issn 1868-3207 • Vol. 22 • Issue 4/2021

4/21

implants

international magazine of oral implantology

research
The Implant Protection Plan

case report
The Stable Tissue Concept

events
50 plus one years into the future

Sinus augmentation and simultaneous implant placement

using one-stage Sandwich Technique

Drs Fernando Duarte, Carina Ramos, Paulo Veiga & Marco Infante da Câmara, Portugal

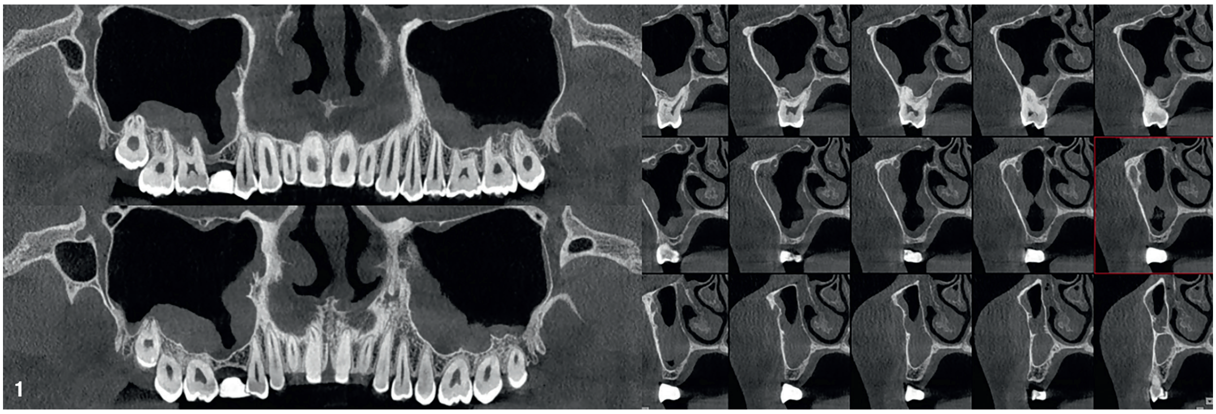


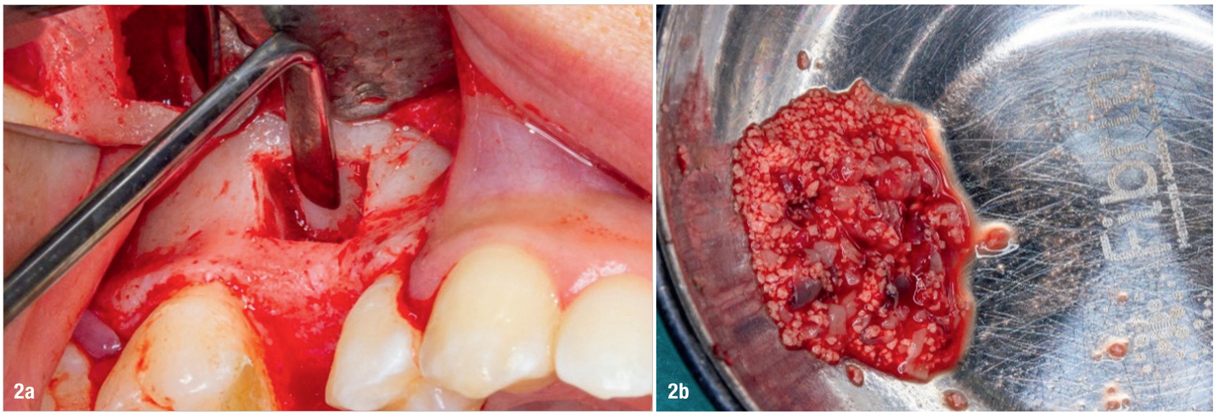
Fig. 1: Initial CT scan with coronal and sagittal sections.

