Management of Extensive Carious Lesions in Permanent Molars of a Child with Nonmetallic Bonded Restorations — A Case Report

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Abstract

The badly decayed molar teeth of a 12-year-old were restored using resin composite and ceramic restorations. The maxillary first left permanent molar, which had an extensive carious lesion that had destroyed most of the coronal hard tissues of the tooth, was restored to shape and function with a heat-treated resin composite onlay restoration. The restoration was followed up for two years. The mandibular right first molar had a failing large amalgam restoration with extensive recurrent caries. After a three-month period of pulp-capping, the tooth was restored with a bonded ceramic onlay restoration. A nine-month follow-up of this restoration is provided. The maxillary right first molar, which also had a failing large amalgam/resin composite restoration, was restored with a direct resin composite restoration. Under traditional treatment regimens, these extensive cavities would have been treated using more invasive procedures such as pin-retained restorations or elective root canal therapy, post placement, core build-up and crowning. Bonded non-metallic restorations avoid the trauma, time and cost that accompany such extensive procedures and offer a more conservative approach.

MeSH Key Words: *composite resins; dental porcelain; inlays*

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This article has been peer reviewed.

The demand for esthetic restorative materials for the replacement of decayed or damaged tissue in the posterior teeth has increased significantly. The growing controversy about amalgam's mercury content is one of the forces behind this trend: There is increasing environmental concern about the use of mercury in a number of industries, including the dental materials industry. Many manufacturers of dry batteries and manufacturers of house paints are now producing mercury-free products. Mercury in amalgam restorations is present in a reacted compound form that is much less toxic than the elemental form. In spite of this, mercury content remains an issue for health and environmental reasons. Another force behind the trend away from amalgam is that many people perceive these restorations as unsightly. Finally, excessive tarnish and corrosion are problems with conventional amalgam formulations; however, high-copper-content alloys tend to perform better in this respect (Fig. 1).

The currently available choice for esthetic restorative materials for posterior teeth is limited to resin composite, porcelain/ceramic or porcelain fused-to-metal. Resin composites seem to be utilized more than other restorations for a number of reasons. Directly placed resin composite restorations are the least expensive of the three, allow more conservation of tooth structure and can be placed in one appointment. However, their manipulation procedures can be daunting to the inexperienced operator; open proximal contacts and inadequate marginal adaptation are among the most common problems. In addition, post-operative sensitivity is a likely outcome for the patient if the operator does not follow the recommended placement steps with great care or is ill-informed about the subject of bonding to dentin. Nonetheless, in the hands of the well-informed, sufficiently equipped and skilled operator, direct resin composites work extremely well and can be rewarding for both the patient and the treating dentist.

Over the last few years the teaching of posterior composite restorations has become an integral part of the undergraduate curriculum of many dental schools in North America. A recently published study from Germany in which posterior direct and indirect resin composite restorations were placed by undergraduate students concluded, "Posterior composite restorations provided a satisfactory clinical performance over a

***Figure 1:** Judging by the extent of corrosion, amalgam restorations on maxillary second premolar and second molar teeth were probably fabricated from a conventional amalgam alloy. The one on the first molar shows much less corrosion, indicating that it could have been made from a high-copper amalgam alloy.*

***Figure 2:** Left maxillary first molar of a 12-year-old girl with lost amalgam restoration and evidence of recurrent caries.*

***Figure 3:** Cavity preparation for an adhesive resin composite onlay restoration.*

***Figure 4:** The dentist-fabricated onlay restoration seated on the stone model.*

***Figure 5:** Occlusal adjustment was done after rubber dam removal.*

***Figure 6:** View of the cemented onlay restoration two years after placement.*

two-year period when placed by relatively inexperienced but supervised students."[1] Many continuing education courses for practising dentists are designed for updating the recent techniques for placement of posterior composite restorations. Coupled with this is the continued advancement in the materials and bonding technology. The increasing pressure from governing bodies to reduce or limit the use of mercury for environmental reasons and with the increasing demand from the public to have non-metallic esthetic restorations has set the stage for suitable replacement materials to be widely utilized.

Figure 7: *This massive carious lesion on lower first molar tooth occurred underneath an existing amalgam restoration.*

Figure 8: *After three months of pulp-capping, the tooth was prepared to receive an onlay ceramic restoration.*

Figure 9: *View of the cemented IPS Impress onlay restoration nine months after placement.*

In this article, three restorative procedures using bonded non-metallic restorations on the molar teeth of a 12-year-old girl with extensive carious lesions are described. These bonded restorations enabled the author to avoid using amalgam and at the same time helped to preserve the little remaining coronal tooth structure. While such restorations are not expected to last this young patient's lifetime, they are going to help in delaying more invasive types of treatment until the pulpal tissues have receded far enough to allow for the safe placement of other types of restorations.

