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Osseodensification for maxillary sinus lifting and immediate implant placement

Levantamento de seio maxilar através da técnica de osseodensificação e instalação imediata de implantes dentários

Osteodensificación para la elevación del seno maxilar y la colocación inmediata de implantes

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ABSTRACT

Aim: To report a clinical case using the bilateral osseodensification technique for lifting the maxillary sinus and implants placement. **Case report:** In total, 4 implants were placed in order to rehabilitate the patient, including 3 external hexagons. The patient had not enough bone height and width available for the placement of implants (classified for subantral technique surgical - SA-3), by the traditional technique and, therefore, the bilateral osseodensification technique was recommended for rehabilitation in the posterior region of the maxilla, with simultaneous placement of endosseous implants. The osseodensification technique consists of using drills with a biomechanical approach and technology for bone preparation that is different from the conventional technique. The bone tissue was compacted and autografted simultaneously towards the outside, expanding from the osteotomy. The short-term results showed the formation of dense bone at the implants` apex, reducing the osseointegration period from 6 to 4 months and enabling the achievement of primary stability in bone of low height and low density. **Final considerations:** Based on the clinical and radiographic results, it can be afirmed that the osseodensification technique is efficient for posterior regions of the maxillary classified for subantral technique surgical (SA-3), providing adequate osseointegration of endosteal implants after 4 months.

Keywords: Sinus floor augmentation, Bone substitutes, Alveolar bone loss, Osteotomy, Implant Placement.

RESUMO

Objetivo: Relatar um caso clínico utilizando a técnica de osseodensificação bilateral para levantamento do seio maxilar e colocação de implantes. **Detalhamento de caso**: No total foram instalados 4 implantes para reabilitar o paciente, incluindo 3 hexágonos externos. O paciente não possuía altura e largura óssea suficiente para colocação de implantes (classificados para técnica cirúrgica subantral - SA-3), pela técnica tradicional e, portanto, a técnica de osseodensificação bilateral foi recomendada para reabilitação na região posterior da maxila, com colocação simultânea de implantes endósseos. A técnica de osseodensificação consiste na utilização de brocas com abordagem biomecânica e tecnologia de preparo ósseo diferente da técnica convencional. O tecido ósseo foi compactado e autoenxertado simultaneamente para fora, expandindo-se a partir da osteotomia. Os resultados em curto prazo mostraram a formação de osso denso no ápice dos implantes, reduzindo o período de osseointegração de 6 para 4 meses e possibilitando a obtenção de estabilidade primária em osso de baixa altura e baixa densidade. **Considerações finais**: Com base nos resultados clínicos e radiográficos, pode-se afirmar que a técnica de osseodensificação é eficiente para

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regiões posteriores da maxila classificadas para técnica cirúrgica subantral (SA-3), proporcionando osseointegração adequada dos implantes endosteais após 4 meses.

Palavras-chave: Levantamento de seio maxilar, Substituto ósseo, Perda óssea alveolar, Osteotomia, Instalação de implante.

RESUMEN

Objetivo: Reportar un caso clínico utilizando la técnica de oseodensificación bilateral para elevación del seno maxilar y colocación de implantes. **Detalles del caso:** En total se colocaron 4 implantes para rehabilitar al paciente, incluidos 3 de hexágono externo. El paciente no tenía suficiente altura y ancho óseo disponible para la colocación de implantes (clasificados para técnica quirúrgica subantral - SA-3), por la técnica tradicional y, por lo tanto, se recomendó la técnica de oseodensificación bilateral para la rehabilitación en la región posterior del maxilar, con colocación simultánea de implantes endooóseos. La técnica de oseodensificación consiste en el uso de fresas con abordaje biomecánico y tecnología de preparación ósea diferente a la técnica convencional. El tejido óseo fue compactado y autoinjertado simultáneamente hacia el exterior, expandiéndose a partir de la osteotomía. Los resultados a corto plazo mostraron la formación de hueso denso en el ápice de los implantes, reduciendo el período de osteointegración de 6 a 4 meses y permitiendo alcanzar la estabilidad primaria en huesos de baja altura y densidad. **Consideraciones finales:** Con base en los resultados clínicos y radiográficos, se puede afirmar que la técnica de oseodensificación es eficiente para las regiones posteriores del maxilar clasificadas para la técnica quirúrgica subantral (SA-3), proporcionando una adecuada osteointegración de los implantes endóseos después de 4 meses. Palabras clave: Alimentos Funcionales, Dieta, Enfermedad Crónica.

