Rehabilitation of maxillary unilateral posterior edentulism

Drs Jean-Baptiste Verdino, Sepehr Zarrine, Thierry Louvet & David Mardenalom, France

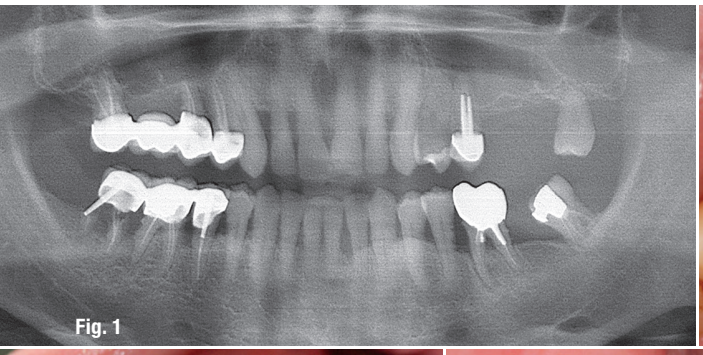
There are two options for treating partially edentulous maxillae: a removable partial denture or an implant-supported fixed partial denture. The resorption of the upper jaw, in association with maxillary sinus pneumatisation, often requires pre-implant surgery, such as inlay/onlay grafting or crestal/lateral sinus lift to allow the insertion of regular implants. A graftless approach including tilted implants,[1] such as zygomatic implants, has been proposed to avoid long-lasting treatment sequences.

Zygomatic implants

Introduced by P.-I. Brånemark in the 1980s, the zygomatic anchorage was developed to treat patients after a complete or partial maxillectomy.[2–4] The development of this technique allowed the rehabilitation of completely edentulous atrophied maxillae. The process was then described as an alternative to a sinus lift.[5] This procedure requires the insertion of a 30.0–52.5 mm long titanium implant (NobelZygoma, Nobel Biocare) from the maxillary edentulous ridge to the zygomatic bone, with an intra- or extra-sinus path (ZAGA classification[6]). The diameter of the apical part is 3.9 mm, while the maxillary part is 4.1 mm. The platform is a 4.2 mm external hexagon with a 45° angle to allow for the prosthetic restoration.

Completely and partially edentulous maxillae

The original protocol for treating completely edentulous maxillae was carried out using two zygomatic implants and two or four regular implants inserted in the anterior maxilla.[7] In the case of terminal atrophied maxillae, a quadruple zygomatic implant placement can currently be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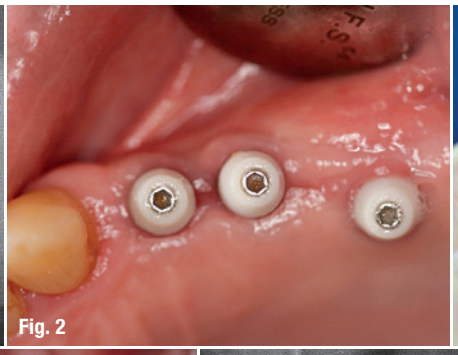
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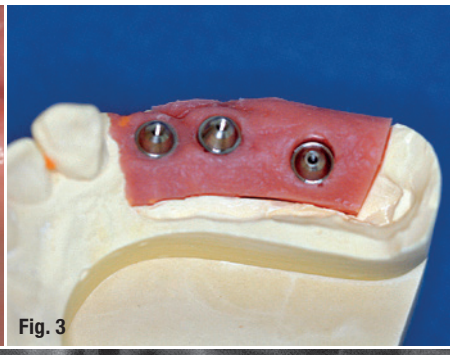
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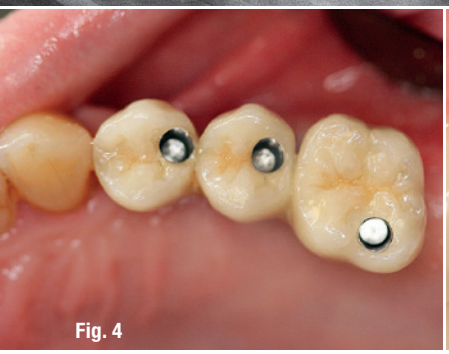
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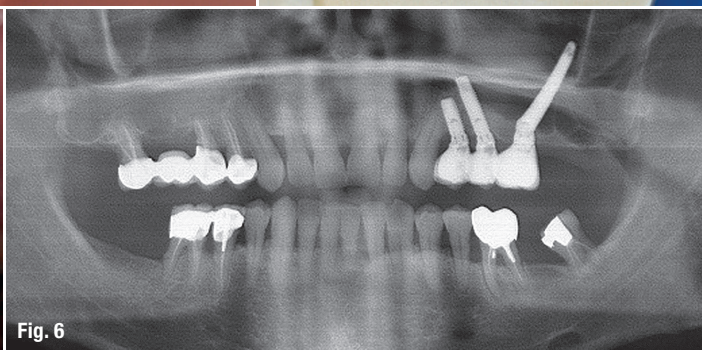


