Precision implant surgery in the aesthetic zone

Buccal wall reconstruction using a resorbable magnesium membrane

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Guided bone regeneration (GBR) is a well-established and widely adopted surgical technique designed to reconstruct alveolar bone deficiencies, particularly in preparation for or in conjunction with dental implant therapy. The core principle of GBR is based on the selective exclusion of soft-tissue cells from the defect site through the application of a barrier membrane, thereby promoting the repopulation of osteoprogenitor cells and the formation of new bone.[1,2]

Over the past decades, GBR has become a standard component of implant therapy, especially in cases of alveolar ridge atrophy or post-extraction defects where maintaining or reconstructing bone volume is critical for functional and aesthetic outcomes.[2,3]

Physiological bone remodeling following tooth extraction is a well-documented phenomenon, with the most pronounced dimensional changes occurring within the first three to six months post-extraction.[4,5] The buccal aspect of the maxilla is particularly susceptible to resorption due to the predominance of thin cortical bone, which in many cases measures less than 1 mm in thickness.[6,7,20–22] This rapid loss of alveolar structure can compromise ideal implant positioning, negatively affect peri-implant soft-tissue contours, and ultimately impair both the aesthetic and long-term functional outcomes.[7] In scenarios where the buccal plate is absent or severely resorbed, spontaneous healing often leads to soft-tissue collapse and loss of the natural ridge architecture.[8,20–22] As a result, ridge preservation or augmentation using GBR techniques has become an integral part of contemporary implantology, especially in the anterior maxilla where aesthetic demands are high.[21,22]

A variety of membrane materials have been utilised in GBR procedures, each with distinct biological and mechanical properties. Resorbable collagen membranes are commonly favoured for their biocompatibility, ease of handling and predictable degradation profiles.[9–11] However, their limited mechanical stability and susceptibility to premature resorption present challenges in cases with insufficient soft-tissue coverage or when space maintenance is critical. Conversely, non-resorbable membranes, such as expanded polytetrafluoroethylene (ePTFE) and dense PTFE (d-PTFE), offer superior structural integrity and space maintenance but are associated with increased risk of membrane exposure and necessitate a secondary surgi-

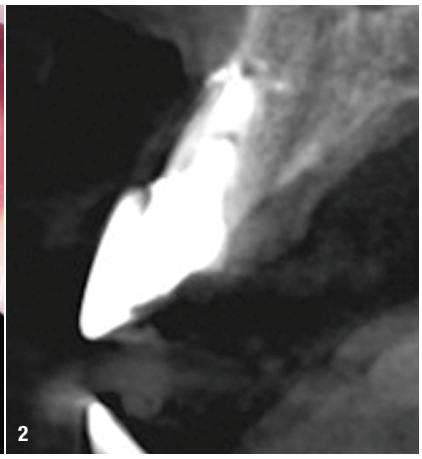


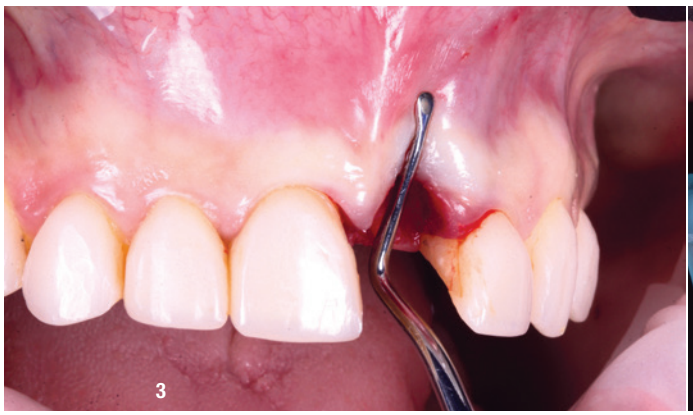
Fig. 1: Intra-oral view. Recession and suppuration left central incisor. – **Fig. 2:** Control CBCT before tooth extraction.

cal procedure for removal, potentially increasing patient morbidity.[10,11]

