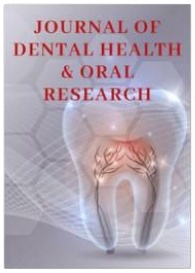

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Case Report

Clinical Management of Titanium Mesh Exposure Following Guided Bone Regeneration (GBR): A Case Report

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Abstract

Tooth loss resulting from infections, trauma or disease may lead to a progressive reduction in both the quantity and quality of the alveolar bone. In this context, Guided Bone Regeneration (GBR) has become a highly effective technique for restoring bone volume in atrophic areas, enabling more predictable and stable long-term implant-based rehabilitation. Recently, classifications such as the one proposed by Vroom have provided useful tools for the clinical management of membrane exposures, establishing treatment protocols according to severity from passive observation to surgical intervention.

Clinical Case: A 44-year-old female patient, systemically healthy, presented with mobility in tooth #11, increased probing depth and a surrounding periapical radiolucent lesion. Based on these findings, tooth extraction was indicated, aiming for future dental implant rehabilitation. After extraction and over the following months, alveolar ridge collapse was evident and a Class III edentulous ridge was diagnosed according to the Seibert classification. Due to the observed collapse, Guided Bone Regeneration (GBR) was performed in the area of tooth #11 using a titanium mesh as a containment device. Following the surgical procedure, membrane exposure occurred; however, after six months, radiographic evaluation showed adequate bone fill and satisfactory volume gain. Notably, the titanium mesh showed no clinical signs of infection throughout the follow-up period.

Conclusion: Guided Bone Regeneration (GBR) remains a fundamental therapeutic strategy for rehabilitating patients with severe bone defects, enabling predictable and successful dental implant placement. Premature or late exposure of titanium mesh constitutes a significant clinical complication that may jeopardize treatment outcomes. Nevertheless, proper soft tissue management can significantly reduce the incidence of such exposures. Additionally, the use of topical antiseptics such as chlorhexidine has proven effective in prolonging the viability of exposed mesh by reducing bacterial load and promoting bone regeneration. This article describes the clinical management and six-month follow-up of a titanium mesh exposure, highlighting the strategies that preserved regenerative outcomes.

Keywords: Guided Bone Regeneration; Titanium Mesh; Exposure

Introduction

The progressive loss of quantity and quality of the alveolar bone is a natural and inevitable process that primarily occurs following tooth extraction. However, other factors can accelerate this resorptive phenomenon, including periodontal or endodontic infections, local pathologies, trauma or even maxillary sinus expansion. After tooth extraction, bone resorption initially occurs in a horizontal direction and over time, vertical loss of the alveolar ridge is also observed [1,2]. Since the 1980s, Guided Bone Regeneration (GBR) has been introduced as a predictable technique for hard tissue reconstruction through the use

of barrier membranes—both resorbable and non-resorbable that enable the formation of new bone in atrophic sites or in defects associated with teeth and implants [3]. Currently, GBR is considered a successful approach for bone augmentation prior to or simultaneously with dental implant placement, with reported success rates close to 95% [4]. The biological basis of GBR lies in the PASS principles proposed by Melcher which include: primary wound closure, adequate angiogenesis, space maintenance and clot stability [5,6]. The application of barrier membranes facilitates adherence to these principles by acting as a physical barrier that prevents epithelial and connective tissue cell migration into the surgical site, thereby promoting bone regeneration [4]. For a membrane to be considered clinically effective, it must meet certain essential criteria, including biocompatibility, tissue integration, cellular occlusion capability, mechanical stability, space creation and maintenance, ease of handling, resistance to postoperative complications and in the case of resorbable membranes—controlled biodegradation [7,8]. With regard to bone substitute materials, they can be classified as autografts, allografts, xenografts and alloplastic materials [9]. Ideal grafts should meet key properties such as osteoinduction, osteogenesis, osteoconduction, osseointegration, low immunogenicity, ease of handling, minimal morbidity and angiogenic potential [10]. A 1:1 combination of freeze-dried allograft and xenograft has been suggested, taking advantage of the rapid remodeling induced by the allograft and the volumetric stability of the xenograft. This combination also helps preserve bone volume in the long term, which is beneficial in cases where future implant placement may be required [9,11]. The use of titanium meshes in GBR has proven effective due to their high rigidity, biocompatibility, low density and excellent corrosion resistance. These properties allow for effective maintenance of the space required for bone regeneration [12]. In cases of severe horizontal or vertical defects, several clinical studies have confirmed the mechanical performance and osteogenic potential of titanium meshes [13]. Nevertheless, premature or late exposure of the mesh is one of the most frequent and clinically significant complications, as it can lead to surgical site contamination, biomaterial infection and regenerative failure [14]. In response to this issue, Vroom proposed a clinical classification for non-resorbable membrane exposures, such as d-PTFE or titanium-reinforced membranes. This classification includes three grades: Class I (exposure without exudate), Class II (exposure with purulent exudate) and Class III (abscess formation without visible membrane exposure). Depending on the classification and case evolution, it is recommended to maintain the membrane for 6 to 12 weeks before removal [15]. This article presents the clinical management of a postoperative exposure of a titanium mesh used in a GBR procedure, emphasizing the therapeutic decisions made and the outcomes obtained after six months of follow-up.

