CLINICAL CASE STUDY

Increase of Vertical Dimension of Occlusion (VDO) with Temporary CB Resin in a Complex Rehabilitation Case

In this paper, Dr. Antonio Busato and dental technician Luca Giovenzana give a step-by-step overview of the digital process to plan and produce provisional restorations in a complex rehabilitation case with loss of vertical dimension of occlusion using CAD/CAM technology.

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About the Authors

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Degree in Dentistry and Dental Prosthesis in 1985 at the University of Milan. Experimental thesis: holographic interferometry in dentistry (techniques of analysis of deformation patterns Professor Dario Marini). Dr. Busato has been working at the Associated Dental Office Dr. Veronica Vismara / Dr. Antonio Busato since 1986. In TETRA he is responsible for the analysis of clinical cases and the design and planning of orthodontic, prosthetic and surgical-orthognathic and implant therapy.

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Introduction

The introduction of new technologies in the dental field, such as 3D printing, are setting new standards of care. Digital data collection technology, including intraoral scanning, facial scans, and clinical photography, are enabling more accurate patient models than traditional methods.. This allows clinicians and dental laboratories to integrate the intraoral clinical situation with extraoral facial data to perform more precise occlusal analysis and production of restorations or prosthetics. This is especially critical for cases that require extensive oral reconstruction where form, function and esthetics are altered.

Moreover, 3D printing technology and materials provide highly customizable treatment options for complex cases where temporization is key to testing and preserving a new Vertical Dimension of Occlusion (VDO), esthetics, function before receiving permanent restorations. Accurate restorations can be effectively fabricated via 3D printing and materials have been developed for these purposes. Temporary CB Resin is a material that contains ceramic fillers providing excellent polishability, esthetics, low plaque retention and optimal mechanical properties that maintains the VDO unaltered throughout the adaptation process to this new clinical scenario.

This clinical case shows the rehabilitation process of a patient with extensive wear and loss of VDO using CAD/CAM workflows. Patient registration was done via intraoral and facial scan in the dental practice. The data was combined and restorations were planned and designed via CAD software in the dental lab. Finally, these were produced in the dental laboratory with Formlabs' Form 3B and Temporary CB Resin and sent back to the dental practice for cementation.

Case Presentation and Diagnosis

A female patient of 52 years old sought care at the practice to address esthetic and functional deficiencies.

Fig 1 - Initial clinical situation

During the clinical examination, the following was detected:

- Esthetic alteration (collapse of lower facial third, alteration of nasolabial angle, and labiomental sulcus depth and anatomy).
- Functional alteration both in static (altered overjet and overbite) and dynamic occlusion (lack of anterior and canine guidance during protrusion and laterotrusion, respectively).
- Presence of multiple restorations from different materials in bad conditions showing extensive wear, fracture and deterioration, especially in the lower anterior sector of incisors and canines. Presence of rough surfaces that facilitate plaque accumulation in this sector and in teeth 45 and 47 due to restorations and buccal soft-tissue recession exposing root surfaces.
- Signs of attrition in occlusal surfaces of posterior teeth in the lower arch.
- Loss of VDO of 5 mm.
- Clinical absence of teeth: 12, 13, 14, 15 and 46.
- Alveolar bone resorption in quadrant 4 (area of tooth 46).
- Removable partial denture in quadrant 1.

Treatment Plan

In this clinical case study, only **Phase I** is described.

Phase I:

The patient undergoes an increase of VDO of 5 mm via temporary restorations in the lower arch to allow for adaptation of the temporomandibular joint (TMJ) in the new position and test new occlusion. Full crown preparation were done to remove old restorations and allow the cementation of provisional restorations which include:

Fixed 3 unit bridge from 45 x 47 with full crown coverage type retainer.

7 unit provisional with full crown coverage for 33, 32, 32, 41, 42, 43.

3 unit provisional with full crown coverage for 47, 46, 45.

Phase 2:

After 10 months, provisionals will be removed and permanent restorations fabricated in zirconia via milling will be placed.

