Rehabilitation: A Challenging Task

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Abstract

Utilizing implant restorative to replace missing maxillary posterior teeth can be challenging due to the proximity of the sinuses and nerves, as well as the resorption of the maxillary alveolar crest. The surgeries have become less invasive with higher rates of osseointegration for the implants today.

Objectives

- Review surgical techniques used to restore the atrophic posterior maxilla
- Review the history of jaw reconstruction and augmentation from invasive surgical procedures to more successful, less invasive procedures used today
- Learn the CM Misch Classifications to help develop a surgical treatment plan to obtain adequate osseointegration of the implants
- Identify when long implants in the facial buttresses are necessary
- Review the Cortically Fixed at Once concept for rehabilitating patients who have considerable resorption of the alveolar process

Introduction

The rehabilitation of patients with distal maxillary adentia still remains one of the most challenging tasks of implantology and maxillofacial surgery. The reason for this is the complex anatomy and topographical vicinity of important structures such as the maxillary sinus, the nerve and vessel bundles etc., as well as the progressive resorption of the residual ridge.

Through three-dimensional analysis, J. Cawood and R. Howell found that during maxilla resorption the residual alveolar crest moves superiorly and medially (the so-called centripetal resorption). This eventually leads to a thin layer or even absence of bone below the sinus cavity creating the worst conditions for long-term implant anchorage.

Historically, a plethora of surgical techniques have been proposed to restore the atrophic posterior maxilla, including partial or complete osteotomies, bone grafting, sinus floor elevation, zygomatic fixtures, use of short implants etc. Since, G. Scortecci created a disc implant design in 1980 and explained some "know-how" of lateral insertion of the implants and J.F. Tulasne described the original technique of placement of pterygoid implants, the engagement of cortical anatomical areas became a matter of interest for many dental practitioners, especially those working in the field of basal or cortical implantology.1,2,3

The purpose of this study was the brief review of available treatment options for rehabilitation of posterior atrophic maxilla with the particular focus on engagement of existant cortical buttresses of the midface.

Results and conclusions. We know that historically, the evolution of pre-prosthetic surgery went a separate direction from maxillofacial surgery as far back as the early 20th century and was concerned with the works of C. Thiersch. However, the fifties and eighties seemed to be the "golden era" of bone transplantation and jaw reconstruction. In 1977, W. Bell and colleagues proposed the technique of LeFort 1 maxillary osteotomy for improvement of interalveolar relationship.4

In 1992, J. Tidwell et al. perfected an osteotomy procedure by simultaneous "inlay" maxillary grafting with autologous bone for the placement of endosteal implants.5 Autogenous bone from intraoral and extraoral sites has been succesfully used for jaw augmentation without regard for the obvious disadvantages of greater morbidity and expenses. However, the impetuous inculcation of substitution materials into routine maxillofacial practice caused a gradual replacement of autogenous grafts by different synthetic, xenogenic and allogenic substitutes frequently combined with platelet-rich plasma/fibrin or barrier membranes to accelerate bone healing and improve its quality.6,7,8,9

The sinus-floor-elevation procedure through a classical lateral window approach (open sinus-lift) and bone marrow substitution to gain a vertical bone height in posterior maxillary area was proposed in 1980 by P. Boyne and R. James.10 Later the technique was developed actively by other investigators with success rate ranging from 82 percent to almost 100 percent. As a less invasive alternative, R. Summers in 1994 introduced a method of sinus membrane elevating with osteotome through a crestal approach and simultaneous graft and implant placement (closed sinus-lift).11

The formation of new bone around the implant apex and complete osseointegration of implant after three to six months postoperatively was confirmed in several investigations. When considering the indications for this or that sinus-lift technique, C.M. Misch classification, which includes four subantral classes, is widely used:
SA1—Bone height of more than 12mm allows to perform implantation without any additional augmentation;
SA2—One height of about 10mm allows to perform implantation after local sinus-lift procedure;
SA3—Bone height of 5-8mm allows to perform an open sinus-lift procedure with simultaneous implantation;
SA4—Bone height less than 5mm requires a two-stage approach: a sinus membrane elevating and implantation after six to 10 months.12

The use of short implants (less than 10mm long) as a viable and simple option to avoid augmentation procedures with a relatively high survival rate was described in a series of publications.13,14 In general, a minimum width of 5mm and height of 7-10mm is accepted by most clinicians as the adequate parameters for implants placement. But honestly, do the majority of our patients match these criteria?

