Restoration using minimally invasive techniques

Severe bone atrophy of the maxilla and mandible

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Nowadays, dental implants are a highly predictable technique for the restoration of vertical and horizontal bone atrophies, both complex and simple, and for the replacement of single or multiple teeth, whether to support, crowns, bridges or complete dentures.[1–3] Thanks to the advances in the development of implants, versatile solutions can be found to address the various clinical situations that may arise, which can then be managed with great efficiency and with fewer complicated operations and less morbidity.[4,5] This means that an increasing number of patients can benefit from this type of treatment, and indeed the number of patients with dental implants continues to grow every day.[5]

As with all restorative procedures, implant failures do occur, for mechanical reasons (fracture of various components or of the implant itself) and, mainly, owing to infection (peri-implantitis).[6,7] In most cases when implant treatment has failed in a patient, the bone defect caused either by the removal of the implant or by a previous infection increases the complexity of the attempted retreatment of the case, particularly in the most severe situations

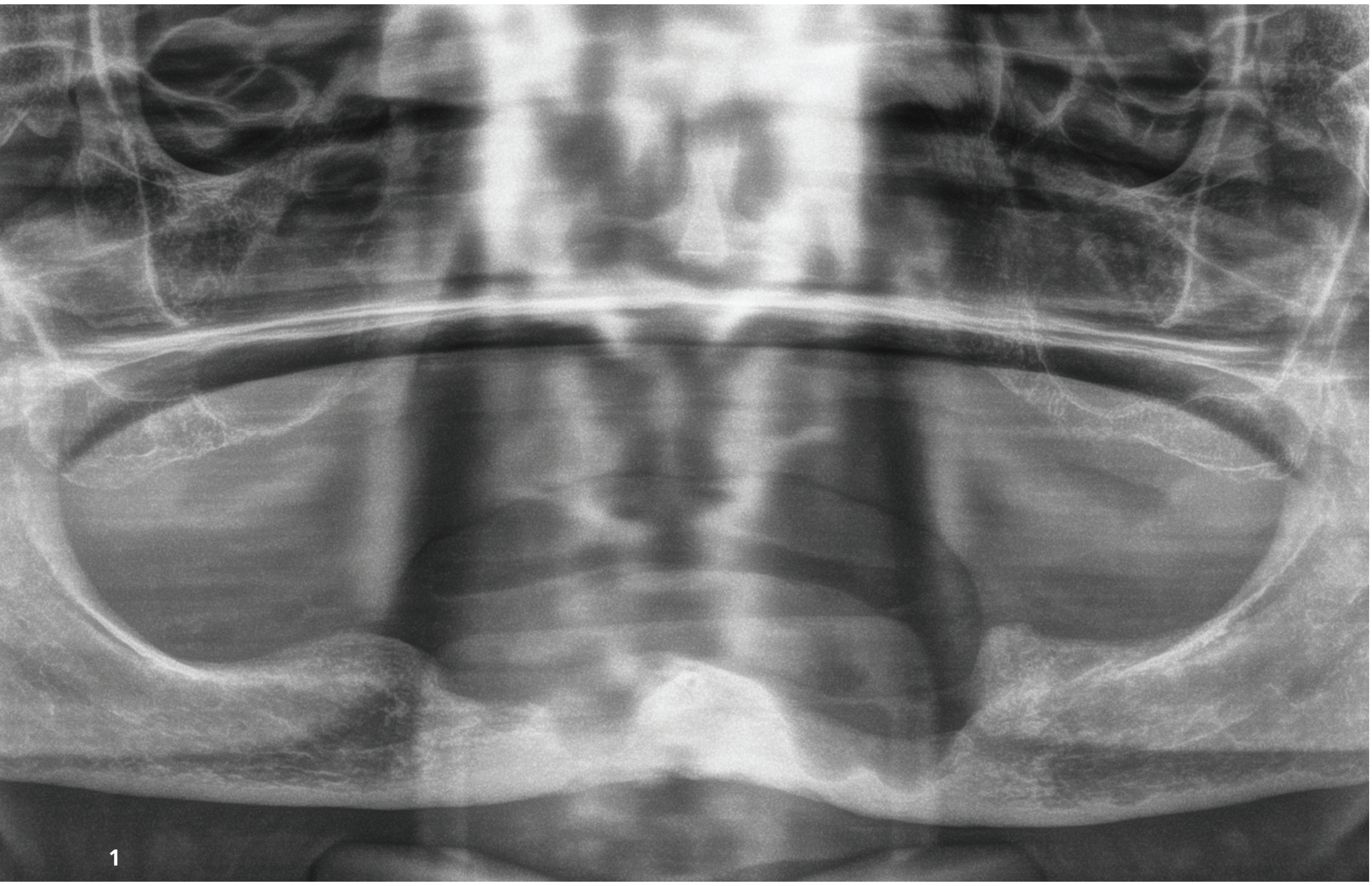
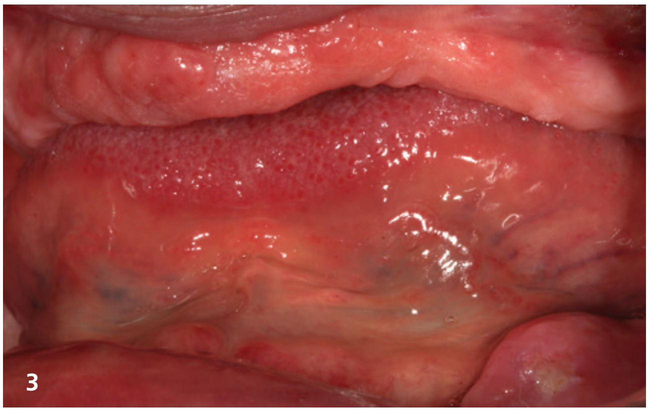


