CLINICAL CASE STUDY

Same-Day Conservative Esthetic Rehabilitation for the Maxillary Anterior Sector With Permanent Crown Resin

By Dr. Alejandro Pineda

In this clinical case study, Dr. Alejandro Pineda from Clínica Lhasa, gives a step-by-step guide of how to produce anterior esthetic restorations using Permanent Crown Resin via a full in-house CAD/CAM workflow for same-day delivery.

formlabs | dental

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About the Author

Dr. Alejandro Pineda

Dr. Alejandro Pineda is a dentist, digital specialist and Director of Clínica Lhasa based in Montevideo, Uruguay. He is passionate about aesthetics, design, and driving state-of-the-art clinical results. He graduated from dental school by Universidad de la República in 2002 and undertook further studies abroad, such as postgraduate courses about implantology, esthetic rehabilitation, and participated in several conferences. During this journey, he collaborated with well known clinicians and dental lab technicians around the world developing digital workflows that he now uses to drive positive patient outcomes.

About Clínica Lhasa

Clínica Lhasa is a digital dental clinic that has implemented full in-house digital workflows. An early adopter of innovative dental technologies, he first invested in Formlabs 3D printers in 2016. Based on their philosophy of having full control of all the digital steps from diagnostics, scanning, designing, and production, each clinical case is produced digitally from beginning to end within the practice to guarantee the best quality, full control over production and delivery times, and offering an 100% personalized attention to patients.

Introduction

Due to the constant influx of new materials and digital workflows, digital dentistry is constantly advancing and changing. It is clear that the focus lies on further simplification of workflows that will not sacrifice quality of results. When looking within the adhesive esthetic rehabilitation field and options available for production, there are two different paths: subtractive (milling) and additive (3D printing) manufacturing. These technologies are widely used in the dental field and, while being complimentary, both have different advantages and disadvantages.

COMPARING MANUFACTURING OPTIONS

Regarding working and production time, for example, for small batches of four unit elements, subtractive manufacturing is the fastest method of production. However, 3D printing is excellent for high-volume production as the print time per part is optimized (the more parts you add, the less time it takes to print each individual element).

When examining costs per part, in-house 3D printing costs only US$4-5 per unit and, compared to one blank for milling, where the price ranges between US$15-18 per unit. If parts need to be produced again, then costs rise for milling and are more favorable with 3D printing. Moreover, 3D printing is very cost effective as it requires less investment on equipment, shorter learning curve, and allows for chairside procedures.

Answering Critical Concerns by Dr. Pineda

CAN 3D PRINTABLE MATERIALS BE USED TO FABRICATE PERMANENT RESTORATIONS?

3D printing is playing a major role in optimizing permanent restorations workflows and where the key for innovation in digital dentistry lies. This technology allows dental professionals to obtain optimal results with less digital tools, less investment on equipment, and reduced cost-per-part among other advantages.

Nevertheless, the question now lies in what is the best material for the different dental applications, and specifically, for restorative dentistry. On a personal level, I have tested all dental materials available to use with 3D printing but lately I have been focusing on the new restorative ones such as Temporary CB and Permanent Crown Resin. Today, my overall perception is that these materials are a viable solution and guarantee a promising future for upcoming restorative printable materials. These resins proved to be able to produce good clinical outcomes, having the right mechanical and esthetic properties to last for a long period of time. We always look to use dental materials that simulate the natural tooth and possess properties that mimic the natural structures and that are not above them.

CAN 3D PRINTABLE RESTORATIONS BE CONSIDERED AS A GOOD ESTHETIC SOLUTION?

It is important to understand that these printable materials are monolithic and, therefore, are esthetically different to ceramics, for example, lithium disilicate. This is important because color modulation and esthetic perception will differ from traditional layered restorative materials when

placing these in the patient's mouth. Though for posterior restorations the esthetic demands are lower, these have raised questions about, how esthetic can these monolithic restorative materials look in the anterior sector? Shall we limit their use to specific sections of the mouth? With this clinical case we want to showcase that high quality esthetic outcomes can be achieved with this material, but that it does not depend on the printing phase alone. It is critical that an optimal design is done in the CAD phase, allowing the creation of natural textures that will be then replicated via 3D printing and will play a vital role in light modulation and overall perception.

