

## CASE REPORT

# Chairside posterior cantilevered fixed partial denture: Case report

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## Key Clinical Message

The cantilevered fixed partial denture (CFPD) is gaining recognition as a sound method of replacing missing teeth in the posterior sector. The purpose of this case report is to demonstrate that this type of restoration can be performed in a single appointment. A 39-year-old patient presented herself to the dental department; she showed agenesis of the two first maxillary premolars with a totally closed mesio-distal gap and a recent loss of the 2s maxillary premolars. This case report concerns the replacement of the upper left second premolar. The patient was treated with a mesial CFPD resting on an “onlay-like” retainer on the first molar and replacing the missing premolar with a cantilevered pontic. The dimensions of the connection's cross-section were maximized as much as possible (>20 mm<sup>2</sup>). The restoration was designed and produced using chairside CAD-CAM from a milled-reinforced glass-ceramic block (Emax CAD, Ivoclar Vivadent). The aesthetic and functional integration of the prosthesis was successful. The patient was examined at 11 months for a follow-up. At this early stage, satisfactory dental hygiene was observed, associated with a smooth prosthetic fit, no periodontal inflammation, normal probing, and no abnormal dental mobility.

## KEYWORDS

CAD-CAM, cantilever, fixed partial denture, prosthodontics

## 1 | INTRODUCTION

The concept of a cantilevered fixed partial denture (CFPD) was described as early as 1960.<sup>1</sup> Subsequently, the innovations in dental materials and adhesive dentistry allowed for the description of full ceramic CFPDs as a sound solution for the replacement of missing anterior teeth in 1997.<sup>2</sup> Since this initial description, this therapeutic solution has provided patients with a less invasive alternative to three-unit fixed partial dentures (FPD). The indication of CFPD is often disputed in comparison with an implant-based

treatment, which, in some cases, can present challenges or even be contraindicated. In this regard, CFPDs benefit from more reproducible esthetics, quicker execution, and lower costs.<sup>2</sup>

The question remains, however, whether this method would also be suitable for the replacement of missing teeth in the posterior sector, the main problem being the significant increase in occlusal loads on the premolars and molars.<sup>3</sup> Because of the increase in occlusal loads from mesial to distal on the arch, mesial cantilever pontics seem to be preferred to distal ones, especially in the case of single

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retainers. Different teams have begun to develop posterior CFPDs, and some already have the necessary follow-up to validate this practice.<sup>4-8</sup> The material used in these early clinical trials has been zirconia doped with 3%mol yttrium oxide (3Y-TZP), which gives the best mechanical properties at the expense of low aesthetic translucency. Yazigii and Kern recommend a thickness of 0.7 mm zirconia in the overlay part and a connector of at least 3 mm in the vertical section and 3 mm in the horizontal section to ensure the mechanical resistance of the CFPD's pontic in the posterior sector.<sup>6</sup> This case report describes the realization of a reinforced glass-ceramic CFPD replacing the first premolar. This material opens the possibility of single-appointment chairside production, and has superior adhesive and aesthetic characteristics compared to zirconia.<sup>9-11</sup> Its lower mechanical resistance is, however, to be taken into consideration,<sup>12</sup> but it still might be suitable if some prerequisites are met.

## 2 | CLINICAL REPORT

A 39-year-old female patient came to the department for a missing upper left second premolar; the tooth had been previously extracted due to decay. The patient had no specific health problems and was not taking any long-term medications. She presented a history of carious disease, mostly treated with composite restorations, and mild gingival inflammation due to the presence of plaque. She

showed agenesis of the two first maxillary premolars with a totally closed mesio-distal gap and a recent loss of the 2s maxillary premolars. This case report concerns the replacement of the upper left second premolar.

The Figure 1 shows the pictures of the situation right before the realization of the CFPD and the initial bitewing radiography taken on the first appointment. The patient was missing her upper left second premolar; the vertical space for a prosthetic tooth was respected; the mesio-distal space was slightly reduced. With the exception of a slight supra-eruption of the upper left canine, the patient's occlusion was stable and satisfactory. The shade of the adjacent teeth was harmonious, with a relatively even shade from the base to a low translucency incisal edge and a slightly saturated yellow color.

