

A Conservative Treatment Option for a Single Missing Anterior Tooth

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Abstract:

This literature review aimed to identify and assess conservative treatment options for replacing a single missing anterior tooth, for patients who cannot afford implants or traditional bridges. The evidence was obtained using MEDLINE searches. A total of 19 studies met the inclusion criteria set by the authors. However, only 6 studies, which were descriptive in design, had relatively strong evidence based on the "efficacy of therapy or prevention checklist" scores. None of these studies scored higher than 10 out of 17, suggesting that all studies did not have strong evidence. Three of the studies examined resin-bonded bridges (RBBs), whereas the other three investigated removable partial dentures (RPDs). The definition of failure of the prostheses was inconsistent between the six studies. None of the studies had random patient selection. Three of these studies had controlled allocation of patients. The other three allowed new patients to enter the study throughout the study period. Placement of the prosthesis was only conducted in one study, whereas the rest of the studies examined patients with pre-existing prostheses. In general, all 19 studies were weak due to poor study design, no acceptable controls, no direct comparison between RBBs and RPDs, lack of longitudinal studies, and no differentiation between anterior and posterior prostheses. Therefore, no definitive treatment conclusion can be made until studies of stronger design are conducted.

MeSH Keywords: missing tooth; anterior tooth; removable partial denture; resin-bonded bridges

Introduction:

Dentists are faced with numerous options when it comes to addressing the age-old dilemma of replacing an unsightly missing anterior tooth. Available treatment options include implants, traditional bridges, removable partial dentures (RPDs), resin-bonded bridges (RBBs), and no treatment. The purpose of this literature review was to find the most conservative treatment, defined as minimally invasive and financially feasible, for a patient who cannot afford a traditional bridge or an implant.

The different treatment options are variable in price according to the Ontario Dental Association (ODA) fee guide. Implants and traditional bridges are the most expensive at \$1000 and \$800, respectively. Considerably less expensive treatment modalities are RBBs costing \$550 and RPDs costing \$450¹. These fees do not include laboratory costs, which vary depending on the laboratory.

In this literature review, treatment with both RBBs and RPDs was investigated. Studies assessing the longevity, survival, reasons for failure, and biological consequences of RPDs and RBBs were critically analyzed²⁻²⁰.

Methods:

RBB and RPD literature was systematically reviewed.

Publication Screening

Studies were selected following four basic workflow stages as highlighted in Fig. 1. In the first stage, MEDLINE was electronically searched for English language articles in the dental literature with publication dates from January 1966 to 2005. Keywords used in this search were: (1) Denture, Partial, fixed, resin bonded or etched cast restorations, (2) Cantilevered bridge, (3) Bonded bridge, (4) Maryland bridge and denture, partial, Fixed, Resin-Bonded, (5) RPD and longevity, (6) RPD and benefits or harms, and (7) Removable partial dentures, RPDs, RPD periodontal health, and RPD oral health. These search words yielded 399, 2, 35, 9, 30, 15, and 263 potentially relevant articles, respectively. In the second stage, titles were screened. Of the relevant titles, abstracts were screened. In the final stage, full articles were obtained and accepted for review based on the inclusion criteria. Overall, after screening over seven hundred potential articles, 19 studies were included in this review. A list of articles excluded and reasons for exclusion can be found in Appendix 1.

Inclusion Criteria:

To maximize the accuracy of our results, five essential criteria were enforced when selecting an article for final review:

- Prospective or retrospective cohort study
- Minimum follow-up time of 5 years
- Long term treatment options only
- Clinical examination of all patients at follow-up visit
- Minimum sample size of 30 patients

This extensive literature search uncovered that there were no randomized controlled trials (RCTs) comparing RBBs and RPDs. Consequently, prospective and retrospective studies were considered to be the highest level of evidence for the purpose of this review.

Data Extraction:

The following information was gathered from each of the 19 articles reviewed¹⁻¹⁹: prosthesis design, survival and success statistics, and biological and technical considerations.