Palabras claves: Aumento del piso del seno, Sustitutos óseos, Pérdida de hueso alveolar, Osteotomía, Colocación de implantes.

INTRODUCTION

The etiology of implant failure of dental implants usually is biomechanical factors that include systemic alterations (systemic diseases, modifications in bone metabolism, use of anti-resorptive and anti-inflammatory drugs, smoking habit), local factors (low-density bone, compromised bone volume, presence of periodontal disease) and occlusal overload caused by parafunctional habits, unadapted prosthetic components, inadequate number and size in rehabilitation planning, which may even trigger implant loss (BILHAN H, et al., 2010; GOIATO MC, et al., 2014; LINDHE J e MEYLE J, 2008).

The correlation and mechanical involvement of the dental implant with the bone at the insertion point is what is defined as primary stability (Mello-Machado RC, et al., 2021). Many factors can influence this primary stability, such as the type and volume of bone at the surgical site, the biocompatibility of the biomaterial to be used, loading conditions, surface technology (micro-nano topography and chemical composition), macrogeometry (implant body and thread design), surgical preparation of the implant placement site (ALBREKTSSON T, et al., 1981).

One of the principles for successful therapy is to achieve primary stability during implant placement. However, not every posterior region of the maxilla has enough bone available, especially in height, in order to promote implant anchorage. Therefore, some surgical techniques have been developed with the aim of increasing bone height without overtaking the maxillary sinus (PAI UY, et al., 2018). In 1987, Misch CE developed a classification system for the posterior region of the edentulous maxilla, based on the amount of remaining bone between the bony ridge and the floor of the maxillary sinus. In this classification, Treatment categories ranged from subantral augmentation category 1 (SA1) to SA4 based on bone height A (>5 mm) and B (2.5-5 mm) based on ridge width (MISCH CE, 1987).

Misch classified the subantral region (SA) of the posterior region of the maxilla into four categories: SA-1 that has an adequate vertical bone for implants, that is 12 mm and no manipulation of sinus is required (> 12 mm); SA-2 with 0 to 2 mm less than the ideal bone height (10 to 12 mm), and may require surgical correction. SA-3 which has 5 to 10 mm of bone below the sinus. SA-4 is characterized by less than 5 mm of vertical bone

below the sinus (KQIKU L, et al., 2013). In this context, in order to achieve increased bone volume in the region for future implant placement, the osseodensification technique can be applied to promote the expansion of the bone ridge, in height and thickness, ensuring greater primary stability, and then contributing to greater torque values during implant insertion, minimizing the risk of dehiscence and fenestration. The technique can be applied to lift the maxillary sinus without opening a surgical window approach (Cadwell-Luc technique), in a simple, safe way and with reduced morbidity for the patient (GASPAR J, et al., 2018).

Osseodensification is a novel approach in bone preparation for dental implants that enhances primary implant stability and bone density. Unlike traditional drilling methods that remove bone to make space for the implant, osseodensification utilizes specially designed densifying burs that compact and preserve the bone, potentially improving clinical outcomes. The principle of the osseodensification technique is to increase the apical bone density in the surgical socket, through the use of specific drills able to promote the compaction of the autogenous bone, while expanding, at the same time, the bone crest. The literature shows as the main results an increase in bone height of up to 3 mm, in regions of SA-1, SA-2 and SA-3 (LAHENS B, et al., 2019).

Despite the high success rate of the technique, there are few studies in the literature that discuss in detail the main stages of osseodensification for adequate clinical results. Therefore, the aim of this study is to report a clinical case using the bilateral osseodensification technique for lifting the maxillary sinus, in regions where there is no favorable bone availability for the application of the conventional technique for dental implants placement.

