FULL REHABILITATION WITH NOBEL CLINICIAN® AND PROCERA IMPLANT BRIDGE®: CASE REPORT

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SUMMARY

Implant surgery has been changing in different ways following improvements of computer technologies. Since its beginning, according to the original procedures of Branemårk system implants, guide-lines in implants-supported prosthetic rehabilitation have been founding on the placement of fixtures in a fairly upright position, after maxillary sinus floor elevation; while in the case of interforaminal rehabilitation, an upright distal implant may need to be placed anterior to the mental foramina without nerve damage (although the consequence would have been bilateral cantilevers to provide good chewing capacity). Some authors have proposed engaging the molar/tuberosity area: Bahat and Venturelli demonstrated these areas reliable and predictable alternative to distal cantilever prostheses or sinus elevation procedures. In recent years, the immediate loading of tilted implants with a provisional restoration has been proposed for the treatment of the atrophic maxilla. Tilted posterior implants in either arches could avoid (cantilever length) and provide to a better load distribution. Further studies have showed excellent outcomes for both tilted and axial implants; indeed this protocol allows to use longer implants, improve bone anchorage and avoid bone grafting procedures. Malò at al., in a retrospective clinical study, showed important results using two posterior tilted implants and two anterior non-tilted ones in the so-called All-on-four technique (Nobel Biocare, Göteborg, Sweden). Instead of the great loss of bone (amount and quality) in long-term edentuly the clinically documented computer-guided implantology software is able, through posterior tilted implants, to improve load distribution. Many authors have reported reduced surgical invasion (sinus grafting surgery is needless), shorter treatment time, lower cost, natural aesthetic profiles and functional bite.

Key words: dental implants, computer guided flapless implant placement, immediate loading, prosthetic rehabilitation.

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

number of implants to support the prosthetic rehabilitations. Several surgical procedures have been developed to improve the quality and the bone volume (1).

The technique for maxillary sinus bone regeneration is validated as a treatment option, but acceptance of this procedure for patients could be lower, because of their invasive nature associated with an increased risk of morbidity, reducing comfort and increasing the time of costs (2-4). Is also recommended a two-stage procedure with delayed implant placement to get the success (5, 6).

To overcome these drawbacks, some authors have suggested alternative anatomical regions to place the implant, such as front or rear wall of the sinus, the septa, the curvature of palatal and pterygoid process (7-9).

It has been proposed to tilt the implants in bone windows to avoid the use of anatomical graft (10-12).

The tilted implants technique has been developed to improve the anchoring and support bone, avoiding and minimizing the request of bone grafting to overhang sinus (8-11).

Using implants inclined (>15° angle to the occlusal plane) mesiodistal or bucco-palatal, it's possible to put implants closer to the front and back walls of the maxillary sinus.

The success rate at 5 years varies from 95.2 to 98.9% for the tilted implants and 91.3 to 93% for the axial (13, 14).

The results of biomechanical analysis show that in this technique the tilted implants have no adverse effect on bone resorption. In this approach the system tilted allows to support posteriorly the rehabilitation prosthetic, thereby reducing the cantilever.

The concept of immediate function, which involves the simultaneous placement of implants, abutments and restorations (temporary or permanent), shows promising results with few complications (15-20, 27).

The All-on-four technique with immediate function combines these concepts in a surgical and prosthetic protocol safe and effective for the immediate function of 4 implants to support a fixed prosthesis in a edentulous (21, 22).

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 Biocare®) 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 tipe 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

