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Clinical Case

Guided Bone Regeneration in the Anterior Maxillary Region for the Installation of Implant Supported Single Restorations

Regeneração Óssea Guiada na Região Anterior Maxilar para Instalação Restaurações Unitárias sobre Implante
Regeneración Ósea Guiada en la Región Anterior del Maxilar para la Instalación de Restauraciones Individuales Soportadas por Implantes

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Abstract
The use of methods to promote tissue regeneration has been widely used in implantology in clinical situations where there are bone deficiencies and anatomical limitations to install implants. The evolution of biomaterials has facilitating clinical resolution for the installation of implants with a safe and reliable prognosis. The advantage is to promote greater comfort, function and aesthetics, in addition to preserving the surrounding soft tissues. This clinical report illustrates an implant supported rehabilitation using bovine grafting to promote guided bone regeneration (GBR) in the same chair time and resulting in osseointegration of the implants. The patient received cone-morse dental implants in the anterior maxilla, and bovine biomaterial (Bio-Oss®) protected by a resorbable collagen membrane. After installing the implants, immediate provisionals were made and after the osseointegration period, second-stage surgery was performed and new provisionals were made. The definitive prosthesis was finalized involving other adjacent elements as previous clinical planning. We conclude that the GBR technique contributed to the successful treatment and osseointegration of the titanium implants besides improvement of soft contour of anterior region. The patient was satisfied in terms of aesthetics and function.
Descriptors: Bone Regeneration; Dental Implants; Mouth Rehabilitation.
Resumo
A utilização de métodos para promover a regeneração tecidual tem sido amplamente utilizada na implantodontia em situações clínicas onde há deficiências ósseas e limitações anatômicas para a instalação de implantes. A evolução dos biomateriais facilitou a resolução clínica para a instalação de implantes, com prognóstico seguro e confiável. A vantagem é promover maior conforto, função e estética, além de preservar os tecidos moles circundantes. Este caso clínico ilustra uma reabilitação por meio de implantes dentários e utilizando enxerto bovino no mesmo tempo clínico para promover a regeneração óssea guiada (ROG), resultando na osseointegração dos implantes. O paciente recebeu implantes dentários cone-morse na região anterior da maxila, junto de biomaterial bovino (Bio-Oss®, protegido por membrana de colágeno reabsorvível. Após a instalação dos implantes, foram confeccionados provisórios imediatos e após o período de osseointegração, foi realizada cirurgia de reabertura e novos provisórios foram confeccionados. Foi confeccionada a prótese definitiva, envolvendo outros elementos adjacentes, como planejado anteriormente em clínica. Concluímos que a técnica ROG contribuiu para o sucesso do tratamento e da osseointegração dos implantes de titânio, além de melhorar o contorno dos tecidos moles da região anterior. O paciente se mostrou satisfeito em termos de estética e função.
Descritores: Regeneração Óssea; Implantes Dentários; Reabilitação Bucal.
Resumen
El uso de métodos para promover la regeneración tisular ha sido ampliamente utilizado en implantología en situaciones clínicas donde existen deficiencias óseas y limitaciones anatómicas para la instalación de implantes. La evolución de los biomateriales ha facilitado la resolución clínica para la instalación de implantes, con un pronóstico seguro y confiable. La ventaja es promover una mayor comodidad, función y estética, además de preservar los tejidos blandos circundantes. Este caso clínico ilustra la rehabilitación mediante implantes dentales y el uso de injerto bovino al mismo tiempo clínico para promover la regeneración ósea guiada (ROG), lo que resulta en la osteointegración de los implantes. El paciente recibió implantes dentales cono-morse en la región anterior del maxilar superior, junto con biomaterial bovino (Bio-Oss®), protegido por una membrana de colágeno reabsorbible. Posterior a la colocación de los implantes se realizaron provisionales inmediatos y transcurrido el periodo de osteointegración se realizó cirugía de reapertura y confección de nuevos provisionales. Se realizó la prótesis definitiva involucrando otros elementos adyacentes, según lo planificado previamente en la clínica. Concluimos que la técnica ROG contribuyó al éxito del tratamiento y osteointegración de los implantes de titanio, además de mejorar el contorno de los tejidos blandos de la región anterior. El paciente se mostró satisfecho en cuanto a estética y función.
Descriptores: Regeneración Ósea; Implantes Dentales; Rehabilitación Bucal.

