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SCIENTIFIC articles

Anterior etched cast-resin bonded bridges: an alternative for adolescent patients

Morton Wood, DDS, MEd

Abstract

This article reviews the literature of "acid-etched bridges" and discusses the critical features of design and mouth preparation. Details of fabrication, bonding and application for the adolescent patient are included. A clinical report is observed from the treatment planning phase through bonding of the bridge.

Replacing missing permanent teeth for the adolescent or young adult patient is often a difficult challenge. Incomplete passive eruption, enlarged pulp chambers, and inadequate gingival embrasure space are often pronounced enough to contraindicate the use of conventional porcelain-fused-to-metal bridgework. Even when fixed prosthodontics is technically possible, abutment teeth are often free of caries or restorations and, therefore, an alternative type of tooth preparation should be sought.

Rather than provide fixed bridgework for the young patient, many dentists place interim removable partial dentures until teeth and tissue relationships are more "mature." However, many patients find that these dentures are bulky and difficult to tolerate, while others will become accustomed to them and use the dentures longer than originally intended. Prolonged use of interim dentures creates possible soft tissue damage and bony defects in the edentulous ridge or inflammation of the tissues under the denture-bearing area.[1,2]

Due to disadvantages found in the use of traditional crown and bridge and interim partial dentures, alternative treatment modalities are attractive to both dentist and patient. Etched cast-resin bonded bridges provide such an alternative.

Literature Review

Improvements in composite resins and the widespread use of acid-etch techniques have led to the use of enamel bonding to replace missing teeth. The first reported use of an "acid-etch" or bonded bridge was actually no more than a pontic attached to adjacent abutment teeth by means of a composite resin which bonded to both the pontic and the acid-etched enamel. A variety of materials have been advocated for these pontic sections and have included acrylic denture teeth,[3-5] composite resin,[6] and the natural extracted tooth.[7] Because most of these bonded pontics had significant short-term success rates,[8] practitioners have been reluctant to use them except as provisional restorations.

In the development of more durable yet conservative bridges, Rochette[9] introduced a splinting technique that utilized lingual cast perforated retainers which were bonded to etched enamel. Howe and Denehy[10] reported a similar resin-bonded technique for the replacement of missing teeth. Their bonded bridge consisted of cast perforated retainers and a porcelain-fused-to-metal pontic. A filled and unfilled composite resin system was used for the actual bonding. Initially, the bridges were advocated for short-span anterior restorations with limited occlusal contact; however, Livaditis[11] reported on the use of cast perforated retainers for replacing posterior teeth. By incorporating proper design criteria, these retainers were able to withstand full occlusal force.

Since cast perforated restorations are bonded to a much larger enamel surface area than single pontic replacements, their retention is improved. Although the limiting factor in the bond is the mechanical retention of the composite in the perforations,[12] Denehy recently reviewed the technique and reported on successful seven-year results.[13]

In an attempt to improve on the retentive properties of the cast perforated bridges, Livaditis and Thompson[14] introduced a major improvement in the field of enamel-bonded bridges. The technique utilizes nonperforated cast retainers that are etched electrolytically where they contact tooth structure (Figure 1). The retainers are bonded to etched enamel using a low-film thickness composite resin.[a] The film thickness is approximately 20 μ[15] and allows a more complete seating of these nonperforated castings.

[a] Compsan, L.D. Caulk Co.: Milford, Del.

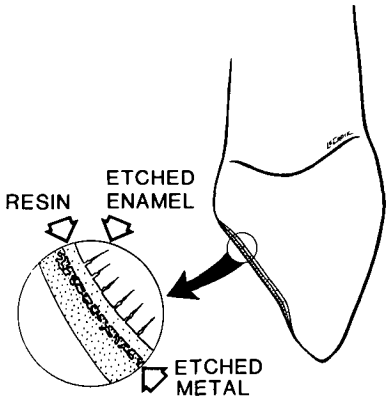


Figure 1. Cross-section view through a tooth bonded with a nonperforated etched casting. Note the mechanical retention of the resin throughout the surface of the etched metal.

Etched cast-resin bonded retainers provide distinct advantages: the resin-to-etched metal bond is at least twice the strength of the resin-to-enamel bond;[16] minimal cross-sectional contours are possible due to the use of nonprecious alloys;[b] margins are thin and featheredged; the oral side of the retainers is smooth and highly polished; they are suitable for anterior and posterior restorations; and the technique appears to be suited ideally for the adolescent patient.