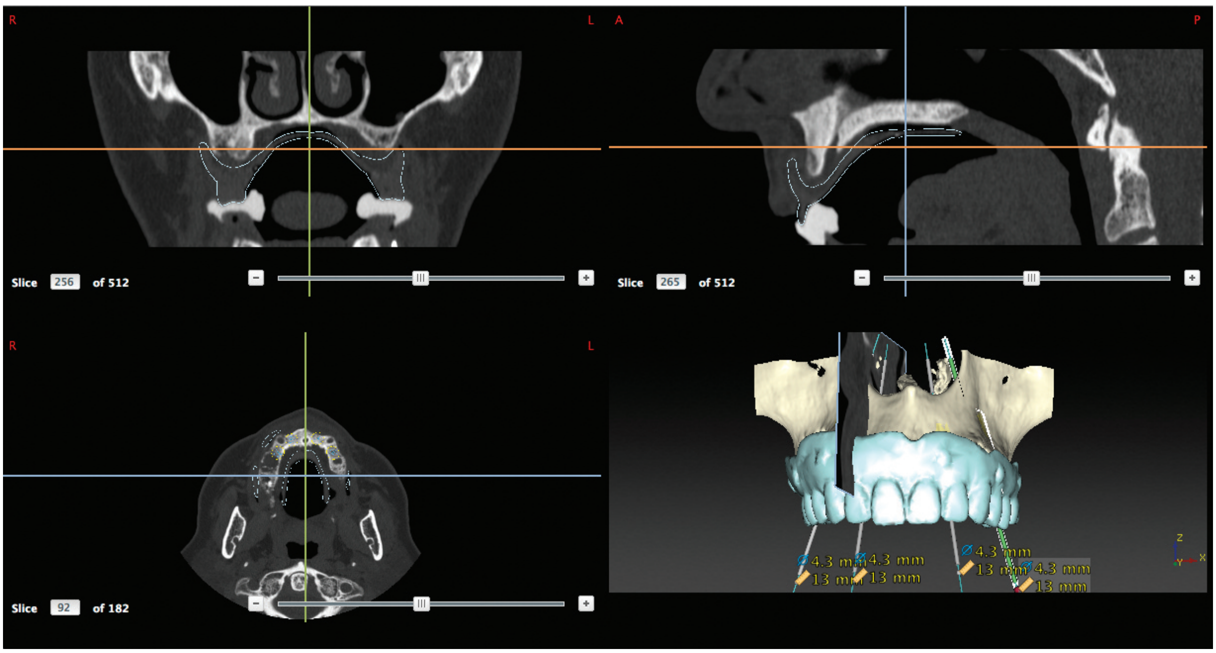

Figure 1
Axial image sections, transverse, frontal and 3D upper jaw.

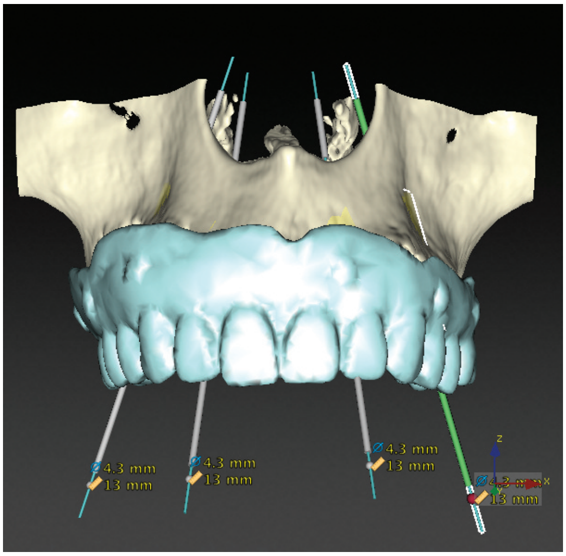

Figure 2
3D image front upper jaw.

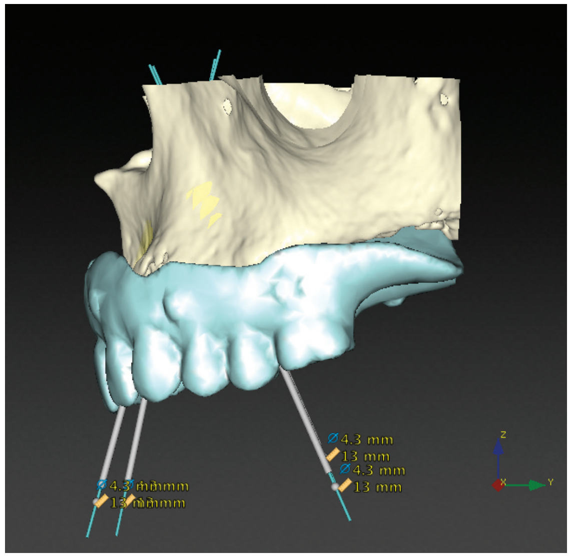

Figure 4
Left lateral 3D image upper jaw.