Moreover, it is critical that dental professionals learn and follow the manufacturer's instructions and protocols regarding post-processing which includes: specific washing times, specific curing cycles with times and temperatures, characterization and glazing and finally, adhesive cementation protocol in order to guarantee short and long-term success of the printed restorations. Following the instructions guarantees biocompatibility of the parts and that their mechanical properties will be optimal.

Case Presentation and Diagnosis

A 30 year old male patient consulted us for a clinical evaluation as he was unhappy with his current evolution and timing of the orthodontic treatment he was undergoing in another clinical practice.

Fig 1: Preclinical situation

A CBCT is indicated in order to do an interdisciplinary evaluation of bone and periodontal structures along with the specialist orthodontist. After the clinical and paraclinical evaluation, the patient is disencourage to continue his orthodontic treatment and recommended to allow stabilization of the structures before moving forward to any restorative or further orthodontic procedures. Once the stabilization of tissues is achieved, the esthetic and health demands of the patient are treated.

At the clinical examination we identified:

- Tooth 12: color change, pulpar implication, and absence of pulp vitality. Presence of a voluminous composite restoration.
- Tooth 22: defective distal closure of diastema (towards tooth 23) with composite which presented pigmentation.

Treatment Plan

The treatment plan is prepared with an interdisciplinary team and consists of the following steps:

- Tooth 12
  - Root canal therapy and placement of an esthetic fiber post.
  - Restore via a full coverage crown.
- Tooth 22: Restore via a veneer with distal diastema closure.
- Both restorations for tooth 12 and 22 are fabricated via 3D printing using Formlabs' Permanent Crown Resin.

A. EXECUTION OF TREATMENT PLAN:

In this case, we describe the phase referring to the esthetic rehabilitation and after the endodontic treatment is completed. Based on the treatment plan and depending on the expertise of the dental professional and team managing each one of the steps of the workflow, one or two appointments are needed. In this case, it is designed and produced fully in-house in one single appointment without temporization.

Flapless crown lengthening is performed in tooth 12 and the pre-existing composite restorations are removed assisted with K-lite fluorescence.

Fig 2-4: Detection of previous restorations via K-lite fluorescence and outcome of flapless crown lengthening in tooth 12 (fig 4).

Sil-Trax® (size 7) gingival retraction cord (Pascal Int.) is used to manage soft tissues. Sufficient tooth preparations are done, in tooth 12 for a crown and tooth 22 for a veneer with different thicknesses and guided by the tooth substrate. After completing the tooth preparation, color is taken by considering the final color to be achieved by observing both the color of the healthy neighbor teeth, and the final color of the prepared tooth substrate (darkened), which also determines the amount of tooth preparation needed.

Intraoral scanning (Trios, 3Shape) is performed to capture the data to proceed to the design phase. In the CAD phase, natural teeth libraries are utilized to design the restorations (3Shape Dental System). Once the design is completed, the file is exported as an STL so we can import them into PreForm and start the manufacturing stage.

