Sinus augmentation and simultaneous implant placement
using one-stage Sandwich Technique

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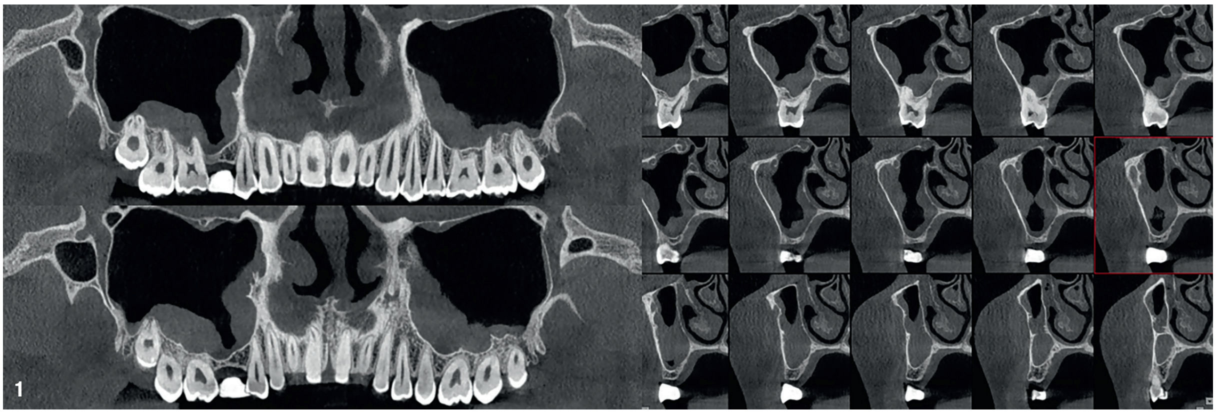

Fig. 1: Initial CT scan with coronal and sagittal sections.

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

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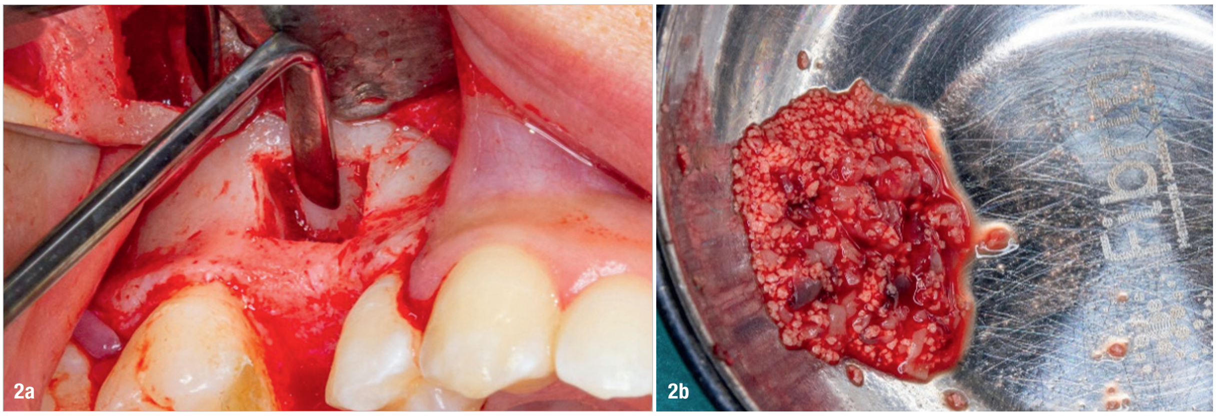
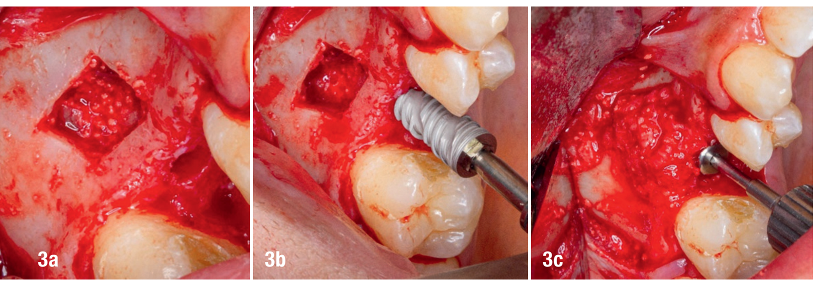


Figs. 2a & b: Osteotomy by piezoelectric surgery and sticky bone for reconstruction.

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