Taking the above-mentioned considerations into account, the use of available corticalized areas of the facial skeleton, especially facial buttresses distributing forces along the solid bone structures and protecting the craniofacial cavities, which are always present independingly on the level of jaw-bone resorption, became a separate direction of the maxillofacial implantology.15 Regarding the maxilla, three of the buttresses namely frontomaxillary, frontozygomatic and pterygomaxillary have been the strategic areas for the placement

of implants (Fig. 1). Moreover, the idea of engagement of these peculiar anatomical areas has required a special design of the implants (so-called tuberopterygoid screws, disc implants, plate implants etc.). This has also been a big challenge for implant manufacturers. (Fig. 1)

Frontomaxillary or canine buttress allow the implant insertion both vertically or with a certain angulation (along the anterior sinus wall), thus achieving a distal extension of the bridgework as it was described by L. Krekmanov and B. Rangert.16

The frontozygomatic buttress is a target area for the so called trans-zygomatic implantation of very long (up to 40mm) implants directed obliquely from the hard palate via the maxillary sinus and anchored in the zygoma body. As an alternative to the above-mentioned invasive procedure, an original technique of external positioning of the zygomatic implants avoiding sinus opening was proposed.17

And finally, the use of pterygomaxillary buttress for placement of implants was first proposed by J.F. Tulasne in 1989.3 According to the original technique, the 15-20mm long implant should be directed from maxillary tuber posteriorly, superiorly and medially, thus avoiding sinus perforation and damage of the major palatal canal, and strongly anchored in the pterygoid process. Taking into account the poor bone quality in the tuberosital area as well as the unfavorable three-dimensional quantity characteristics, engagement of dense cortical layers of pyramidal process of palatine and pterygoid process of sphenoid bone is of utmost importance for initial implant stability. In one recent investigation comparing the survival rate for short (7-13mm) and long (15-18mm) Branemark implants (NobelBiocare), the proponents of traditional bullet-type implants insist now on the necessity of penetration of cortical layers behind the tuber by implant apex for better primary and secondary stabilization.18 The authors also emphasize the need of splintage of pterygomaxillary implants with other implants for adequate distribution of functional loads.

On the basis of J. Cawood, R. Howell classification of jaws atrophy and our own clinical experience, the Cortically Fixed at Once (CF@O) concept was created for prosthetic rehabilitation of patients with considerable (up to basal level) resorption of the alveolar process.19,20,21,22,23,24,25 Regarding the posterior maxilla, the aforementioned highly corticalized areas were the target points for implant placement. According to the surgical protocol, the distal support (the pterygomaxillary buttress) is always provided by placement of a special two-component tuberopterygoid screw (Figs. 2-9), an intermediate support (the frontozygomatic buttress) —by placement of plate-shape implant in the area of the zygomatico-alveolar crest (Figs. 2-5) or a disc implant, in case of presence of 4-5 mm of native bone below the sinus. (Figs. 6, 7). Compression screws of various diameters and lengths (Figs. 2, 3), disc implants (Fig. 4-7) or plate-shape implants (in cases of severe atrophy) (Figs. 8, 9) served as anterior support.

All implants were inserted under local anaesthesia with premedication after creation of a wide mucosal-periosteal flap for adequate visualization of bony bed and neighbouring anatomical structures. Postoperatively, the patients received similar medication, including antibiotics, analgesics, corticosteroids, mouth-rinsing solutions, etc. The sutures were removed five to 10 days after surgery and implants were immediately (within five to 10 days) loaded by temporary/permanent metal-acrylic or metal-ceramic bridgeworks with combined screwing and cementing or completely screwing fixation. The control check-ups were carried out one, three, six and 12 months postoperatively.

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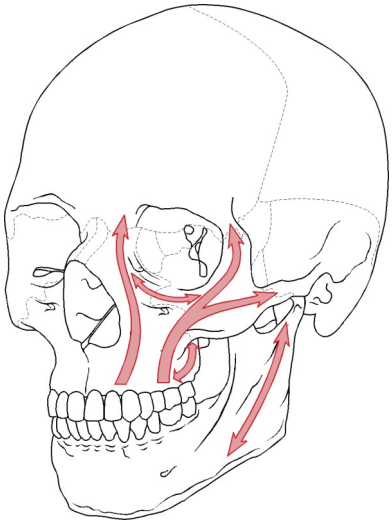


Fig. 1 Buttresses of the face.

