CASE SERIES

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SURGICAL APPROACH TO PERI-IMPLANTITIS: CASE SERIES OF REGENERATIVE TREATMENT PROTOCOL

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Abstract. *The implementation of dental implants has revolutionized the treatment of the partially and completely edentulous patients, offering significant benefits in restoring oral function and esthetics. However, routine dental implant placement is often associated with complications such as peri-mucositis and peri-implantitis, which can compromise the long-term success of the implant. One of the primary challenges in managing peri-implant diseases is the absence of acute symptoms, often leading to delayed detection and diagnosis by the patient. As peri-implant diseases progress, patients may seek dental care due to the exacerbation of symptoms, prompting the dentist to consider surgical intervention. Surgical therapy offers a critical opportunity to restore compromised implants and peri-implant tissues, potentially improving implant survival rates. The surgical management of peri-implantitis, which involves debridement, decontamination, and regenerative procedures, provides an effective alternative for addressing the infected peri-implant tissues and can contribute to long-term implant stability and function.*

Key words: *bone regeneration, peri-implantitis, surgical treatment*

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INTRODUCTION

Peri-implantitis is an infectious-inflammatory disease affecting the soft tissues and underlying bone around dental implants. The accumulation of bacterial biofilm provokes the disease, which leads to an inflammatory host response. In the initial stages, peri-implant mucositis develops, which is a reversible inflammation and, if not controlled, progresses to peri-implantitis, in which progressive bone loss occurs. Several risk factors can increase an individual's susceptibility to developing the clinical manifestations associated with peri-implantitis (PI). Among the most significant of them are a current or previous history of periodontitis, which reflects a predisposition to inflammatory responses around oral structures. Additionally, systemic conditions such as diabetes mellitus, particularly when poorly controlled, can compromise immune function and tissue healing, thereby elevating the risk. Another critical factor is the insufficient control of dental plaque and biofilm accumulation, which directly contributes to bacterial colonization and inflammation around im-

plants. Lastly, tobacco use – especially tobacco smoking – has been strongly linked to impaired oral healing and increased incidence of peri-implant disease, making it one of the primary modifiable risk factors in the development of peri-implantitis [1]. The management of peri-implantitis presents a significant clinical challenge due to the complex nature of the condition. Treatment often necessitates surgical intervention, which is essential to gain adequate access to the implant surfaces that have been contaminated by bacterial biofilms [2].

The aim of this article is to present several clinical cases of peri-implantitis and to discuss timely accurate management and successful surgical treatment with guided bone regeneration (GBR) which can improve the long-term implant stability and function.

CLINICAL CASE DESCRIPTIONS

In the present case series study, four patients diagnosed with peri-implantitis are described. Prior to surgical intervention, all the patients underwent non-surgical therapy along with reinforcement of oral hygiene practices. The surgical procedures were performed by an identical oral surgery team in all four cases. Each case was treated following an identical surgical protocol and post-operative care regimen. The surgical approach aimed to manage the contaminated area after full-thickness flap reflection, using either a resective, GBR (reconstructive), or combined technique. When a GBR (reconstructive) approach was employed, a bone graft was placed in combination with a barrier membrane [3, 4]. In all the patients, the bone defects were filled with a bilayer technique with bone grafts (layer of allograft covered by layer of xenograft) and a resorbable collagen membrane over it. Antibiotic therapy consisted of Augmentin 2 g daily (875 mg amoxicillin and 125 mg clavulanic acid) administered for 7 days and Metronidazole 2 times per 0.500 g for 5 days. For post-surgical pain management, ibuprofen (400 mg) was prescribed for a duration of 3 to 5 days, depending on the patient's needs [5]. A local chlorhexidine disinfection was prescribed via Eludril Classic 2x daily for 14 days. The sutures were removed 10 days after surgery.

CLINICAL CASE 1

A 55-year-old patient, who is normoglycemic, non-smoker, without concomitant diseases and without intake of medications, with history/no history of periodontitis, was referred for consultation due to suppuration and frequent inflammation in the area around the implant in site 21. The patient received immediate implant placement in 2009; bone graft and collagen membrane for recovering the bone deficiencies were also utilized. Brief characteristics of the clinical case are shown in figures 1-3.

The clinical examination in 2024 revealed signs of peri-implantitis. When providing a periodontal probing a peri-implant probing depth ≥ 5 mm was found vestibular with positive bleeding on probing. The radiographic examination was not corresponding with the clinical signs of the disease severity (Fig. 5) underestimating the underlying peri-implant bone defect. After a mechanical debridement was performed, a decision about surgical therapy was proposed. The patient was informed about the procedure proposed and signed an informed consent form.

