Considerations for single tooth replacement in an esthetic zone—review of conservative treatment options

Raghuwar Dayal Singh¹, Saumyendra V Singh¹, Pooran Chand², Ramashanker¹

¹Assistant Professor, ²Associate Professor, Department of Prosthodontics, Faculty of Dental Sciences, Chhatrapati Shahuji Maharaj Medical University (Erstwhile King George Medical College), Lucknow, India.

ABSTRACT

Background: This literature review aimed to identify and assess the conservative treatment options for replacing a single missing anterior tooth, for patients who cannot afford implants or traditional bridges.

Materials and Methods: The evidence was obtained using MEDLINE searches. A total of 19 studies met the inclusion criteria. None of these studies scored higher than 10 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). 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.

Results and Conclusion: 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 the anterior and posterior prostheses. Therefore, no definitive treatment conclusion can be made until studies of stronger design are conducted.

Keywords: Anterior missing 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) or 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. In this literature review, treatment with RBBs and RPDs was investigated. Studies assessing the longevity, survival, reasons for failure and biological consequences of RPDs and RBBs were critically analyzed.^{1–19}

METHODS

The RBB and RPD literature was systematically reviewed. Studies were selected following four basic workflow stages as shown in Flowchart 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 as follows:

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. Removable partial denture and longevity

Flowchart 1 Search strategy.

6. Removable partial denture and benefits or harms
7. Removable partial dentures, 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, the titles were screened. Of the relevant titles, the abstracts were screened. In the final stage, full articles were obtained and accepted for review based on the inclusion criteria. Overall, after screening over 700 potential articles, 19 studies were included in this review (Flowchart 1).

To maximize the accuracy of our results, five essential criteria were enforced when selecting an article for a final review: prospective/retrospective cohort study, minimum 5 years follow-up, long-term treatment options, clinical examination at follow-up visit and 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. The following information was gathered from each of the 19 articles reviewed—prosthesis design, survival and success statistics, and biological and technical considerations.^{1–19}

Survival and success data only applied to RBBs. Survival was defined as an RBB having one debonding and rebonding 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

Table 1 Questionnaire

1. Was the study ethical?
2. Was a strong design used to assess efficacy?
3. Were the 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?
 - d. Was the assignment of patients to treatments randomized?
 - e. Were all the patients who entered the trial properly accounted for and attributed at its conclusion?
 - f. Was the study of sufficient duration?
 - g. Were the patients, health workers and study personnel 'blind' to treatment?
 - h. Were the groups similar at the start of the trial?
 - i. Aside from the experimental intervention, were the groups treated equally?
 - j. Was care received outside the study identified and controlled for?
7. Will the results help in caring for your patients?
 - k. Were all clinically important outcomes considered?
 - l. Are the likely benefits of treatment worth the potential harms and costs?

three aspects: caries, periodontal disease and 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.

The six articles^{2,4–8} that were deemed relevant were then scored according to the 'checklist to assess evidence of the efficacy of therapy or prevention', adapted from Fletcher et al.²⁰ The highest possible score was 17. A questionnaire was adapted to assess the efficacy of the therapy (Table 1).

RESULTS

The six most relevant studies,^{2,4–8} meeting our inclusion criteria, were cited as the primary sources. Three of these studies^{5–7} were prospective longitudinal design and the

other two were retrospective observational design.^{2,7,8} The exclusion of control groups was a limitation for all six studies.^{2,4-8} 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 the variables associated with success or failure. The three strongest studies^{2,6,7} scored between 8 and 10 of a possible 17 points on the checklist to assess the efficacy of a therapeutic intervention.²⁰ As a result, none of these studies were considered to have strong evidence.

Djemal examined RBBs, and scored a 10 on the checklist.² The univariate (Kaplan–Meier) analysis produced log rank statistics and comparative survival curves. The following main variables were found to significantly influence ($P < 0.05$); prosthesis survival: etiology, coverage (anterior), design, extent ($>$ or < 4 units), operator (senior staff, junior staff or postgraduate staff) and perforated versus unperforated retainers (risk ratio of 0.724 compared with perforated). This study did not meet other criteria in the therapeutic intervention checklist. The findings suggested that debonding of RBBs was the main reason for prosthesis failures; however, the statistical significance was not assessed.

Nevalainen examined RPDs.⁶ This study scored 10 of 17 according to the checklist. 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 the 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 were a better treatment option than RPDs; however, this conclusion was not backed by evidence, since RBBs and RPDs were not clinically compared.⁶

Tuominen's (2003)⁷ study controlled for confounding variables by the simultaneous comparison of four 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 chi-square test, student's t -test and logistic regression models to analyze the mean values and the effect of confounding factors.⁷ His findings revealed that there was a higher frequency of mucus 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'.^{4,5,8} Generally, these studies listed many findings that were not statistically significant to the 95% confidence interval.