Fig. 6

Case 1—Fig. 1: Pre-op radiograph: the two premolars and the third molar of the left maxilla would have to be extracted, and there was insufficient bone quantity under the sinus to allow for implant placement. **Fig. 2:** The impression was taken after a healing period of four months. **Fig. 3:** Master model, in which the emergence of the zygomatic implant is in the region of the palatal root of the first molar. **Fig. 4:** A porcelain-fused-to-metal fixed partial denture (ceramic on titanium) was screwed on. **Fig. 5:** Buccal view of the fixed partial denture. **Fig. 6:** Control radiograph: the treatment of the case was completed in five months.

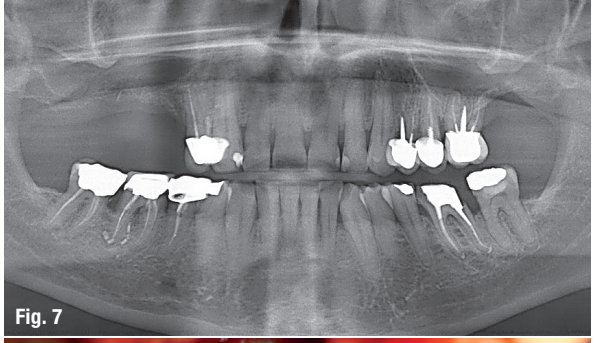
achieved: a traditional molar zygomatic implant and an additional canine zygomatic implant are inserted on each side of the maxilla.[8,9] The treatment of unilateral posterior edentulism must be considered as a high priority considering the loss of masticatory efficiency. There is rapid resorption of bone of the alveolar ridge immediately after tooth extraction. The insertion of a zygomatic implant in this situation is not available considering the biomechanical aspect. The zygomatic implant has to be used with other implants to allow the stabilisation of the restoration. This solution can then be considered only in the case of extractions of the molars in association with avulsion of the premolars.

Case reports

All the patients were healthy non-smokers with satisfying oral hygiene and no general diseases. They desired improvement in comfort, aesthetics and quality of life with a fixed solution. The remaining teeth were not sufficient to support a fixed partial denture. For the treatment of the unilateral posterior edentulous area of their maxillae, two approaches were presented to each patient. On the one hand, a reconstructive option would entail the extraction of the hopeless teeth, the insertion of immediate implants if possible and the achievement of a lateral sinus lift during the same surgery. After six months of healing with a removable partial denture, the remaining implants could be inserted to complete the implant treatment. On the other hand, a graftless solution was proposed, which would involve placing two regular implants in the premolar region and a zygomatic implant in the molar area or a regular implant associated with one zygomatic implant and one pterygoid implant. These three implants connected to healing abutments could be loaded after a four-month period of healing or loaded immediately with a provisional screw-retained fixed partial denture. All the risks of the two options were explained to the patients before they made the final decision. In these three reported cases, the graftless approach was selected because of the shorter duration of the treatment and fewer number of surgeries required. The cost of each treatment was similar for the two options.