Fig. 1. Clinical appearance of the affected area

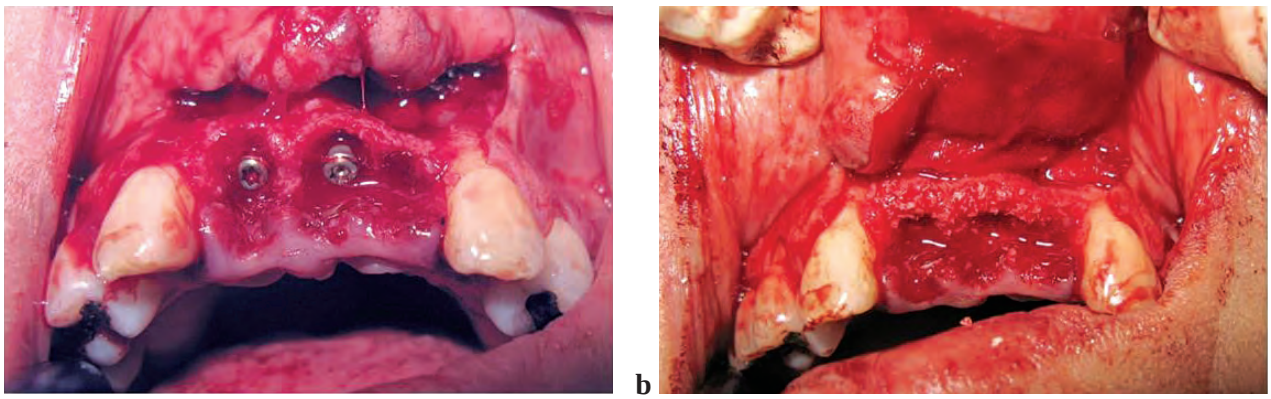

Fig. 2. Implants placed in central incisor sockets (a) with collagen membrane and (b) bone graft

Fig. 3. Radiographic verification after implant placement

Fig. 4. Intraoral view of the gingiva around the affected area

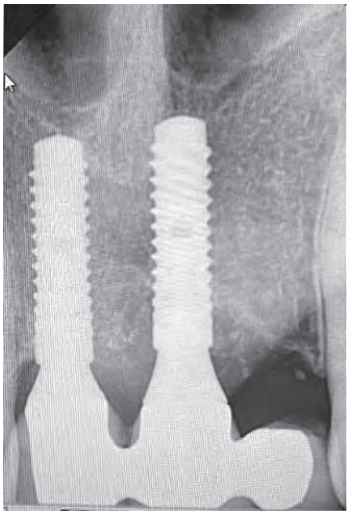

Fig. 5. Discrete radiolucency around implant 21

The surgical protocol was conducted under local infiltration with a local anesthetic. A full-thickness flap around the affected implant was raised with a periosteal elevator after 15 scalpel incision (Fig. 6a). The surgical area was extended one tooth/implant mesial and distal for full visualization of the peri-implant bone defect (Fig. 6a). The affected area confirmed the clinical finding corresponding with severe bone loss around the implant in regio 21. After thorough mechanical debridement, the surgical area was disinfected. For augmentation of the bone defect, a bone graft was applied (Fig. 6b). In order to achieve bone regeneration around the treated area, a collagen membrane was placed (Fig. 6c). For primary closure and flap immobilization, single

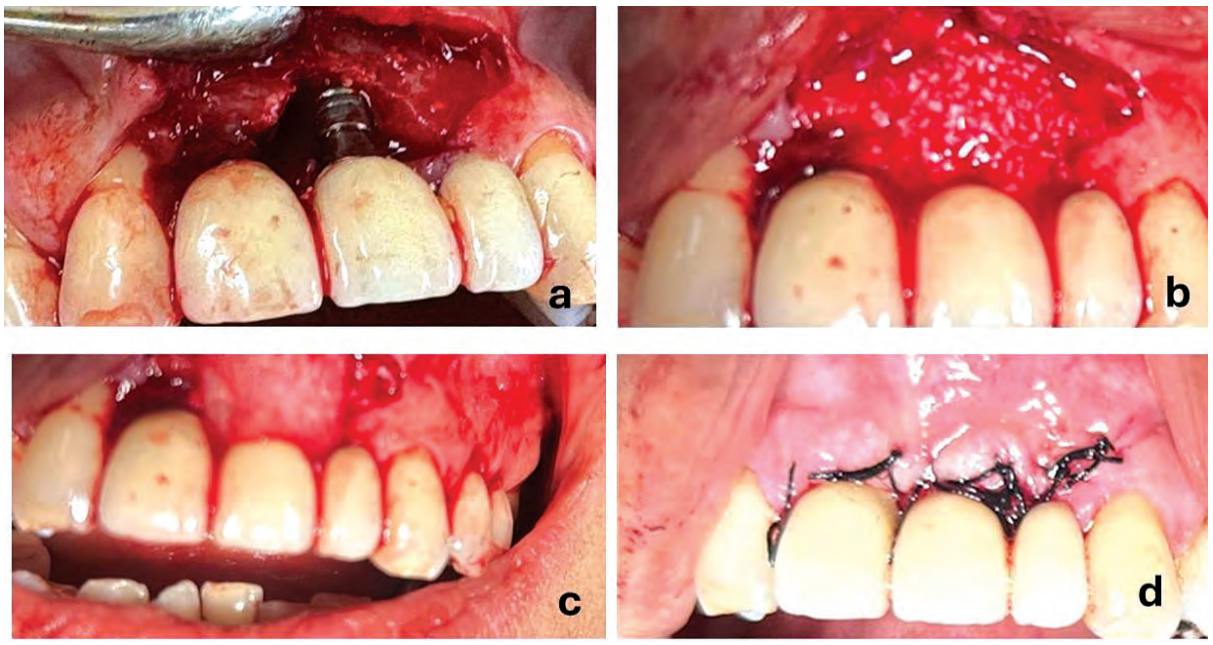

Fig. 6. Surgical protocol – full-thickness flap elevation; bone graft substitution; collagen membrane above the bone; primary closure

interrupted sutures were performed (Fig. 6d). Control radiography was made (Fig. 7).

