Case Report

DENTAL IMPLANT INSERTION AND GUIDED BONE REGENERATION FOR RESTORING LOWER LATERAL INCISOR AGENESIS

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ABSTRACT

The anterior mandible, being a highly esthetic region, presents unique challenges for implant placement and dental restoration. Dental implants have become a cornerstone of modern dentistry, offering a reliable and long-term solution for tooth replacement. However, successful implantation relies not just on the osseointegration of the implant itself, but also on the health and stability of the surrounding soft tissues. This is where bone regeneration and grafted mucosa play a crucial role. Bone loss in the anterior mandible is particularly relevant not only from functional (i.e., chewing, speech) but also from an aesthetic and psychological point of view. Bone loss in the anterior mandible can pose significant challenges for dental treatments, particularly when placing dental implants. Dental implants require a stable and adequate amount of bone for successful integration. When bone loss occurs, it may necessitate additional procedures such as bone grafting or Guided Bone Regeneration (GBR) to augment the bone volume and create a suitable foundation for implant placement. This paper has described a case of replacing lower lateral teeth agenesis in the anterior mandible, focusing on the crucial steps involved in the characteristics of bone regeneration to restore alveolar width. The GBR ensured a good quality of bone around the anterior fixtures and the teeth's roots.

KEYWORDS: *dental implants, keratinized mucosa, peri-implant health, esthetics, implant stability, surgical techniques, maintenance, oral hygiene*

INTRODUCTION

The anterior mandible plays a crucial role in both oral function and facial aesthetics. Missing teeth in this region can lead to significant challenges, including impaired speech, difficulty chewing, and a compromised smile. Dental implants offer a predictable and long-term solution for replacing missing teeth in the anterior mandible.

Implants function similarly to natural teeth, allowing patients to eat and speak normally. Unlike dentures, fixtures are stable and don't slip or cause discomfort during these activities. Implants provide a natural-looking replacement for missing teeth. They can be precisely positioned and shaped to match surrounding teeth, creating a cosmetically pleasing smile.

Dental fixtures have become a cornerstone of modern dentistry, offering a reliable and long-term solution for tooth replacement. However, successful implantation relies not just on the osseointegration of the implant itself, but also on the health and stability of the surrounding hard and soft tissues. This is where guided bone regeneration (GBR) and eventually grafted mucosa play a crucial role (1).

Peri-implant tissues comprise a complex ecosystem of gums and bone that provide support and protection to the implant. A critical component within this ecosystem is the keratinized gingiva (KG). Adequate width of KG around

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implants is essential for several reasons (2). KG acts as a barrier against bacterial invasion, facilitating proper oral hygiene practices, like brushing. Insufficient width can lead to plaque accumulation, thereby increasing the risk of peri-implantitis, a condition that can result in bone loss and implant failure (3). A healthy band of KG contributes to a natural-looking gumline around the implant crown, improving the overall aesthetics of the implant restoration. Adequate KG provides a cushion for the implant, minimizing discomfort or sensitivity during brushing or flossing.

In some cases, the natural amount of KG around a planned implant site may be insufficient. This can occur due to anatomical factors, previous tooth loss, or gum recession. To address this deficiency, dentists can employ grafted mucosa techniques.

Grafting procedures involve taking a small piece of healthy tissue from another location in the mouth, typically the palate, and transplanting it to the implant site. The grafted tissue then heals and integrates with the surrounding tissues, creating a band of functional and aesthetically pleasing KG (4).

There are various types of grafting procedures used for peri-implant soft tissue augmentation, each with its own advantages and considerations. Common techniques include free gingival graft and connective tissue graft. Free gingival graft is considered the "gold standard" for increasing KG. A thin layer of tissue is harvested from the palate and placed over the implant site. Connective tissue graft utilizes subepithelial connective tissue from the palate to increase the volume of the soft tissue without adding additional KG (5).

The choice of grafting technique depends on the patient's specific needs and the available tissue at the donor site. Studies have shown that grafted KG procedures are highly effective in achieving optimal peri-implant health. By increasing the width of KG, grafting can reduce plaque accumulation and the risk of peri-implantitis, improve implant stability and long-term success, enhance the aesthetics of the implant restoration, and minimize discomfort associated with implant cleaning (6, 7). Grafted KG plays a vital role in optimizing the health and longevity of dental fixtures. By addressing deficiencies in KG, grafting procedures can contribute to successful implantation outcomes, improved patient satisfaction, and a beautiful, functional smile.

