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CASE REPORT

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# Comprehensive oral rehabilitation using digital and analog workflows in a patient with generalized loss of tooth structure: a case report

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## ABSTRACT

The sequence of a comprehensive oral rehabilitation is described in a patient with generalized loss of tooth structure, highlighting the importance of restoring stomatognathic system function through a multidisciplinary approach. The patient was a 57-year-old woman diagnosed with occlusal disharmony, generalized attrition due to parafunction, mild dental crowding, defective restorations, carious lesions, and partial mandibular edentulism. Treatment was performed in two phases: initially, an esthetic mini-JIG was used, and occlusion was stabilized by increasing the vertical dimension using stamped composite resins restorations. In the second phase, veneers, vonlays, and implant-supported crowns were placed in the maxilla, along with a removable partial denture in the mandible, followed by delivery of a protective occlusal splint. The combination of analog and digital techniques allowed for the restoration of both function and esthetics.

**Keywords:** oral rehabilitation; prostheses and implants; vertical dimension; digital workflow; CAD-CAM.

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## INTRODUCTION

The stomatognathic system is one of the most complex and specialized structures of the human body. Its proper function depends on the coordinated interaction among muscles, ligaments, teeth, the temporomandibular joint, and a sophisticated neuromuscular system (1).

Loss of dental structure compromises this balance, often leading to alterations in vertical dimension (VD), occlusal plane, anterior guidance, and occlusal interferences (2). Although the stomatognathic system has a certain capacity to adapt to functional and structural alterations, various pathologies can be triggered when these exceed the patient's adaptive limit (3).

In such cases, rehabilitation requires accurate diagnosis and comprehensive planning to restore function and systemic harmony. For this purpose, tools such as the esthetic JIG are particularly useful, as they allow evaluation of the proposed VD and provide esthetic and functional parameters that facilitate the fabrication of provisional prostheses prior to the definitive prosthetic treatment (4).

The incorporation of CAD/CAM technology has optimized clinical care by offering greater patient comfort, increased accuracy in restoration fabrication, and reduced working time (5, 6). The mixed workflow, which combines digital and analog technology, promotes clinical efficiency, optimizes interdisciplinary communication, and facilitates the gradual transition to a fully digital environment (7) by maintaining clinically acceptable adjustments and precision in partial and complete restorations (8).

This case report describes the sequence of comprehensive oral rehabilitation in a patient with loss of dental structure. It highlights the importance of restoring the functions of the stomatognathic system through a strategic combination of analog and digital techniques, which positively impacts both clinical outcomes and patient satisfaction.

## CASE PRESENTATION

A 57-year-old female patient, apparently in good health and with no relevant systemic medical history, attended the Oral Rehabilitation Service of the Teaching Dental Center at Universidad Peruana Cayetano Heredia. The reason for her visit was related to the patient's concern about being able to chew properly and improving her dental problems.

The intraoral clinical examination revealed generalized loss of dental structure due to attrition affecting both maxillary and mandibular anterior teeth, associated with parafunctional habits (bruxism), as well as mild dental crowding, multiple restorations in poor condition, carious lesions, and partial lower edentulism (Figures 1A-1F).

The diagnostic protocol included: photographic documentation, panoramic and periapical radiographs, mounting of study models on a semi-adjustable articulator (SAA), vertical dimension (VD) analysis, digital smile design (DSD), planimetry, diagnostic wax-up, tomographic analysis, auxiliary examinations, and specialist consultations (Figures 1 and 2).

Radiographic examination revealed alveolar pneumatization of both maxillary sinuses, radiopaque images compatible with restorative materials in teeth 16, 17, 24, 25, 38, 47, and 48, and defective fixed prostheses on teeth 14 and 26. In addition, tooth 14 showed a radiopaque image consistent with an incomplete previous root canal treatment and a cast post (Figure 1G). On the coronal view of the tomography, a distal fissure line at the level of the middle third of the root was identified (Figure 1H).

Assessment of the VD was performed using a JIG adapted to the maxillary central incisors (Figure 2A), which allowed the establishment of esthetic and functional parameters and served as an intermaxillary record (IMR) for mounting the study models on the SAA (Figure 2B). With the aid of DSD (Figure 2C) and the esthetic mini-JIG, a diagnostic wax-up and a mock-up were fabricated (Figure 2D) for visualization and patient approval.