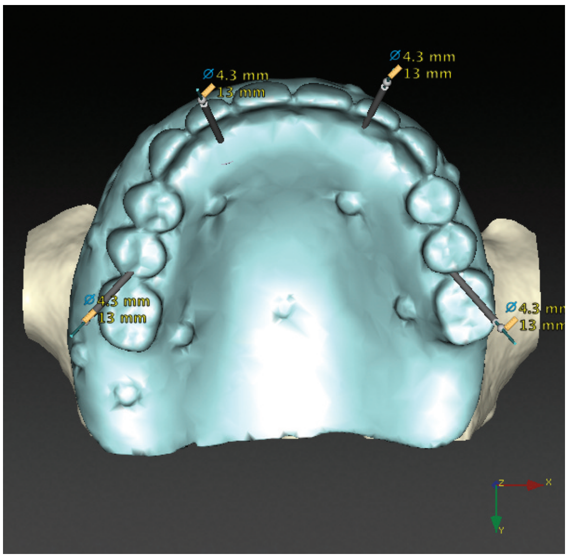

Figure 3
3D image occlusal upper jaw.

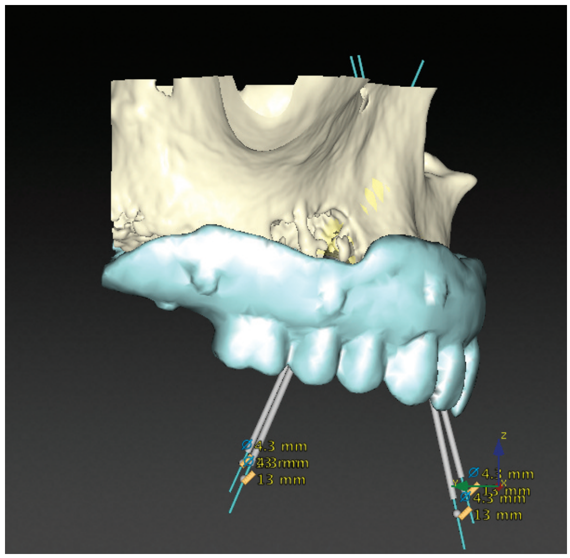

Figure 5
3D image right side upper jaw.

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

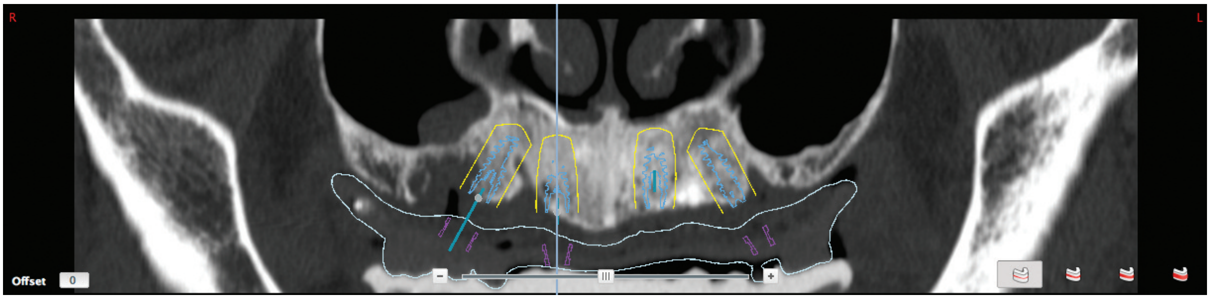

Figure 6
Image section front upper jaw.

