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CASE REPORT

Cantilever Resin Bonded Bridges…What evolution? About case reports

Soraya El Yaagoubi, Morchad Bouabid, Amal El Yamani
Department of Prosthodontics, Mohamed V University, Faculty of Dental Medicine of Rabat

ABSTRACT
Resin-bonded, fixed partial dentures have the potential to offer a minimally invasive, fixed-prosthetic approach to tooth replacement in patients who may not be candidates for implant therapy (periodontal diseases or anatomical and prosthetic obstacles).
Cantilever resin-bonded bridge has many advantages compared to the traditional bridge: simpler and faster to make, more economical for the patient, easier hygiene, traditional preparation protocols often recommend extensive preparation designs on two abutment teeth, thereby potentially compromising the long-term health of the adjacent abutments and often resulting in unilateral debonding of one of the retainers in the long term. Now with the advances in high-strength ceramic systems, new preparation designs and methodologies can be advocated.
The following case reports demonstrate a comparison between an all-ceramic and a metal-ceramic cantilever resin-bonded bridge.
Using a cantilever resin-bonded bridge is a viable option for replacing a single anterior missing tooth if the placement of an implant isn't indicated.

KEYWORDS: Resin-bonded bridge, Cantilever resin-bonded bridge, metal- ceramic, all-ceramic, zirconia

Correspondence: Resident in Prosthodontics Department, Mohamed V University, Faculty of Dental Medicine of Rabat.
Email: elyaagoubisoraya@gmail.com

INTRODUCTION

Nowadays, the dentist is frequently confronted with unitary edentulous situations, mainly due to dental avulsion (carious, traumatic, or periodontal), agenesis, or even dental inclusion. Non-compensation of edentulousness can have functional and aesthetic consequences.
The choice of the dental replacement technique is not easy to decide, as many might think, because of the existence of a variety of therapeutic modalities to remedy this dental absence.
The choice is guided by many general, local, and technical factors to restore masticatory functions and aesthetics (1).
The main techniques used are conventional bridges, resin-bonded bridges, and dental implant crowns.
In cases where the placement of an implant is impossible, the use of a resin-bonded bridge could represent in certain clinical situations an alternative to conventional techniques used for unitary edentulousness. The main interest would be the significant tissue preservation that these bonded restorations would allow compared to conventional bridges in the context of minimally invasive dentistry.
In 1955, the introduction of bonding by Buonocore opened up new possibilities in dentistry. (2) The history of resin-bonded bridges began with Rochette in 1973 (3), who designed perforated precious alloy fins to increase retention during bonding on abutment teeth using the resin of methyl methacrylate (MMA). This allowed a more conservative preparation of the abutment teeth, but the survival rate was, on the other hand, reduced (4).
In 1977, Howe and Denehy used nickel-chromium alloys for the fins, which are stronger than gold alloys, and replaced MMA with composites to increase durability (5).
In the 1980s, Livaditis extended the technique to molars and used electro-etching of the underside of the fins rather than perforations to create a bonding surface (6).

From the early 1990s, high-strength ceramic materials, including lithium disilicate and zirconia, replaced metals giving way to all-ceramic resin-bonded bridges.

The resin-bonded bridges have the advantage of replacing an absent tooth while carrying out a conservative preparation of the abutment teeth. Without local anesthesia, thereby reducing anxiety and stress in our patients and with less time spent in the chair and the laboratory than conventional bridges and therefore are less expensive. What matters the most to us about these bridges is their survival rate and longevity. (7)

Single-retainer all-ceramic resin-bonded fixed dental prostheses

A single-retainer design for resin-bonded fixed dental prostheses was introduced at the beginning of the 1980s. The introduction of this design arose from clinical experience since fixed dental prostheses with the classic two-retainer design sometimes had complications from debonding one of the retainer wings. Some of these fixed dental protheses were converted to a single-retainer format by cutting off the debonded retainer wing and therefore remained fully functional.

