Integration of the 3P concept and same day provisionalisation

Digital workflow for immediate maxillary full-arch implant reconstruction

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A 60-year-old male with a compromised maxillary dentition underwent a digitally planned, immediately loaded full-arch reconstruction. A unified diagnostic dataset combining CBCT, intra-oral scanning and a digital wax-up was used within the 3P concept (Plan–Print–Place) to design implant positions and surgical guides. Six Axiom bone level implants were placed using a dual-guide protocol, followed by same-day digital impressions. A Ready to smile (RTS) workflow enabled rapid fabrication of a screw-retained PMMA provisional prosthesis through validated CAD/CAM libraries and model-less positioning of temporary cylinders. After three months of healing, a monolithic 3Y-TZP zirconia definitive prosthesis on Ti-base abutments was delivered following a hybrid analogue-digital verification process.

The patient achieved stable peri-implant soft-tissue health, satisfactory occlusion and improved masticatory function. No mechanical complications occurred during the provisional or definitive phases. Aesthetic continuity with the pre-existing smile was maintained, and follow-up evaluations at one, three and six months confirmed stable function and tissue adaptation.

This case illustrates the feasibility of combining the 3P Concept with a structured RTS digital workflow to support predictable immediate loading in maxillary full-arch rehabilitation.[4–7, 10–12] Integration of digital planning, guided surgery and CAD/CAM provisionalisation contributed to efficient treatment progression and favourable short-term outcomes.[4–9] Further studies are needed to validate long-term performance and to standardise fully digital full-arch protocols.[8, 9]

Introduction

Immediate full-arch implant rehabilitation increasingly relies on digital workflows that combine CBCT-based diagnosis, intra-oral scanning and CAD/CAM-generated restorations.[4, 5] Recent studies have shown that virtual prosthetic planning, digitally prefabricated provisional prostheses and guided implant placement can streamline treatment, reduce clinical steps and support predictable immediate loading when case selection and primary stability criteria are met.[4–7,10–12]

Static computer-assisted implant surgery (s-CAIS) has demonstrated higher accuracy than freehand placement, particularly in full-arch cases, and is associated with high implant survival and prosthesis success in the short to medium term.[6, 7] Methodological reviews also suggest that digital tools enhance communication between clinic and laboratory, reduce chairside time and improve prosthetic accuracy, although long-term evidence and standardised protocols are still limited.[8, 9]

Within this context, the 3P concept (Plan–Print–Place), developed by the author, provides a structured digital pathway in which prosthetically driven virtual planning, additive manufacturing of guides and guided implant placement are integrated into a unified sequence. When combined with Ready to smile (RTS) solution, an immediate loading concept based on validated digital libraries and CAD/CAM fabrication, the workflow enables a direct transition from virtual wax-up to guided surgery and rapid screw-retained provisionalisation.[10–12] This is particularly useful in situations where patients refuse removable interim prostheses or prolonged edentulism.[2]

The present clinical case illustrates the application of this combined digital strategy in a compromised maxillary arch requiring extraction of terminal teeth and failing implants, guided placement of new implants with simultaneous bone grafting, and same-day intra-oral digital impressions.

Initial situation

A 60-year-old healthy, non-smoking male presented with recurrent peri-restorative inflammation and perceived mobility affecting a maxillary fixed restoration placed approximately 15 years earlier. Owing to previous discomfort and social embarrassment during an earlier provisional phase, he categorically declined any removable interim solution and stated that he would not accept being edentulous for more than a few days. From an aesthetic standpoint, he was generally satisfied with his current smile but reported intermittent inflammation in the canine region associated with localised changes in gingival contour. He requested that any new rehabilitation preserve the overall tooth morphology and smile appearance as closely as possible.