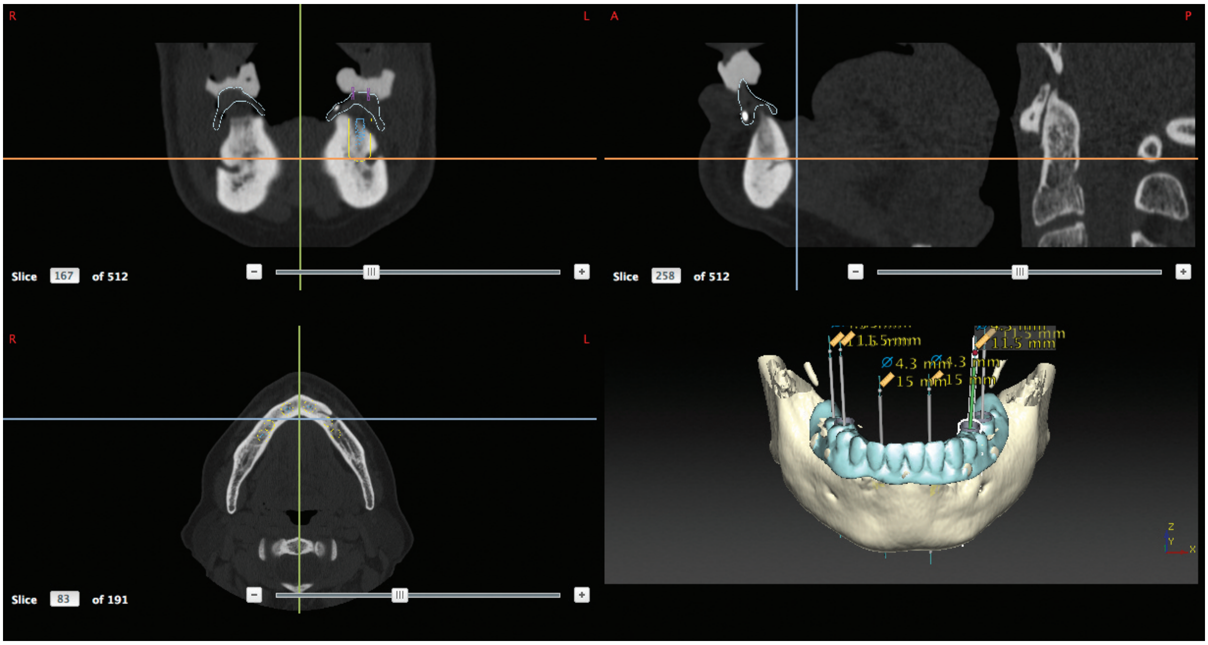

Figure 7
Axial image sections, transverse, frontal and 3D lower jaw.

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).

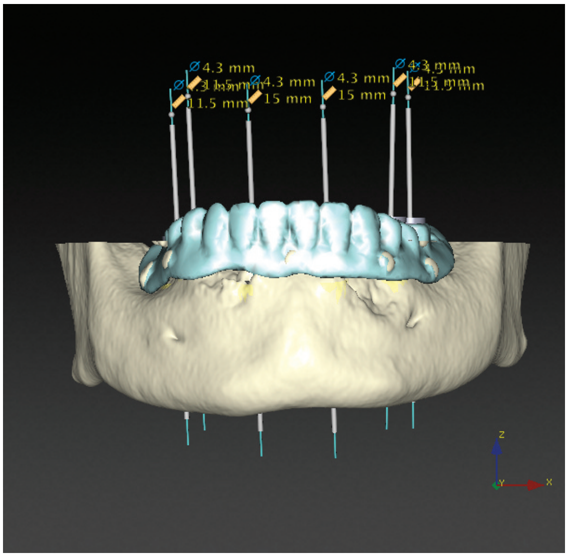

Figure 8
3D image front lower jaw.

