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**Indexed in:**  
 - IME  
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Date received: March 15, 2019.  
 Date accepted for publication:  
 September 25, 2019.



**Clinical case**

**Extreme vertical and horizontal atrophy combined in posterior mandibular sectors; use of short implants and 2-phase ridge expansion with transitional implants: A clinical case**

*Published in spanish Científica Dental Vol. 16. Nº 3. 2019  
 www.cientificadental.es*

**ABSTRACT**

The objective of this work is the presentation of a clinical case in which we show two surgical techniques to solve the horizontal bone atrophy.

Currently in implant dentistry, we are increasingly faced with cases of extreme bone resorption that force us to implement different surgical dental implant techniques. The coexistence of vertical and horizontal atrophy makes successful resolution of these cases more difficult, as well as having to face these types of more complicated situations with increasing frequency, due to patients demanding implant treatment even in such very severe cases. It is not uncommon therefore to use combined techniques which include ridge expansion or short implants, for example. The following clinical case presented advanced horizontal and vertical alveolar atrophy in the right and left posterior regions of the mandible. The treatment plan included the use of short implants for the vertical atrophy and a two-stage alveolar ridge split to treat the horizontal atrophy.

**KEYWORDS**

Bone atrophy; Split crest; Short implants.

## INTRODUCTION

Approaching the posterior sectors of the maxilla with extreme resorption is a common situation in dental practice. The loss of antral teeth produces pneumatisation of the maxillary sinus, which progressively occupies the space corresponding to the dental roots, in some cases leading to complete atrophy and in a residual bone height of 1-2 mm after the dental socket heals. This pneumatisation occurs over time after tooth extraction, but is unpredictable in terms of quantity and speed, and appears to be slightly related to the type of relationship that occurs between the apex and the sinus. This relationship was described by Sharan and Madjar in 2008, who established a classification with greater pneumatisation is expected in its types 3 and 4 (Figure 1)<sup>1</sup>.

Until the arrival of short and extra-short implants, the only alternative treatment in these cases was sinus elevation



Figure 1. Initial images of the patient where we can see (A) the removable prosthesis and (B) the critical defects, especially at the antero-inferior level.

(laterally or transcrestally), and there were different techniques and procedures for this. The attempt was to gain the lost bone volume and the subsequent insertion of conventional length implants at this level<sup>2-6</sup>.

The development of short implants and the entire technique for their use sometimes allows the insertion of implants in large posterior vertical atrophies of the maxilla, avoiding sinus elevations.

Nowadays, most authors accept short implants to be those with a length less than 8.5 mm, although there are many cases of lengths well below this figure<sup>7-9</sup>. Extra-short implants, meanwhile, have more variation in terms of their classification; although the latest articles published consider extra-short implants to be those with a length less than 7 mm<sup>10-12</sup>. These shorter implants mean less morbidity for patients, at the same time as it is now possible to rehabilitate patients who may refuse to have additional techniques performed. These are sinus elevation and even more complex techniques which may be contraindicated in these patients for different medical reasons<sup>13-17</sup>. These short and extra-short implants can be inserted in the atrophic areas of the maxilla directly without displacement of the lower sinus cortex and without therefore having to manoeuvre the maxillary sinus. The main surgical challenge with this technique is to achieve implant stability, since generally in these cases we are faced with little remaining bone height and with high porosity<sup>18-22</sup>. Therefore, the establishment of a careful surgical protocol based on drilling into the receptor bed depending on its condition is key to the success of these treatments<sup>13-17</sup>.

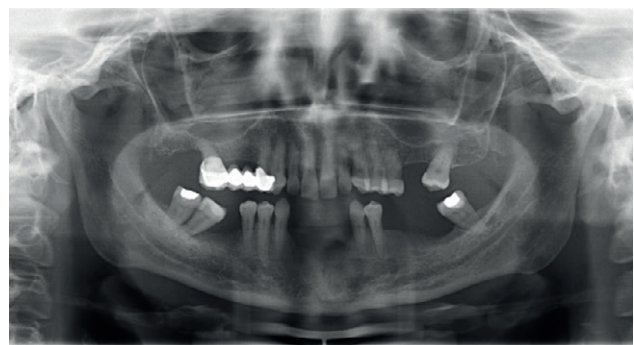


Figure 2. Panoramic radiograph showing the defect in tooth 47 and the edentulous areas.

