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Systematic Review

A Systematic Review on the Success and Debonding Rates of Conventional and Cantilevered Resin Bonded Fixed Dental Prostheses

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Abstract

Introduction: Resin bonded fixed dental prostheses (RBFDPs) have been available in dentistry for nearly 40 years since its introduction in the 1970s and is an accepted alternative for the replacement for a single missing tooth. Functional longevity, however, has always remained an issue with these types of restorations demonstrating frequent incidences of debonding leading to complete failure of the intended therapy. There have been clinical studies which demonstrate that a cantilevered design (Cantilevered Resin bonded fixed dental prostheses CL-RBFDPs) in such restorations exhibit lesser chances of failure of restorations.The objective of this review was to evaluate the Success rates and Debonding rates of conventional and cantilevered resin bonded fixed dental prostheses.

Materials and Method: *Search strategy*-A literature search was conducted using a combination of electronic search engines such as PUBMED (U.S. National Library of Medicine, Bethesda, MD, USA), referencing relevant titles and citations and manual searching of journals for identifying studies which evaluated conventional RBFDPs and cantilevered RBFDPs and reported on the success rates and debonding rates of these two types of restorations. The electronic search was conducted without any date restrictions. *Selection of Studies* - Eligibility criteria included human studies and excluded any reviews, case reports and in vitro trials. The publications' intervention had to have been both conventional and cantilevered RBFDPs for replacement of missing teeth. *Data extraction*- Data were extracted from the final studies according to a customised data collection form. The outcome measures success rates and debonding rates of the restorations.

Results: The search strategy yielded a total of 30 articles. Abstract analysis performed for these articles augmented with hand searching of journals resulted in 6 studies which met the inclusion criteria formulated for this review. The prospective and retrospective studies obtained were analysed and the most common complication for these types of prostheses were found to be debonding irrespective of design, choice of material or luting system, or preparation design followed by a fracture of retainers. Survival rates were also provided in a few of these studies. The cantilevered RBFDPs appear to demonstrate a lower incidence of debonding, and fractures compared to conventional RBFDP

Conclusion: Further well designed randomised controlled trials with long term follow up are required to provide higher levels of evidence for this treatment modality. However, based on all the studies currently available the overall incidences of debonding appear to be lesser when cantilevered RBFDPs were provided. Hence, we are able to conclude that Cantilevered RBFDPs are an acceptable alternative to conventional RBFDPs with lower incidences of complications resulting in improved clinical performance.

Keywords: *Bondable restoration; Fixed dental prosthesis; Fixed prosthesis; Resin bonded prosthesis.*

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INTRODUCTION

Edentulism continues to be one of the most persistent problems in dentistry till current date. Fortunately, a deeper understanding of dental structures and their functioning along with rapid technical progression have opened up multiple strategies to aid in replacing the missing tooth structure thereby restoring function as well as esthetics without causing any detrimental effects to biological tissue. In cases of partial edentulism with tooth bound saddles, fixed bridges remain one of the standards of replacement along with dental implants [1]. However, Conventional fixed bridges require preparation of adjacent tooth structure to provide retention and support for the entire prostheses. The preparation of abutment teeth requires removal of tooth structure to accommodate the prostheses which results in weakening of the tooth structure and increasing chances of pulpal morbidity [2]. This results in a prosthetic dilemma when faced with small edentulous spans where the adjacent abutment teeth do not require crowns. Dental implants could be considered but not all cases are conducive to the placement of implants.

One modality of treatment which reduces removal of tooth structure would be Resin bonded Fixed dental prostheses (RBFDPs), also referred to as Adhesive bridges. Rochette (1973) first described perforated metal retainers for periodontal splints as a mode of providing macromechnical retention [3,4]. Howe and Denehy (1977) described the use of these perforated retainer designs for bridgework in the anterior segments and such restoration designs have subsequently become known as “Rochette bridges” [5]. This technique was eventually extended to the posterior region along with incorporation of paralleling guide planes in the interproximal and lingual aspects to enhance retention and resistance forms and rests on the occlusal aspect to prevent dislodging forces (Livaditis 1980) [6,7]. A variety of methods which employed surface irregularities to aid in the retention of such restorations were then developed. Such methods include electrochemical etching, sandblasting, usage of meshworks and even a technique which involves loss of soluble crystals to provide macromechanical retention in conjunction with adhesive luting systems [8].