Recent advances in biomaterials have led to the development of resorbable metallic solutions, such as those composed of magnesium, which aim to combine mechanical strength with gradual resorption. Magnesium-based biomaterials represent a novel class of fully resorbable devices for bone regeneration in oral and maxillofacial surgery.[12] As a physiologically relevant element, magnesium plays a central role in bone metabolism and has been shown to promote osteogenesis through stimulation of osteoblastic activity and matrix mineralisation.[13,14] Compared to collagen-based alternatives, magnesium-based devices provide superior mechanical strength, enabling reliable space maintenance and fixation in larger or more complex defects.[12,15] A recently developed biomaterial is designed to overcome the limitations of conventional resorbable and non-resorbable solutions. It maintains structural integrity during the critical healing phase, ensuring reliable space maintenance, and gradually degrades *in vivo*, eliminating the need for surgical retrieval.[12,16,17]

The reconstruction of extensive buccal bone defects, particularly in the anterior maxilla, remains a significant clinical challenge in implant dentistry. In cases of complete buccal plate loss, immediate implant placement must be carefully planned and executed to avoid complications such as implant malposition, soft-tissue collapse, and aesthetic compromise.[20–22] Predictable outcomes in such scenarios depend on precise three-dimensional implant positioning, adequate volumetric bone support, and meticulous soft-tissue management.[21,22] The advent of digital treatment planning and guided implant surgery has significantly improved surgical accuracy and has become an essential tool in the management of anatomically complex cases. The Magnesium Membrane Shield Technique (MMST) has been previously described as a novel approach for bone wall reconstruction in compromised sockets, enabled by the unique mechanical and biological properties of resorbable magnesium. Initial clinical reports have demonstrated favourable outcomes, including reliable space maintenance, simplified handling compared to conventional approaches, and consistent formation of new cortical bone.[18,19]

Currently, clinical evidence on the use of resorbable magnesium-based biomaterials in the aesthetic zone remains limited, particularly in the context of immediate implantation in compromised extraction sockets. This report presents the clinical application of the MMST in a



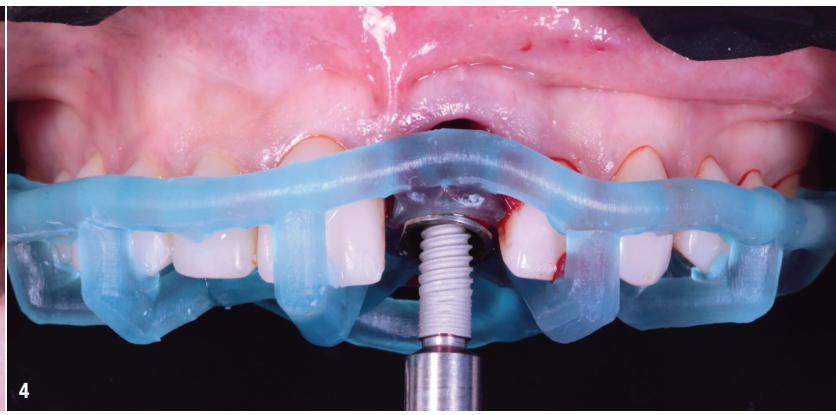


Fig. 3: Atraumatic, flapless extraction with a different gingival margin on the left incisor and loss of the vestibular wall. – **Fig. 4:** Immediate implant placement.

young female patient with a fractured maxillary central incisor and complete loss of the buccal bone wall, corresponding to a Type 2C socket defect and aims to expand the existing body of knowledge by detailing the clinical workflow, handling characteristics, and associated surgical considerations.

Case presentation

A 28-year-old female patient with no relevant medical history presented to the clinic with a horizontally fractured upper left central incisor, accompanied by suppuration and pain (Fig. 1). The patient's primary concern was the restoration of aesthetics and function, particularly the replacement of defective composite restorations. Written informed consent was obtained for the use of clinical images and all case-related documentation.

