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Guided Implantology: A New Perspective from the Company Service Approach

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ABSTRACT:

Introduction*: Modern Implantology, considered as a functional restoration-implant site-implant unit, is becoming an effective, repeatable and predictable procedure; however, due to the advent of digital techniques, it has become even more complex to implement. The digital workflow obliges us to proceed according to obligatory steps that start from the collection of the appropriate diagnostic data, arriving at the guided execution of implant insertion and the production of prosthetic restorations. In this context, design plays a key role in determining the success of clinical work.*

Aim of the Work: *Evaluate the DIO NAVI Guided Implantology system for the design and clinical application of digital protocols to complex clinical cases.*

Material and Methods: *We selected three patients who needs a full arch restoration. After collected requested digital datasets, we edited a full restoration/implant project. Once received the guide, the restoration and the abutments required, we performed the surgical phases and we placed the provisional restorations (once registered ISQ value) following the instructions and actions provided in a slavish manner.*

Results: *Workflows indicated in the DIONAVI protocol have proved to be reproducible and effective. In both cases evaluated, starting from our precise indications and technical requests, we arrived at the immediate implant loading.*

Discussion: *Digital workflows, wich are only apparently more complex in the execution than analog ones, are predictable and repeatable in clinical practice, if they are relativized to a more complex design phase than that envisaged by traditional methods.*

Conclusions: *The Workflow proved to be effective. Moreover, the Protocol fully satisfied the expectations of the clinician and patient.*

Introduction

The term "Implant-prosthetic functional rehabilitation" embodies a very important concept of modernity understood as a transition from an approach to implant insertion based on the mere availability of bone support, to a much more extensive and complete design of a functional implant unit - implant site - prosthetic restoration. This assumption is now universally recognized by the international literature to such an extent that the guidelines have been profoundly influenced by it. Prosthetic driven implant positioning has become the guiding concept as an operative orientation followed [1]. Modern implant-prosthetic rehabilitation sees long-term success in the harmonization of the three “functional compartments” represented by implant fixture, implant site and prosthetic restoration. [Fig1]. This modern concept of functional implant-prosthetic rehabilitation has been widely discussed in the world cultural context and reported in the most eminent literature.

The technical response to these changed production and clinical design needs has materialized very well in the digital techniques that have been able to give a more than exhaustive answer to all three phases mentioned.

The digital project has brought about the great practical innovation represented by the contextualized previsualization of all the data necessary for the functional optimization of rehabilitation on the patient. It is based on a set of volumetric data in the form of files in different formats, concerning the local alveolar bone support, the architecture of the gingival tissues, the dental asset at the time of clinical check-in and the preview of the required prosthetic rehabilitation. Furthermore, another huge innovation, it was possible to preview the implant position relative and contextualized to the anatomical and functional site object of the rehabilitation. [Fig2] [2.3.4.5]

The passage from the planning phase to the clinical one involves the possibility of recreating in the patient's mouth what is previewed in the project; then, the prosthetic restoration and the relative implant position the implant position is transferred to the site to be rehabilitated through the use of a surgical template, obtained by milling which will allow the packaging of the bone sites of dimensions and position suitable for the insertion of the corresponding fixture. Surgical template and prosthetic restoration are both produced by milling or moulding according to the more traditional digital techniques [Fig3].

The evolution of the concept of digital approach to implant-prosthetic rehabilitation has been that of "service". More and more companies are proposing themselves to the Implantologist Clinician with the provision of a pre-clinical service ranging from the digital design of the case in question to the production of the devices necessary for the "chairside" phase such as surgical template and temporary prosthetic restoration. The service also includes the supply of the expected hardware including implant fixtures and prosthetic connections. The Clinician will therefore only have the task of carrying out the Surgical and Prosthetic phases provided for in the rehabilitation plan [Fig4].

The purpose of this work is to evaluate the usability of one of these services applied to different situations offered by our daily Clinical practice. We will report the complete results of the chair-side work by analysing which, in our opinion, are the advantages and which the disadvantages, always referring to the chosen protocol, of which we will give a complete description below in the Materials and Methods chapter. The author declares the complete absence of conflicts of interest or economic interrelations with the Company provider of the digital system used.

Material and Methods

The aim of the work was to evaluate the clinical application of the most modern digital techniques applied to implant prosthetic rehabilitation and to evaluate the efficacy, repeatability and safety of an implant-prosthetic digital service system offered by a manufacturer of implant systems.

We selected a group of patients who needed an implant-prosthetic rehabilitation of one of the two dental arches, upper or lower, or both, whether they are full-arch, or partial rehabilitations.

We used materials and implementation flows offered by Dio Implant, a company producing rehabilitation systems already in use in our clinical reality for several years with conventional analogue methods. The choice of the brand depended on the fact that, having known the biological and mechanical performance of fixtures and prosthetic connection systems for some time, we were able to focus on the effectiveness of digital procedural flows, taking for granted the goodness of the physical product [6] and supported from the specific literature consulted.

Inclusion Criteria → we have not placed restrictions on access to both sexes and the age range, without prejudice to national and international directives that advise against the implementation of implants for patients under 21 years of age or over 85 [7]. The sample of cases presented is of heterogeneous geographical origin without any foreclosure, so much so that the place of birth was incorporated for the obligations imposed by law but not included among the characteristics of the sample group.

Family History: diabetes and periodontal diseases with evident familial unfolding were not considered as directing factors clinical inclusion in the working group we are reporting on

Remote and Next Medical History: absolute exclusion criteria were considered chemotherapies and treatment cycles with bisphosphonates used in the year prior to check-in [8]. Alcoholism, drug addiction and smoking were considered in the same way as the official Italian and international guidelines. Like all systemic diseases considered contraindicating an implant treatment. Regarding the oral sphere, we considered an exclusion criterion or a repeated and important inability to manage oral hygiene at home. Superficial or deep periodontal diseases are not included in the exclusion criteria.

Objective Intraoral Examination: particularly unfavourable occlusal patterns or unsuitable gingival assets were not considered as criteria for patient exclusion but certainly included in the planned rehabilitation program [9]. As a criterion for inclusion, we considered the edentulous class B-3 and all those of class C 1-2-3 according to the classification of Bartolini Testori et al.

We treated a case of edentulous A1, characterized by the lack of 21 and 22 [Fig5].

Recruitment → we have recruited the following cases: 3 full arch upper arch cases, 1 partial lower arch case and 1 edentulous case 21 22. All selected patients are in good health and fully fall within the inclusive criteria just set out. None of the exclusion criteria was found in the 4 selected cases.

The FIRST VISIT included the interview with the patient, the family and personal anamnestic survey, remote and immediate, the physical examination, an initial opt-in examination and the registration of two study models including registration of the bite in the usual closure. SECOND VISIT a description was given to the patient about the objective conditions found and the proposed therapeutic plan with the relative economic and procedural plan. Having obtained an adequate manifestation of consent, we proceeded with the acquisition of the datasets necessary for the parent company to draw up an appropriate work plan.

Dataset Acquisition → as a general concept, in order to proceed with planning a case of implant-prosthetic rehabilitation with digital methods, it will be necessary:

1. Acquire data in digital format relating to alveolar bone support // intraoral situation // patient's usual or centric closure bite (according to the prosthetist's indications) [Fig5].

2. Make sure that all these data are spatially relativized to each other as in the real situation (obtaining data relating to the components mentioned and spatially oriented in a way corresponding to reality is called matching). In order for the matching to be possible, but above all in conformity with reality, different stratagems are used. In our case, the parent company requires the use of radiopaque markers whose placement in the intraoral cavity before 3D radiographic examination and intra oral scans, depends on the condition of the patient at check-in and on the type of edentulism found. Radio opaque markers and wax bite registration plates are supplied by the parent company. [Fig.6]

Project → Once the required documentation has been received by uploading the data to a dedicated portal, the Headquarters (Head Quarter HQ) draws up a project concerning the prosthetic restoration and the related implant support [Fig. 7]. The HQ also provides for the positioning of the prosthetic connections deemed most valid in order to ensure good stability during the immediate loading of the implants. In our case we wanted to proceed with a customized project to evaluate the correspondence between what was requested and the design performances offered by default. We then proceeded to design the prosthetic restoration for all patients and to place the implant using a cad software we usually use [Fig.8a b c]. This information was provided to the HQ in the form of spatially oriented STL files with

the required 3D images. In one case we also simulated a post-extraction plastic alveolus of the site to be implanted, requiring a surgical guide to perform the same. To facilitate the work, we have created and sent a 3d image of the bone site resulting from the required reductive alveolus-plastic and we have included it in the documentation sent, always spatially oriented in compliance with the indications provided and necessary for the design. The collected data was transferred to the HQ through a dedicated company website through which the required files and clinical information regarding the prosthetic restoration are uploaded [Fig 9]. After a few days, the Hq will share with the Clinician a complete project showing the implant position, the instructions and the surgical sequences for their insertion, an indicative evaluation of the bone density of each site and the indications for the assembly of the implant. prosthetic restoration. The Clinician has the right to request changes to the proposed plan. Changes that, in our case, were promptly accepted and made. The final approval of the project by the clinician marks the beginning of the production phase.

The Supply → about ten days after the approval of the project we received a set for each patient containing the implants, prosthetic connections, surgical templates and prosthetic restorations (note that the clinician has the possibility to request, as prosthetic restorations, both a fixed artifact for immediate loading, and a mobile one if it is decided to defer the implant load) [Fig.10].

Surgical Phases → guided implant insertion includes operating phases that are standard and precisely: adaptation and fixation of the surgical guide> execution of the calibrated osteotomies> insertion of the implants> removal of the guide> measurement of the ISQ values [10 11 12]> assembly of the connections prosthetics / cover screws> prosthetic finalization based on the clinician's decisions on the type of load. The method of fixing the surgical guide depended on the patient's edentulous condition at check-in and on the type of surgical approach required. In the specific case of our experience, we have always used dental-supported implant templates. In one case, given the extraction sequence, we used two templates, the first with dental support and the second with implant support [Fig.11 12 13]. In the case in which we requested a plastic-alveolus we used a set of three surgical templates as illustrated by the relative photographic sequence. A case of post-extraction full arch deserves a particular mention where, after implant insertion, we made an alveolar refilling using autologous material from the transformation of the extracted teeth obtained using the tooth transformer technique [fig14] [13]. The Drill-Sequence involves different steps in which the achievement of the depth, diameter and anatomy of the bone site for the implant neck is treated in successive phases. The insertion of the implants provides in addition to the control of the insertion depth, also of the angular position through the reference notches present both on the sleeve of the surgical guide and on the mounter provided for the insertion itself [fig.15 a b]. Once the insertion is complete, the controlled surgical guide is removed, the bone anatomy at the implant neck is removed and the ISQ value for each fixture is measured. This measurement, following the dictates established by international literature, is now universally recognized as a safe parameter for evaluating implant stability. We used it as a criterion to decide when or not to immediately load the

inserted fixtures. The suture was made after having assembled the prosthetic components provided in order to guarantee the best juxtaposition of the gingival tissues in the emergency area of the prosthetic abutment. We used fine (5/0) nylon sutures. The scheme used involved the removal of the sutures 15-21 days after surgery. An Orthopantomography check was performed on each patient at the end of the surgical phase [fig16].