Case 1

A 56-year-old male patient presented for the rehabilitation of his partially edentulous left maxilla, complaining of low masticatory efficiency. Teeth #26 and 27 had been extracted and had not been restored, while teeth #28 and 24 were mobile. Tooth #25 was endodontically infected. These three teeth were under a high level of occlusal load. They presented a low level of surrounding bone and were diagnosed as hopeless teeth. We noted a generalised but stable periodontitis (Fig. 1). Two cylindrical self-tapping implants (Brånemark System Mk IV TiUnite regular platform [RP], Nobel Biocare) of 10 and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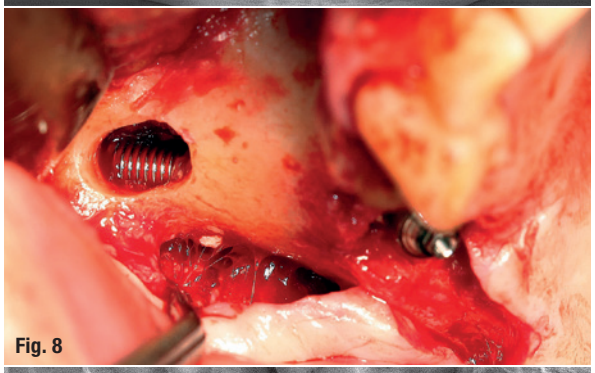
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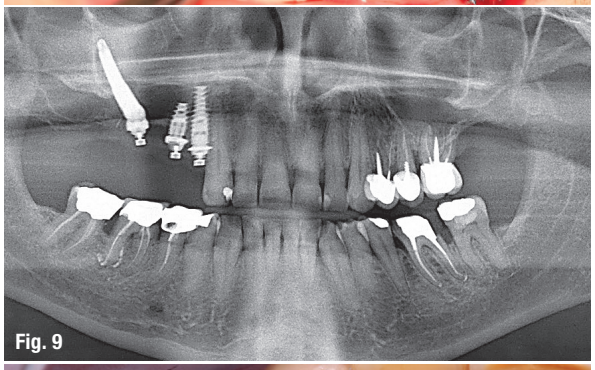
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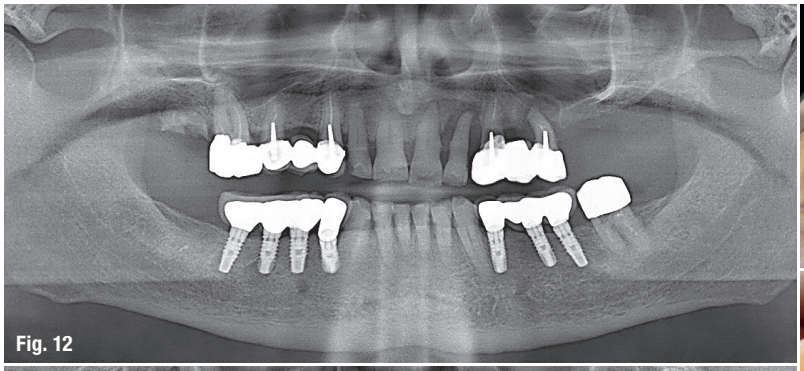
Fig. 10