Clinical Procedures

1. Extraoral Patient Registration: Face Building and Photogrammetry

Face building technique was used for extraoral registration. This technique consists of the use of multiple pictures to reconstruct a 3D image of the patient's face. For this case, the camera of a mobile phone was used.

Figure 2 - Extraoral image registration: frontal and lateral views of the patient.

The 3D reconstruction of the patient's face was performed in order to correctly orient the intraoral scans (corresponding to the dental arches) to the skull. This was done through a registration protocol developed by Tetra (Tetra Protocol). This protocol combines an intraoral scan registration, CBCT and photogrammetry with the Tetra transfer fork (customized bite plane) and an accurate scaling and mesh alignment procedure. The Tetra alignment and scaling protocol was tested on 100 patients with face Cone Beams. The average coupling error between the transfer fork scan and the landmarks on the patient's face is between 0 and 0.2 mm. The images needed for face building and face photogrammetry reconstruction are obtained from a camera (5 pictures) and a smartphone (90 pictures), respectively.

Figure 3 - Photogrammetry

2. Intraoral Patient Registration: Photographic Records and Intraoral Scanning

Intraoral pictures were taken using a cheek retractor from several views, including frontal, lateral, maximum occlusion and disocclusion.

Figure 4 - Frontal view (left: maximum occlusion; right: disocclusion).

Figure 5 - Lateral view in maximum occlusion (left: right side of patient; right: left side of patient).

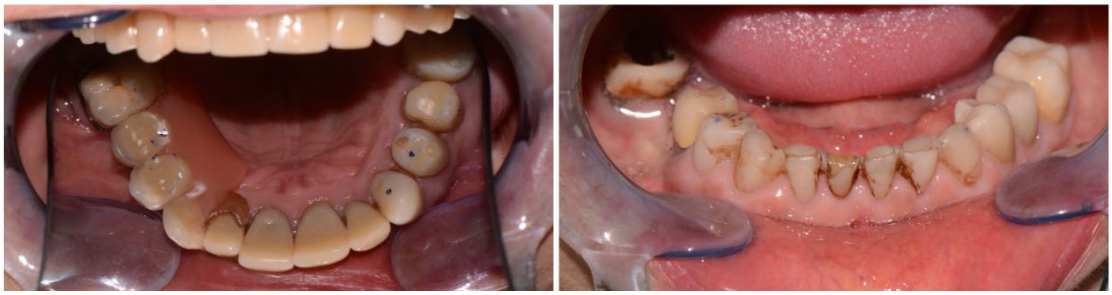

Figure 6 - Occlusal view (left: upper arch; right: lower arch).

Using an intraoral scanner (TRIOS 4 by 3Shape), the initial clinical situation was registered in order to perform the digital simulation analysis with the models mounted in the virtual articulator. This intraoral scan was also used to combine the digital data (images and face building) for a complete analysis of the clinical case and do a functional and facially driven wax-up. Combining the digital data in software enabled confirmation of proper articulation and alignment before moving forward to the planning and preparation stages.

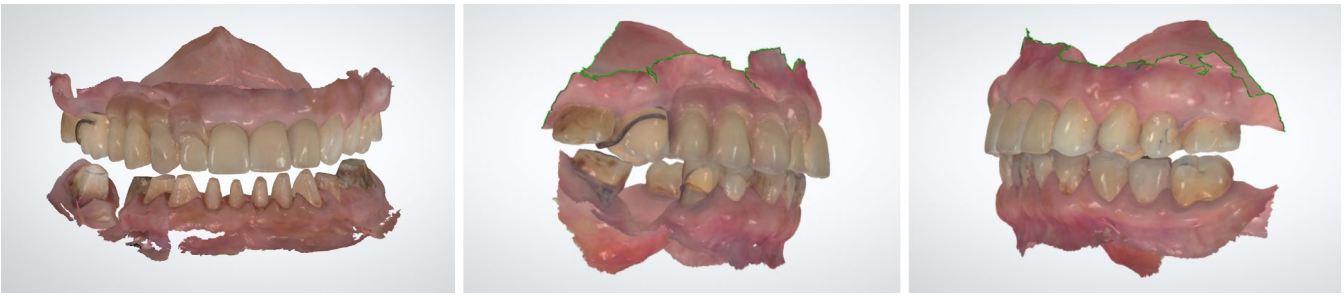

Figure 7 - Intraoral scan in maximum occlusion from frontal and lateral views.