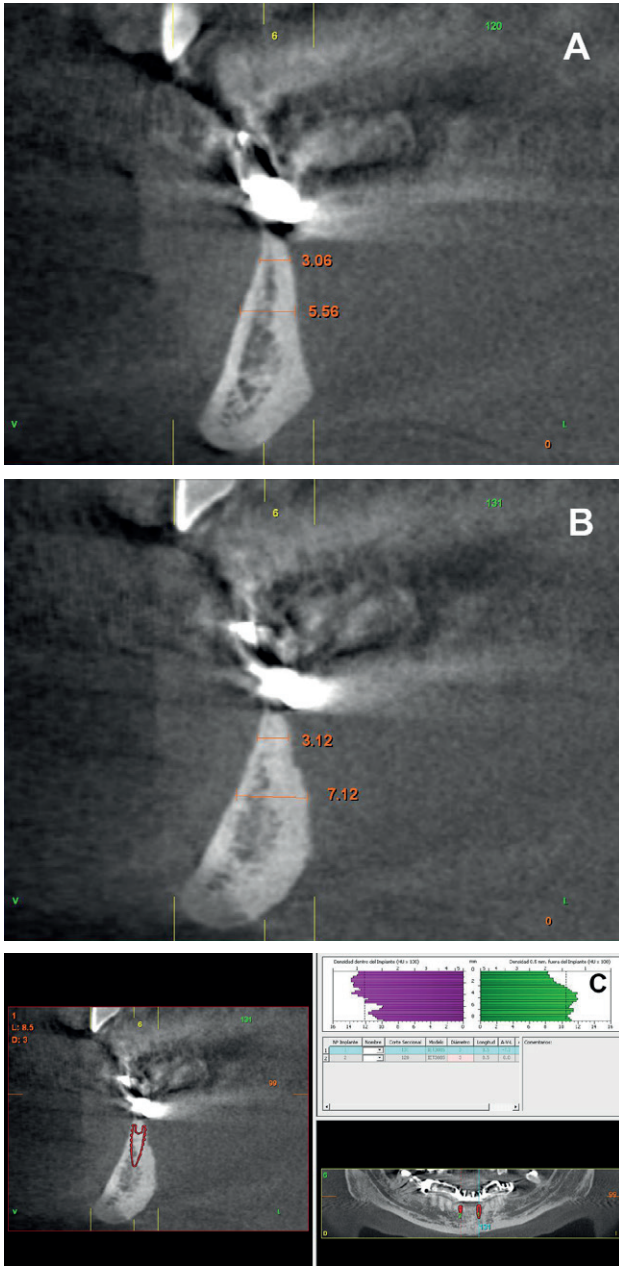


Figure 3. Dental CBCT planning images showing the extreme horizontal resorption of the antero-inferior sector in the incisor area; (A) area corresponding to tooth 42 (B) area corresponding to tooth 32 (C) Planning of the expander implant in the CT cut.

The clinical case described is of a patient receiving both procedures: extra-short implants inserted directly into one maxillary quadrant and a sinus lift with conventional length implants in the other quadrant. The evolution of both treatments in the same patient was able to be observed over eight years.