The definitive diagnosis included periodontal health with an intact periodontium and a thick-flat phenotype, a Seibert Class III ridge defect in edentulous areas, recurrent caries in teeth 24, 25, 26, 38, 47, and 48, attrition in teeth 13, 12, 11, 21, 22, 23, 31, 32, 33, 41, 42, and 43, previous root canal treatment in tooth 14, and occlusal disharmony.

## TREATMENT

### Initial phase

After signing the informed consent, occlusal deprogramming and stabilization were performed. The defective fixed prostheses on teeth 14 and 26 were removed, and the old restorations on teeth 16, 17, 24, 25, 38, 47, and 48 were replaced with composite resin restorations. In the periodontal phase, extraction of tooth 14 was carried out. Then, the incisal edges of the mandibular anterior teeth were restored and stamped composite resin restorations were fabricated on the maxillary anterior teeth to reestablish anterior guidance. Tooth 26 was re-prepared and temporarily restored. After that, a provisional removable prosthesis was placed in the lower jaw.

## Final phase

*Surgical phase*

As planned, dental implants were placed in the areas of teeth 14 and 15, along with guided bone regeneration (Figures 2E and 2F).

*Oral rehabilitation phase*

Teeth 13 to 23 were prepared for the placement of buccal veneers, while teeth 24 and 25 were prepared for vonlay-type restorations. This are indicated for premolars with sufficient enamel and consist of a combination of a vonlay and a veneer extension toward the buccal surface (9) (Figures 3A and 3B). Digital impressions were obtained using a Virtuo Vivo intraoral scanner (Straumann®), generating an STL file that was processed using Exocad software for the design and fabrication of the restorations (Figure 3C).

After shade selection of the substrate, the veneers and vonlay-type restorations were milled from lithium disilicate (e.max CAD®, Ivoclar Vivadent). To enhance the characterization of the incisal edges, feldspathic porcelain was added using the cut-back technique. Subsequently, a clinical try-in was performed (Figure 3D), followed by cementation using adhesive techniques (Figures 3E and 3F).

Once the implant osseointegration period was completed, soft tissue management was initiated using heat-cured acrylic provisional crowns on temporary titanium abutments (Figure 4A). Over a six-week period, periodic increments of light-cured resin were performed to progressively shape the emergence profile (Figure 4B) (10).