Fig. 1: Initial radiograph of the patient showing bone defects present in the mandible due to peri-implantitis and the state of the bone volume of the maxilla.

Figs. 2 & 3: Intra-oral images of the patient without the prostheses. The vertical antero-superior defect and the interocclusal distance indicating the bone loss in the height of the maxilla and mandible could be observed when the protheses were removed.

of low residual bone volume.[8–10] Minimally invasive techniques are important for cases of extreme atrophy. In the maxilla, short and extra-short implants, as well as trans-crestal sinus lift techniques and more recently the sinus lift technique, make implant placement possible in the most extreme situations, thus avoiding accessory techniques of bone augmentation and highly complex procedures.[11–14] Ultra-short and extra-short implants, as well as the placement of implants over the dental nerve using the latter as an anchorage, may be the alternative.[15–17] When the bone defect is located horizontally, narrow implants with a reduced platform and diameter can be used.[18,19] On occasions where bone atrophy is extreme in the maxilla and mandible, all these techniques together may be necessary, as in this clinical case, where there was a bone defect both vertically and horizontally in both bone beds, using several minimally invasive procedures to place the implants and to carry out the restoration.

Case presentation

A 72-year-old female patient who requested implant treatment presented to our practice. She had an implant-supported prosthesis in the mandible. The implants had developed peri-implantitis, and after implant failure, the vertical bone atrophy of the mandible had worsened. In the maxilla, long-term edentulism had also generated severe bone resorption. In the initial radiograph, the mandibular bone defects could be observed, and these had advanced to the extent of compromising even the stability of the basal bone at some points, and bone atrophy of the upper mandible was beginning to be visible (Fig. 1). When the maxillary and mandibular complete dentures were removed, the vertical bone loss between both jaws could be observed and the antero-inferior defect of the mandible became very evident (Figs. 2 & 3).