The advantages of these restorations are the reduced removal of abutment tooth structure which also reduces chances of pulpal morbidity, reduction of gingival problems resulting from supragingival margin placement, reduced laboratory costs and reduced chairside times [8-13]. Since the preparations for these restorations are largely confined within enamel, the need for local anesthesia may also be minimised resulting in reduced anxiety for the patient [14]. RBFDPs, however, require careful planning and case selection to predictably

provide a restoration with acceptable clinical survival. The preparation design has to be minimised to reduce tensile stresses. The Retainer design, type of luting agent, location of prostheses, periodontal status of abutment teeth are all factors which directly influence the success of these restorations. Excessive occlusal function or parafunction, reduced interocclusal clearance, short crown height are a few factors which reduce the clinical survival of such restorations [8,15,16]. Functional longevity has always been the Achilles' heel of RBFDPs with the most common complication being debonding and other, less frequent complications such as fracture of prostheses and incidence of caries developing below retainers [9, 17-20].

The conservative tooth preparation needed for such restorations, however, reduces the damage in abutment teeth enabling easier retreatment. In cases of RBFDPs with a fractured retainer wing, one method of treatment would be the removal of the fractured retainer wing, essentially converting the RBFDP into a cantilevered prosthesis (CL-RBFDP) [21,22]. It has been observed that such CL-RBFDPs exhibit longer terms of clinical survival compared to conventional RBFDPs [9,23,24]. The cantilevered design eliminates micro movements resulting from tensile and shear stresses along the retainer-abutment interface thereby reducing the inter abutment forces and decreasing the rate of debonding [21,22,25,26].

Other advantages include limiting the preparation to a single tooth. Clinical studies have shown that these CL-RBFDPs demonstrate a lower incidence of debonding and fractures and therefore results in a longer survival rate [21,24,27]. The main objectives of this systematic review where to evaluate the success and debonding rates of Conventional and Cantilevered RBFDPs.

Aim

The aim of this review is to evaluate the success rates and debonding rates of conventional and cantilevered RBFDPs.

Structured question

In a partially edentulous patient with a small tooth bounded edentulous span requiring replacement of not more than a single missing tooth, what are the success rates and debonding rates of Cantilevered RBFDPs when compared to Conventional RBFDPs?

Is there a difference in incidence of debonding and success rates for Conventional and Cantilevered RBFDPs in patients requiring the replacement of a single missing tooth?

PICO Analysis

Population - Patients with small edentulous tooth spans requiring replacement of a single tooth
Intervention - Resin bonded Fixed dental prostheses with Single retainer design (Cantilever)
Comparison/Control- Resin bonded Fixed dental prostheses with double retainer design (Conventional)
Outcome- Comparison of Success rates and debonding rates of conventional and cantilevered RBFDPs

Null Hypothesis - there is no difference in incidence of debonding and success rates for Conventional and Cantilevered RBFDPs in patients requiring the replacement of a single missing tooth

Alternate hypotheses - there is a difference in incidence of debonding and success rates for Conventional and Cantilevered RBFDPs in patients requiring the replacement of a single missing tooth

MATERIALS AND METHOD

Search Strategy: For identifying articles pertinent to this review a detailed search strategy was formulated for use in electronic databases consisting of controlled vocabulary, free text and MeSH terms.

Databases Searched: A literature search was conducted using an electronic database (MEDLINE) for clinical studies reporting on the complication rates and survival rates of conventional and cantilevered RBFDPs. An Electronic search without date restriction was undertaken in the PUBMED website (U.S. National Library of Medicine, National institutes of health, USA)
Language – Only articles published in the English language were considered for this review

The following search terms were used in the Search strategy
Search terms
Subject & adjective
The terms were used alone or in conjunction with different combinations

Subject
Conventional resin bonded Fixed dental prostheses/ Double retainer three unit RBFDP/ Cantilevered resin bonded fixed dental prostheses/ Single retainer two unit RBFDP

Adjective
Survival rates/ Survival analysis/ Complication rates/ Debonding rates
Related articles as well as references and citations from these studies were searched to identify more articles matching the inclusion criteria.