Survival and success data only applied to RBBs. Survival was defined as an RBB having one de-bonding and re-bonding event during the entire observation period. Success was defined as having the RBB remain in its original condition without requiring any intervention during the observation period. In the case of RPDs, failure occurred when the appliance caused damage to the surrounding oral tissue. The evaluation of biological considerations included three aspects: caries, periodontal disease, tooth mobility. Finally, technical considerations included fracture and deformation of the prosthesis framework, loss of retention between the tooth and the prosthesis, and abutment fracture or abutment tooth loss.

Validity Instrument:

The 6 articles that were deemed relevant^{2,4-8} (Table 1 and 2) were then scored according to the "checklist to assess evidence of the efficacy of therapy or prevention," adapted from Fletcher et al. and Sackett et al. (Table 3)^{20,21}. The highest possible score was 17.

Results:

The six most relevant studies^{3,5-9}, meeting the previously described inclusion criteria, were cited as primary sources. Three of these studies were prospective longitudinal design^{5,6,7} and the other two were retrospective observational design^{3,8,9}. The exclusion of control groups was a limitation for all six studies^{3,5-9}. As a result, all studies were found to be grade **III** level of evidence, with recommendation grades **B** or **C**²³. The relevance and strength of each primary article was based on the study's ability to validly describe, beyond chance, the success or failure of the prosthetic intervention and variables associated with success or failure. The three strongest studies^{3,7,8} scored between 8 and 10 out of a possible 17 points on the checklist to assess the efficacy of a therapeutic intervention²¹. As a result, none of these studies were considered to have strong evidence.

Djemal et al.'s study, which examined RBBs, scored a 10 on the checklist²¹. The researchers of this study performed a univariate (Kaplan-Meier) analysis to produce log rank statistics and comparative survival curves. The following main variables were found to significantly influence ($P < 0.05$) prosthesis survival: aetiology, coverage (anterior), design, extent (more or less than 4 units), operator (senior staff, junior staff, or post-graduate staff) and perforated versus unperforated retainers (risk ratio of 0.724 compared to perforated). This study did not meet other criteria in the therapeutic intervention checklist²¹. The findings suggested that debonding of RBB's was the main reason for prosthesis failures, however the statistical significance of this was not assessed.

Navalainen et al. examined RPDs. This study scored 10 out of 17 according to the checklist²¹. Researchers used a logistic regression analysis to measure the effect of RPD use on oral health. An insignificant increase of caries was found during the 5 years of the study.

However, the results (odds ratio <2) suggest that use of any type of RPD correlated with a higher incidence of tooth loss, and thus RPD failure. In addition, subjects wearing any type of RPD were found to have higher microbiological counts than subjects with a natural dentition ($P<0.05$ and $P<0.01$). This study concluded that RBBs are a better treatment option than RPDs, however this conclusion was not backed by evidence in the study, since RBBs and RPDs were not clinically compared⁷.

Tuominen's (2003) study controlled for confounding variables by the simultaneous comparison of 4 groups. The control group received no dentures and the test groups received dentures prepared by dentists, denturists or laboratory technicians. Different clinicians placed the dentures, without consistent procedural guidelines. Tuominen utilized the chi-square test, student's t-test, and logistic regression models to analyze mean values and the effect of confounding factors⁸. The findings revealed that there was a higher frequency of mucous membrane lesions among denture wearers than non-wearers ($P<0.01$).

The remaining three studies presented weaker evidence, as indicated by the "checklist to assess evidence of efficacy of therapy"^{5,6,9}. Generally, these studies listed many findings that were not statistically significant to the 95% confidence interval.

Discussion:

This literature survey found that there is unsupported evidence due to weak study designs when the treatment options for the replacement of a single anterior tooth are examined. RCTs are a feasible option in directly comparing RBBs and RPDs but no such studies were available. Furthermore, none of the studies contained an acceptable control group. Although many studies make claims for or against the use of RBBs or RPDs, the evidence from these descriptive studies should be approached cautiously.

Much of the scepticism surrounding the literature stems from the fact that no studies were found that directly compared RBBs and RPDs, forcing a comparison between studies that looked at these treatments separately. This results in an inconsistent assessment of survival, since failure is defined differently for RBB treatment (which is based on debonding) versus RPD treatment (which is based on resulting damage to oral tissues)²⁻²⁰.