INTRODUCTION

For implant dentistry, the primary stability is the main concern to successful treatment. In this way, bone architecture is fundamental and determines the osseointegration of the endosseous implant[1,2]. However, tooth loss can lead to horizontal and vertical bone resorption caused by local injury, and this anatomical factor is a limiting factor for the good installation of osseointegrated implants[3,4].

Various techniques have been proposed to solve bone defects, such as guided bone regeneration (GBR)[2,3], which uses autogenous or xenogeneic grafts or synthetic biomaterials to enable the formation of quality and quantity of bone[4-6]. The use of resorbable membranes is also an important resource, as they act as a physical barrier and promote local homeostasis[4,6,7].

Autogenous grafting is still the gold standard in the treatment of bone defects; however, due to surgical impossibilities and donor sequelae, other options serve as bone substitutes. For dentistry and orthopedics, Bio-Oss® is the most widely used biomaterial in the world[8,9]. It is a hydroxyapatite of bovine origin that is biocompatible and has osteoconductive properties, thus stimulating the proliferation and maturation of osteoblastic cells, making it essential for the formation of healthy bone tissue[9-11].

The type of implant connection is also fundamental to successful osseointegration. The conical connections of Morse-type implants have been presented a high level of stability between the bone-implant interface. In addition, the formation of bone above the implant-abutment junction has been presented, with no gaps between the interfaces, as well as the absence of micro-gaps and high-level stability of the peri-implant hard and soft tissues in vivo and in vitro studies[3,12,13]. Consequently, this connection can be considered superior to internal and external hexagon connections, since the identification of bacterial microleakage is reduced and there is no detectable separation between the implant and the abutment, with the Morse connection being less likely to generate inflammation in the peri-implant tissues[14].

Therefore, this study describes a clinical case in which Morse-type conical connection implants were used in an area with horizontal bone resorption, using bovine bone graft (Bio-Oss®) and a resorbable collagen membrane (CollaTape®) to promote guided bone regeneration and the success of the proposed treatment.

CLINICAL CASE REPORT

A 60-year-old female patient came to the dental clinic to have her anterior maxillary removable prosthesis replaced. Her main complaints were discomfort, poor adaptation of the prosthesis, and aesthetic dissatisfaction.

A previous clinical examination revealed a loss of support for the upper lip, the presence of a removable partial denture in elements 11, 12, 14, 15, 16, 21, and 22, a fixed partial denture in elements 23, 24, and 25, implants installed in elements 26, 34, 36 and 46 and the absence of a definitive fixed crown (Figure 1).

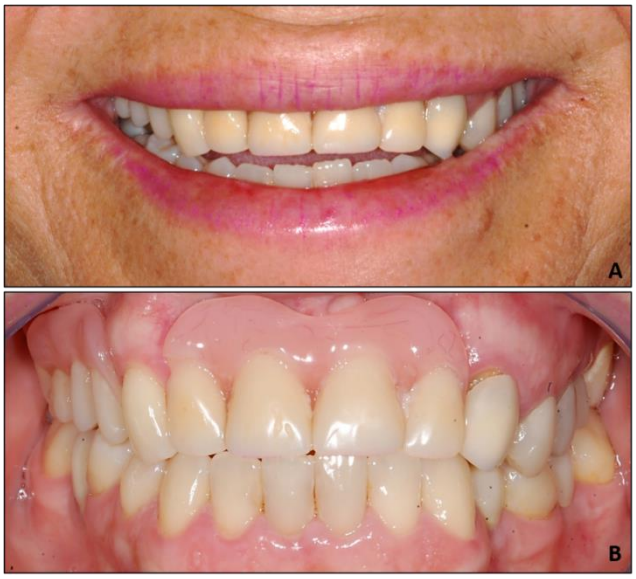

Figure 1. (A) Initial smile of the patient with total disocclusion of the teeth and (B) Initial smile of the patient with total occlusion of the teeth, removable prostheses visible.