Before beginning treatment, a nutrition questionnaire and oral hygiene education, resulting in a satisfactory plaque index, were conducted to decrease the risk of future cavities. Existing cavities and unsatisfactory restorations were first treated with bonded resin composites. More specifically, the dental amalgam present on the upper left first molar was removed and replaced by a resin-bonded composite restoration.

The patient, in addition to an agenesis of the upper left first premolar, had lost her upper left second premolar. The long-standing loss of this second premolar had two consequences that would complicate eventual implant treatment: First, the delay resulted in significant bone resorptions, and a bone graft would be necessary prior to



**FIGURE 1** Initial clinical situation after basic cavity treatments and the replacement of an unsatisfactory restoration. (A) frontal view. (B) occlusal view. (C) buccal view. (D) pre-dating bitewing radiography of the first appointment.

implant placement; second, the mesial shift of the molar reduced the available mesio-distal gap. But on the other hand, this reduction of space should limit the torque generated by a CFPD and should improve its mechanical behavior.<sup>13</sup> After the patient refused implant treatment, a CFPD solution was proposed. The patient was made aware of the risks of this alternative indication, and a written informed consent form was signed. A single appointment was scheduled for preparation, optical impression, chair-side fabrication, and bonding of the prosthesis.

Although the tooth to be replaced was a second premolar, it occupied the site of a first premolar, so the aesthetic aspect of the restoration was therefore of great importance. A milled-reinforced glass-ceramic (Emax CAD A3 Highly Translucent, Ivoclar Vivadent) was selected for the prosthesis.

Local anesthesia using articaine with 1/200,000 adrenaline was administered. The tooth preparation process is shown in Figure 2. The design of the CFPD's retainer preparation was chosen based on previous studies. Finite element research seems to show that beyond 3 mm from the proximal edge, the width of the connector seems to be of less importance.<sup>13</sup> However, it seems that the mechanical resistance of the connector is proportional to the width of its cross-section and, more importantly, its squared height. An "onlay type" retainer design was therefore selected based on different studies on the subject,<sup>14-16</sup> preparation of the two mesial cusps of the upper left first molar was then performed with a diamond bur. The preparation

was then finished with a fine-grained bur. The preparation's dimensions were 1.5 mm occlusal and 1 mm axial.

The optical impression was then performed with the Primescan intraoral scanner (Dentsply Sirona), and computer-aided design and manufacturing were performed using the Cerec.5 software (Dentsply Sirona). After validation of the maxillary, mandibular, and occlusal digital models, the finish line tracing was facilitated by sharp preparation edges. The design of the CFPD is illustrated in Figure 3. Considering that the material used would be Emax CAD, the dimensions of the connector were increased as much as possible, resulting in an ellipse section of approximately 4.4 mm in height and 6.8 mm in width (it is possible that the cut underestimated these values due to the fact that the section of connector was not actually flat). These values still allowed for a connector surface  $>20\text{mm}^2$ . In addition, in order to alleviate occlusal loads on the molar, the pontic was designed to minimize contacts during protrusive, working, and non-working excursive movements. Static maximum occlusion contacts were retained.

With the design validated, the prosthesis was manufactured from a C14 A3 highly translucent Emax CAD Cerec block (Ivoclar Vivadent) with a Cerec MC XL milling machine (Dentsply Sirona) (Figure 4). The satisfactory CFPD bonding was validated on the patient, in addition to the verification of correct gingival embrasures allowed by the connector. The CFPD was then polished and characterized with Emax Glaze, Shades, and Stains (Ivoclar Vivadent). It