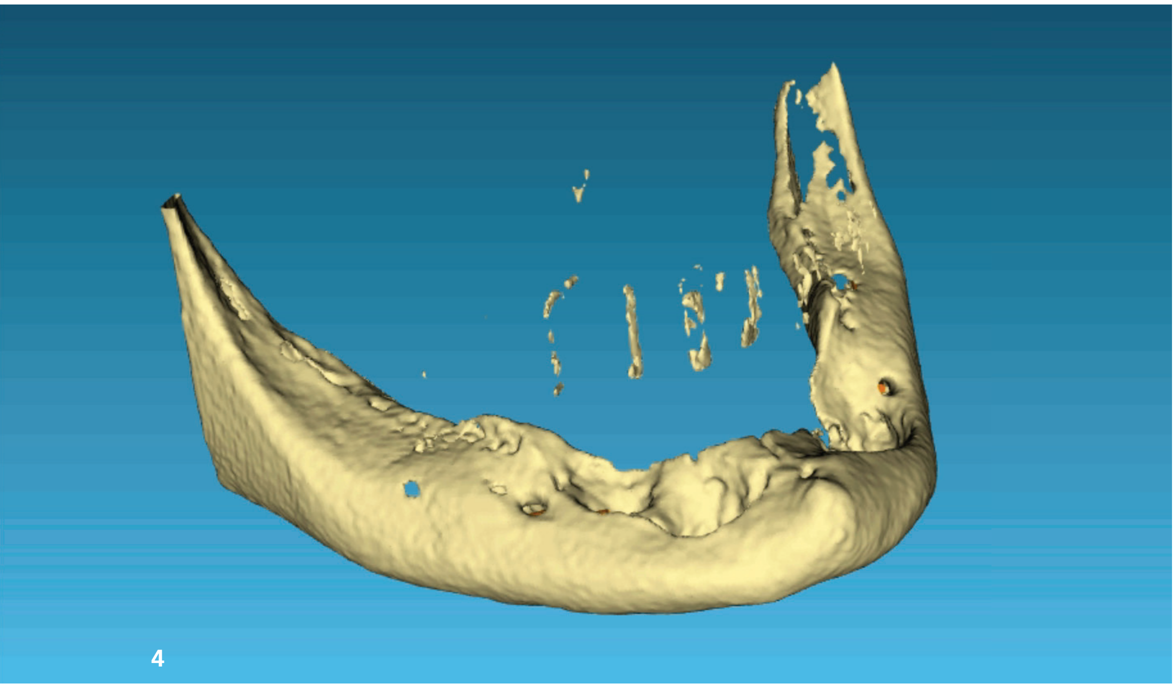
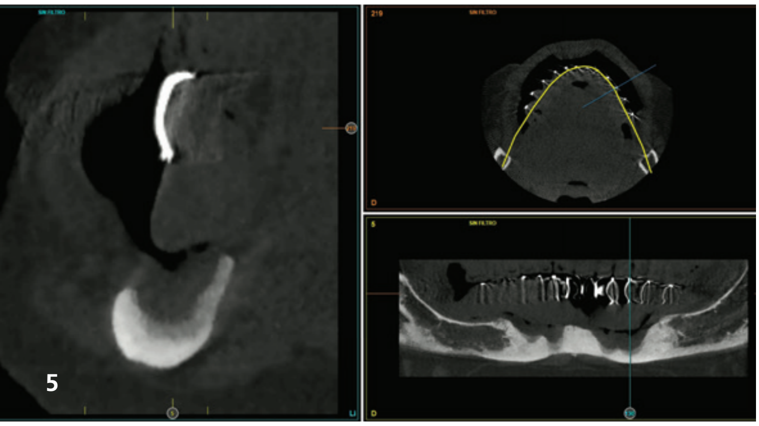
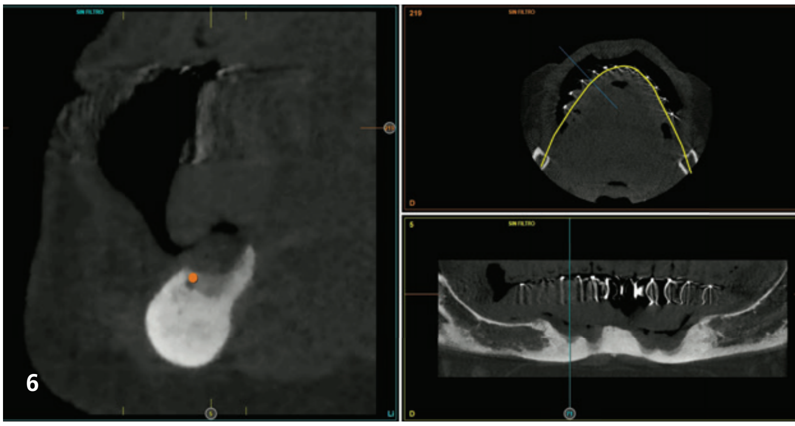
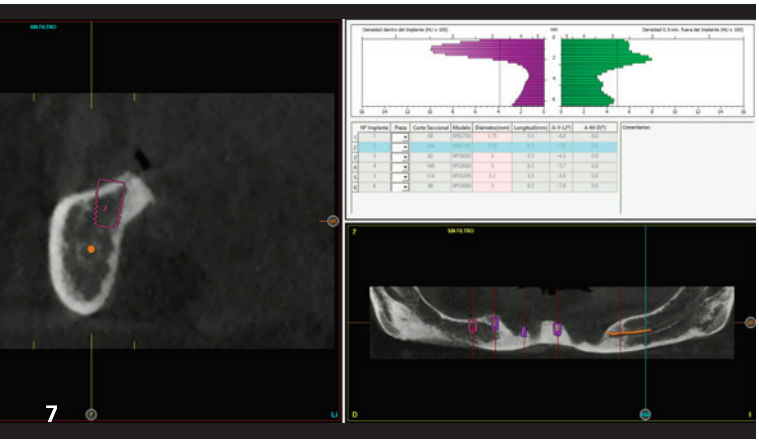
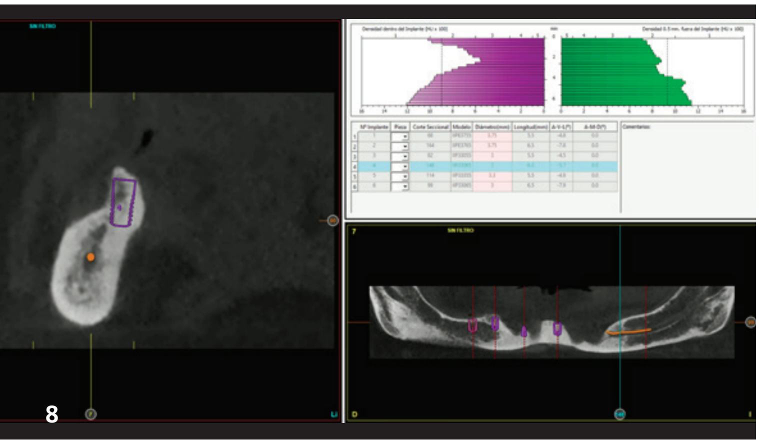