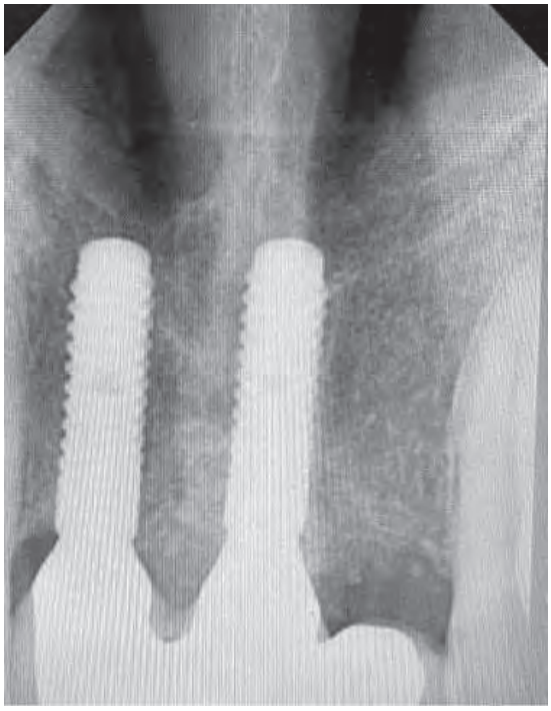

Fig. 7. Post-operative periapical radiography

CLINICAL CASE 2

A 62-year-old female patient, who is a non-smoker, with no relevant systemic conditions, presented to the dental office 10 years after the implant placement, reporting recurrent suppuration and inflammation in the peri-implant area. Radiographic examination confirmed peri-implant bone loss. Based on the clinical and radiographic findings, a diagnosis of peri-implantitis was established. In Figures 8 and 9, the main steps of the surgical treatment are presented.