Fig. 11

Case 2—Fig. 7: Pre-op radiograph: the first premolar would have to be removed and there was insufficient bone under the sinus. **Fig. 8:** A zygomatic implant was placed across the sinus. **Fig. 9:** Two regular implants were inserted in positions #14 and 15 (implant #14 was immediately placed after extraction), and a machined 45 mm Brånemark zygomatic implant was placed into position #14. **Fig. 10:** Full-zirconia fixed partial denture. **Fig. 11:** Buccal view.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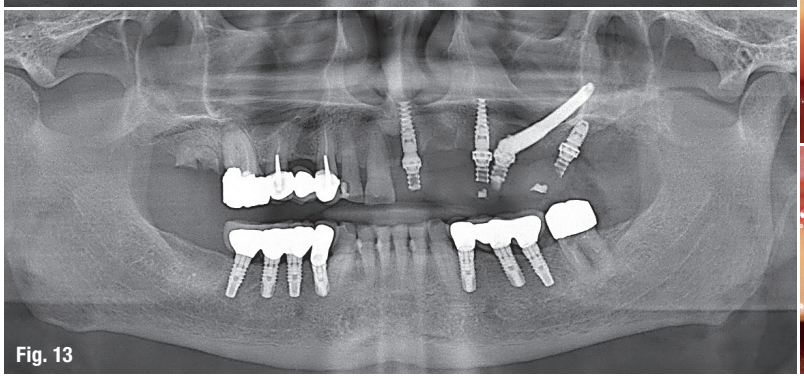
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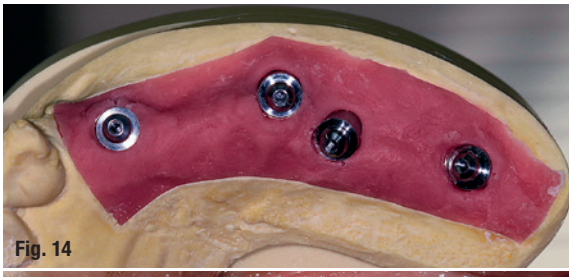
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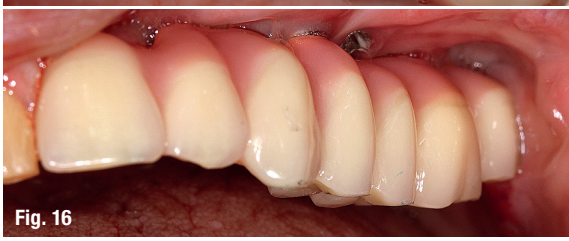


Fig. 16

Case 3—Fig. 12: Pre-op radiograph: all the teeth of the left maxilla would have to be removed owing to periodontal disease. **Fig. 13:** Three implants were placed into the remaining bone, completed by a 42.5 mm zygomatic implant. **Fig. 14:** Master model, in which the emergence of the zygomatic implant is slightly palatal. **Fig. 15:** Titanium screw-retained fixed partial denture with pink acrylic and composite teeth. **Fig. 16:** Buccal view.

15 mm in length and 4 mm in diameter were inserted as replacements for teeth #24 and 25, respectively, while a 35 mm long zygomatic implant was inserted in position #26. A provisional non-functional screw-retained fixed partial denture was immediately connected to the three implants, considering their sufficient insertion torque. A 3 mm 17°, a 2 mm 17° and a 3 mm straight RP multi-unit abutment (MUA, Nobel Biocare) were used for the screw-retained fixed partial denture. The final fixed partial denture was connected after four months of healing (Figs. 2–6).

Case 2

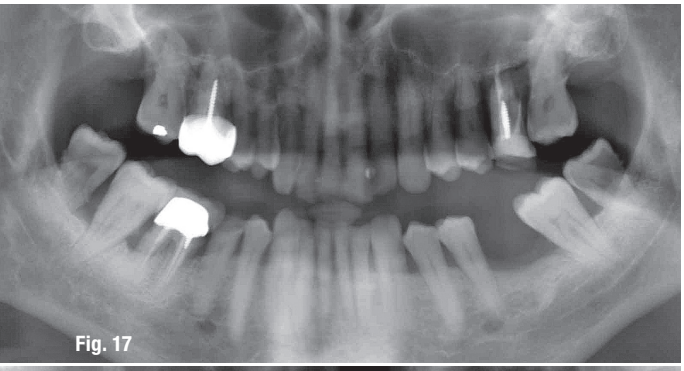
A 40-year-old male patient presented for rehabilitation of his right maxilla. Tooth #14 was infected by an abscess due to root fracture (Fig. 7). At the time of the extraction of tooth #14, teeth #14 and 15 were replaced by a 10 mm long and an 8 mm long NobelActive RP straight implant (Nobel Biocare), respectively, while a 40 mm long zygomatic implant was inserted in position #16 (Figs. 8 & 9). These three implants were connected to a screw-retained fixed partial denture by the use of a 1.5 mm MUA and a 2.5 mm 17° MUA for implants #14 and 15 and a 1 mm straight MUA for the zygomatic implant after four months of healing (Figs. 10 & 11). Note that the use of a machined zygomatic implant allows the use of a larger range of MUAs, which is not possible with TiUnite zygomatic implants (only 3 and 5 mm MUAs are available).