Clinical examination revealed failing implant-supported restorations in both

Fig. 1: Diagnostic right lateral view. – **Fig. 2:** Diagnostic frontal view. – **Fig. 3:** Diagnostic left lateral view.

posterior maxillary segments and a failing tooth-borne fixed dental prosthesis extending from 14 to 23, with bleeding on probing and cervical caries at 13 and 14. The mandibular arch presented no acute issues relevant to the maxillary treatment plan (Figs. 1–3).

CBCT demonstrated advanced vertical and horizontal bone loss in regions 16, 25 and 26, while the implant at 17 appeared radiographically stable. Considering the compromised dentition, the pattern of bone loss and the patient's refusal of removable temporisation, a prosthetically driven, immediately loaded maxillary full-arch implant-supported rehabilitation was indicated, provided that adequate primary stability could be achieved and standard clinical selection criteria fulfilled[2] (Figs. 4+5).

Digital planning: 3P concept and RTS solution integration

The 3P concept structures all treatment steps into three phases:

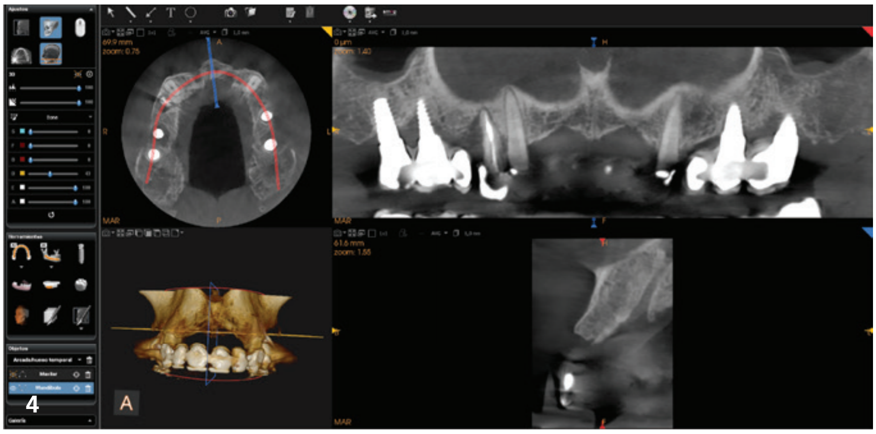
- Plan: diagnostic and prosthetically driven planning, combining CBCT data, photos, intraoral scans and a virtual wax-up to define ideal implant and prosthetic positions.[4–7]
- Print: chairside/laboratory fabrication, including 3D printing of surgical guides and milling or printing of provisional restorations.[4,5,10–12]
- Place: clinical execution of guided implant surgery and subsequent delivery, adjustment and follow-up of provisional and definitive prostheses.[6,7,10–12]

Within this framework, the RTS solution provides the prosthetic bridge between digital planning and immediate loading.[10–12] Starting from an intra-oral scan of the implants, the IOS file is imported into CAD software and specific RTS libraries are selected to design the provisional restoration, which is then exported for milling (typically in PMMA) or 3D printing. RTS offers two main design modalities:

1. Monobloc: the provisional framework is screwed directly onto multi-unit abutments without intermediate titanium abutments to be bonded.
2. Abutment-based: the framework incorporates internal housings for titanium temporary abutments that are cemented extra-orally and then screw-retained onto the multi-units.[10–12]

RTS libraries also include angulated screw-channel options on multi-units, allowing correction of unfavourable implant angulations and relocation of screw-access holes to more favourable aesthetic or functional positions.[10–12] This combination of the 3P concept with RTS establishes a continuous digital chain from prosthetically driven planning, through guide fabrication and provisional framework design, to chairside immediate loading in both full-arch and partial rehabilitations.[4–7,10–12]

All extra- and intra-oral photographs, CBCT data and diagnostic intra-oral scans were uploaded to the digital SmileCloud® platform (Straumann Group®). Using its 3D tooth library and dynamic smile-simulation modules, an aesthetic and functional pro-