DISCUSSION

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 the resulting damage to the 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 the entrance of subjects throughout the study period and reported final statistics by combining the results of the initial subjects with those joining later,^{2,4,5} which is a non-controlled allocation of the subjects. Thus, the findings from such studies are not based on strong evidence. Moreover, most studies grouped anterior and posterior prostheses, and long or short edentulous spans together.¹⁻¹⁹ This made the interpretation of their statistics unreliable, since the factor of interest in this review was the replacement of a single missing anterior tooth. Lastly, an inherent weakness in all these studies was their inability to control for confounding variables, such as intermittent outside care.

Barrack⁵ had a 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 the confounding variables, or show statistical significance of the results.

Djemal et al² also had a 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.

Probst and Henrich⁴ did not have a representative sample since they examined patients under the age of 30 years, 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 weakened the evidence due to inconsistencies in the study methods.

Oral health status 5–6 years after the placement of RPDs was assessed for patients selected via survey. Only patients who were motivated enough to respond were included in this study. Of these, about half of the patients approached were no longer wearing their prosthesis, so were not examined further. This led to a non-representative sample and the results would have been greatly altered had the not wearing the prosthesis patients also been examined.

Nevalainen et al.⁶ study, examining RPDs, had the limitation of fewer subjects, 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 the RPDs are more harmful to oral health than fixed partial dentures (FPDs), which is not based on evidence, since only RPDs were studied.

Tuominen⁷ 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 three 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 the weaknesses of the previous studies: stronger study design, preferably RCTs, controlled allocation of patients in longitudinal studies; a suitable control group; comparison of RBBs and RPDs in a single limited study for a single missing anterior teeth; standardized placement protocol of prostheses among clinicians; a unified definition of survival comparable between RBBs and RPDs; and multivariate analyses to control for the confounding variables.

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.

REFERENCES

1. Ketabi AR, Kaus T, Herdach F, et al. Thirteen-year follow-up study of resin-bonded fixed partial dentures. *Quintessence Int* 2004;35:407–10.
2. Djemal S, Setchell D, King P, Wickens J. Long-term survival characteristics of 832 resin retained bridges and splints provided in a post-graduate teaching hospital between 1978 and 1993. *J Oral Rehab* 1999;26:302–20.
3. Butz-Jorgensen E, Isidor F. A 5-year longitudinal study of cantilevered fixed partial dentures compared with removable partial dentures in a geriatric population. *J Prosthet Dent* 1990;64:42–7.
4. Probst B, Henrich GM. 11-year follow-up study of resin-bonded fixed partial dentures. *Int J Prosth* 1997;10:259–68.
5. Barrack G. The etched cast restoration-clinical techniques and long-term results. *Quintessence Int* 1993;24:701–13.
6. Nevalainen MJ, Narhi TO, Ainamo A. A 5-year follow-up study on the prosthetic rehabilitation of the elderly in Helsinki, Finland. *J Oral Rehab* 2004;31:647–52.
7. Tuominen R. Oral health in relation to wearing removable dentures provided by dentists, denturists and laboratory technicians. *J Oral Rehab* 2003;30:743–8.
8. Yeung AL, Lo EC, Chow TW, Clark RK. Oral health status of patients 5–6 years after placement of cobalt-chromium removable partial dentures. *J Oral Rehab* 2000;27:183–9.
9. Briggs P, Dunne S, Bishop K. The single unit, single retainer cantilever resin bonded bridge. *Br Dent J* 1996;181:373–9.
10. Berekally TL, Smales RJ. A retrospective clinical evaluation of resin-bonded bridges inserted at the Adelaide Dental Hospital. *Aust Dent J* 1993;38:85–96.
11. Berekally TL, Makinson OF, Pietrobon RA. A microscopic examination of bond surfaces in failed electrolytically etched cast metal fixed prostheses. *Aust Dent J* 1993;38:229–37.
12. Zalkind M, Ever-Hadani P, Hochman N. Resin Bonded fixed partial denture retention: a retrospective 13-year follow up. *J Oral Rehab* 2003;30:971–7.
13. Vallittu PK. Survival rates of resin-bonded, glass fiber-reinforced composite fixed partial dentures with a mean follow-up of 42 months: a pilot study. *J Prosthet Dent* 2004;91:241–6.
14. Hikage S, Hirose Y, Sawada N, Endo K, Ohno H. Clinical longevity of resin-bonded bridges bonded using vinyl-thiol primer. *J Oral Rehab* 2003;30:1022–9.
15. Hussey DL, Linden GJ. The clinical performance of cantilevered resin-bonded bridgework. *J Dent* 1996;24:251–6.

16. Ibbetson R. Clinical considerations for adhesive bridgework. *Dent Update* 2004;31:254–6, 258, 260 passim.
17. Lechner SK. A longitudinal survey of removable partial dentures. III. Tissue reactions to various denture components. *Aust Dent J* 1985;30:291–5.
18. Wagner B, Kern M. Clinical evaluation of removable partial dentures 10 years after insertion: success rates, hygienic problems, and technical failures. *Clin Oral Investig* 2000;4:74–80.
19. Waldman C. Then anterior resin bonded bridge: a conservative alternative. *Oral Health* 1998;88:19–25.
20. Fletcher RH, Fletcher SW, Wagner EH. In: *Clinical Epidemiology: The Essentials* 3rd edn. Baltimore: Lippincott Williams & Wilkins, 1996:276.