A cone beam computed tomography (CBCT) scan revealed complete loss of the buccal bone plate at the affected site (Fig. 2). Given the anatomical deficiency and aesthetic demands of the anterior maxilla, immediate implant placement was considered with caution, as such defects are associated with an increased risk of improper three-dimensional implant positioning, peri-implant soft-tissue collapse, and compromised aesthetic outcomes. A comprehensive digital treatment plan was developed, incorporating guided implant placement to ensure prosthetically driven positioning. Due to the highly specific apical bone availability, precision in execution was essential. A novel resorbable magnesium-based barrier (NOVAMag® SHIELD, botiss biomaterials) was selected to provide mechanical stability and eliminate the need for a second surgery for removal.

Digital planning and guided surgery

Intra-oral scanning was performed using the Aoralscan 3 (Shining 3D) and CBCT imaging was acquired with the I-Max 3D Ceph (Owandy). The digital data were imported into MSOFT (MIS Implants) for the design of a custom surgical guide, which was 3D printed using a Formlabs system.

Under intravenous sedation (midazolam 3 ml iv) and local infiltration anaesthesia (articaine with epinephrine 1:100,000), a minimally invasive, flapless extraction was performed to preserve the surrounding soft tissues and prevent papillary collapse (Fig. 3). The extraction socket was thoroughly debrided using a serrated curette. The surgical guide was positioned intra-orally and a full osteotomy was performed, followed by the insertion of a MIS V3 implant (3.9 × 13 mm, MIS Implants) with primary stability (> 40 Ncm). An intermediate abutment (CONNECT, 2 mm, MIS Implants) was placed immediately in accordance with the "One Abutment, One Time" protocol to minimise micromovement and microleakage at the implant–abutment interface (Fig. 4).

Buccal bone reconstruction was achieved using a structured three-layer regenerative approach. This included the application of a subepithelial connective tissue graft, a resorbable magnesium-based shield (NOVAMag® SHIELD, botiss biomaterials) and a cortico-cancellous allograft (maxgraft®, botiss biomaterials; Fig. 5). To facilitate the placement of these biomaterials, a submucosal tunneling technique was employed, allowing for atraumatic access and adequate soft-tissue coverage (Fig. 6). The tunnel was carefully extended mesiodistally to encompass approximately 50 per cent of the adjacent teeth and apically to the mucogingival junction, ensuring sufficient space for stable biomaterial integration. A free de-epithelialised connective tissue graft was harvested extra-orally and secured in position using resorbable monofilament sutures (Seralene 5/0, Serag-Wiessner) to provide additional soft-tissue volume and support for the underlying augmentation procedure.

The magnesium shield was adapted and shaped using manufacturer-specific instruments (NOVAMag® Instruments, botiss biomaterials), ensuring smooth edges to minimise the risk of galvanic corrosion (Fig. 5). The barrier

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was placed at least 3 mm below the gingival margin and extended 2 mm mesiodistally beyond the adjacent teeth to enable passive stabilisation without fixation screws or additional sutures (Fig. 6). The buccal defect was then filled with allogeneic bone material, completing the Magnesium Membrane Shield Technique (Fig. 7).

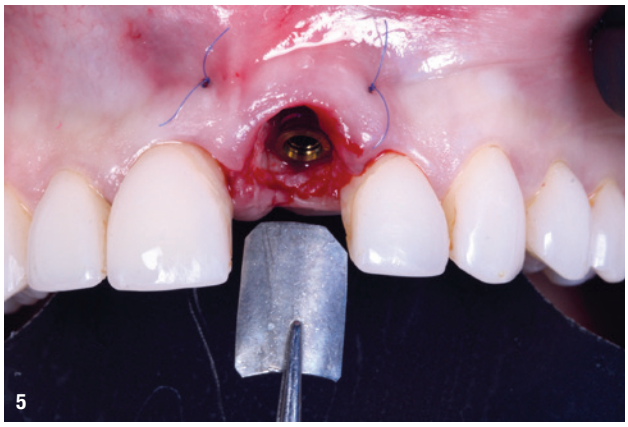
An immediate provisional restoration was delivered to meet aesthetic expectations and support the peri-implant tissues. Gingival margin contouring was achieved using a double-crossed traction suture (Fig. 8). The patient was prescribed an appropriate postoperative regimen and throughout the follow-up period, the patient reported no discomfort or complications at the surgical site.