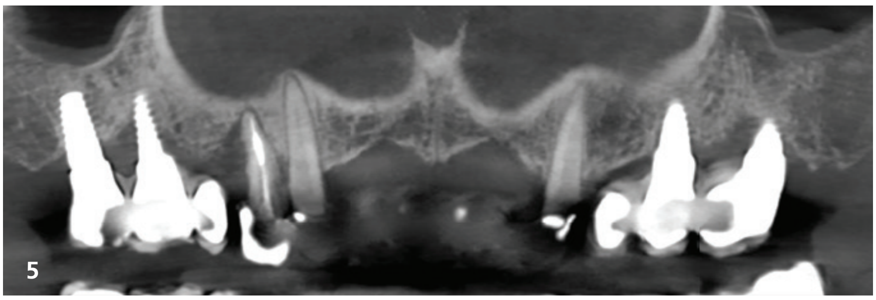


Fig. 4: CBCT of the initial situation. – **Fig. 5:** Detailed view of the maxillary arch.

posal was generated that reproduced the patient's existing restoration as closely as possible, in line with his request to maintain the same general appearance. This virtual set-up was used both to visualise the intended outcome and to communicate the treatment objectives to the patient. In parallel, the CBCT and diagnostic intra-oral scans were imported into the planning software and merged. The diagnostic IOS served as a virtual wax-up, again respecting the existing tooth form and smile line. By superimposing the planned tooth set-up on the radiographic data and using segmentation tools, relevant anatomical structures (maxillary sinus, nasal floor, residual ridges) were precisely outlined and correlated with the prosthetic design, allowing accurate three-dimensional assessment of the available bone and of the prosthetically oriented implant positions[4–7] (Figs. 6+7).

On this basis, a prosthetically driven surgery plan was established, with the specific aim of minimising implant placement in aesthetically critical areas and avoiding unfavourable screw-access channels or excessive angulations in the anterior region.[6,7,10–12] Six bone level implants were planned (Anthogyr Axiom BL®), together with preservation of the existing implant 17, to provide seven maxillary supports. The area 25–26 was considered the most critical due to the extent of bone loss; four implants were therefore planned in the second quadrant, including a "strategic" implant in position 27 to provide robust posterior support and built-in redundancy. All peri-implant defects were scheduled to be grafted with xenograft (XenoOss ®Plus) at the time of implant placement (Figs. 8+9).

RTS was selected for both clinical and laboratory reasons. Clinically, it allowed delivery of a fixed screw-retained provisional within two hours when printed and less than four hours when milled, in line with the patient's refusal of removable dentures.[2,10–12] In addition, the CAD design was generated as a direct transfer from the digital wax-up to the provisional prosthesis, helping to preserve the existing tooth shape and smile line.[4,5,10–12] From

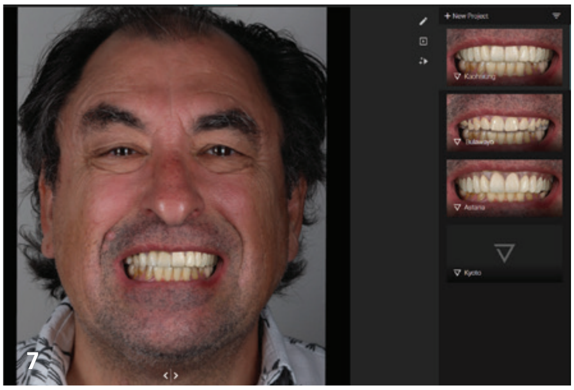
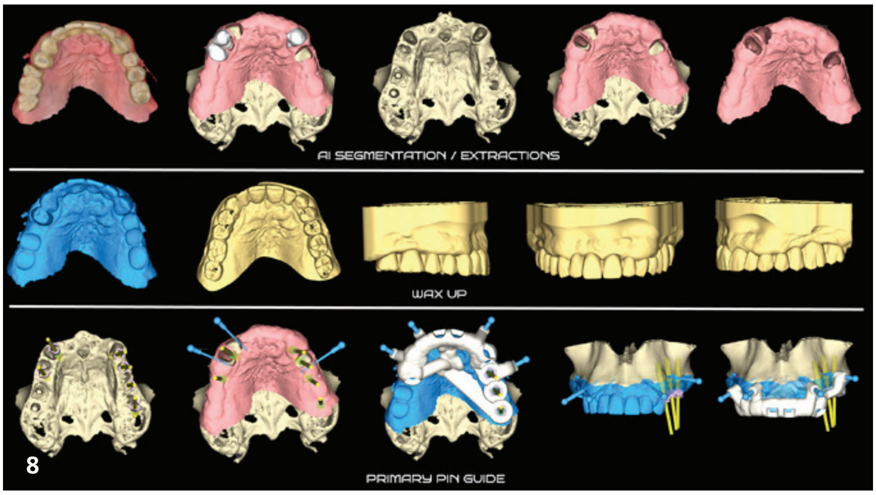


