

A Case Series on the Versatility of Resin-bonded Bridges – A Minimally Invasive Fixed Dental Prosthetic Option

Ishan Roy Choudhury^{1*}, Kritika Rajan¹, Tirthankar Debnath², Nibir Sarkar¹

¹Department of Prosthodontics and Crown and Bridge, Dr. R. Ahmed Dental College and Hospital, Kolkata, West Bengal, India.

²Department of Periodontia, Dr. R. Ahmed Dental College and Hospital, Kolkata, West Bengal, India.

Abstract

The resin-bonded dental prostheses are a minimally invasive and quick fixed partial dental prosthesis that is used as an alternative to conventional fixed or removable partial dentures and dental implants when these are contraindicated due to esthetics, patient's demands or limited time. It is an extremely versatile treatment option and combines the rigidity of a fixed partial denture but at the same time allows little or no tooth preparation. The preparation in the case of resin-bonded bridges is completely palatal or lingual. The present case series describes the successful treatment of replacing missing teeth in an adolescent child with a large pulp chamber and helping splint mobile teeth in a middle-aged working woman with a busy schedule with the help of resin-bonded dental bridge.

Keywords: Esthetic dentistry, Maryland bridges, Minimal preparation, Resin-bonded bridges, Virginia bridge.

INTRODUCTION

Conventional abutment preparations can lead to aggressive removal of healthy tooth structure. This could often lead to disastrous long-term prognosis on the abutment teeth in young patients who have lost their teeth due to trauma or disease. Furthermore, there is always the risk of iatrogenic pulp exposure to these young teeth, due to their large pulp chambers. A resin-bonded fixed dental prosthesis in these scenarios offers acceptable esthetics, conserves tooth structure, and hence improves long-term prognosis, due to advancements in adhesive dentistry.

The resin-bonded fixed dental restoration consists of one or more pontics supported by thin metal retainers bonded lingually and proximally to the enamel of the abutment teeth. The success of these conservative fixed dental prosthesis depends on the retention provided by adhesive bonding between etched enamel and the metal, and the precise adaptation of the metal to the abutment.^[1]

In 1973, Rochette introduced a perforated metal framework for resin-bonded partial dentures. The primary disadvantage of this technique was the selective wearing of resin from the perforations and early failure of the restorations. Kern and Thompson later improved this with the Maryland bridge, using etched non-precious alloys for better bonding. However, limitations such as technique sensitivity and restriction to specific alloy

combinations prevented widespread adoption of this method. In 1983, Hudgins *et al.* developed particle-roughened retainers using the lost salt technique (the Virginia bridge), which avoided these issues with resin-bonded metal retainers.^[2]

Indications

- Replacement of missing anterior teeth in children and adolescents – Traditional fixed prosthodontic treatment modalities are typically not recommended for young patients due to insufficient plaque control, the large size of dental pulps, and the fact that children often engage in sports thus increasing chances of tooth fracture should conventional fixed dental prostheses be used,
- Splinting – Resin-bonded bridges can be used as splints to stabilize teeth before, during, or after periodontal therapy, they are used in conjunction with a splint design to treat periodontal problems that involve missing teeth,
- Caries-free abutment teeth – Healthy teeth or those with minimal restorations can serve as suitable abutments for

Address for correspondence: Dr. Ishan Roy Choudhury,

Department of Prosthodontics and Crown and Bridge, Dr. R. Ahmed Dental College and Hospital, Kolkata, West Bengal, India.
Email: ishanr3@gmail.com

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resin-bonded retainers. Having interproximal restorations does not rule out the use of a bonded retainer. However, extensive restorations or those that affect the incisal edge may compromise the bond strength and the mechanical integrity of the abutment. These restorations should be included in the design,

- Resin-bonded fixed dental prostheses are better suited for shorter edentulous spans,
- Single posterior tooth replacement – Replacement of posterior teeth can be achieved given that the span of restoration does not include more than three units. Resin-bonded fixed partial dentures consisting of greater than three units should be used only if there is some mitigating treatment-planning consideration, such as opposing a removable partial denture, which would result in less occlusal stress,
- Significant clinical crown length – Use of short clinical crowns is contraindicated due to the reduction of surface area available for bonding, and
- Excellent moisture control – as with all adhesive dentistry, moisture control is of utmost importance.