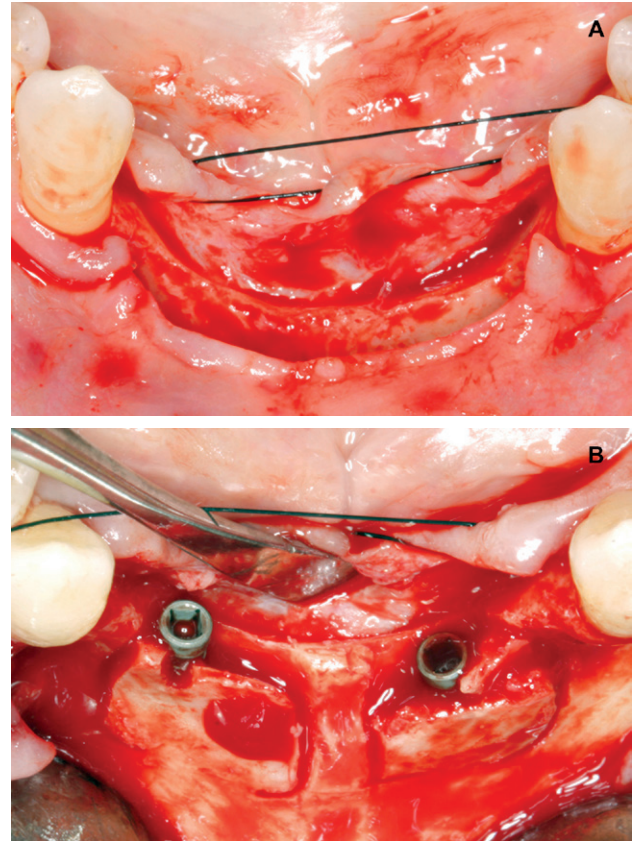


Figure 4. (A) surgery image showing extreme horizontal resorption and (B) the insertion of the two transitional implants for the ridge split in two phases.

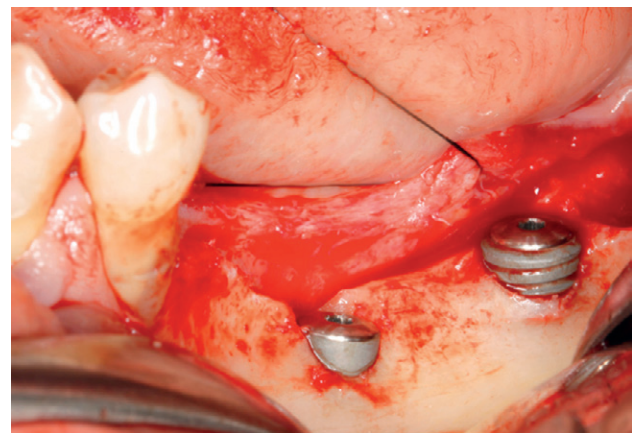


Figure 5 Insertion of the third quadrant implants where the uneven resorption of the mandible can be seen, leaving a lower bone height at the vestibular level. This leaves part of the coils uncovered.