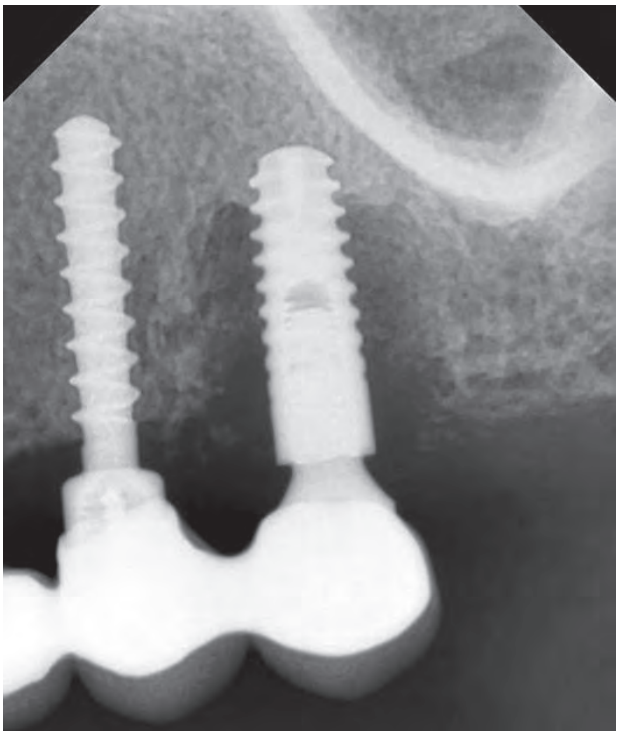

Fig. 8. Significant bone loss around the second implant

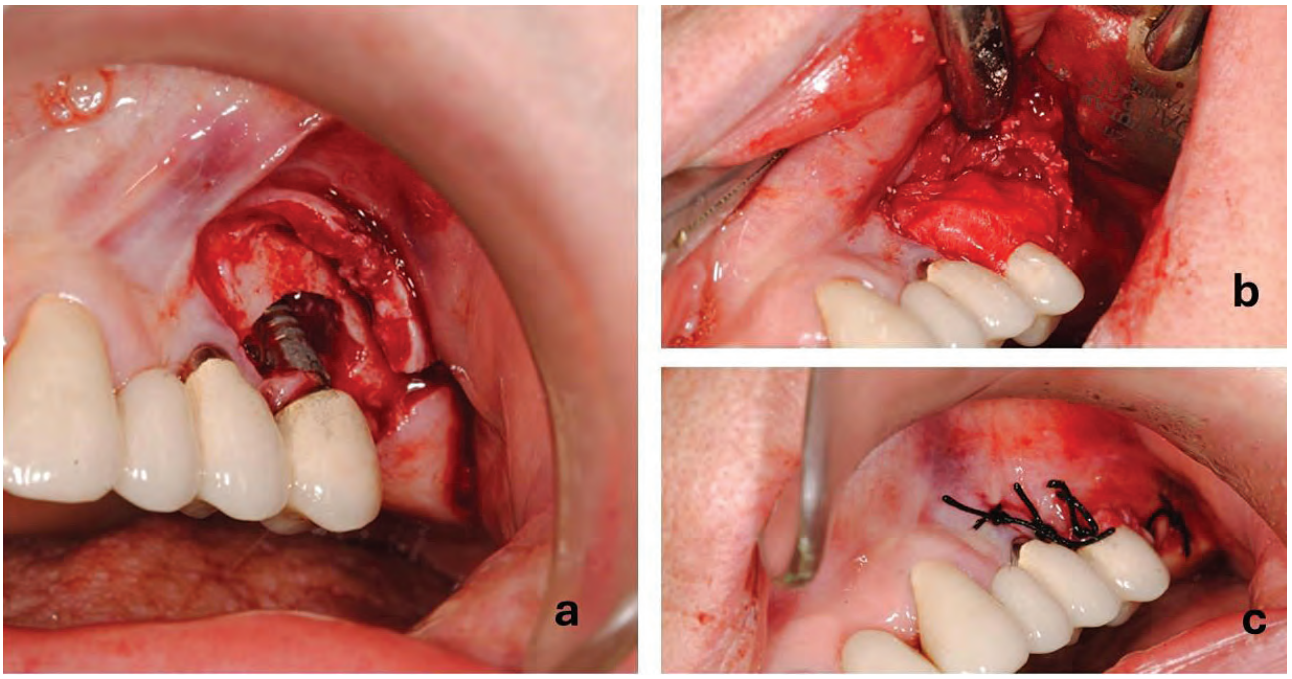

Fig. 9. Full thickness envelope flap elevation and visualization of the defect (a); placement of bone graft and collagen membrane (b); single interrupted sutures securing primary closure (c)

CLINICAL CASE 3

A 59-year-old female patient, who is a non-smoker, without concomitant diseases, after 8 years of the implant placement, reported frequent discomfort in the implant area of the fourth quadrant.

After non-surgical treatment, a regenerative procedure was suggested. The surgical protocol of 4th quadrant is briefly described in Fig. 11.

CLINICAL CASE 4

A 50-year-old female patient visited the dental office for check-up of dental implants placed 9 years ago. After a cone-beam computed tomography (CBCT) investigation, the peri-implant bone loss around the second implant was revealed (Fig. 12).

Following the above-discussed surgical protocol bone graft and collagen membrane were used to treat the affected area (Fig. 13). Post-surgical radiographs were made (Fig. 14).