Prosthetic Phases → the scheme adopted for the fixed prosthetic restoration is the classic one of a Toronto Bridge screwed onto the Multi Unit Abutment and connected to the implant by means of metal turrets joined to the Mua and then glued to the dental restoration. One of the full-arch cases will be presented in its definitive prosthetic restoration version in the form of a removable prosthesis joined to a milled bar and counter-bar system. The choice of the chosen occlusal scheme deserves a special speech. As a general principle, the prosthetic restoration must not be subjected to chewing pressure. For this, very light cusp inclinations were designed, balanced and group exclusive schemes, total absence of cantilever on distal implants. The patient is prescribed an absolutely soft diet and absolute ban on chewing consistent foods for at least 30 days after the operation [Fig. 17 18 a b c d] [14 14a 14b].

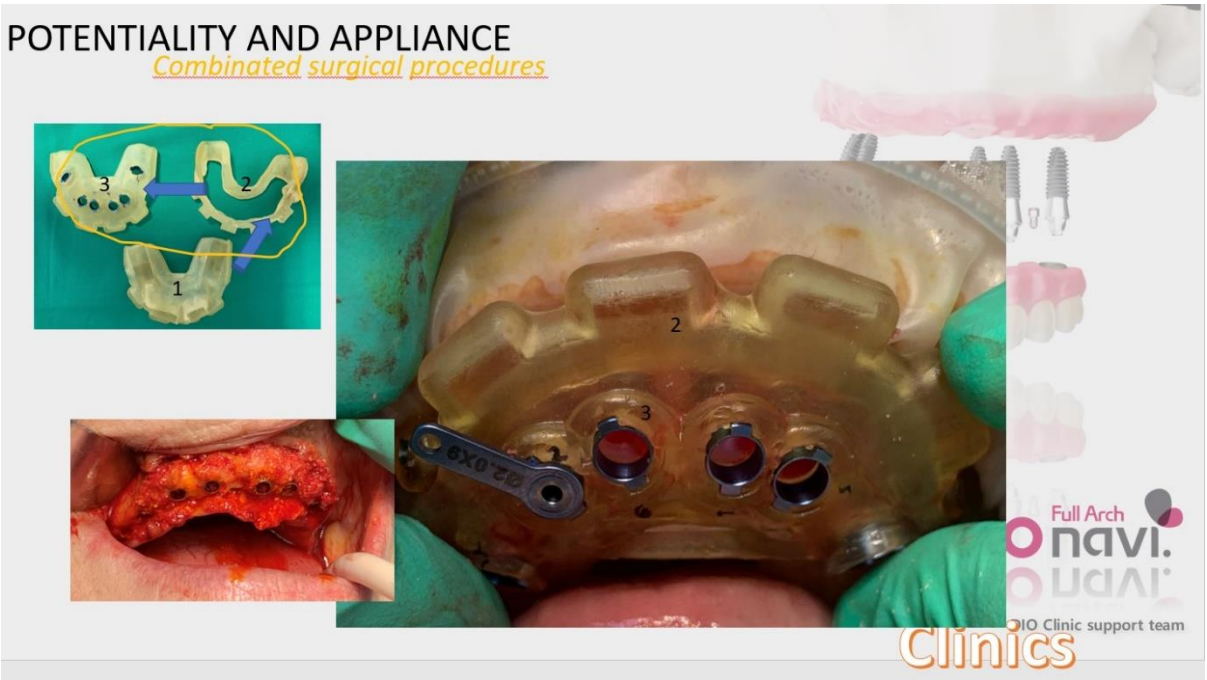


Fig 1: The Three Functional Compartment Of A Rehabilitation : Restoration, Implant And Connection, Soft Tessues And Alveollar Bone