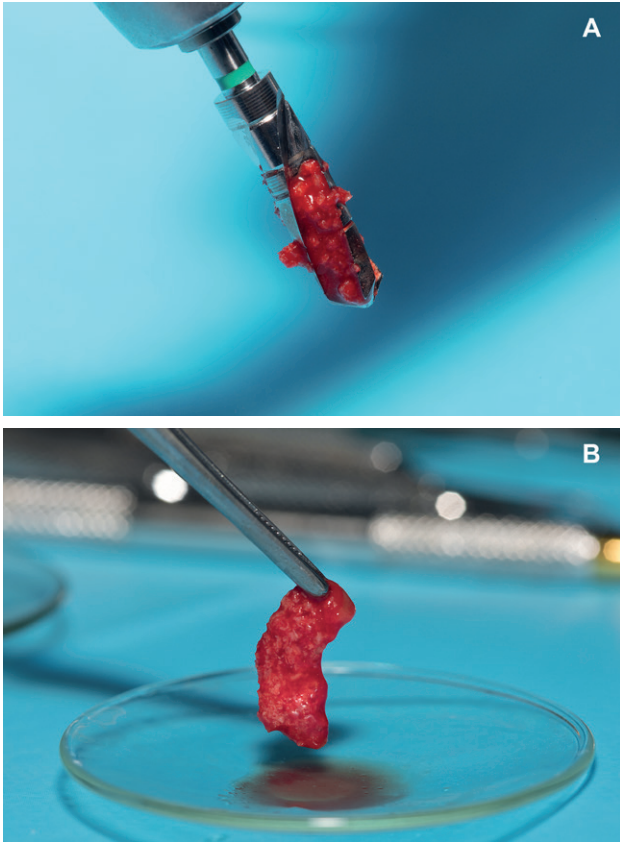


Figure 6. (A) Obtaining autologous bone from drilling and (B) performing a particulate bone graft composed of the bone from the drilling soaked in freshly activated PRGF-Endoret, ready for placement.

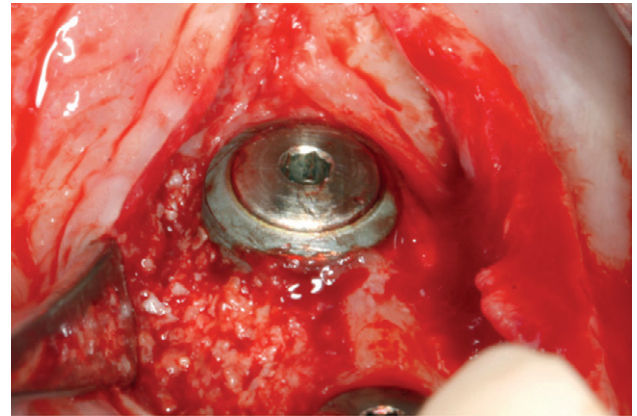


Figure 7. Particulate graft placed on the implants to achieve vertical growth.

## CLINICAL CASE

This was the case of a 58-year-old female patient who attended the dentist practice to assess the 16th and 17th molars for pain and mobility. On clinical examination, mobility of both was observed with suppuration at the level of the sulcus. Radiography confirmed our diagnosis of considerable bone loss and sinus perforation at the apex of both molars (Figure 2).

Both teeth were extracted and alveoli regenerated with PRGF-Endoret to seal the perforation and provide the most favourable evolution possible for subsequent insertion of the implants in the area.

After two months, the dental cone-beam showed the perforation had

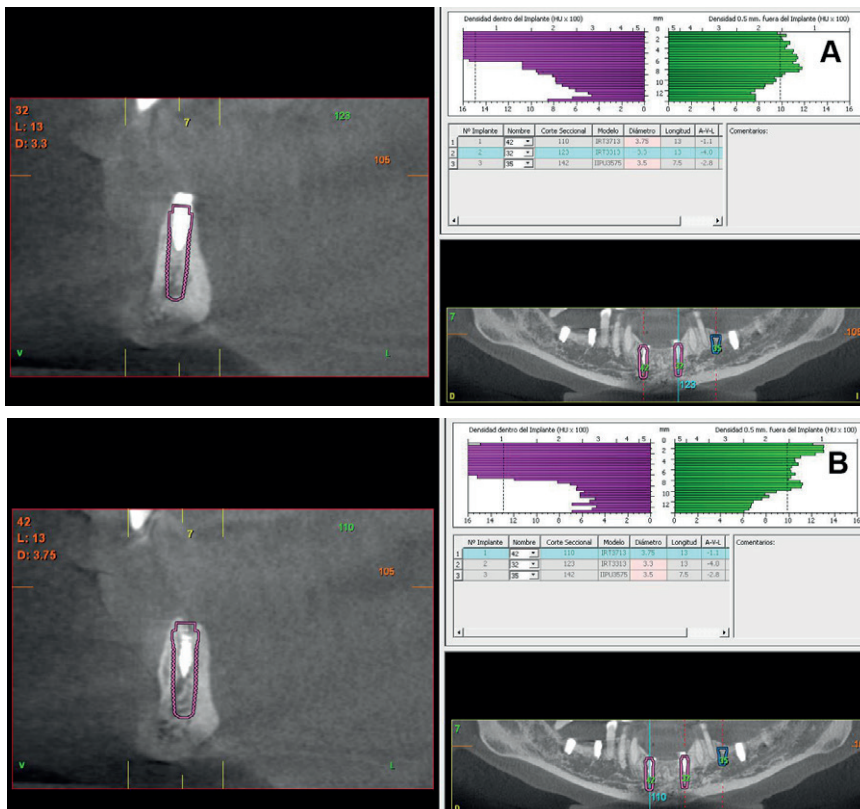


Figure 8. Planning the implants, where the gain in width achieved at the antero-inferior level can be observed. (A) position 42, (B) position 32.