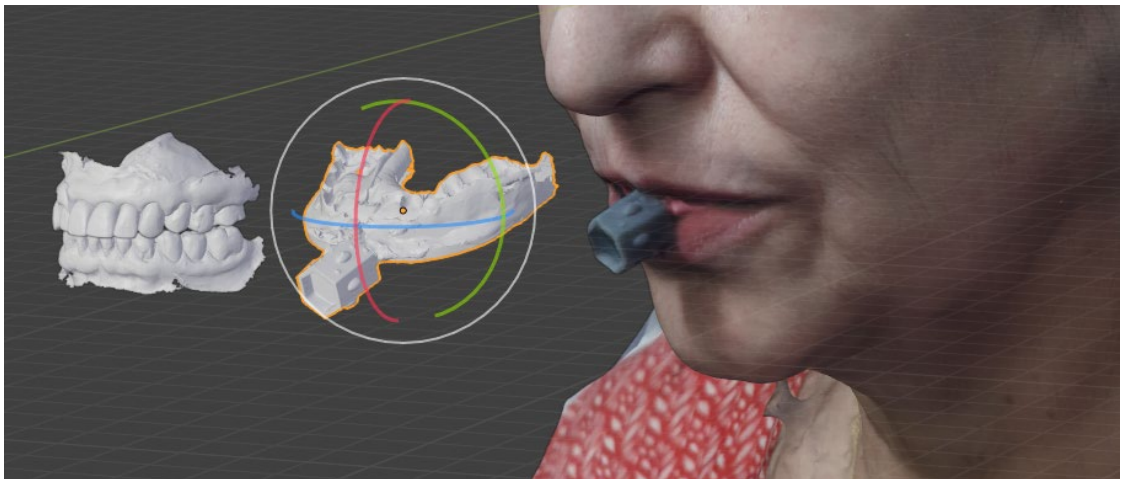

Figure 8 - Intraoral scan combined with the bite registration and face building.

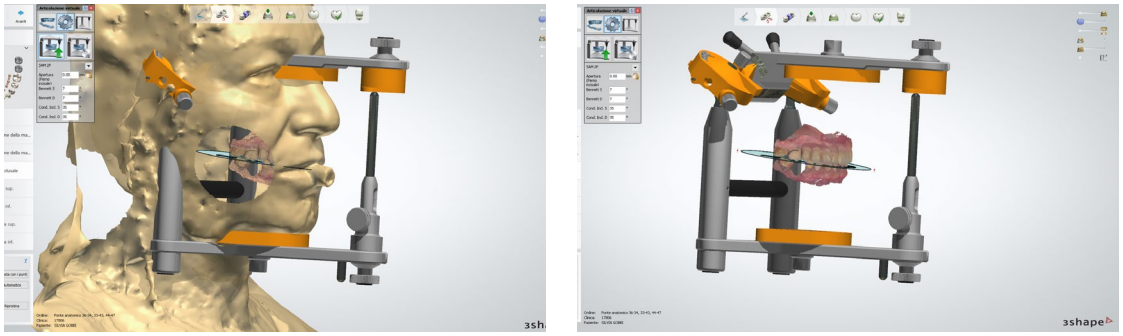

Figure 9 - Mounting models in digital articulator using intraoral scan, bite registration and face scan.

3. Digital Wax-Up

Using the digital data and software (3Shape Dental System), a digital wax-up was designed. The dental laboratory was able to check and confirm the increase of the VDO using teeth libraries available in the software, before the clinician moved forward with teeth preparation in the patient. This step also allowed us to check that the provisional restorations would integrate seamlessly with the natural elements in the mouth.

Based on the digital analysis, it was decided that the increase of the VDO was going to be done via the lower arch because the masticatory, swallowing, phonetic and esthetic deficiencies diagnosed were associated with the lower lip/third.