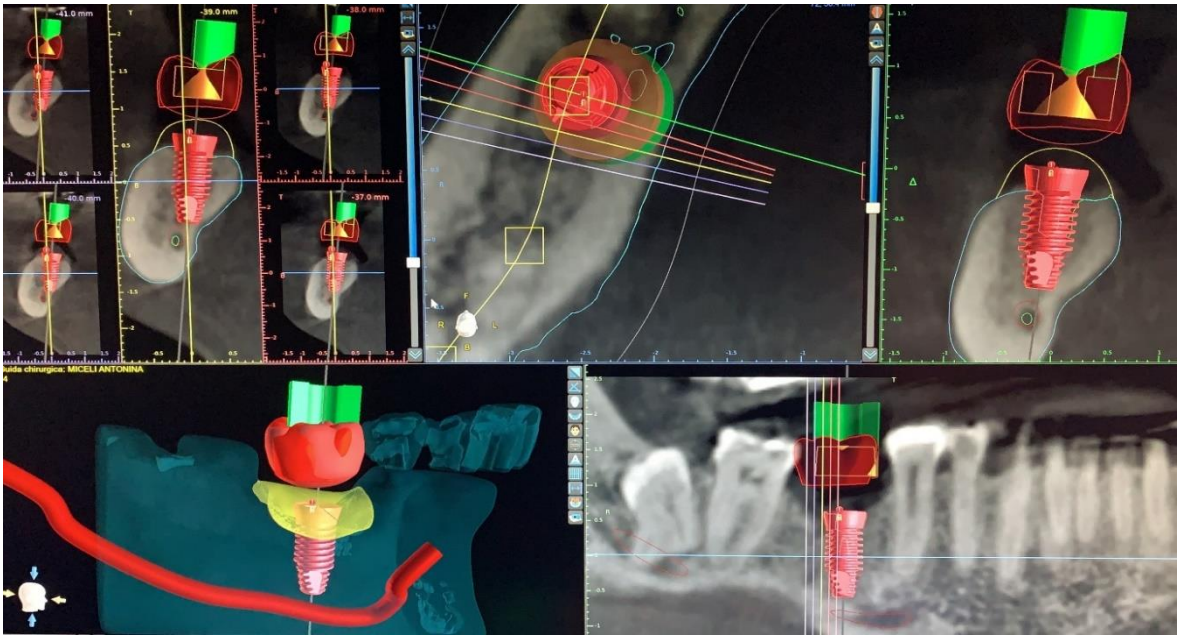


Fig 2: Implant Position Contextualized on Site and Restoration Requested

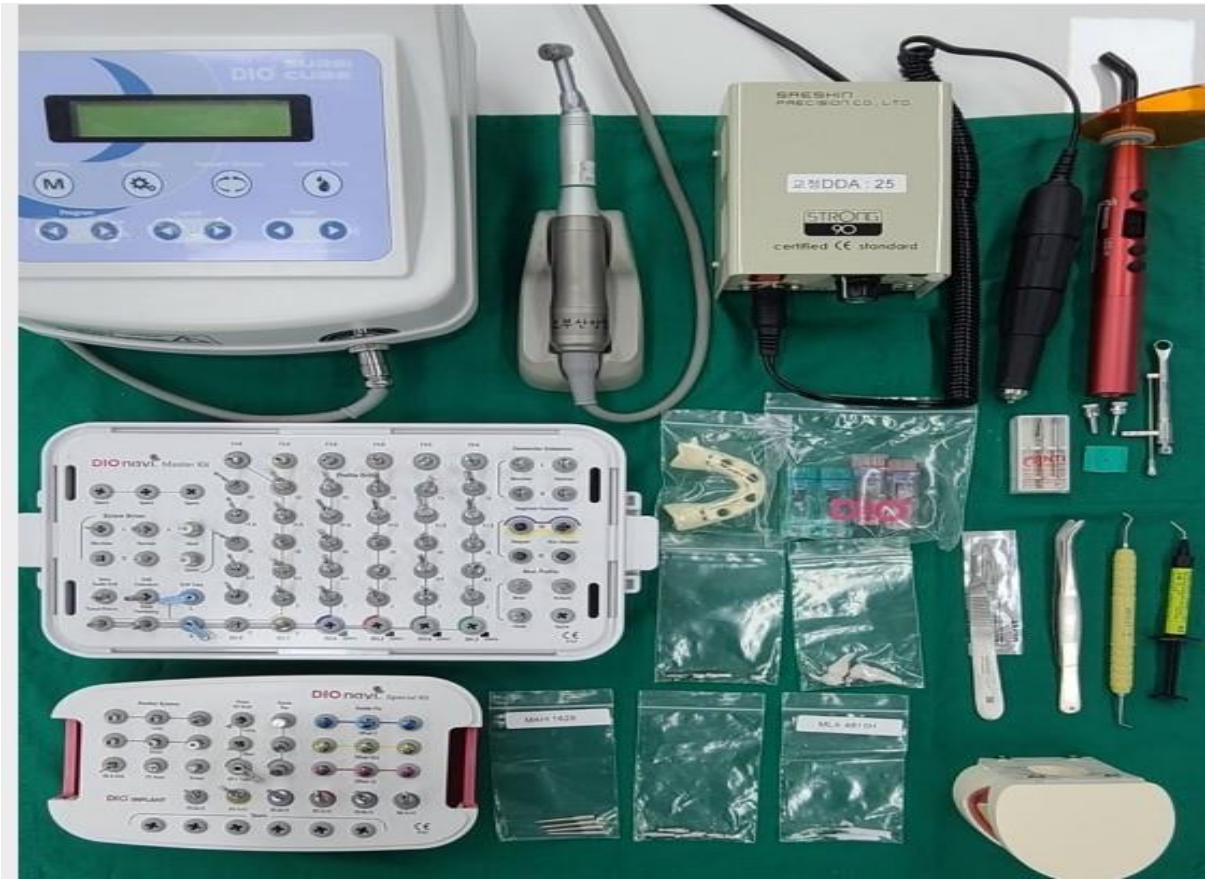


Fig 3: Samples of Surgical Guide Both for Alveoplasty and Implants Positioning

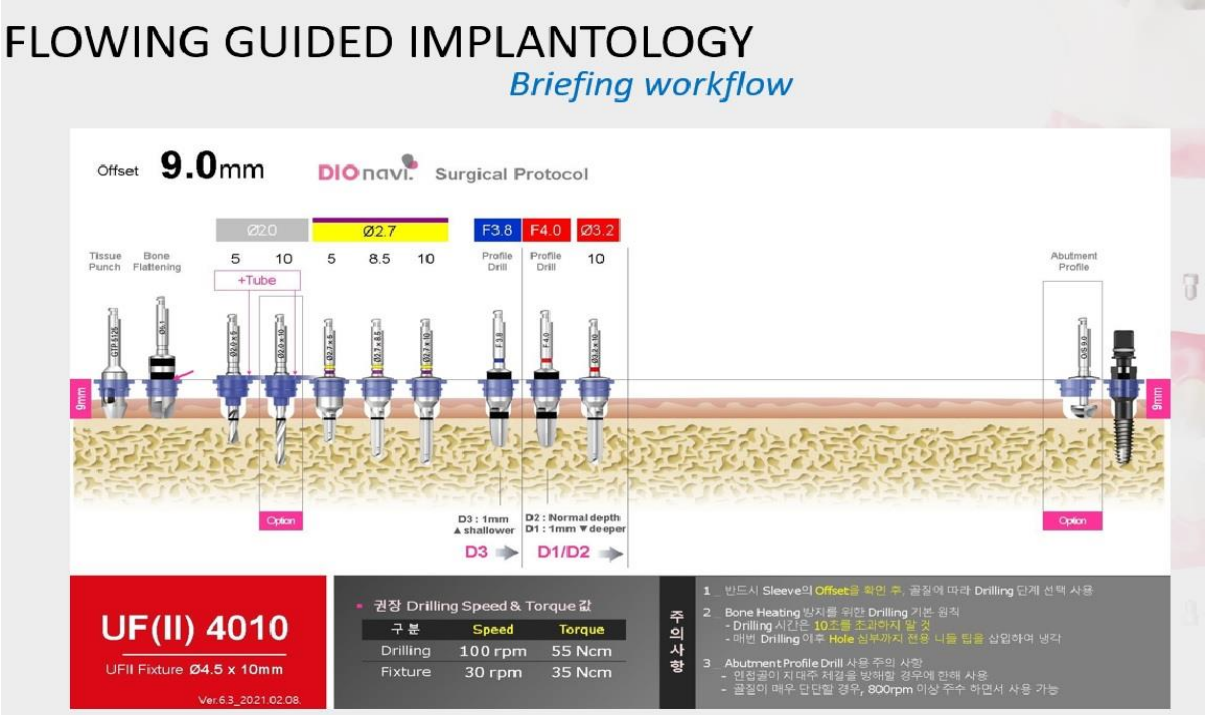


Fig 4: Kit Provided by Modern Implant Factories Including Both Implants Restoration, Guides and Prosthetical Connections.

Fig 5: Overview of Digital Dataset Acquisition Flow

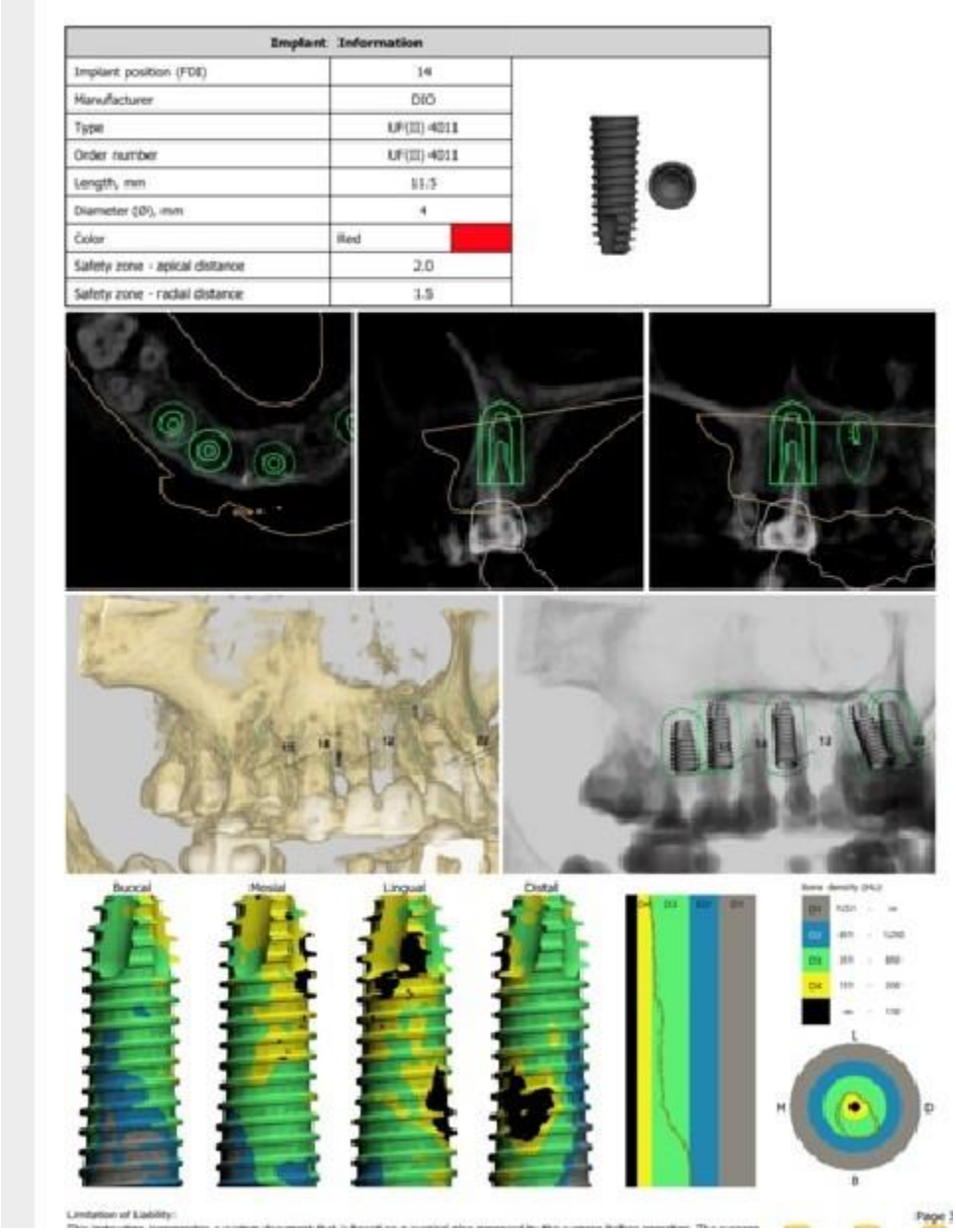


Fig 6: Radio-Opaque Markers to Allow Digital Matching of Intraoral and Bone Renderings

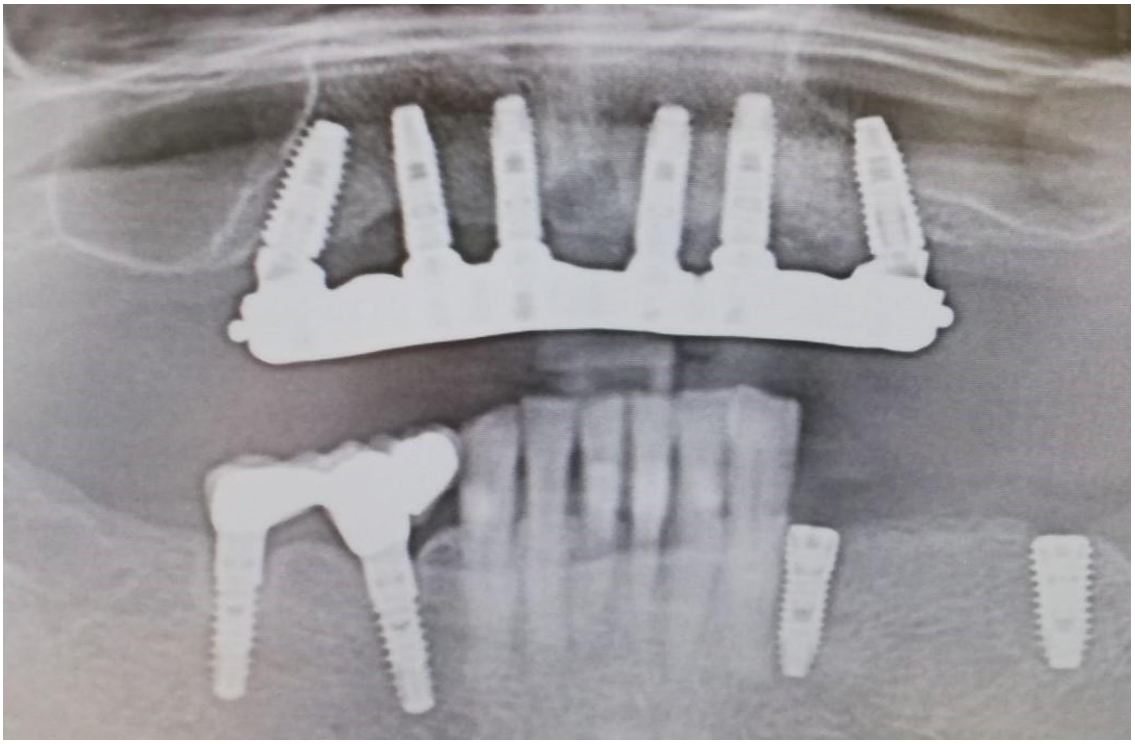
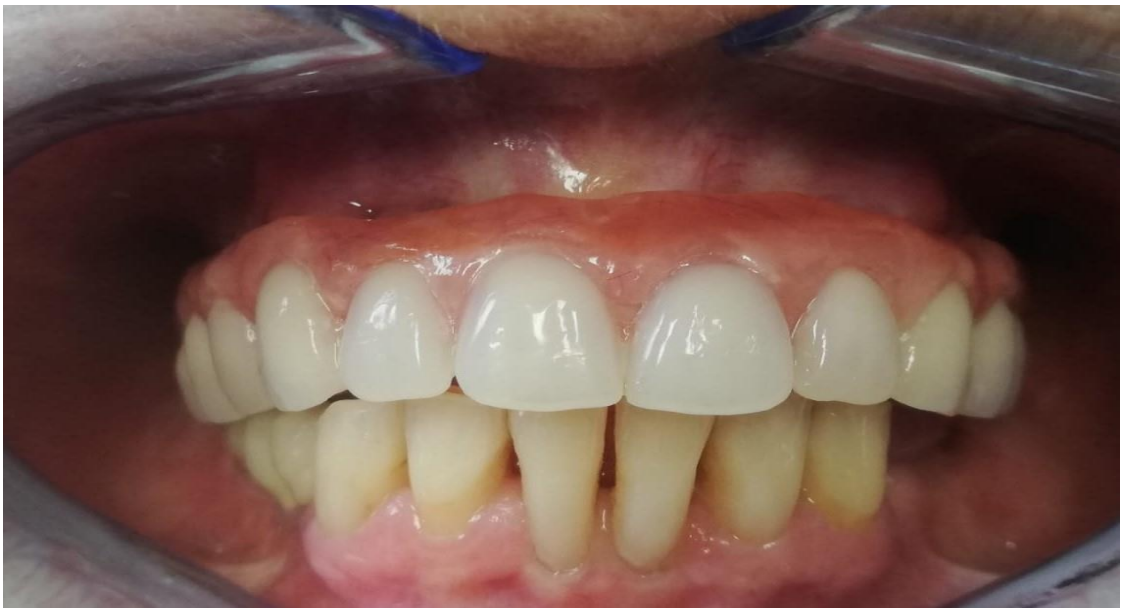


