Introduction

The implant-prosthetic technique introduced by Malò in 2003 is one of the most modern innovations of recent years in the implant-prosthetic rehabilitation of the atrophic maxilla, with very high success rate in the short to medium term follow-up.

The technique provides for the inclusion of only four intraforaminal implants within in the mandible and in the pre-maxilla, which support a fixed prosthesis screw type, under a immediate loading.

The mesial fixture are orthogonal to the occlusal plane and the distal are tilted at 45°.

This technique, despite the short periods of follow-up, but thanks to the simplicity of the surgical protocol, the minimal invasiveness and the possibility of applying the implants under immediate load, is widespread, with a good function and aesthetic, reducing processing time, the biological and economic costs.

By combining the technique All-on-four and All-on-six with the concept of guided surgery it's possible to obtain the advantages offered by the innovative surgical technique together with the immediate function and by precision of the prosthetic rehabilitation realized with the computer-assisted method.

The severely atrophied maxilla is a challenging therapeutic problem, because the bone volume is necessary to allow placement of a sufficient
The integration of technology at All-on-four immediate function with the concept of computer-guided surgery for implant placement in the rehabilitation of completely edentulous jaws is a predictable treatment with a very high rate of implant survival (23).

It’s more easy to tilt the implants in a correct biomechanical position with good primary stability (19-23) and avoid bone graft. The angle of the front wall of the sinus has been viewed through a hole in the side of the sinus and the implant was placed in parallel and close to it. Thus, this system has been tilted distally about 30-35 degrees.

This technique provides the following three advantages: 1) the support system is moved posteriorly, 2) the implant length increased, 3) the system follows a dense bone structure, the anterior wall of the sinus, thus increasing the primary stability.

In patients with a volume of sufficient bone in the tuberosity, a similar procedure was performed for placement of an implant sloping near back wall the sinus (8). The advent of 3-D and of the computer-guided surgery optimizes treatment planning, allowing the doctor to put implants in a correct angle based on anatomical and prosthetic needs with high accuracy and low invasiveness (24-26). The prosthetic restoration on tilted implants is challenging for both the dentist and technician. After implantation, the angle can be easily compensated using angled abutments.

CAD-CAM allows production of custom pillars by changing the angle of inclination of implants according to functional prosthetic emergence profile.

The prosthetic rehabilitation can be delivered using a load approach delayed or immediate. The prerequisites for immediate loading are: high primary stability (45 N or more), splinting of the implants through a temporary prosthesis and an osteoconductive surface (28). To minimize complications and provide rigid mechanical support for implants, especially in the case of immediate loading, it is always recommended to strengthen the superstructure with a metal frame (21, 22).
Materials and methods

The computer-assisted planning system used in this study is the Nobel Clinician® (Nobel Bio-care®) and was the first virtual planning system introduced on the market. The software interacts with most X-ray computed tomography systems commercially available (23). The DICOM files obtained from CT are introduced in the software that displays both axial cross sections, 3D front and interactively with each other (Fig. 1). The placement is virtual therefore the system can be controlled simultaneously in different projections. The image can be rotated in different planes, allowing a complete real anatomy in a spatial vision (Figs. 2-5).

The software allows a good approximation to evaluate the bone quality of the 24 sites surveyed. The program is applicable to most implant systems. It is equipped with a library stored which has almost all the type of implants. These are represented by their real shape, so the clinician can make a realistic virtual surgery through the overlap of the silhouette of the implant on the corresponding section of bone. You can control the input from various angles simultaneously, and it is possible to immediate verification, for example of collisions with respect to anatomical structures or other installations that were included (Figs. 6, 7). You can simulate also possible reconstructive measures to correct existing volumes if there is insufficient bone for implant placement.

The program can calculate a good approximation of the volumetric extent of the increase necessary, which allows the clinical guidelines on the levy or the amount of material for use homologous or heterologous. The software has a monitoring system that informs in the case of interference between the trajectories chosen implant and anatomical areas at risk (alveolar nerve, maxillary sinus, etc....) (Figs. 8, 9). Also it highlights, with a color change, the occurrence of dehiscence, fenestration, and any kind bone morphology (Figs.10-14).

The operator has all the information needed to perform a volumetric virtual surgery by inserting...
the implants in a good and congenial bone anatomy. After the virtual planning you can collect the files in the project developed and to build a surgical guides that will allow the surgeon to faithfully follow the virtual design. 

The workflow of this system is as follows:

The first step is the duplication of complete dentures of the patient if is functionally correct, or inserting into it some radiographic secure retrieval (Fig. 15).