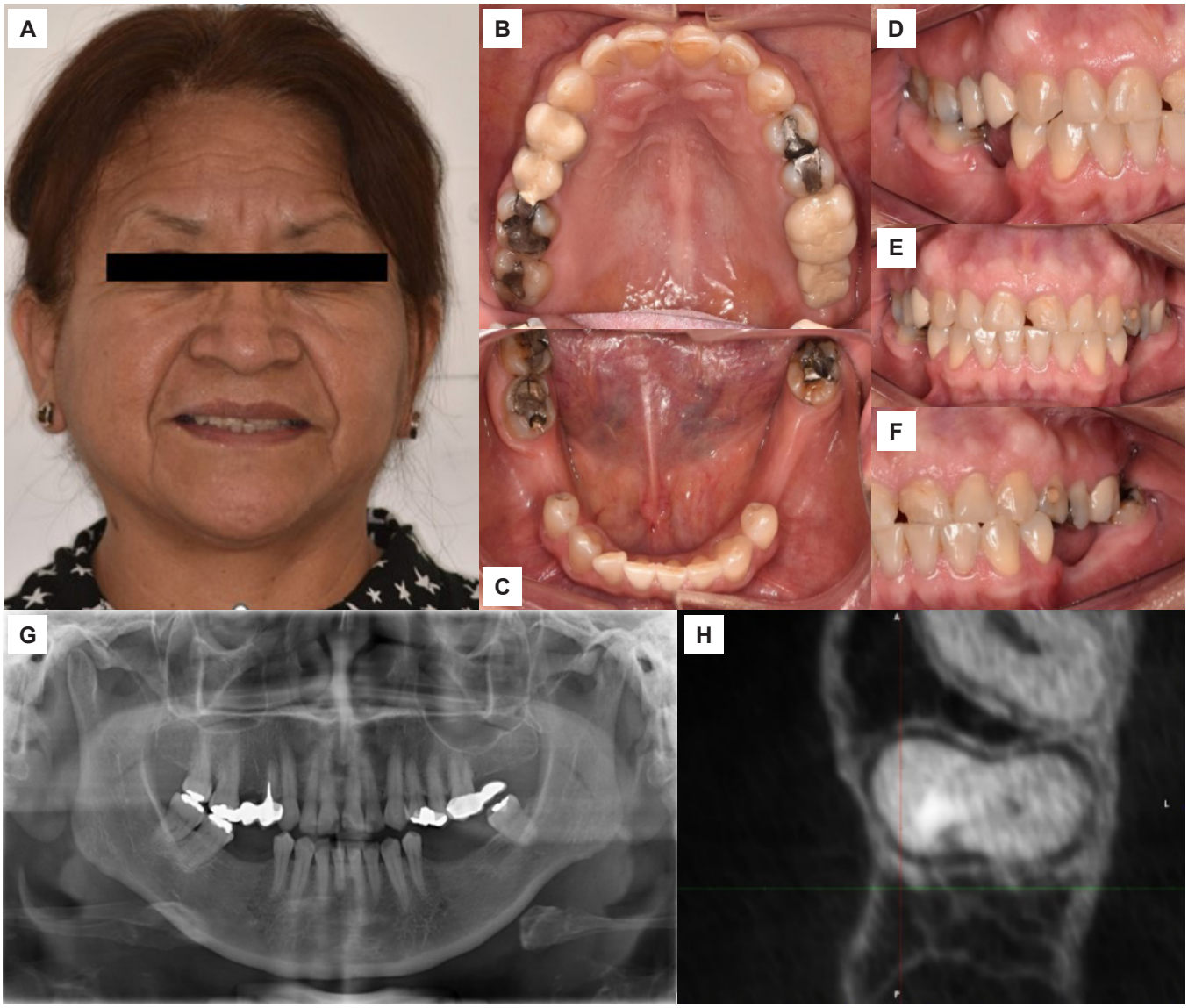


**Figure 1.** Photographs and auxiliary examinations. A) Extraoral image. B) Occlusal view of the upper jaw. C) Occlusal view of the lower jaw. D) Right lateral view. E) View in maximum intercuspation. F) Left lateral view. G) Panoramic radiograph. H) Tomography of tooth 14 (coronal view).