CASE REPORTS

This case report was approved by the Research Ethics Committee from Antônio Pedro University Hospital / Fluminense Federal University, under number 5.682.361 and CAAE 61162822.9.0000.5243 and the participant signed an informed consent form, agreeing to their participation in the study.

Female patient, 56 years old, attended the Clinic of Specialization in Implantology of the Faculty of Dentistry of the Federal Fluminense University, in May 2022, for evaluation regarding the possibility of replacing the missing tooth. During the anamnesis, the patient reported using Citoneurin® 5000. (Merck, S.A. de C.V., Mexico). Furthermore, she had no smoking habits and no previous history of periodontitis.

At the extraoral clinical examination, no inflammatory characteristics were observed. The patient did not use a removable partial denture and had missing teeth 18, 16, 15, 26, 27, 28, 46, 36 and 37. In the first exam, impressions were taken of the upper and lower arches and occlusal registration, with condensation silicon for study model and creation of the multifunctional guide. The Computadorized Tomography (CT) scan revealed alveolar extension of the maxillary sinus bilaterally, promoting a significant decrease in the height of the corresponding ridge; thickening of the mucous lining of the floor of the maxillary sinuses; moderate bone trabeculation in the maxilla; intact maxillary cortices; widespread mild/moderate horizontal bone loss; maxillary ridge moderately resorbed in height; moderately atrophic vestibulopalatal thickness. Complementary blood tests were requested, including complete blood count, coagulogram, total glucose and fasting glucose.

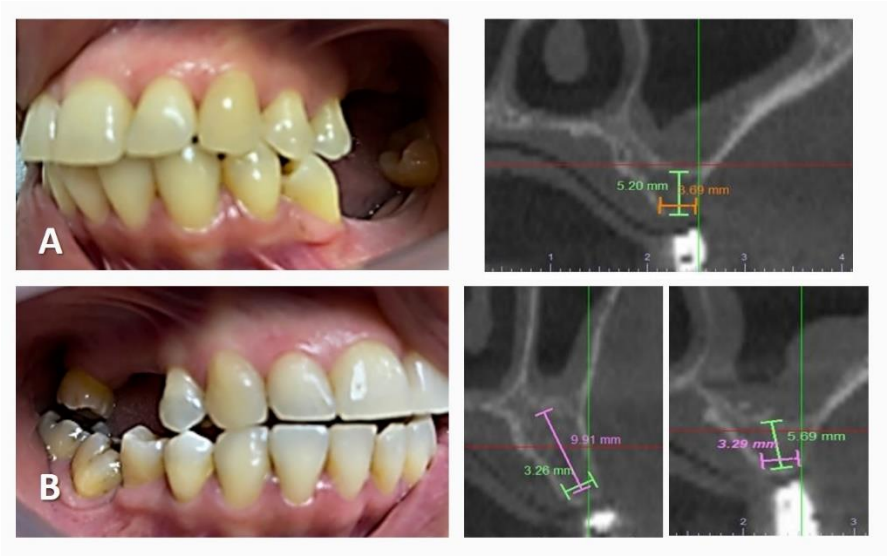
In view of the observed clinical and tomographic aspects, the recommended treatment method was an atraumatic maxillary sinus lift, using the osseodensification technique in regions 16 and 26, and placement of dental implants in regions 15, 16 and 26. After accessing CT images in the Dental Slice software, measurements were made in height and width of the available bone in the regions to be implanted (**Table 1** and **Figure 1**).

Table 1 - Bone availability evidenced on CT scan and implants of choice (SIN, São Paulo – Brazil).

Region	Bony Availability		Implant of Choice (SIN, São Paulo – Brasil)	Reference
	Height	Thickness		
26	5,69	3,29	STRONG HE 5x 8.5	SWHE5085N
15	9,91	3,26	TRYON HE 3.75x 10	SA310
16	5,20	3,69	TRYON HE 3.75 x 7	SA307

Source: Almeida CS, et al., 2025.

Figure 1 – Clinical and Tomographic aspects showing bone availability in the regions of elements 26 (A), 15 and 16(B).