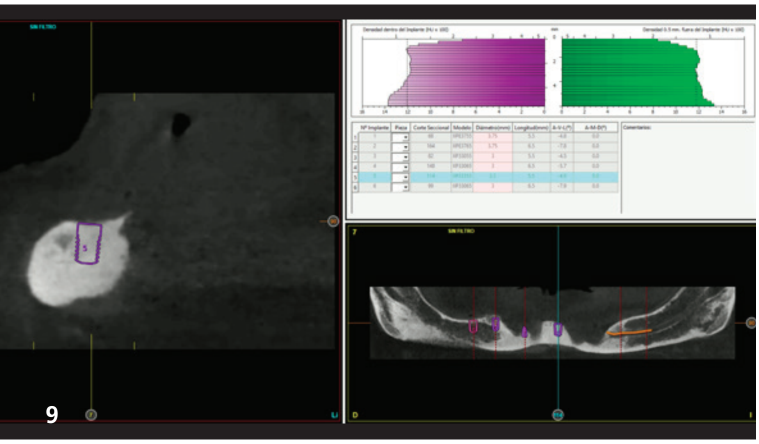
Fig. 4: 3D reconstruction of the mandible showing the most affected areas.











Figs. 5 & 6: Resorption in the bone defects caused by peri-implantitis and involvement of the dental nerve in the lower right quadrant, which had become superficial, lying only below soft tissue. **Figs. 7–9:** Planning of extra-short, narrow and reduced-platform implants in the mandible.

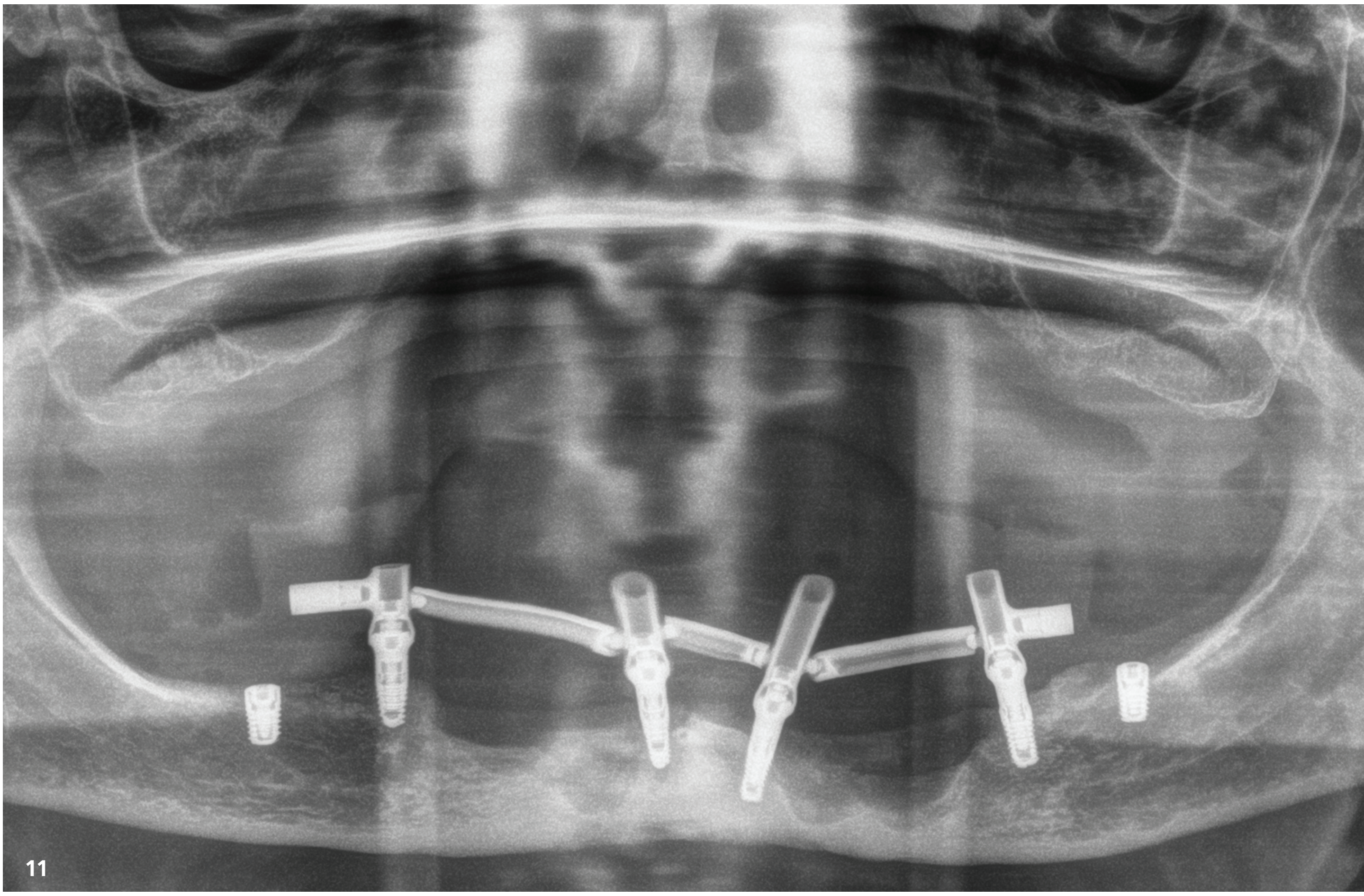
To continue with the diagnosis, a CBCT scan was performed to determine the residual bone volume and the therapeutic options available for the patient's rehabilitation. In the 3D reconstruction of the mandible, several defects were observed in the inter-foraminal area that reached the basal bone in some areas, thus compromising even the structural integrity of the mandible. In the lower right quadrant, there was also involvement of the dental nerve, which was exposed and covered only by soft tissue in the areas of greatest bone resorption (Fig. 4). In the cross-sectional sections of the most affected areas, only a few millimetres of residual bone height was observed (Figs. 5 & 6). Once the diagnosis had been completed, the insertion of implants was planned. In the areas with greater bone height, the placement of extra-short and narrow implants was planned, and implants of reduced platform and diameter (NobelActive 3.0, Nobel Biocare) would be placed in the areas of greater horizontal resorption (Figs. 7–9).