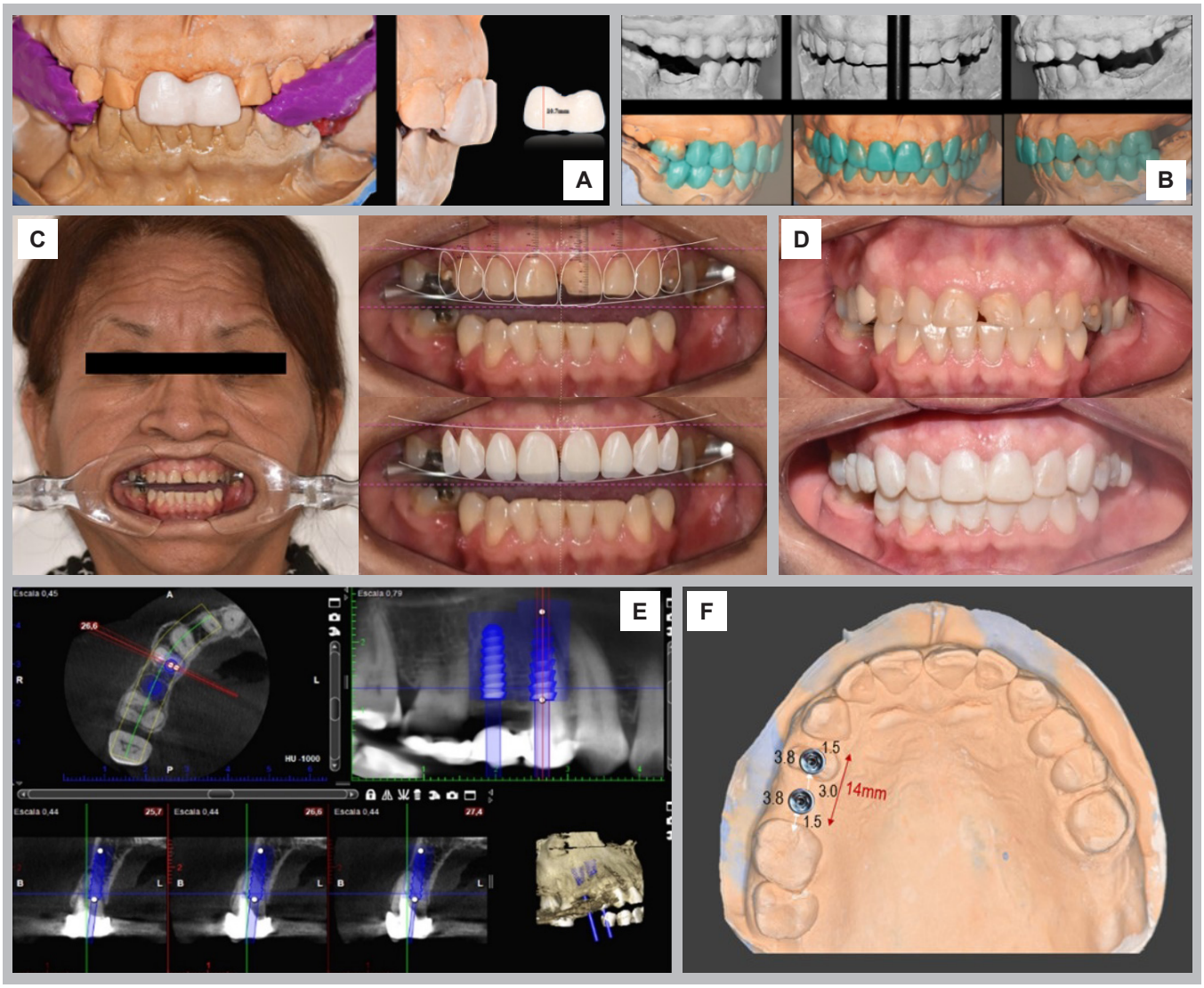


**Figure 2.** A) Determination of the vertical dimension-JIG. B) Mounting on a semi-adjustable articulator. C) Digital smile design. D) Mock-up. E) Implant planning. F) Planimetry.

The transfer of the implant platform and the emergence profile was performed using the open-tray technique, with customized impression posts fabricated from the previously adapted provisional crowns using flowable resin (Figure 4C) (11).

A hybrid workflow combining analog and digital techniques was used to fabricate the definitive monolithic zirconia crowns (ZirCAD®, Ivoclar Vivadent) for the implants and tooth 26. A Type IV extra-hard gypsum model was obtained and subsequently scanned for the design and manufacturing of the restorations in the laboratory (Figure 4D). After clinical verification of fit and occlusal adjustment, the crowns were extra-orally cemented onto titanium bases using adhesive techniques and subsequently screw-retained onto the implants according to the manufacturer's instructions (Figure 4E).

In the lower jaw, rehabilitation was completed with a tooth-supported removable partial denture (Figures 4F and 4G). Prosthetic follow-up visits were performed at 3, 7, and 15 days. Then, a protective occlusal splint was fabricated using printed resin based on digital records (Figures 4H and 4I).

### Follow-up and results

The patient attended periodic follow-up visits over a three-month period, during which the necessary adjustments were made. During this time, no complications were reported (Figures 4G and 4J).

## DISCUSSION

Comprehensive oral rehabilitation is a complex procedure that requires the coordinated involvement of multiple dental specialties. To achieve predictable and satisfactory outcomes, it is essential to make an accurate diagnosis and develop a treatment plan consistent with that diagnosis (12).