Bone loss in the anterior mandible refers to the reduction of bone volume in the front part of the lower jaw. This phenomenon is particularly relevant not only from functional (i.e., chewing, speech) but also from an aesthetic and psychological point of view. Several factors contribute to bone loss in the anterior mandible. One of the primary causes is tooth loss, particularly when it results from trauma, decay, or periodontal disease. When a tooth is lost, the surrounding bone that once supported it can start to resorb or shrink over time. This process is accelerated in the absence of a tooth root, which normally provides stimulation to the jawbone. In cases of prolonged tooth loss or edentulism, the reduced mechanical loading on the jawbone can lead to further bone atrophy. Additionally, factors such as age, hormonal changes, and systemic conditions may also affect bone density in the mandible. Bone loss in the anterior mandible can pose significant challenges for dental treatments, particularly when placing dental implants. Dental implants require a stable and adequate amount of bone for successful integration. When bone loss occurs, it may necessitate additional procedures, such as bone grafting or Guided Bone Regeneration (GBR), to augment bone volume and create a suitable foundation for implant placement (8-20).

GBR is a surgical procedure designed to enhance the growth of bone in areas where it is deficient. During the GBR procedure, a barrier membrane is placed over the deficient bone area to prevent soft tissue ingrowth and allow space for bone regeneration. This membrane acts as a guide, protecting the site from unwanted cells while creating a secluded environment that encourages the growth of new bone. The barrier can be made of various materials, such as resorbable or non-resorbable membranes, and is selected based on the patient's specific needs and the procedure. The primary goal of GBR is to stimulate the body's natural healing processes, facilitating the formation of new bone that is both structurally and functionally similar to the surrounding native bone. This technique is crucial in cases where there is insufficient bone volume due to factors like trauma, periodontal disease, or tooth loss. GBR is often performed in conjunction with bone grafting procedures, where additional bone material may be introduced to further support regeneration. The success of GBR relies on several factors, including the choice of membrane, the patient's overall health, and adherence to postoperative care protocols.

Overall, GBR is a valuable and commonly used approach in oral surgery, enabling clinicians to restore or augment bone volume, thereby improving outcomes in procedures such as dental implant placement. Here, a case of GBR and implant placement is reported, along with a discussion of the relevant literature. In this paper, we describe a case of implant-prosthetic rehabilitation of teeth agenesis in the anterior mandible, with GBR, which ensured a good quality of bone around anterior implants and teeth’s roots.

Case report

A 27-year-old female patient was referred to the dental clinic complaining of poor aesthetics of the Maryland prostheses replacing the teeth 32 and 42 (Fig. 1). In agreement with the patient, it was decided to replace the Maryland bridge with an implant-prosthetic rehabilitation. The patient underwent a cone-beam computed tomography scan and orthopantomography. She claimed neither systemic diseases nor a history of bruxism. The horizontal and vertical prosthetic spaces of the edentulous area were sufficient for implant prosthetics with an anatomical design. However, the bone volume was insufficient in width for complete implantation. Based on the patient's condition, we arranged a one-step surgical procedure of fixture insertion and GBR by means of heterologous bone chips and resorbable membrane.

Before surgery, the patient was informed about the operative risk and complications, and written consent was obtained from the patient for publication of this case report and accompanying images.

Fig. 1. *Frontal view of Maryland bridge to replace missing teeth 32 and 42.*

Under local infiltration anesthesia with articaine, a linear incision was made on the alveolar ridge crest of 32 and 42. The mucosa and periosteum were detached exposing the alveolar bone, and small holes were drilled in the alveolar bone to create retention (Fig. 2) to provide bleeding to guarantee bone graft integration.