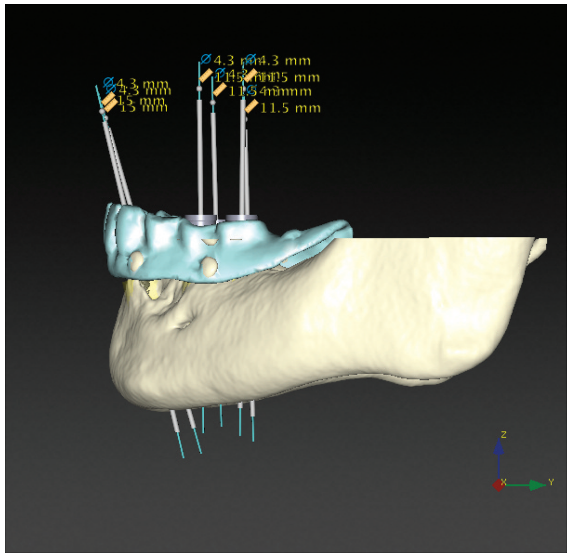

Figure 10
Left lateral 3D image lower jaw.

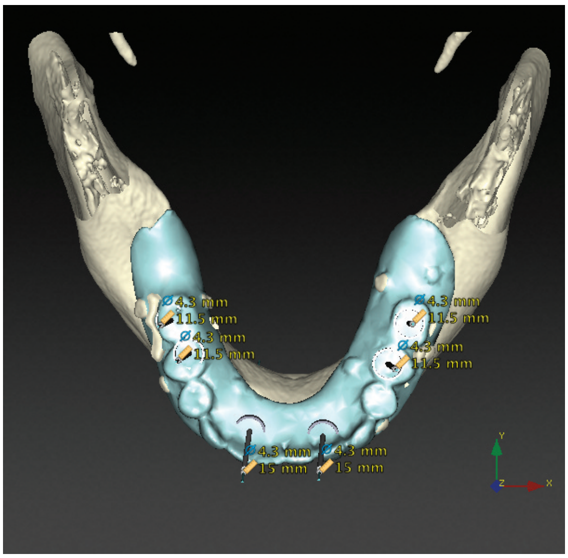

Figure 9
3D image occlusal lower jaw.

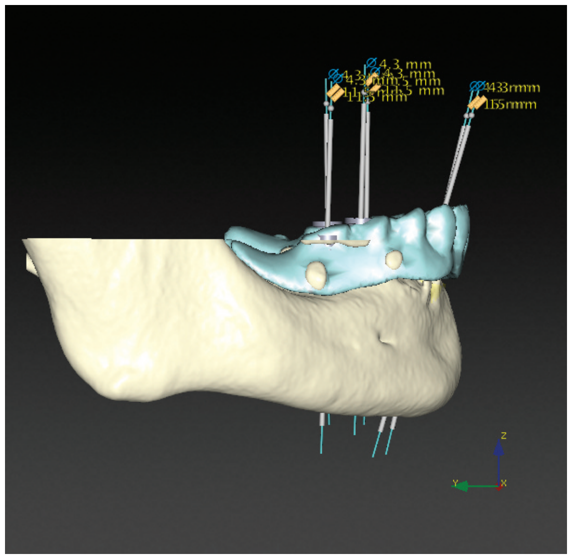

Figure 11
Right lateral 3D image lower jaw.

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

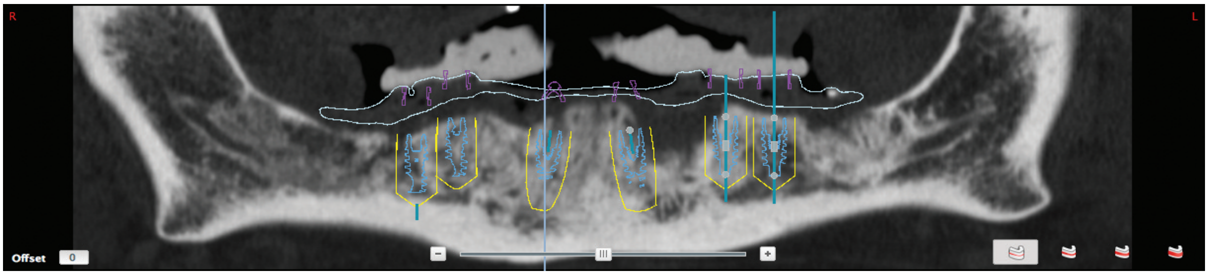

Figure 12
Image section front lower jaw.

Figure 13
Vision intraoral.

Figure 14b
Preoperative intraoral view lower jaw.