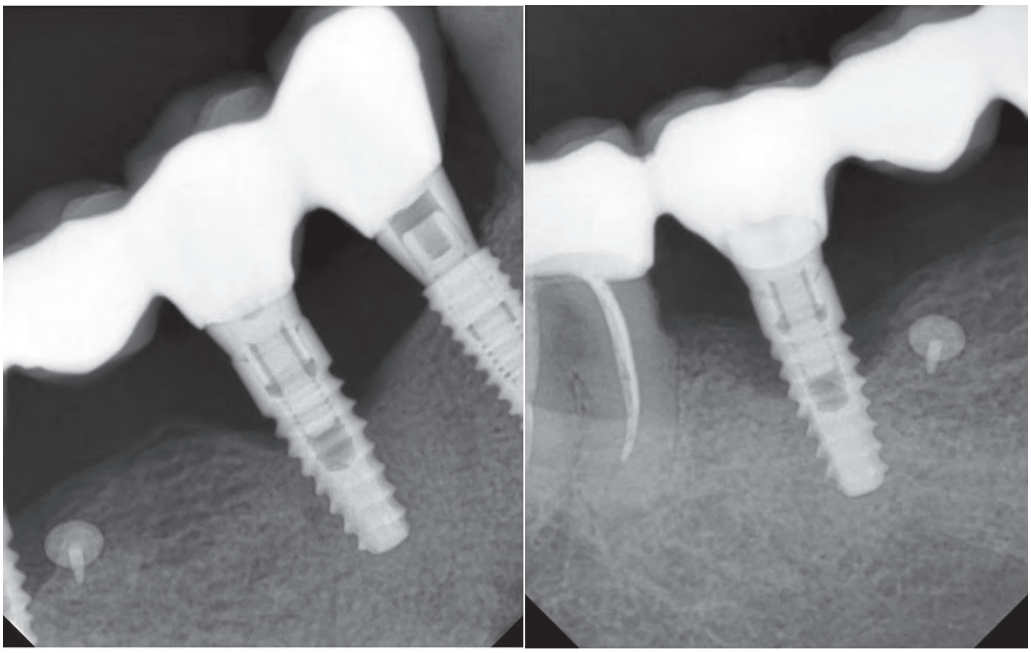

Fig. 10. Radiographic bone loss around the implants

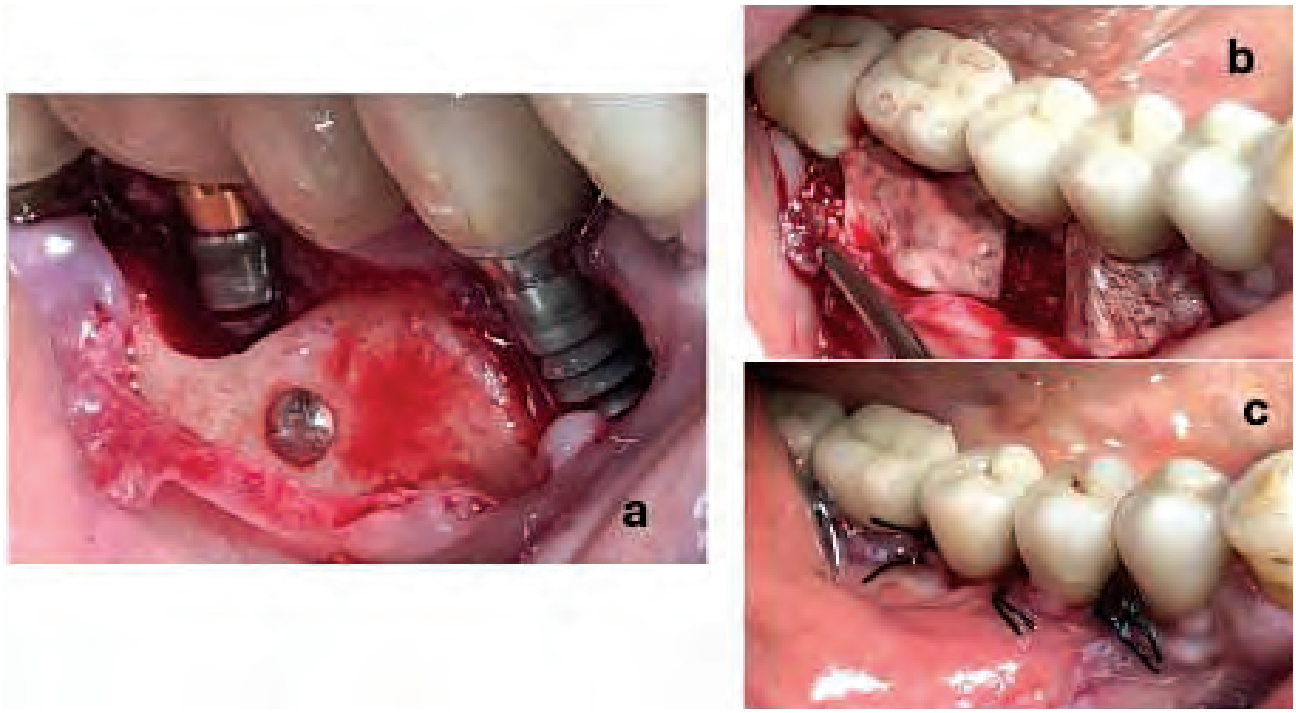

Fig. 11. After full thickness envelope flap reflection, a significant bone loss around the implant in 4th quadrant is revealed (a); bone graft secured by two collagen membranes (b); single interrupted sutures securing primary closure (c)

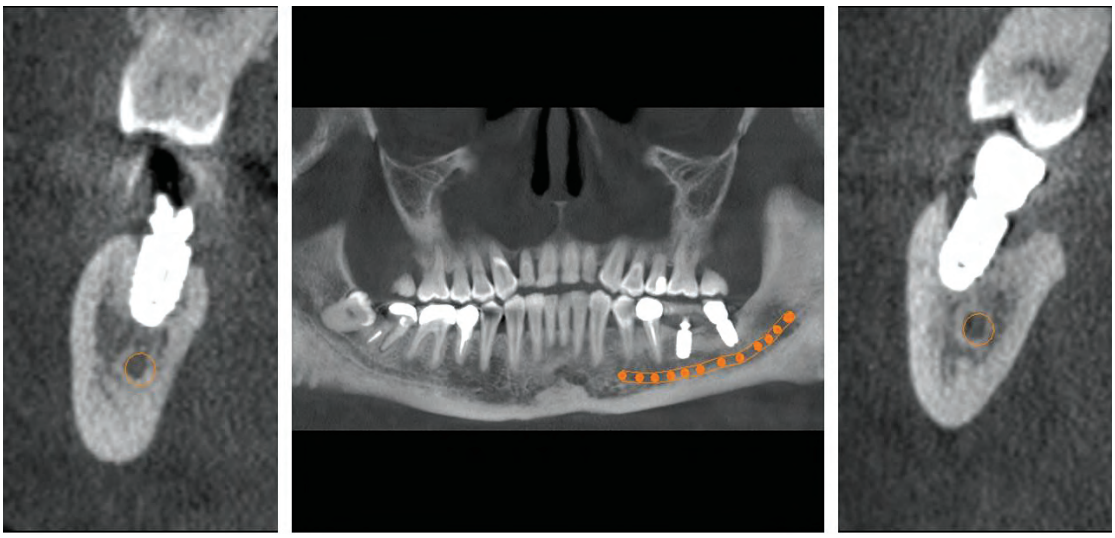

Fig. 12. Cone beam computed tomography slices revealing the bone loss around the second implant