Once the implants had been placed, four of the six implants were immediately loaded with a hinged bar structure. This was possible due to the achievement of the correct primary stability in surgery (above 20 Ncm). The remaining two implants (the two more distal ones) with a lower insertion torque were left to heal. The prosthesis designed according to this technique was placed 12 hours after surgery, offering a fast and versatile approach to this type of prosthesis (Figs. 10 & 11).

The first phase of the mandibular treatment completed, the study of the maxilla was performed. In the diagnostic CBCT sections, extreme atrophy in both height and width of the area corresponding to the premaxilla could be observed. In some areas, the ridge width was 2 mm and the height between 3 and 4 mm, so in order to achieve direct insertion of implants in this area, it would be necessary to perform a sinus lift procedure in combination with the placement of extra-short and narrow-platform implants (Figs. 12 & 13).

10

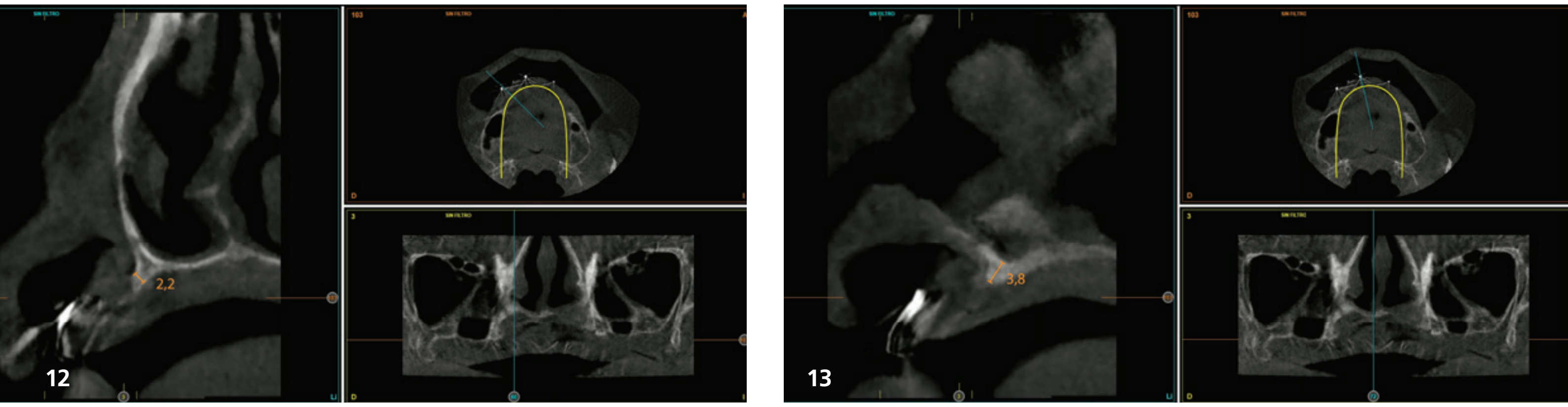
Fig. 10: Image of the patient with the immediately loaded mandibular prosthesis. **Fig. 11:** Panoramic radiograph with the prosthesis immediately loaded on the four implants of the anterior sector and the use of articulated bars.



11

To perform the sinus lift procedure, the technique described by our study group was used, in which biological drilling is used throughout and a socket is created with drills of increasing diameter and the sinus floor is removed with a specific front-cutting drill.[20–22] This drill, owing to its design with cutting blades at the tip arranged in a circular shape on its axis mounted on a cylinder without cutting capacity, allowed us to remove the inferior cortex of the sinus without damaging the internal membrane covering it. This design provides exclusively apical advancement capacity, which increases depth without damaging the nasal membrane. Once the sinus wall is exposed, it is carefully lifted with a specific instrument and detached to be able to insert the implant. According to the bone volume to be gained in the area, a graft (generally autologous bone obtained from drilling with Endoret PRGF [BTI Biotechnology Institute], autologous fibrin or biomaterial) can be placed beforehand or with implant insertion to maintain the elevation until new bone forms.