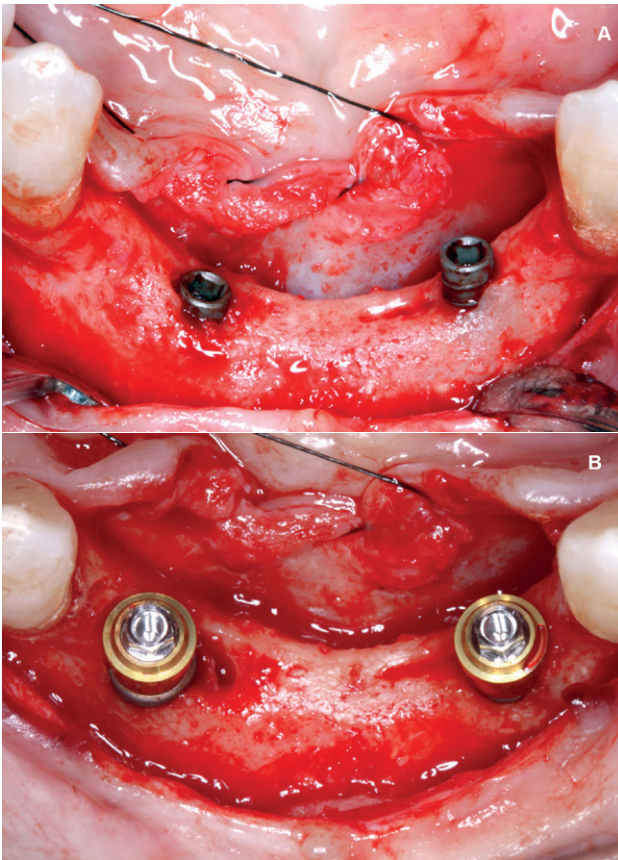


Figure 9. Surgery images showing (A) the appearance of the area before removing the transitional implants and (B) the new implants inserted in the anterior area with the transepithelial ones for immediate loading.

closed completely but the residual bone volume provided 2 mm of bone height only, which was insufficient to insert the implants (Figures 3 and 4).

Therefore, it was decided to carry out a sinus lift using biomaterial (bovine hydroxyapatite) bound to PRGF-Endoret. The elevation was performed and after five months a new dental cone beam displayed the quantity and quality of the graft obtained for the insertion of dental implants. In the cuts corresponding to the molars of the first quadrant, we observed excellent consolidation of the graft with space to insert 13 mm implants. Today, we would not choose this implant length, since studies published by our group with short and extra-short implants support their use, in addition to showing their diameter is more important than the length to distribute the loads of an