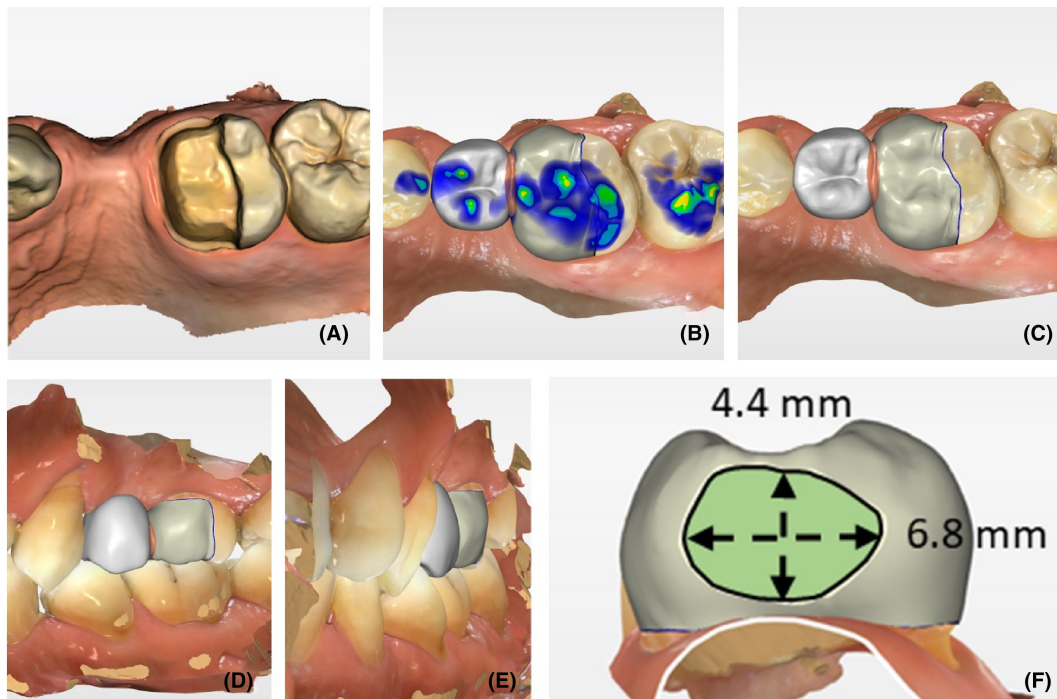


**FIGURE 2** Clinical view of the tooth preparation process; (A) initial situation. (B) occlusal view of the tooth preparation. (C) buccal view of the tooth preparation.

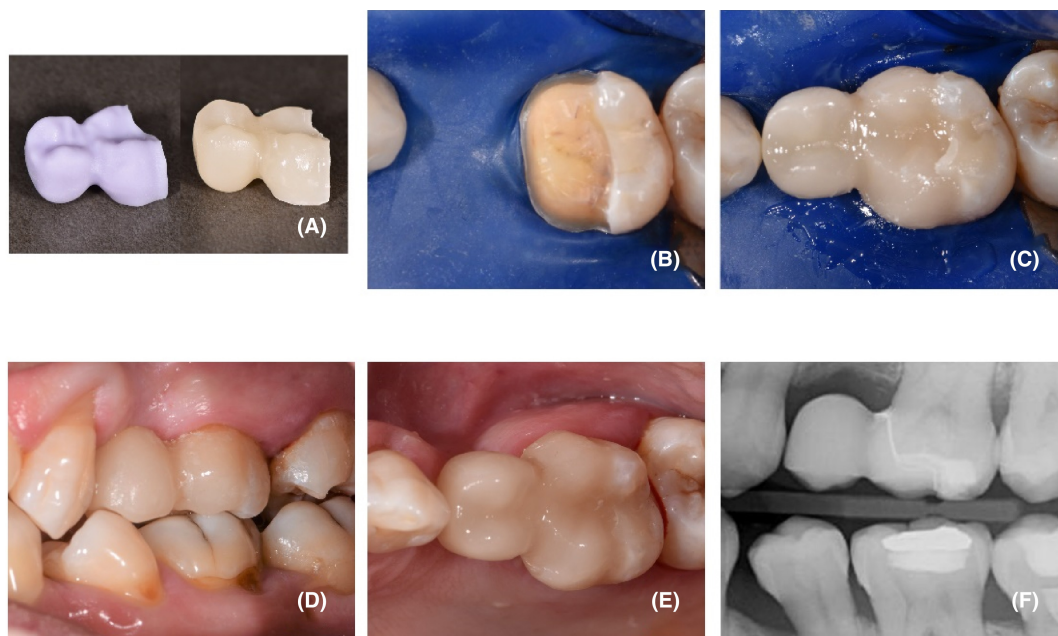


was then synthesized using the Programat P300 (Ivoclar Vivadent). After aesthetic validation on the patient, the CFPD internal surface was prepared by etching with hydrofluoric acid and was then rinsed in an ultrasonic

cleaner for 3 min, followed by the application of a thin layer of Monobond Plus primer (Ivoclar Vivadent), and condensed with a hairdryer. After application of a dental dam, the tooth was prepared by etching the enamel (30s)



**FIGURE 3** Screenshots of the cantilevered fixed partial dentures CAD process: (A) digital model of the preparation. (B) occlusal view with occlusal contacts. (C) occlusal view without occlusal contacts. (D) buccal view. (E) frontal view. (F) cross-sectioned view of the connector.