Case Report

A 44-year-old female patient presented to the Postgraduate Program in Periodontics at the School of Dentistry, Universidad Juárez del Estado de Durango, for specialized evaluation. The patient was systemically healthy and reported the reason for consultation as: "I was referred because I have bone loss." She denied any relevant medical history. Clinical examination revealed periodontal pockets with probing depths greater than 12 mm, amalgam restorations in teeth #36 and #46 and a crater-type defect in tooth #11 (Fig. 1). Radiographic analysis showed a generalized bone loss pattern. Based on the clinical and radiographic findings, the diagnosis of generalized Stage IV, Grade C periodontitis was established. Phases I and II of conventional periodontal treatment were performed [16]. After four weeks, during the re-evaluation, surgical phase III was indicated and carried out in all four quadrants. Due to the extensive bone defect and poor prognosis of tooth #11, extraction was performed [16]. Subsequently, a Seibert Class III alveolar ridge defect was diagnosed in the anterior maxillary region, characterized by horizontal and vertical bone loss [17]. Following the surgical procedure, therapeutic options for managing the residual defect were discussed with the patient. She opted for guided bone regeneration (Fig. 1), aiming to preserve and reconstruct the site for future prosthetic rehabilitation.

Perioral asepsis was performed using povidone-iodine (Pharmalife®), followed by antisepsis with a 0.12% chlorhexidine rinse (Perioxidin Lacer®). Subsequently, a sterile field was placed and local anesthesia was administered using the infiltration technique, with four cartridges of 2% lidocaine with epinephrine 1:100,000 (ZEYCO®) injected into the anterior superior alveolar and nasopalatine nerves. Next, intrasulcular incisions and a horizontal incision on the alveolar ridge were made using a 15c scalpel blade (Ambiderm®) and a No. 3 scalpel handle (Hu-Friedy®) (Fig. 2), positioned as apically as possible on the flap to ensure adequate coronal displacement and flap passivity, aiming for primary closure. A full-thickness mucoperiosteal flap was then elevated, extending apically beyond the mucogingival line and horizontally from the right canine (tooth 13) to the left canine (tooth 23) (Fig. 2), using a Buser periostome (PPBUSER6, Hu-Friedy®).The next step involved bone perforation to promote angiogenesis, performed with a low-speed handpiece and a No. 8 round bur under irrigation with saline solution (Fig. 2). For bone reconstruction, a preformed vertical titanium mesh (10x9x9 mm) was placed in the palatal area (OssBuilder 3 - Jaw Builder Vertical, Hiossen®) and fixed with a 1.4x6 mm screw (Bone Screw, Hiossen®) using the GBR kit (Hiossen®). The bone defect

was then filled with a mixture of particulate xenograft (0.5-1.0 mm, Cerabone®, Straumann®) and particulate allograft (500-800 μm, Biograft®) in a 1:1 ratio (Fig. 2). Subsequently, the titanium mesh was secured on the vestibular aspect with a 1.4x6 mm screw (Bone Screw, Hiossen®) (Fig. 2). A collagen membrane (15x20 mm, OSSMEM Hard, Hiossen®) with an estimated resorption time of four months was placed over the titanium mesh. The membrane was pre-hydrated in saline solution for 2 minutes before placement (Fig. 2).

Finally, the flap was sutured with 5-0 polyglycolic acid absorbable suture (Vicryl, Ethicon®) using horizontal mattress subperiosteal sutures at the apical level of the flap (Fig. 3).