In the rest of the maxilla, short and extra-short implants were chosen for the two posterior sectors and reduced-diameter 3.0 platform implants in the areas of smaller bone width (Figs. 14–17). In this way, a minimally invasive approach to the entire maxilla was achieved, without loss of predictability, by avoiding grafting

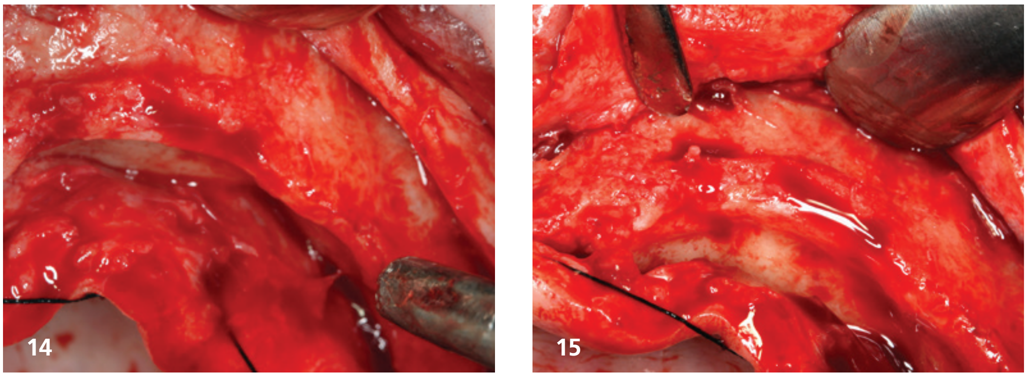


Figs. 12 & 13: Planning for implants in the maxilla. In some areas, such as the selected one, a width of less than 3 mm and a length of approximately 3–4 mm were observed, so an extra-short implant and sinus lift were planned.

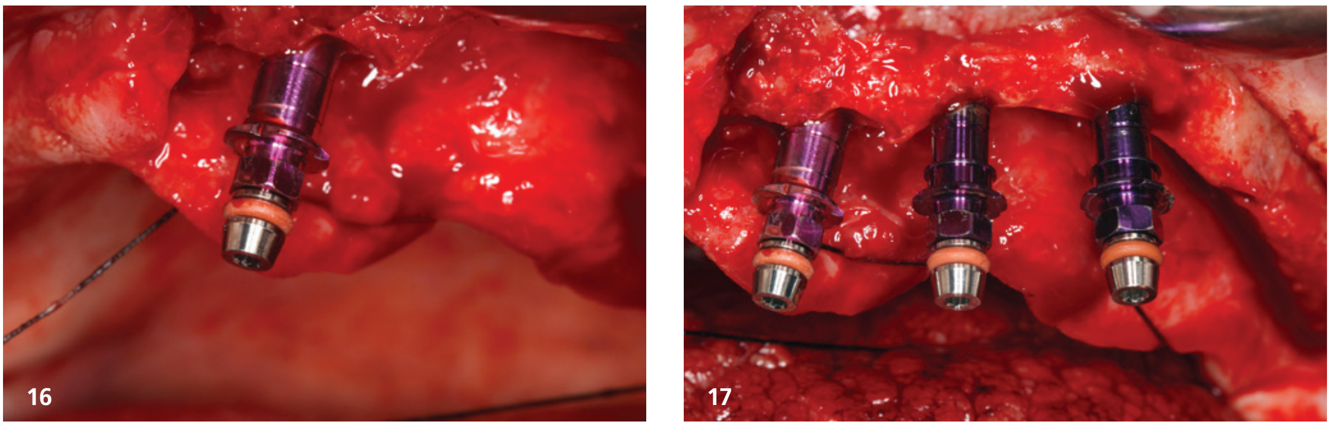
and regeneration techniques, which increase morbidity and the number of surgeries to be performed to achieve the patient's rehabilitation. All the implants placed in the maxilla were restored in two phases, immediately following the same technique as that used for the mandible.

Five months after the insertion of the maxillary implants, the second phase was begun with progressive loading of the maxilla. This prosthesis was fabricated in the same way as the immediately loaded prosthesis, using articulated bars. At this point, a new set of provisional prostheses were also prepared for the mandible, connecting the implants that were not loaded in the first phase to the initial implants (Figs. 18 & 19). The patient wore these prostheses for a few months to adapt the occlusion before placement of the definitive prostheses.