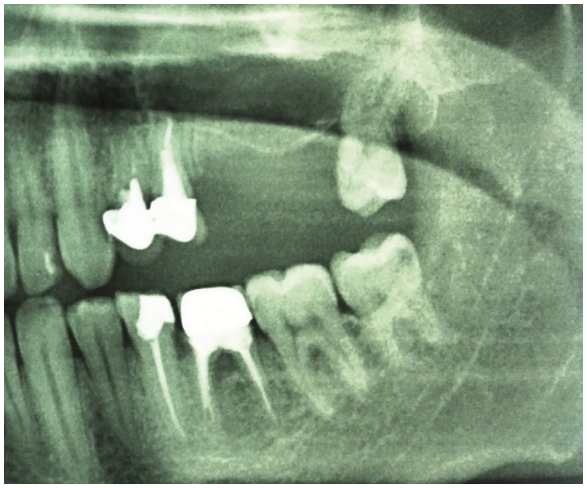


Fig. 2. A fragment of preoperative OPG, patient Y., 42-year-old, teeth 24, 25, 28 with periodontal pathology.

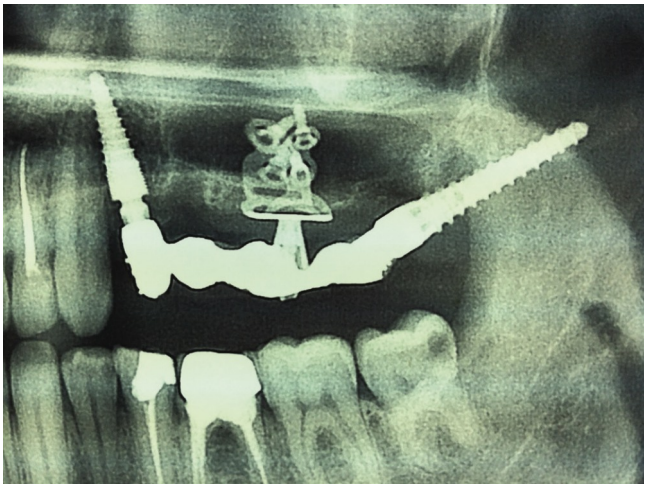


Fig. 3. A fragment of postoperative OPG, patient Y., 42-year-old, use of tuberopterygoid, plate-shape and screw-type implants. Immediate loading with temporary metal-acrylic bridge three days after surgery.

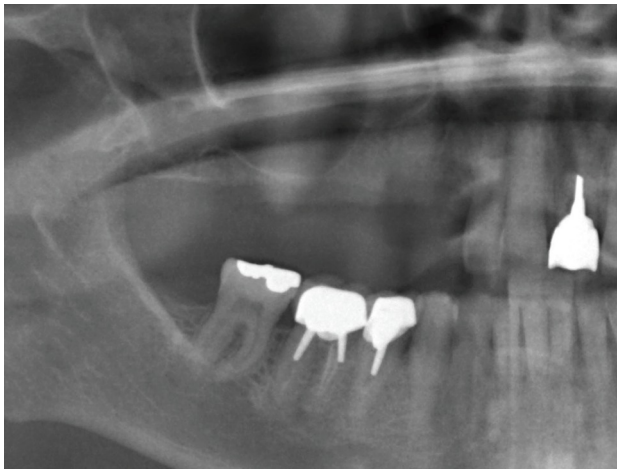


Fig. 4. A fragment of preoperative OPG, patient F., 56-year-old, absence of teeth 13, 14, 15, 16, 17, 18.

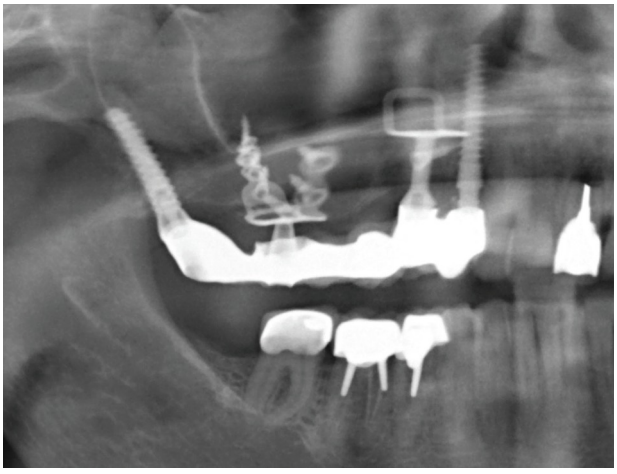


Fig. 5. A fragment of postoperative OPG, patient F., 56-year-old, use of tuberopterygoid, plate-shape, disc and screw-type implants. Immediate loading with permanent metal-ceramic bridge 10 days after surgery.

