CLINICAL CASE STUDY

Maxillary Premolar Inlay Restorations with Permanent Crown Resin

by Dr. Édouard Lanoiselée

In this paper, Dr. Édouard Lanoiselée gives a step-by-step overview of creating inlay restorations using an indirect CAD/CAM process in collaboration with Argoat Prothèse Dentaire.

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About the Author

Dr. Lanoiselée is a general practitioner in a group practice in Nozay (France). He graduated from the Faculty of Dentistry in Nantes (France) in 2008. Dr. Lanoiselée has always maintained a link with the faculty since his graduation, whether for clinical supervision of students or for theoretical instruction at the graduate level. He is a lecturer for the University Diploma in Aesthetic Dentistry at the University of Nantes, for the Master 1 in Biology and Health, as well as for the higher education certificates. Dr. Lanoiselée has obtained several certificates in prosthetics (fixed, as well as partial and complete removable), and is a former teaching hospital assistant lecturer at the care, research and teaching center of the Faculty of Dentistry of the University of Nantes for the prosthetics department. He has been a user of CAD/CAM systems since 2009, and regularly speaks at conferences on topics related to aesthetic dentistry and digital workflow.

About Argoat

Argoat Prothèse Dentaire is a dental laboratory combining conventional and digital techniques. They have created an industrial machining and 3D printing centre for their own production in order to be totally autonomous. A team of technicians focused on prosthetists makes the link between the digital impression, the machine and the prosthetist, who can devote more time to optimising the aesthetic work. They machine and print all the materials available in the dental field. The digital workflow is accelerating the comfort of the patients and the dental professionals.

Introduction

Digital dentistry methods and materials have surpassed traditional ones in many ways. Digital tools particularly enhance interconnectedness and communication between patient, doctor, and laboratory. Additionally, the development of new dental materials for restorative dentistry opens up a new world of possibilities as they allow for shorter delivery times and reduced costs, while still delivering high quality restorations.

Today, intraoral scanners and 3D printing systems are performing at a high level while maintaining simplicity of use. The Form 3B printer from Formlabs Dental is an excellent example of this; its plug and play operation puts it within equal reach of printing experts and beginners. Permanent Crown Resin, also from Formlabs, is a restorative material released in 2020 that allows the direct printing of high quality dental permanent single unit restorations at a reduced price.

The clinical case presented here shows an indirect CAD/CAM step-by-step workflow for the production of inlay restorations: the intraoral impression was made in the practice, after which the data were transmitted to the prosthetic laboratory, where the prosthetic elements with Form 3B and Permanent Crown Resin were designed and 3D printed. The restorations were sent back to the practice, prepared for adhesive cementation, and the treatment was delivered to the patient.

Case Presentation and Diagnosis

A 58 years old female patient with treated hypothyroidism consulted us for a sensitivity to cold in the area of her 24.

Fig 1: Initial Clinical Situation

At the clinical examination we identified an occlusal-distal fracture of the dental amalgam of the 14. The restorations on 25 and 26 were carried out at the same time and appeared to be infiltrated. Following the tests, we diagnosed a reversible pulpitis in 24. The teeth 25 and 26 did not show pulpal symptoms.

Treatment Plan

The treatment plan consisted of the removal of amalgam restorations and the transition to direct composite restorations (26) and indirect printed composite resin restorations (inlays on 24 and 25).

The treatment was carried out in 2 sessions: a preparation session and a cementation session.

Execution of Treatment Plan

The amalgams are placed under the operating field. In order to conceal the residual discolouration caused by the amalgam and to fill undercuts, the cavities were filled with composite. The 16 is filled using the direct composite resin technique. The shade of the indirect restorations is determined by the shade selected to fill the cavities of 24, 25 and the filling of 26. The composite filling also protects against the risk of bacterial contamination and prevents possible pulpal sensitivities.

Fig 2: Teeth after preparation

The teeth are then prepared using calibrated burs for onlays. After polishing, an intraoral impression was made (TRIOS 4 3Shape) both statically and dynamically. The patient's mandibular movements were recorded to improve the accuracy of the occlusion