The radiographic examination (panoramic radiograph – Figure 2) showed acceptable ridge height, but the clinical examination showed that the thickness in the anterior maxillary region was questionable for the installation of dental implants without reconstruction surgery and. Therefore, the need to use grafts for guided bone regeneration (GBR) was foreseen. Computed tomography was therefore requested to check actual bone availability.

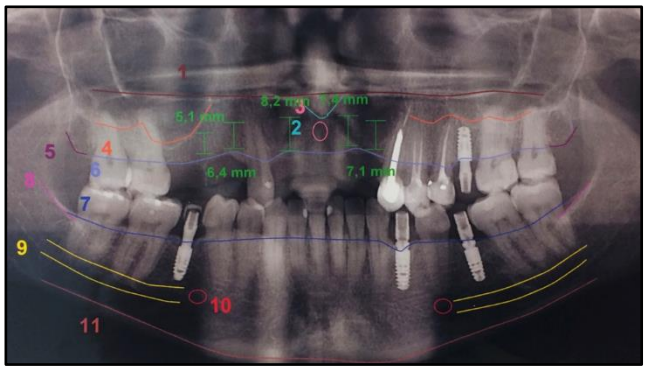

Figure 2. Panoramic radiograph with digital planning.

The treatment indicated and accepted by the patient was the installation of osseointegrated dental implants in the anterior maxillary region, corresponding to elements 11, 12, 21, and 22, grafting with biomaterial, and rehabilitation with a four-element fixed prosthesis on the implants; implants and single fixed crowns on elements 14, 15 and 16; and fixed crowns on teeth on elements 13, 23, 24 and 25.

Surgical planning was based on a volumetric Cone Beam computed tomography scan and a panoramic radiograph (Figures 2 and 3). Immediate provisionalization of elements 14, 15, and 16 began, followed by the installation of new cores in elements 24 and 25, and the preparation of teeth 23, 24, and 25 (Figure 4).

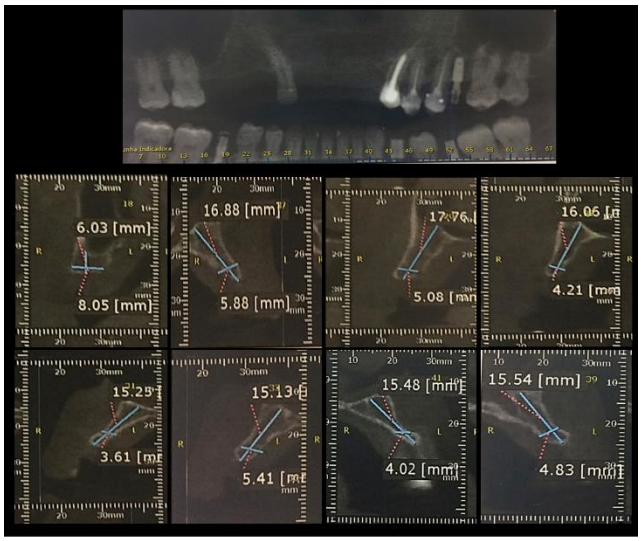

Figure 3. Computed tomography with digital draping.

