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Resin Bonded Bridges - Revisited

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ABSTRACT

To date, resin bonded bridges made either in general dental practices or government clinical settings appear to have high failure rates. This is mainly due to unsuitable case selections, unfavorable bridge designs and inappropriate cementation protocol. It is beneficial to highlight that if the fundamental principles of making resin bonded bridges are strictly followed, this prosthesis can become one of the simplest and predictable method for replacing missing teeth. This article discussed the recommended method for bridge fabrication pertaining to case selection, bridge designs and cementation protocol. It is hoped that this detailed discussion will able to renew the public interest in this prosthesis and increases its prescription in daily dental practices.

Key Words: Resin bonded bridge, Bridge design, Cementation protocol

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INTRODUCTION

Resin Bonded Bridge (RBB) had gained its popularity nowadays due to the progression of adhesive dentistry and the reputation of Minimally Intervention Dentistry concept. RBB is a minimally invasive treatment option to replace missing tooth/teeth. In certain condition, it is provided as intermediate provisional prosthesis; for example as a provisional bridge after implant or bone grafting surgery that will not interfere with the healing of the surgical site, or as provisional bridge for teenagers who experienced tooth lost while waiting for the fabrication of definitive prosthesis when they reach maturity. Main advantages of RBBs include preservation of tooth structure, fixed replacement of missing teeth, short treatment time and less financial commitment. However, restoration of missing teeth using RBBs remains somewhat controversial due to the poorly controlled long-term prospective data regarding success.[1]

In the latest systematic review by Pjetursson *et al.*, they reported a five-year survival rate for RBBs as 87.7%.[1] This survival rate is lower than conventional bridges which is at the range of 90%[2] and implant retained single crowns which is at 94.5%.[3] However, majority of the studies included in this systematic review were poorly controlled, used different cements, used different design of retainers and also used different preparation techniques. In another study by Patsiatzi and Grey, they found that high proportion of practitioners used unfavourable RBB designs in general practices and hospital settings.[4] In fact, the persistent failure due to debonding (93%) as reported by Durey, can become obsolete by improving patient's dental education and thorough treatment planning by the clinician.[5] Today, RBBs are considered to be much more successful than before due to the development of chemically active adhesive resins, appropriate choice of metal for the retainer and implementation of better retention methods.

The aim of this article is to provide a clinical guide to produce predictable RBBs in general dental practices as well as government clinical settings pertaining to case selection, bridge designs and cementation protocol

CASE SELECTION

In general, a detailed assessment of general and local factors is crucial to optimize the success of a RBB. General factors including age, medical health and patients' expectations need to be taken into account. For example, Jepson *et al*. reported that they found a higher incident of caries after restoration of edentulous mandibular distal extension with removable partial denture compared to RBBs.[6] Therefore it is preferable to restore shortened dental arch using cantilever RBBs in elderly patients with reduced manual dexterity compared to replacing all posterior missing teeth using removable partial denture. As for expectation, patient must be informed and is willing to compromise the unaesthetical appearance coming from the metal retainer on the occlusal/incisal and lingual/palatal side of abutments. Young patients with translucent enamel edge have a high tendency for the greyish metal retainer colour to shine through their abutment tooth exhibiting greyish incisal edges.[7] However, this can be overcome by the design of a partial coverage palatal metal retainer or by the usage of opaque resin cements to block the greyish colour.[8]

With regards to local factors, assessments of space availability (mesio-distal and interocclusal) and condition of the abutments' coronal and periodontal support are important. Abutment tooth morphology such as shovel shape (anterior teeth) and prominent tubercle (canines) may compromise the bonding mechanism due to poor adaptation of metal retainer to these morphological surfaces. Poor adaptation will increase cohesive failure in the cements during function. Patients' occlusion must be thoroughly assessed too before being provided with RBBs. Patients with heavy occlusion or with existing parafunctional habit (bruxism) might not be suitable for RBB provision due to the higher risk of fixed prosthesis failure as reported by Beier et al. and Tomonaga *et al*.[9,10]

Post orthodontic treatment is also an important factor to be considered in the case selection. A retrospective study by Garnett *et al*. concluded and recommended that the fabrication of RBB must be 6 months or more post orthodontics treatment.[11] This is to allow for periodontal and gingival reorganization of the abutment teeth considering that residual forces can remain in the tissues of the periodontium after orthodontic tooth movement, and reorganisation of the periodontal ligament occurs over a three to four months period after treatment. The gingival collagen fibre network will then require four to six months to remodel and stabilize.[11]

Large and sound enamel with wide root surface areas are the preferable abutments for RBBs. Good quality of sound enamel is required to maximize the bonding efficiency of resin cement to the abutment tooth.[12] Therefore, the existing restorative status on the desired abutment tooth must be assessed for case selection. Aboush *et al*. and Guler *et al*. evaluated the bond strength of a recommended RBB luting cement (Panavia EX, Kuraray Co. Ltd, Osaka, Japan) onto enamel, dentine, and various restorative materials. They concluded that Panavia EX showed the two highest bond strength values to enamel and light-cured composite resin. Thus it is suggested that an amalgam restoration on the bonded surface of the abutment tooth is better replaced by a light-cured composite resin cement.[13,14]

The RBB design that might improve longevity

The most recommended type of RBB is a two-unit cantilever design bridge. However, a three unit fixed-fixed or hybrid design RBB can also be used in properly selected cases. Resin bonded bridges with multiple abutments are more likely to debond due to the differential movement of abutment teeth.[7,8,15]

i. Design of retainer

   Full coverage of the palatal and incisal surfaces of anterior teeth and the occlusal and lingual surfaces of posterior teeth will maximize the coverage/ bonding surface of the retainers (Figure 1). Djemal et al. have reported that maximized retainer coverage would improve the survival rates.[7]

   The metal retainers should be 1800 wrap around the posterior abutments where it covers the mesial and distal proximal surfaces to provide maximum coverage for retention.[16] If the abutment tooth morphology prevents any of this, minimal preparations (guide planes) can be made to allow framework extension into the coverage areas and provide path of insertion. Additional feature that can be placed at abutments to increase the resistance of retainer displacement are grooves at bucco-proximal line angle or pin channels.[17]

Figure 1. Full coverage design of metal retainers at anterior and posterior teeth.