**FIGURE 4** A clinical view of the fabrication and bonding processes. (A) milled and finished prosthesis. (B) occlusal view with dental dam. (C) prosthesis in place before the removal of excesses of bonding resin. (D) final buccal view. (E) final occlusal view. (F) radiographic control.

and dentin (15s) with orthophosphoric acid, followed by application of the Scotchbond Universal adhesive (3M). The NX3 Nexus bonding resin (Kerr) was then used to fit the prosthesis permanently. After polishing and occlusal adjustments, a control bitewing radiography was taken, which showed no bonding resin excesses and a satisfactory integration of the CFPD. At the end of the appointment, the team and the patient were overall satisfied with the conduct of the session.

For the follow-up appointment, since the CFPD was the last step in the treatment schedule, and without any short-term grievances from the patient, she was re-examined at 11 months. The pictures taken during the check-up are shown in [Figure 5](#).

During this follow-up appointment, we found satisfactory dental hygiene, a smooth dento-prosthetic fit, no periodontal inflammation, normal probing, and no abnormal dental mobility. However, 11 months is a relatively short follow-up period, and longer-term monitoring will be necessary to validate the success of the treatment.

### 3 | DISCUSSION

The use of mesial CFPD for the replacement of posterior teeth seems to be a suitable indication to treat patients who are not eligible for implantology.

Concerning the design of the retainer's preparation, it has been found that realizing a preparation with limited possible disinsertion axes seems to be beneficial for the long-term survival of the prosthesis,<sup>6</sup> and CFPDs' preparations have not yet been fully standardized. In this case, the preparation was made so that the occlusal contact was entirely on the tooth and not on the margin, as can be seen

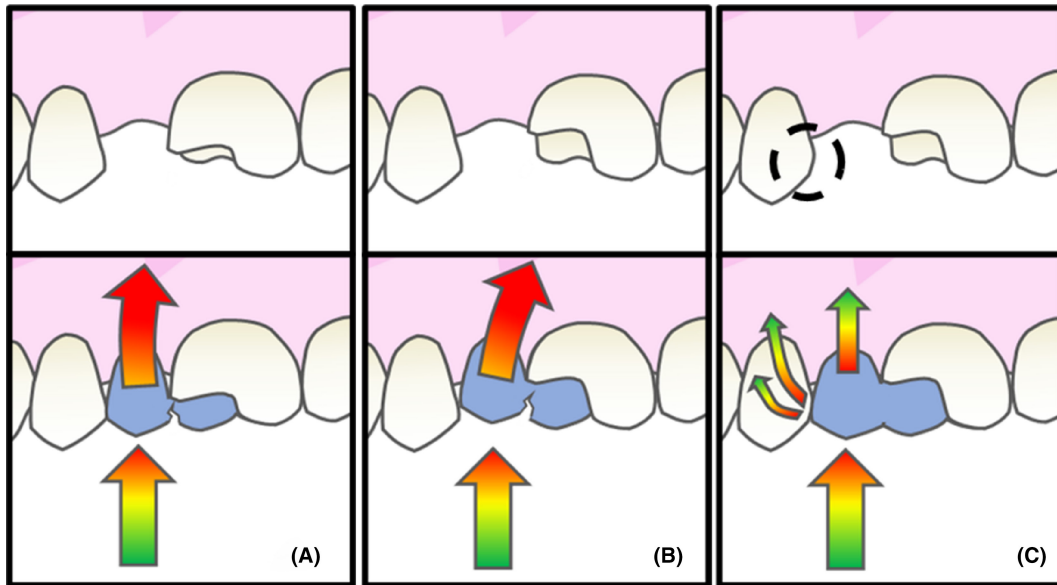
in [Figure 3B](#). In reality, the contact slightly overlapped the margin; it is possible that this problem was partially solved at the occlusal adjustments stage, but it could indeed generate long-term problems.