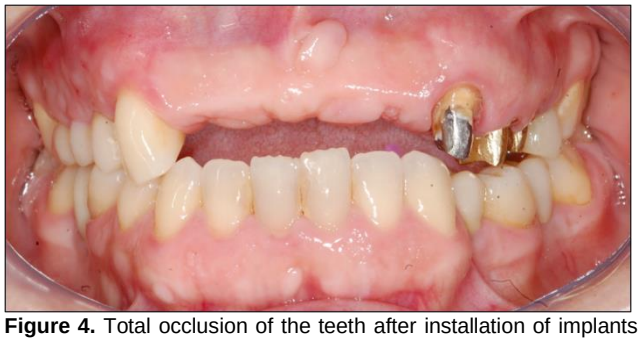

Figure 4. Total occlusion of the teeth after installation of implants 14, 15, and 16, with preparations of teeth 23, 24, and 25 that were molded to make the surgical guide.

A diagnostic wax-up was made of elements 13 to 25 (Figure 5A) for the patient's approval and to study the clinical case, followed by the making of a conventional surgical guide for elements 12 to 25, based on the preparations of elements 23, 24 and 25, which served as a surgical guide when milling implants 12, 11, 21 and 22 (Figure 5B). Element 13 was prepared on the day of surgery, beforehand, by making a mockup direct provisional over the wax-up, including tooth 13.

The complete treatment shown in this paper concerned elements 11 to 25. Tapered implants with a S.I.N Unitite (S.I.N. Implant System Ldt., São Paulo, SP, Brazil) Morse Cone connection were indicated for elements 11, 12, 21, and 22, chosen due to their macro-geometric characteristics and rapid osseointegration, combined with the aesthetic factor due to the Morse connection concept itself. The implants were selected based on the height of the ridge at the limit of the floor of the nasal cavity, with implants expected to be between 11.5 mm and 13.0 mm in length and 3.5 mm in diameter, inserted 1.5 mm subosseously to maximize the aesthetic profile.

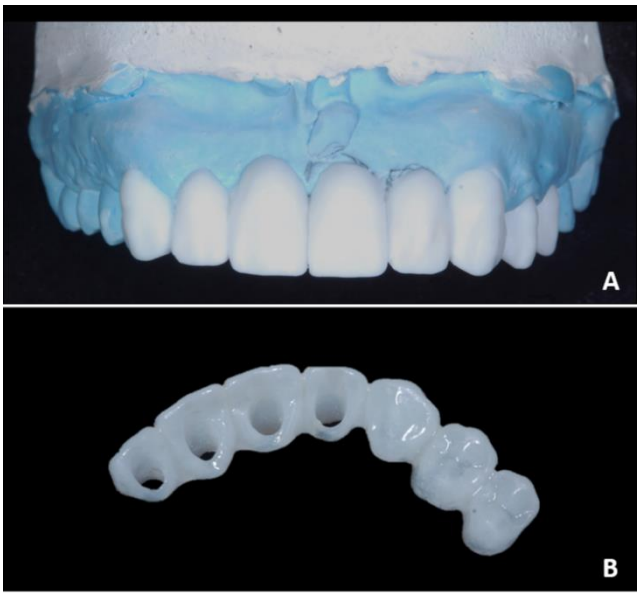

Figure 5. (A) Diagnostic wax-up (13-25), and (B) Fabrication of conventional guide for positioning implantes 12 to 22.

At the time of surgery, a horizontal linear incision was made on the bony ridge, slightly displaced palatally from elements 13 to 23, with a contour on their gingival papillae and a vertical relaxation (trapezoidal flap) extending to the bottom of the vestibule fornix. After detaching the vestibule-lingual gingiva and periosteum (Figure 6A), milling began with the S.I.N. system (S.I.N. Implant System, Ltd., São Paulo, SP, Brazil), using the first 2.0 mm cutter (Figure 6B), at a length of 14.5 mm from the alveolar crest to the limit stipulated for element 12 to seek apical locking due to vestibular bone loss, and for elements 11, 21 and 22 a length of 13 mm, following the preparation with the 3.5 mm cutter, this being the final cutter.

