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**Review Article**

# A Review of Recent Literature on the Handling of Anterior Resin-Bonded Cantilever Restorations

**Adolfo Di Fiore[1*], Edoardo Stellini[1], Gianpaolo Savio[2], Stefano Rosso[3], Lorenzo Graiff[1], Stefano Granata[1], Carlo Monaco[4], Roberto Meneghello[3]**

[1]Department of Neurosciences, School of Dentistry, Section of Prosthodontics and Digital Dentistry, University of Padova, 35100 Padova, Italy.
[2]Departments of Civil, Environmental and Architectural Engineering, University of Padova, 35100 Padova, Italy.
[3]Departments of Management and Engineering, University of Padova, 36100 Vicenza, Italy.
[4]Department of Biomedical and Neuromotor Sciences (DIBINEM), Division of Prosthodontics and Maxillofacial Rehabilitation, Alma Mater Studiorum— University of Bologna, 40121 Bologna, Italy.

***E-mail** ✉ adolfo.difiore@unipd.it

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## ABSTRACT

Various treatment options are available for replacing missing anterior teeth, including implant-supported prostheses, fixed dental prostheses, and resin-bonded fixed dental prostheses. However, implant placement can pose challenges, particularly in edentulous sites with insufficient bone or soft tissue. In such cases, procedures such as bone augmentation and connective tissue grafting may be required. This study systematically reviews the management of anterior resin-bonded cantilever restorations and provides insights for clinicians on addressing failures associated with RBFDPs. A comprehensive search was conducted using electronic databases, including PubMed, Cochrane, Google Scholar, and SDL research databases, for English-language articles published between 2000 and 2022. The initial search yielded 3,225 articles, which were refined through title screening, duplicate removal, and exclusion of irrelevant studies, leaving 110 relevant papers. After evaluating the full text of 40 studies, 14 studies were selected for inclusion in this review. The findings suggest that RBFDPs demonstrate favorable clinical performance with high survival rates, making them a viable alternative to other restorative approaches. While debonding remains a major concern, its incidence can be reduced through the use of resin-based luting agents and zirconia ceramic frameworks.

**Keywords:** Dental rehabilitation, Prosthodontics, Resin bonded cantilever, Literature review

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## Introduction

Several treatment options exist for replacing missing anterior teeth, including implant-supported prostheses, fixed dental prostheses, and resin-bonded fixed dental prostheses. However, placing an implant in an edentulous site can present challenges [1]. Patients with inadequate soft and hard tissue may require procedures such as bone augmentation and connective tissue grafting [2]. In these cases, the invasiveness of surgical interventions and the anxiety associated with surgery often lead patients to seek simpler, less invasive alternatives [3]. Additional factors, such as age-related restrictions, may also prevent younger patients from receiving implant-supported prostheses until they reach adulthood to minimize the risk of implant infra-position [4].

A conventional fixed dental prosthesis relies on adjacent natural teeth for retention. However, its placement requires extensive tooth preparation, resulting in the removal of approximately 63% to 72% of healthy tooth structure. In some instances, the preparation process, combined with factors such as pulp chamber size and tooth morphology, may necessitate endodontic treatment, further increasing treatment complexity and cost [5].

A resin-bonded fixed dental prosthesis provides a conservative solution that aligns with patients' expectations for both function and esthetics [6]. In 1973, Rochette pioneered a technique that involved securing a metal retainer to enamel using adhesive cement. By the early 1990s, this method evolved with the incorporation of oxide ceramics as a replacement for metal frameworks. Advances in material science and clinical methods have significantly minimized complications such as debonding and ceramic fractures in RBFDPs [7].

Opting for a single-retainer design comes with several advantages, including a minimally invasive preparation process, a lower likelihood of endodontic involvement, and cost-effectiveness [8]. The resin-bonded cantilever features an extended wing-like structure that is affixed to the abutment tooth or teeth using high-strength dental adhesive, ensuring long-lasting retention [9].

The retention of an (RBFPD) relies on the use of adhesive resin cement, which securely bonds the restoration to the enamel surface [10]. Successful outcomes depend on proper case selection and an optimal bridge design. Several patient-related factors must be evaluated, including age, expectations, pontic placement, abutment tooth condition, and occlusal considerations [11]. When selecting an abutment tooth, key criteria include good periodontal health, minimal previous restorations, and a clinically adequate crown height [12].

This study aims to systematically review the management of anterior resin-bonded cantilever restorations and provide practitioners with guidance on addressing (RBCFPS) failures.