Fig. 13. Before and after the flap elevation

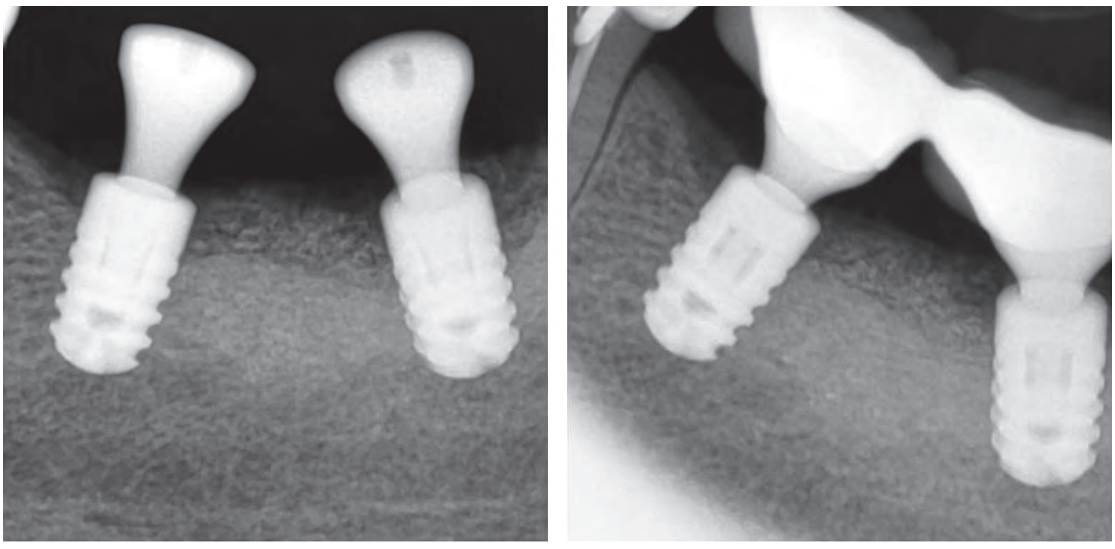

Fig. 14. Radiographic image after the surgical treatment at the time of the procedure and 1 year after

DISCUSSION

During the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions, significant emphasis was placed on the bacterial etiology underlying both peri-implant mucositis and peri-implantitis. This workshop underscored the crucial role that bacterial infections play in the initiation and progression of these conditions, highlighting the need for effective microbial management in the prevention and treatment of peri-implant diseases [6]. The main objective of treating peri-implantitis is to eradicate the infection and prevent further deterioration of the bone around the dental implant [7]. A key focus in treatment is the use of minimally invasive techniques, which should be prioritized to reduce damage to surrounding tissues. However, this approach must be carefully balanced with the need for sufficient access to thoroughly address the entire bone defect involved. The adjunctive use of systemic antibiotics in the treatment of peri-implantitis is a widely adopted clinical practice. This approach aims to enhance the effectiveness of mechanical and/or surgical debridement by targeting the microbial component associated with peri-implant inflammation. However, the literature presents a range of therapeutic protocols, and considerable debate remains regarding the optimal antibiotic regimen, timing, and its overall impact on treatment outcomes. Various studies have explored the efficacy of different antibiotic strategies – both systemic and local – with mixed and often inconclusive results, highlighting the need for further high-quality, evidence-based investigations [8, 9]. Numerous clinical protocols have been proposed for the management of peri-implantitis, reflecting the complexity and multifactorial nature of the condition. These approaches encompass non-surgical methods such as mechanical debridement and the adjunctive use of antiseptics and antibiotics – administered either locally or systemically – as well as surgical interventions. Surgical strategies include both access flap procedures aimed at thorough decontamination of the implant surface and more advanced regenerative or resective techniques intended to restore lost peri-implant bone or recontour the peri-implant soft and hard tissues [10, 11].

Over time, various treatment approaches have been explored for managing peri-implantitis, one of which is photodynamic therapy (PDT). However, evidence suggests that when PDT is applied as a single adjunctive treatment alongside open flap debridement (OFD), it does not result in significant additional improvements in clinical or radiographic outcomes related to peri-implant health. In other words, the combination does not appear to enhance the therapeutic effectiveness of OFD alone in treating peri-implantitis [12]. Numerous attempts have been made to incorporate enamel matrix derivatives (EMDs) into the surgical management of peri-implantitis, to enhance regenerative outcomes and support re-osseointegration around affected implants [13]. Several researchers have examined the reliability and predictability of surgical outcomes following regenerative therapy for peri-implantitis, particularly focusing on the use of concentrated growth factors or collagen membranes. These materials are commonly used to promote bone regeneration and support soft tissue healing around affected implants. The findings of the present study indicate that both the regenerative techniques led to significant improvements in clinical indicators – such as probing depth and attachment levels – as well as radiographic outcomes, including bone fill. Notably, the approach that combined the use of a collagen membrane with a bone substitute yielded superior results after a 12-month follow-up period in the treatment of peri-implantitis-related regenerative surgical therapy (RST), highlighting its potential as a more effective intervention for long-term success [14].

In addition to halting further bone loss, regenerative therapy plays a crucial role in promoting the restoration of bone that has already been lost. This therapeutic method works by stimulating osteogenesis – the process of new bone formation – to help regenerate the affected bone tissue and improve the overall health of the implant site [15].

Unlike periodontitis, where nonsurgical treatments can often be effective, peri-implantitis generally requires more advanced care, particularly in severe cases with significant bone loss. Nonsurgical treatment alone is typically insufficient to fully address peri-implantitis, especially when deep bone defects are present. However, it is still considered an essential first step in the treatment process. This initial nonsurgical approach helps to improve the conditions around the implant, making the area more favorable for the subsequent surgical procedures needed for more comprehensive treatment [16].