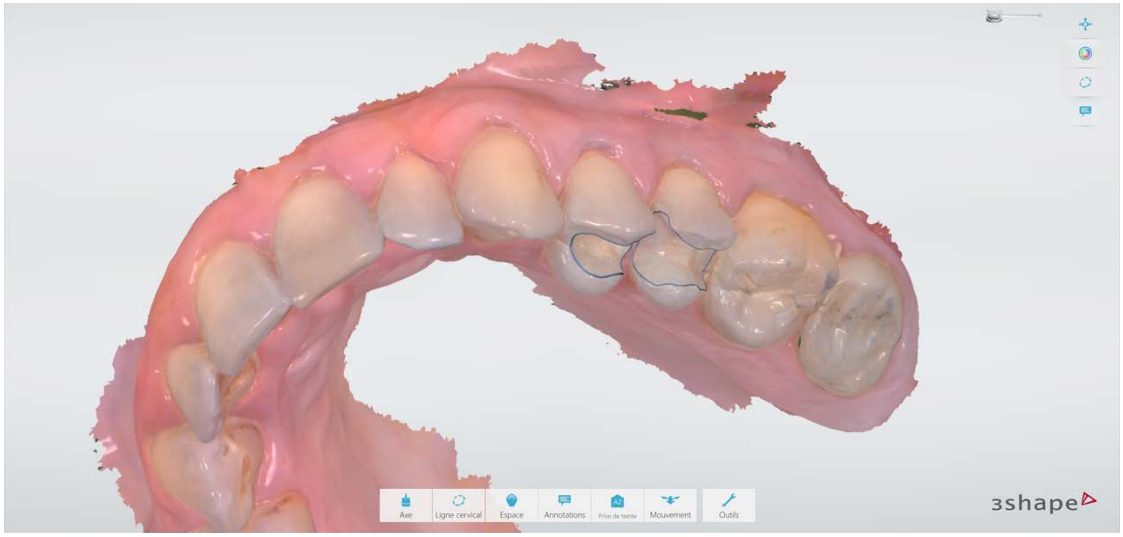


Fig 3: Maxillary impression with trace of the limits of the teeth preparations

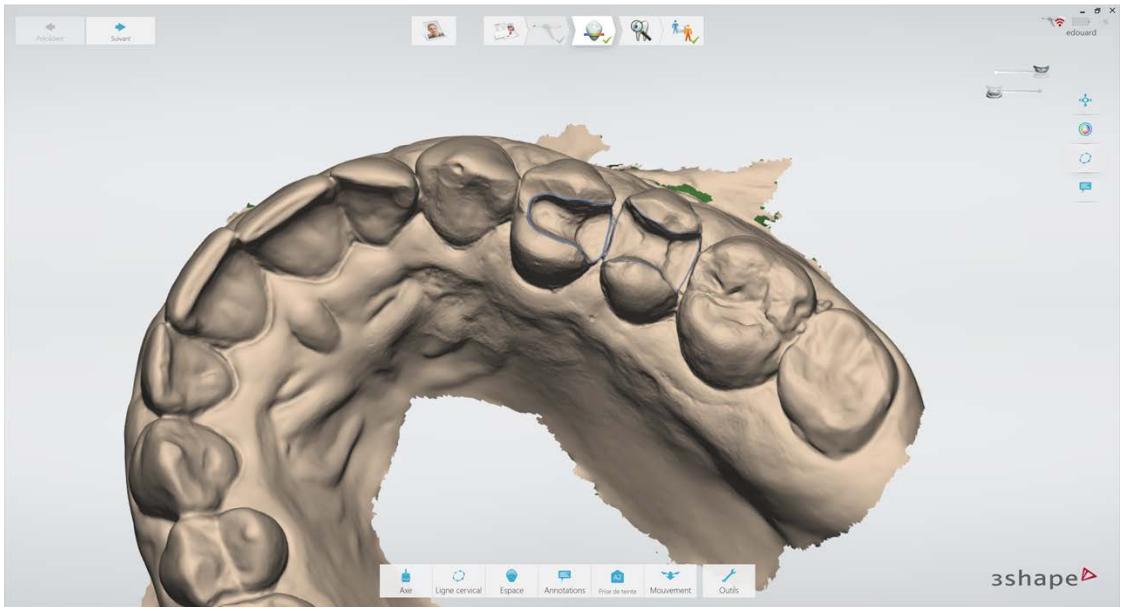
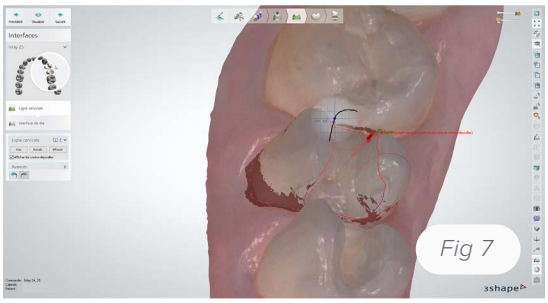
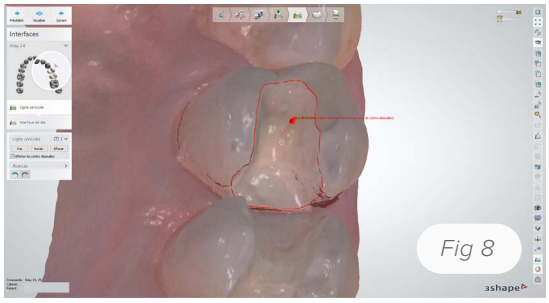