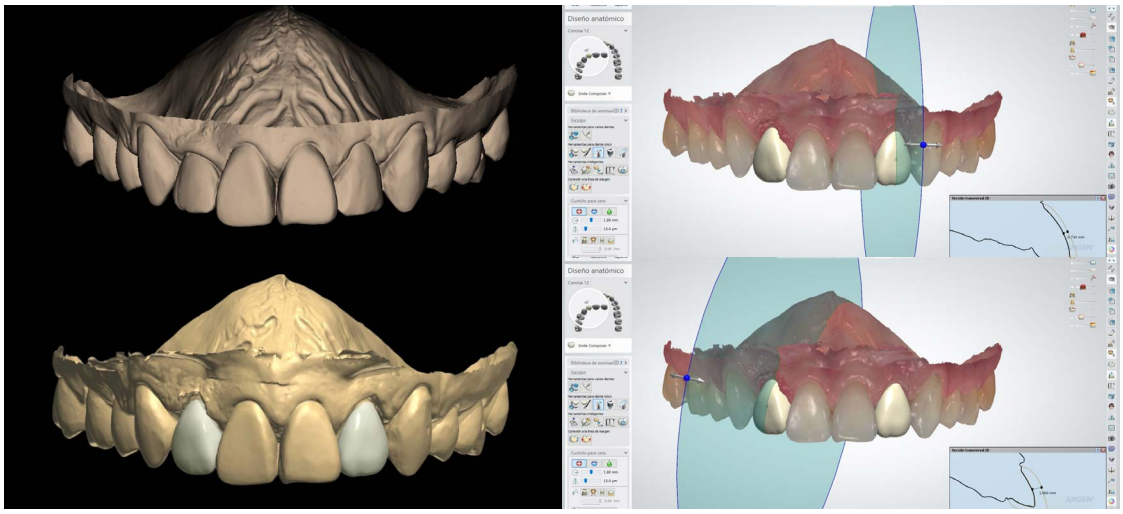

Fig 5-8: Digital scanning and design (3Shape Dental System)

B. MANUFACTURING STAGE

The STL files are imported into PreForm, Formlabs print preparation software. Here the restorations are given the correct print orientation and added support structures. The restorations are sent to the Form 3B printer to be fabricated with Permanent Crown Resin in B1 shade within our clinic.

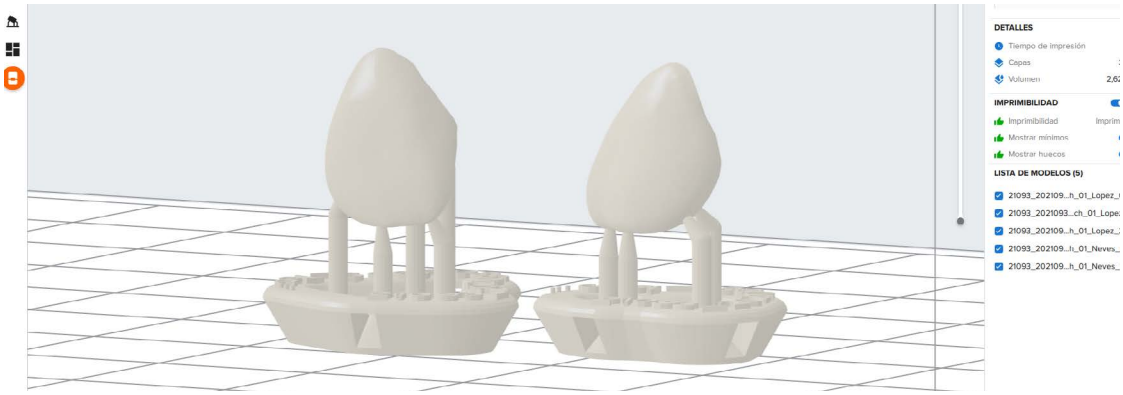

Fig 9: Oriented and supported restorations in PreForm

Fig 10: Permanent Crown Resin Shade B1 and the Form 3B, SLA 3D printer

After printing, the restorations are removed from the build platform and washed in 99% isopropyl alcohol (IPA) for three minutes in the Form Wash. The parts are dried using compressed air.

The first cure cycle is done in the Form Cure for 20 minutes at 60°C. The surfaces are sandblasted carefully to remove the powder surface coating (which are the ceramic fillers contained in the resin) using a sandblaster or Aquacare at 1.5 bar maximum pressure. We then remove the support structures using a diamond disc.

Fig 11-12: Sandblasting and support removal with ultrafine diamond disc.

The second curing cycle is done in the Form Cure for 20 minutes at 60°C.

The next steps are critical for guaranteeing success.

All external surfaces of the restorations are polished in two stages utilizing DiaShine® products as follows:

- Application of DiaShine® Super Fine Soft with a soft brush at 8000 RPM.
- Application of DiaShine® Coarse with a medium brush at 8000 RPM.

Fig 13-14: Application of DiaShine® Super Fine Soft with a soft brush and DiaShine® Coarse with a medium brush at 8000 RPM.

Restorations are then characterized and glazed (GC Optiglaze) for further customization.

Fig 15-16: Characterization (GC Optiglaze)

After completing this step, a final characterization step with the restorations seated in the patient's mouth is done. This is a critical step to ensure the perfect esthetic integration of the restorations. After placing the printed restorations in the patient's mouth, an evaluation on the impact of the tooth substrate color on the restoration is done. In a moisture-controlled operating field, the restorations are finally characterized in different areas (cervical, incisal edges, borders). Glaze is applied to finalize the restorations.