Fig. 6: Uploaded data for digital smile simulation. – **Fig. 7:** Smile design simulation.



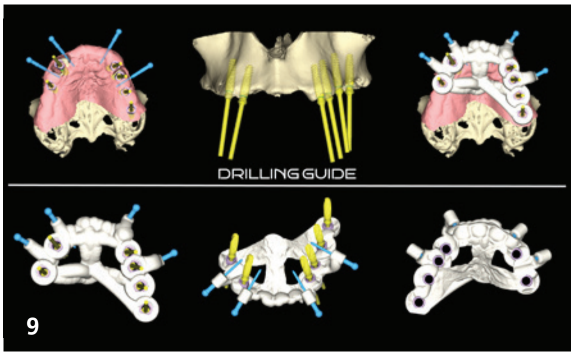


Fig. 8: Prosthetically driven implant planning. – **Fig. 9:** Digital surgical guide design.

the laboratory perspective, RTS offered a streamlined digital pathway: standardised monobloc and abutment-type libraries enabled model-less CAM fabrication of the provisional, while the specific internal geometry of the RTS receptacles allowed precise extra-oral cementation of titanium abutments when this option is chosen.[10–12] The definitive restoration could then be designed either by reusing the initial digital wax-up or by refining the CAD file after final digital impressions, maintaining or optimising pontic morphology and soft-tissue contours.

Surgical procedure

Local anaesthesia was administered across the maxillary arch using 4% articaine with epinephrine 1:100,000 via buccal and palatal infiltrations. The tooth-supported guide was positioned and used to prepare the sites for horizontal fixation pins. After pin placement, the guide was removed and all remaining maxillary teeth and failing implants were atraumatically extracted using a flapless approach. Extraction sockets were thoroughly debrided to eliminate granulation and inflamed tissues.

The mucosa-supported surgical guide was then seated and secured onto the previously placed fixation pins, with additional palatal support ensuring stable positioning. Fully guided osteotomies were performed using the Integral 4.2 system following the manufacturer's sequential drilling protocol. All six implants were placed under guided conditions and achieved insertion torques exceeding 40 Ncm.[6,7]

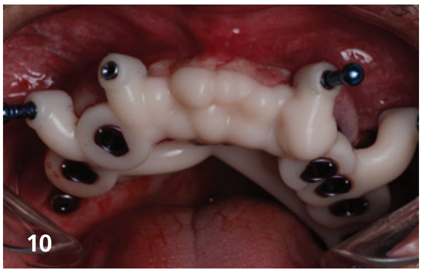
Following implant placement, the guide was removed and six 4.0 mm diameter and 2.5 mm height multi-unit abutments (OPMUN0-2) were connected to the implants and torqued to 25 Ncm in accordance with manufacturer recommendations. Peri-implant defects were grafted, and the operative field was then prepared for immediate digital impressions and RTS-based provisional prosthesis fabrication (Figs. 10+11).