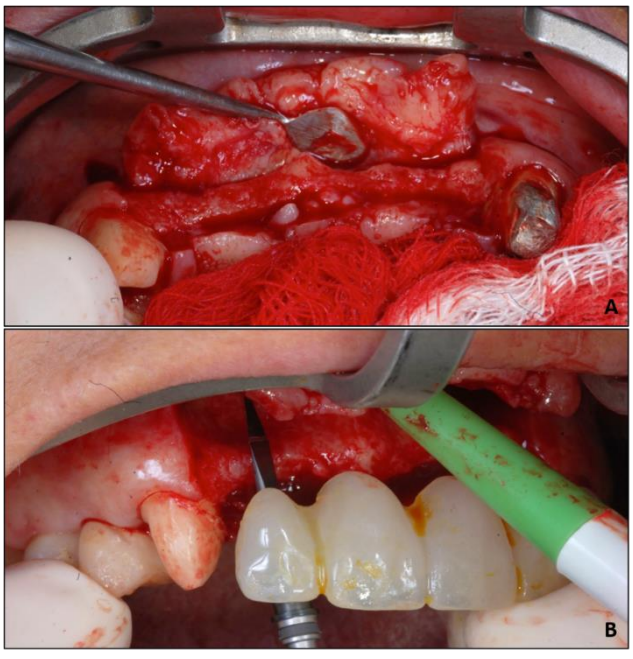

Figure 6. (A) Exposure of the anterior maxillary ridge after incision and detachment of the gingival tissue and periosteum and (B) Surgical guide at the time of milling supported on elements 23, 24, and 25.

After preparation, all the implants were installed and inserted approximately 1.5 mm below the bone crest, achieving a primary stability of 40 N/cm (Figure 7).

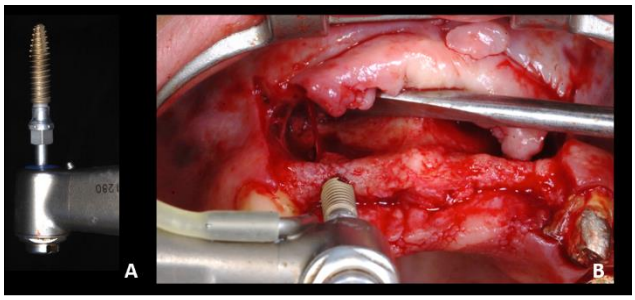

Figure 7. (A) Conical implant coupled to a contra-angle, and (B) Installation of the implant after milling.

The critical defect was then prepared to receive the bone graft, a bovine hydroxyapatite, Bio-Oss® 0.5 cc (Geistlich Pharma® do Brasil Comercio e Serviços de Produtos para Saúde Ltd., São Paulo, SP, Brazil) covered with a resorbable collagen membrane, CollaTape® (Zimmer Biomet Ltd., Somerset West, Western Cape, South Africa) (Figure 8), followed by continuous and simple suturing with 6-0 Nylon thread (Shalon® Medical Ltd., Goiânia, GO, Brazil) (Figure 9A).

As initially planned, to promote aesthetics and function for the patient until the metal-reinforced provisionals were planned, and an immediate provisional was installed with Structur A2 (VOCO Ltd., Cuxhaven, Lower Saxony, Germany) from elements 11 to 25, since element 13 was prepared in the same session (Figure 9B).

Seven days after the surgery, the old provisionals were replaced with new ones with metal reinforcement from elements 13 to 25, and pontics from elements 12 to 22. The cement used was temporary (Temp-Bond NE, Kerr, Orange, California, USA).