In general, there were several weaknesses common to all studies. There was a shortage of longitudinal studies performed. In addition, most long term studies allowed entrance of subjects throughout the study period and reported final statistics by combining the results of initial subjects with those joining later on in the study^{3,5,6}. This is considered a non-controlled allocation of subjects. Thus, the findings from such studies are not based on strong evidence. Moreover, most studies grouped anterior and posterior prostheses, and long and short edentulous spans together²⁻²⁰. This made interpretation of their statistics unreliable at best since the factor of interest in this review was replacement of a single missing anterior tooth. Lastly, an inherent weakness in all the studies examined was their inability to control for confounding variables, such as intermittent outside care.

Barrack *et al.* (1993) had non-random allocation of patients. The researchers did not explicitly state a survival definition, making it difficult to compare the results of this study with other studies found. Also, no statistical analyses were conducted to control for confounding variables, or show statistical significance of the results.

Djemal *et al.* (1999) also had non-random allocation of patients. Since this was a retrospective study, an unknown number of different clinicians placed the initial restorations, therefore there was no standardized placement protocol. This study concluded that most RBBs fail due to debonding, however the statistical significance of this result in comparison with other reasons for failure was not assessed.

Probster *et al.* (1997) did not have a representative sample since they examined patients under the age of 30, most of who had congenitally missing teeth or lost their teeth due to trauma. This prospective study had several clinicians placing the prostheses without a common placement protocol, introducing variables that could have been controlled for if a standardized placement protocol was used. Lastly, treatment modalities and inclusion/exclusion criteria were modified throughout the study period as the researchers gained clinical experience. These changes weaken the evidence due to inconsistencies in study methods.

Yeung *et al.* (2000) examined the oral health status of patients 5 – 6 years after placement of RPDs. These patients were selected via survey. Only patients that were motivated enough to respond to the survey were included in the study. Of these, about half of the patients approached were no longer wearing their prosthesis, and these patients were not examined further. This led to a non-representative sample and the results would have been greatly altered had the aforementioned patients been examined in the study.

The Nevalainen *et al.* (2004) study, examining RPDs, had the limitation of having fewer subjects who were solely from a geriatric population. Loss of subjects throughout the study was a major issue since 31% of the study population died during the study period. Furthermore, many subjects were too ill, or refused to participate in the follow-up. This study reached an invalid conclusion that RPDs are more harmful to oral health than fixed partial dentures. This conclusion is not based on evidence, since only RPDs were studied.

Another RPD study by Tuominen (2003) showed that RPD users had a non-representative study sample including only geriatric males. Approximately half of the patients invited to participate responded and agreed to be clinically examined, therefore patient motivation was a confounding variable. There were 3 different groups of clinical providers who did not use a standardized placement protocol. Age and general health status of subjects did not allow for re-examinations, thus weakening the evidence.

The following recommendations for future research examining RBBs and RPDs would overcome weaknesses of the previous studies:

- Stronger study design, preferably RCTs. Case-control or cohort studies should also be performed.
- Controlled allocation of patients in longitudinal studies (subjects not permitted to join study after it has commenced).
- Studies performed without randomization require a suitable control group.
- Researchers should aim to study RBBs and RPDs in a single study and limit their research to single missing anterior teeth.
- Placement protocol of prostheses should be standardized among clinicians.

- A unified definition of survival is required that can be comparable between RBBs and RPDs.
- Multivariate analyses should be performed to control for confounding variables.

In conclusion, there is insufficient evidence to allow a recommendation to be made for the use of RPDs over FPDs or vice versa in the case of a single missing anterior tooth. More studies of stronger design with suitable controls are required before a definitive treatment conclusion can be made.