Prosthetic workflow within the 3P concept and RTS solution

Immediately after surgery, six metal scanbodies (151-04-MDT) were connected to the multi-unit abutments and a healing cap was placed on implant 17. A full-arch digital impression was acquired with the intra-oral scanner using the full-arch protocol, which merges the pre-extraction reference scan with the post-operative scan of soft tissues and scanbodies. This approach has been shown to improve the trueness of full-arch implant impressions with intra-oral scanners, bringing their accuracy close to that of conventional techniques in many scenarios.[3] In this case, it ensured precise registration of implant positions, preservation of the planned vertical dimension and accurate transfer of occlusal relationships for the RTS temporary prosthesis design[3,4–7] (Fig. 12).

At the Plan → Print interface, the laboratory adapted the previously generated wax-up design to the definitive 3D implant positions. An access channel was incorporated at site 17 to allow intra-oral connection of a titanium provisional abutment, as this configuration is not natively available in the RTS digital library for that implant brand (Fig. 13).

The CAD file was then used in the milling phase to manufacture a full-arch provisional prosthesis milled from multilayer PMMA (Ivoclar®, A3 shade). When the "abutment" RTS libraries were selected, the software generated specific internal receptacles corresponding to the geometry of the titanium temporary cylinders (MUNC-100). Thanks to this pre-defined internal geometry, the cylinders could be extra-orally bonded to the PMMA framework in a model-less procedure using a dual-cure resin cement (VITA Adiva®), while maintaining alignment with the virtual design.[10–12] A 3D-printed resin model was nonetheless produced to verify passive fit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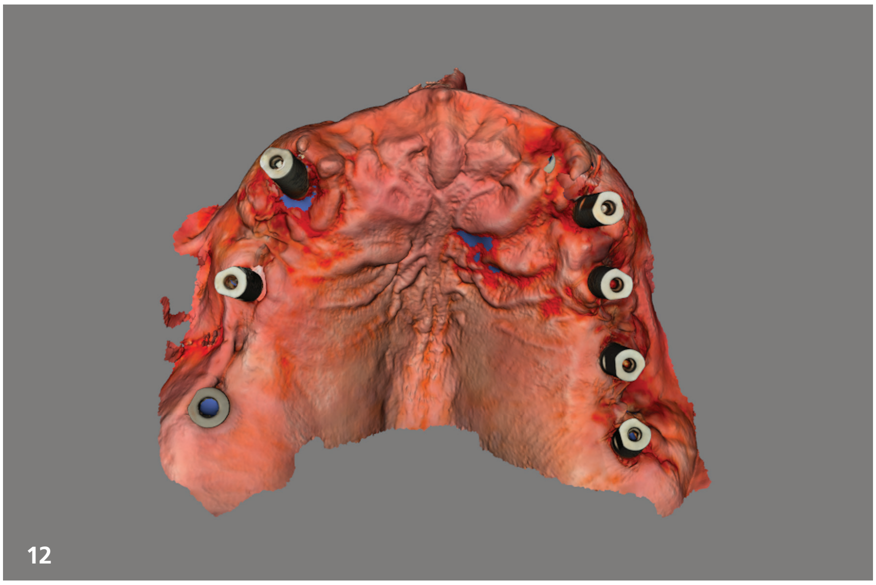
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Fig. 10: Surgical guide in place for drilling. – **Fig. 11:** Xenograft used for guided bone regeneration (GBR). – **Fig. 12:** Intra-oral digital impression taken during surgery.

as an additional check. This combination of RTS receptacle design and CAD/CAM accuracy is what enables predictable model-less bonding within the RTS workflow[10–12] (Fig. 14).

At the end of the surgical appointment, healing abutments were placed and sutures were completed. The pre-operative medication regimen (amoxicillin, ibuprofen and 0.12% chlorhexidine rinses) was maintained.