A cantilever resin-bonded bridge consists of a single retainer bonded to an abutment tooth secured by a connection to the pontic, an extending element. In the anterior, maxillary, or mandibular sector, the abutment tooth is either the central incisor (for replacement of a central or lateral) or the canine (for replacement of the lateral).

The first cantilever resin-bonded bridges used were those with a metal framework and were the best option for anterior single tooth replacement for the long term. More recently, ceramic ones have been proposed (zirconia, infiltrated ceramic zirconia, and Emax type glass-ceramic) and have demonstrated excellent results in terms of durability, aesthetics, and function.

Cantilever bonded bridges are indicated in cases of single anterior edentulousness when at least one adjacent tooth is not significantly or not damaged, with the presence of enamel on the lingual surface. A prosthetic space of at least 0.8 mm is required to accommodate the retainer. (8)

This article aims to focus on the treatment by resin bonded cantilever bridge in the anterior sector, its indications, as well as the operating protocol, all this through two clinical cases.

Case report 1:

This is a 24-year-old patient who is consulting to replace 12. She is in good general health. The patient refuses the implant and wants a lasting aesthetic restoration. The clinical examination shows good periodontal health. Analysis of the teeth bordering the toothlessness reveals that 13 and 11 are healthy. These two teeth are in a normal position. At 13, the Le Huche index is low and the coronal height satisfactory. The edentulous area is covered with a firm and adherent fibro mucosa, which is poorly absorbed. The length of the edentulism is favorable for the placement of a lateral.

Figure 1: Initial state in vestibular view. The 12 is missing and the 13 is healthy.

Several therapeutic possibilities are available to compensate us for this unitary tooth loss: implant-supported prosthesis, a bonded bridge, and a conventional bridge. The implant solution is discarded for financial reasons, and the traditional bridge is often made for abutment teeth with excessive decay. In our case, we preferred to favor a more conservative solution, in this case, a resin-bonded but cantilever bridge, because of the many failures associated with bonded bridges with two retainers and all-ceramic zirconia for cosmetic damage.

The preparation involved the palatal face of 13:

• A supragingival cervical palatal limit in the form of a 10/10 mm;

• The preparation extends over the cingulum 2 mm from the free edge;

• A homothetic reduction of the cingulum region of 2 mm;

• Making grooves on the mesial and distal face of 13 with a flat end bur placed beyond the contact interface (towards the palatal face);

Figure 2: The impression is made by the one-step technique with silicone.

After scanning the master model, the framework was made from a block of zirconia milled digitally by computer, a try-in of the zirconia framework was performed in the mouth. Then in the laboratory, enameling of the zirconia piece is carried out with aesthetic ceramics followed by a try-in phase.

The cantilever resin-bonded bridge has been bonded using self-adhesive resin cement, and the occlusion was checked, and the patient was instructed regarding adequate oral hygiene.

Figure 3 : One step dental impression.

Figure 4 : Cantilever resin bonded bridge after mounting the aesthetic ceramic.

Figure 5 : Final result after bonding and checking occlusion.

Case report 2:

In this case, a metal-ceramic cantilever bonded bridge is made on a Frasaco model with the 11 and 13 in ivory. We've started by doing the retainer wing preparation, which consists of a palatal veneer preparation, a delicate cervical chamfer of 0,6 mm, a fine incisal finishing shoulder 2mm from the free edge of the tooth, and a small proximal boxes preparation of 1 mm beyond the contact surface.

Figure 1 : Preparation of the ivory tooth

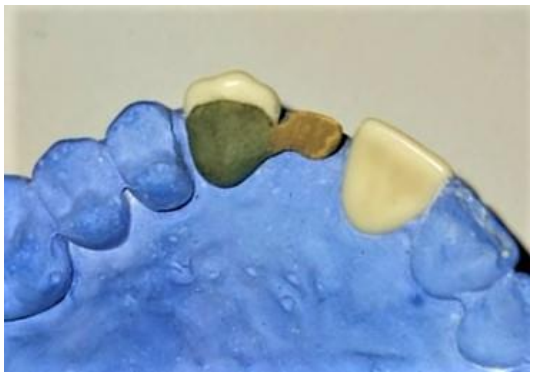

Figure 2 : The single retainer's resin bonded bridge metal infrastructure.