Selection of studies
The review process consisted of two phases. The first phase included screening for relevant titles and abstracts obtained through the electronic search. Articles were screened according to the following inclusion criteria:

Inclusion Criteria

1. Randomised controlled trials, Prospective and Retrospective studies
2. Inclusion of both conventional and cantilevered designs of RBFDPs
3. Follow up period of more than 1 year
4. Utilisation of proper clinical technique

Exclusion Criteria

1. Laboratory studies (In Vitro studies)
2. Case reports
3. Expert opinions
4. Literature reviews
5. Clinical studies with no follow-up or follow-up less than a year
6. Clinical studies with same patient cohort

Hand searched Journals
The search was augmented with hand searching (Time period: January 1985-June 2014) of the following

journals: Journal of Prosthodontics, International journal of Prosthodontics, Journal of Prosthetic dentistry, Journal of dentistry, British dental journal, Journal of oral rehabilitation, Journal of adhesive dentistry, Australian dental journal, Journal of american dental association, Quintessence, European journal of restorative dentistry, Journal of esthetic dentistry.

The Studies which passed the screening process were finally classified according to the strength of the evidence, into five levels:

Level 1 – Randomised controlled trials

Level 2 – Prospective trial

Level 3 – Retrospective trial; Case control study

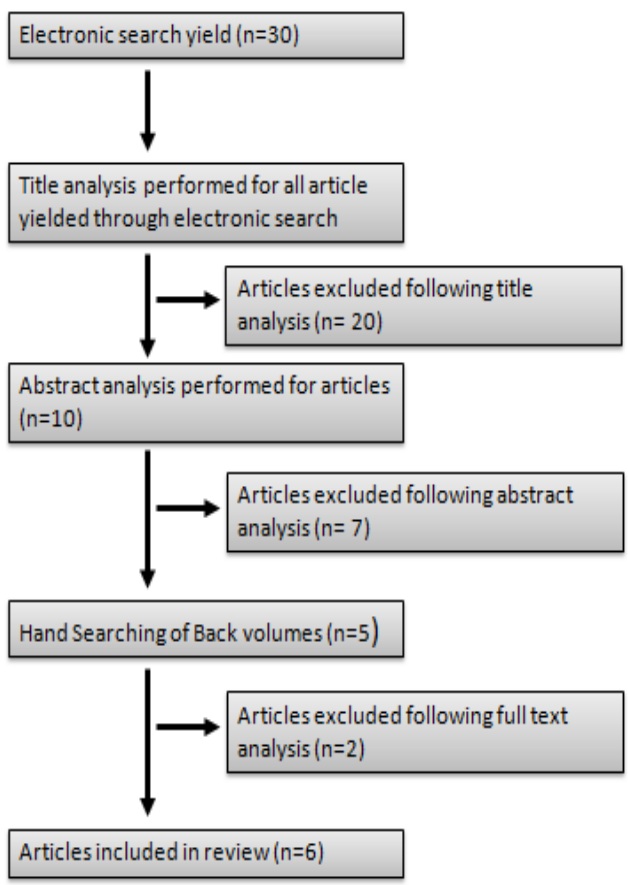
Level 4 - Case series

Level 5 – Expert opinions

Data extraction

Data of the final studies were tabulated for the most common complication associated with RBFDPs: Debonding and Success rates. In cases of multiple publications following the same cohort of patients, the study with the longest follow-up was included.

Flowchart of Search Strategy



Level of Evidence

S.No	Author	Month/ Year	Study Design	Evidence Level
1	Hussey et al	1991	Retrospective	3
2	Dunne & Millar	1993	Prospective	2
3	Gilmour et al	1995	Retrospective	3
4	A.W.K Chan	2000	Prospective	2
5	Chai et al	2005	Retrospective	3
6	Kern & Sasse	2011	Prospective	2

Risk of Bias

S.No	Author	Randomisation	Assessor Blinding	Allocation Concealment	Risk of Bias
1	Hussey et al	Nil	Nil	Nil	High
2	Dunne & Millar	Nil	Nil	Nil	High
3	Gilmour et al	Nil	Nil	Nil	High
4	A.W.K.Chan	Yes	Nil	Nil	High
5	Chai et al	Nil	Nil	Nil	High
6	Kern & Sasse	Nil	Nil	Nil	High

Variables of Interest

1. Success rates
2. Debonding rates

RESULTS

A total of six studies were included in the review. The articles included three prospective trials and three retrospective trials (Figure 1). The characteristics of the selected studies are shown in Table 1. The oldest study matching the criteria was published in 1990 and the most recent study in 2011. The outcome variables assessed were success rates and debonding rates.

"Success" was defined as a restoration remaining in situ without requiring any modification of the restoration.