At the 12-hour visit (Place phase), the patient was asymptomatic and only mild irritation was observed at the fixation-pin entry sites. Healing caps were removed, and a titanium provisional abutment for multi-unit was connected to implant 17; this abutment was then intra-orally bonded to the PMMA prosthesis in the area previously reserved in the CAD design. After finishing and polishing the bonded zone, the bridge was seated on the multi-unit abutments. Prosthetic screws were tightened in a cross pattern to perform a Sheffield test and verify passivity before applying the final torque of 15 Ncm. Achieving a passive framework is considered critical for immediate full-arch loading, as it minimises implant micromovement and reduces mechanical stress on the bone–implant interface.[6, 7, 10–12] Occlusion was evaluated in maximum intercuspation and adjusted to obtain stable bilateral contacts and group function in lateral excursions, ensuring controlled load distribution from day one[4–7, 10–12] (Fig. 15).

The patient received post-operative instructions and was scheduled for follow-up visits at one and three months. At the one-month review, peri-implant soft tissues appeared healthy and well adapted around the multi-unit abutments. The patient reported excellent comfort, normal masticatory function and high satisfaction with the immediate aesthetic result.

Postoperative follow-up and clinical outcomes

The patient was reviewed 15 days after surgery to assess early comfort, soft-tissue adaptation and the absence of temporomandibular joint symptoms. Subsequent visit at three months was planned to take a panoramic X-ray to control bone healing around implants, to monitor peri-implant tissue stability, to evaluate oral hygiene, and to verify occlusal contacts and reinforce maintenance protocols as required[2, 8, 9] (Fig. 17).

Throughout the follow-up period, peri-implant soft tissues demonstrated favourable healing, with no suppuration, no bleeding on probing and no plaque accumulation of clinical relevance. The maxillary provisional remained mechanically stable, with no incidents of screw loosening or prosthetic fracture.

Definitive prosthetic procedure

After a three-month healing period, the patient returned for definitive records. A new full-arch digital impression was obtained with the IOS using the same full-arch protocol. Metal multi-unit scanbodies were connected to all implants, and MedentiWings enablers were used in wide edentulous spans to shorten distances in between implants and improve overall scanning precision.[3] The impression captured implant positions together with peri-implant soft-tissue contours and the emergence profiles shaped by the RTS provisional (Figs. 18–20).

Because of library incompatibilities between the implant system (position 17) and the CAD software, a combined analogue–digital workflow was adopted. A digital master model was created and 3D-printed with digital replicas in place, incorporating an access channel for the analogue of implant 17. A passive metal verification framework was fabricated and clinically tested; once passive fit was confirmed, the analogue for implant 17 was picked up chairside and repositioned into the printed model through the dedicated channel. This produced a hybrid master model