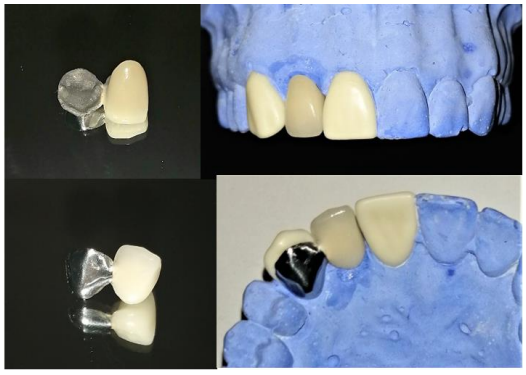

Figure 3 : Final result after insertion, with both buccal and palatal views.

DISCUSSION

The resin bonded bridge is a reliable option for replacing a missing tooth when the placement of an implant is impossible for financial or medical reasons. There are two sorts of resin-bonded bridges: one with two commonly used retainers and the other with a single retainer or Cantilevered.

Since their appearance in 1973 with Rochette (3), the resin bonded two retainers bridge has been most often used. However, it has some disadvantages, such as partial detachment, which caries could complicate under prosthetics in the abutment tooth, and led to thinking of a new form of bonded bridge cantilevered with a single wing, thereby avoiding the most common failure of two retainer resin-bonded bridges, which is partial detachment. (9)

The resin bonded cantilever bridge consists of bonding a single retainer wing on an anterior abutment tooth secured by a connection to a pontic. In the anterior, maxillary, or mandibular sector, the abutment tooth is either the central incisor for replacing a main or a lateral or the canine to replace the lateral. (10)

Indication : These cantilever bonded bridges are indicated in cases of anterior edentulousness when there is at least one adjacent tooth with little or no deterioration, the presence of enamel on the lingual surface is required, and a prosthetic space of at least 0.8 mm is needed to

accommodate the wing. It is also preferable to place the branch in an area of occlusion.

The indication of a cantilever resin-bonded bridge is reserved for favorable occlusal situations. (10)

Metal-ceramic cantilevered resin-bonded bridge: (case n°2)

Following the several failures of two-wing bonded bridges, the majority of cases of partial detachment were converted to a metal-frame cantilever bonded bridge by eliminating the separate part. It was suggested that this cantilever bonded bridge was more resistant to occlusal forces and performed the same way as a conventional two retainers bridge. (11)

Tooth preparation : The first two retainer resin-bonded bridges were done without the preparation of the abutment teeth. Nowadays, preparation characteristics can improve the strength of bonded bridges. These geometric shapes guarantee the retention of the prosthesis (12). Botelho described the tooth preparation design, allowing an optimal form of resistance while keeping the preparation conservative and in the enamel. (13)

A 10-year study (Behr, 1998) concluded that the surface treatment of the bonded bridge's abutment teeth did not affect the bridge's survival rate. The restoration's longevity is determined primarily by the preparation technique. According to this same study, the retentive preparation allowed a survival rate of 95% after ten years. Detachment could be minimized by recommending the retentive practice. (14)

The preparation of the bonded bridge must regroup mechanical, aesthetic, and biological requirements, as we show in our case (fig6). It consists of a uniform reduction of the lingual face of the concerned abutment teeth by 0.6 mm also mesial and distal grooves with a finishing line located 1 mm from the gingival margin and 2 mm from the free edge. To avoid the visibility of the metal, the preparation is set back from the proximo-buccal junctions. No occlusal impact must be at the limit of the retainer wing on the abutment tooth.