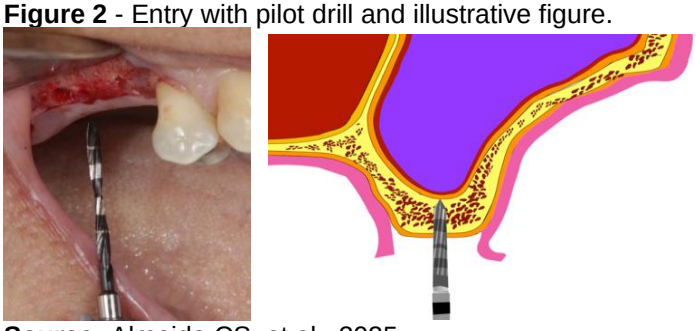
Source: Almeida CS, et al., 2025.

Taking into account these aspects, compatible with the SA-3 region according to the Misch classification, the recommended treatment method was lifting the maxillary sinus through the osseodensification technique in regions of elements 16 and 26, and immediate placement of dental implants in regions 15, 16 and 26. Complementing the patient's rehabilitation, the bone available in section 114 was also evaluated, measuring 8.24 mm in height and 4.15 mm in width. Therefore, the implant of choice for the mandible in the region of element 36 was TRYON HE line, 5 mm wide x 7 mm high, reference SA507 (SIN, São Paulo - Brazil). Preoperative medication prescribed included 2g of Amoxicillin (EMS Phamas, Campinas, SP, Brazil) 1 hour before the procedure, and 1 tablet of Dexamethasone 4 mg (EMS Phamas, Campinas, SP, Brazil) 1 hour before surgery. The patient chose to perform the procedure under conscious sedation by the care of an anesthesiologist.

Osseodensification technique

The osseodensification technique consists of using drills with a biomechanical approach and technology for bone preparation that is different from the conventional technique. Unlike traditional dental drilling techniques, bone densification does not excavate bone tissue. The bone tissue is compacted and autografted simultaneously towards the outside, expanding from the osteotomy. When drills are rotated at high speed, in a reverse, non-cutting direction, with constant external irrigation, a strong and dense layer of bone tissue is formed along the walls and base of the osteotomy.

Figure 2 - Entry with pilot drill and illustrative figure.

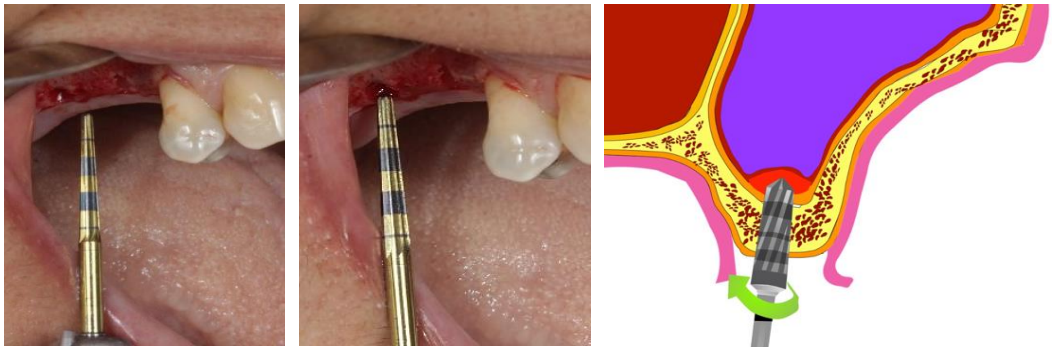


Source: Almeida CS, et al., 2025.

In order to perform the osseodensification technique, we used the Osseodensification Drill Kit (Maximus®, Minas Gerais - Brazil), according to the manufacturer's guidelines for maxillary sinus lift with autograft protocol

II. Step 1: With the patient under sedation the surgical guide was positioned after an incision on the ridge in order to detach the tissue. Step 2: The height of the bone up to the sinus membrane was checked and the pilot drill was inserted (**Figure 2**).

Figure 3 - Entry with drill 2.0, follow with drill 3.0 for boné compaction and illustrative figure.



Source: Almeida CS, et al., 2025.