Contraindications

- Extensively restored or damaged abutments should not be used as they pose an increased risk of debonding or fracture of abutments. In these scenarios, one heavily restored, and one sound abutment can be satisfactorily be used, with a conventional preparation done on the heavily restored tooth,
- Para-functional habits – In patients with para-functional habits, resin-bonded fixed dental prostheses should be used carefully because they are more likely to become displaced than conventional fixed dental prostheses. It is best to restrict their use when strong lateral forces are expected, like in patients with para-functional habits or those needing an anterior tooth replacement without stable back teeth. In these situations, techniques to enhance the retention of the framework – such as grooves, occlusal rests, or metal extensions should be employed,
- Long edentulous spans pose an increased risk of debonding or fracture with repeated loading,
- Deep overbites prevent adequate enamel reduction and places excessive forces on the abutment teeth, and
- Nickel allergy – Metal resin-bonded fixed dental prostheses are usually fabricated from nickel chrome (Ni-Cr) alloys.

Advantages

- Minimal removal of tooth structure – A minimal tooth preparation limited to enamel is required. Only about 10% of hard tissue is removed compared with 40–60% hard tissue removal (enamel and dentin) when preparing teeth for conventional crowns,
- Minimal potential for pulpal trauma, as the preparation is usually limited to the enamel. Consequently, there is no need for local anesthesia.
- Supra-gingival preparation – The finish line is placed equi- or supra-gingivally, hence preventing violation

of the biological width. Supra-gingival preparations also un-complicate impression-making procedures and precludes the need for hemostasis,

- Interim restorations are usually not required, as the abutments are not altered occlusally, hence maintaining vertical dimension and preventing supra-eruption. In addition, there is no dentin exposure, and thus no post-operative sensitivity,
- Reduced chair time due to minimal preparation also reduces patient expense,
- Should the prosthesis fail, re-bonding of the same is possible, and
- All routine treatment options such as conventional fixed dental prostheses and implants, remain viable. Thus, these considerably more invasive treatment modalities can be postponed to an older age should they become necessary. This increases the functional lifespan of these abutment teeth.

Disadvantages

- Reduced restoration longevity due to the inherently less retentive preparation design. Additional retentive features, if employed, make the preparation challenging,
- When the pontic space is greater or less than the dimensions of a normal tooth, achieving an esthetic result with this restoration is difficult. As with conventional fixed dental prostheses, treatment of a diastema is demanding, although a cantilever option may be appropriate,
- Good alignment of abutment teeth is required because the fixed partial denture path of placement is limited by the thickness of enamel to be included in the preparation, and
- Especially on anterior teeth, there is a significant chance of show through of the gray metallic retainers through the translucent enamel. White-opaque luting resins are required to mask the dark metal framework. This can result in a visible and unesthetic bonding line in the proximal area at the transition to the pontic.

Advancements in adhesive dentistry since the 1980s have unleashed a new era in dentistry, allowing the direct metal-to-tooth bonding using conventional polymethyl methacrylate resin modified with adhesion promoter 4-methacryloxy trimetallic anhydride (4-META) and tri-n-butyl borane catalyst system. This system was tougher and more elastic than the bisphenol A-glycidyl methacrylate (bis-GMA) based resin cements of the time but showed variability in results with different Ni-Cr alloy combinations and noble metals. Following this, a new bis-GMA resin modified with the 10-methacryloyloxydecyl dihydrogen phosphate adhesion promoter (Panavia) was introduced which further mitigated the limitations of the 4-META system. Using 50-µm alumina to abrade the alloy surface before bonding is recommended and enhances the surface by creating a rougher texture thereby increasing the surface area for bonding. In addition, this process forms a molecular layer of alumina on the surface, which has been shown to improve the bond strength.^[3]

CASE SERIES

Case report 1 – Resin-bonded bridges used to replace anterior teeth in young adolescent

A 15-year-old female patient reported with chief complaint of unesthetic smile due to missing tooth in the lower front teeth region for the past 4 months. History revealed that the patient had met with an accident and lost her tooth. There was no relevant medical history given by the patient. Extra-oral examination revealed no abnormalities. Intra-oral examination revealed a missing mandibular right central incisor. The edentulous site was 5–6 mm mesiodistally. The patient was young and wanted a minimally invasive treatment option to treat the esthetic issue. A resin-bonded fixed dental prosthesis was planned from 32 to 41 (Figure 1).