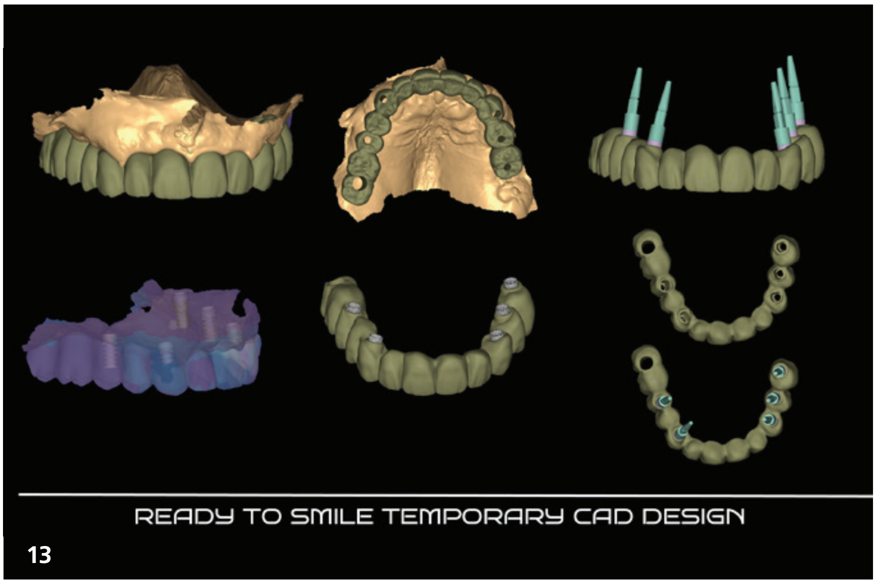


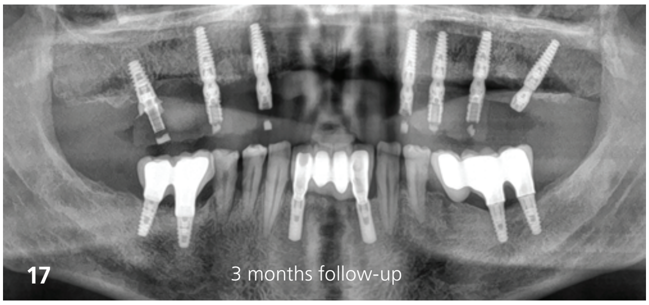
Fig. 13: CAD design of the temporary "Ready to smile" restoration. – **Fig. 14:** Occlusal view of the milled PMMA restoration. – **Fig. 15:** Intaglio view of the PMMA restoration with bonded Ti-bases.

that incorporated all implants and could be used to verify passive fit and occlusion for the definitive restoration[6,7] (Figs. 21–23).

The final prosthesis was planned as a continuation of the RTS design. The technician could either reuse the original digital wax-up or refine the CAD file of the provisional based on the definitive scans, maintaining established pontic morphology and soft-tissue contours. A monolithic 3Y-TZP zirconia framework on cemented X-Base® abutments was selected, supported by evidence that zirconia-based FDPs show satisfactory medium-term survival and complication rates comparable to metal-ceramic alternatives.[13–15] The main reason for choosing Anthogyr X-Bases was their ease of bonding to the zirconia framework, ensuring anti-rotation stability, eliminating micromovements, providing a precise fit with the inner core of the framework, and enhancing cement retention thanks to their patented laser grip bonding surface.

In the anterior segment, a controlled buccal cutback was created to allow limited veneering ceramic on a printed resin model support, while posterior areas remained fully monolithic for improved mechanical durability[13–15] (Figs. 24+25).

The completed zirconia prosthesis was seated and screw-retained on all multi-unit abutments. Screws were tightened in a cross pattern to reassess passivity, followed by final torque of 15 Ncm according to manufacturer recommendations.



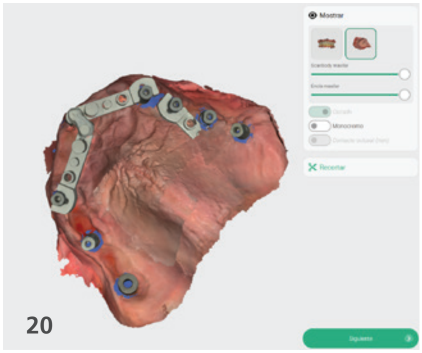
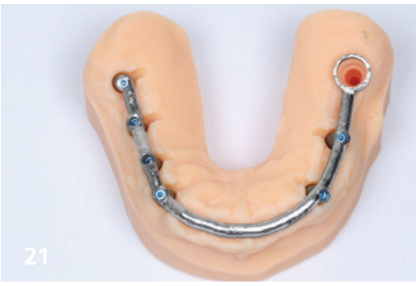


Fig. 16: Temporary restoration placed at the 12-hour follow-up visit. – **Fig. 17:** Radiograph at the three-month follow-up. – **Fig. 18:** Restoration at the three-month follow-up visit. – **Fig. 19:** Soft-tissue healing after three months. – **Fig. 20:** Final digital impression.