Six months after the placement of the progressive loading prostheses, the preparation of the definitive prostheses began. For this purpose, a wax-up transferring the parameters from the provisional prostheses was prepared that could be placed and adjusted in the patient's mouth for the definitive prostheses (Fig. 20). Once the tests had been completed, the definitive prostheses, both divided into three sections, were completed. This resulted in good occlusal and biomechanical behaviour and decreased the stress on the bone compared with conventional rigid unitary structures (Fig. 21).



Figs. 14 & 15: Bone ridge after flap raising and before insertion of the implants. The extreme bone atrophy, leaving a knife-edge ridge along practically its entire extent, was observed.
Figs. 16 & 17: Placement of implants with a reduced platform and diameter, avoiding bone augmentation.



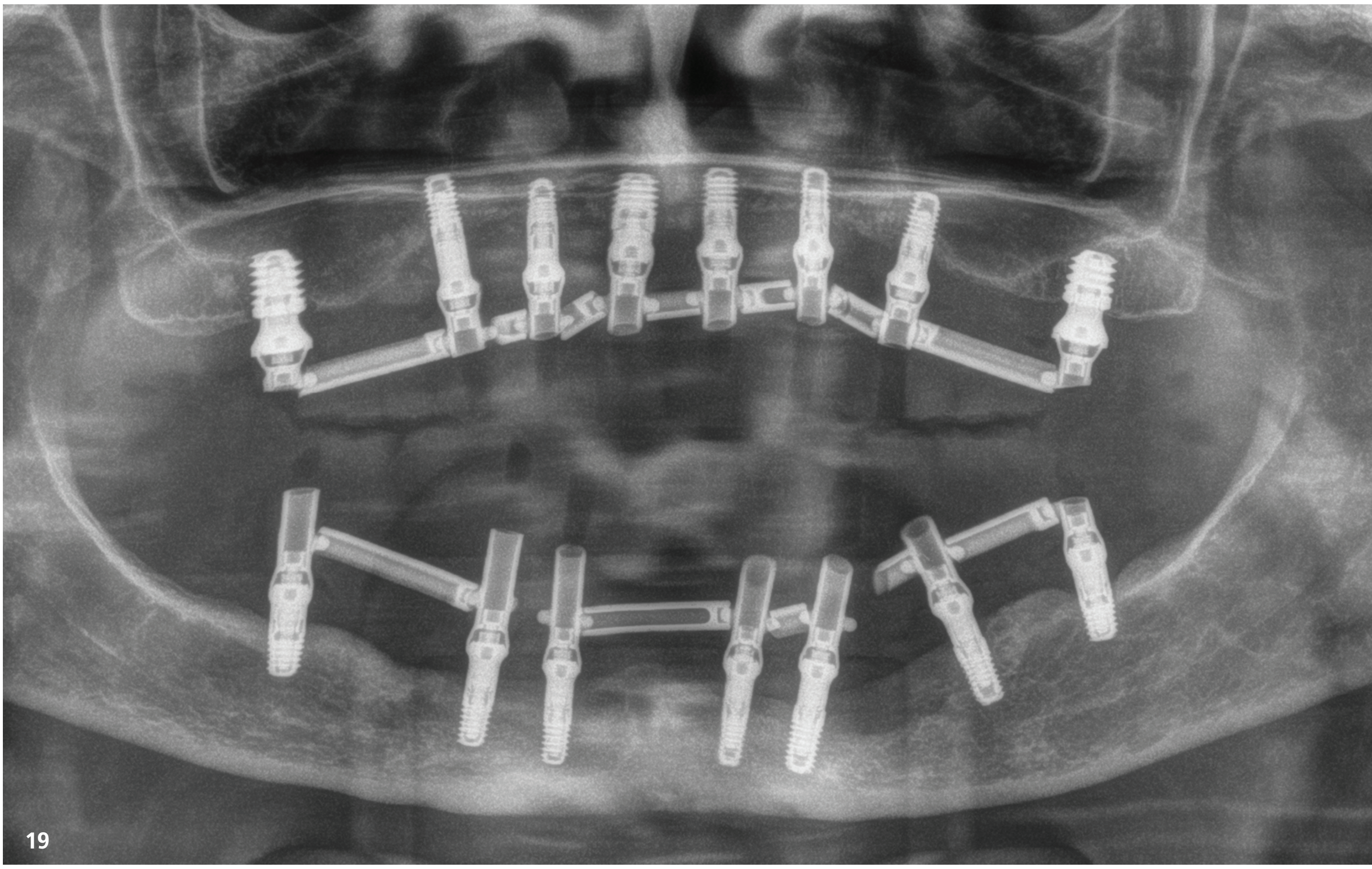


Fig. 18: Maxillary and mandibular progressive loading prostheses. **Fig. 19:** Radiograph with both progressive loading prostheses in place showing the construction by means of preformed bars, allowing rapid and efficient restoration and modifications to the structures and prostheses whenever necessary.