Permanent Maxillary First Left Molar

Clinical examination revealed a lost restoration and the presence of recurrent caries, which was the likely reason for the failure of the original amalgam restoration (Fig. 2). Treatment options included replacement of the lost amalgam restoration with a pin-retained amalgam build-up followed with a crown restoration; alternatively, a pin-retained cast gold onlay restoration could be made. However, because of the young age of the patient, it was desirable to delay these elaborate and invasive types of treatment as much as possible until some recession of the pulp horns had taken place. Instead, a bonded resin composite onlay restoration was selected. This option required minimal tooth preparation and was the least invasive treatment.

After careful removal of the carious tooth tissue with a large round bur at slow speed with light intermittent pressure, cavity margins were finished with a butt-joint (Fig. 3). Shallow putt holes were made using a small round bur at slow speed at available sites at the corners of the preparation. These holes increased the surface area for adhesion through bonding to dentin and, more importantly, provided secondary means of resistance against horizontal displacement. After cavity preparation, an impression was taken using a silicone material (Express, 3M, St. Paul, Minn.). Jaw relation registration was then performed, and the cavity was temporarily restored with IRM (Dentsply, Milford, Del.). The impression was poured in dental stone and the cavity margins were marked in pencil. Herculite XRV Laboratory kit (Kerr Manufacturing Co., Romulus, Mich.) was used for fabrication of an indirect resin composite restoration. Die spacer was applied to the cavity surfaces except the marginal areas, and the cavity surfaces were sealed with the die sealer provided. A coat of separating medium was applied and allowed to dry. The onlay restoration was built incrementally using appropriate shades of dentin and enamel resin composite material in the kit. Each increment was light-cured before addition of the next one. At the marginal areas of the cavity preparation, when an increment of composite material was adapted against the margin, an imprint of the margin was made on the composite increment. When the onlay was removed from the model, it was easy to see where the cavity margins were; trimming of the added composite increment was made accordingly. To ensure optimum contact with the adjacent tooth, the contact area of the adjacent tooth was lightly scraped with a sharp knife to create space to build a positive contact area for the onlay. After occlusal adjustment, the fabricated onlay restoration was subjected to heat treatment through boiling in water for 10 minutes while seated on the model (Fig. 4). The fitted surface of the onlay was cleaned with a micro-etcher (Micro-etcher model-erc, Danville Engineering, San Ramon, Calif.) using 50 μm aluminum oxide powder in a dust-limiting chamber (Microcab, Danville Engineering, San Ramon, Calif.). This

Figure 10: *This maxillary first molar presented with a combined amalgam/resin composite restoration with evidence of breakdown.*

Figure 11: *Completed cavity preparation for an adhesive resin composite restoration.*

Figure 12: *Completed direct resin composite restoration eight months after placement.*

Figure 13: *Large resin composite restorations on maxillary premolars eight years after placement. These were made using the material P-50 (3M).*

method results in a microscopically rough surface conducive to micromechanical bonding with the cementing resin material.

At the next appointment, rubber dam was applied and the onlay was tried-in to verify seating. Both enamel and dentin were then etched with 37% phosphoric acid gel for 20 seconds (Ultra-Etch, Ultradent Products Inc., South Jordan, Utah), rinsed for 10 seconds and dried gently with a weak stream of air until water puddles disappeared from the line angles but the surfaces remained moist. Etched surfaces were then primed with Prime and Bond 2.1 (Dentsply DeTrey GmbH, Konstanz, Germany). One thin coat was applied thoroughly and light-cured for 20 seconds. A second layer was applied but was left uncured. A dual-cure resin cement (Enforce, Dentsply Caulk, Milford, Del.) was mixed and applied onto the fitted surface of the onlay. The onlay was then seated in place and maintained under pressure. Most excess cement was removed with a dry primer brush. Initial light-curing for only five seconds followed, and the rest of excess cement material was removed with an explorer. The restoration was then subjected to full light-curing from all accessible aspects. The rubber dam was removed and occlusal adjustment carried out (Fig. 5). The onlay was polished with Soflex discs (3M dental products, St. Paul, Minn.).

Figure 6 is a picture of the onlay restoration two years after placement. While the occlusal anatomy of the onlay restoration was not detailed, the function of the tooth was restored with this procedure. Today, after two years, the gingival margin of the restoration is now 1 mm to 1.5 mm above the level of the gingiva. This is due to continued eruption and repositioning of the tooth as changes in occlusion took place with the growth of the bony structures of the jaw typical for this age. Tooth vitality was maintained throughout and a more extensive restoration was avoided, outcomes that are in the best interest of a patient who is only 12 years old.