Results

Four months after surgery, a second-stage reentry procedure was performed. Clinical inspection and CBCT analysis revealed successful bone regeneration and full integration of the allograft (Fig. 9). Notably, no remnants of the magnesium shield were detected, and no signs of encapsulated material were observed within the soft tissue, confirming complete and uneventful resorption. The peri-implant soft-tissue architecture remained stable, and the gingival margins showed ideal contour and volume preservation.

A final full-mouth rehabilitation was carried out from tooth 15 to 25 using lithium-disilicate restorations, achieving a functionally stable and aesthetically pleasing outcome. This case demonstrates the potential of resorbable magnesium-based barriers to provide structural support and promote predictable bone regeneration in challenging anterior maxillary defects, particularly when combined with immediate implant placement in compromised sockets.

Definitive prosthetic rehabilitation was initiated after appropriate healing, using a fully digital workflow. An intra-oral scan was performed with the Shining 3D Aoralscan 3, following the REPLICA-D technique as described by Clavijo et al., which enabled the dental laboratory to obtain a highly accurate replica of the intra-oral conditions. For the restoration of tooth 21, a custom monolithic zirconia abutment (Aidite 3D Pro) was designed and fabricated. This served as the foundation for a cement-screw-retained veneer, ensuring optimal aesthetic integration and functional stability. The restoration achieved a seamless match in shape, colour, and translucency with



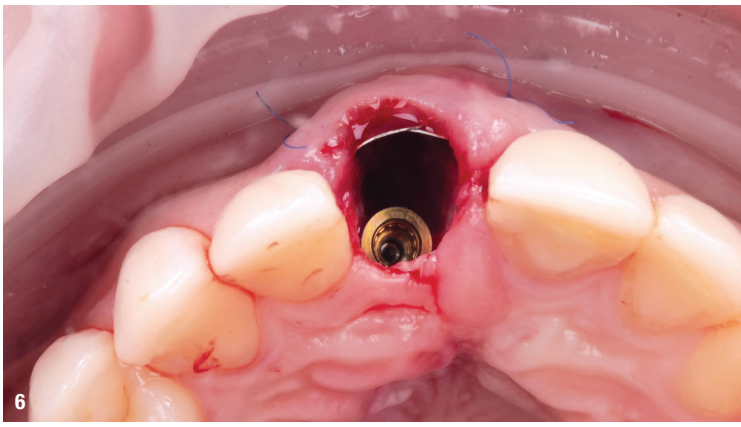


Fig. 5: Resorbable magnesium shield was used to reconstruct the buccal alveolar wall, placing it between the soft tissue and remaining bone wall without any fixation. – **Fig. 6:** Occlusal view. Soft tissue supported by the magnesium-based structure without additional fixation. CTG its sutured to the buccal gingiva.

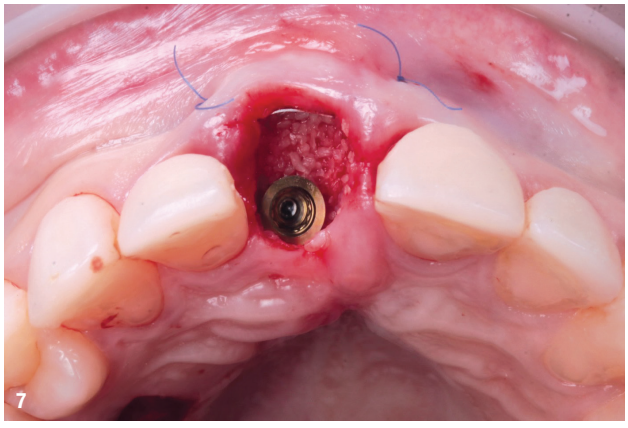


Fig. 7: Occusal view after allograft placement to fill the alveolar gap. – **Fig. 8:** Immediate loading and double-crossed suture to traction the flap.