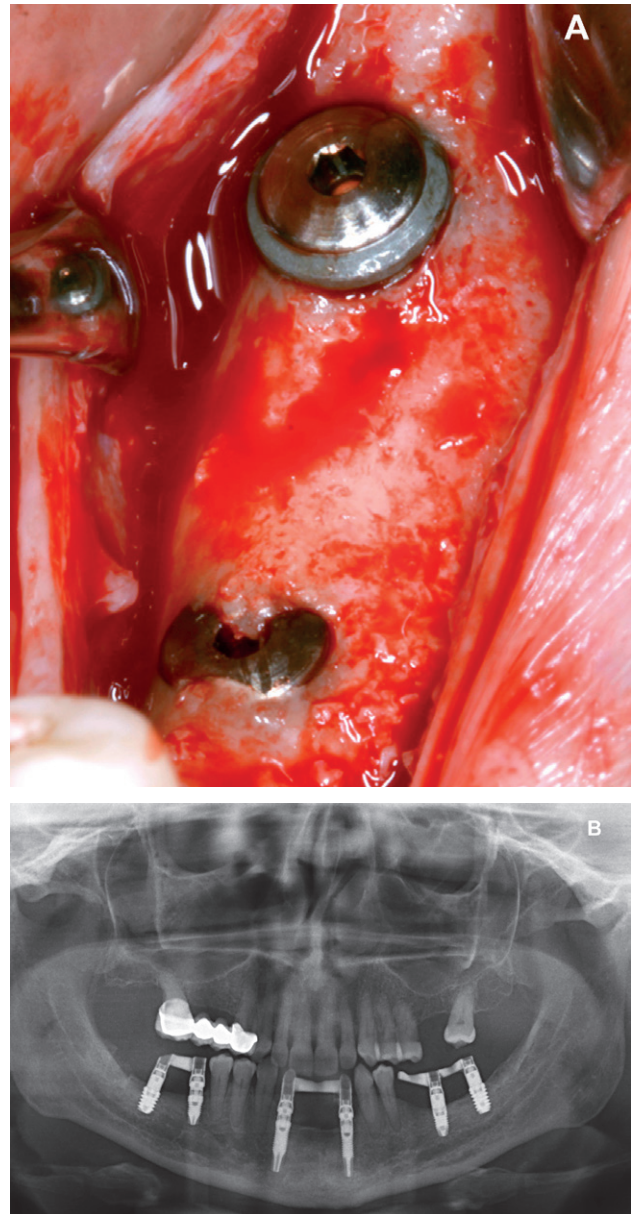


Figure 10. (A) Clinical image after vertical growth of dental implants and (B) radiography with immediate anterior loading prosthesis and posterior progressive loading prosthesis

already integrated implant; where an 8.5 mm length implant would work in the same way as a 13 mm implant of the same diameter<sup>18</sup>.

Back in 2007, the therapeutic protocol for these cases was very different (Figures 5-7), with short implants without full development - and without studies demonstrating the importance of diameter over implant length - efforts were

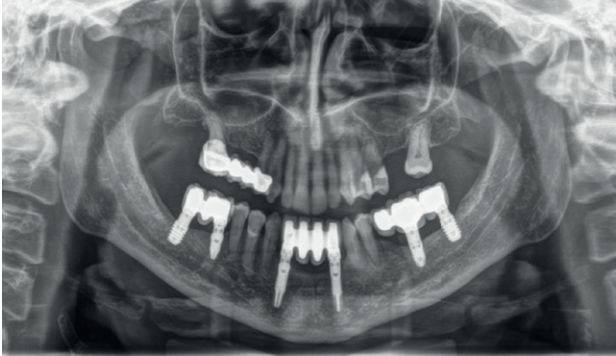


Figure 11. Follow-up radiograph at 5 years.

focused on the search for anchorage by implant length instead of looking for the bicortical (vestibular-lingual) stability that short and wide implants perform. During this time, the failure of molars 46 and 47 also occurred; these were also extracted and replaced with dental implants.

Six months after implant placement, the final prosthesis was made by using a cemented bridge. This prosthetic protocol is also not one we currently use, where tightness, sealing and the use of screw-retained prostheses using an intermediate or transepithelial component prevail. However, at that time, this type of rehabilitation and the conformation of a “bio” emergence profile in the abutments was how these cases were treated (Figure 8)<sup>13-18</sup>. The implementation of transepithelial implants in screw-retained prostheses opens a new horizon in the prosthesis, changing our working group protocol of towards an improvement in the implant-prosthesis seal, at the same time as prosthetic imbalance is reduced (due to taking the impression directly on the transepithelial and not on the implant connection) and tightness is improved; which reduces the risk of peri-implantitis, among other things<sup>19-20</sup>.