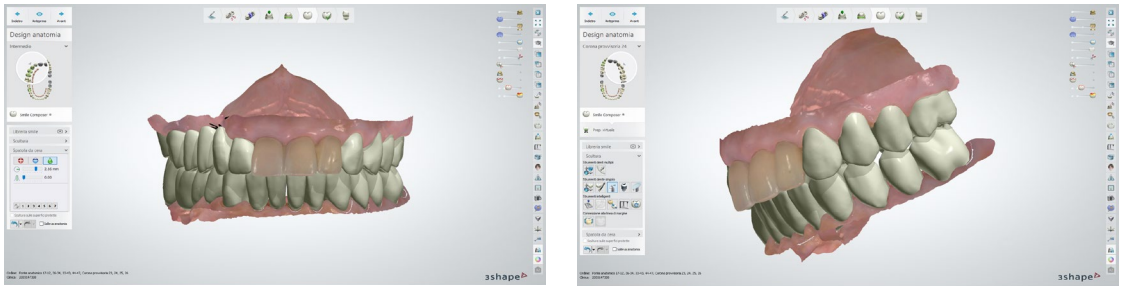

Figure 10 - Digital wax-up.

4. Tooth Preparations and Design of the Provisional Restorations

Tooth color A2 for the patient was selected using VITA shade guide as a reference.

All the present teeth of the lower arch were prepared using calibrated burs for full coverage crowns. From a structural perspective, the provisional restorations were planned as follows:

- Quadrant 4: A fixed bridge for 44, 45 x 47 with full coverage crown retainers.
- Anterior sector: A cross arch fixed bridge with crown retainers from canine to canine (33 to 43).
- Quadrant 3: A fixed bridge for 34, 35 and 36 with full coverage crown retainers.

After polishing, an intraoral impression was made both statically and dynamically and sent to the dental laboratory via email.

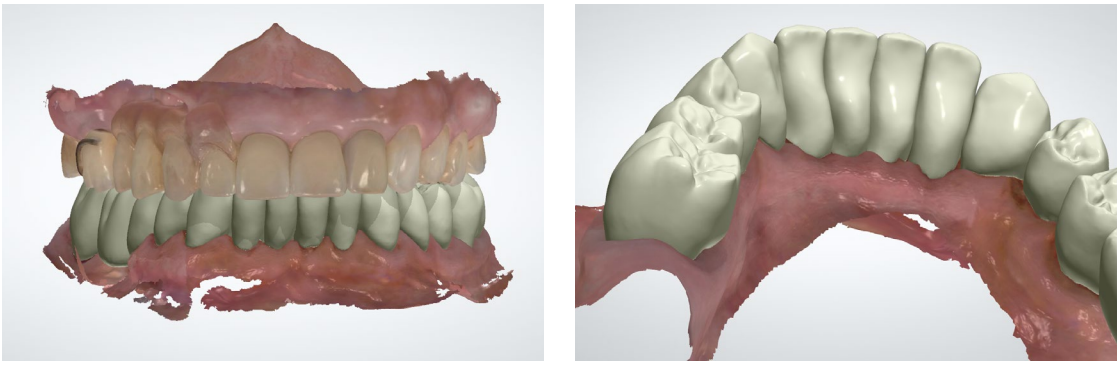

Figure 12 - Design of provisional restorations upon prepared teeth.