Introduction

The posterior sector of the maxilla consists of an extremely thin facial lamina, with the underlying trabecular bone having a low mineral content. The loss of maxillary posterior teeth is a typical bone resorption pattern that implies a decrease in the bone width available at the expense of the labial plate.[1] This is the explanation why the width in the posterior sector of the maxilla decreases at a faster rate compared to other regions.[2] It should also be noted that the lack of vascularisation accelerates the phenomenon of bone resorption and initial Class D3 or D4 trabecular bone. Even if it decreases by 60%, however, the residual ridge is wide enough in the posterior maxilla for root-form implants. Progressive resorption shifts the alveolar crest towards the palate at the expense of bone width.[3] The posterior maxilla continues to atrophy until the entire alveolus is ablated to basal bone. The vestibular cusp of definitive prosthetic rehabilitation must result from a balance between aesthetic requirements, biomechanical conditions, and bone availability in moderate to severe atrophic crests.[4]

Maxillary sinus resorption

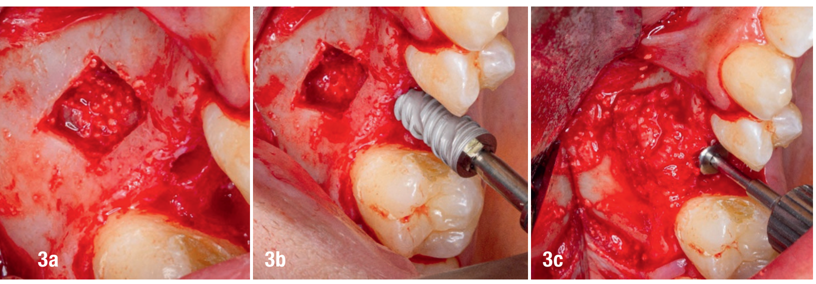
The inner anatomy of the maxillary sinus maintains its full size while the teeth remain in arch and function, but expands when the posterior teeth are lost.[1] There is an expansion of the antrum in the inferior and lateral directions, potentially invading the canine region and even the lateral piriform sinus. After the loss of teeth, sometimes related to periapical infectious processes, the amount of bone available in the posterior region of the maxilla for implant placement is greatly reduced. This phenomenon is likely the result of atrophy caused by reduced bone tension due to lack of occlusal function. Implants placed under the ungrafted sinus floor are known to stimulate increased bone formation in the sinus floor. Among the main criteria for the success of treatment with implants, bone quality and quantity stand out. In a limited literature review, it can be seen that, statistically, implants with a height of 10 mm or less have a 16% lower survival rate than implants with more than 10 mm in height.[5] It is therefore important to emphasise that, bone height is a factor to consider in predictability and longevity of implant-supported rehabilitation. In periodontal compromised patients, a phenomenon known as pneumatic trifurcation is frequently observed, whereby the maxillary sinus extends between the roots almost to the furca in the area of the first molar. Tooth extraction leaves 4–5 mm of bone available as a result of this anatomical peculiarity of the sinus. The limited vertical dimension further aggravates the problem of the position of the medialised crest and the already compromised alveolar width. As a general rule, bone quality in



Figs. 2a & b: Osteotomy by piezoelectric surgery and sticky bone for reconstruction.

the posterior maxilla is worse than in any other intra-oral anatomical region.[6] The bone density of the maxilla is often five to ten times lower than that of the anterior mandible, namely the symphysis and para-symphysis regions.[7] Bone mineral density directly influences the amount of contact between the implant and the bone surface, which in turn transmits the load to the bone.[8] The tension pattern spreads more towards the apex of the implant in low-density bone than in dense bone.[9] When tension is excessive, bone loss occurs in the trabecular bone, which begins in the cervical and may travel throughout the entire body of the implant. Strategies to increase bone–implant contact, both surgically and by modification of implant topography, are being developed.