Fig 7: The Project Made by Company Hq Once Uploaded Didgital Dataset by Clinician



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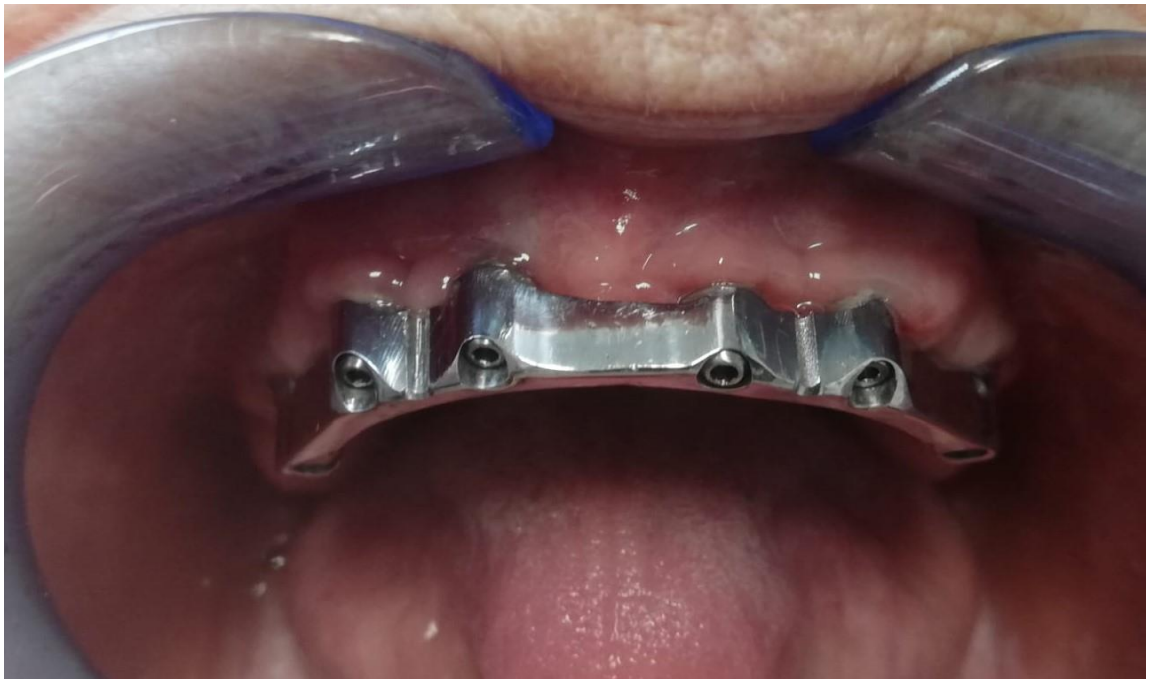
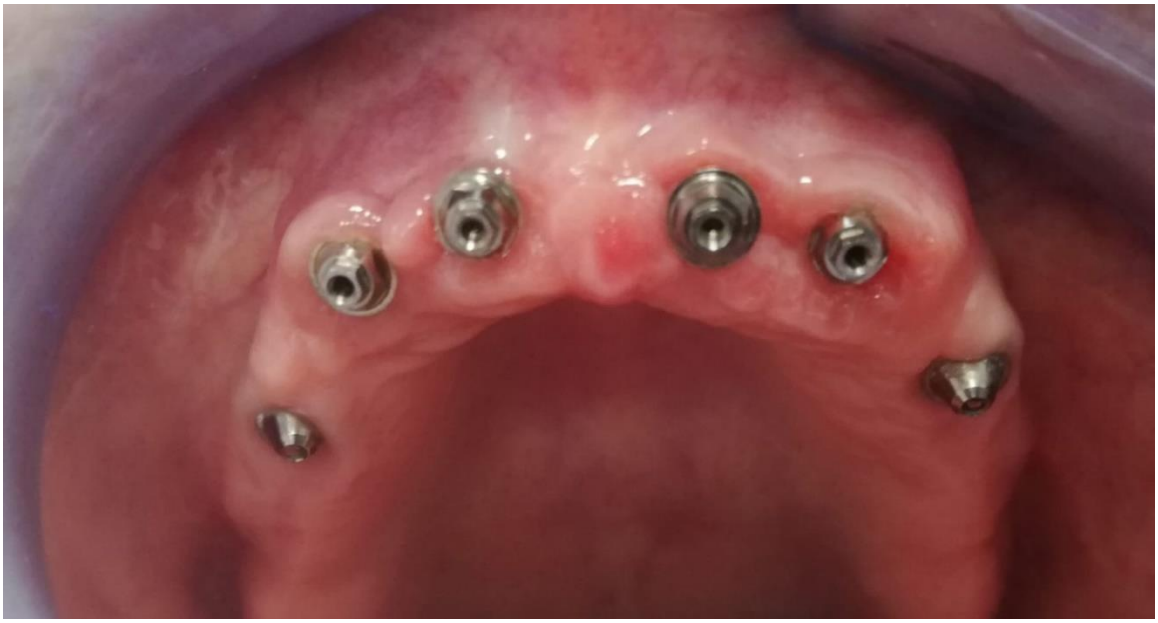


(b)



(c)

Fig 8 a,b,c : For Each Patient We Previously Make A Project Before Uploading Datasets to Company In Order To Establish Congruency For Implant Site As Requested Bworldwide Scientific Consensus