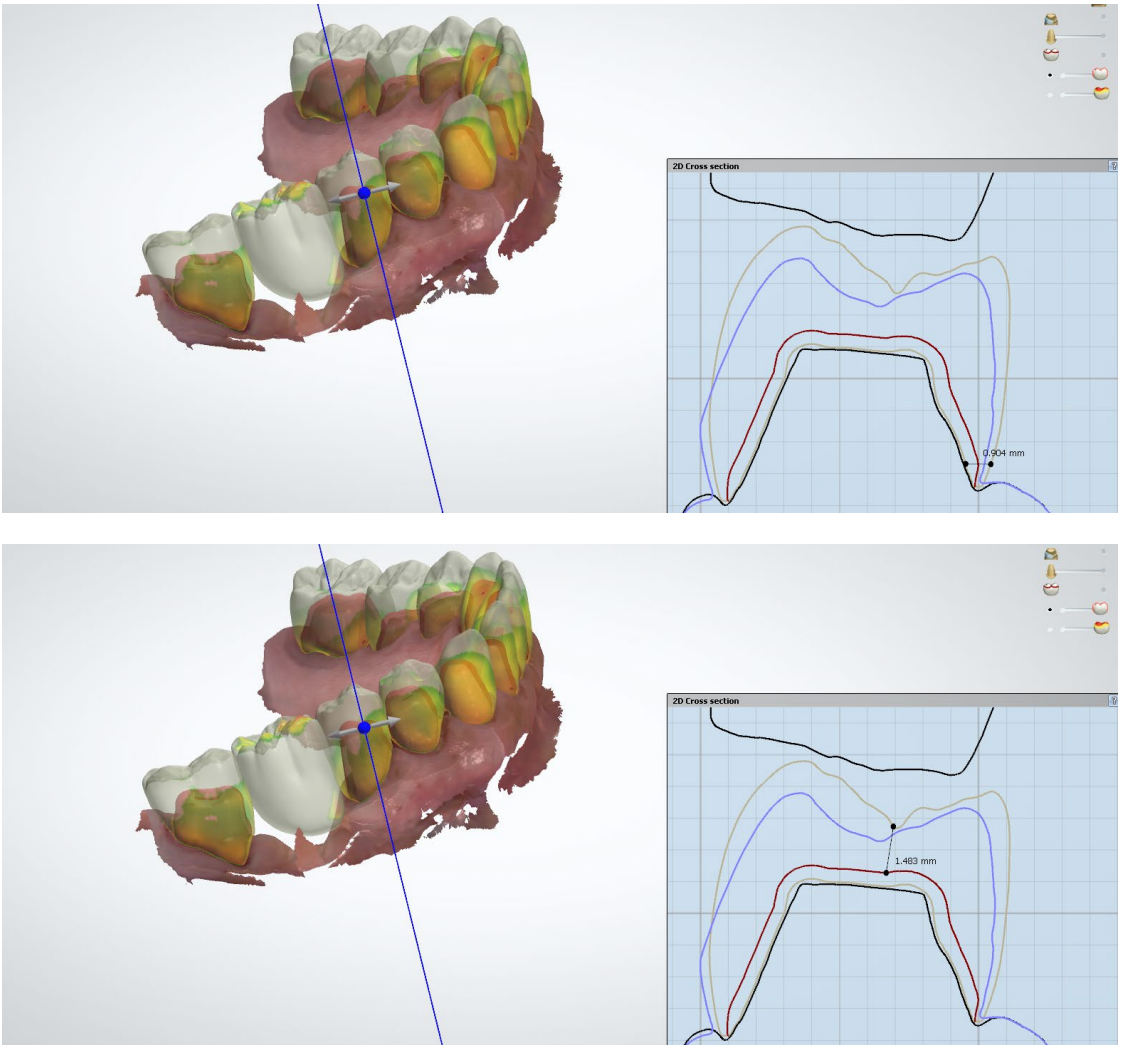

Figure 13 - Minimum thickness check at the margin (top) and occlusal surfaces (bottom).

The patient received immediate provisionals fabricated with a thermoformed appliance and injected acrylic resin as an intermediate solution.

5. Manufacturing Stage of Provisionals via 3D Printing

After digital design was completed in 3Shape Dental System, the three provisional structures were exported in STL format and imported into PreForm software (Formlabs) and printed in Temporary CB Resin A2 shade in the dental laboratory.