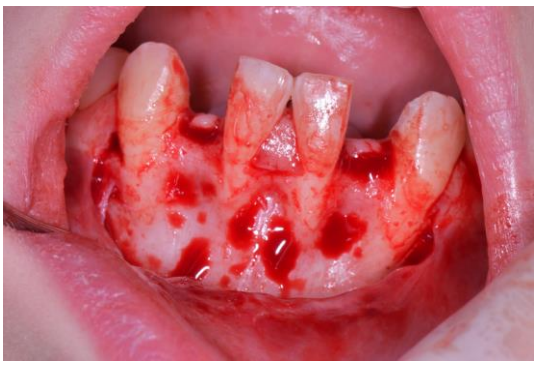

Fig. 2. *Frontal view of surgical field. The alveolar crest is thin, and the tooth roots are partially exposed.*

Implant socket preparation was performed step by step under permanent cooling with 0.9% saline, and two bone-level implants were placed with a final insertion torque of 20 N/cm (Fig. 3).

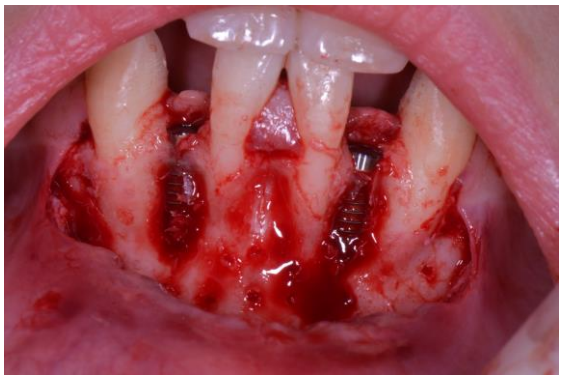

Fig. 3. *Dental fixtures inserted to replace the roots of teeth 32 and 42. Implants are out of the bone in the vestibulum.*

Thereafter, heterologous bone chips were placed on the vestibular side of the alveolar bone crest to cover implants and dental roots. Additionally, a resorbable membrane was used to stabilize the bone graft, which was then fixed in place with titanium pins (Fig. 4). At the end of the GBR surgical procedure the mucosa was sutured (Fig. 5).

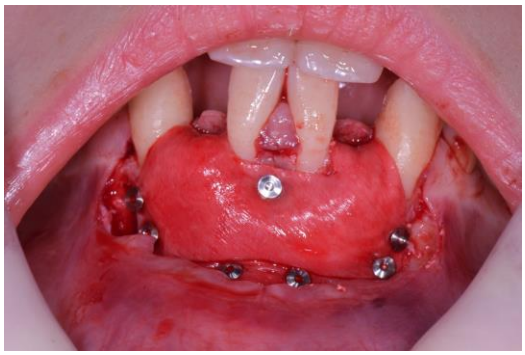

Fig. 4. *The resorbable membrane is secured with pins to stabilize heterologous bone chips.*

Fig. 5. *Sutured mucosa.*

Six months after GBR, the case was finalized with a prosthetic rehabilitation with screw-retained crowns (Fig. 6 and 7). According to radiographic examinations and probe measurements, osseointegration was satisfactory, and the keratinized tissue volume was sufficient for the manufacture of the next-stage prosthesis.

The patient was satisfied with both the healing process and the final outcome, achieving a natural-looking and harmonious smile.

Fig. 6, 7. *Frontal and occlusal view of prosthetic rehabilitation with screw-retained crowns.*

DISCUSSION

The anterior mandible plays a crucial role in facial esthetics and dental function. The loss of a tooth or multiple teeth in this region can significantly impact a patient's self-confidence and oral health. Dental fixtures have revolutionized

the field of restorative dentistry, providing a reliable and aesthetically pleasing solution for replacing missing teeth. However, the anterior mandible presents unique challenges due to its thin alveolar bone, proximity to vital structures, and demanding esthetic requirements. Understanding the anatomy of the anterior mandible is essential for successful implant placement. Sometimes, to improve the aesthetics and long-term success of the implants, it is necessary to perform a GBR in one stage to restore an adequate alveolar ridge volume.