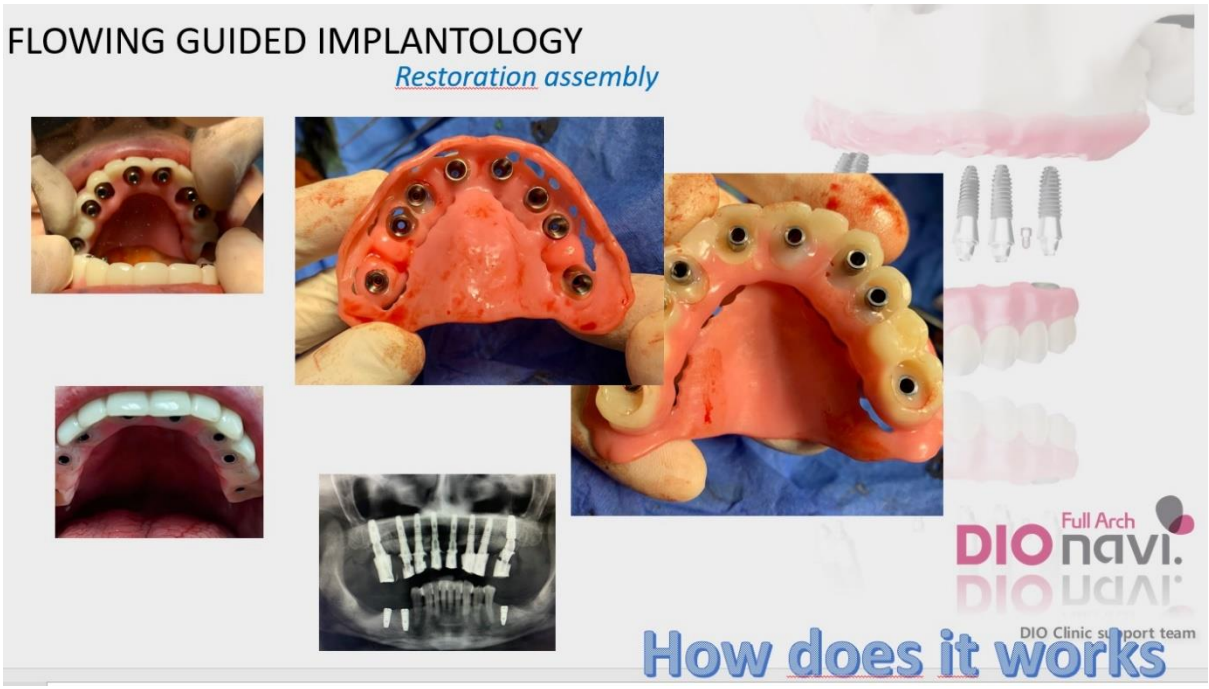


Fig 9: Digital Datasets Uploading Format to Hq

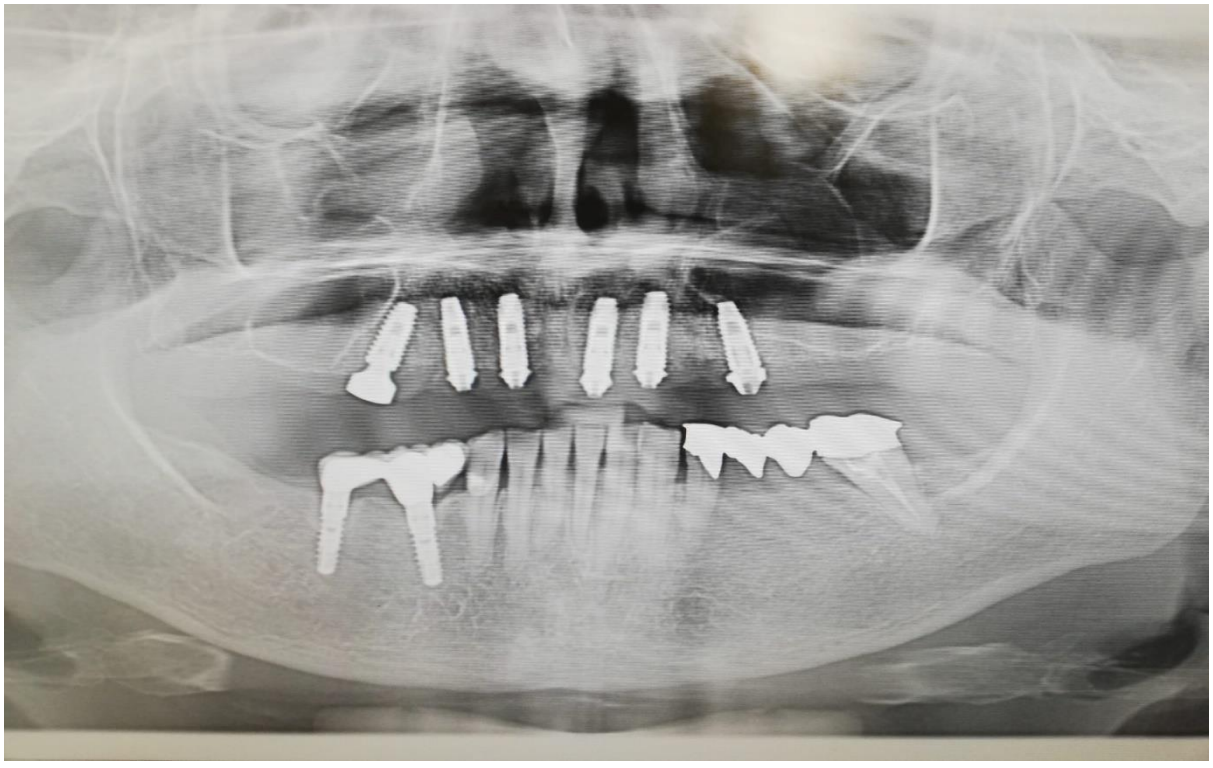
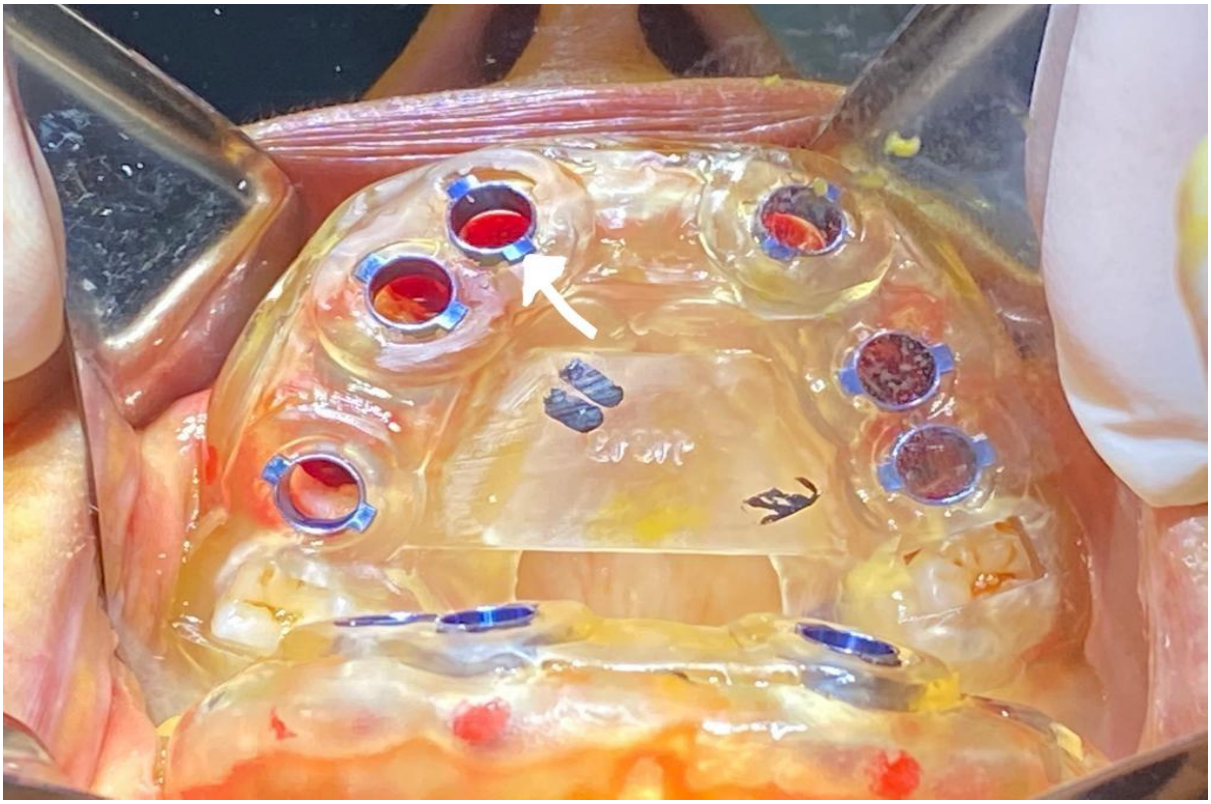


Fig 10: Restoration Provided by Company. Can Be Used Both for Mobile or Screwed Device



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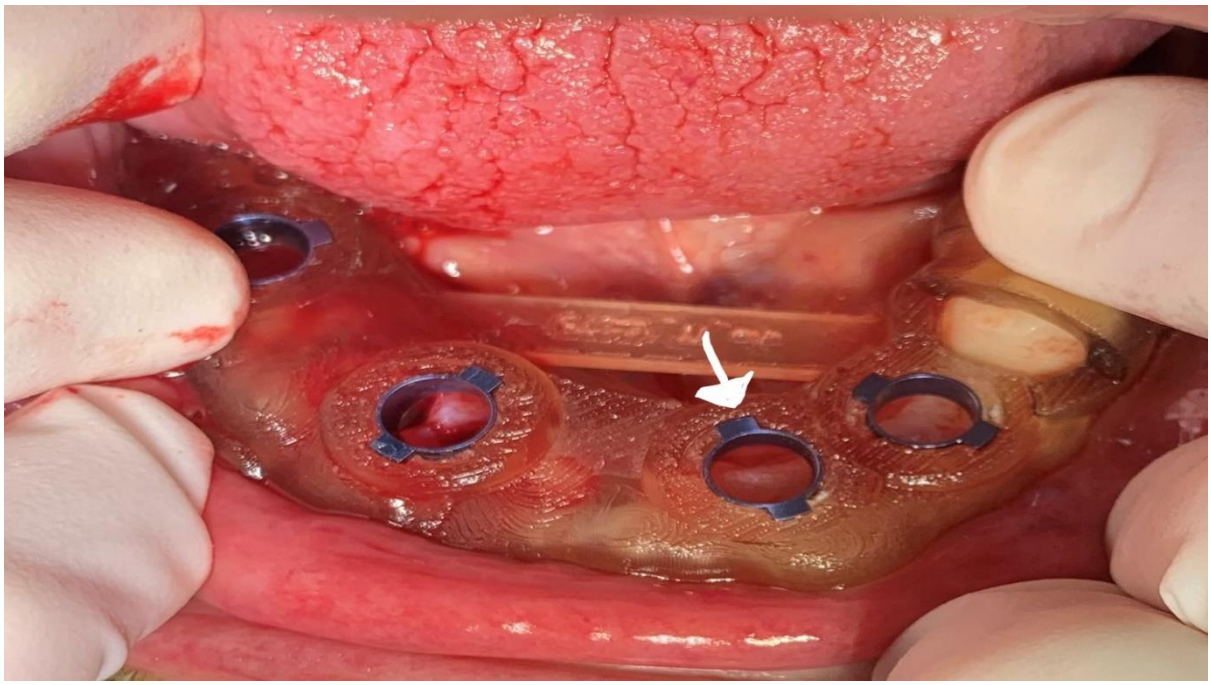

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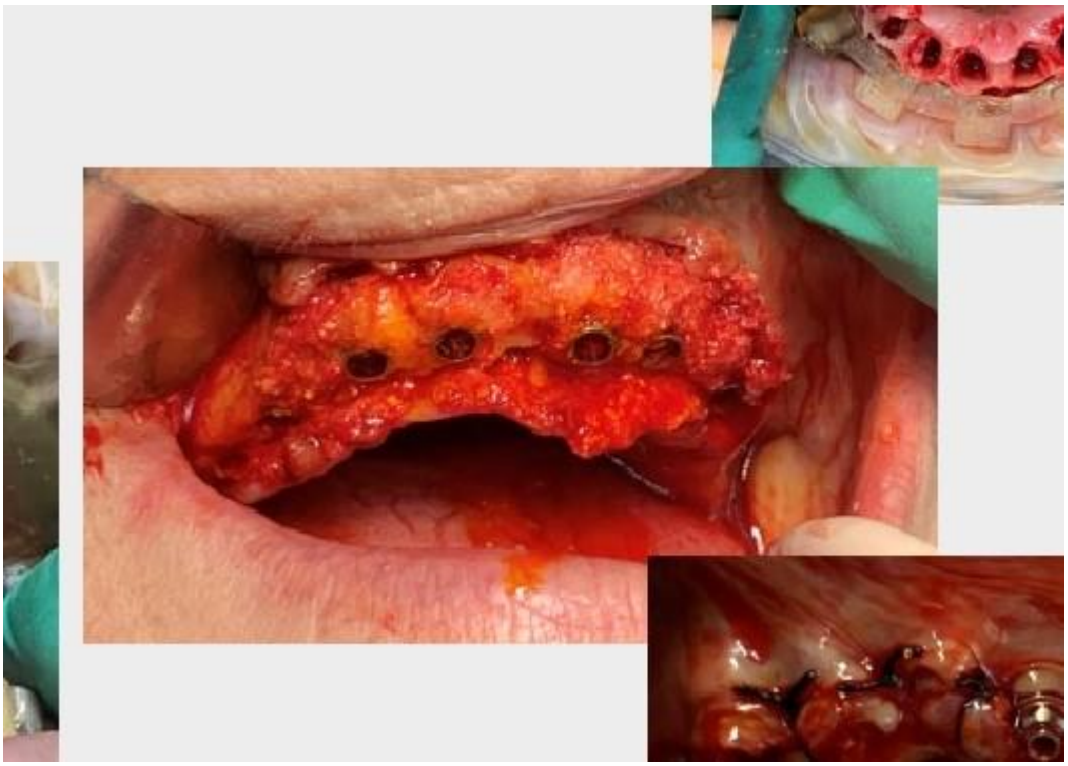

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Fig 11 12 13: Surgical Steps