Case 3

A 70-year-old male patient presented for the treatment of his left maxilla. He presented with a fixed partial denture extending from tooth #23 to tooth #25. Tooth #24 presented a vertical fracture, due to occlusal overload. Teeth #21 and 22 presented a high degree of mobility (Fig. 12). Three NobelActive narrow-platform implants were inserted into the remaining bone: tooth #21 was extracted and immediately replaced with an implant, while two other implants were placed, one in position #23 and one in the tuberosity. Three MUAs (Nobel Biocare) with a diameter of 1.5 mm were immediately screwed on. A 42.5 mm long zygomatic implant was placed between tooth #25 and tooth #26, and received a 1 mm MUA (Fig. 13). Immediate loading was performed with a screw-retained full-acrylic fixed partial denture. After a healing period of four months, a seven-unit fixed partial denture of acrylic on a titanium frame (NobelProcera, Nobel Biocare) was inserted (Figs. 14–16).

Case 4

A 65-year-old patient with periodontal disease had an infection of the posterior maxillary area and tooth mobility involving a lack of alveolar bone in the molar area (Fig. 17). The radiographic examinations, panoramic radiograph and 3D imaging, showed sinus infection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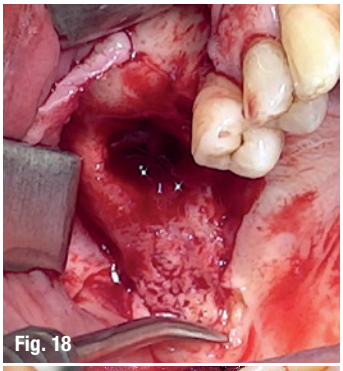
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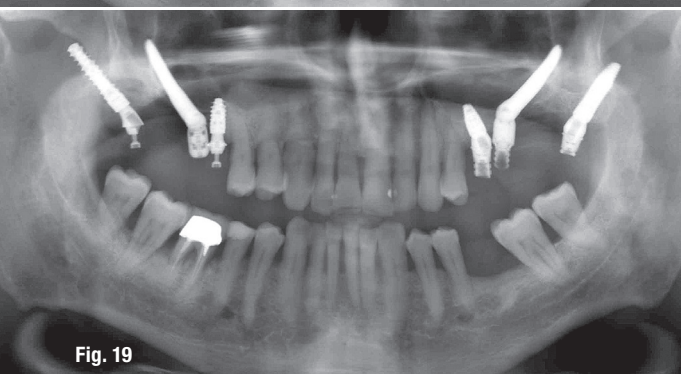
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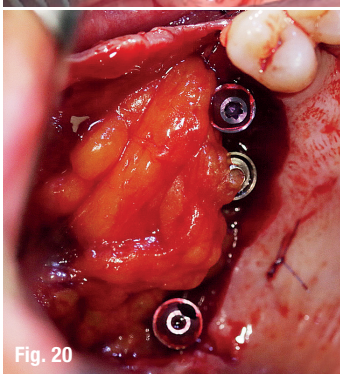
Fig. 20

Case 4—Fig. 17: Initial situation with periodontal disease, infection of the posterior maxillary area and lack of alveolar bone. **Fig. 18:** Right sinus with an oroantral communication. **Fig. 19:** Immediate loading on both sides with regular, zygomatic and pterygoid implants. **Fig. 20:** The machined zygomatic implant partially closed the oroantral communication and the rest was closed by the pedicled buccal fat pad.

linked with the teeth. Firstly, teeth #16, 17, 25, 26 and 27 were extracted. The left sinus quickly became healthy, while the right sinus developed a new phase of purulent sinusitis. The left side was implanted with a Straumann BLT implant of 8.0 mm in length and 4.1 mm in diameter in position #25, with a straight screw-retained abutment. In position #28, a Straumann BLT implant of 16 mm in length and 4.1 mm in diameter was anchored in the pterygoid notch, and a 25° angulation screw-retained abutment was screwed on. A 40 mm long zygomatic implant (Nobel Biocare) was inserted in position #26. In the same surgery, the right sinus was drained by an existing unhealed oroantral communication. On the same day, a provisional non-functional fixed partial denture was screwed on to the three implants. The right side was implanted after six weeks in order to work with a healthy maxillary sinus, but there was still an oroantral communication (Fig. 18).

