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Resin-bonded bridges for the pediatric patient

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Abstract

The resin-bonded bridge is a relatively new clinical technique that has had favorable clinical reports. Recently, new materials and techniques have been developed which may improve the retention of resin-bonded bridges. The following article will review recent developments concerning resin-bonded bridges, present a case report, and give practical suggestions regarding the fabrication of resin-bonded bridges.

Literature Review

Replacing a missing permanent tooth for a child requires special care and treatment planning. The resin-bonded bridge offers a conservative method for replacing a missing tooth by either A) bonding a tooth directly to the adjacent teeth, or B) bonding a cast retainer to the adjacent teeth.

The Simple Resin-Bonded Bridge

This type of resin-bonded bridge is ideally suited as a short-term prosthesis that can be made at chairside and inserted at the same appointment (Ibsen 1973). Depending on the circumstances, the dentist may bond an acrylic tooth, the patient's own tooth, or a composite resin tooth directly to the adjacent teeth (Fig 1). If an acrylic denture tooth is used, a retention groove should be cut in the lingual surface of the acrylic to increase the bond strength between the composite resin and the acrylic tooth. If the pontic is made from composite resin, this groove is unnecessary. When the patient's own tooth is used for the pontic, all pulpal tissue should be removed to prevent discoloration of the tooth due to hemolytic byproducts from the necrotic pulp (Borer and Frank 1984).

Metal Framework Resin-Bonded Bridge

A more permanent yet still conservative bridge uses cast retainers bonded to etched enamel. Several different techniques have been proposed:

1. Rochette Bridge

The cast perforated lingual retainer first was described by Rochette (1973) as a technique for making a periodontal splint. In this type of retainer design the metal framework is attached to the resin through perforations in the framework. These perforations are a weak link, and under high loads the resin may fail at the isthmus of the perforations (Eshleman et al. 1981).

2. Etched Metal Bridge

To improve the strength of the resin-to-metal bond, Thompson et al. (1981) developed the electrolytically etched metal resin-bonded bridge. This technique creates retentive micropores in the metal framework which can produce a resin-to-metal bond that has 2 to 3 times the bond strength of the resin to etched enamel.

The metal electrolytic etching process is a technique-sensitive procedure that differs according to the alloy

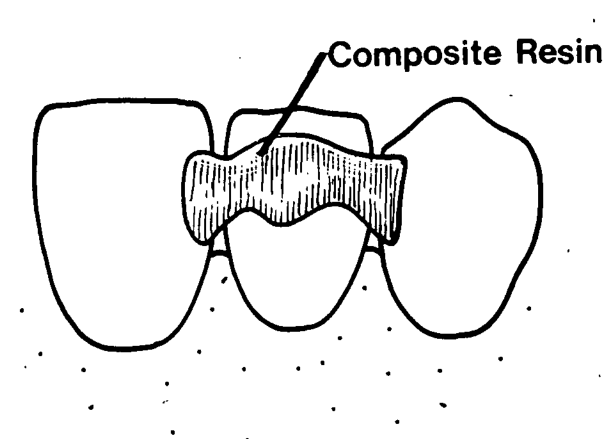

Fig 1. Diagram of lingual view of simple resin-bonded bridge showing composite resin bonding pontic to adjacent teeth.

used (Livaditis 1986). Unfortunately, the only reliable method of checking the 3-dimensional quality of the etched metal is with the scanning electron microscope. However, it has been observed that the bonding agent spreads rapidly over a properly etched metal surface. If this "spreading" is not observed during cementation, the bridge should be returned to the laboratory for re-etching.

Few long-term clinical trials of the etched metal resin-bonded bridge (EMRB) have been conducted. Thompson and Wood (1986) evaluated 80 bridges that had been placed 3-5 years previously. The overall failure rate was 22%; no caries was detected in any of the retainers; and the periodontal response was increased only slightly. Mohl et al. (1988) reported five failures out of 33 EMRB bridges that had been cemented using Comspan (Comspan—L.D. Caulk Co.; Milford, DE) which were followed for at least 24 months. All failures occurred at the resin-enamel interface. The results showed that good moisture control during cementation and a strong rigid framework were necessary for a successful restoration. These studies suggest a favorable long-term clinical success for the EMRB.