Any modification required such as bonding a dislodged restoration was considered a "Failure"

The number of restorations which debonded over the follow-up period were analyzed and the percentage of restorations which had undergone debonding were calculated to be the debonding rates (failure rates). The percentage of restorations remaining in situ without any complications over the follow-up period were considered as Success rates (Figure.3). Table 2 and Figure.2 shows the number of prostheses and number of failed prostheses in each study.

Debonding has been observed to be the most common complication occurring in RBFDPs [9,18,19,28] and thus the incidence of debonding for each group was calculated (Figure.4). The heterogeneity of the studies precluded any attempt to directly compare the data with each other using statistical analysis. Table 3 shows the Success rates and debonding rates calculated for each study.

Table 1: General Characteristics of Selected Studies

Study	Year of publication	Study Design	Manufacturing procedure		No.of patients	Mean follow-up period	Age range	Mean age
			RBFPD Design	Cement				
D.L.Hussey et al	1991	Retrospective	Maryland, Rochette, Hybrid (slot on retainer)	Panavia Ex, ABC cement, Comspan, Other	347	2.7 years	13.4-85.1 years	33.9 years
S.M.Dunne&B. J.Millar	1993	Prospective	Rochette bridges, Maryland bridges with electrochemical etching Maryland bridges with sandblasting	Concise, Comspan, Panavia Ex	309	NR	12-74 years	31 years
A.S.M.Gilmour et al	1995	Retrospective	Maryland bridges with Sandblasting	Panavia Ex	119	24.5 months	NR	NR
A.W.K.Chan& I.E.Barnes	2000	Prospective	Maryland bridges with Sandblasting	Panavia	24	NR	15-56 years	NR
J.Chai et al	2005	Retrospective	Maryland bridges with Sandblasting	Panavia, Panavia Ex, Panavia 21	168	31 months	NR	NR
Matthias Kern & Martin Sasse	2011	Prospective	Maryland Bridge with tribochemical coating Maryland bridge with sandblasted single retainer	Panavia TC, Panavia 21	38	120 months; 111 months	NR	NR

Table 2: Total Number Of Prostheses And Number Of Debonded Prostheses

Study	Year of publication	Number of Prostheses		Mean observation period	Number of Failures	
		Double retainer	Single retainer		Double retainer	Single retainer
D.L.Hussey et al	1991	285	70	2.7 years	65	12
S.M.Dunne&B.J.Millar	1993	272	47	NR	74	10
A.S.M.Gilmour et al	1995	81	43	24.5 months	33	12
S.Djemal et al	1999	424	171	NR	NR	NR
A.W.K.Chan&I.E.Barnes	2000	12	13	NR	1	0
J.Chai et al	2005	77	47	31 months	20	3
Matthias Kern & Martin Sasse	2011	16	22	120 months; 111 months	7	1

Table 3: Summation Of Success Rates And Debonding Rates

S.No	Study	No. of Prostheses		Success Rate		Debonding Rates	
		Conventional	Cantilever	Conventional	Cantilever	Conventional	Cantilever
1	Hussey et al	285	17	73.6%	82.9%	7.9%	5.7%
2	Dunne & Millar	272	47	73%	79%	27%	21%
3	Gilmour et al	81	43	59.2%	72.9%	41%	29%
4	Chan	12	13	83.33%	100%	16.67%	0%
5	Chai et al	77	47	63%	81%	19.4%	4.2%
6	Kern&Sasse	16	22	67.3%	95.46%	43.7%	4.54