An antibiotic regimen consisting of amoxicillin 500 mg every 8 hours for 7 days, ibuprofen 600 mg every 8 hours for 3 days and a 0.12% chlorhexidine mouthwash twice daily for two weeks was prescribed. At the 14-day postoperative review, wound dehiscence was observed, with approximately 3 mm exposure of the titanium mesh. Additionally, loose sutures were noted at the surgical site (Fig. 4). Exposure of the membrane was confirmed in the distal and middle areas without signs of suppuration. Given these findings, conservative management was implemented, reinforcing oral hygiene instructions and recommending irrigation with 0.12% chlorhexidine mouthwash twice daily. Weekly follow-ups were maintained and after four weeks of exposure, the mesh exposure increased to more than 3 mm (Fig. 4). Consequently, partial removal of the exposed titanium mesh was performed using precision scissors. The area was re-sutured with 5-0 nylon (Fig. 4) and chlorhexidine gel was prescribed for the exposed site twice daily for two weeks. Adequate epithelialization was observed in the area where the exposed mesh was removed (Fig. 4).

Weekly follow-ups continued and at three months, a 1 mm mesh exposure was observed on the vestibular aspect (Fig. 5). No clinical signs of infection were evident; thus, biweekly monitoring was maintained until six months postoperative, at which time definitive removal of the mesh was performed (Fig. 6).

Figure 1: Intraoral radiographs and photographs. (A) Initial condition. (B) Seibert Class III ridge defect.

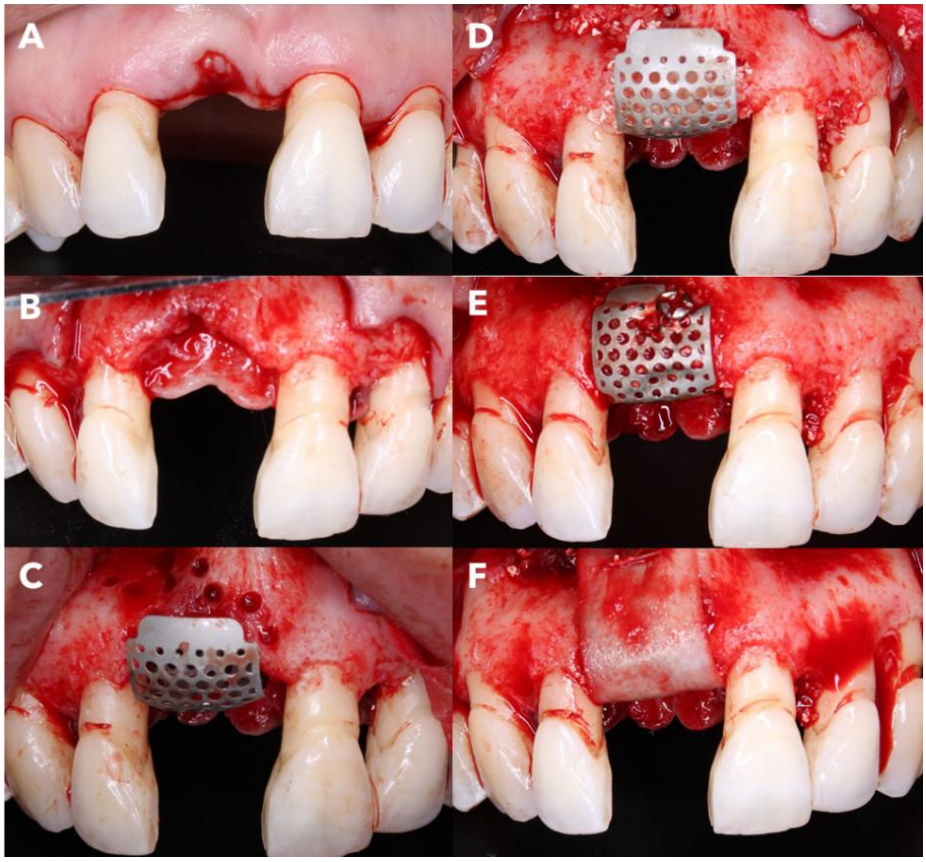

Figure 2: (A) Intrasulcular incisions; (B) Full-thickness flap elevation; (C) Bone perforation and palatal titanium mesh fixation; (D) Bone graft placement; (E) Vestibular fixation of the titanium mesh; (F) Collagen membrane placement sutured to periosteum.