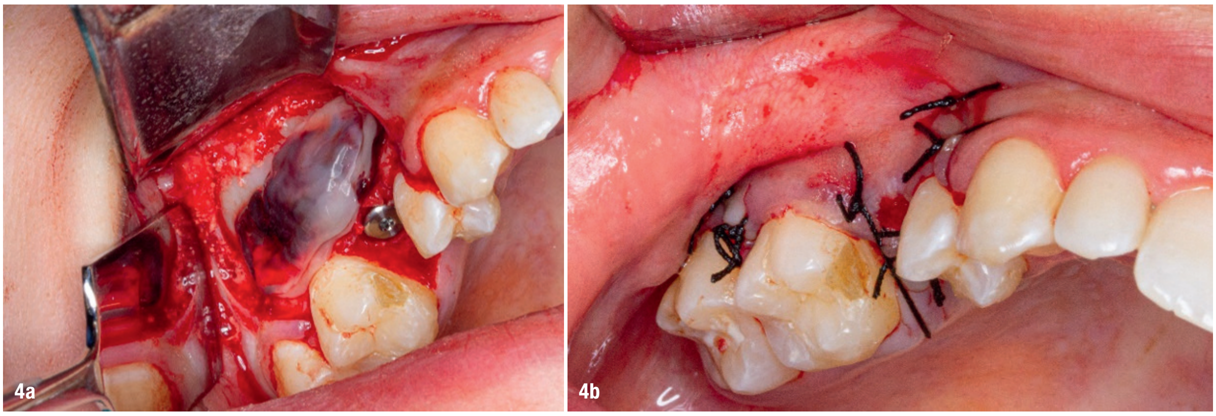
Bone mineral density is extremely important for the survival of the implant in function.[6] Implants have an increased risk of failure in conditions of poor mineralisation. Deficient bone structure compromises not only the primary stability of the implant, but also the ability to support occlusal forces. The absence of cortex on the ridge crest compromises the primary stability of the implant and, since the buccal cortical plate is generally very thin and the crest is relatively wide, it does little to increase stability. The occlusal forces in the posterior region are greater than in the anterior region of the oral cavity by up to five times.[10] The maximum occlusal force in the anterior region varies from 241 to 345 Pa, compared to the maximum occlusal force in the molar region which varies from 1,378 to 1,723 Pa.[11] Natural maxillary molars have 200% more surface area as well as a significantly larger diameter than premolars,[1] and clearly the combination of the two factors contributes to the reduction in bone tension. In accordance with the clinically observed morphology, in the oral cavity, the support of the implant should be greater in the molar region, thus allowing a more functional and aesthetic prosthetic rehabilitation.[1] It should be noted that the decrease in bone quantity and quality, as well as the increase in occlusal strength, should be highly considered aspects in the treatment of the posterior maxillary region.



Figs. 3a–c: Intra-op images of bone reconstruction and implant placement.

Sinus floor approach

Tatum was the first clinician to suggest a crestal approach to sinus floor elevation and placement of submerged implants.[12] The technique, used in thin residual crestal bone, involved an upfracture into the sinus using a socket-forming instrument. A bone graft was placed beneath the tented sinus membrane. Later, a modified Caldwell–Luc procedure was developed in which the lateral sinus wall was infractured and the wall was used to help elevate the sinus membrane. Autogenous bone was then placed into the area.[13] Since then, a variety of techniques have been described for augmenting the maxillary sinus floor. Two general procedures for sinus elevation for dental implant placement are currently in use: a two-stage technique using a lateral window approach and a one-stage technique using a lateral or a lateral from the crest approach.[14–17] The decision to use a one- or two-stage technique is made based on the amount of bone present at the alveolar crest. Piezoelectric surgery has certain fundamental characteristics that make it safer and more precise than the instruments (manual and motorised) traditionally used in this type of surgery. Morphological and histo-morphometric studies have found that the tissue responds better to piezo-surgery than to the drill.[18,19] The extreme precision and safety of the method are assured by the following: a) Micrometric cutting action allows effective cutting of mineralised structures but is inactive on soft tissue; b) Absence of macro-vibrations permits better handle



Figs. 4a & b: Autologous fibrin membranes and sutures.

control, thus assuring completely safe access to the most difficult anatomical zones and high cutting precision; c) Cavitation with the cooling saline solution that is generated from the characteristic ultrasonic vibrations produces tiny sprayed particles of water that keep the area cool and free of blood, thus avoiding overheating of the tissue and allowing optimal intra-operative visibility.