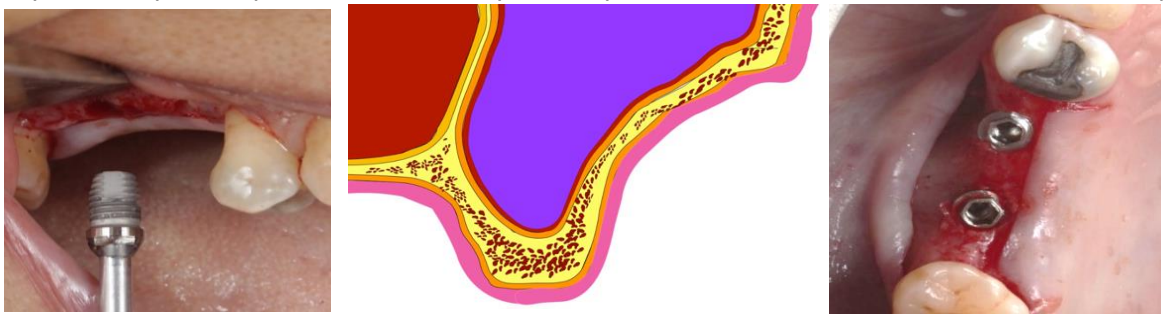
Step 3: The Maximus® drill (3.0) was used up to 3mm above the sinus membrane. In this way, the bone was pushed towards the apical end and began to gently lift the membrane and compacted bone of the autograft up to 3 mm (**Figure 3**). Step 4: The 3.3 drill was used up to 3 mm above the sinus membrane. Then, the sequential drills in densification mode (counterclockwise, drill speed 800-1500 rpm, with copious irrigation) was applied with a pumping motion until achieving additional width with the maximum membrane lift of 3 mm (in 1 mm increments) and obtaining the desired final width for implant placement (**Figure 4**).

Figure 4 - Entry with drill 3.3 and illustrative figure demonstrating bone expansion.

Source: Almeida CS, et al., 2025.

Step 5: Finally, the implant was placed until the motor reaches maximum insertion torque (50 N) (**Figure 5**).

Figure 5 - Placement of the implant and illustrative figure of the maxillary ridge and immediate implant aspect. (TRYON, HE implants placed - SIN, São Paulo – Brazil).