Figure 14a
Preoperative intraoral view upper jaw.

Figure 15
The removable dentures of the patient, functionally and esthetically correct, with secure radiographic landmarks that make possible the right matching tc patient/tc dentures.

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).

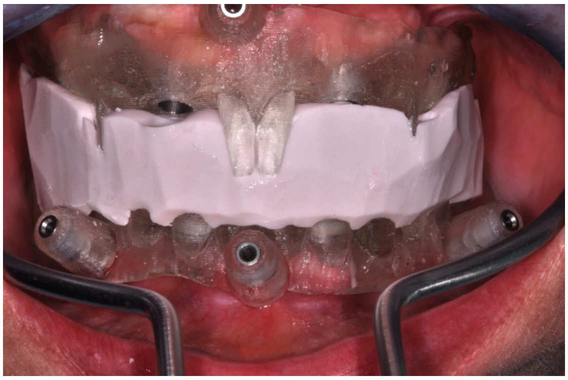

Figure 16
Surgical template with silicone index.

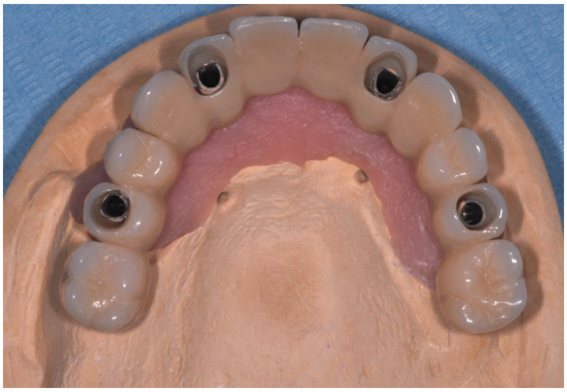

Figure 17
The master model of the provisional superior.

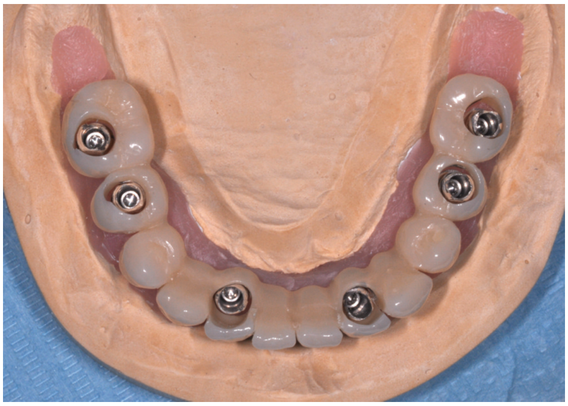

Figure 18
The master model of the provisional inferior.

Figure 19
Immediatly after the surgical stage we can proceed the application of the provisional prosthesis.

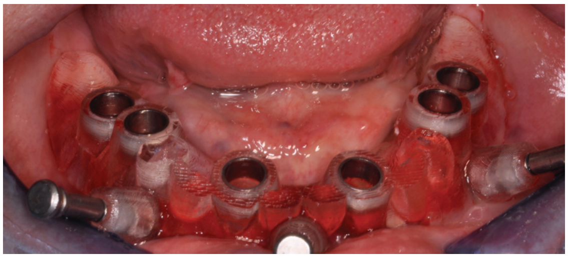

Figure 20
Surgical stage: preparation of the implant sites.

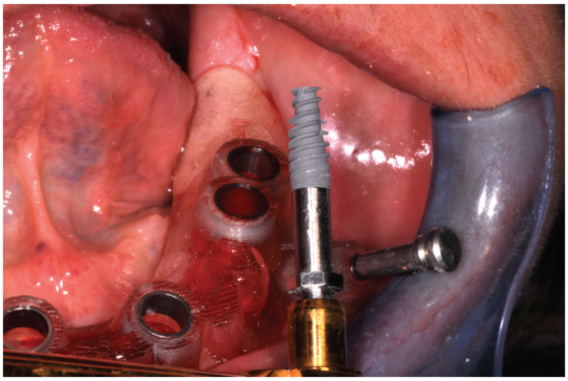

Figure 21
The manual installation of implants.