Permanent Mandibular Right First Molar

In the next case the child presented with a fractured amalgam restoration with extensive recurrent caries that had destroyed the distal and most of the facial aspects of the crown of the tooth (Fig. 7). Pulp testing confirmed vitality of the tooth. Cavity preparation followed. First, the periphery of the carious lesion was negotiated to expose sound tooth tissue at the margins. The soft central carious lesion was then removed with great care with a large round bur at slow speed using light, intermittent pressure. A thin layer of calcium hydroxide was applied to the deepest central area of the cavity and the cavity was restored with IRM. Three months after the pulp-capping procedure, pulp vitality was tested once more and the IRM restoration was removed. Final preparation of the cavity to receive an onlay restoration was completed (Fig. 8). An impression was taken in a silicone material (Express, 3M Dental Products, St. Paul, Minn.), and a pressed ceramic onlay restoration (IPS Impress, Ivoclar North America, Amherst, NY.) was fabricated in a dental laboratory. The fitted surface of the ceramic restoration was microetched with aluminum oxide powder to provide the microroughness necessary for bonding with the resin cement.

The restoration was later tried-in and then cemented following the same procedure and materials as above. Figure 9 shows a picture of this onlay restoration nine months after cementation.

Permanent Maxillary Right First Molar

This tooth presented with a combination of an amalgam restoration and a resin composite restoration with evidence of failure (Fig. 10). The resin composite part was a repair undertaken when the child was going through a course of orthodontic treatment and a recurrent carious lesion was detected while the tooth had an orthodontic band around it. On removal of the amalgam restoration, more recurrent caries was found underneath it. Cavity preparation continued, and the tooth was prepared to receive a direct resin composite restoration. Wide horizontal retention grooves were prepared at available sites at the corners of the cavity to aid in the stability and retention of the restoration (Fig. 11). The cavity was etched for 20 seconds with an acid etchant and, after rinsing and drying as mentioned above, a primer/bonding resin was applied (Prime and Bond NT, Dentsply DeTrey GmbH, Konstanz, Germany). The cavity was restored incrementally with a resin composite material (Herculite XRV, Kerr Manufacturing Co., Romulus, Mich.). Figure 12 is a picture of the restoration at eight months.

Discussion

Short-term data on the clinical performance of moderate-sized resin composite inlays are available.[2] Furthermore, since this study was published, improvements in the composite material and in the bonding procedure have been made. Therefore, inlays made from the current generation of materials would be expected to outperform inlays made from older materials. Occlusal wear should not be a concern, as resin composite materials that were available in the 1980s have been reported to be sufficiently wear-resistant.[3] Improved formulations of these materials that were available in the 1990s proved to perform even better in this respect.[4] Although bulk fracture of large resin composite restorations might be a concern, only long-term clinical trial studies can provide us with data about it. The author's own experience with these restorations has been positive. Figure 13 shows two large resin composite restorations on maxillary first and second premolar teeth eight years after placement. The one on the first premolar was placed as a build-up on a prefabricated post after root canal therapy of the tooth in preparation for a crown restoration, which the patient was never able to afford. The restoration on the second premolar was placed as a final restoration on vital tooth tissues as partial replacement for the damaged buccal cusp.

Zinc oxide eugenol cement was used for temporization purposes here mainly because of its sedative effect. The cavities were deep and the possibilities for postoperative discomfort were high. Although the use of eugenol-containing bases under direct resin composite restorations is contraindicated because it can retard the polymerization reaction, zinc oxide eugenol used for temporization undergoes maturation with time, which eliminates its effects on subsequent bonding to dentin and enamel.[5-8] Because of the configuration and size of the cavities, removal of the IRM was not difficult; usually it separated as a whole.

The possibility of recurrent caries due to microleakage is less likely with the two cemented restorations in this case report, because these restorations were cemented with a resin cement that is insoluble in the oral environment and is micromechanically bonded to both enamel and dentin on one side of the interface and to the onlay fitted surface on the other side. Also, the use of the dual-cure resin cement Enforce, which has a reliable chemical-curing capability,[9,10] ensures that optimum hardening of the cement took place, even in the obscure areas under the onlay restoration that are difficult for the curing light to reach.

Subjecting resin composite to heat-treatment results in enhancement of the mechanical properties of the restoration. This has been confirmed by many in vitro studies.[11-18] However, there is no evidence in the literature that links improved mechanical properties with successful long-term clinical performance of indirect resin composite restorations. In addition, there are other advantages of indirect resin composite restorations over directly placed resin composites. Achieving a superior quality proximal contact with the indirect resin composites is much easier, as they are done under more controlled conditions. Also, occlusal adjustment is less time-consuming, as most of it is done on the articulator. Better adaptation at the gingival margin — which reduces the possibility of microleakage — is more likely to occur with the indirect restorations because polymerization shrinkage associated with the direct resin composites is eliminated. Finally, although ceramic and porcelain restorations are typically fabricated in a laboratory or in the office with the aid of costly and elaborate equipment, indirect resin composite restorations can be made in the dental office with simple fabrication techniques. ◈

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The author has no declared financial interest.

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