The author and colleagues have been placing etched cast bridges for more than three years, and where indicated they provide a viable alternative for the young adult patient. Although etched restorations cannot yet be considered permanent, they give every indication that they will provide long-term service and are a definite improvement in the area of resin-bonded bridges.

Clinical and Laboratory Procedures

Design

Design and outline form of the restoration are based on the development of a distinct path of insertion which allows individual retainers to cover as much enamel as possible — provided occlusion, esthetics, and periodontal health can be maintained. Besides covering differently directed enamel rods, the cast framework is designed to engage tooth structure in several different planes so that retention and resistance to dislodgement are combined functions of both enamel bonding and proper metal design.

In addition to their outline, the actual contours of individual retainers are important features since they are extracoronal and result in slight overcontouring. Therefore, the supragingival margins must be finished to a thin featheredge, while the remainder of the retainer is adapted intimately to the tooth structure and kept fairly thin except where it broadens into the pontic connector area. Thin retainers with feathered margins and open embrasure form allow bridges to be hygienic and easily tolerated by patients.

Mouth Preparation

In general, mouth preparation consists of creating occlusal clearance, modifying the lingual height of contour, developing proximal extensions, preparing cingulum rests and establishing a path of insertion.

1. *Occlusal clearance.* Develop 0.5 mm interocclusal clearance and verify clearance throughout all mandibular movements. Diamond wheels and tapered burs are indicated for the enamel reduction and can be used on the abutment teeth and occluding teeth in the opposing arch. To maintain the clearance established for a maxillary prosthesis, bond composite resin to the occluding enamel surfaces of the mandibular teeth. Since the adolescent dentition is often in a dynamic stage, the resin "holds" occlusal contacts and prevents supereruption of the mandibular teeth during bridge fabrication. To verify the occlusal relationship of the bridge, the composite resin can be removed from the mandibular teeth for trial insertion or before bonding.
2. *Lingual height of contour.* On permanent anterior teeth the lingual height of contour normally is located in the gingival one-third. If it is found more incisal, use fine tapered diamond burs to lower it to the gingival one-third. Do not make chamfer-type finish lines or penetrate enamel.
3. *Proximal extensions.* Prepare parallel proximal surfaces on the abutment teeth adjacent to the edentulous space. Use a tapered diamond bur and extend the preparation 2-4 mm in an occlusogingival direction and as far to the labial as esthetics will allow (Figure 2). These proximal extensions allow a "wraparound" design of the metal framework which prevents any labiolingual displacement of the restoration once it is seated (Figure 3). Esthetics are not compromised with this design because the metal which engages the area of the proximal extensions is masked by both the proper contour of the pontic porcelain and the sealing action of the composite resin.
4. *Cingulum rests.* Prepare the rest seats or notches with a #35 or 37 inverted cone placed in the greatest bulk of enamel (Figure 2). They should be V-shaped and angled gingivally to allow a more positive seating of the retainers.

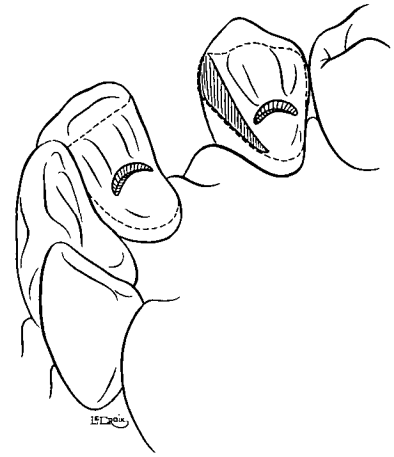


Figure 2. Lateral view of anterior abutment teeth showing the proximal outline of the projected metal extension as well as the placement of the cingulum rest seats.

[b] Rexillium III, Jeneric Industries: Wallington, Conn.