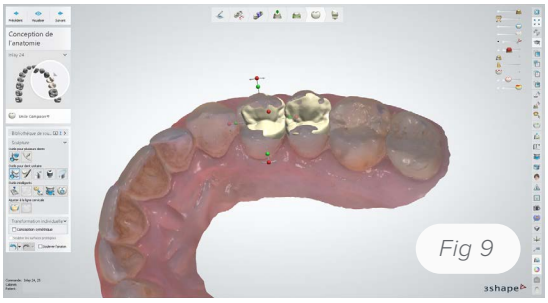
Fig 4: Black and white imprint control

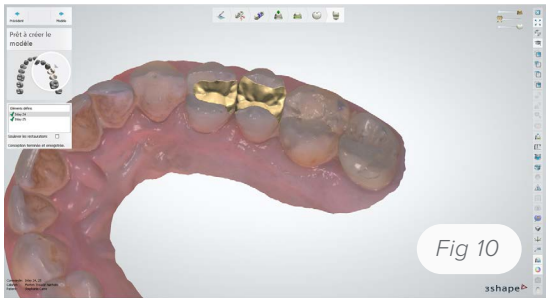
Fig 5: Dynamic Occlusion Recording (Specific motion)

The impression was sent to the prosthetic laboratory (Argoat Prothèse Dentaire) via the secure 3Shape Communicate web portal. The provisional restoration was made using a flexible composite (Luxatemp inlay, DMG), which was selected for easy removal during the assembly session.









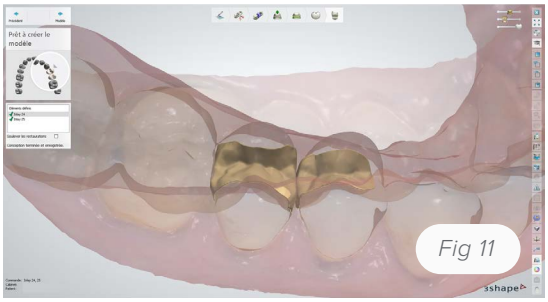


Fig 6 to 11: Inlay Design

Manufacturing Stage

The restorations were modelled in the 3Shape Dental System software. After digital design was completed, the inlays were exported in STL format and imported into the PreForm software (Formlabs) and printed in Permanent Crown Resin A2 Shade in the prosthetic laboratory.