After locating the pterygoid hamulus, which helps to avoid the descending palatine artery, a pterygoid implant was inserted in position #18. A Straumann BLX implant of 3.75 mm in diameter and 18.00 mm in length was placed and a 25° angulation screw-retained abutment was used to achieve the axis correction of this implant. In position #16, with low bone height, another BLX implant (3.75 mm in diameter and 8.00 mm in length), with an extensive self-drilling capacity, provided high primary stability and a straight screw-retained abutment was screwed on at 35 Ncm. A 40 mm long Neodent zygomatic implant was strongly anchored in the zygomatic bone (Fig. 19). The machined surface of this implant allowed partial closure of the oroantral communication, the rest of which was covered by the pedicled buccal fat pad (Fig. 20). The implants were loaded immediately with a provisional screw-retained fixed partial denture. After five weeks, the two sinuses were perfectly healthy (Fig. 21). The final screw-retained fixed partial dentures were connected on both sides after four months of osseointegration (Figs. 22–24).

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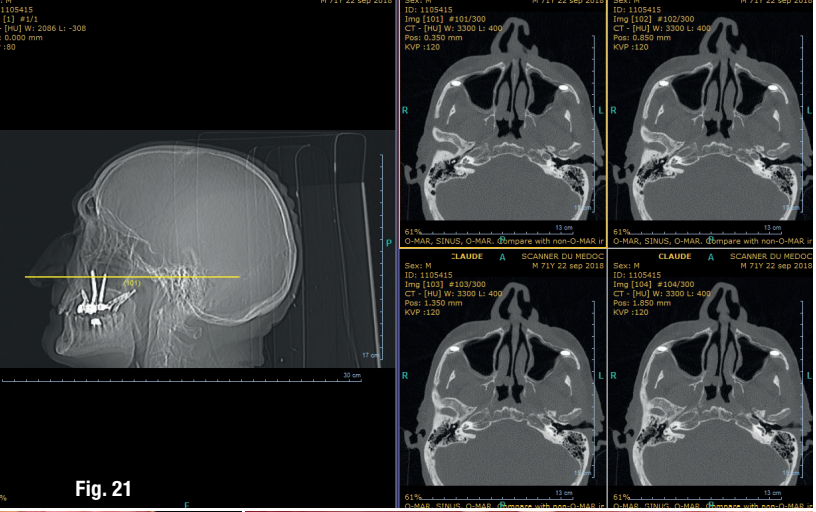
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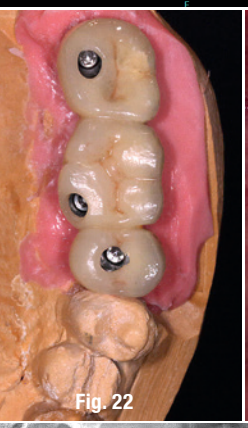
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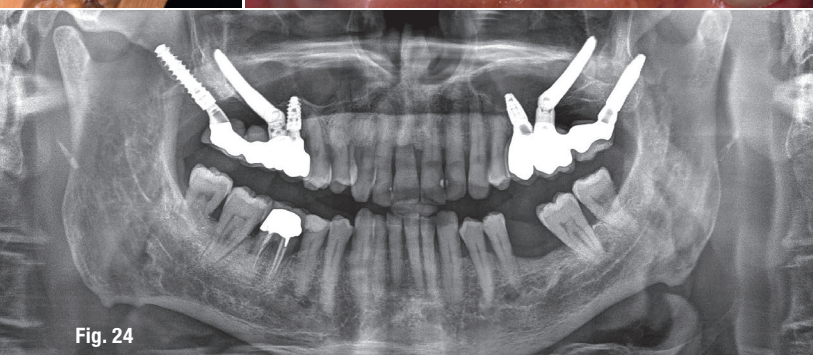
Fig. 24

Case 4—Fig. 21: Five weeks after closing the oroantral communication, the two sinuses were perfectly healthy. **Fig. 22:** Screw-retained fixed partial denture. **Fig. 23:** The final fixed partial dentures were connected on both sides after four months of osseointegration. **Fig. 24:** Post-op radiograph.