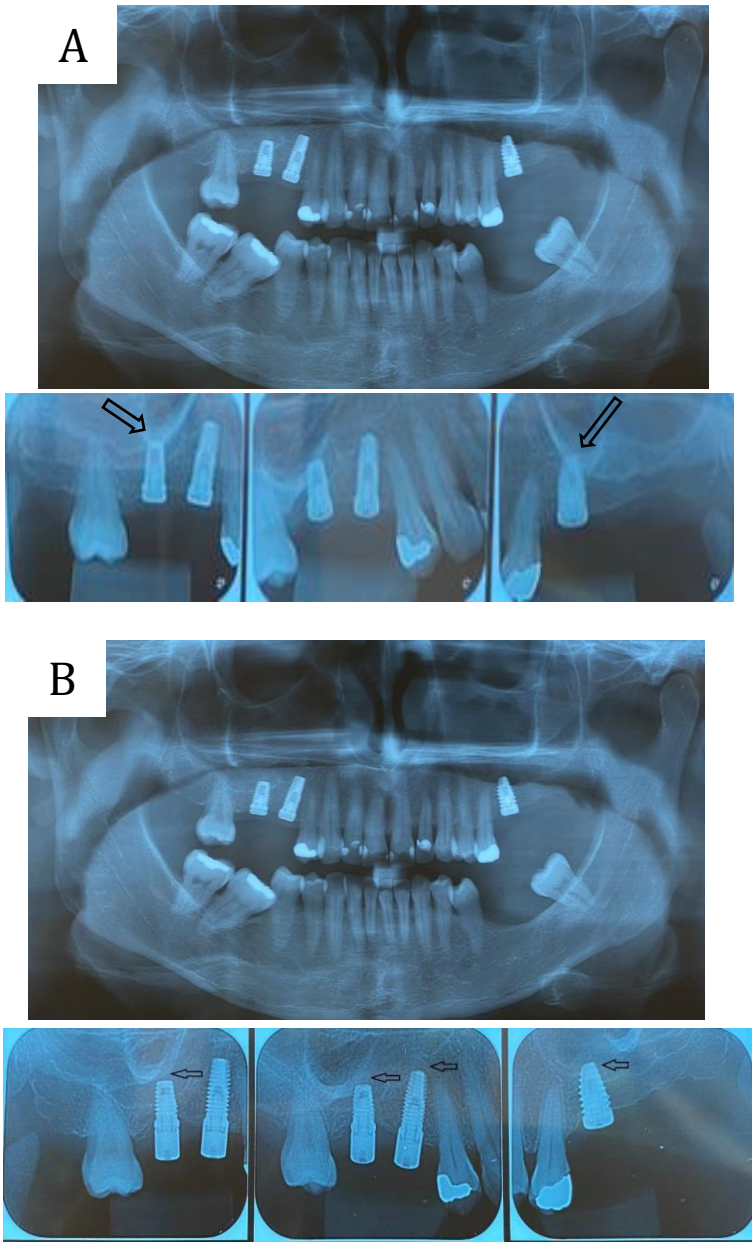


Source: Almeida CS, et al., 2025.

At the end of the surgery, Amoxicillin 500 mg every 8 hours for 7 days, Nimesulide 100 mg every 12 hours for 5 days, Dexamethasone 4 mg 24 hours and 48 hours after the procedure, Dipyrone monohydrate 6/4 6 hours in case of pain and/or fever.

After 7 days, the imaging exams showed an immediate result regarding the placement of the implants through the osseodensification technique. After 4 months, the patient showed no bone resorption around the implants and maintenance of peri-implant bone height (**Figure 6**).

Figure 6 - Panoramic radiograph (A) Panoramic and periapical radiographs taken 7 days after the surgical procedure, showing the dense bone at the apex of the implants (arrows). (B) 4 months after the surgical procedure, showing maintenance of the bone at the apex of the implant, after the period of osseointegration.



Source: Almeida CS, et al., 2025.

Based on the clinical-radiographic aspect, the implants were exposed, confirming the secondary stability and enabling the procedures for making the definitive prostheses.

DISCUSSION

Rehabilitation with dental implants has a high success rate when there is adequate bone height and thickness. However, in rehabilitations in posterior regions of the maxillary, when they have inadequate height and bone thickness, it is necessary to perform a maxillary sinus lift, which can present high rates of postoperative complications (TESTORI T, et al., 2020), including sinusitis after implant surgery (JAMALI S, et al., 2020). Therefore, taking into consideration that osseodensification is a technique gaining traction for implant ability to preserve and enhance bone quality during dental implant procedures, this study reported a clinical case using the bilateral osseodensification technique for lifting the maxillary sinus, in regions where there is no favorable bone availability for the application of the conventional technique for dental implants placement. Our results became evident the advantages of this technique in order to achieve success in implant dentistry rehabilitation.

In this work, it was used the technique of bilateral osseodensification in order to place two implants in the posterior region of the maxilla simultaneously, lifting the maxillary sinus, without access to the lateral window by Cadwell-Luc. Our results showed primary and secondary stability, with no postoperative complications, making the patient ready for rehabilitation with an implant-supported prosthesis after 4 months of osseointegration. The main observed advantages were: (i) increased primary stability; osseodensification compacts and densifies the bone around the implant site, leading to higher initial stability, which is crucial for the success of the implant during the early stages of healing; (ii) enhanced bone density; as evident on CT, the technique preserves bone during drilling and compacts loosened bone particles back into the osteotomy site, this increases the density of the peri-implant bone, potentially improving osseointegration; (iii) minimized bone loss: traditional drilling removes bone, leading to potential volume loss and reduced implant stability. In contrast, osseodensification preserves and compacts the bone, minimizing bone loss around the implant site; (iv) improved healing and integration: by enhancing the density of the surrounding bone, osseodensification can promote better vascularization and faster bone remodeling, thus improving the healing process and implant integration.