Sandwich Technique

This technique recommends 3D bone reconstruction around the entire body of the implant in cases of elevation of the sinus floor by 4–5 mm and implant placement in the same stage. The technique recommends that two vertical osteotomies be performed on the lateral wall of the maxillary sinus to delimit the bone area to be grafted. A third inferior horizontal osteotomy is performed according to the bone availability shown on a CT scan and a fourth superior horizontal osteotomy to delimit the height of the graft. The bone window produced is reflected into the maxillary sinus with the intention of functioning as a ceiling for the grafted area. Whenever possible, it is advisable to maintain the integrity of the Schneiderian membrane. If it is eventually perforated during the osteotomy or is already perforated, it is necessary to place an additional membrane. Sticky bone (CERASORB M, curasan; and platelet-rich fibrin) is placed and compressed in the posterior (palatal) portion of the bone window. It is easy to manipulate and accelerates tissue healing and minimises bone loss during the healing period. Subsequently, the implant is placed, the existing cervical bone acting as the primary stability source. Finally, new sticky bone is placed in the anterior portion (vestibular) and membranes of autologous fibrin are applied as a cover of the bone graft.

CERASORB M is a resorbable beta-tricalcium phosphate, pure phase, biomimetic and totally resorbable to fill, join and rebuild bone defects of small, medium and large dimensions; as well as to promote bone fusion throughout the skeletal system. CERASORB M is made of biocompatible synthetic ceramic material with a phase purity of approximately ≥99%.[20] CERASORB M granules have a polygonal shape which allows for better structural adaptation between them, they have an open interconnected micro, meso and multiporous structure macropores (about 65%), radiopacity is lower and absorption and remodeling in autologous human bone are achieved more quickly than with conventional biomaterials. Over the course of months in contact with vital bone, the CERASORB M material is resorbed and simultaneously replaced by autol-

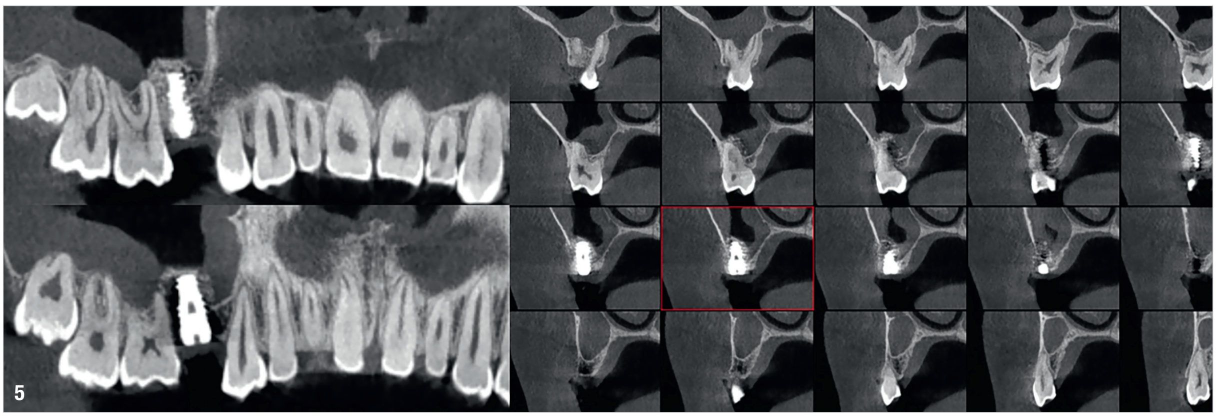


Fig. 5: Final CT scan with coronal and sagittal sections.