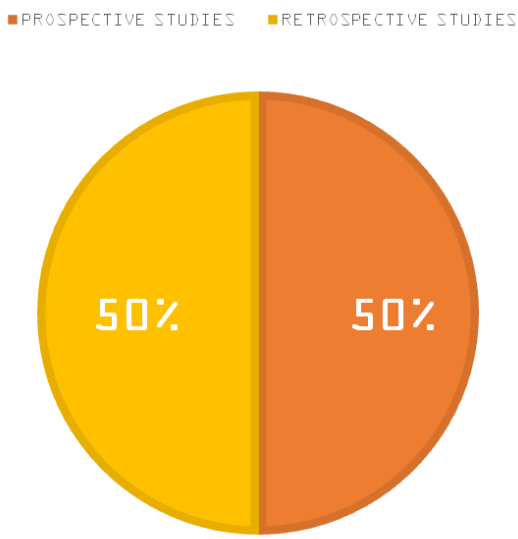


Figure 1: Shows the study design of selected articles

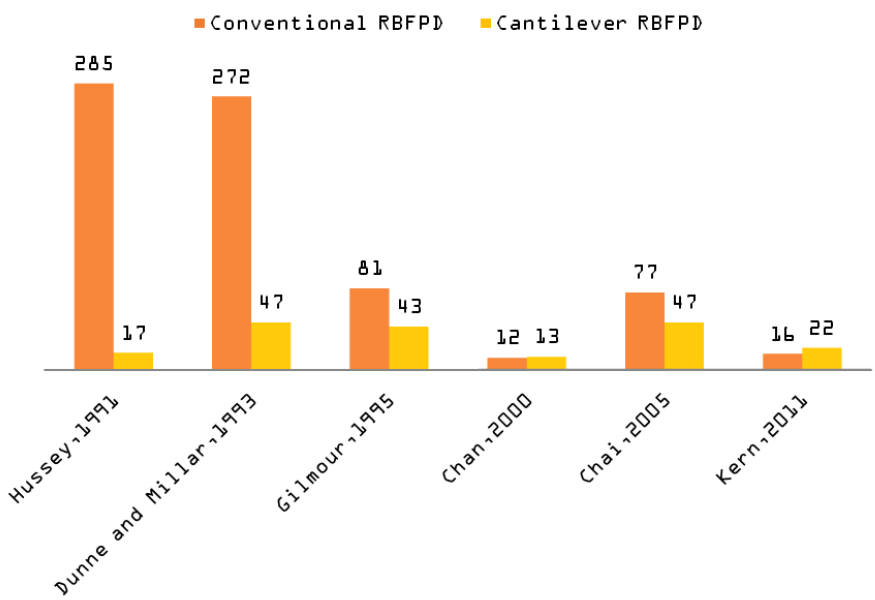


Figure 2: Shows the number of prostheses in each group

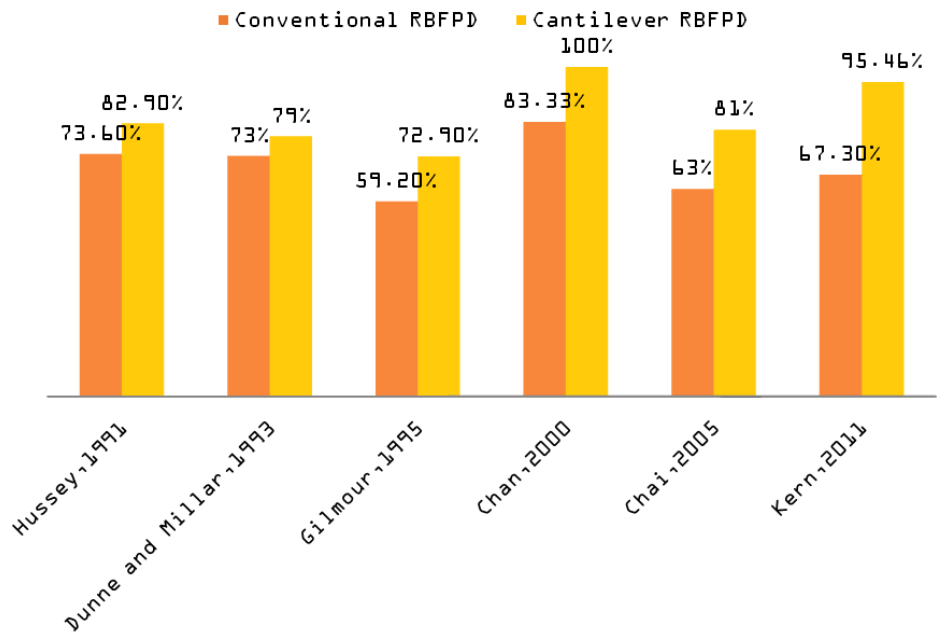


Figure 3: Shows the success rates of conventional and cantilevered RBFDPs

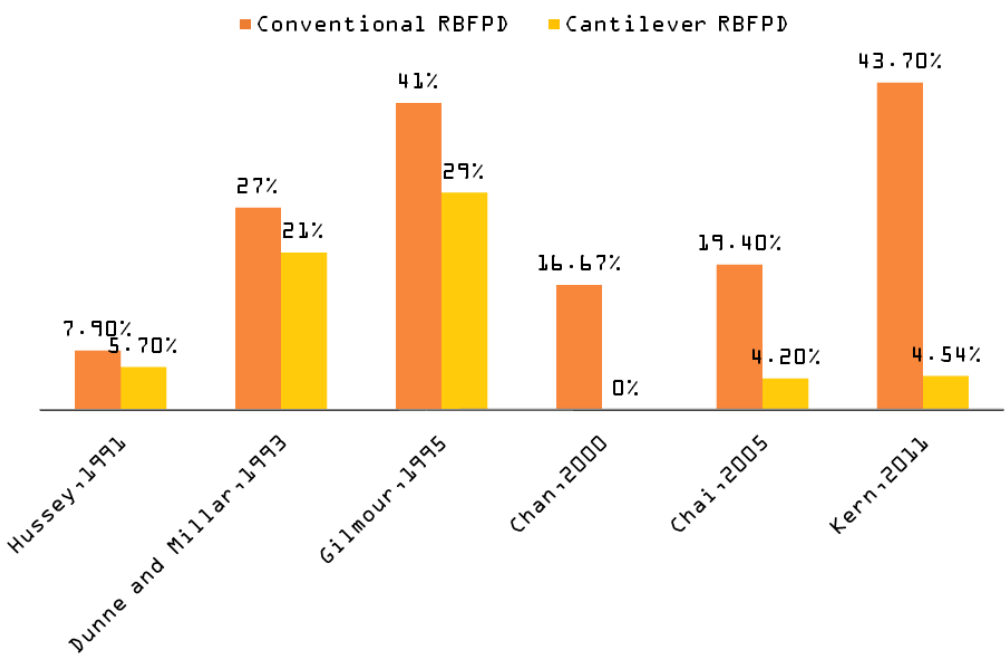


Figure 4: Shows the Debonding Rates of conventional and cantilevered RBFDPs

DISCUSSION

RBFDPs were developed with the idea of reducing the amount of tooth reduction required for provision of restorations [3,6,7,27]. Initially developed as periodontal splints followed by application as interim restorations, RBFDPs are currently an accepted alternative for replacing small edentulous spans provided the criteria for providing such restorations are met. Majority of publications agree on three steps for provision of RBFDPs. Minimalist preparation designs incorporating proximal grooves, rest seats and slots, a surface roughened retainer which may be electrochemically etched or possess macro/micromechanical irregularities (lost salt methods, sandblasting with 50um grit alumina particles) and an appropriate adhesive system [8,9,12,13,29]. Other factors influencing the success rates of these restorations include the surface area of abutment tooth, occlusal clearance, location of the restoration (anterior/posterior) and the number of teeth being replaced.

The survival rates of RBFDPs are varied between studies with one systematic review (Pjetursson et al 2007) [30] reporting an 87.7% survival rate after a period of 5 years and another systematic with meta-analyses (Creugers&Van't Hof 1991) reporting a 74% survival rate over a period of 4 years [31]. Therefore, attempts to modify RBFDP designs or changes in protocol have been undertaken to increase the clinical longevity of these restorations.