In the absence of clear, evidence-based surgical guidelines, there are several important concepts to consider for the reconstructive therapy of peri-implant defects. First, deep and narrow defects tend to be more promising for graft stabilization, as they provide a more stable environment for subsequent new bone formation. Careful planning is necessary when considering full-thickness flap extensions. The procedure should aim to minimize invasiveness while ensuring adequate access to the defect for proper treatment. When selecting a regenerative biomaterial, it is essential to choose one that is backed by

solid scientific validation. It is equally important to avoid overfilling the defect with the material, as this could lead to complications. Bone grafting should only be performed after thoroughly removing any granulation tissue and decontaminating the implant surface to ensure proper graft integration. In cases where the keratinized mucosa is insufficient, a connective tissue graft should be placed over the entire defect, extending around 2-3 mm onto the surrounding alveolar bone. This ensures the stability of the graft. If the defect is located in an area lacking keratinized mucosa, a larger connective tissue graft may need to be perforated and adapted to fit around the defect, offering more comprehensive coverage. Lastly, patients must follow post-surgical instructions rigorously, including maintaining cleanliness at the surgical site. This will help ensure proper primary healing of the wound and reduce the risk of complications during recovery [15-20].

Regenerative therapy plays a fundamental role in treating peri-implantitis, as it helps restore lost bone and enhances the stability of the dental implant. A successful approach involves combining multiple treatment techniques – such as thorough debridement and decontamination – alongside regenerative methods using suitable biomaterials. It is essential to strictly adhere to established indications and surgical protocols to achieve optimal outcomes. By carefully selecting and integrating these treatments, peri-implantitis can be managed effectively, leading to predictable clinical results. The choice of the most suitable treatment plan depends on the patient's unique characteristics and the stage of the disease, ensuring a tailored approach for the best possible outcome [21, 22].

The future perspectives are related to the integration of emerging technologies in regenerative dentistry, with bioprinting standing out as a particularly innovative approach. Bioprinting represents a highly promising frontier in the field of peri-implant tissue regeneration, particularly for managing complex cases of peri-implantitis. This advanced technology offers several potential advantages, including the ability to precisely tailor scaffolds and biomaterials to patient-specific anatomical and pathological conditions, real-time monitoring of tissue development, and dynamic adaptability to the evolving microenvironment around the implant site. These features make bioprinting an attractive tool for promoting more predictable and functional tissue integration [23]. Nevertheless, it is crucial to acknowledge that the application of bioprinting in the context of peri-implantitis remains largely experimental. Further in vivo studies, clinical trials, and regulatory evaluations are necessary to validate its efficacy, safety, and long-term outcomes before it can be integrated into routine clinical practice.

PROTOCOL OF PERI-IMPLANT SURGICAL TREATMENT

The first step is to assess the patient's overall oral health, implant condition, and any signs of peri-implantitis. This step includes evaluating the severity of the infection and bone loss around the implant, which helps in determining the appropriate treatment plan.

Before opting for surgical intervention, non-surgical therapies like mechanical debridement and chemical decontamination of the implant surface are used to remove bacteria and reduce inflammation. This helps to improve the conditions around the implant, making the site more favorable for healing.

If non-surgical methods are insufficient, surgical treatment may be required. This involves procedures like bone grafting or guided tissue regeneration to restore the lost bone around the implant. The goal is to stabilize the implant and promote healing and bone growth in the affected area.

The final goal is to resolve the peri-implantitis infection, improve the health of the implant site, and restore bone and soft tissue. This stage ensures that the implant remains stable and functional for long-term success.

The management of peri-implantitis typically follows a staged and multidisciplinary approach, beginning with a thorough patient screening process that assesses critical clinical parameters, such as implant stability, the degree of peri-implant bone loss, and any evident signs of infection or inflammation. This initial evaluation is essential in determining the appropriate course of treatment and tailoring interventions to the individual patient's needs. Following the diagnostic phase, non-surgical periodontal therapy is employed as the first line of treatment. This typically involves mechanical debridement, which is used to remove plaque, calculus, and biofilm from the implant surface, coupled with chemical decontamination techniques aimed at eliminating inflammatory mediators and pathogens. The primary objective at this stage is to reduce the microbial load surrounding the implant and promote soft tissue healing, thereby halting disease progression and improving the clinical environment around the implant. In cases where non-surgical methods fail to provide sufficient improvement, more invasive surgical procedures are considered. Surgical bone regeneration techniques, such as bone grafting or guided tissue regeneration (GTR), are commonly indicated to address significant

bone loss and restore the peri-implant bone structure. These procedures not only help to regenerate lost bone but also create an optimal environment for re-osseointegration, which is crucial for the long-term success of the implant.

CONCLUSION

The ultimate goal of peri-implantitis management is multifaceted: it involves the complete eradication of infection, stabilization of the implant, and the restoration of both the bone and soft tissue integrity. Achieving these objectives ensures that the implant can function optimally and remain stable over time. Given the complexity of the condition, a personalized treatment plan that may include a combination of non-surgical and surgical interventions or implantoplasty is often necessary to achieve the best possible outcome. Long-term follow-up care and maintenance are also critical in preventing recurrence and ensuring the enduring success of the implant.