Most of the disadvantages of the electrolytic etching technique are due to the electrical components of the system (Livaditis 1986). Chemical etching is a simpler procedure and should allow more laboratories to produce a properly etched alloy surface. Successful results using Assure-Etch (Assure Etch—Williams Gold Refining Co. Inc.; Buffalo, NY) to etch the alloy chemically have been reported (Livaditis 1986; Priest and Donatelli 1988).

The success of the resin-bonded bridge also depends on the properties of the adhesive resin cement. Several resin cements are available, but long-term clinical trials have yet to show a definite preference for one cement. Wiltshire et al. (1987) found no statistical difference between the tensile bond strengths of ABC Cement (ABC Cement—Vivadent; Schaan, Liechtenstein), Comspan, Conclude (Conclude—3M; St.Paul, MN), Maryland Bridge Adhesive (Maryland Bridge Adhesive—Teledyne/Getz; Elk Grove Village, IL) and Resin-Bonded Bridge Cement (Resin-Bonded Bridge Cement—Kerr/Sybron; Romulus, MI). Comspan cement also has had favorable reports in clinical trials (Mohl et al. 1988, Priest and Donatelli 1988).

New dental cements [e.g.: Super-Bond C&B (Super-Bond C&B—Sun Medical Co., Ltd.; Minami-Ku, Kyoto, Japan), Panavia EX (Panavia Ex—J.Morita Inc.; Tustin, CA)] have been marketed recently that are claimed to bond chemically to enamel, sandblasted nickel chromium (NiCr) alloys, and tin-plated gold alloys. This chemical bond eliminates the need for etching the metal. Super-Bond C&B, a 4-META adhesive resin, has been reported to adhere to enamel and metal (Hamada et al. 1985; Myers et al. 1987). In an in vitro study, Watanabe et al. (1987) reported that Panavia EX and Super-Bond C&B cements had higher bond strengths to metal than Conclude cement.

However, since the new bonding cements and the more recent techniques for preparing the alloy surface have not undergone long-term clinical trials, a conventional resin-bonded bridge cement, Comspan, and electrolytic etching were used in the following case.

Case Report

A 14-year-old white male presented for treatment at the University Dental Clinic requesting that "something be done about the space in the front of his mouth." Six years earlier he had fallen off his bicycle and fractured the permanent right maxillary central incisor. The patient stated his dentist had attempted to do a root canal; subsequently, the tooth continued to "crumble and fracture." At time of presentation, only a root tip of the right maxillary central incisor and an associated draining fistula remained. The upper left permanent central incisor also had been traumatized five years prior in another bicycle accident. No treatment had been rendered; the left central incisor had an Ellis Class 2 mesioincisal angle fracture and was asymptomatic. All secondary teeth except the third molars were erupted and well aligned. Occlusal examination revealed canine guidance on right and left sides and incisal guidance in protrusive excursions.

Initial treatment consisted of extraction of the retained root tip of the maxillary right central incisor and an acid-etched composite restoration on the maxillary left central incisor. An acrylic partial denture was constructed to replace the missing maxillary right central incisor.

This patient had no clinical contraindications to placement of a resin-bonded bridge. Preliminary records (diagnostic casts) were taken one year after extraction of the maxillary right central incisor. A diagnostic wax-up was done to determine whether the edentulous space would accommodate a pontic of acceptable size and shape. The maxillary left central incisor and the maxillary right lateral incisor were prepared with a mini-chamfer finish line gingivally and proximally, a knife edge finish line incisally, and cingulum rests (Fig 2). An impression was taken with President (President Coltene—Cook-Waite Laboratories; Aurora, ON) in a custom tray. The framework was cast in Rexillium III metal (Rexillium III—Jeneric Industries; Wallingford, CN), as recommended by the manufacturer. At the next appointment the bridge was fitted, and the pontic contour and occlusion were adjusted to provide light