Cantilevered RBFDPs have been observed to exhibit a longer survival rate than conventional double retainer designs. The improved clinical performance of cantilevered designs were observed when a double retainer design restoration fractured and the fractured wing was removed with the remainder of the restoration intact, essentially converting a two-retainer design into a single retainer design [21,22,25].

Cantilevered designs are advantageous over conventional double retainer designs in that only one abutment tooth is prepared and extensive modifications are not required to increase the amount of retention for such designs. The minimalist preparation protocol of providing rests, proximal grooves and slots are adequate in providing optimal retention. Such simplicity in design reduces laboratory time as well as cost. Current design protocol recommends a connector thickness of 3mm inciso/occluso-gingivally and 2mm labio lingually. The minimum thickness of the retainer wing should be 0.5-0.7mm and an occlusal clearance of 0.8mm is recommended [8,12,16,22,32-34]. Another advantage includes a reduced incidence of caries under the retainers upon debonding [14]. In such designs the prostheses would dislodge completely thereby eliminating any chance of debris or food accumulation under the retainer.

Clinical studies have reported on the efficacy of cantilevered RBFDPs [9,21-23,25,26,35,36] However, studies comparing the clinical performance of conventional and cantilevered designs are few. Till current date, there have been no RCTs comparing these two interventions together. Therefore, an attempt was made in the form of this review to evaluate the effectiveness of these two restoration designs in order to aid clinical decision making on appropriate restoration design. This systematic review aims to address the success and failure rates of conventional and cantilevered RBFDPs. In the absence of RCTs, a lower level of evidence with prospective and retrospective cohort studies was used in this review to obtain data available on the success and failure rates of the restorations under evaluation.