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Table 1 - Studies presenting stronger evidence regarding the most conservative treatment of a missing anterior tooth

Author; year	Population/ Case Selection	Study/ Study Design	Prosthesis Design	Prosthesis Survival Def'n	Results	Conclusion	Classification
Djermal, S. et al; 1999	832 restorations in 593 patients selected from people receiving treatment at the Eastman Dental Hospital	Retrospective; observational time of 15 years	Resin-retained fixed bridges	Survival defined as no significant event requiring remedial treatment or remake of the prosthesis.	·Three failures due to caries ·Two failures due to periodontal bone loss·209 failures due to debonding·Total 72% success rate ·Median survival rate was 7 years and 10 months	·The RBB is a minimally invasive technique with acceptable survival time·No significant biologic adverse effects from RBBs ·Most problems due to	III, level B

						debonding·High patient satisfaction	
Nevalaine n et al., 2004	36 subjects	Random prospective cohort study, 5 year follow- up study	Removable partial denture		·RPDs correlated with tooth loss- subjects with RPDs harbored high counts of salivary mutans streptococci, lactobacilli and yeasts than those with natural dentition	·The use of RPDs is associated with several oral diseases and impaired oral conditions.	III Level B
Tuomine n, R.,	362 subjects, 242 denture	Retrospective	Removable partial		·There was a significantly ($P <$	·The 242 denture wearers had a	III Level B

2003	wearers, 120 non-denture wearers		denture		0.01) higher frequency of mucous membrane lesions among denture wearers (78.7%) than among non- wearers (27.5%) ·A coating of tongue was observed significantly (P < 0.001) more often among denture wearers (45.3%) than others (21.7%). ·Almost as significant (P <	higher Frequency of mucous membrane lesions.	
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					0.005) difference was observed in the presence of cheilitis angularis (10.6% in denture wearers vs 0.8% in others)		
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Table 2 - Studies presenting weaker evidence regarding the most conservative treatment of a missing anterior tooth

Author; Year	Population / Case Selection	Study/ Study Design	Prosthesis Design	Prosthesis Survival Definition	Results	Conclusion	Classification
Barrak G; 1993	127 restorations in 109 patients from New York University, College of Dentistry	Prospecti ve, Longitudi nal; Maximu m observati on time of 11 years	Etched cast restoration with a retentive framework (i.e. Maryland bridge)	<i>Not explicitly stated.</i>	- Mean longevity is 5 years and 8 months (for the RBBs that survived) - No changes in pocket depth or bleeding on probing - A total of 9 failures	- Success rate was 92.9% (i.e did not debond at all) - RBB is a good treatmeant option for missing teeth	III, Level C
Probster <i>et al;</i>	264 patients	Prospecti ve,	Etched cast restoration	1)Survival with no	-Survival rate after 5 years was 76% and 10	- Prosthetic replacement of	III, Level C

1997	with mean age of 29 at Johannes Gutenberg, University Dept of Prosthetic Dentistry	longitudinal; maximum observation time of 11 years	with a retentive framework (i.e. Maryland bridge)	debonding 2)Survival with one rebond	year survival was found to be 60% -Including the survival of the single debond-rebond cases increases the survival by 15%	single teeth using resin-bonded fixed partial dentures offered an acceptable survival probability	
Yeung <i>et al</i> ; 2000	87 patients from the Prince Philip Dental Hospital, University of Hong	Retrospective, longitudinal; Patients received Co-Cr RPDs 5-6	Co-Cr RPDs	<i>-In contact with RPD-teeth within 3 mm of RPD. -Not in contact with RPD-teeth 3</i>	<i>-Teeth in contact had more: plaque retention, gingival bleeding, periodontal attachment loss, 3X more root caries</i>	- RPDs related to adverse oral health effects	III, Level C

	Kong. 552 teeth in contact with RPD and 1130 teeth not in contact	years prior to study. Patients selected by random sampling		mm or further from RPD			
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Table 3 – Checklist for assessing evidence of efficacy of therapy or prevention

General Questions

1. Was the study ethical?
2. Was a strong design used to assess efficacy?
3. Were outcomes (benefits and harms) validly and reliably measured?
4. Were the interventions validly and reliably measured?
5. What were the results
 - a. Was the treatment effect large enough to be clinically important?
 - b. Was the estimate of the treatment effect beyond chance and relatively precise?
 - c. If the findings were “no difference” was the power of the study 80% or better?
6. Are the results of the study valid?
 - a. Was the assignment of patients to treatments randomized?
 - b. Were all the patients who entered the trial properly accounted for and attributed at its conclusion?
 - i. Was the loss to follow-up less than 20% and balanced between test and controls?
 - ii. Were patients analyzed in the groups to which they were randomized?
 - c. Was the study of sufficient duration?
 - d. Were the patients, health workers, and study personnel “blind” to treatment?
 - e. Were the groups similar at the start of the trial?
 - f. Aside from the experimental intervention, were the groups treated equally?
 - g. Was care received outside the study identified and controlled for?

