STICK WITH IT:
A Systematic Approach for Bonding CAD/CAM Restorations

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Abstract
This article will demonstrate a step-by-step approach to bonding CAD/CAM restorations. The article will demonstrate proper technique, as well as explain all materials used and why they were selected.
Objectives

1. Define CAD/CAM restorations as they relate to dentistry, and discuss their importance.
2. Present a case from start to finish, restoring it with a partial coverage CAD/CAM restoration.
4. Discuss the importance of dual-cured resin cements when restoring teeth with CAD/CAM restorations.
5. Display the importance of proper management of the adhesive interface when bonding all ceramic restorations.

Computer-aided design and computer-aided manufacturing (CAD/CAM) dentistry utilizes these technologies to improve the design and creation of dental restorations. These prostheses include crowns, inlays and onlays, fixed bridges, dental implant restorations, veneers, provisional, etc.

CAD/CAM technologies are useful in dentistry for a myriad of reasons, including increasing the speed of design and fabrication; increasing the convenience, creation, and insertion processes; and making possible restorations and appliances that otherwise would have been more time-consuming and difficult.

Other goals include reducing costs to make restorations and appliances more affordable. Finally, it is clear that tooth-colored restorations for posterior teeth have been gaining popularity due to aesthetic, biologic, and functional considerations. With the help of chairside CAD/CAM units, the fabrication of indirect restorations in one clinical appointment is now a reality.

Adhesive cementation is a requirement for the long-term success of many of these indirect ceramic and composite restorations. This article discusses a step-by-step guideline for their cementation with the adhesive resin cement, Duo-Link Universal (BISCO).

Case presentation

A 36-year-old male presented to the office for replacement of a large amalgam restoration (Fig. 1). Treatment options of resin versus an indirect ceramic restoration, along with risks and consequences of each, were discussed with the patient prior to beginning treatment. The patient opted for an indirect restoration.

An inferior-alveolar block injection was administered using 1.8cc of mepivacaine. Following profound anesthesia, tooth #19 was isolated with a rubber dam, and a pre-operative scan of the tooth was taken with a PlanScan Chairside CAD/CAM unit. Following the scan, the existing failed amalgam was removed, along with all evidence of decay (Fig. 2).

Generally speaking, the design of preparations for indirect inlays and onlays mainly depends on the physical properties of the restorative material and should follow manufacturers’ recommendations. Lava Ultimate, a resin nano ceramic material block (3M ESPE) was chosen for the final restoration. Less brittle than glass ceramic, the resin nano ceramic material also will resist chipping and cracking when milled.

Following final preparation, a decision was made to place a base/liner in the deep areas evident in the preparation seen in Fig. 2. The material chosen was TheraCal LC (BISCO). TheraCal LC is a light-cured resin-modified calcium silicate pulp protectant/liner designed to perform as a barrier and to protect the dental pulpal complex. The indications for use include direct pulp capping carious exposures, mechanical exposures and exposures due to trauma. It is also indicated for indirect pulp capping, used under amalgam restorations, as well as under Class I and II composite restorations. Further indications include use under other base materials, under cements or as an alternative to calcium.
hydroxide, glass ionomer/RMGI, and cavity varnish sealer (Fig. 3).

The preparation was scanned with the Planmeca PlanScan, driven by E4D technologies (Fig. 4) following the placement of TheraCal LC. The restoration was then designed and milled and followed by try-in and evaluation. Next, the intaglio surface for this Lava Ultimate restoration was sandblasted, rinsed, dried and silanated per the manufacturer’s instructions. A matrix band was placed around the tooth with dry angles and along with suction to isolate the tooth prior to bonding the restoration. The author’s cement of choice for bonding indirect restorations is Duo-Link Universal due to:

• Quick and easy clean-up
• Easy identification on radiographs for an effective diagnosis
• Low film thickness, ensuring the restoration is completely seated
• An extremely high degree of conversion that ensures a long-lasting restoration placement
• Its ideal use for all CAD/CAM restorations
• Its outstanding bond strengths to multiple substrates: zirconia, ceramics/lithium disilicate, alumina, metals, endodontic posts and composites.

Following isolation and prior to selective etching and bonding the preparation with All-Bond Universal (BISCO), the dentin was scrubbed for one minute with BISCO’s Cavity Cleanser, a two percent solution of chlorhexidine digluconate (CHG) intended for cleansing and moistening/rewetting cavity preparations. It is recommended for use upon completion of tooth preparation or etching prior to sealing the dentinal tubules.

Next, Select HV Etch (BISCO), a 35 percent high-viscosity phosphoric acid etchant containing benzalkonium chloride (BAC), was used to etch the enamel margins without etching dentin (Fig. 6). The etchant was left in place for 15 seconds and then rinsed thoroughly for one minute. An absorbent pellet was used to remove excess water in order to avoid desiccation. Two separate coats of All-Bond Universal were applied (Fig. 7).