Statically, occlusal contacts should be light on the bridge intermediate.

In dynamics, the intermediary shouldn't be solicited.

In the event of parafunction, bonded bridges must not be used. (15)

All ceramic cantilever resin-bonded bridges: (case n°1)

In the early 1990s, glass-infiltrated aluminum oxide ceramic resin-bonded bridges were introduced in dentistry, overcoming bonded metal-framed bridges' aesthetic and biocompatibility issues.

Almost a third of the resin-bonded bridges with two all-ceramic wings suffered fractures between the pontic and the wing during the first year of operation, giving way to a bonded bridge that only held with a single cantilevered wing. This all-ceramic fractured single retainer bonded bridge remained functional as a cantilever resin-bonded bridge for five years (Kern and Gläser 1997) (16).

In 2005 Kern et al. started the use of infiltrated zirconia ceramics. It was concluded that the resin bonded cantilever bridge represented a better alternative to the resin bonded two-wing all-ceramic bridge. (9)

Likewise, another study in 2006 confirmed the results of the previous one using the pressed glass ceramic this time (17).

Finally, with the advent of new technologies in dentistry, including CAD / CAM, the manufacture of zirconia substructure for the bonded cantilever bridge is now possible with a high survival rate and a reduction or even an absence of fractures in the single retainer resin-bonded bridge.

The use of all-ceramic cantilevered resin-bonded bridges is only indicated for the anterior region. (18)

Tooth preparation and impression taking:

The retainer wing preparation consisted in case n°1 of a lingual veneer preparation, a delicate cervical chamfer, a fine incisal finishing shoulder, a groove on the cingulum, and a small proximal box preparation (approximately 2 × 2 × 0.5 mm) (19) (fig2)

The preparation does not provide mechanical retention but enables precise positioning of the restoration during bonding (20).

The results of a study carried out in 2018 (21) confirm that only the preparation of the proximal box is sufficient for better retention.

All the pontics should be designed free of contact during protrusive and lateral movements (22).

Temporary restoration of the prepared tooth is not necessary, but the position of the adjacent teeth should be retained by any means. Impressions can be made using a polyvinyl siloxane or a polyether impression material.

A zirconia ceramic framework is constructed in the dental laboratory and milled with the help of a computer-aided design/computer-assisted manufacture (CAD/CAM) system. The minimum thickness of the retainer wing must not fall below 0.5 mm under any circumstances, and the ideal minimum thickness is 0.7 mm. The proximal connector size should be no less than 3 mm (vertically) × 2 mm (horizontally). (19)

Insertion: The final clinical try-in follows the final veneering of the zirconia framework. The accuracy of fit, marginal adaptation of the retainer wing, aesthetics, and the proximal contact should be checked carefully.

The abutment tooth and the other adjacent tooth next to the edentulous space are kept dry using a rubber dam.

Resin-bonded cantilever bridges can be bonded using auto curing composite resins such as Panavia 21 or SuperBond (Sun Medical).

-For cantilevered metal-ceramic resin-bonded bridges, the metal bonding surface is cleaned using a solvent (acetone type), and the treated bridge is placed away from any contamination. Most authors currently agree about the excellent performance of treatments by deposition silica either by pyrolysis or by reactive sandblasting (called tribochemical treatment) compared to all other treatments of metal surfaces (simple sandblasting, electrolytic etching, etc.…).

This treatment can be performed in the laboratory using the Rocatec system or directly in the CoJet System chair. The tribochemical treatment should be followed by the application of a silane.

The self-cure dental adhesive resin cement placement is done in two stages: first, you must mix the monomer with the activator according to the manufacturer's recommendations, then apply this mixture with a brush to the treated metal surface. The activated liquid acts as a primary, and this pre-application increases adhesion by 25%. The polymer powder is then added to the cup, which contains the first mixture. The resin cement is then deposited quickly with a brush on the lower surface, and the prosthetic piece is inserted into the preparation.