When the implants were reopened 11 months after installation, excellent osseointegration of the implants was observed, with minimal exposure of parts of the first two turns of the implant for element 11. It was therefore decided to re-cover with Bio-Oss® 0.5 cc biomaterial and suture the gingival tissue with Nylon 6-0, with the installation of the healers (Figure 10). After 15 days, the healers were replaced with direct implant provisionals, on an universal abutment, for element 22 (3.3x4x4.5 mm) and elements 11, 12, and 21 (3.3x4x3.5 mm), with a torque of 32 N/cm. After capturing the provisional coping, they were cemented and elements 13, 23, 24, and 25 were cemented in isolation (Temp-Bond NE, Kerr, Orange, California, USA). The definitive prostheses were installed 4 months after the surgical reopening, with elements 16, 15, 14, 12, 11, 21, and 22 on implants and 13, 23, 24 and 25 on teeth being cemented with 3M™ RelyX™ U200 self-adhesive resin cement (3M™ do Brasil Ltd., Sumaré, SP, Brazil) (Figure 11).

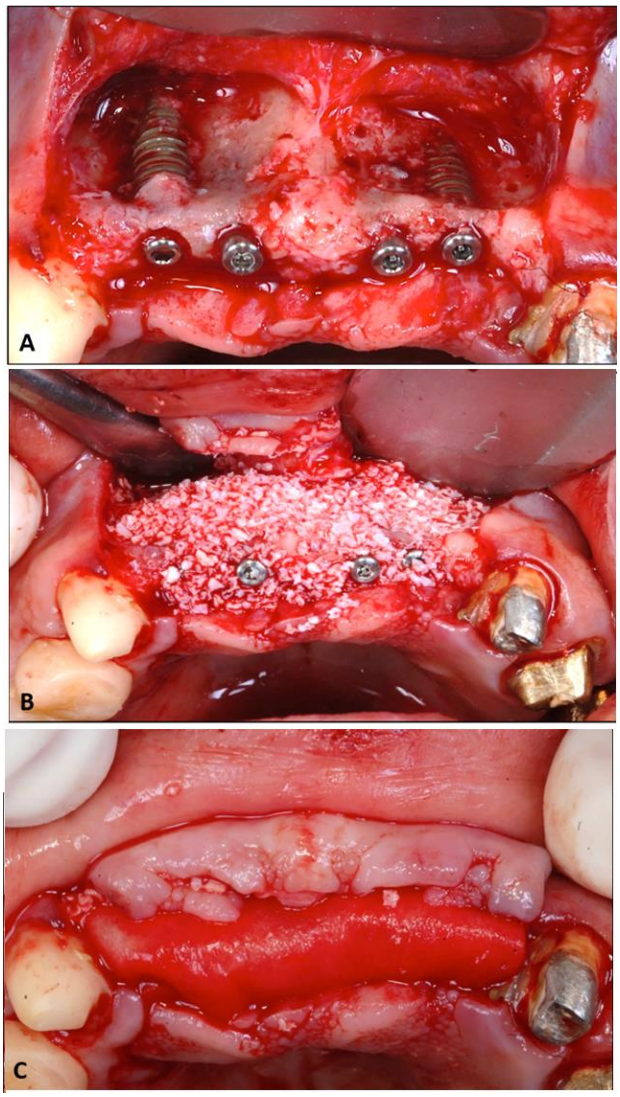

Figure 8. (A) Installation of 4 implants in the anterior region of the maxilla with preparation of the recipient bed to receive the biomaterial, (B) Biomaterial (Bio-Oss® 0.5 cc) grafted and (C) CollaTape® positioned over the bone graft.