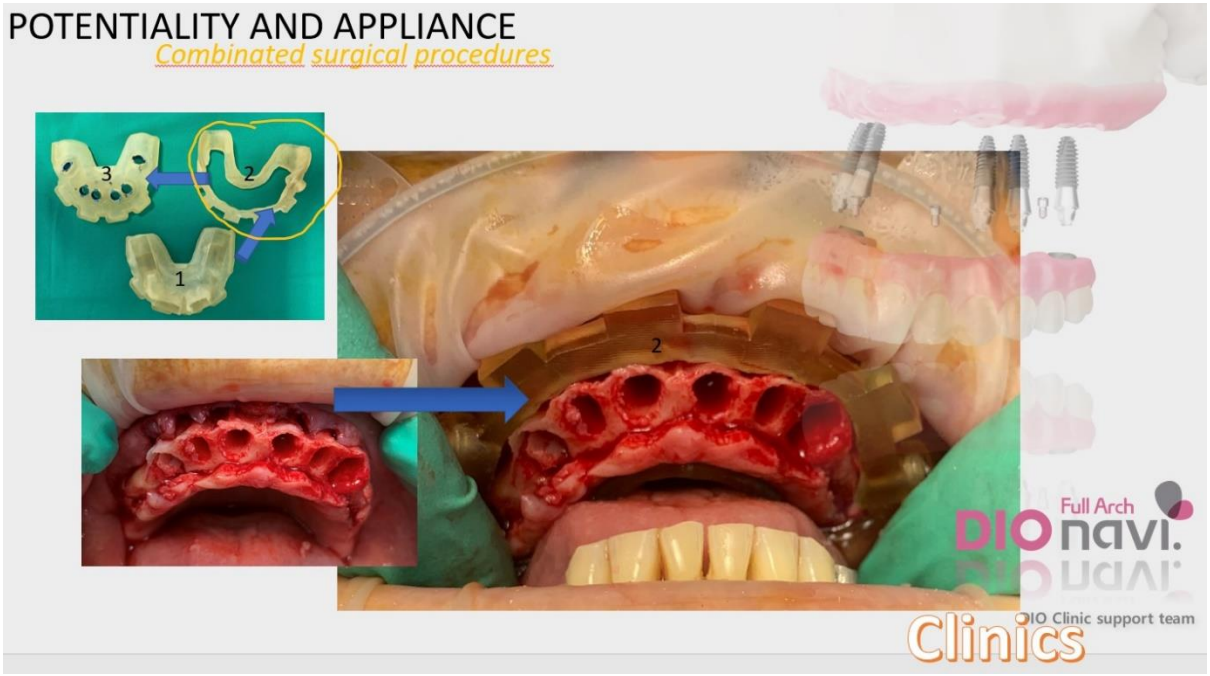
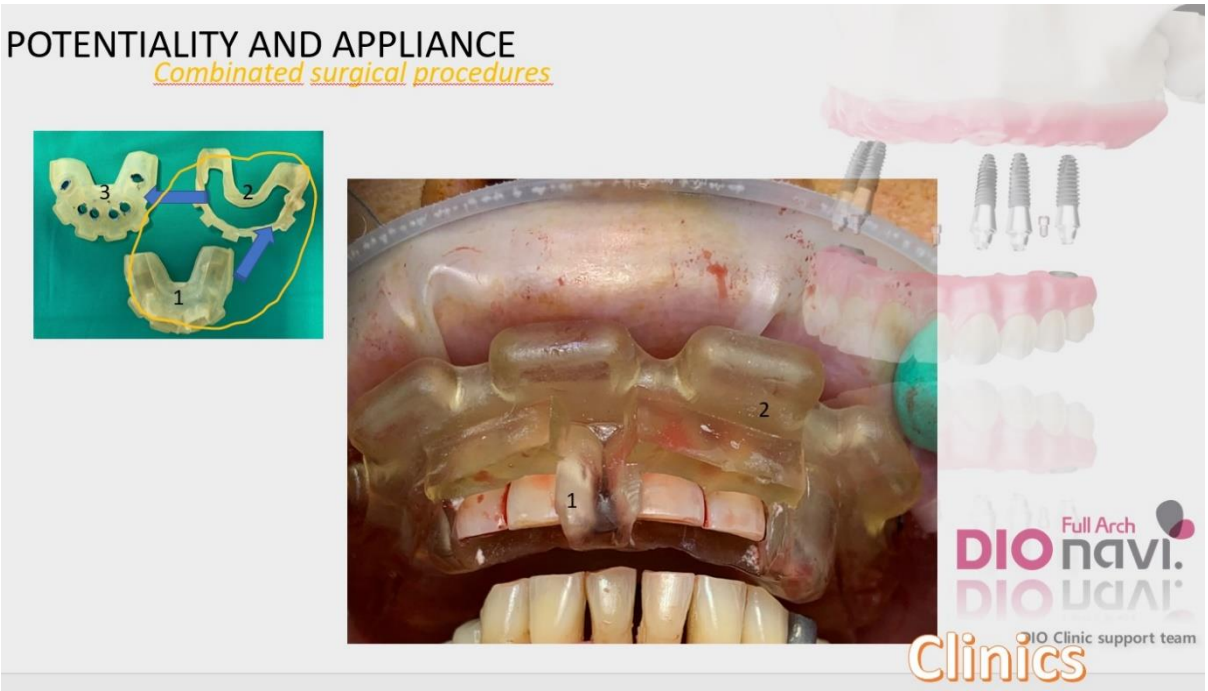


Fig 14: Autologous Material to Refine Implant Position Obtained from Tooth Transformer



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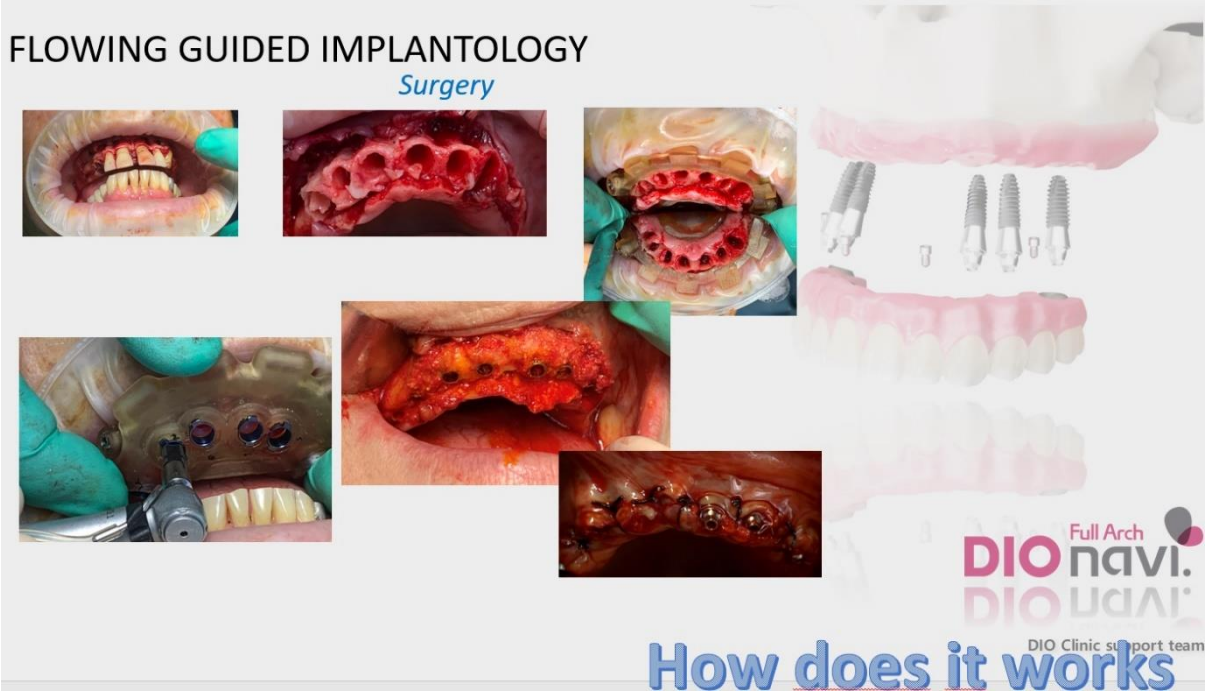


(b)

Fig 15a b: The Implant Guided Positioning.

Fig 16: Final Opt Control for Check Of Implants Position

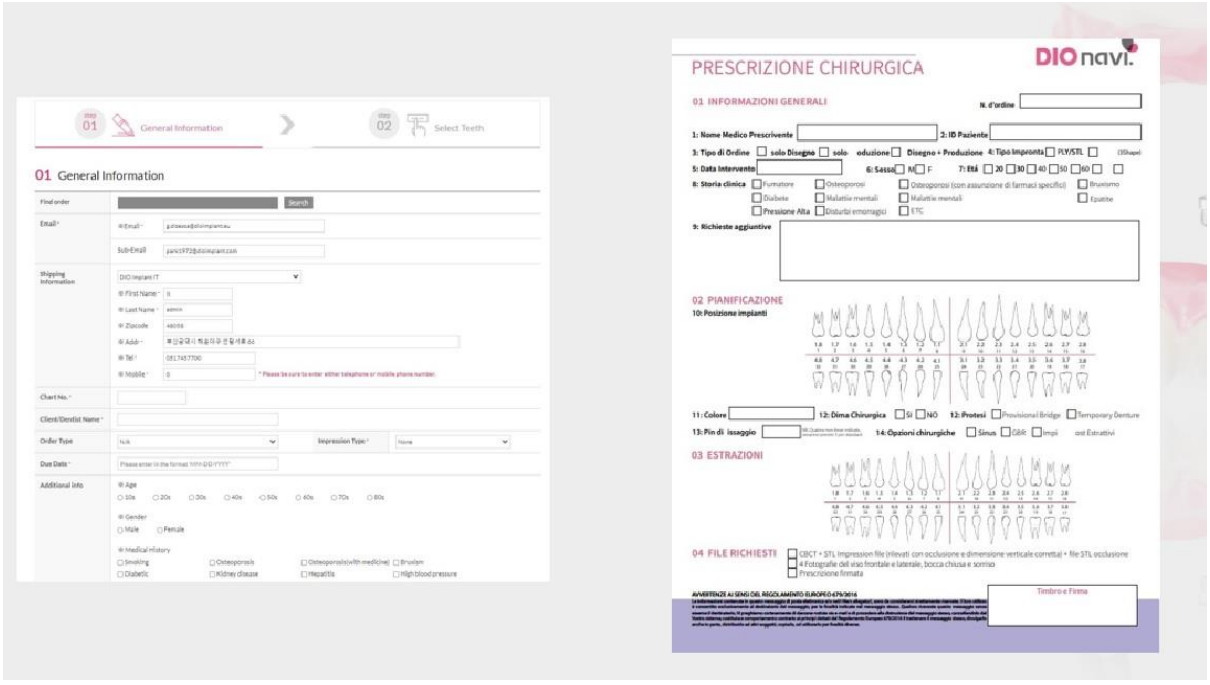
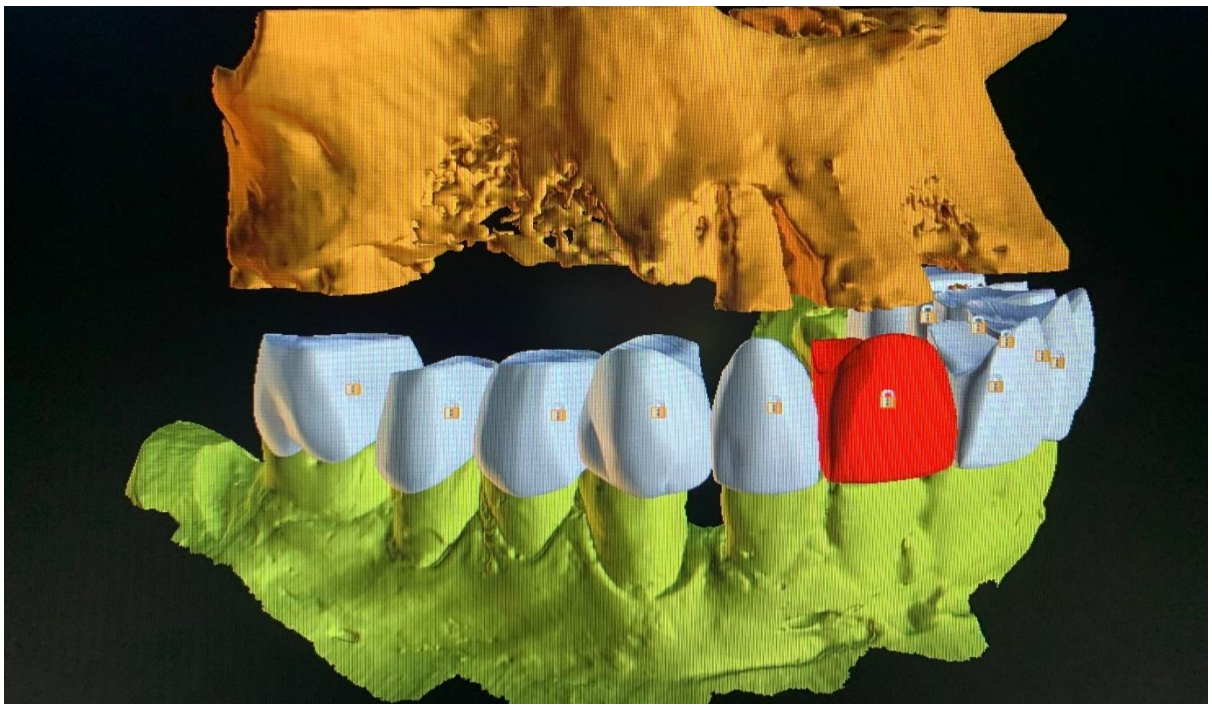