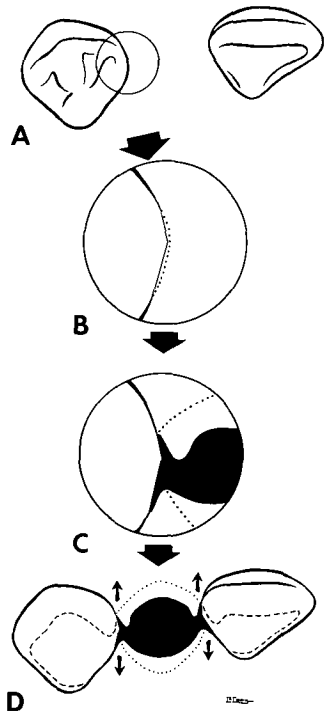


Figure 3. (A) Incisal view of the unprepared abutment teeth. (B) Close-up of the proximal preparation of the canine. The dotted line represents the contour of the original tooth structure. (C) Close-up of the canine shows the wraparound design of the retainer and pontic. The dotted line represents the outline of the porcelain while the solid area shows the metal substructure. (D) Incisal view of both prepared teeth shows that the metal substructure extends just beyond the facioproximal line angle of both abutment teeth. The dotted lines represent the area of porcelain while the broken lines reveal the outlines of the lingual retainers. The arrows indicate how the framework is "locked" into position and cannot be displaced in a labial or lingual direction.

5. *Path of insertion.* After completion of all modifications on the abutment teeth, there should be a distinct path of insertion which is free of undercuts.

Fabrication and Trial Insertion

Hard die stone casts are made from any of the accurate elastomeric impression materials. Removable dies are not used; therefore, the tooth position and relationship to gingival tissues is unaltered and accurate.

1. *Development of framework.* The outline of the retainers is drawn lightly on the cast. The pattern is developed by adapting a poly (methyl methacrylate) resin.[c] Although there are no definitive finish lines on tooth structure, margins are placed supragingivally and finished to a featheredge. The nonmargin areas of the retainers are kept between 0.3 and 0.5 mm thick while establishing contours that are in harmony with the existing tooth structure. The pontic section is established in inlay wax and attached to the retainers. The pattern then is invested and cast. After finishing the metal surface, porcelain is applied and the bridge is returned to the dentist for try-in.
2. *Try-in goals.* Adjust occlusion, characterize and glaze the porcelain, and verify the esthetics. The etched surface of the casting tends to darken or make gray the incisal edge of some anterior abutment teeth. This color change appears to be a function of the translucency and thinness of enamel and is most pronounced after the restoration is bonded.[17] To simulate the bonded result, seat the bridge on the unetched teeth with a mix of composite resin containing a small drop of eugenol. The eugenol inhibits the setting reaction of the composite resin and allows the material to be removed easily both from the retainer and tooth structure. If discoloration of the enamel appears, the restoration can be bonded with a composite resin which contains an opaque substance that masks the dark surface of the etched metal.[d]
3. *Etching.* Following trial insertion, the oral side of the retainers is polished and the restoration is etched electrolytically. Details of the etching have been described previously[14,18] but, in general, the bridge is attached to a stainless steel electrode and the nonetched surfaces are masked with sticky wax. The bridge then is emerged in an acid bath and subjected to an electric current. The etching leaves a black residue layer which is removed by placing the bridge in an ultrasonic bath with a solution of 18% hydrochloric acid for 15 minutes. The acid is rinsed off and the etched surface is examined under a 60-80x stereoscopic microscope to verify a proper etch pattern. The bridge is removed from the electrode and sticky wax by running cold water over it.

Bonding

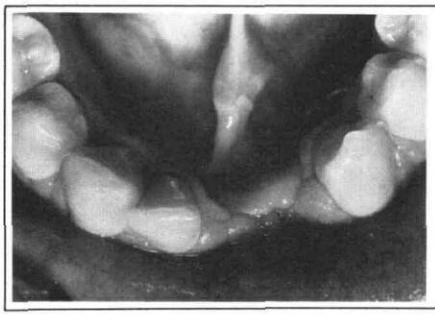
Care must be exercised in handling the etched surface of the bridge, and should contact occur, it must be solvent-cleaned in methyl methacrylate monomer, acetone, or chloroform and dried before bonding.

Since the weakest link in the system is the resin-to-enamel bond, a dry field is essential. Whenever possible, the bonding should be accomplished under a rubber dam which is well inverted to prevent any moisture leakage. Because the composite resin has a relatively short working time, the practitioner should become familiar with the path of insertion by a trial seating of the bridge. During this trial seating, verify that the rubber dam does not impinge on any area of the retainers. Care must be exercised not to abrade the etched surface and the bridge should be cleaned with solvent once again as mentioned above.

The teeth then are cleaned with a fine flour of pumice, rinsed, dried, and the 30-50% orthophosphoric acid applied for 60 seconds. The teeth are rinsed for 30 seconds, dried, and the characteristic frosty appearance verified. It is essential that close coordination and efficiency between the dentist and assistant be established so that no critical time is lost during the bonding procedure. A bonding agent (unfilled resin) is applied to both etched enamel and etched metal, while the composite pastes are mixed and applied to the metal side only. The bridge immediately is brought to the mouth and seated with even force until the composite sets. Before polymerization is complete, ex-

[c] Duralay, Reliance Dental Manufacturing Co.: Wath, Ill.