The clinical approach to place dental implants in low-density bone, such as the posterior region of the maxilla, usually consists of an under-instrumented in the implantation site to improve primary implant stability and to enable subsequent osseointegration. On the other hand, implants that have biomimetic surfaces can enhance the bone healing process, benefiting when clot chambers (HCs) are present on the surface (Pantani F, et al., 2010). Furthermore, when osteotomy is performed to allow the presence of clot chambers at the bone-implant interface, it reduces BIC (bone-implant contact).

However, inflammation of the maxillary sinus, bacterial contamination and graft infections can compromise the surgical success of the summer's technique. Furthermore, despite the fact that perforation of the membrane is a contraindication to continue the procedure, it usually can lead the dentist to abort the surgery, especially if the size of the perforation is substantial. In the presence of a condition with a high risk of perforation of the maxillary sinus, the chance of membrane perforation is increased, and consequently, postoperative complications are also increased (TESTORI T, et al., 2020).

A study by Degidi M, et al. (2015), reported a primary improvement in implant stability with 10% under-instrumentation in osteotomy preparation. In the presence of poor bone quality, a 10% under-instrument protocol is sufficient to improve primary implant stability. However, subinstrumented osteotomy can compromise the healing process between the bone and the implant and consequently the biological fixation (stability). A systematic review and meta-analysis study by Inchingolo AD, et al., 2021 compared the effectiveness of different osseodensification systems. According to the results described, the alveolar preparation performed with drills for osseodensification allows to increase the implant surface:autologous bone contac significantly, increasing the primary stability and predictability of the surgical procedure (LAHENS B, et al., 2019; ALIFARAG AM, et al., 2018; DEGIDI M, et al. 2015, TIAN JH, et al., 2019; TRISI P, et al., 2016). Elsaid M, et al. (2022), showed that the crestal maxillary sinus floor elevation using Osseodensification technique with simultaneous implant placement provided superior results regarding bone density and implant stability and less duration of surgical procedure. In our study, the external hexagon implants placed showed

secondary stability in a fast osseointegration interval. In 4 months after implant placement, was possible to observe complete clinical osseointegration.

Biomechanical and histological validation studies on bone densification have shown that, in both the tibia of pigs and the iliac crest of sheep, bone densification can aid in bone expansion, enhance implant stability, and form a densified layer around the preparation site through the compaction and autografting of bone particles along the depth of the osteotomy (LAHENS B, et al., 2019; TRISI P, et al., 2016; LOPEZ CD, et al., 2017). In addition, in this case report was observed that by using counterclockwise osseodensification drills allows to preserve and to compact the residual bone around the implant more effectively than clockwise use. In another analysis, a comparison was performed on the quantity and quality of autologous bone maintained by the osseodensification preparation versus Summers osteotomes. The osseodensification technique reported a BIC (bone-implant contact) greater than 19.4% using the technique with counterclockwise drills (INCHINGOLO AD, et al., 2021).

Another study by Inchingolo et al., 2021, compared the implant placement procedures using the traditional technique and the osseodensification technique. The parameters used were BAFO (bone area fraction occupation - 4 out of 11 articles evaluated) and BIC (bone implant contact - 6 out of 11 articles). The results showed that the osseodensification technique had better bone formation compared to the conventional technique.

In this case report, there was clearly an acceleration of the osseointegration process. In the literature, 6 months are recommended to achieve secondary stability after lifting the maxillary sinus using the summers technique. However, with the use of osseodensification, the patient's rehabilitation became feasible in just 4 months. This result suggests that there is greater bone-implant contact due to the bone densification that occurs at the apex of the implant, favoring contact between osteoblastic precursor cells and the titanium surface of the placed implants (SIN, São Paulo, Brazil). In addition, radiographically, we immediately observed a layer of bone separating the floor of the maxillary sinus from the apex of the implant, which clearly indicates protection against the rupture of the sinus membrane. In conclusion, the osseodensification technique is efficient for posterior regions of the maxilla classified as SA-3, providing adequate osseointegration of endosteal implants after 4 months.

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