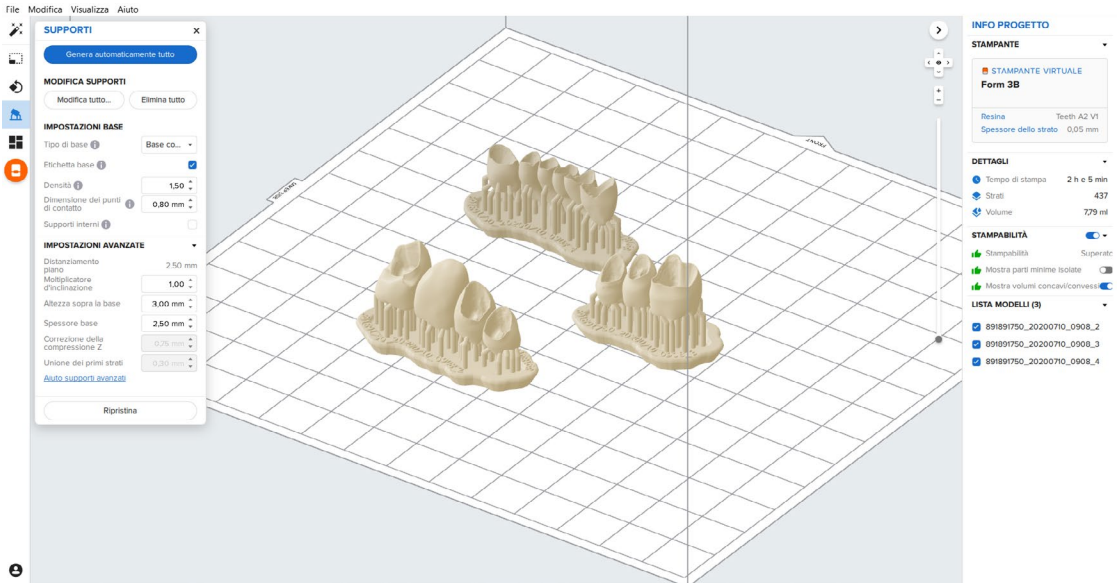

Figure 14 - Preparation in PreForm for printing.

After printing, parts were removed from the build platform and post-processed following the Instructions for Use of Temporary CB Resin.

Parts were washed in IPA (99%) for 3 minutes in the Form Wash and allowed to dry completely for 30 minutes. The provisionals were inspected to check that no uncured resin remained upon the external and intaglio surfaces.

Parts were cured with their support structures in the Form Cure for 20 minutes at 60°C. After this step, printing supports were removed with a cutting disk and rotary elements. Sandblasting of internal and external surfaces was done using glass bead blasting material (Perlablast® Micro) in order to remove the layer of ceramic fillers which remains on the surface after washing. A second curing stage was done for 20 minutes at 60°C in the Form Cure to allow the material to achieve its final mechanical properties.

After curing, parts were polished, characterized via staining and glazed (GC Optiglaze) and sent to the dental practice for cementation.

6. Cementation Protocol

The three bridges were disinfected and tried upon the prepared teeth to guarantee fit, quality of functional surfaces and esthetics. No modifications to the internal surface were needed.

The cementation protocol was as follows:

- The operating field was partially isolated using cotton rolls, cheek retractors and a surgical aspiration system.
- Prophylaxis of the prepared teeth was done with non-fluoride paste, prophylactic brush and handpiece.
- TEMREX Temporary Cement was used for cementation of the three bridges starting by quadrant 4, quadrant 3 and finally the anterior sector.
- Excess cementing agent was removed from surfaces and in gingival areas.
- Occlusion was checked both statically and dynamically to assure proper functioning using articulating paper.

Figure 15-18 - Provisional restorations cemented

An intraoral scan was performed to register the new clinical situation and compare to the initial wax-up design. This scan will also be used to monitor if there is any loss of material throughout the adaptation period with the new VDO.