Figure 3: Immediate postoperative result.

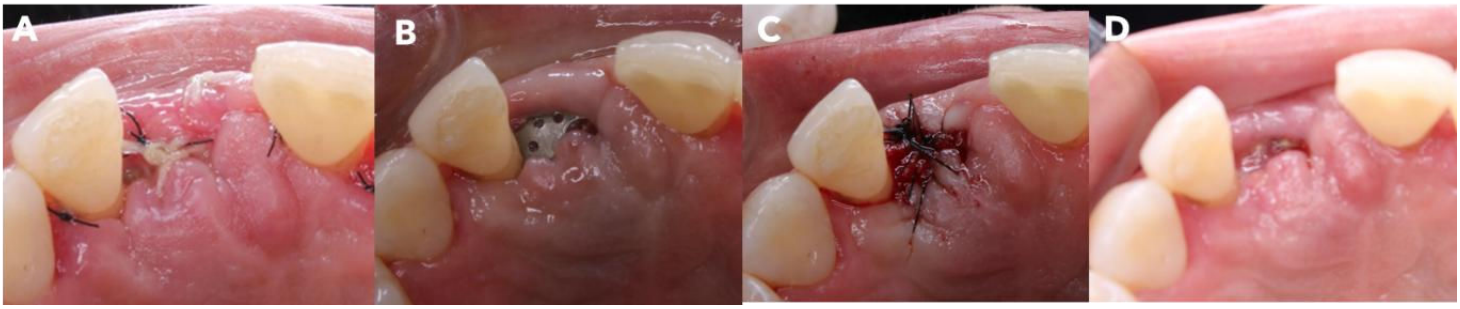

Figure 4: (A) Exposure at the distal zone of the collagen membrane; (B) Titanium mesh exposure at 6 weeks; (C) Partial removal of exposed mesh and suturing; (D) Healing at two weeks.

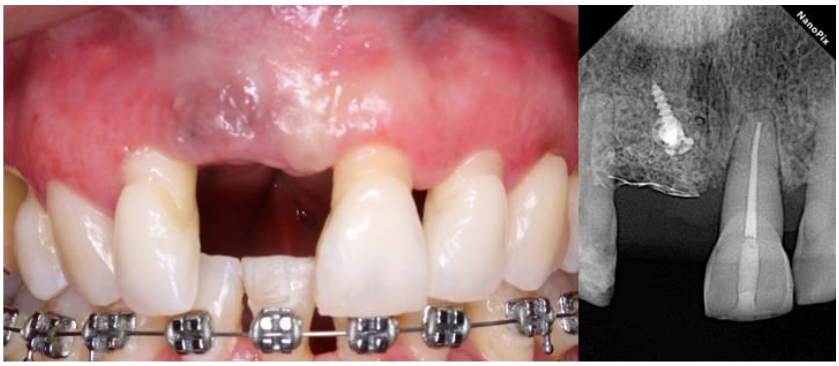

Figure 5: Three-month postoperative follow-up.

Figure 6: Six-month postoperative follow-up.

Results

At six months of follow-up, clinical, radiographic and Cone-Beam Computed Tomography (CBCT) evaluation (Fig. 7) preoperative status and 6 months postoperative status of the surgical site revealed adequate bone fill with satisfactory bone tissue gain, consistent with the planned therapeutic objectives. During the control period, the exposed titanium mesh did not exhibit clinical signs of infection and maintained its position, suggesting good biomaterial integration. This supports the use of titanium meshes as a predictable and safe alternative in Guided Bone Regeneration (GBR) procedures, even in cases where exposure occurs.