The patient performs the test with this X-ray tomography mask, stabilized by an occlusal index
of silicone realized previously. And he has performed a CT scan technique with double images that were acquired with a conventional CT scanner (Tomoscan SR-6000, Philips) using a standard dental CT protocol (1.5 mm slice thickness, 1.0 mm of play table, 120 kV, 75 mA, 2 - s scan time, 100 - 120 mm field of view) (25). The first scan was of the maxilla with the model of planning, the second scan only the model. Using the software for treatment planning Nobel Clinician® we acquired scans and we obtained the overlapping of two sets of three-dimensional scans. After planning the data are transferred to the processing and production center, which produce a template surgical precision resin with cylindrical guides titanium (Fig. 16). The planned deep osteotomies were determined precisely by cross-sectional images of the site. The planned drilling depth was calculated by adding 10 mm to this value (9 mm distance between the top edge of planned installation and the top tube of titanium, plus 1 mm height of drill guides).
Surgical procedures

One hour before surgery, antibiotic prophylaxis was done with 2 g of amoxicillin and clavulanate (Augmentin, GlaxoSmithKline). It was prescribed, three days before surgery, a mouthwash based chlorhexidine digluconate 0.2% (Corsodyl, GlaxoSmithKline). Before surgery was given local anesthesia with Articaine hydrochloride 4% (40 mg / mL) and epinephrine.
1:100,000 (Septodont Inc). The surgery was performed by placing The Procera® Surgical Guide was placed, ensuring its complete seating through the placement of three pins for stabilization on maxillary. All implants were located with a flapless technique, that minimize postoperative pain with short post-surgical healing time (Figs.17-22).
Upper maxilla implants placement

In the anterior areas we placed at 24 degree angle implant Nobel Active™ NP (Ø 3,5mm x length 15mm, Nobel Biocare™) on the right and a 29 degree angle implant Nobel Active™ NP
(Ø 3.5 mm x length 15 mm, Nobel Biocare™) on the left. In the posterior areas we placed at 24 degree angle implant Nobel Active™ RP (Ø 4.3 mm x 15 mm length, Nobel Biocare™) on the right and a 29 degree angle implant Nobel Active™ RP (Ø 4.3 mm x 15 mm length, Nobel Biocare™) on the left (Figs. 23, 24).

Jaw's implants placement

Intraforaminal implants were both off angle: on the right to Nobel Active™ RP (Ø 4.3 mm x 15 mm length), and on the left to Nobel Active™ RP (Ø 4.3 mm x 15 mm length).

In two right premolar regions implants: on the right to Nobel Active™ RP (Ø 4.3 mm x length 11.5 mm), on the left to Nobel Active™ RP (Ø 4.3 mm x length 11.5 mm).

In two other regions molar implants right: on the right to Nobel Active™ RP (Ø 4.3 mm x length 11.5 mm), on the left to Nobel Active™ RP (Ø 4.3 mm x length 11.5 mm) provided anatomical sites with a free flap approach. The drilling protocol is customized based on bone density of the implant site to achieve primary stability prior to placement with a torque 40 N cm (Fig. 25).

Postoperatively, the patient received amoxicillin and clavulanic acid 1 g twice daily for 4 days, then 0.5 g daily for 3 days. Chlorhexidine daily for 10 days.
The pillars prefabricated CAD / CAM have been established for facilities with screws prosthetic dedicated tightened in titanium with a torque of 30 N cm. The reinforced acrylic resin provisional restoration with a metal substructure was immediately positioned on the pillars. The installation of the temporary restoration allowed to offset any loss of precision positioning system. The marginal accuracy, the retention and the stability were improved by a rebasing with a self-curing polyurethane resin (Voco, GmbH) (Figs. 26-28). All centric and lateral contacts were evaluated with articulating paper 40 microns (Bausch) and adjusted to obtain a correct occlusal contact.

Five months later permanent restorations were fabricated using Procera® Implant Bridge (PIB) (CAD / CAM technology). The PIB was connected to the implants with abutment screws to 35N. Procera® Implant Bridge (Nobel Biocare®) consists at the one-piece machined titanium substructure with aesthetic ceramic (Figs. 29-32). Maxilla rehabilitation consisted of All-on-4® concept, whereas for jaw were used procedures for conventional fixed prosthesis.
Conclusions

The case that suggests immediate loading associated with tilted implants prosthesis can be considered a viable treatment modality for the atrophic maxilla.

These results indicated that if the prerequisites for immediate loading as high primary stability (45 N or more), splinting of the implants through a temporary prosthesis and the use of an osteo-conductive surface are satisfied, the tilt of the implant may not affect the final result. Analysis of the case shows that the use of guided surgery system for positioning and axial tilt is predictable, and reduces surgical invasiveness. This treatment option is an effective and biologically useful alternative to the procedures for increasing the sinus floor. Thanks to recent computer-assisted methods is now possible to place implants "anatomically optimized" using all the available bone, in accordance with the vascular and nerve noble structures and the maxillary sinus, while taking into account the prosthetic needs.

Finally, we must emphasize that the use of computer-assisted methods and the surgery without flap, despite an obvious simplification of surgical and prosthetic procedures, needs experience in the planning and execution of the case.

References


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