After 4 years, the second and third quadrant molars began to have excessive mobility and serious periodontal problems, so it was decided to remove them and regenerate the alveoli with PRGF-Endoret. Once the area was regenerated (a month and a half later), a cone-beam was performed to evaluate the residual bone volume. It can be seen how there was an uneven bone crest with areas of 3.3 mm in height up to a maximum of 7 mm (Figures 9 and 10). On this occasion, due to

the protocol change described above, we opted for the direct insertion of extra-short implants, since the surgical protocols to address this type of situation in 2011 varied substantially, with these implants being a first-line tool for the treatment of this type of atrophy (Figure 11). Two extra-short implants were selected (5.5 mm diameter x 6.5 mm length for tooth 26, and 6 mm diameter x 5.5 mm length for tooth 27).

Six months after the insertion of the extra-short implants, the final prosthesis was inserted; in this case, screwed and with an intermediate (transepithelial) component; just as the lower prosthesis in the third quadrant was made. At this point in time, the philosophy of work using a screw-retained prosthesis with a transepithelial and the search for tightness and passive fit were the dominant concerns for implant rehabilitation, and this is still so today (Figure 12).

Finally, the stability of both treatments can be seen in the final X-ray at 8 years of age, where both are stable without bone loss (Figure 13).

## DISCUSSION

Therapeutic protocols in implantology have evolved markedly in recent years, moving towards minimally invasive approaches, without renouncing reliability. Therefore, short and extra-short implants are an option used increasingly to avoid aggressive surgeries with high morbidity, and are also an alternative for the rehabilitation of the atrophic posterior maxilla in height, avoiding having to use techniques to lift the sinus when the residual bone height allows<sup>15-17</sup>.

Since the description of the conventional sinus lifting technique (lateral window) by Tatum in 1986<sup>22</sup>, this procedure has been used for the rehabilitation of posterior maxillary sectors with vertical atrophy, with highly successful rates, currently around 98%, and long-term follow-up (over 15 years)<sup>26-27</sup>. A drawback of this technique is that it can cause perforation of the Schneiderian membrane and, although today this is no longer an exclusion for the insertion of implants in the same surgery (depending on the extent of the perforation and the case), when this perforation occurs, the success

rates of implants inserted in these areas decreases to 88.6%<sup>6</sup>. In addition, the need for several surgeries together with a greater increase in patient morbidity, make us opt for less invasive techniques, such as short implants. When inserted in edentulous posterior sectors with elevated vertical resorption, these implants have a lower rate of surgical and prosthetic complications and less marginal bone loss; they are therefore a reliable alternative to bone augmentation procedures and subsequent implant insertion<sup>28</sup>.

Summers in 1994 described the first variation of the lateral approach technique with a modification to reduce its invasiveness. This technique consists of an approach from the alveolar crest through the use of progressive calibre osteotomes that make a hole that serves both for the elevation of the Schneiderian membrane and the subsequent placement of the dental implant<sup>29</sup>. This technique has been widely used for the crestal approach of the extreme posterior resorption of the maxilla, with survival figures of the inserted implants between 88.65%<sup>30</sup> and 100%<sup>31</sup>.

Other techniques have been used to approach the atrophic posterior maxilla to varying degrees; such as bone

distraction, zygomatic implants, en bloc grafts and guided bone regeneration. All of them have similar success rates to the two shown in this clinical case; with the short and extra-short implants being the ones with the lowest rate of complications and morbidity for the patient<sup>32-35</sup>.

Long-term survival of short implants also has a very similar rate to that of long implants with sinus lift; therefore, both can be considered as the technique of choice. However, from the point of view of morbidity, the short implants are the better alternative<sup>36-37</sup>.

## CONCLUSIONS

In the clinical case described, both therapeutic alternatives show successful treatment for this clinical situation and this specific patient, and can be considered equally valid for resolving the vertical atrophy of the maxilla. For cases with a higher degree of vertical atrophy or those with different bone density and residual volume, the application of one or another technique must be assessed for the success of the treatment.



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