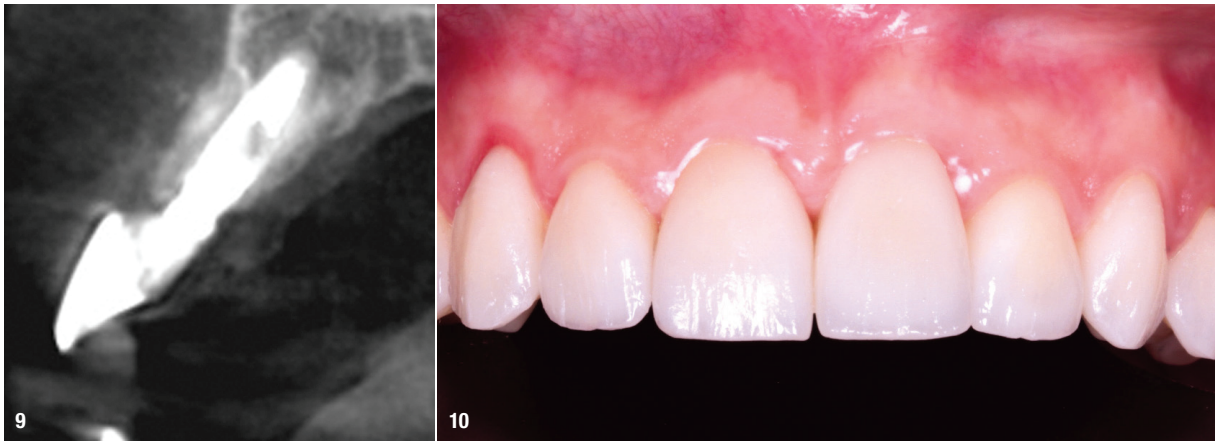


Fig. 9: Control CBCT after implant placement. – **Fig. 10:** Clinical situation one year after implantation.

the adjacent lithium-disilicate veneers, fulfilling the patient's high aesthetic expectations.

At the one-year follow-up, clinical evaluation confirmed stable peri-implant soft tissues with no signs of inflammation or recession (Fig. 10). Complete regeneration of the buccal wall was demonstrated, including the formation of a well-defined corticalised plate, effectively restoring the vestibular wall that was previously absent at the time of implant placement. These outcomes underline the long-term success and predictability of the applied regenerative and prosthetic protocol in managing complex anterior maxillary defects.

Conclusion

This case report demonstrates the successful application of a novel resorbable magnesium-based solution for buccal wall reconstruction in conjunction with a three-layer regenerative protocol for the immediate implant placement in a highly compromised aesthetic zone. The complete loss of the buccal bone plate presented both surgical and prosthetic challenges, necessitating precise digital planning, guided implant surgery, and advanced hard- and soft-tissue augmentation techniques. The use of a pre-shaped, mechanically stable, and fully resorbable magnesium material enabled effective space maintenance without the need for fixation devices or secondary surgery for removal. The minimally invasive, flapless surgical approach preserved the soft-tissue architecture and enhanced the aesthetic outcome, while the use of an immediate provisional restoration maintained tissue stability during healing. One year postoperatively, clinical and radiographic evaluations confirmed long-term stability of both hard and soft tissues, with complete integration of the grafted material and resorption of the magnesium shield. The Magnesium Membrane Shield Technique thus represents a promising, innovative approach for complex defects, combining mechanical reliability with biological advantages. This magnesium shield not only supported effective bone regeneration upon immediate implant placement in the aesthetic area but also simplified the clinical procedure by allowing easy adaptation and placement without fixation, eliminating the need for a second surgery. This case supports the growing clinical evidence for the use of magnesium-based biomaterials in regenerative implant dentistry, offering a reliable solution for achieving both functional and aesthetic success.

Literature

about the author

Dr Erick Mota Gonzalez obtained his dental degree in 2015 in the Dominican Republic and completed his implantology training at the University of Barcelona in 2018. He is Director of the Scientific Committee of the Dominican Society of Implants and lecturer in implant-focused master's programmes at two Dominican universities. Since 2020, he is part of the MIS LATAM Expert Team.

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