Case report 2 – Resin-bonded bridges used for splinting periodontally compromised teeth

A 52-year-old female reported with a chief complaint of mobile teeth in the lower front tooth region for the past 4 years. The patient gave a history of periodontal problems which lead to mobile teeth for which she had undergone splinting 4 years back in which her mandibular centrals and lateral incisors were involved. No extraoral abnormalities were noted. Intra-oral examination revealed Grade II mobility in 31, Grade I mobility in 41, and a space present between 31 and 32 due to pathological migration. The edentulous site was measured 3 mm mesiodistally. The patient was also clear that she did not want to undergo any extraction procedure and wanted a suitable treatment plan which would treat both the mobility as well as esthetics. A resin-bonded fixed dental prosthesis was planned from 33 to 43 (Figure 2).

Treatment plan

Diagnostic impression was made using irreversible hydrocolloid and the diagnostic cast was poured using Type III gypsum product (Ultradent, Kalabhai Karson Pvt. Ltd., Mumbai, India). Maxillary and mandibular cast was mounted on a mean value articulator. The diagnostic wax-up was made for

the missing teeth and a putty index was made over the same for the fabrication of provisional restoration. A full lingual preparation was made for tooth 32 and 41 in case report 1. A lingual window preparation was made for tooth 32, 33, 42, and 43 and a full lingual preparation was made on tooth number 31 and 41 in case report 2. Final impression was made using the addition silicone putty and light body elastomeric impression material (GC flexceed). The master cast was poured using Type IV gypsum product (Ultradent, Kalabhai Karson Pvt. Ltd., Mumbai, India). Provisional restoration was fabricated using the tooth-colored cold cure resin (Pyrex® High-Quality Cold Cure SC-10) using the direct technique.

The wax pattern was prepared using inlay wax over the die cast. It was removed carefully from the die, then sprue wax was attached, followed by investing it in the casting ring. The conventional dewaxing and casting procedure was done in an induction casting machine followed by finishing of metal coping. The metal try-in was carried out in the patient's mouth, after which the conventional porcelain layering, firing, glazing, finishing, and polishing were done. The final prosthesis was evaluated for marginal fit and occlusion. After necessary corrections, the tooth and prosthesis were acid etched using 37% phosphoric acid and hydrofluoric acid, respectively. The bonding agent was applied and both prostheses were cemented using dual cure resin cement (Figures 3 and 4). Post-delivery instructions were given to both patients and both were recalled at on week, 1 month and 6 months follow-up.

DISCUSSION

Although there has been a pervasive understanding that resin-bonded bridges are fragile, prone to failure, and merely temporary restorations, studies have shown a 5-year survival rate of 73.9% for the two-retainer designs and 92.3% for the single-retainer design.^[4] When unilateral fractures of the fixed partial denture were counted as failures, the rate



Figure 1: Top: Intra-oral view of missing 31. Bottom: Occlusal view of mandibular arch showing the prepared lingual surface in 32 and 41



Figure 2: Top: Intra-oral view of mobile 31 and 41 after periodontal therapy. Notice the small edentulous space present distal to it due to pathological migration of tooth, bottom: Occlusal view of mandibular arch showing prepared lingual surface in 31, 32, 33, 41, 42, and 43



Figure 3: Top: Intra-oral view of resin-bonded bridge after cementation, bottom: Occlusal view of mandibular arch showing resin-bonded bridge in place



Figure 4: Top: Intra-oral view of resin-bonded bridge after cementation, bottom: Occlusal view of mandibular arch showing resin-bonded bridge in place

for the two-retainer group fell to 67.3%, indicating that two retainer designs are inferior to the single retainer restoration,

probably due to the unfavorable non-axial forces placed on each abutment, and the limitation of their freedom of movement.^[5,6]

Marinello *et al.* in 1987 made a joint evaluation of 496 resin-bonded bridges as opposed to splints anchored by composites in cases of congenital anodontia and loss of teeth due to caries and trauma. After 3 months, 95% of bridges were still in place without need for reattachment procedure. After 6 months, the figure was 91% after 1 year 81.5%, and after 11/2 years it was 73%. It was also seen that the rates for splints were significantly lower.^[7]

CONCLUSION

In the situations discussed above, the resin-bonded fixed dental prostheses were regarded as the most befitting treatment modality due to the reduced chairside time and minimally invasive procedure. Resin-modified bridges are an economical, esthetic, and minimally invasive treatment option compared to other modalities of treatment hence they are best suited for many scenarios.

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