The concern for the mechanical strength of the prosthesis greatly influenced the design of the preparation. Two elements specific to the posterior cantilever situation stand out ([Figure 6](#)). First, the surface area of the connector had to be maximized; therefore, the mesial finish line was lowered as much as possible. Second, to improve the distribution of stresses during mastication, the distal surface of the canine was slightly modified exclusively at the expense of the enamel, allowing the creation of an area of support for the mesial part of the pontic to rest on. In addition, it has been observed that the radius of curvature of the connector can influence the strength of glass-ceramic FPDs. For conventional FPDs, the radius of curvature of the gingival embrasure should be maximized.<sup>17</sup> With a different stress distribution for CFPDs, this requirement should rather apply to the radius of curvature of the occlusal embrasure; however, in this case, the radii of curvature of the two embrasures were maximized.

The question raised by this case is the use of reinforced glass-ceramic versus zirconia. For this specific situation, several elements supported this choice. First, the dimensions of the mesial face of the molar allowed the design of a prosthesis with a sufficiently wide and, even more importantly, high connector. Second, the reduction of the mesio-distal gap allowed the reduction of the cantilever. Finally, the aesthetic challenge in this case for the replacement of a first premolar and the veneering of a molar was high, and the aesthetic quality of the reinforced glass-ceramic could only be matched by 5Y-TZP zirconia, which has only slightly better mechanical properties and



**FIGURE 5** Pictures taken 11 months after the bonding of the cantilevered fixed partial denture. (A) buccal view. (B) occlusal view.



**FIGURE 6** Different designs of cantilevered fixed partial denture preparations; (A) narrow connector due to insufficient mesial preparation could result in ceramic fracture. (B) unmodified distal area of the canine does not allow for dispersion of occlusal stresses. (C) a slightly modified distal area of the canine allows for some dispersion of occlusal stresses.

a decreased bonding capability.<sup>12,18</sup> However, the gold standard suitable for most indications remains 3Y-TZP zirconia, with the optional layering of the pontic with fluoro-apatite ceramic.<sup>6</sup>

One of the other advantages of the glass–ceramic is its cost-efficiency and the appreciated advantage of the single appointment. However, this requires good planning of the appointment and anticipation of design and aesthetic integration difficulties. Indeed, problems resulting in the need for multiple machining or firing to meet the functional and aesthetic prerequisites could result in too much time being lost to allow single appointment bonding.

In conclusion, mesial CFPDs seem to be a suitable solution for the replacement of posterior teeth; however they require a good knowledge of restorative materials, adhesive protocols, and the fundamentals of dental preparations specific to these indications. Further investigation and clinical trials with sufficient follow-up are necessary to validate this statement. In addition, the relevant indication of CFPD compared to implant treatments must be systematically considered.

## 4 | SUMMARY

This case report concerns the replacement of a missing upper left second premolar. A 39-year-old patient was treated with a CFPD resting on an “onlay-like” retainer on the first molar and replacing the missing premolar with a mesial cantilevered pontic. The restoration was designed

and produced using chairside CAD-CAM from a milled-reinforced glass–ceramic block (Emax CAD, Ivoclar Vivadent). The immediate aesthetic and functional integration of the prosthesis was successful; good integration was observed at 11 months of follow-up.

## AUTHOR CONTRIBUTIONS

**Lucien Dupagne:** Conceptualization; investigation; methodology; writing – original draft. **Vincent Fouquet:** Conceptualization; methodology; validation; writing – review and editing. **Jean-Pierre Attal:** Conceptualization; validation; writing – review and editing.

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## CONFLICT OF INTEREST STATEMENT

None.

## DATA AVAILABILITY STATEMENT

Data are available (pictures) on request from the authors. The data that support the findings of this case report are available from the corresponding author, LD, upon reasonable request.



## CONSENT

After a detailed explanation of the procedure to the patient, a written informed consent form was signed by the patient, including authorization to take and use radiographic and photographic images.

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