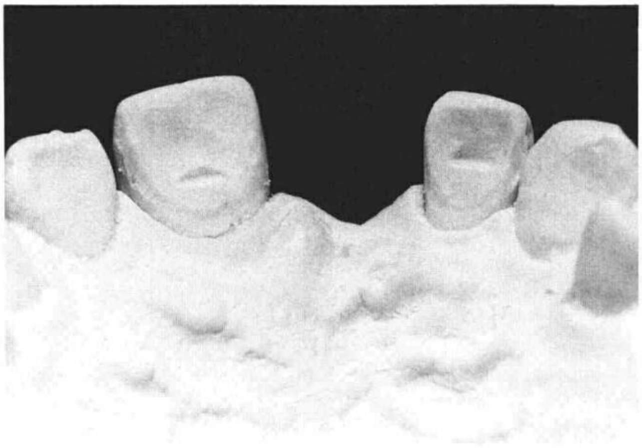

Fig 2. Lingual view of working model showing cingulum rests and finish line lingual to the contact point on abutment teeth.

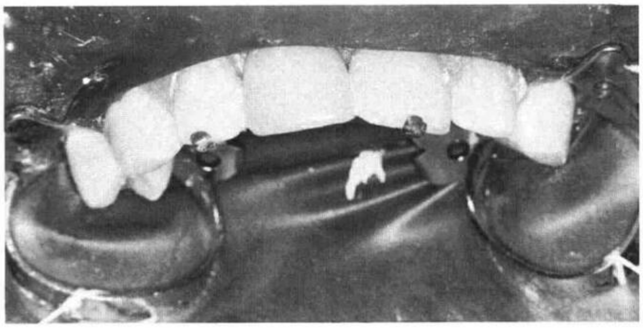

Fig 3. Cementation of bridge with rubber dam isolation; the incisal seating guides visible from labial will be removed after resin cement is set.

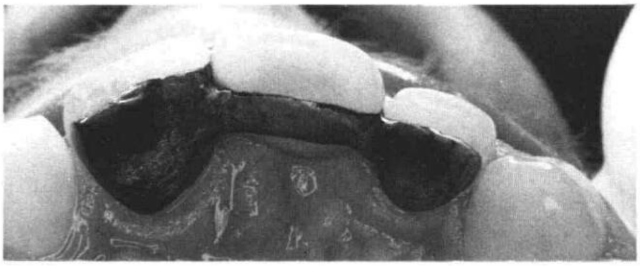

Fig 4. Lingual view of cemented bridge after removal of incisal seating guides.

Fig 5. Labial view of cemented bridge at one-year recall.

occlusal contact on the pontic. The porcelain was glazed, and the metal framework was electrolytically etched. Two weeks later the bridge was cemented under rubber dam isolation using Comspan Opaque cement to minimize incisal graying (Fig 3). After the cement had set, the incisal seating guides and excess cement were removed (Fig 4). Oral hygiene and flossing instructions were given to the patient. At both one- and two-year follow-ups, the patient had no problems with the bridge and was pleased with both appearance and function (Fig 5).

Practical Suggestions

Proper modification of the abutment teeth increases the success of a resin-bonded bridge. The entire preparation should be within enamel, and the teeth should be modified to provide the following.

1. Occlusal clearance of approximately 0.5 mm to provide adequate strength to the metal framework. This occlusal clearance can be maintained while the bridge is being made by adding composite resin to the incisal edges of the opposing teeth. If sufficient occlusal clearance cannot be obtained in centric occlusion and in excursive movements without removing all of the enamel, either the opposing tooth should be adjusted or an alternative type of prosthesis should be used.

2. Adequate resistance form by extending the preparation outline as far as possible onto both proximal surfaces of the abutment teeth (Fig 6, page 192). In the anterior region esthetics usually dictate a preparation that finishes lingual to the contact point (Fig 6). In the posterior region the preparation should be extended beyond the contact point only on the surface adjacent to the pontic. An occlusal or cingulum rest (Fig 7C, page 192) will provide increased resistance to occlusogingival forces on the bridge.