CAD/CAM manufactured inlays and onlays require adhesive bonding as it increases retention and improves marginal seal, as well as strengthens the restoration and the supporting tooth.

All-Bond Universal is an ethanol/water-based dental adhesive that bonds to dentin and to cut and uncut enamel. It bonds to all indirect substrates, and is compatible with all composite and resin-based cements without an additional activator. The solvent was evaporated with a tooth dryer for 30 seconds (Fig. 8) until there was no visible movement of the material and the surface had a uniform glossy appearance.

The surface was then light-cured for 10 seconds. Duo-Link Universal was applied directly into the matrix band (Fig. 9) enclosed preparation. The restoration
was fully seated (Fig. 10) and the excess cement was removed with a brush prior to spot-curing the margins for two to three seconds per quarter surface. After the excess cement was removed and floss was run through the contact, each surface of the restoration was cured for 40 seconds. Following final curing, the occlusion was adjusted as the patient sat in an upright position, the restoration was finished and polished (Fig. 11) and a postoperative bitewing was taken to ensure all margins were indeed closed.

CAD/CAM manufactured inlays and onlays require adhesive bonding as it increases retention and improves marginal seal, as well as strengthens the restoration and the supporting tooth. A strong and durable resin bond to ceramics is dependent upon a true chemical bond and micromechanical interlocking. It is therefore mandatory to follow manufacturers’ recommendations closely when following a cementation protocol.

Dual-curing resin cements provide a sufficient degree of polymerization (conversion rate) underneath ceramic restorations. Adequate polymerization may not be achieved with strictly light-cured composite resin cements, which is why it is especially important when bonding CAD/CAM fabricated ceramic restorations to utilize a dual-cure system. In most cases, the restorations will be thicker than 1mm, limiting the amount of light that can penetrate the final restoration, and completing the polymerization of the resin cement.

Without a blueprint for success and the use of a proven system, a restoration may look good at the time of insertion, but it will never be able to stand the test of time under the complexities of the oral cavity. Proper management of the adhesive interface, a clear understanding of the materials being utilized and a precise, systematic clinical protocol are essential for the long-term success of our adhesively retained restorations.

**Author Bio**

Dr. Adamo Notarantonio is a graduate of the State University of New York at Stony Brook School of Dental Medicine (2002), where he received honors in both removable and fixed prosthodontics. He completed his residency in the advanced education in general dentistry program at Stony Brook in 2003, and was chosen by faculty to complete a second year as chief resident.

Notarantonio is one of approximately 400 dental professionals internationally to achieve accreditation status in the American Academy of Cosmetic Dentistry, and has been elected to serve on the American Board of Cosmetic Dentistry. He also volunteers for the AADC’s Give Back A Smile (GBAS) program, golfs often and is fluent in Italian.
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1. What does CAD/CAM stand for?
   A) Computer-aided dentistry and computer-aided manufacturing
   B) Computer-aided design and computer-aided manufacturing
   C) Cosmetic-aided dentistry and computer-aided milling
   D) Computer-aided dentistry and computer-aided milling

2. Why do CAD/CAM manufactured inlays and onlays require adhesive bonding?
   A) To increase retention
   B) To improve the marginal seal
   C) To strengthen the restoration and supporting tooth
   D) All of the above

3. CAD/CAM restorations are useful in dentistry because they:
   A) Increase speed of design and fabrication
   B) Are possible in a single visit
   C) Reduce cost and make restorations more affordable
   D) All of the above

4. What maximizes the retention of a restoration?
   A) Accurate occlusion adjustments
   B) Design of preparation
   C) Applying a pulp protectant/liner
   D) None of the above

5. Resin luting cement is the only material recommended for cementing this type of restoration because it
   A) Bonds to only enamel
   B) Doesn’t bond to dentin
   C) Increases microleakage
   D) Enhances strength

6. What are the advantages of inlays/onlays over direct resin composite restorations?
   A) Less likely to have open contacts
   B) Better marginal integrity
   C) Increased stability
   D) All of the above

7. Combining light and chemical curing components with a dual-cured luting cement allows for
   A) Only polymerizing on light exposure
   B) Only polymerizing in areas where light doesn’t penetrate
   C) Chemical polymerization in areas where light doesn’t penetrate and polymerizes on light exposure

8. What should be placed before the restoration is placed to reduce postoperative sensitivity and avoid damage to the pulp?
   A) Bond/Adhesive
   B) Varnish
   C) Protective base
   D) None of the above

9. What are the advantages of using all-porcelain restorations?
   A) Attrition to opposing teeth
   B) Beautiful esthetics
   C) Brittle and hard to handle
   D) None of the above
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