In addition, it is of paramount importance to evaluate the quantity and quality of KG around teeth and implants. KG is firmly attached to the underlying bone and is composed of keratinized epithelium, connective tissue, and underlying peri-implant bone. It is thicker and more resistant to mechanical and microbial challenges compared to non-KG. The presence of KG enhances the stability and function of dental fixtures, providing a protective barrier against external irritants. KG plays a vital role in maintaining peri-implant health by reducing inflammation and preventing bacterial migration into the peri-implant sulcus. It helps to minimize the risk of peri-implant diseases, such as peri-implant mucositis and peri-implantitis (21). The presence of KG contributes to the esthetic outcomes of dental implant restorations. It provides a natural-looking gingival contour, harmonizing with the adjacent natural teeth and soft tissues. Adequate KG ensures a seamless transition between the implant and the surrounding gingiva, resulting in a more pleasing smile. KG enhances the stability of dental implants by providing a firm and resistant tissue attachment. It helps to distribute occlusal forces evenly, reducing the risk of implant mobility and bone loss.

Proper maintenance and oral hygiene practices are crucial in preserving the health of KG and ensuring long-term implant success. Regular professional cleanings, plaque control, and patient education are essential components of implant maintenance protocols. KG plays a pivotal role in ensuring peri-implant health, stability, and esthetics. Clinicians should prioritize the preservation or augmentation of KG during implant treatment planning and surgical procedures (22, 23). Future research should focus on investigating the optimal width and height of KG required for long-term implant success. A 10-year prospective comparative study reported that fixtures not surrounded by KG showed a smaller survival rate, as they were more prone to plaque accumulation and soft-tissue recession (24).

Treatment of anterior bone atrophy of the mandible is a challenging problem since that area is particularly relevant not only from functional (i.e., chewing, speech) but also from aesthetic and psychological points of view. Alveolar bone reduction in the aesthetic zone of the mandible is connected with keratinized gingival reduction, which is an additional problem for implant long-term survival.

Some reports described the use of bone blocks for ridge reconstruction (8-12). Steigmann and Coll. (8) reported that a bovine-bone mineral block was used to treat a severe horizontal and vertical anterior ridge deficiency. Such a block can be shaped to conform to the defect, thereby avoiding the need for harvesting autogenous bone or fixing the block with screws. After a 6-month integration period, an implant was placed. Six months later, the implant was restored with a single crown. The case has been followed for 3 years.

Moon and Coll. (9) assess the efficacy of the piezoelectric sandwich osteotomy for vertical augmentation in the atrophic segment of the anterior mandible through clinical and histologic studies. Interpositional mineral allograft materials were inserted in the space between the basal bone and the segmented bone with favorable results. Felice and Coll. (10) reported a case treated with inlay augmentation procedure with resorbable bone plates and fixation screws, showing that the effectiveness of resorbable plates during the graft healing process is similar to that of titanium plates. Chaushu and Coll. (11) evaluated the application of allograft cancellous bone blocks for the augmentation of the anterior atrophic mandible, demonstrating that cancellous bone block allografts for the reconstruction of partial edentulism in the anterior mandible are a promising material. Mangano and Coll. (12) documented the clinical, radiographic, and histologic outcome of a custom-made computer-aided-design/computer-aided-manufacturing (CAD/CAM) scaffold used for the alveolar ridge augmentation of a severely atrophic anterior mandible. A custom-made scaffold was milled from a synthetic micro-macro-porous biphasic calcium phosphate block. The scaffold closely matched the shape of the defect, which helped reduce the time required for surgery and contributed to good healing. One year later, the newly formed and well-integrated bone was clinically available, and two implants were placed. The histologic samples retrieved from the implant sites revealed compact mature bone undergoing remodeling, marrow spaces, and newly formed trabecular bone surrounded by residual particles.

Other surgical procedures were also used (13-17). Cohen and Coll. (13) reported the outcome of four cases with localized vertical osseous deficits in the anterior mandible, treated by using a technique that utilized the bony defect's margins through a vestibular approach to wedge inlay grafts without additional fixation or distraction hardware, thus overcoming the surgical difficulties and achieving a favorable outcome.

Uehara and Coll. (14) retrospectively evaluated the success rate of staged localized alveolar ridge augmentation using titanium micromesh. To verify their hypothesis, the authors treated twenty-three alveolar ridges using titanium micromesh and were retrospectively assessed. This limited study suggested that the predictability of augmented bone

volume in staged alveolar ridge augmentation using titanium micromesh was insufficient to ensure an ideal and planned implant placement. The success was influenced by the distance of the augmentation site and the infection of the graft material, which were associated with moderate to severe vertical ridge resorption and/or mechanical and functional loading on the surgical site.