Table 3 (continued)

7. Will the results help in caring for your patients?
 - a. Were all clinically important outcomes considered?
 - b. Are the likely benefits of treatment worth the potential harms and costs?

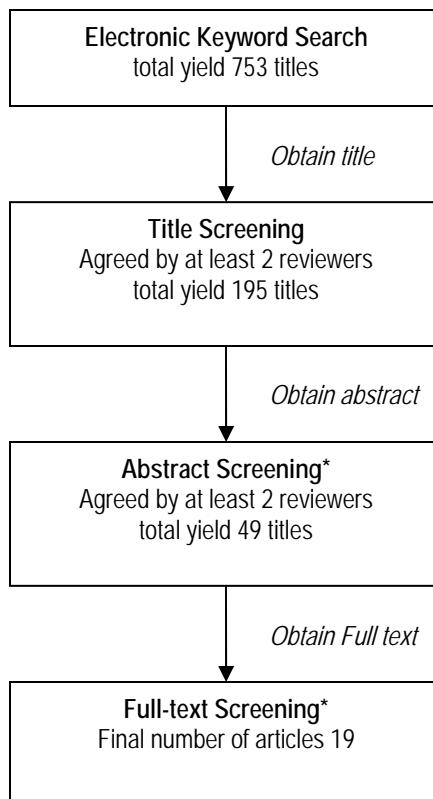


Figure 1: Search Strategy

Appendix 1 (List of excluded articles and reasons for exclusion):

Reason for Exclusion	Articles
Case Reports.	Hagiwara <i>et al.</i> 2004; Javaheri 2001; Javaheri 2003; Johnston and Hussey 1993; Leal 2001; Van Wijlen 2000; Ziada and Barrett 2000
Not a study but a review.	Ancowitz 2004; Chan and Tseng 1994; El-Mowafy and Rubo 2000; El-Mowafy 2003; Mazurat and Mazurat 2003; Petridis and Hempton 2001
Too few subjects studied over a span of <5years.	Al-Wahadni AM <i>et al.</i> 2004; Vanzeveren <i>et al.</i> 2002
Not a study, but a description of factors influencing choosing RPDs (no numbers on survival, outcomes of use etc. provided).	Davenport 2000;189(7); Davenport 2000;189(8)
Not a study, but a description of considerations by dentists when making RBBs.	Andrews <i>et al.</i> 1994
Focused on importance of dentist being involved in designing RPDs, without long term survival analysis.	Lechner and Thomas 1994
Focused on the percentage of the certain types of designs of RBBs used, how well the prescriptions were written out and the laboratory procedures of making RBBs (no	Patsiatzi and Grey 2004

clinical relevance).	
Focused on Cantilever bridges which were excluded from our study due to lack of convincing evidence.	Pjetursson <i>et al.</i> 2004
Focused on Rochette bridges which are a very old design of RBBs no longer in use and were case reports.	Poyser <i>et al.</i> 2004
Focused on an old technique of designing RBBs.	Nakazawa 1977
Non-convincing evidence.	Roberts 2003
Focused on costs and was found irrelevant when the ODA fee guide was available.	Smith and Brownlea 1993
Same cohort of individuals was used as in another paper that was accepted. Thus it was rejected to decrease redundancy.	Isidor and Butz-Jorgensen 1990; Kern and Wager 2001
Focussed on aesthetics since results were based on questionnaires about patient satisfaction with their RPD.	Knezovic'zlataric <i>et al.</i> 2003
Focussed on RPD designs.	Saito 2002
Focussed on <i>S. mutans</i> levels in the mouth of RPD wearers.	Rocha 2003

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