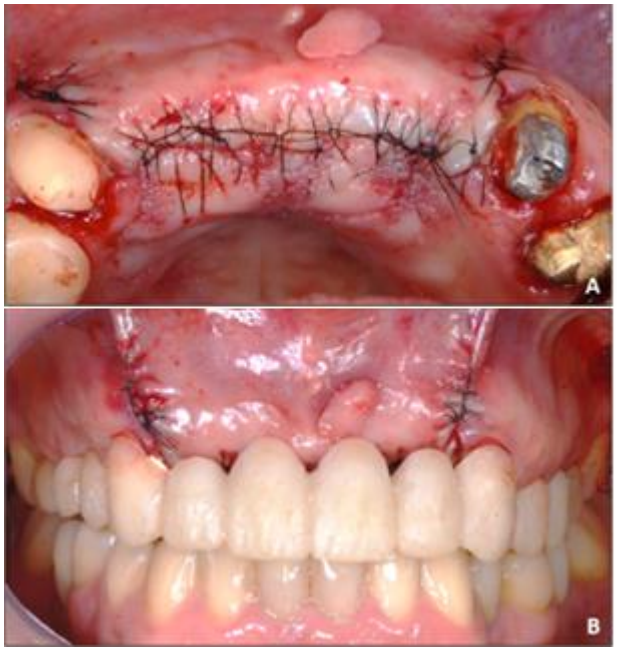

Figure 9. (A) Continuous and simple suture, and (B) Provisional made by mockup installed after surgery.

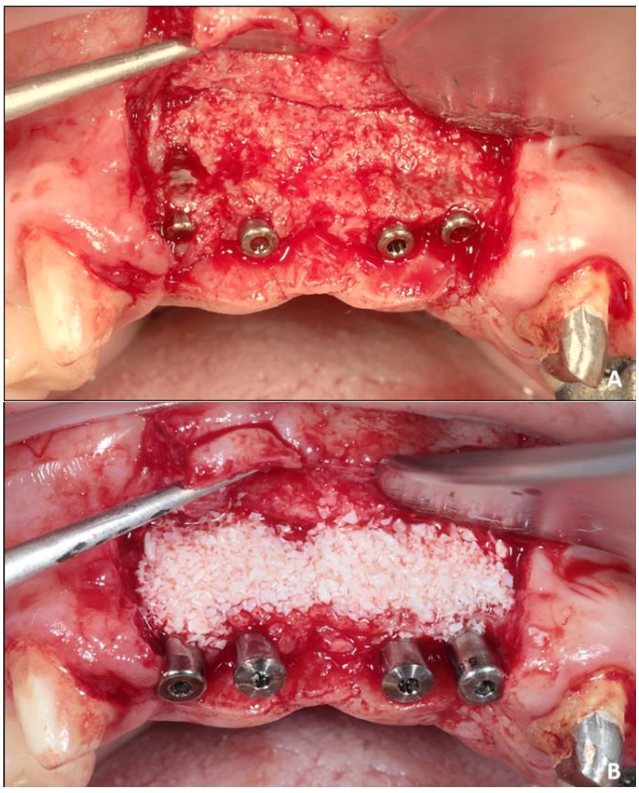

Figure 10. (A) Surgical reopening after 11 months of healing and (B) Covering with Bio-Oss® 0.5 cc.

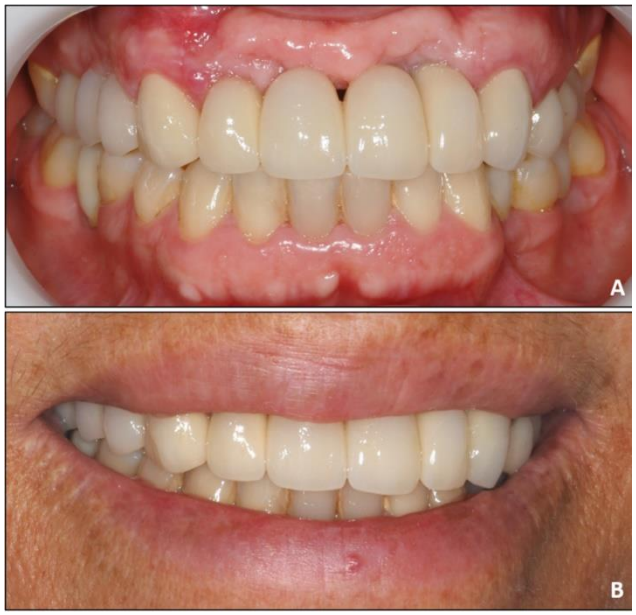

Figure 11. (A) Immediate final result, intraoral photograph and (B) Final result, extraoral photograph.

