease are at increased risk of implant failure, as similar subgingival micro-biota can be found in pockets around teeth and implants [20]. Although the literature does not definitively establish the severity of peri-implantitis and criteria for surgical versus non-surgical approaches, studies have shown that surgical techniques are more effective for treating peri-implantitis [24].

According to Amorim, Coqueiro, and Ferreira Neto [25]), peri-implant decontamination can be achieved through mechanical and chemical methods, with commonly used approaches including surface scaling with curettes, sandblasting, citric acid, tetracycline fibers, chlorhexidine, metronidazole gel, water, or saline. Inadequate decontamination of the implant surface appears to be a significant barrier to successful bone regeneration around exposed implants [25]. Therefore, Carvalho et al. [26] argue that peri-implant region decontamination can involve mechanical instruments, antiseptics, drugs, or photodynamic devices, primarily aimed at removing microorganisms and bacteria without altering the morphological characteristics of the implants [26].

In the reported clinical case, mechanical and chemical decontamination was performed using Teflon curettes and chlorhexidine, combined with guided bone regeneration to eliminate the peri-implant pocket and preserve bone in the socket and defect. Additionally, low-intensity laser therapy with methylene blue was utilized as part of photodynamic therapy to aid in surgical treatment. According to Xie et al. [27], guided bone regeneration (GBR) is considered one of the most widely employed techniques for reconstructing alveolar bone and regenerating peri-implant bone defects [27]. This method optimizes bone healing by preventing invasion of the regeneration site by rapidly growing fibrous tissues that could hinder proper healing [28].

Da Costa [29] describes GBR as a surgical intervention utilizing bone substitute materials and membranes as barriers to facilitate bone formation in pre-existing defects [29]. GBR allows for the organization and transformation of blood clot into granulation tissue, which later matures into bone tissue [30]. GBR helps preserve adequate ridge dimensions by controlling epithelial cell infiltration into the socket while promoting connective tissue cell proliferation inside it [31].

In the present case, GBR was chosen due to the necessity to preserve the original ridge dimension for future dental implant rehabilitation. The use of absorbable membranes has become more common, limiting the use of non-absorbable membranes. Reasons for this shift include shorter recovery times and less need for a second surgical intervention in most cases, which facilitates the implant process. Nonetheless, e-PTFE membranes remain the gold standard in GBR procedures [32]. In this reported case, a Teflon membrane (e-PTFE) was chosen due to the extent of the intraosseous lesion and the need to preserve the alveolar socket of tooth 26, which could be exposed to the oral environment, necessitating secondary intention healing. Bio Oss® was selected as the bone substitute material due to its recognized efficacy, safety, and high success rates in terms of osteoformation quality and quantity in grafting interventions, leading to satisfactory integration and low resorption rates [33].

5. Conclusion

Guided bone regeneration (GBR) has demonstrated high success rates and greater predictability when properly indicated and executed, playing a crucial role in maintaining periodontal and peri-implant health. It is particularly effective in pre-serving dental elements and implants, as well as in cases requiring implant installation for rehabilitation purposes. This procedure is recognized as a reliable and effective technique for regenerating bone defects, especially when combined with a barrier membrane, which aids in eliminating undesirable cells or tissues from sites intended for future implant placement. The use of non-absorbable membranes can be effective in GBR, provided they are carefully selected and applied according to appropriate technical protocols, aiming to minimize any potential complications.

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Conflicts of Interest: None.

Supplementary Materials: None.

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