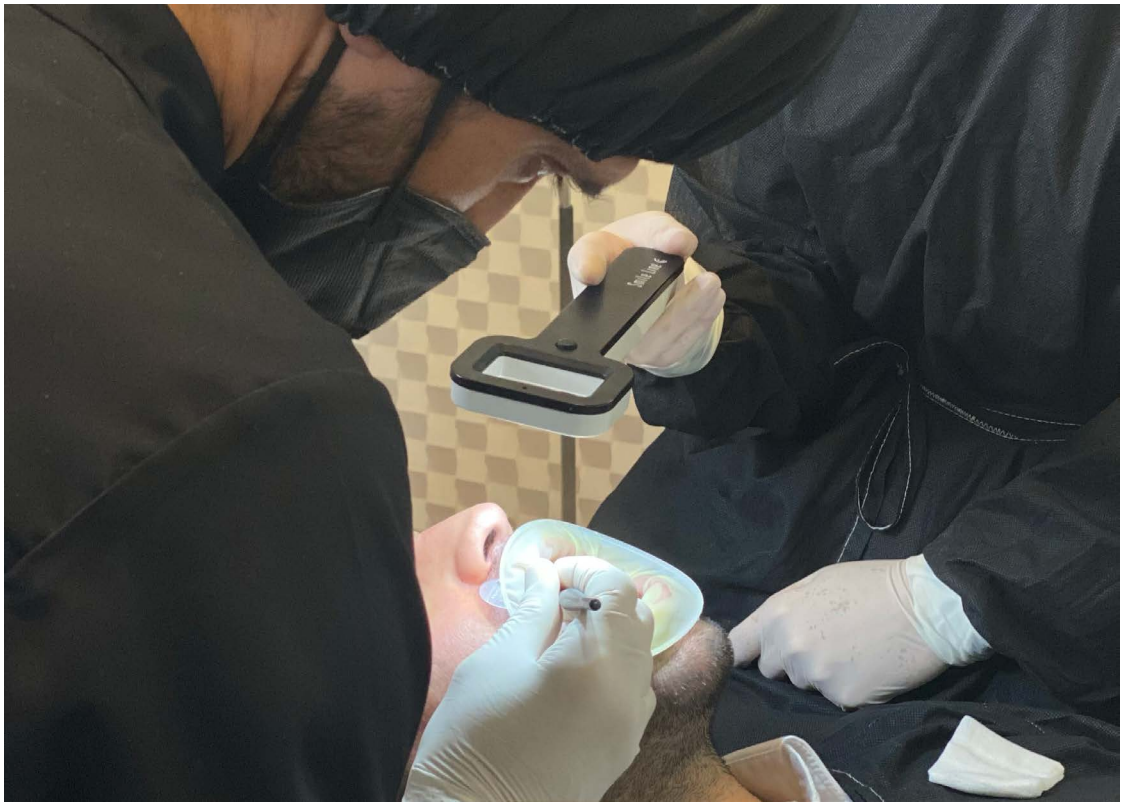

Fig 17: Characterization of restorations in the patient's mouth

Delivery and Cementation Protocol

As this case is for same-day delivery, no temporary restorations were placed upon the treated teeth after tooth preparation.

The operating field is set up using a rubber dam. This allows us to completely isolate the site from the moisture of the oral cavity and improve visibility. The restorations are tried to validate their insertion and fit.

Fig 18: Isolation of the operating field.

Fig 19: Try-in of restorations.

As for cementation, the following steps are taken and done simultaneously in the tooth structures and the internal surface of the restorations with the help of the dental assistant:

INTERNAL SURFACE PREPARATION OF THE PRINTED RESTORATION:

1. Sandblasting with aluminum oxide 53 microns (Aquacare) to increase the mechanical retention.
2. Cleaning to remove aluminum oxide particles with water and compressed air.
3. Silanization (Porcelain Primer - BISCO) for two minutes and drying.
4. Cementation protocol is done via the pre-heated resin adhesive technique (69°C in Hot Set by Technolife) therefore we place the cementing agent in the internal surfaces of the restorations.