[d] Compsan Opaque, L.D. Caulk Co.: Milford, Del.
Conclude, 3M Co.: St. Paul, Minn.
Retain, Pentron Corp.: Wallingford, Conn.



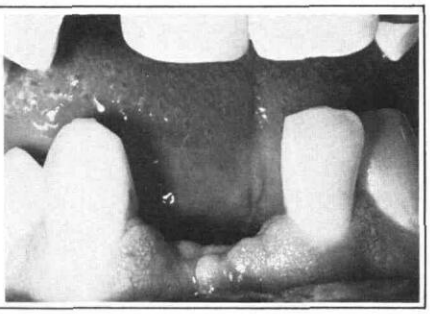


Figure 4. Preoperative occlusal view (A) reveals a healthy dentition with no carious lesions or restorations (left), while the facial view (B) shows the crowding and narrowness of the edentulous span (right).

cess resin easily can be removed with an explorer; however, after the resin sets, scalers, gold foil knives, or finishing burs are necessary to remove any remaining flash.

Adolescent patients are often lax in oral hygiene; therefore, it becomes imperative to teach and emphasize home care. Periodic recall and close postoperative supervision also are esssential.

Patient Presentation

Following an automobile accident, a 16-year-old adolescent sought treatment to replace his lower incisors. In addition to avulsing three mandibular incisors, he had fractured the symphysis of the mandible and had a large horizontal fracture of his maxillary right central incisor. Initial examination revealed no carious lesions or restorations in the mandibular anterior region, and complete healing of the fracture site (Figure 4).

During the treatment planning phase, the maxillary incisor was restored with composite resin, a consultation with an orthodontist was obtained, and a diagnostic waxing was performed to determine the most appropriate contours for the pontic section.

Neither the patient nor his parents desired comprehensive orthodontic treatment; however, it was confirmed that future orthodontics would not be compromised with the placement of an etched cast-resin bonded bridge.

The three original avulsed teeth were severely crowded and the resulting edentulous span had a narrow mesiodistal dimension. The diagnostic waxing revealed that the edentulous space was wide enough for only two appropriately contoured and nonoverlapping incisors.

The bridge was completed in three visits. The initial visit, consisting of tooth preparations, involved establishing proximal extensions on the abutment teeth adjacent to the edentulous space, placing cingulum rests on the anterior abutment teeth, and incorporating an occlusal rest seat on the left first premolar. A porcelain shade was selected and a rubber base impression made.

During the second visit, the bridge fit was verified and the porcelain was stained and glazed. The bridge was tested for incisal graying; since the effect would be negligible, no alteration of the framework or basic technique was indicated. The bridge was returned to the laboratory for a final polish and etching.

The restoration was bonded at the third appointment (Figure 5). Even though an attempt was made to remove thoroughly all excess resin, the patient was seen two weeks after bonding to check for any excess resin and review home care.

Dr. Wood is an assistant professor, Department of Fixed Restorative Dentistry, Baltimore College of Dental Surgery, Dental School, University of Maryland at Baltimore, 666 W. Baltimore St., Baltimore, Md. 21201. Requests for reprints should be sent to him.

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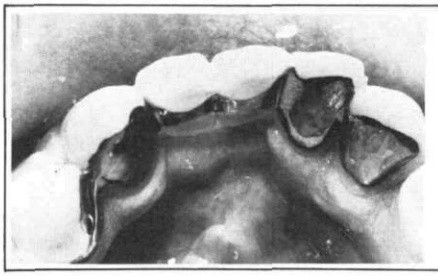

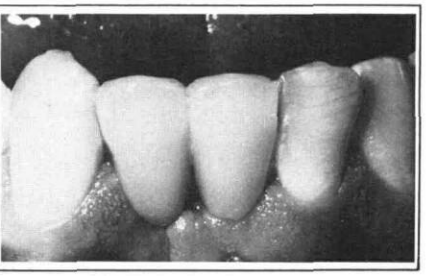

Figure 5. (A) The lingual outline of the completed bridge. To incorporate maximum enamel coverage, the bridge used double abutments on both sides of the pontic (left). (B) Facial view of the bridge reveals excellent esthetics and harmony with the adjacent teeth (right).

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