Majority of the studies differed on the study designs and outcome variable assessed. In the absence of homogeneity between studies a meta-analysis could not be performed. In several studies, only debonding rates

were reported with respect to individual designs of the restorations. This data was taken as the basis for formulation of success and failure rates for this review. The restorations were assessed as "Success" when a restoration did not require any modification post cementation. This included rebonding of dislodged restorations. The restoration was considered as "Failed" when it experienced dislodgement. Assessment of Success and Failure varied between other studies with a restoration considered as successful even if it was debonded and only considered a failure after multiple rebonds. This method of assessment, however, only leads to fragmented evaluation results since the survival rates of prostheses decreases with each subsequent rebond. Such decreases in survival rate after multiple rebonds have been reported by multiple authors.

Although language restrictions were not applied the search strategy did not yield any additional studies matching the inclusion criteria than the one included in the review.

Publications which included both conventional and cantilever designs were chosen for producing a clinically relevant evaluation of the incidence of complications encountered with either type of prostheses. Studies with any one restoration design would have been provided under different clinical situations and assessed for different outcomes. Such variability between study designs are not amenable in making a practical evaluation of the clinical performance of two different designs.

A retrospective study by Hussey et al 1991 [37] between RBFDPs of different designs demonstrates a lower incidence of debonding failures when cantilevered RBFDPs were provided. In the conventional group, 65 prostheses out of a total of 285 debonded whereas in the cantilevered group, 12 prostheses out of a total of 70 underwent debonding. A success rate of 73.6% was calculated for the conventional group and a rate of 82.9% for the cantilevered group. The debonding rates were 7.9% and 5.6% respectively. Being a retrospective study there are many variables which have not been accounted for (materials used for construction of prostheses, luting systems, different operators). The authors have acknowledged the need for well-designed controlled clinical trials to validate the results obtained with this study.

A Prospective study by Dunne and Millar in 1993 [27] on various designs of resin bonded bridges demonstrated debonding failures in 74 out of 272 prostheses in the conventional group and 10 out of 47 prostheses in the cantilevered group. The success rates were calculated to be 73% and 79% and the debonding rates to be 27% and 21% respectively. One limitation to be noted in this study is the lack of standardization of retentive elements. Retentive elements were changed over the course of the study as newer methods became available such as electrochemical etching, sandblasting, etc.

Gilmour et al 1995[38] reported that 33 out of 81 prostheses debonded in the conventional group and 12 out of 43 prostheses debonded in the cantilevered group. The success rates were calculated as 59.2% and 79.2% respectively and the debonding rates were 41% and 29% respectively. Mode of retention was standardized with the luting system restricted to one type for all groups.

A.W.K.Chan&I.E.Barnes in 2000 [14] reported a single failure out of a total of 12 prostheses in the conventional group and no failures in the cantilevered group(n=13). A success rate of 83% and 100% and a debonding rate of 16.67% and 0 were obtained for the conventional and cantilevered groups respectively. A limitation of this study is the low sample size which is not representative of a population though standardization of clinical procedures has been done along with randomization of patient allocation to each group.

A retrospective analysis by J.Chai et al in 2005 [24] reveals a success rate of 63% and 81% and a debonding rate of 19.4% and 4.2% for the conventional and cantilevered groups respectively. It was found that posterior cantilevered RBFDPs had more longevity than anterior restorations. The authors suggest that cantilevered resin bonded bridges are not indicated for replacing molars and exclusively used to replace premolar teeth. The avoidance of increased occlusal loading may play a significant role in the increased longevity observed for these restorations.

Kern and Sasse in 2011 [25] reported on the long-term survival of anterior all-ceramic resin bonded fixed dental prostheses. A success rate of 67.3% and 95.46% and a debonding rate of 43.7% and 4.54% were calculated for conventional and cantilever groups respectively. The low sample size is a limitation of this study.

The data obtained from all these studies imply that cantilevered prostheses may be functionally retained in the oral cavity for a longer period than the conventional double retainer restorations. It has been suggested that this clinical longevity is a result of elimination of differential micromovements occurring in abutment which may induce tensile stresses in the abutment retainer interface. Another hypothesis states that the periodontal mechanoreceptors aid in detecting increased occlusal load on the pontic when it is bonded to a single abutment tooth and this aids in preventing excessive loading with the prosthesis moving in tandem with its singular abutment [16,21,22,25,26,32,34,36].