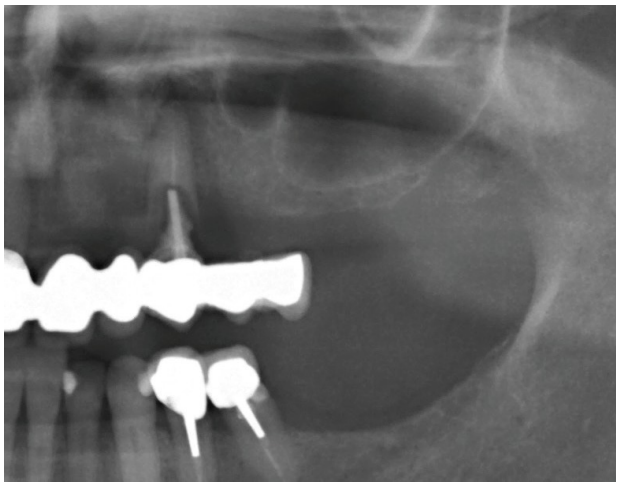


Fig. 6. A fragment of preoperative OPG, patient V., 59-year-old. Absence of teeth 21, 22, 24, 25, 26, 27, 28. Periapical pathology of tooth #23.

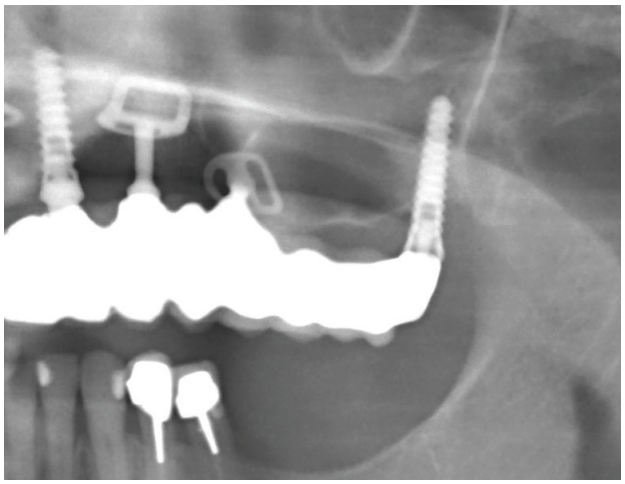


Fig. 7. A fragment of postoperative OPG, patient V., 59-year-old. Use of tuberopterygoid and two disc implants. Immediate loading with permanent metal-ceramic bridge 10 days after surgery.

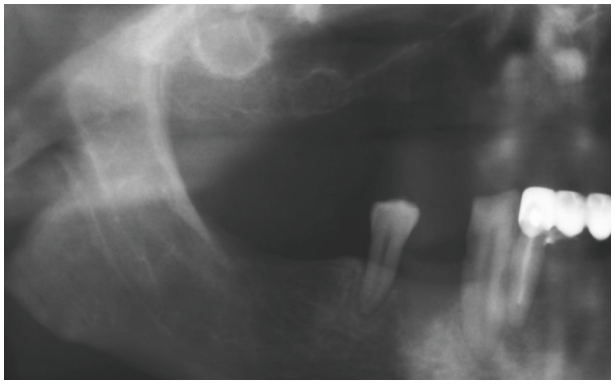


Fig. 8. A fragment of preoperative OPG, patient T., 66-year-old. Complete maxillary adentia.