Figure 2. (A) A mesial cantilever RBB (replacing 46) was cemented at an increased OVD. (B) Full re-establishment of occlusion after 3 months post-cementation on same patient.

Figure 3. A mesial cantilever RBB

ii. Three ways of creating space for the metal retainers.

Occlusal preparation (0.7 – 2.0mm.)[18] of the abutment tooth can be done in order to allow space for the retainer. One important precaution in using this technique is to ensure that there is still adequate amount of enamel remaining after tooth preparation to provide bonding surface for the prosthesis.

Adjustment of the antagonist tooth (shape/height) with an aid of a diagnostic wax-up.[18] It is important to note that the antagonist teeth should be correctly reduced to only provide the space needed as planned.

Application of relative axial teeth movement/ Dahl concept.[19] This concept can be utilized by cementing the RBB at an increased occlusal vertical dimension on a metal retainer and wait for the full arch tooth contact to be re-established over a period of time (Figure 2). This is the recommended technique by the authors.

iii. Design of bridge.

Cantilever design is sufficient to withstand the occlusal loading forces and resist tipping movement of the prosthesis (Figure 3).

Study done by Briggs et al. looked at 54 units of cantilever RBB with the mean follow-up of the prosthesis at 26.7 months. They reported only 20% (11 unit) debonded with a mean of 8 months.[20] Few similar studies were carried out and they reported higher debonded rates for fixed-fixed design.[21,22] In their discussion, the low debonded rates for cantilever design are due to the opportunity for free movement in the periodontal ligaments area of the pontic and single retainer. Sato et al. and Morgan et al. also supported the one unit abutment cantilever RBB design, due to the fact that this design provided more freedom of movement to the bridge unit.[23,24]

A fixed-fixed design is a rigid unit that unites two abutments with different individual mobility characteristics.[7] This design could be beneficial in replacing missing anterior teeth due to the aesthetical constraint in providing incisal metal coverage on anterior abutment teeth. Thus the extension of metal retainer coverage will be designed as partial coverage. By using the fixed-fixed design, the metal retainer coverage for retention will be increased on two abutments. Besides, if selecting a fixed-fixed design, the mobility characteristic of the abutment teeth should be almost similar, thus making them susceptible to be splinted.[25]

However, the authors would recommend the use of RBB with cantilever design with maximum incisal, palatal and proximal metal retainer coverage to replace anterior and posterior missing tooth.

v. Design of pontic

To increase longevity, pontic design should be self-cleansing and easy to be maintained by the patient. The ideal pontic design should have slight contact with the ridge labially, and a highly glazed convex surface palatally/ lingually.[28] A good example is the modified-ridge lap design. Other design such as the ovate pontic is also favourable due to the pontic's closely adapted emergence profile from the gingivae, which can mimic a natural profile of a tooth. The convex surface of the pontic makes the ovate design easily cleaned, and ensures no trapped food debris between the pontic and the gingivae.[29]

Cementation protocol of RBBs

Dental composite resin material has improved exponentially throughout the years. One particular composite resin luting cement that is recommended for RBBs is Panavia F2.0TM (Kuraray Co. Ltd, Osaka, Japan), due to the evidence of prolonged high bond strengths to the base metal. The 10-Methacryloyloxydecyl Dihydrogen Phosphate (10-MDP) in PanaviaTM will chemically bond to oxide layer of nickel-chromium alloys.[8] Furthermore, any greying effect of the metal retainer can be masked using Panavia F2.0TM opaque-coloured to improve the aesthetics of the anterior abutment teeth.

1. First, try-in of the RBB prosthesis intra-orally. Check for fit and seating of the bridge.
2. Then, continue with surface treatment procedures:

   Metal retainer – Protect the pontic and margin with wax and sandblast the retainer's fitting surface with 50µ alumina particles and followed by steam cleaning (optional to use ultrasonic water bath for 10 minutes). Dry with air from the 2-way syringe.

   Abutment teeth – Clean the tooth surface with pumice and water. Etch the surface with 37% phosphoric acid for 15 - 20 seconds. Wash for 20 seconds and dry with the 2-way syringe.
3. Resin luting cement application – Follow manufactures instruction with strict moisture control protocol using rubber dam.
4. Only perform minimal finishing during the cementation visit to avoid heat and stress that may debond the prosthesis. Continuation of the final finishing can be done during the following review visit.

CONCLUSION

RBB have a good prognosis as observed by various researchers; about 7 years 10 months by Djemal *et al*. and 9.4 years by Botelho *et al*.[7,30] Thorough assessment of cases with proper execution of treatment plannings and procedures will improve the success rate of this prosthesis. Patient motivation to maintain a good oral hygiene and their commitment for routine review appointments are also important to optimise the treatment outcome.

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