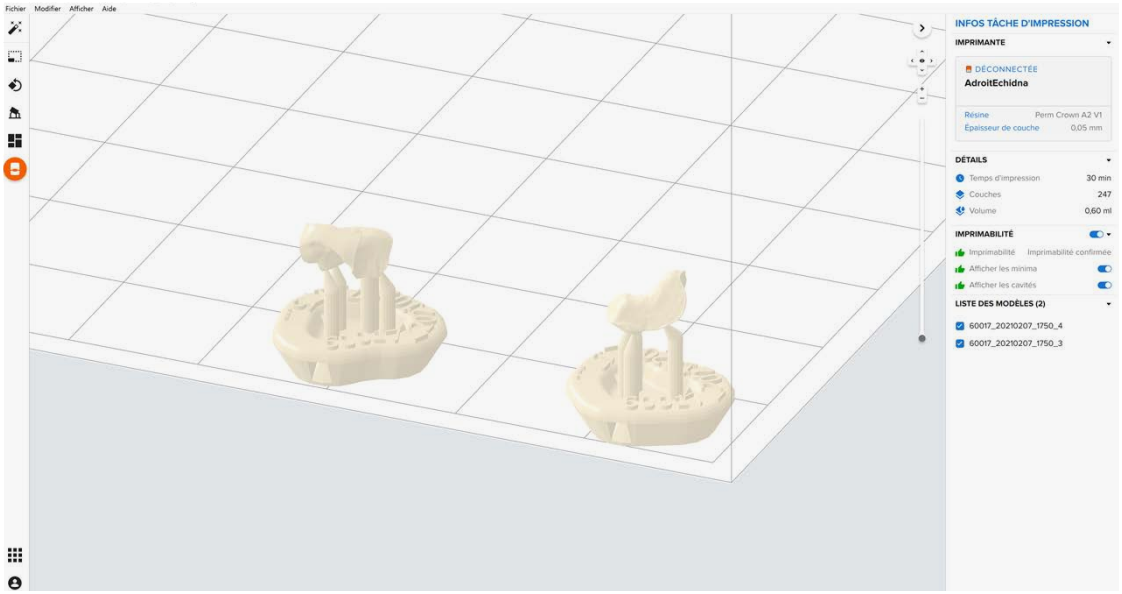


Fig 12: Print preparation in Preform

The restorations were then characterized via staining (GC Optiglaze) and glazing and sent to the dental practice for cementation.

Fig 13: Inlay characterization

Delivery and Cementation Protocol

After removal of temporary restorations, the inlays were tried in to validate their insertion and adaptation. Their internal surface was then prepared in 3 steps:

1. Micro sandblasting (50 micron alumina) to create mechanical retention.
2. Cleaning: to remove residual alumina particles.
3. Silanization (G-multi primer, GC): after thorough drying the primer was applied in a single layer, then the excess was evaporated with a blower and the prosthetic part was placed in a heater to activate the silane.

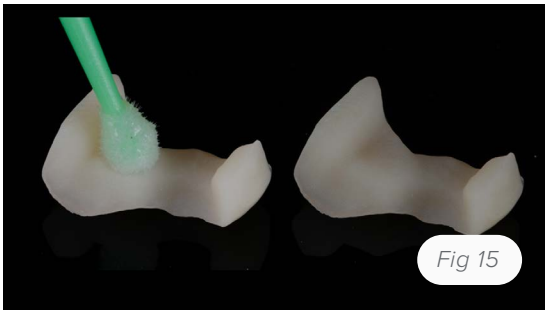


Fig 14 and 15: Surface preparation of inlays

We then proceeded to the assembly by cementing according to the following protocol:

1. Setting up an operating field: using multiple dental dams. This allowed us to isolate the site from the moisture of the oral cavity and improve visibility.
2. The cavities were conditioned using a micro-sander (27 micron alumina). The sandblasting reactivates the composite for bonding, cleaning the cavity of possible residues of temporary cementation agent and restoration. We rinsed abundantly to remove alumina particles, which can decrease the adhesion value.

Fig 16: Preparation of tooth surfaces

Orthophosphoric acid was applied for 30 seconds on the enamel and 15 seconds on dentine. The etching creates the micromechanical keying and helps to finish cleaning the bonding surfaces.

Fig 17: Application of orthophosphoric acid

The surfaces have a matte appearance as a sign of the conditioning action of microsanding and acid etching.

Fig 18: The tooth preparations after conditioning

For cementation, a universal cement agent (G-cem Linkforce, GC) with dual setting (chemical and light-curing) was used. The adjacent teeth were insulated with Teflon to avoid the adhesive and cementing agent getting to undesired surfaces.

The adhesive was applied by actively rubbing it into the surfaces and applying the dry air blower to evaporate the solvents. The adhesive was applied to the prosthetic restoration, which was then gently placed into the prepared cavity.

Fig 19: Cementation of the inlay on 25

Excess cementing agent was carefully removed with a brush and then the restoration was light-cured for 20 seconds.

Fig 20: Cementation of inlay on 24

The second inlay was then placed following the same protocol. Here again, the excess was removed with a brush before photopolymerisation. The two inlays were then light polymerised for one minute from all sides.

Fig 21: Fitting view

A first polishing was carried out using silicone polishers (Spiral Komet Kompoline).

Fig 22: Polishing under surgical field

The rubber dam was then removed, the occlusion checked and the final polishing carried out.

Fig 23: Final view after occlusion check and polishing

Follow-Up

The aesthetic integration was satisfactory. The patient will be seen again in 6 months for oral follow-up.

Conclusion

Permanent Crown Resin is an excellent alternative to composite block for inlay applications. 3D printing allows an economical solution with a satisfactory aesthetic result both in terms of morphology and colour. While a composite block can cost between 10-12€/piece, using 0.40ml/inlay reduces costs significantly to 4-7€/inlay. This flow proposed here in collaboration with the prosthetic laboratory can easily be done within the dental practice in a direct CAD/CAM framework.

Additional Resources

Explore Formlabs dental resources for more in-depth guides, step-by-step tutorials, white papers, webinars, and more.

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