The assembly is maintained for 10 minutes under pressure. Most of the excess should be removed when the resin cement is in the elastoplastic phase with a cotton ball impregnated with alcohol. The rest of the excess after hardening, in 15 minutes, with a scalpel or a CK6 type curette. (15) (fig8)

-For all ceramic cantilevered resin-bonded bridges, the zirconia surface is treated first with sandblasting of the fin surface with 50mm alumina particles at 0.25 MPa. During air abrasion, the ceramic superstructure is protected with a temporary resin coating. Then the preparation is ultrasonically cleaned in 97% isopropyl alcohol.

After setting up the rubber dam, the prepared surface on the abutment tooth is cleaned with an air-polishing system using a water-soluble sodium bicarbonate cleaning powder. The enamel is etched with 36% phosphoric acid for 30 s, rinsed with water spray, and air-dried. Then the single retainer all-ceramic resin-bonded bridge is bonded using Panavia 21 or Superbond. (18) (fig5)

Advantages and disadvantages:

The bonded cantilever bridge has many advantages compared to the traditional bridge: more straightforward and faster to make, more economical for the patient, easier hygiene, and absence of partial detachment that can lead to secondary caries lesion. In addition, the bridge's intermediary will have the same amplitude of displacement as its supporting tooth, which makes it possible to manage a potential problem of different periodontal mobility between the two teeth bordering the edentulism. Excessive periodontal mobility is a contraindication to the installation of a cantilever.

The most feared drawback of cantilever resin-bonded bridges with an anterior metal framework remains the reduced translucency and greyish appearance of the free edge of the abutment tooth as well as any visible metal substructure.

The aesthetic demands of patients and the reluctance and phobia of intraoral metal have led to the development of anterior metal-free restoration alternatives.

The cantilever bonded bridge has a low risk of failure and better longevity compared to two-wing bonded bridges. The significant advantage of all-ceramic cantilever bonded bridges is their aesthetic potential with a pontic in harmony with the adjacent teeth despite low visibility of the retainer wing due to the increased opacity of the material but broadly acceptable compared to the metal retainer. All ceramics offer the advantage of reduced plaque build-up as well as remarkable biocompatibility. The first ceramic bonded bridges were prone to fracture, most often occupying the connection. To overcome this drawback and the use of a single abutment, the advent of new ceramics with improved mechanical properties has contributed to the increase in survival rates of this technique. (23)

	Metal	Zircon
Advantage	Excellent mechanical properties, Connection fracture almost impossible, Low retainer wing thickness, Re-bonding possible in case of failure, Interesting clinical decline +++	Good mechanical properties, connection fracture unlikely Biocompatibility +++ Re-bonding possible in case of failure Clinical decline +
Disadvantage	Aesthetics - - Preparation often more mutilating Bonding Biocompatibility	Realization by CFAO only Bonding requires the use of specific protocols that must be known

Table 1: Comparative advantages and disadvantages of resin bonded cantilever bridges depending on the material used (metal or ceramic)

CONCLUSION

The replacement of missing teeth with a cantilever resin-bonded bridge is a conservative alternative to conventional fixed partial dentures and should be included as a treatment option. Even though it had suffered some disadvantages, often related to frequent debonding, decays under the abutment tooth, use of metal for the infrastructure, which was unesthetic. Treatment planning and attention to all factors will help to fabricate successful restorations with longer survival rates.

Zirconia cantilever single-retainer resin-bonded bridge can be considered an aesthetic, reliable, minimally invasive, cost- and time-effective option for rehabilitating a missing single anterior tooth. It should be presented to the patient as a viable alternative to implant therapy.

AUTHORS' CONTRIBUTIONS

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

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COMPETING INTERESTS

The authors declare no competing interests with this cases.

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PATIENTS CONSENT

Written informed consents were obtained from the patients for the publication of this case report.

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