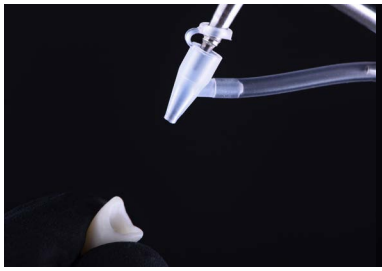

Fig 20: Sandblasting

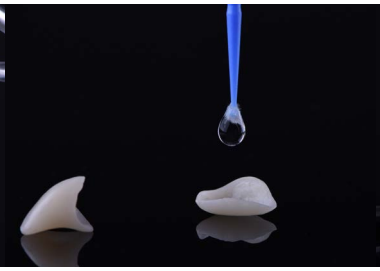

Fig 21: Silanization

Fig 22: Cementation via the pre-heated resin adhesive technique (69°C in Hot Set by Technolife)

TOOTH STRUCTURE PREPARATION FOR ADHESIVE CEMENTATION:

1. Cleaning of surfaces with aluminum oxide “sylc” with Aquacare.
2. Protection of neighboring teeth with teflon.
3. Etching for 15 seconds in enamel.
4. Washing with water and drying.
5. Application of self conditioning adhesive system, by active application in dentine for 20 seconds, drying for 15 seconds to evaporate the solvent.

Fig 23: Cleaning surfaces with Aquacare

Fig 24: Protection of neighboring teeth with teflon

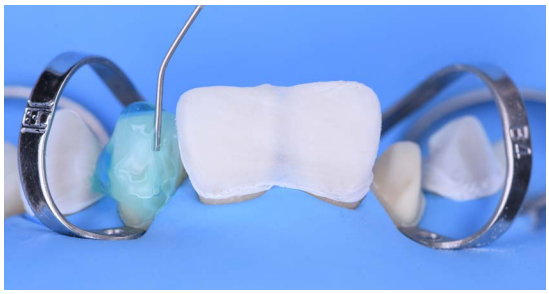

Fig 25-26: Acid etching

Fig 27-28: Washing and drying

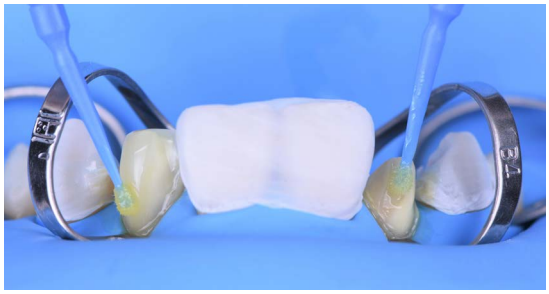

Fig 29: Application of primer and bonding

Fig 30: Placement of restorations.

Fig 31: Photopolymerization.

Fig 32: Cemented restorations.

The restorations are placed upon the prepared teeth in their position, cement excess are removed with a brush and they are light-cured for 40 seconds.

The rubber dam is removed, the occlusion checked and photographs were taken for documentation purposes.

Fig 33: Final photograph with restorations in place.

Fig 34: Tooth 12 with full crown.

Fig 35: Tooth 22 with veneer.

Follow-Up

After 6 months, the printed restorations are stable and without any signs of clinical variations.

Conclusions

The 3D printable ceramic-filled resin, Permanent Crown Resin, is an excellent option to offer to patients that are in need of adhesive anterior esthetic and conservative restorations and that allows the production of these via a full in-house CAD-CAM workflow. With this material we achieved very good results in regards to adaptation, morphology, texture, surface finish, and color.

Regarding investment costs, 3D printing has considerably lower costs associated with hardware, resins, and consumables compared to milling systems. Moreover, as for overall production costs, printed restorations are three times less expensive compared to milled restorations.

This clinical case is evidence that the future of printable materials is here to stay.

Credits

Dr. Verónica Champret: Endodontics

Evangelina Escobar: Dental Clinical Assistant

Lorena Moncalvo and Paola Azarello: KPG

Dr. Alejandro Pineda: Clinical case registration, clinical treatment (tooth preparation, scanning, digital design, 3D printing, post-processing, staining in mouth, glazing and adhesive cementation

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