Chan and Coll. (15) reported the outcomes of interpositional osteotomy with mineralized allograft in the treatment of alveolar vertical defects in preparation for implant placement. Thirteen defects were treated with osteotomy segments ranging in length from two to five missing teeth. The segments were positioned 5-7 mm coronally, with the gap space filled with allograft and then fixated with titanium hardware. Vertical bone augmentation was analyzed by superimposing pre- and post-surgical cone beam computed tomography images and stratified based on the length and number of missing teeth in each edentulous segment. Mampilly and Coll. (16) reported six patients treated with a stainless steel vertical alveolar distraction device to augment the atrophic anterior mandibular ridge. Parthiban and Coll. (17) reported a case treated with a contemporary application of platelet-rich fibrin membrane, ridge split technique, and simultaneous implant placement.

Other authors focused on soft tissue procedures (18, 19). Adams and Coll. (18) utilized a pre-prosthetic mucosal flap combined with a re-positional periosteal flap concomitant with an alveoloplasty and placement of endosteal implants as a single-stage procedure in the anterior mandible. This approach (i.e., a lip switch vestibuloplasty combined with placement of two implants) provides a valued alternative for dental rehabilitation in patients with poor masticatory efficiency using a conventional denture. Urban and Coll. (19) described a novel surgical approach for releasing the lingual flap, which can help clinicians achieve primary closure without incurring intraoperative complications.

In our case, the quantity of KG was adequate; however, there was a need for implant insertion and GBR in a single stage. The surgical procedure has several key points, among them the freedom of soft tissue to completely cover the graft at the end of the procedure. Achieving natural-looking and harmonious restorations is crucial in the anterior mandible, given the various restorative options available, including single crowns, implant-supported bridges, and implant-supported removable prostheses. The importance of proper implant-abutment selection, emergence profile, and management of both hard and soft tissues is emphasized to achieve optimal aesthetic results. Furthermore, the role of patient-related factors, such as oral hygiene, smoking habits, and systemic diseases, must also be considered.

CONCLUSIONS

While the efficacy of GBR is well-established, ongoing research continues to explore ways to improve the techniques and materials used. This includes investigating the potential of alternative membranes and heterologous bone, as well as the development of minimally invasive grafting procedures. Additionally, ongoing research aims to better understand the long-term effects of grafting on peri-implant health and patient outcomes.

REFERENCES

1. Brito C, Tenenbaum HC, Wong BK, et al. Is keratinized mucosa indispensable to maintain peri-implant health? A systematic review of the literature. J Biomed Mater Res B Appl Biomater 2014; 102:643–50.
2. Chung DM, Oh TJ, Shotwell JL, et al. Significance of keratinized mucosa in maintenance of dental implants with different surfaces. J Periodontol 2006;77:1410–20.
3. Baltacıog E, Bag B, Korkmaz FM, et al. Peri-implant plastic surgical approaches to increasing keratinized mucosa width: which to use and when? J Oral Implantol 2015;41:73–81.
4. Thoma DS, Goran I, Benic´, et al. A systematic review assessing soft tissue augmentation techniques. Clin Oral Implants Res 2009;20(Suppl 4): 146–65. Suppl 4.
5. Thoma DS, Naenni N, Figuero E, et al. Effects of soft tissue augmentation procedures on peri-implant health or disease: a systematic review and meta-analysis. Clin Oral Implants Res 2018;29(S15):32–49.
6. Buyukozdemir Askin S, Berker E, Akincibay H, et al. Necessity of keratinized tissues for dental implants: a clinical, immunological, and radiographic study. Clin Implant Dentistry Relat Res 2015;17:1–12.
7. Akcali A, Trullenque-Eriksson A, Sun C, et al. What is the effect of soft tissue thickness on crestal bone loss around dental implants? A systematic review. Clin Oral Implants Res 2016.
8. Steigmann M. A bovine-bone mineral block for the treatment of severe ridge deficiencies in the anterior region: a clinical case report. Int J Oral Maxillofac Implants. 2008 Jan-Feb;23(1):123-8.
9. Moon JW, Choi BJ, Lee WH, An KM, Sohn DS. Reconstruction of atrophic anterior mandible using piezoelectric sandwich osteotomy: a case report. Implant Dent. 2009 Jun;18(3):195-202.
10. Felice P, Pistilli R, Marchetti C, Piana L, Checchi V, Nisii A, Iezzi G. Reconstruction of atrophied anterior mandible with an inlay technique and resorbable miniplates: a case report. Implant Dent. 2011 Aug;20(4):262-6.