Discussion

When treating patients with severe horizontal atrophy, to ensure correct osseointegration and a good prognosis, it is necessary to have at least 1 mm of bone width surrounding the implant in the vestibular and lingual or palatal direction.[23–26] The reduction of the implant platform to 3 mm allows us to preserve this bone volume, avoiding the use of accessory regeneration techniques to obtain a greater bone volume.[23] In cases of severe combined vertical and horizontal atrophy, the use of short and narrow implants is also a highly predictable means of rehabilitating patients with minimally invasive techniques. As an alternative to more complex bone augmentation techniques, short and extra-short implants are a safe option for the rehabilitation of maxillary and mandibular areas with height atrophy and have long-term survival rates of over 98%.[27–31] Narrow implants also have survival rates of between 90 and 94%, although when the survival rate is differentiated from the expansion and/or regeneration techniques that generally accompany these implants, the rate is higher, reaching 100% in some studies.[32–35] In addition, in this case, along with short, extra-short and narrow implants, the sinus lift technique was used. This technique employing a novel insertion protocol published by our study group[20] allows the treatment of this area even in cases with a residual bone ridge

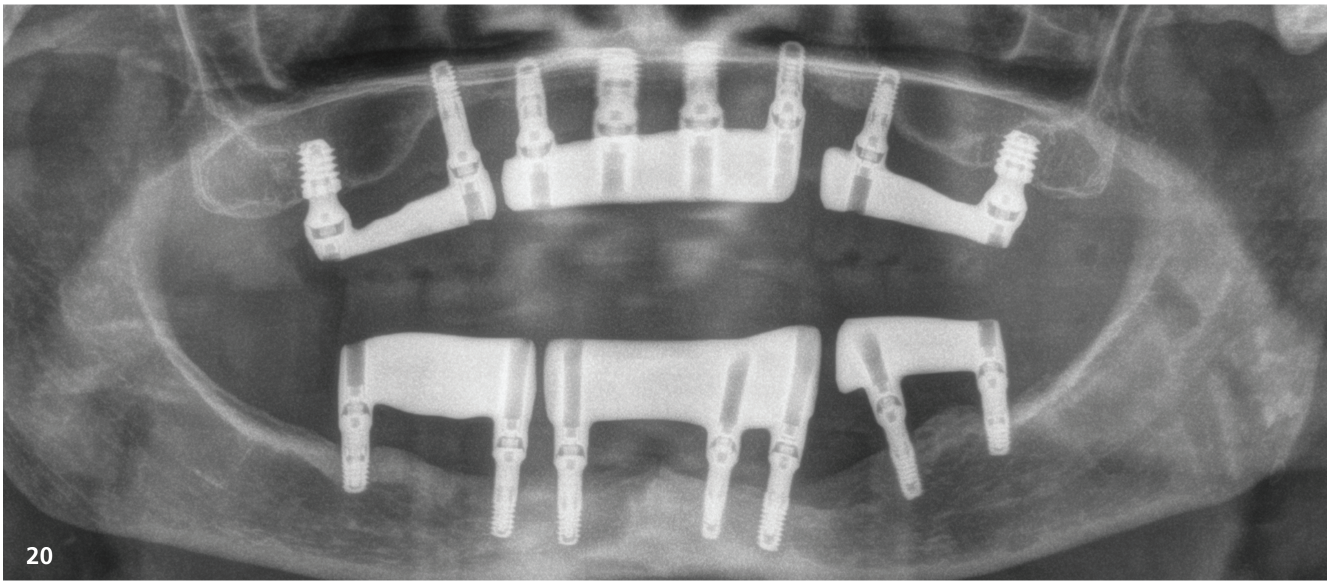


Fig. 20: Final radiograph of the patient after one year of follow-up wearing the definitive prostheses. The three-section division of both hybrid prostheses to improve the flexion of the bone (both mandible and maxilla) during masticatory movements can be observed. **Fig. 21:** Both prostheses *in situ*, showing the division into sections.

of less than 10 mm (the bone volume which research on sinus lift has employed until now).[36,37] With this new approach and the use of extra-short implants, critical situations can be solved with excellent results, as shown in the present clinical case.

Finally, I would like to mention the reversibility of our implant treatments. In this case, specifically in the mandible, we observed how the defects generated by failed implants had jeopardised the integrity of the mandible and the future rehabilitation of the patient. Whenever an implant treatment is performed, we must always think about the future of the treatment and therefore about the impact that our implants will have on the bone in case the treatment fails or an implant needs to be replaced. Therefore, the use of the smallest possible bone volume reduces the possibility of serious error in case of having to start our treatment again, and this approach should be a general strategy for every patient to be treated with implants, at least from my point of view.[38,39]

Conclusion

Cases of severe mixed bone atrophy are becoming increasingly frequent in the dental clinic. The use of minimally invasive techniques for their resolution too is becoming more frequent, and good long-term results have been achieved. Therefore, knowing all the procedures for successfully addressing this type of situation and carefully planning our cases can effect a difference in the results obtained. Finally, always preserving as much residual bone as possible by using implants of reduced length and diameter ensures that retreatments can be performed if necessary.

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