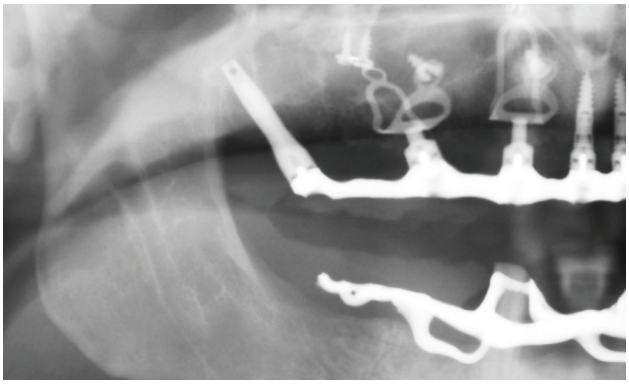
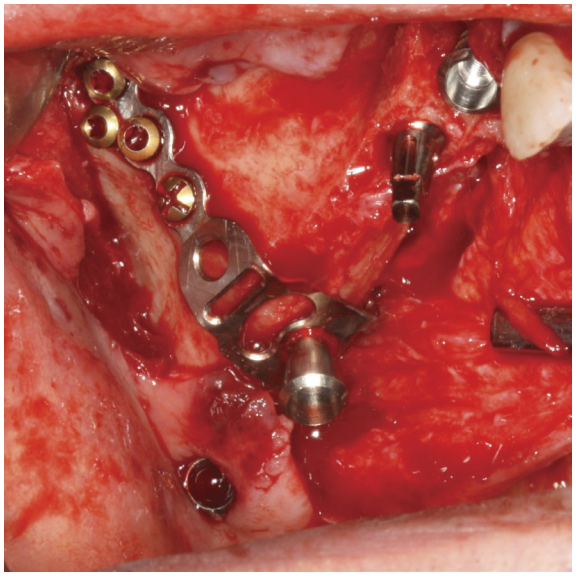
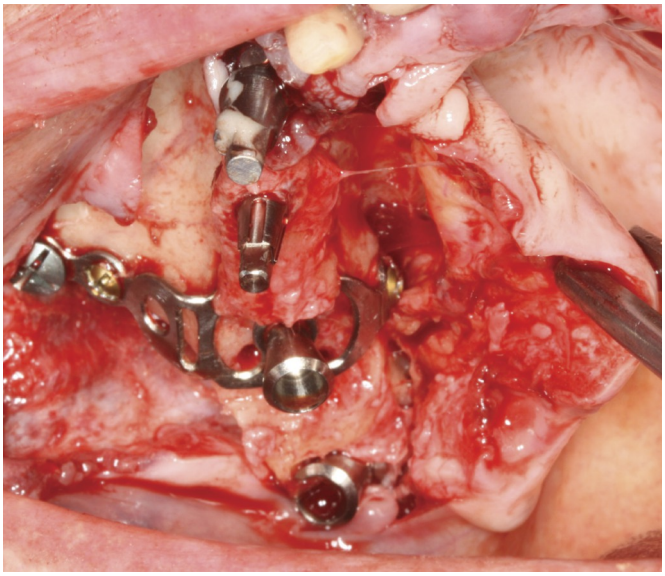


Fig. 9. A fragment of postoperative OPG, patient T., 66-year-old. Use of tuberopterygoid and two plate-shape implants. Immediate loading with temporary metal-acrylic bridge 10 days after surgery.



Intra-oral view of plates implants in place.



The implants are fixed at the zygomatic bone.

Thus, since 2013, 60 patients with posterior maxilla defects were operated on in three separate dental clinics (30 patients in Dr. Henri Diederich's private clinic, Luxembourg; 18 patients in the Center of Basal Implantology, Thionville, France; 12 patients in the Department of Maxillofacial Surgery of The Danylo Galycky Lviv National Medical University, Lviv, Ukraine). The obtained data of multicentral clinical and roentgenological examinations were systematized and analyzed. In 57 cases (95.0 percent), the earliest and most distant (up to 12 months) results of the treatment were evaluated as satisfactory. All implants were absolutely stable, painless on percussion, and there were no signs of inflammation around the implants.

Regarding complications, all of them were found on patients treated in the Department of Maxillofacial Surgery of The Danylo Galycky Lviv National Medical University probably due to the lack of experience in this particular area of dental implantology. In one case (1.6 percent) the mobility of the bridgework due to a placement of the implant in the area of very fragile maxillary tuber occurred one month postoperatively requiring surgical removal of the implant. In two cases (3.3 percent) a partial exposure of the plate implants was observed requiring no special treatment except thorough oral hygiene procedures.

Conclusion

The obtained results match the information of other scientists about successful rate of implant placement In distal maxillary aspects without bone augmentation procedures.26,27,28 The procedure requires no general anesthetization, keeps the sinus integrity and not only provides an aesthetic effect but also a very important functional one, improving the patients' quality of life. In addition to the need for a highly skilled and specialized surgeon, an engagement of strong cortical areas in cases of maxillary adenia creates a serious alternative for traditional crestal implantation with variety of additional pre-implant surgical procedures.

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