Chairside posterior cantilevered fixed partial denture: Case report

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INTRODUCTION

The concept of cantilevered fixed partial denture (CFPD) was described as early as 1960.[1] 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.[2] Since this initial description, this therapeutic solution has provided patients with a minimally 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 benefits from more reproducible esthetics, quicker execution and lower costs.[2]

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.[3] Different teams have begun to develop posterior CFPDs and some already have the necessary follow-up to validate this practice.[4-8] 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 0.7mm zirconia of the overlay part and a connector of at least 3mm in vertical section and 3mm in horizontal section to ensure the mechanical resistance of the CFPD's pontic in the posterior sector.[6] This case report describes the realization of a reinforced glass-ceramic CFPD replacing à first premolar, this material opens the possibility of single appointment chairside production, and has superior adhesive and esthetic characteristics compared to zirconia.[9-11] Its lower mechanical resistance is however to be taken into consideration,[12] but still might be suitable if some prerequisites are met.

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 recent loss of the two second 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 yellow saturated 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 1st molar was removed and replaced by a resin bonded composite restoration.

The patient, in addition to an agenesis of the upper left 1st premolar, had lost her upper left 2nd premolar. The long-standing loss of this 2nd 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 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.[13]After the patient refusal of 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, chairside fabrication, and bonding of the prosthesis.

Although the tooth to be replaced was a 2nd premolar, it occupied the site of a first premolar, the esthetic 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 1/200000 adrenaline was administrated. The tooth preparation process is showed 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 3mm from the proximal edge, the width of the connector seems to be of less importance.[13] However, it seems that the mechanical resistance of the connector is proportional to the width of its cross section, and more importantly, the its height squared. An "onlay type" retainer design was therefore selected based on different studies on the subject,[14-16] preparation of the two mesial cusps of the upper left 1st 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), the computer aided design and manufacturing was 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 of height and 6.8 mm of 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 $>20mm^2$. In addition, in order to alleviate occlusal loads on the molar, the pontic was designed in order to minimize contacts during protrusive, and 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) (Fig. 4). The CFPD satisfactory 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 was then syntherized using the Programat P300 (Ivoclar Vivadent). After esthetic 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 minutes, followed by the appliance 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 of the enamel (30 sec) and dentin (15 sec) 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, it 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**,** **s** ince the CFPD was the last step in the treatment schedule, and without any short-term grievances form 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.

DISCUSSION

The use of CFPD for the replacement of posterior teeth seems to be a suitable indication to treat patient non eligible to 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.[6] The indication for CFPDs being relatively new, their preparation has not yet been fully standardized.

The concern of the mechanical strength of the prosthesis greatly influenced the design of the preparation. Two elements specific to the posterior cantilever situation stand out (Fig. 6). First, the surface area of the connector had to be maximized, therefore the mesial finish line was lowered as much as possible. Secondly, 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.[17] 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. Secondly, the reduction of the mesiodistal gap allowed the reduction of the overhang. 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 a decreased bonding capability.[12,18] However, the gold standard suitable for most indications remains 3Y-TZP zirconia with the optional layering of the pontic with fluoro-apatite ceramic.[6]

One of the other advantages of the glass-ceramic and its cost-efficiency and the appreciated advantage of the single appointment. However, the complexity of design and aesthetics of this type of cases, combined with the need of a sintering phase, implies that the assembly cannot necessarily be ensured in a single appointment.

In conclusion, cantilevered fixed partial dentures seem to be a suitable solution for the replacement of posterior teeth, they do however 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 cantilevered fixed partial denture compared to implant treatments must be systematically considered.

SUMMARY

This case report concerns the replacement of a missing upper left second premolar. A 39-year-old patient was treated with a cantilevered fixed partial denture resting on an "onlay-like" retainer on the first molar, and replacing the missing premolar with a 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.

PATIENT 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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FIGURES

Figure.1. Initial clinical situation after basic cavities treatments and replacing of unsatisfactory restoration. A, Frontal view

Figure.2. Clinical view of the tooth preparation process; A, Initial situation. B, Occlusal view of the tooth preparation. C,

Figure.3. Screenshots of the CFPD's CAD process: A, Digital model of the preparation. B, Occlusal view with occlusal con

Figure.4. Clinical view of the fabrication and bonding process. A, Milled and finished prosthesis. B, Occlusal view with den

Figure.5. Pictures taken 11 months after the bonding of the CFPD. A, Buccal view. B, Occlusal view.

Figure.6. Different designs of CFPD preparations; A, Narrow connector due to insufficient mesial preparation could result i