## Materials and Methods

A systematic review was carried out by searching electronic databases, including Cochrane, Google Scholar, SDL Research Databases, and PubMed, for English-language articles published between 2000 and 2022. The search terms used were (anterior resin bonded cantilever and management of cantilever). After applying exclusion criteria, all titles and abstracts underwent thorough screening, followed by a detailed analysis of the findings.

*Inclusion criteria*

1. Studies conducted on human subjects.
2. Articles published in English.
3. Research focusing on anterior all-ceramic and metal-ceramic cantilever RBFDPs.
4. Eligible study designs include randomized controlled clinical trials (RCTs), controlled clinical trials (CCTs), retrospective studies (RSs), and prospective studies (PSs).
5. Publications dated from 2000 to 2022.
6. Studies with a minimum follow-up period of one year.
7. Research specifically related to anterior RBFDPs.
8. Peer-reviewed publications.

*Exclusion criteria*

1. Studies involving animal models.
2. Articles published in languages other than English.
3. Research-based on in vitro experiments or finite element analysis.
4. Case reports, case series, and studies on posterior RBFDPs.
5. Publications before the year 2000.
6. Studies with an observation period shorter than one year.
7. Investigations focused on posterior RBFDPs.

*PICO*

P: Patient with anterior resin-bonded cantilever.

I: Identify the changes in the anterior resin-bonded cantilever.

C: Compare the old and new cantilever management.

O: Educate practitioners about improvement and management.

PRISMA diagram illustrating the process of screening studies for inclusion is presented in **Figure 1**.

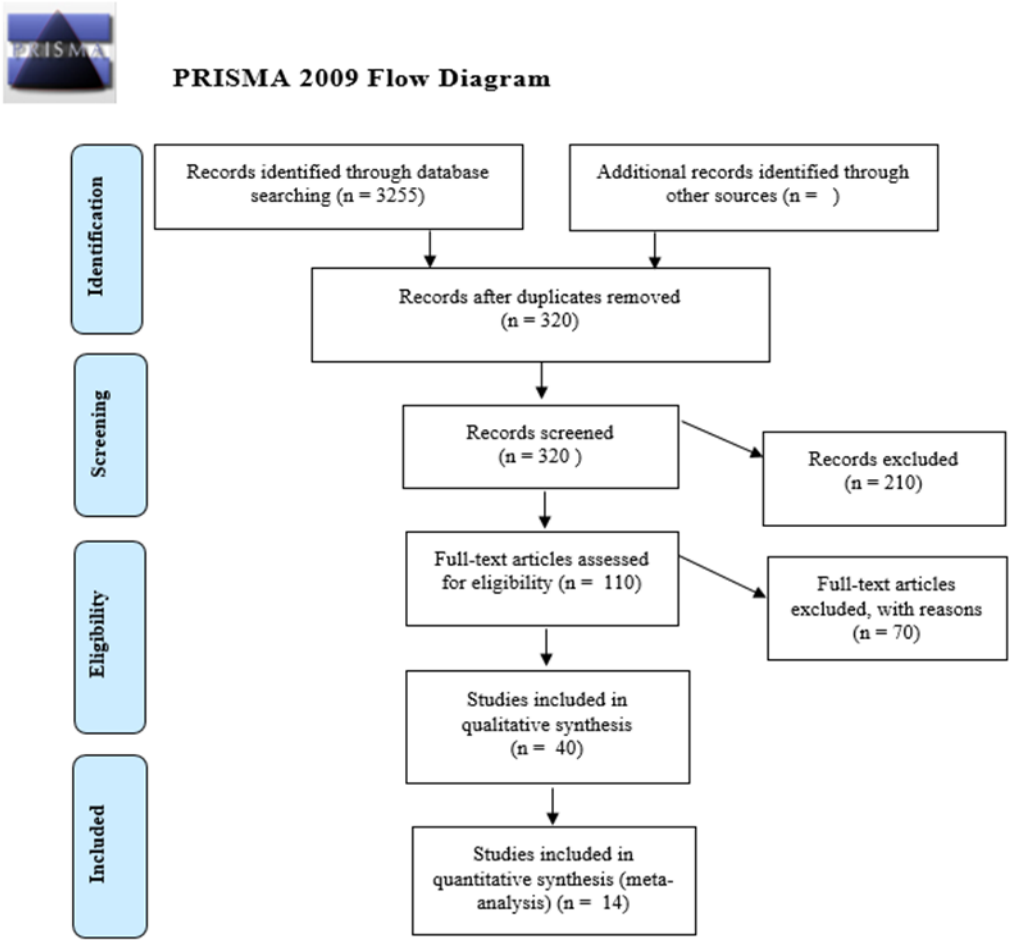


**Figure 1.** PRISMA diagram illustrating the process of screening studies for inclusion



## Results and Discussion

A total of 3,225 articles were identified through the initial electronic search. After applying manual screening, removing duplicates, and excluding irrelevant studies, 110 studies remained. Following a full-text evaluation of 40 articles, 14 studies were selected for inclusion in this review.