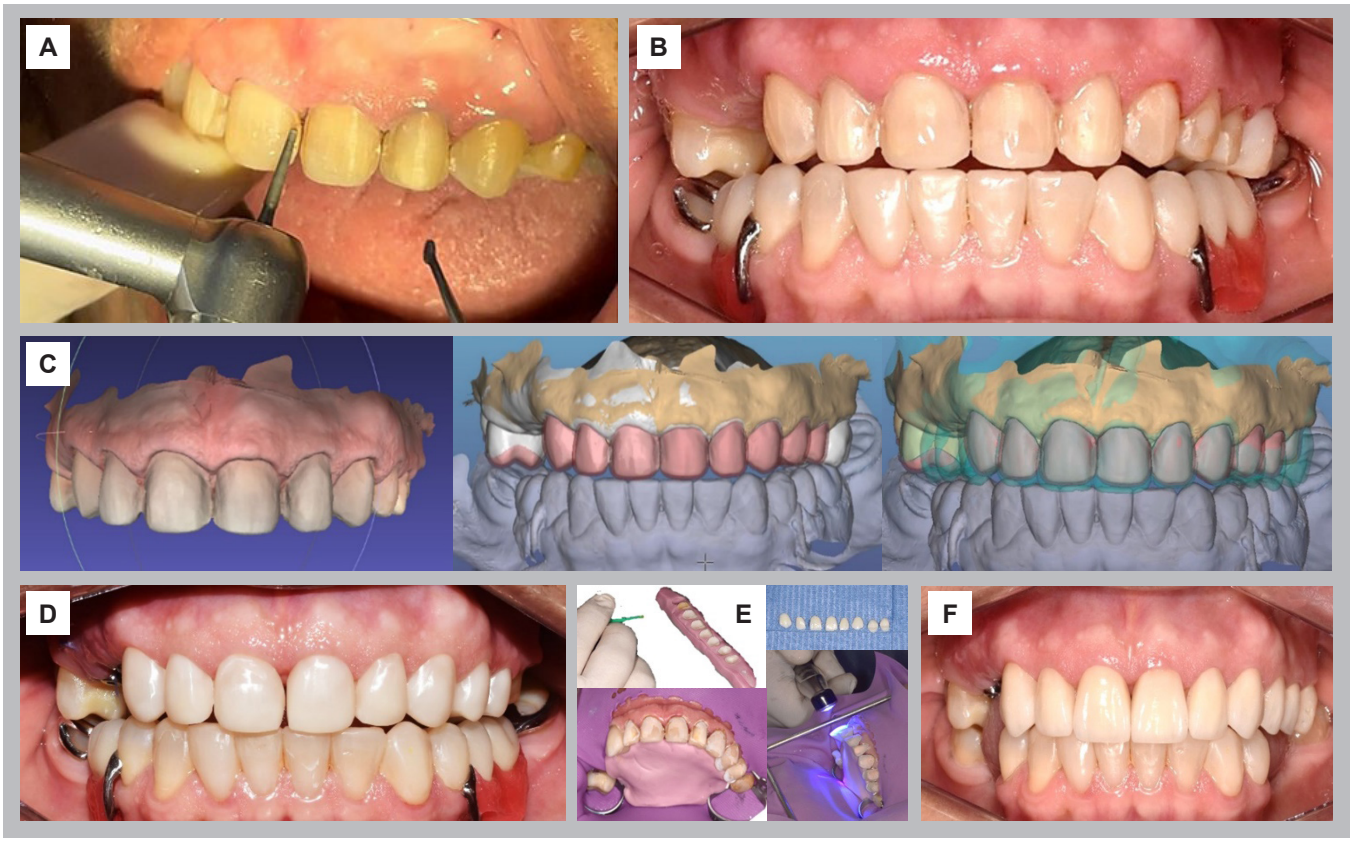


**Figure 3.** A) Tooth preparation for veneers. B) Frontal view of dental preparations. C) Veneers and vonlays STL file. D) Try-in of the restorations. E) Cementation protocol. F) Cemented veneers and vonlays.