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Ethical statement: *This study has been performed in accordance with the ethical standards as laid down in the Declaration of Helsinki.*

Consent for publication: *Consent form for publication was signed by the patients and collected.*

REFERENCES

1. de Oliveira Neves J, Vitória OA, Fortunato GL, et al. Evaluation of combined therapies in the surgical treatment of peri-implantitis: an integrative review. Unifunec Cient Multidiscip. 2024;13(15):1-22.
2. Romandini M, Bougas K, Alibegovic L, et al. Long-term outcomes and prognostic factors of surgical treatment of peri-implantitis: a retrospective study. Clin Oral Implants Res. 2024; 35:321-329.
3. Monje A, Amerio E, Cha JK, et al. Strategies for implant surface decontamination in peri-implantitis therapy. Int J Oral Implantol. 2022;15(3):213-248.
4. Schwarz F, Jepsen S, Obreja K, et al. Surgical therapy of peri-implantitis. Periodontol 2000. 2022;88(1):145-181.
5. La Monaca G, Pranno N, Annibali S, et al. A 10-year follow-up of reconstructive treatment of peri-implantitis using mineralized dehydrated allograft and resorbable membrane: a retrospective case series. Clin Oral Implants Res. 2025;36(3):325-338.
6. Berglundh T, Armitage G, Araujo MG, et al. Peri-implant diseases and conditions: consensus report of workgroup 4 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Clin Periodontol. 2018;45(Suppl 20):S286-S291.
7. Berglundh T, Mombelli A, Schwarz F, Derks J. Etiology, pathogenesis and treatment of peri-implantitis: a European perspective. Periodontol 2000. 2024;00:1-36.
8. Riben Grundström C, Lund B, Kämpe J et al. Systemic antibiotics in the surgical treatment of peri-implantitis: a randomized placebo-controlled trial. J Clin Periodontol. 2024;51(8):981-996.
9. Ramanauskaite A, Saltzer I, Padhye N et al. Systemic antibiotic prophylaxis adjunctive to surgical reconstructive peri-implantitis treatment: a retrospective study. Clin Implant Dent Relat Res. 2025;27(1):e13429.
10. Khoury F, Keeve PL, Ramanauskaite A et al. Surgical treatment of peri-implantitis–Consensus report of working group 4. Int Dent J. 2019;69:18-22.
11. Schwarz F, John G, Schmucker A, et al. Combined surgical therapy of advanced peri-implantitis evaluating two methods of surface decontamination: a 7-year follow-up observation. J Clin Periodontol. 2017;44:337-342.
12. Albaker AM, et al. Effect of antimicrobial photodynamic therapy in open flap debridement in the treatment of peri-implantitis: a randomized controlled trial. Photodiagnosis Photodyn Ther. 2018;23:71-74.
13. Regidor E, Dionigi C, Ghoraishi M et al. Enamel matrix derivative in the reconstructive surgical therapy of peri-implantitis: a randomized clinical trial. J Periodontal Res. Epub ahead of print. 2025.
14. Isler SC, Soysal F, Ceyhanlı T et al. Regenerative surgical treatment of peri-implantitis using either a collagen membrane or concentrated growth factor: a 12-month randomized clinical trial. Clin Implant Dent Relat Res. 2018;20(5):703-712.
15. Roccuzzo M, Mirra D, Roccuzzo A. Surgical treatment of peri-implantitis. Br Dent J. 2024;236:803-808.
16. Maynalovska H, Popova C, Mlachkova A. Non-surgical treatment of peri-implantitis: case report. J IMAB. 2023;29(2):4866-4868.
17. Rotenberg SA, Steiner R, Tatakis DN. Collagen-coated bovine bone in peri-implantitis defects: a pilot study on a novel approach. Int J Oral Maxillofac Implants. 2016;31:701-707.
18. Schwarz F, Alcoforado G, Guerrero A, et al. Peri-implantitis: summary and consensus statements of group 3. The 6th EAO Consensus Conference 2021. Clin Oral Implants Res. 2021;32:245-253.
19. Salvi GE, Stähli A, Imber JC, et al. Physiopathology of peri-implant diseases. Clin Implant Dent Relat Res. 2023;25:629-639.
20. Monje A, Pons R, Insua A et al. Morphology and severity of peri-implantitis bone defects. Clin Implant Dent Relat Res. 2019;21(4):635-643.
21. Ichioka Y, Trullenque-Eriksson A, Ortiz-Vigón A, et al. Factors influencing outcomes of surgical therapy of peri-implantitis: a secondary analysis of 1-year results from a randomized clinical study. J Clin Periodontol. 2023;50:1282-1304.
22. Mercado F, Hamlet S, Ivanovski S. Regenerative surgical therapy for peri-implantitis using deproteinized bovine bone mineral with 10% collagen, enamel matrix derivative and doxycycline: a prospective 3-year cohort study. Clin Oral Implants Res. 2018;29:583-591.
23. Shopova D, Mihaylova A, Yaneva A et al. Biofabrication approaches for peri-implantitis tissue regeneration: a focus on bioprinting methods. Prosthesis. 2024;6(2):372-392.