Fig 17: Restoration Assembly Steps



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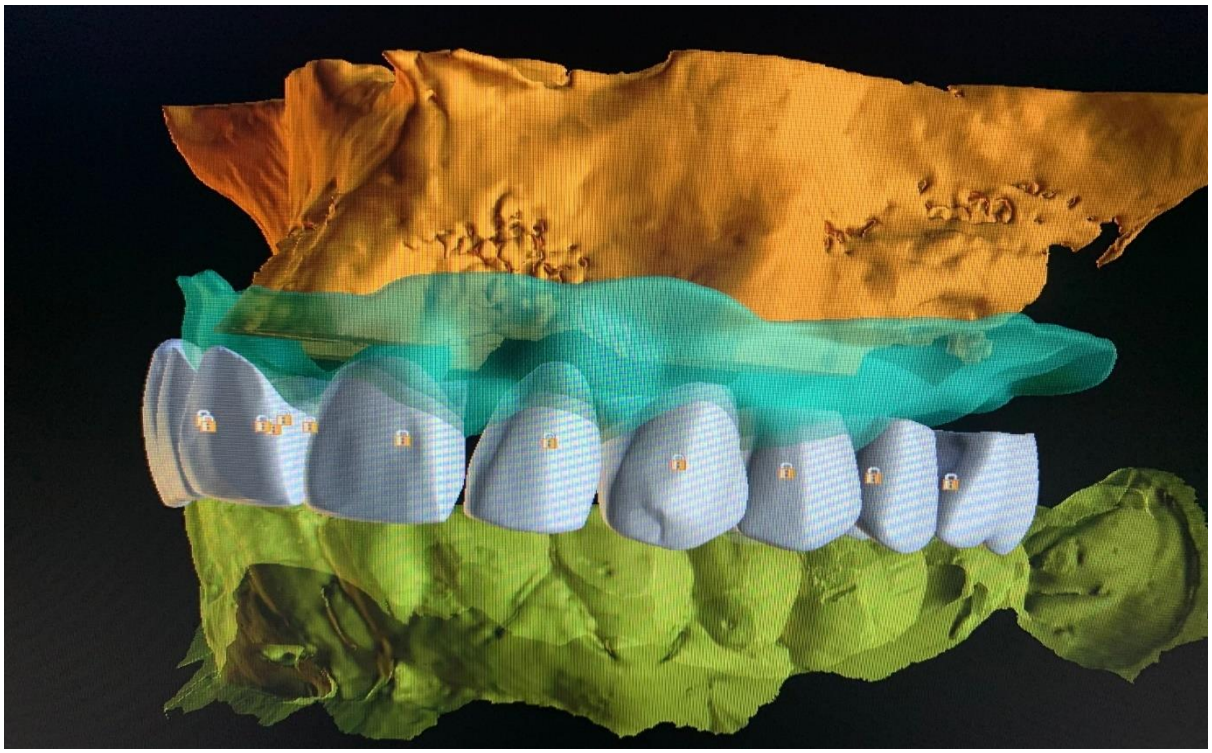

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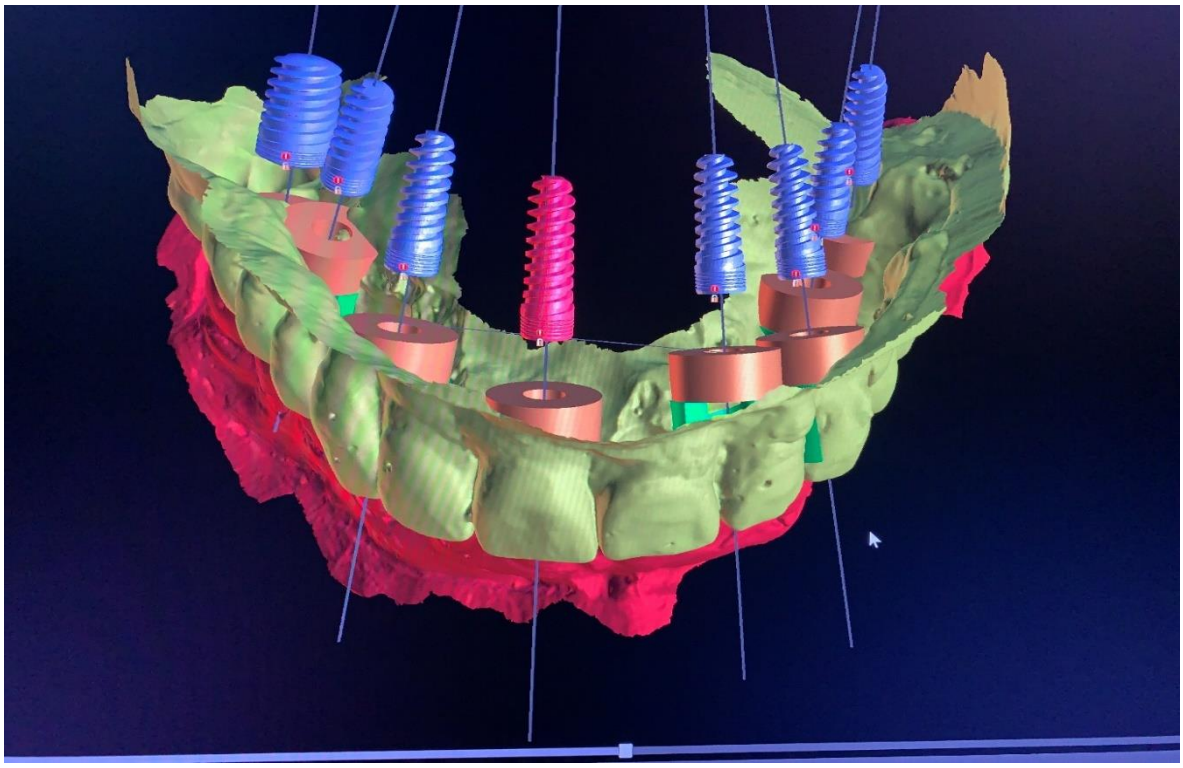

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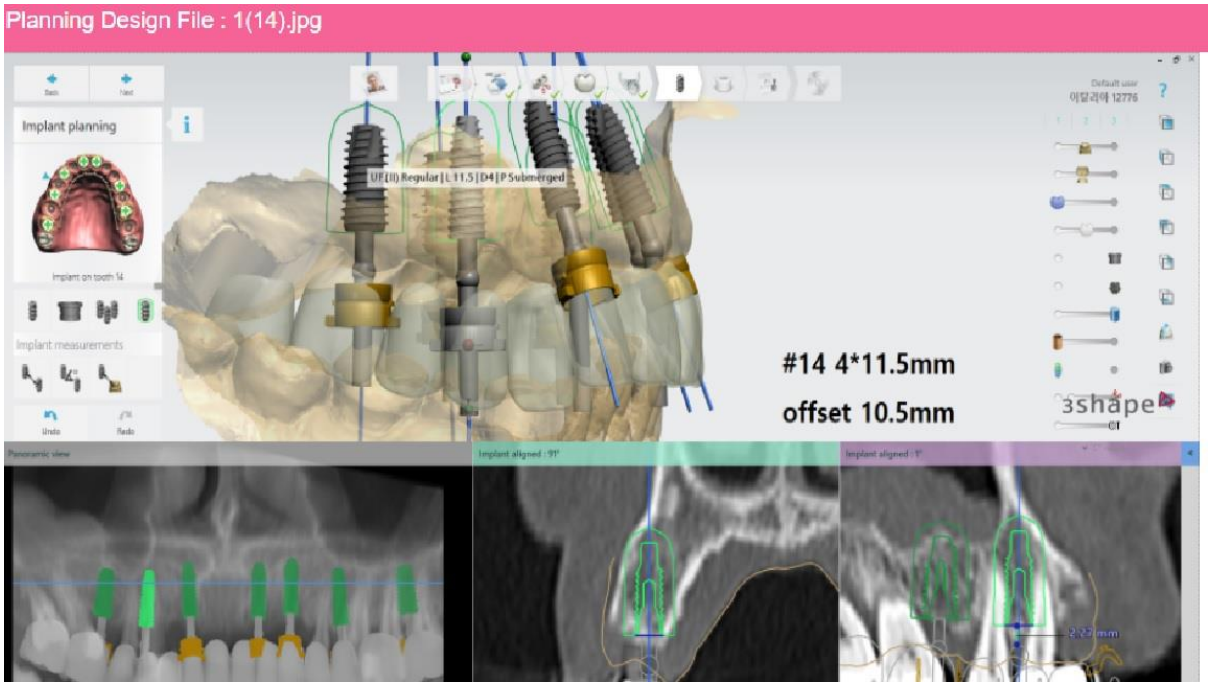


(d)

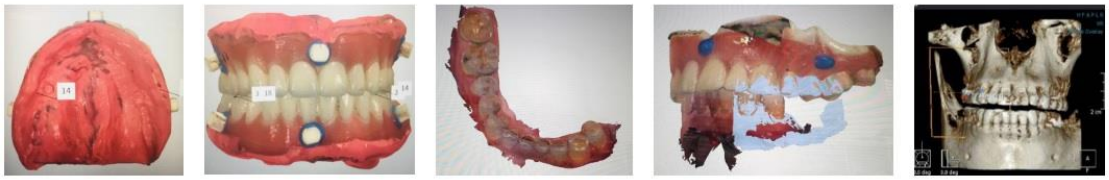
Fig 18 a,b,c,d Definitive Restoration Workflow And Xray Check

DIO Full Arch navi.