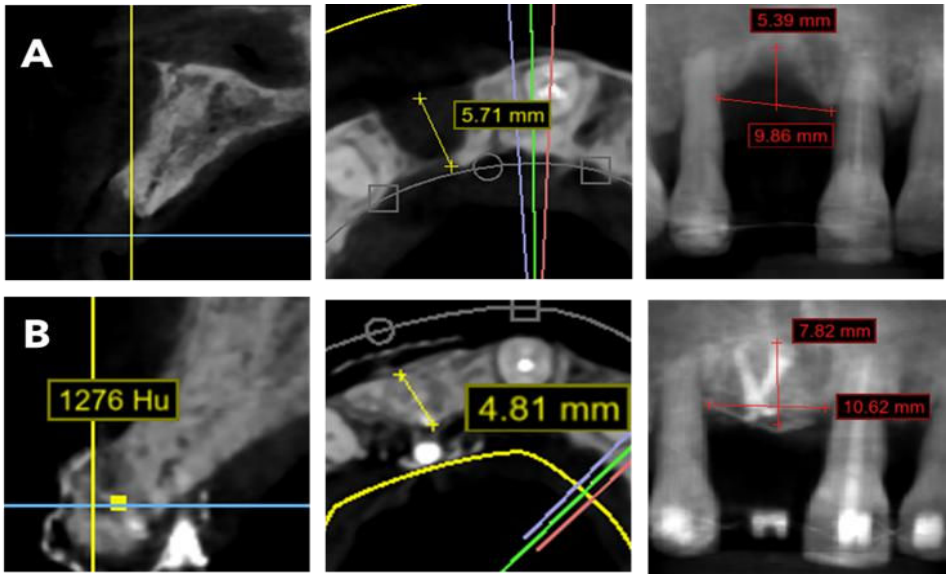

Figure 7: CBCT images: (A) Coronal, sagittal and axial slices before Guided Bone Regeneration (GBR) show morphological characteristics compatible with an intraosseous defect; (B) Coronal, sagittal and axial slices at 6 months demonstrate significant improvement in bone architecture with signs of defect regeneration, achieving a vertical bone gain of 7.82 mm, a buccopalatal ridge width of 4.81 mm and a mesiodistal dimension of approximately 10.62 mm, with a bone density of 1276 Hounsfield units.

Discussion

In the presented clinical case, tooth extraction resulted from advanced periodontal disease. Tonetti C, emphasize that, in addition to periodontitis, factors such as trauma, severe alveolar bone loss and significant microbial contamination contribute to the need for extraction [18]. Setzer and Kim report high success rates, between 96.7% and 97.5%, for single-tooth implant restorations, reinforcing the viability of implant-assisted rehabilitation in similar cases [19]. Regarding bone regeneration, the use of titanium meshes has proven particularly effective for vertical defects. Zhang Z, concluded that these structures allow greater bone regeneration due to their ability to maintain adequate space for the graft, facilitating predictable regeneration [20]. Additionally, the combination with collagen membranes provides an effective barrier against soft tissue invasion, promoting new bone formation and maintaining graft volume stability [21]. However, a common complication in GBR procedures is titanium mesh exposure. Gu X, observed that exposure is not directly related to the type of biomaterial but largely depends on surgical technique and proper soft tissue management [22]. Similarly Mateo-Sidrón APG, note that satisfactory outcomes can still be achieved despite exposure when appropriate management measures are implemented [23]. Various authors, including Ghensi S, Jegham M, Belleggia, agree that chlorhexidine rinses are an effective therapeutic tool to prevent postoperative infections [24-26]. Chlorhexidine, with its broad-spectrum antimicrobial activity against Gram-positive and gram-negative bacteria, yeasts and some viruses, reduces plaque formation by 30% to 80% [27,28]. Avoring an oral environment conducive to healing, especially in patients with limited mechanical hygiene. In this context, adequate control until membrane removal is possible without evidence of active infection, which does not compromise the final treatment outcome. Finally, Cone-Beam Computed Tomography (CBCT) has become a key diagnostic tool, providing three-dimensional images that allow precise assessment of bone quality and density (Hounsfield units), selection of the optimal implant site and prediction of primary stability. This translates into reduced surgical risks and improved clinical outcomes [29].

Conclusion

Guided Bone Regeneration (GBR) remains a key therapeutic strategy for rehabilitating patients with severe bone loss, enabling successful dental implant placement. Premature or late exposure of the titanium mesh represents a relevant clinical complication. Proper soft tissue management can significantly reduce the incidence of such exposures. Furthermore, the use of antiseptics like chlorhexidine helps prolong the viability of the exposed membrane by reducing bacterial load, thereby favoring the regeneration process. Over six months of follow-up, adequate bone gain and absence of clinical infection signs were observed, suggesting good biocompatibility and material stability. These results support the clinical utility of titanium meshes in GBR procedures for the treatment of complex bone defects.

Conflict of Interest

The authors declare that they have no conflicts of interest with the contents of the article.

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Author Contributions

All authors contributed equally for this paper.

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