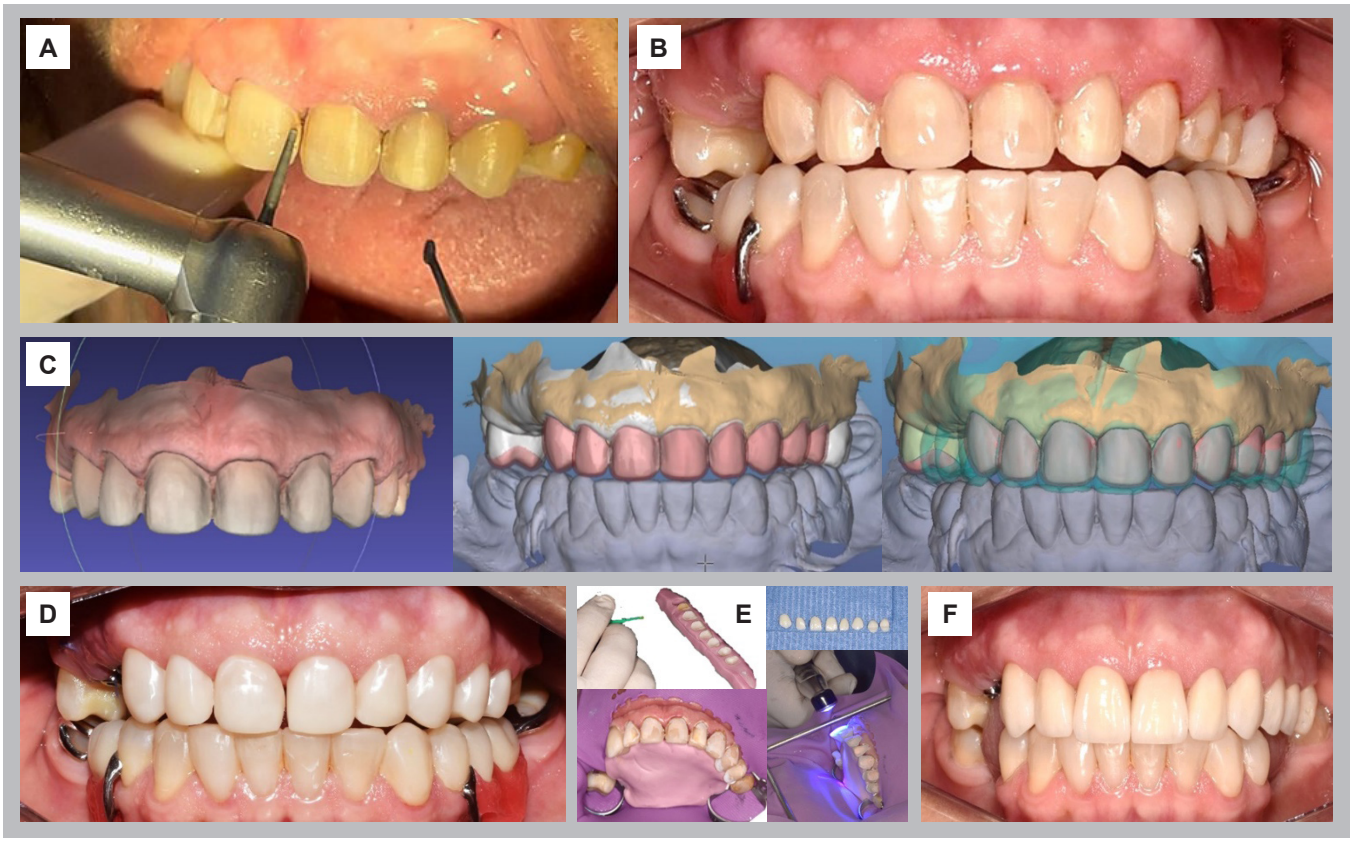


**Figure 4.** A) Provisional crowns. B) Occlusal view of the emergence profile shaping. C) Transfer at the level of the implant platform and emergence profile. D) Definitive cement–screw-retained monolithic zirconia crown. E) Occlusal view of definitive crowns on a titanium base. F) Inferior occlusal view of the removable partial denture in situ. G) Intraoral image of adhesive restorations, implant-supported crowns, and the removable prosthesis installed intraorally. H) Digital design of the occlusal splint. I) Occlusal splint installed. J) Extraoral image of the patient with rehabilitation treatment completed.