This systematic review consists of five retrospective studies, six prospective studies, and three randomized controlled trials that met the inclusion criteria. A summary of the included studies is provided in **Table 1**.

**Table 1.** Summary of results from included studies.

| Author, Year | Study design | Sample size | Follow up period | Material | Cement | Type of failure | Success rate/ Survival rate | Complication |
|---|---|---|---|---|---|---|---|---|
| Chan *et al.*, 2000 | A prospective study patient divided into two groups: group A FF group B CL | 24SUBJECT 25RBFPD 12FF 13CL | 14 to 45 months | Metal framework | Panavia (resin cement) + Rubber dam | The debonding of ONE FF occurred, after which it was converted into a CL and reattached with new cement. | Success was solely determined by retention, with no mention of the survival rate. | The metal framework becomes visible through the thin or translucent anterior teeth. |

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|---|---|---|---|---|---|---|---|---|
| Kern *et al.*, 2005 | A prospective study | 30P 37RBFPD 16FF 21CL | 75.8 months in FF<br>51.7 months in CL | Glass-infiltrated alumina ceramic in cream | Panavia or panavia 21 | Fracture: 1 CL, 6 FF - 1 fractured at both connectors, 1 was accidentally removed, and 4 fractured at one connector but stayed in place as CL. | -5 Year, 92.3% CL 73.9% FF survival rate | No issues were reported |
| Sasse *et al.*, 2012 | Randomized clinical trial | 30CL | 5 years | Zirconia ceramic (IPS e.max ZirCAD with IPS e.max Ceram veneer; both by Ivoclar Vivadent). | Either a resin containing phosphate monomer (Panavia) applied directly without a primer, or the use of an adhesive bonding system paired with a phosphoric acid acrylate primer for the zirconia ceramic (Multilink–Automix bonding system with Metal/Zirconia primer). | Two debonding by a traumatic event. | Both RBFPDs were successfully rebonded, achieving a 100% survival rate over three years. | - |
| Sasse *et al.*, 2014 | A prospective study | 37p<br>42cl | -61.8 months | Ytrium oxide-stabilized zirconium oxide ceramic | Panavia 21 TC | Debonding only two debonding happened | The success rate stood at 95.2% after six years. | No issues were reported. |
| Galiatsatos, 2014 | Clinical evaluation | 54 | 1, 2, 4, 6, and 8 years following placement. | Glass-infiltrated alumina ceramic In-Ceram | Dual polymerizing composite resin cement (Variolink II, Ivoclar Vivadent) | Two debonded, one patient dissatisfied, and six fractures occurred. | After 8 years, the success rate was 85.18% | - |
| Saker *et al.*, 2014 | Retrospective cohort study | (22 women, 18 men | 60 Months | Cobalt-chromium-ceramic or glass-infiltrated alumina | Resin cement | 2 fractures were noted with AC. No debonding occurred with MC (n = 0), while debonding was seen with AC. | MC: 100 %; AC: 90%; | - |

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|---|---|---|---|---|---|---|---|---|
| Sailer, *2014* | Retrospective study | 15 | 8  years | Zirconia ceramic | Resin cement (Panavia 21 TC). | Two debonding | . There were no severe failures caused by RBFDP fractures. Additionally, none of the RBFDPs needed to be removed because of technical or biological issues. As a result, the zirconia ceramic RBFDPs achieved a 100% survival rate. | - |
| Botelho *et al.*, 2016 | A prospective study | 22p<br>13CL<br>FF10 | 216.5 ± 20.8 months | Metal framework | Panavia (resin cement) + Rubber dam | | Retention | No complications that necessitated intervention were observed. |
| Klink *et al.*, 2016 | A prospective study | 18p<br>9m<br>9f<br>24CL | 35 months | Different zirconia materials | All luting materials, Ivoclar Vivadent | Debonding | A success rate of 95.5%, with survival rates ranging from 82.4% to 76%. | - |
| Kern *et al.*, 2017 | A retrospective study | 92.2 ± 33 months. | 108CL<br>Restorations were designed using CAD/CAM technology and milled out of pre-sintered zirconia ceramic blocks. | Restorations were designed using CAD/CAM technology and milled out of pre-sintered zirconia ceramic blocks. | Panavia 21 TC, Kuraray, or Multilink Automix<br>+ Rubber dam | Debonding occurred in restorations luted with Panavia 21 TC (4.2%) and those luted with Multilink Automix (14.2%). Loss of restoration was observed. | The survival rate after 10 years was 98.2%. | |
| Abuzar, 2018 | A retrospective study | | 206Arrbs | - | Adhesive resin cement | Debonding | The survival rate reached 95.1% at twelve years and beyond. | - |