The patient has chosen not to carry out definitive treatment to date on elements 34, 36 and 46, only carrying out complete treatment on the upper teeth (16-25).

DISCUSSION

Osseointegratable titanium implants appeared more than six decades ago and over time have changed shape, geometry, dimensions, structure, and surface treatment[15]. In theory, the replacement of lost teeth with titanium implants and fixed prostheses has shown satisfactory results, especially in regions where there is adequate quantity and quality of bone to guarantee the primary stability required for implant osseointegration[16].

In this clinical case, the need to use implants with a Morse connection was identified due to the location of the surgery in an area considered to be aesthetic. For this reason, we opted for an implant with a more suitable platform, since Morse connection implants are essential for preserving the bone tissue around their threads, as well as having a lower rate of bone loss when compared to other types of connection, such as external and internal hexagon. Several clinical and laboratory studies have pointed to various gains when using the Cone-morse connection, showing greater efficiency in maintaining bone integrity and superior biomechanical performance compared to other implants[3,12,13].

After choosing the best characteristics for the implants, it was necessary to use biomaterials for bone reconstruction. The graft indicated for this case was a bone substitute composed of bovine hydroxyapatite (Bio-Oss®), covered with an absorbable collagen membrane (CollaTape®). Bio-Oss® is the most commercialized biomaterial in the world. It is a graft that has biocompatibility with the biological system and induces osteoblast differentiation to form quality bone around implants[17]. In addition, the hydroxyapatite present in its structure has vast osteoconductivity due to the large amount of calcium and phosphate (Ca/P), which results in a lower resorption rate[17,18]. Consequently, this biomaterial is absorbed gradually, giving it high mechanical resistance[17,18].

The membrane of choice performs the function of mechanically preventing the migration of epithelial cells, protecting against the displacement of the blood clot formed due to the pressure caused by the expansion of adjacent tissues, as well as keeping the biomaterial in position[19,20]. This creates a protected and safe environment for the clot to settle in, facilitating the migration of bone precursor cells, which results in the formation of neoformed bone tissue[19-21].

Healthy periodontal tissue is also essential for the success of the clinical case[22]. In turn, certain requirements must be taken into account: the Morse connection implant needs to be approximately 1.5 to 2 mm below the bone crest so that bone loss is reduced and, consequently, soft tissue collapse is minimized. Another key indication is to make provisionals immediately after the surgical phase. At this stage, in addition to the aesthetic factor for patient acceptance, the functional aspect is also important, as it improves the morphology of the periodontal tissue and creates the ideal space to receive the definitive prosthesis[2].

In this case, the patient was satisfied in

terms of aesthetics and function. The entire surgical and prosthetic region of the maxilla has been completed, but the definitive prostheses for the lower elements have not yet been completed; however, provisionals have been made for greater comfort and mechanical function. Planning for conjunctival and epithelial grafting must be taken into consideration in order to improve the contour of the gingival tissue in the anterior maxillary region if necessary.

Thus, given the importance of the final result of the treatment, in which all the mandatory prerequisites were achieved, we stress the importance of using biomaterials as bone substitutes in the process of guided bone regeneration, carried out in a planned and controlled manner through periodic clinical appointments. In addition, optimal reverse planning before the start of treatment is necessary, since these factors are essential for successful treatment.

CONCLUSION

We can conclude that the procedures and techniques used were viable, safe, and effective option for the treatment of edentulous patients, showing that an initial planning is essential to achieve a successful prognosis. In addition, the presence of sufficient bone is essential for good initial stability of titanium implants and the bone substitutes is helpful for a successful treatment.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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