Resin bonded bridges have been used as an alternative mode of restoration when indicated even though the clinical longevity does not approach that of conventional FDPs. Use of a cantilevered design to maximize its clinical longevity may be considered based on the results obtained from this study. It must be noted however that these studies are not entirely homogeneous in terms of study designs and outcomes. The levels of evidence from the included studies are not of the highest quality and the risk of bias is high. However, the cantilevered group in all the studies under review seems to exhibit longer clinical performance than the conventional groups with none of the studies showing a lesser performance of the cantilevered group. The cantilevered RBFDP may be considered a viable treatment option when a single tooth is to be replaced.

Inference

Implications for practice –
The Cantilevered RBFDP can be considered as a treatment option for replacing single missing teeth.

Implications for research –
The number of clinical trials comparing the efficacy of cantilevered RBFDPs with conventional RBFDPs are limited in number. Further randomized clinical trials with an optimally designed protocol may be conducted to improve our understanding on this mode of treatment and to provide higher levels of evidence on its efficacy.

CONCLUSION

Based on the results obtained from this study and keeping in consideration the levels of evidence of the studies included in the review, it can be concluded that cantilevered RBFDPs may be an acceptable alternative in cases of replacing single missing teeth.

Conflict of Interests: Nil

Source of funding: Nil

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Appendix

Table of Excluded articles

S.No	Author	Year	Study Design	Reasons for Exclusion
1	Djemal et al	1999	Retrospective study	Inadequate data on failure rates for conventional and cantilevered RBFDPs
2	Kern.M	2005	Prospective study	Same patient cohort as in study included in review
3	Sasse.m& kern	2013	Prospective study	Evaluation of bonding systems; Evaluated only Cantilevered restorations
4	Sasse et al	2012	RCT	Evaluation of bonding systems
5	Howard-Bowles et al	2011	Literature review	Review on Double retainer RBFDPs
6	Boening et al	2012	Retrospective study	Evaluation of clinical performance of Double retainer RBFDPs
7	Kern et al	2012	Prospective study	Long term evaluation of all ceramic FDPs
8	Cortellini et al	2011	RCT	Evaluation of periodontal regeneration vs. extractions
9	Dogus et al	2011	InVitro study	Evaluation of internal connections in screw retained cantilevered prostheses
10	Komine et al	2010	Review	Literature review on Zirconia based restorations
11	Van Heumen et al	2010	Prospective study	Evaluation of survival rates of FDPs and 3-unit FRC restorations
12	Ghavanasiri et al	2010	Clinical report	Evaluation of PFM crown as an abutment for RBFDPs
13	Wolfart et al	2009	Prospective study	Evaluation of clinical outcomes of Lithium disilicate FDPs
14	Van Heumen et al	2009	Prospective study	Evaluation of survival rates of 3-unit FRC restorations in the posterior region
15	Baltzer A	2008	Review	Review on preparation design for all ceramic restorations

16	Rosentritt et al	2008	InVitro study	Evaluation of fracture resistance of Zirconia RBFDPs
17	Ohlmann et al	2008	Prospective study	Evaluation of clinical performance of Inlay retained FDPs
18	Thomason et al	2007	RCT	Clinical performance of cantilevered RBFDPs compared with RPDs
19	Monaco et al	2006	Prospective study	Evaluation of bonding systems and survival of FRC inlay retained FDPs
20	Marquardt et al	2006	Prospective study	Evaluation of lithium disilicate crowns and FDPs
21	Abou Tara et al	2011	Prospective study	Evaluation of clinical outcome of inlay retained Zirconia FDPs
22	Audenino et al	2006	Prospective study	Evaluation of long-term survival rates of RBFDPs
23	Creugers et al	1998	RCT	Evaluation of risk factors and survival rates of posterior RBFDPs
24	De Kanter et al	1998	Prospective study	Evaluation of bonding systems and survival rates of posterior RBFDPs
25	El Salam Shakal et al	1997	InVitro study	Evaluation of tooth preparation design on bond strength of RBFDPs
26	Hussey & Linden	1996	Prospective study	Evaluation of clinical performance of cantilevered RBFDPs
27	Verzijden et al	1994	Prospective study	Evaluation of survival rates of posterior RBFDPs

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