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|---|---|---|---|---|---|---|---|---|
| Naenni, 2020 | Retrospective study | 10 years | 10 | Zirconia (IPS e.max ZirCAD, Ivoclar Vivadent; Cerion, Straumann | Panavia 21 TC, Kuraray | Two loss of retention, | The survival rate was 100% after a mean follow-up period of no less than 10.0 years. | - |
| Qiu *et al.*, 2020 | Prospective | 12 to 40 months. | 186 CRBFPDs | Cobalt-chrome alloy | Panavia F 2.0 | A failure rate of 1.1% was observed. | 88% of the cases were successful. | - Complications were recorded when bridges were debonded on ! 2 occasions |
| Malgaj, 2021 | Randomized clinical trial | 3 year | | Zirconia frameworkS | Panavia (resin cement) was used with a rubber dam, and the samples were split into two groups for different pretreatment methods. The first group (n = 15) underwent airborne particle abrasion (APA) of the bonding surface and served as the control. The second group (n = 16) had the restorations pretreated with NAC. | Debonding | The NAC RBFDPs demonstrated a higher 2-year survival rate of 93.8%, compared to 86.7% for the APA RBFDPs. | |



This review aims to evaluate the management of cantilever RBFDPs in the anterior region. Cantilever RBFDPs present a viable alternative to more invasive treatments like implant surgery or FDPs, particularly when there are contraindications for these options, such as in young or medically compromised patients. Mourshed *et al.* [13] found that the longevity of RBFDPs can be comparable to that of FDPs. Additionally, shifting from the traditional two-retainer RBFDP design to a cantilever design has been shown to improve survival rates and longevity [13, 14]. According to Sasse *et al.* [15], the cantilever design offers a higher success rate due to the absence of inter-abutment stress, which occurs in two-retainer designs. In these traditional designs, the differential movements of the abutment teeth place stress on the bonding interface, leading to fatigue and eventual debonding over time [15]. The literature reviewed highlights that debonding is the most common failure type, a complex issue influenced by factors such as RBFDP design, choice of luting cement, and the material of the RBFDP framework [16].

Most of the studies included in this review utilized composite resin luting cement containing phosphate monomers, such as Panavia 21, which demonstrated superior bonding strength compared to alternatives like Multilink-Automix. However, no significant differences were found between these cements. Debonding may also occur due to various factors, including trauma, food culture, and patient habits. Naenni *et al.* [17] noted that retention loss is primarily influenced by the framework material, with metal and zirconia frameworks showing higher retention loss, while alumina glass-infiltrated ceramics exhibit lower retention loss, though they have higher fracture rates. Notably, fractures in RBFDPs were observed exclusively in alumina glass-infiltrated ceramics [17]. Saker *et al.* [18] suggested that fractures could result from the protrusive and lateral movements that apply torque forces on the abutment teeth. In the reviewed studies, no fractures were observed with zirconia ceramics (specifically, IPS E.maxZircad veneered with IPS e.max ceramic). Zirconia is known to possess the highest fracture strength among dental ceramics and delivers promising results [18, 19].

In certain studies, a rubber dam was employed during the cementation process, but no clear benefit was found regarding the survival of the prostheses. All prostheses underwent air-borne particle pretreatment, although some researchers suggested that RBFDPs made from zirconia and pretreated with nano-structured alumina particles could serve as effective alternatives to the traditional airborne-particle abrasion method [20, 21].

**Conclusion**

RBFDPs demonstrate favorable results with high survival rates, making them a viable option alongside other treatment methods. While debonding remains a significant concern, its occurrence is minimized when using resin cement-based luting agents and zirconia ceramic frameworks.

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**Ethics Statement:** None

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