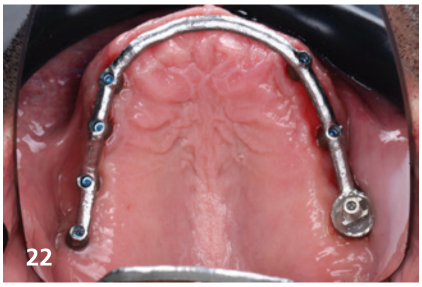


Fig. 21: Model prepared for the pick-up of implant site 17. – **Fig. 22:** Pick-up of implant position 17. – **Fig. 23:** Repositioning of the implant replica at site 17 in the model. – **Fig. 24:** Milled zirconia restoration before sintering. – **Fig. 25:** Final restoration after sintering.

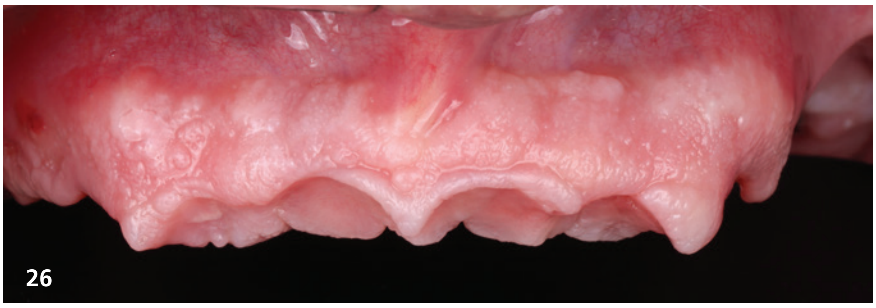


Fig. 26: Healed soft tissue.
Fig. 27: Insertion of the final restoration.
Fig. 28: Final lateral view.

Minor occlusal refinements were performed to optimise functional guidance. The patient reported good comfort and function with the definitive restoration, and peri-implant soft tissues appeared stable. Follow-up appointments were scheduled at three, six and 12 months to monitor soft-tissue health, hygiene, occlusion and radiographic bone levels. At approximately six months, a control radiograph was planned to document the post-healing bone baseline after biological-width stabilisation (Figs. 26–28).

The definitive restoration exhibited harmonious tooth proportions and an aesthetic integration consistent with the pre-existing smile.[13–15] Functionally, the patient reported marked improvement in masticatory efficiency, phonetics and overall comfort compared with the pre-operative condition. Soft-tissue contours around the implants remained stable, and occlusion was maintained with no occlusal adjustments at routine visits.[2, 4–7, 10–12]

Clinical summary and final considerations

This case demonstrates how a structured digital workflow anchored in prosthetically driven planning, guide assisted implant placement and same-day intraoral digital impressions can support predictable immediate loading in full-arch rehabilitation.[4–7, 10–12] The favourable outcomes align with recent reports showing that fully digital full-arch protocols can improve treatment efficiency, enhance the transfer of virtual planning to surgery and yield high patient satisfaction when appropriate stability thresholds and case-selection criteria are respected.[2, 4–7, 10–12]

Consistent with current methodological reviews, the integration of CBCT-based planning, virtual wax-ups and CAD/CAM provisionalisation in this case contributed to reduced chairside time, streamlined laboratory communication and more controlled prosthetic workflows.[8, 9] The ability to capture implant geometry immediately after placement allowed rapid fabrication of a screw-retained provisional with clinically verified passivity, like other digitally prefabricated PMMA approaches for immediate loading.[10–12]

While the workflow proved effective here, further refinement is possible. Future improvements may include broader digital-library compatibility across implant systems to reduce the need for hybrid analogue–digital models, additional validation of digital impression accuracy over long edentulous spans and long-term studies evaluating peri-implant tissue stability around monolithic zirconia full-arch frameworks.[3, 8, 9, 13–15]

Continued research aimed at standardising fully digital full-arch protocols will help strengthen the predictability and reproducibility of such workflows across different clinical settings.[8, 9]

Overall, this case adds to the growing evidence supporting digitally driven, immediately loaded full-arch rehabilitation as a viable treatment modality when guided by careful planning, adequate primary stability and meticulous execution.[2, 4–7, 10–12]

References

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