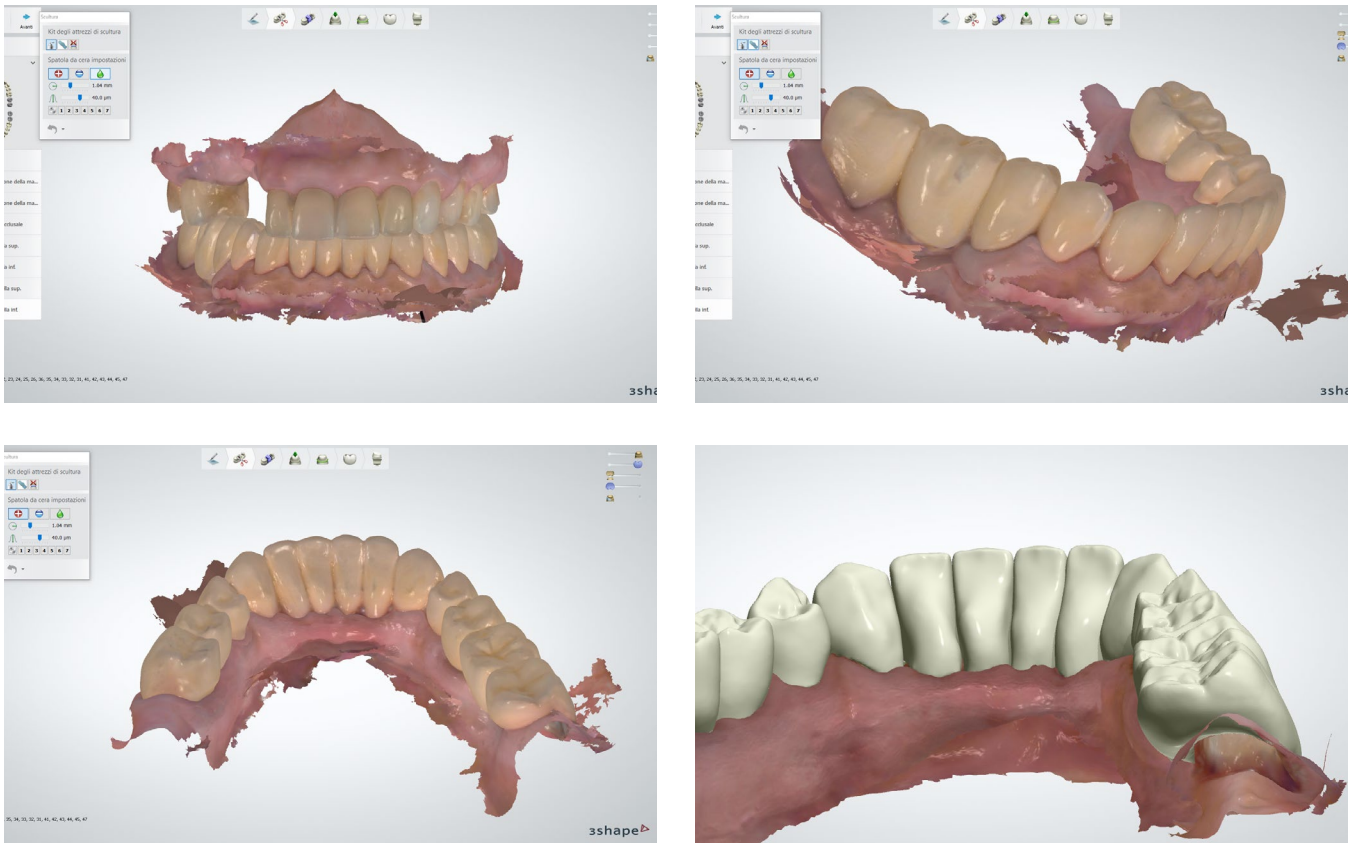

Figure 19-22 - Intraoral scan of new clinical situation with cemented provisionals.

Follow-Up

The patient had a follow-up visit 1 week after cementation to evaluate adaptation of TMJ to new clinical position, esthetics, gingival adaptation and patient satisfaction. The patient will be evaluated every 2 weeks for 10 months and will then transition to Phase II.

Conclusion

The production of provisional restorations via 3D printing with the Form 3B and Temporary CB Resin is an advantageous alternative to standard manufacturing processes. The digital workflow simplifies existing processes and allows for improved communication with the dental laboratory. Moreover, 3D printing can produce complex designs, such as undercuts, that are difficult to produce with milling. Finally, Temporary CB Resin is able to produce high quality dental restorations with excellent esthetics and fit that perform correctly in complex rehabilitation cases.

Additional Resources

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