ogous bone tissue. As a synthetic and bioactive ceramic material, CERASORB M has excellent histocompatibility and absence of local or systemic toxicity. Unlike materials of biological origin, CERASORB M does not present a risk of infection or allergic reaction, which should be considered an important advantage.[20] Platelet-rich fibrin is composed of therapeutic blood matrices obtained by selective centrifugation and acts as an adjuvant in bone and tissue repair. To obtain the fibrin matrices, autologous blood samples are collected in dry 10 ml pure glass tubes (Montserrat) and blood samples in dry polystyrene tubes (Greiner Bio-One), in a tube ratio of 6:2. They should be centrifuged in a centrifuge (Ortoalresa), according to the protocol described by Duarte de Almeida and Alves de Oliveira,[21] which uses a relative centrifugal force of 200 × g for 10 minutes to obtain two physical forms of fibrin, the polymeric form or solid gel, and the monomeric or temporary liquid form only in one centrifugation step.

Clinical case

A 21-year-old female patient attended the oral-maxillofacial surgery consultation at Clitrofa medical centre in Trofa in Portugal for placement of an implant in anatomical position #15. In the anamnesis, no allergies or use of medications was reported. On extra-oral clinical examination, no abnormalities were observed. On intra-oral physical examination, a slight bone depression was noted in position #15 as a result of dental agenesis. In the CT scan, a sinus floor of 4 mm in height was detected in position #15, making the case suitable for a one-stage implant technique—the Sandwich Technique (Fig. 1). Two vertical osteotomies were performed on the lateral wall of the maxillary sinus to delimit the bone area to be grafted. A third inferior horizontal osteotomy was performed according to the bone availability shown on the CT scan and a fourth superior horizontal osteotomy was performed to delimit the height of the graft 10 mm. The bone window produced was reflected into the maxillary sinus, and the Schneiderian membrane was kept intact. The use of platelet-rich fibrin in the grafting process offers the benefits of modelling of the inflammatory response, immune response and tissue repair, tissue reorganisation and angiogenesis. The association with mineral biomaterials facilitates handling and application and allows immediate adhesion to the receiving bed (Fig. 2).

The sticky bone was inserted with maximal light compression into the posterior (palatal) portion of the bone window. Subsequently, the implant (Epikut HE, 4.5 × 10.0 mm; S.I.N. Implant System) was placed, the existing cervical bone acting as the primary stability source. More sticky bone was inserted into the anterior portion (vestibular; Fig. 3). The autologous fibrin membranes create a protected environment for bone regeneration in the defect area and support osteogenesis by presenting a barrier to the infiltration (migration) of soft tissue and thus promote growth of osteogenic cells in the bone defect. Suturing was performed with simple sutures using non-resorbable thread (#4/0 silk; Fig. 4). The patient underwent systemic antibiotic, analgesic and anti-inflammatory therapy for eight days. Regarding postoperative care, the patient was instructed to maintain strict oral hygiene. After a post-operative period of six months, evaluated by a postoperative CT scan, there was evidence of new bone formation of 12 mm in height around the entire implant body and apex (Fig. 5).

Conclusion

Diffuse maxillary sinus remodeling and posterior maxillary morphology after tooth loss suggest several treatment options. Maxillary sinus graft is an increasingly common procedure in implantology, and the use of resorbable and biomimetic bone regeneration materials, such as CERASORB M, in combination with platelet-rich fibrin (sticky bone), should be considered. This technique has a safety, predictability and longevity character for the rehabilitation of the posterior maxillary sector, and it can be performed alone or in conjunction with other reconstructive procedures. When approached and managed properly, the sandwich technique leads not only to bone reconstruction of the posterior maxilla, but simultaneously to the placement of the dental implant, with consequent restoration of the orthoalveolar shape and function between the arches.

Conflict of interest: The authors declare that there is no conflict of interest regarding the publication of this article.

about the authors




Dr Fernando Duarte
Author details

Dr Carina Ramos
Author details

Dr Paulo Veiga
Author details

Dr Marco Infante da Câmara
Author details

contact

Dr Fernando Duarte
Clitrofa—Centro Médico,
Dentário e Cirúrgico
Trofa, Portugal
+351 252 428960
fduarte@clitrofa.com

Literature