In recent years, digital workflows have been shown to improve clinical efficiency and patient satisfaction; however, their high cost and the need for specialized training limit their widespread implementation (13). In the present case, the availability of equipment and the need to balance precision, efficiency, and clinical feasibility determined the selection of a hybrid workflow that combined digital and analog resources.

Zavolski et al. (7) reported a case of oral rehabilitation using a multidisciplinary approach with a hybrid workflow as a transitional proposal toward digital dentistry. In their study, digital technology was used for smile design, implant planning, and the fabrication of anterior lithium disilicate crowns and veneers, which is consistent with our report. Furthermore, a hybrid workflow was applied for posterior crowns: impressions and model acquisition were performed digitally, while the laboratory procedures for these metal–ceramic crowns were carried out conventionally. It should be mentioned that this study employed metal-free restorations only in the anterior region. Although the literature supports their use in posterior teeth (14), metal–ceramic crowns remain a valid treatment alternative.

Similarly, Alresheedi (15) reported the clinical management of a patient undergoing oral rehabilitation using a hybrid workflow, similar to the present case. In that study, a digital workflow was used for smile design, periodontal surgical planning, and fabrication of the surgical guide. Anterior rehabilitation was performed with lithium disilicate crowns, whereas the posterior region was restored with monolithic zirconia crowns and screw-retained implant crowns, concluding with a protective splint. An obvious difference is that the diagnostic models and waxing were done digitally, unlike in our case, where they were done conventionally.

It is important to emphasize that working with a hybrid workflow may involve multiple combinations of digital and conventional techniques, depending on the patient's clinical conditions, technological availability, and the clinician's expertise. Although digital technology simplifies numerous procedures, not all steps of oral rehabilitation can be performed exclusively through digital means. Mastery of analog techniques remains necessary to integrate them with digital workflows in a synergistic process aimed at restoring the patient's oral health (7,13,16).

Regarding partial restorations, the use of lithium disilicate–milled veneers and vonlays is supported by their favorable clinical performance. In this regard, several authors, such as Guachetá et al. (17) and El-Naggar et al. (18) report that vonlay restorations fabricated from Emax CAD® blocks demonstrate clinically acceptable marginal adaptation and represent a more conservative alternative for premolars, with fracture resistance exceeding masticatory forces (19).

Additionally, two cement–screw-retained crowns were planned, an option that combines the advantages of both cement-retained and screw-retained restorations, such as passive fit, extraoral cementation, minimal soft tissue disruption, improved esthetics, and the possibility of reversibility (20). Furthermore, monolithic zirconia crowns on titanium bases have been shown to provide favorable outcomes with minimal mechanical and technical complications (21). To reduce the risk of failure of implant-supported restorations, particularly in patients with parafunctional habits, the use of a protective splint was indicated (22).

A limitation in the management of this case was the insufficient mandibular bone volume, which led to the selection of a removable partial denture. Under ideal conditions in terms of time and budget, bone regeneration prior to the placement of a fixed prosthesis on implants would have been considered, which would provide greater chewing efficiency and esthetics for the patient. In addition, limited access to digital technology, as well as insufficient experience in its use, conditioned the application of analog procedures in stages that could otherwise have been performed digitally.

In summary, this case demonstrates that the strategic integration of digital and analog techniques, tailored to clinical and logistical constraints, allows for the achievement of satisfactory functional and esthetic results. The available literature supports that, although digital technology offers notable advantages in terms of precision, efficiency, and planning, mastery of conventional techniques remains essential for a comprehensive and successful approach.

## CONCLUSION

This case report demonstrates that a multidisciplinary approach and the combined use of analog and digital techniques facilitate prosthetic rehabilitative procedures. This approach increases predictability, reduces clinical time, and improves patient satisfaction by restoring both function and esthetics of the stomatognathic system.

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The authors declare no conflict of interest.

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Written informed consent was obtained from the patient for the publication of this case report.

**Authorship contribution:**
**LKAC:** conceptualization, visualization, methodology, writing of the original draft, writing – review & editing.
**OPLV:** conceptualization, methodology, writing of the original draft, writing – review & editing.
**MIFN:** methodology, visualization, writing of the original draft, research, writing – review & editing.
**HOCH:** conceptualization, methodology, writing – review & editing.

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