Discussion

Regarding the rehabilitation of a posterior maxilla without bone grafting, Schramm et al. reported in 2001 the case of a patient with a maxillary unilateral defect treated with two zygomatic implants and a canine regular implant.[10] In 2004, Ferrara and Stella reported the treatment of a unilateral posterior edentulous maxilla with two regular implants inserted in the maxillary first and second premolar positions and a zygomatic implant.[11] In 2008, Aparicio Magallón and Soto-Yarritu Quintana reported a case of a partially edentulous maxilla treated with a canine regular implant and a pterygoid implant associated with a zygomatic implant.[12] In 2008, Davó et al. reported the rehabilitation of four patients with partially edentulous arches with two regular implants in association with one zygomatic implant.[13] The same concept was also used for the restoration of an anterior edentulous maxilla. In 2010, Aparicio et al. detailed the rehabilitation of two patients with cemented fixed partial dentures.[14]

In this case series, all the surgeries were performed under local anaesthesia and without the use of guided surgery. The postoperative medical treatment consisted of 1 g of paracetamol every six hours for five days, mouth rinsing with chlorhexidine after each meal for seven days, and 2 g of amoxicillin per day for six days, starting the day before the surgery. The three patients were followed for five, four and three years, respectively. No infections, bone loss or prosthetic problems were reported. The three implants were judged as stable. The three patients were fully satisfied regarding the improvement of their aesthetics, masticatory efficiency and comfort.

Conclusion

Based on the cases described in this article, it can be concluded that the rehabilitation of maxillary unilateral posterior edentulism with zygomatic and regular implants or zygomatic, regular and pterygoid implants is a successful alternative to a grafting approach. This experimental protocol allowed a shorter treatment time with fewer interventions and no risk of morbidity or complications linked to a graft donor site. However, more cases are needed in order to adequately assess the long-term results of this treatment protocol. It is important to note that successfully placing zygomatic and pterygoid implants requires excellent anatomical knowledge. The experienced surgeon must surround himself or herself with an equally experienced and trained team. Moreover, he or she must be familiar with the precise surgical procedures, as well as potential complications and effective ways of solving them if they occur.

Literature

about the authors

Dr Jean-Baptiste Verdino is a French dentist who graduated from Aix-Marseille University in 1985. He currently runs an exclusive private practice in Hyères in France specialising in implant dentistry. In addition, he is an internationally published author with a specific interest in zygomatic implants.
Dr Sepehr Zarrine is a France-based dentist, who specialises in implant dentistry and complex cases involving immediate loading, bone grafting, and zygomatic implants. He currently practises in Saint-Dié-des-Vosges in France.

contact

Dr Jean-Baptiste Verdino
13 Avenue Gambetta
83400 Hyeres, France
Phone: +33 4 94650551
docjbv@cabinetverdino.fr

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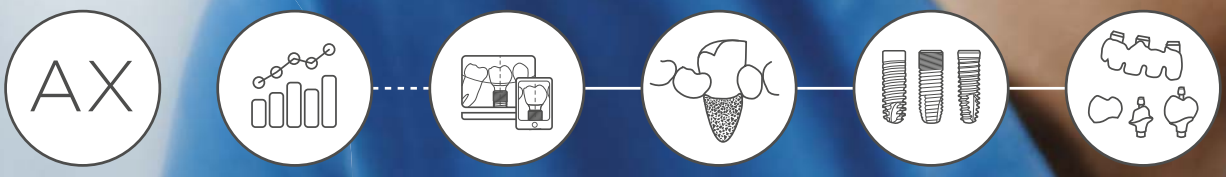

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