3. Adequate retention form by covering the maximum surface area of enamel with the framework. The framework ideally should cover more than 180 degrees of the tooth's circumference to produce a "wrap around" effect that maximizes both the resistance and retention form. Due to esthetic concerns, this effect often is not possible in the anterior region.

4. A guide plane in the proximal area giving a single incisogingival path of insertion (Fig 7D). To give a buccolingual bracing effect, the guide plane should be contoured in the proximal areas to produce a convex outline (Fig 6, arrows). If the proximal area is flattened buccolingually, this bracing effect is lost and resistance form is compromised.

5. A knife edge incisal finish line 1.0-1.5 mm below the incisal edge (Fig 7A). If incisal graying of the retainer teeth is observed where the framework shows through

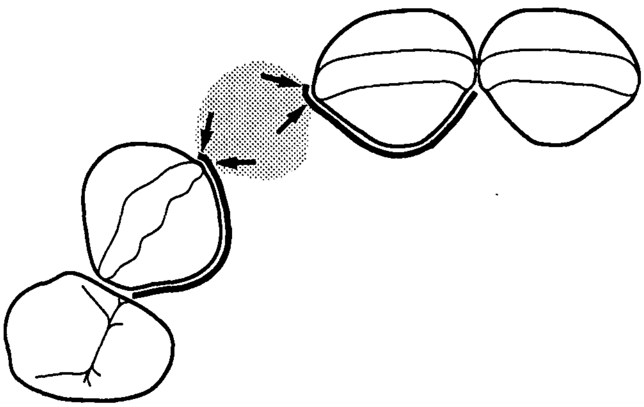

Fig 6. Diagram of metal framework for resin-bonded bridge showing ideal extent of enamel coverage. Arrows show where proximal areas of abutments have been prepared to give a convex outline which helps prevent buccolingual displacement.

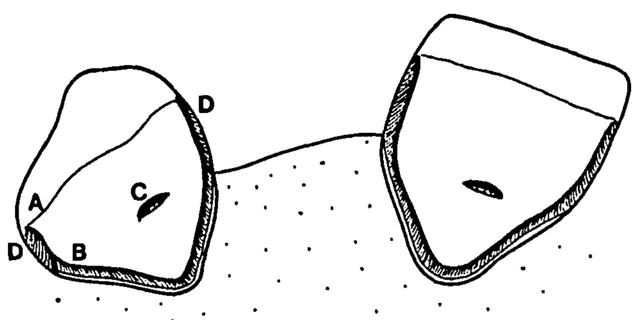

Fig 7. Diagram of preparations of anterior abutment teeth showing (A) knife edge incisal finish line 1.0 - 1.5 mm below incisal edge, (B) mini-chamfer at gingival margin located 1.0 mm supragingivally, (C) cingulum rest and (D) proximal guide planes.

the incisal enamel, the framework then can be cut back incisally at the try-in appointment. The amount of graying also can be reduced by using an opaque resin-bonded bridge cement (e.g.: Comspan Opaque) when cementing the bridge. The gingival margin should be a mini-chamfer located supragingivally (Fig 7B) and should not extend beyond the cementoenamel junction.

6. Incisal seating guides (Fig 3) in the metal framework. These seating guides are not etched and are useful aids to ensure that the bridge is seated fully during cementation. After the resin has set, these guides are cut off easily with an ultraspeed drill. A copious amount of water coolant is used to prevent the metal framework from overheating and damaging the metal-resin bond (Caughman et al. 1988).

Conclusions

Some former concerns with resin-bonded bridges have been resolved because of improvements in adhesive resins and bonding techniques. This paper has reviewed recent developments in the fabrication of resin-bonded bridges and has outlined some practical considerations for their use in pediatric dentistry. With the advances that are being made in materials and techniques, the resin-bonded bridge should last the pediatric patient into adulthood. When a replacement is required, a similar type of conservative prosthesis can be used.

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