Raccolta Dati

CBCT - SCAN- FOTO DEL PAZIENTE

ESEMPIO DI PROTOCOLLO SCANSIONE

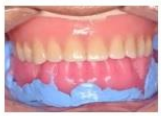


1.Ribasatura | 2.Posizionamento i maker | 3. Scansione antagonista | 4. Scansione morso | 5. CT scan Close Bite

DIO Full Arch navi.

Workflow Full Arch

DATASET COLLECTING CHAIRSIDE



1.1 Scansione protesi in cera

2-1.Posizionamento protesi

2-2.Scansione protesi

2-3. Guida chirurgica & Fabbricazione Protesi Provvisoria

Intervento 1/2ora~1ora + P/B set-up 1ora = Tot. 1.5~2ore

Protesi Provvisoria: caricamento immediato

3-1. Intervento DIOnavi

3-2.Regolazione del ponte di fornitura

3-3.Scansio ne della protesi provvisoria

3-4.Posizionamento Protesi Provvisoria

4-1. Design & Conferma

4-2.Posizionamento della protesi definitiva


10.5
SURGICAL GUIDE
IMPLANT FIXTURE
MULTIUNIT ABUTMENT

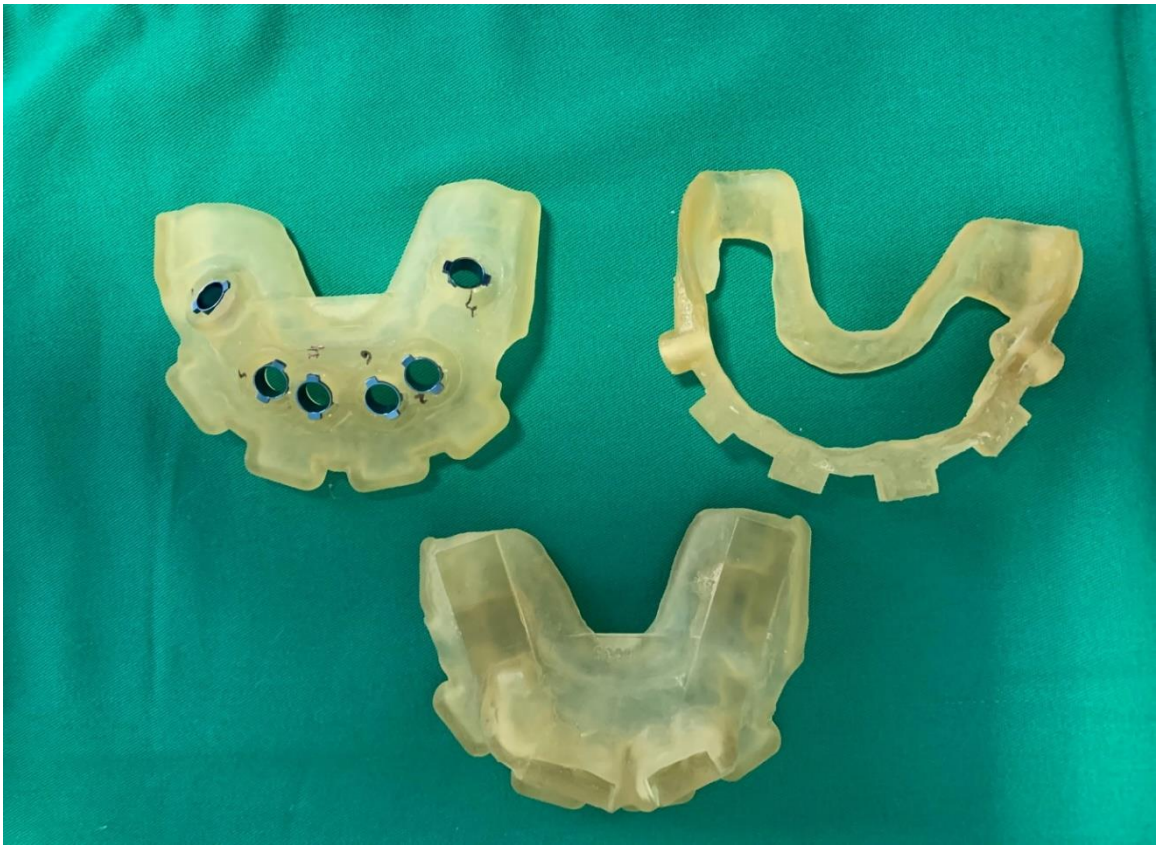


Fig 20: Drills Sequence

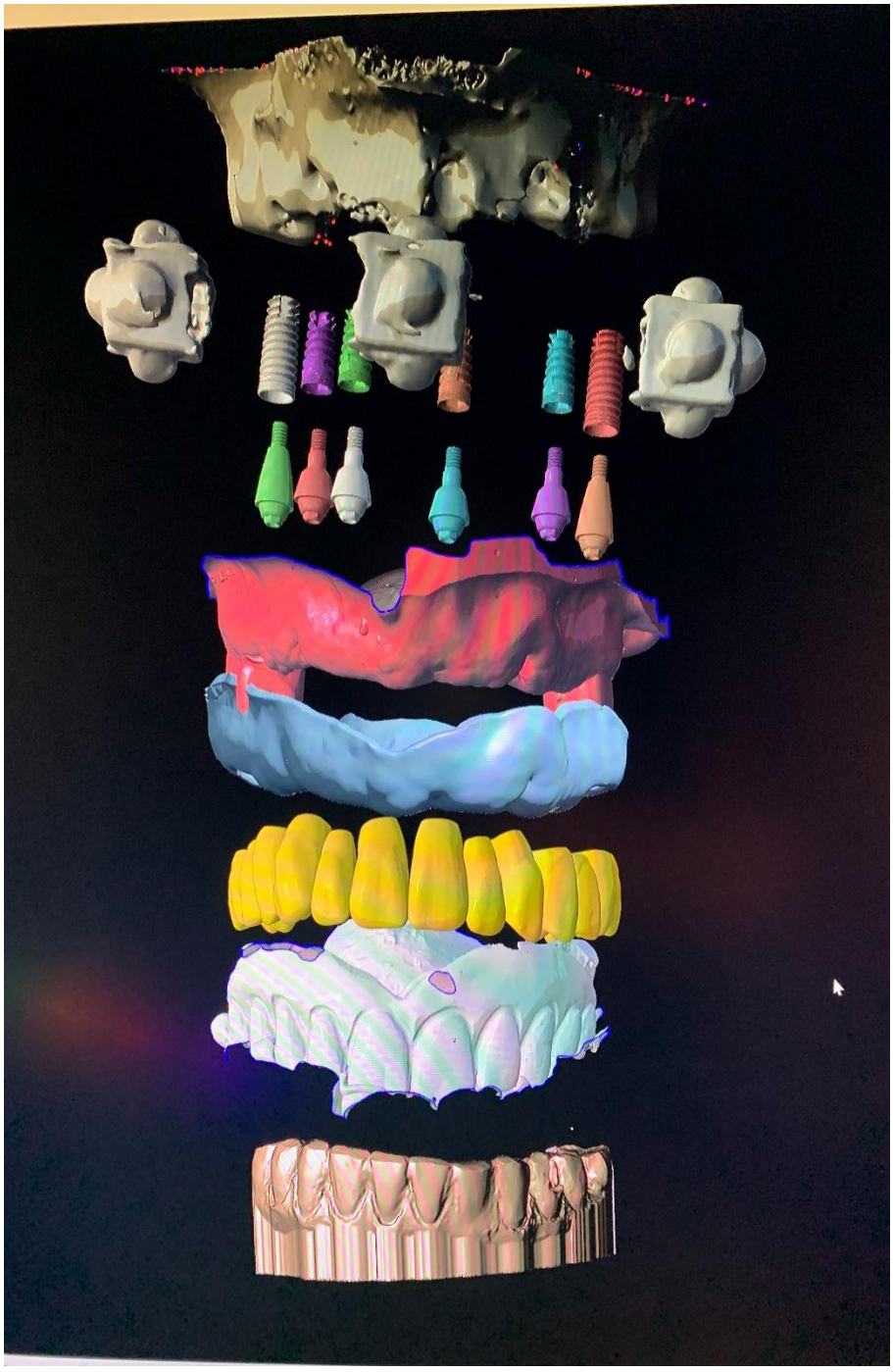


Fig 21: Hardware Used

Conclusion

As a goal, modern implant-prosthetic rehabilitation must have the full satisfaction of the patient's expectations prolonged over time. The principle outcomes are "restitution ad integrum" of the masticatory-phonatory function and the satisfaction of aesthetic expectations.

The prerogative of duration over time must be ensured by optimizing a concept of functional unit that sees the alveolar bone-gingival tissue complex, called the implant site, at the center of a second functional unit represented by prosthetic restoration, prosthetic connection, dental implant. These two anatomical-functional units must be harmonized with each other as absolutely as possible. Digital systems are the optimal technical response to this technical need.

The implant site therefore plays a key role in digital design. The project becomes an infallible quality control system, in the sense that it helps the clinician to identify the potential criticalities of the system during the implant site design phase which becomes fundamental for the functional and aesthetic prognosis of the prosthetic implant-connection-restoration system.

The current challenge in digital implantology is aesthetic and functional performance. The perfect adaptation of the restored dental anatomies to the anatomical characteristics of the gingival tissues, still today, represents the golden standard of a therapeutic process, in continuous technical evolution

The systematic object of this work was found to be reliable. The workflow offered is effective. The Clinician's technical appreciation and Customer satisfaction were truly of a high level. We believe that time will mark a profitable refinement of the methods of sharing technical information. A “smart” visualization system could certainly facilitate the involvement of the Clinician whose availability in terms of time is always decreasing.

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