Upper maxilla implants placement

In the anterior areas we placed at 24 degree angle implant Nobel Active™ NP (Ø 3, 5mm x lenght 15mm, Nobel Biocare™) on the right and a 29 degree angle implant Nobel Active™ NP

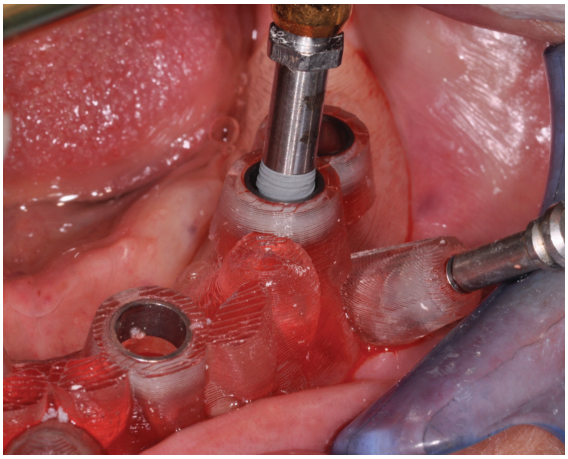

Figure 22
Implant inserted with reference mounter.

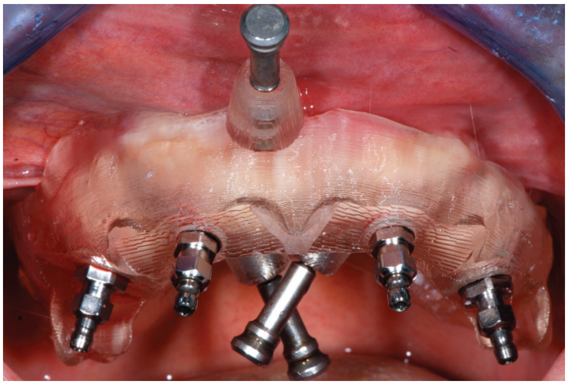

Figure 23
Stage surgery completed.

(Ø 3, 5mm x lenght 15mm, Nobel Biocare™) on the left.
In the posterior areas we placed at 24 degree angle implant Nobel Active™ RP (Ø 4, 3mm x 15mm length, Nobel Biocare™) on the right and a 29 degree angle implant Nobel Active™ RP (Ø 4, 3mm x 15mm 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.

Figure 24
Intraoral post-operative maxillary vision.

Figure 25
Intraoral post-operative mandibular vision.

Figure 26
Final image after application of the immediate provisional prosthesis.

Figure 27
Immediate postoperative aesthetic.

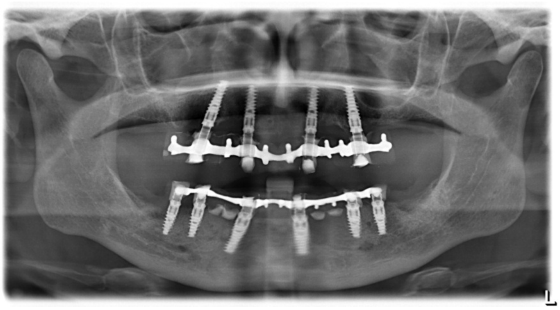

Figure 28
Postoperative radiographic control.

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.

Figure 29
Definitive rehabilitation: test of the framework.

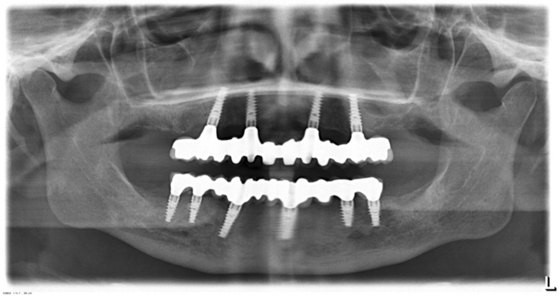

Figure 30
Orthopanoramic control a six months.

Figure 31
Definitive rehabilitation: front view. Correct occlusal relations and aesthetic.

Figure 32
Final aesthetic.

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 osteoconductive 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.

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