11. Chaushu L, Chaushu G, Kolerman R, Vered M, Naishlos S, Nissan J. Anterior atrophic mandible restoration using cancellous bone block allograft. Clin Implant Dent Relat Res. 2019 Oct;21(5):903-909.
12. Mangano FG, Zecca PA, van Noort R, Apresyan S, Iezzi G, Piattelli A, Macchi A, Mangano C. Custom-Made Computer-Aided-Design/Computer-Aided-Manufacturing Biphasic Calcium-Phosphate Scaffold for Augmentation of an Atrophic Mandibular Anterior Ridge. Case Rep Dent. 2015;2015:941265.
13. Cohen A, Lavi A, Alterman M, Casap N. Nonfixated inlay graft for anterior localized mandibular defect. Oral Surg Oral Med Oral Pathol Oral Radiol. 2020 Jul;130(1):e1-e4.
14. Uehara S, Kurita H, Shimane T, Sakai H, Kamata T, Teramoto Y, Yamada S. Predictability of staged localized alveolar ridge augmentation using a micro titanium mesh. Oral Maxillofac Surg. 2015 Dec;19(4):411-6.
15. Chan C, Mirzaians A, Le BT. Outcomes of alveolar segmental 'sandwich' osteotomy with interpositional particulate allograft for severe vertical defects in the anterior maxilla and mandible. Int J Oral Maxillofac Surg. 2021 Dec;50(12):1617-1627.
16. Mampilly MO, Rao LP, Sequiera J, Rao BH, Chandra J, Rai G. Rehabilitation of edentulous atrophic anterior mandible - the role of vertical alveolar distraction osteogenesis. J Clin Diagn Res. 2014 Nov;8(11):ZR01-3.
17. Parthiban PS, Lakshmi RV, Mahendra J, Sreekumar K, Namasivayam A. A contemporary approach for treatment planning of horizontally resorbed alveolar ridge: Ridge split technique with simultaneous implant placement using platelet rich fibrin membrane application in mandibular anterior region. Indian J Dent Res. 2017 Jan-Feb;28(1):109-113.
18. Adams DR, Petukhova Y, Halpern LR. The versatile "lip switch" or transitional flap vestibuloplasty combined with alveoloplasty and implant placement to treat atrophic mandibles with inadequate vestibules and attached tissue: A case series and review of the literature. Spec Care Dentist. 2021 Jan;41(1):78-84.
19. Urban IA, Saleh MHA, Serroni M, Shahbazi A, Baksa G, Szoke P, Ravidà A. Management of the Lingual Flap during Vertical Augmentation of Atrophic Anterior Mandible: Anatomical Overview and Description of the Technique. Int J Periodontics Restorative Dent. 2023 Aug 8.
20. Checchi V, Gasparro R, Pistilli R, Canullo L, Felice P. Clinical Classification of Bone Augmentation Procedure Failures in the Atrophic Anterior Maxillae: Esthetic Consequences and Treatment Options. Biomed Res Int. 2019 Feb 12;2019:4386709.
21. Monje A, Blasi G. Significance of keratinized mucosa/gingiva on peri- implant and adjacent periodontal conditions in erratic maintenance compliers. J Periodontol 2019;90:445–53.
22. Griffin TJ, Cheung WS, Zavras AI, et al. Postoperative complications following gingival augmentation procedures. J Periodontol 2006;77: 2070–9.
23. Romanos GE, Rafael Delgado-Ruiz, Sculean A. Concepts for prevention of complications in implant therapy. Periodontol 2000 2019; 81:7–17.
24. Roccuzzo M, Grasso G, Dalmasso P. Keratinized mucosa around implants in partially edentulous posterior mandible: 10-year results of a prospective comparative study. Clin Oral Implants Res 2015; n/a-n/a.