Louis Mackenzie

FJ Trevor Burke and Adrian CC Shortall

Posterior Composites: A Practical Guide Revisited

Abstract: Direct placement resin composite is revolutionizing the restoration of posterior teeth. Compared to amalgam, its use not only improves aesthetics but, more importantly, promotes a minimally invasive approach to cavity preparation. Despite the benefits, the use of composite to restore load-bearing surfaces of molar and premolar teeth is not yet universally applied. This may be due to individual practitioner concerns over unpredictability, time and the fact that procedures remain technique sensitive for many, particularly with regard to moisture control, placement and control of polymerization shrinkage stress. New materials, techniques and equipment are available that may help to overcome many of these concerns. This paper describes how such techniques may be employed in the management of a carious lesion on the occlusal surface of an upper molar.

Clinical Relevance: Direct posterior composite is the treatment of choice for the conservative restoration of primary carious lesions.

Dent Update 2012; 39: 211–216

Detection and diagnosis

A Class I carious lesion (ICDAS 3)[1] was detected in the mesial pit of an upper second molar (Figure 1). The lesion was diagnosed as active with respect to enamel cavitation exposing dentine. In addition the patient's dietary habits, oral hygiene measures and the presence of active lesions elsewhere indicated the need for operative intervention.

Isolation

Placement of direct restorations in the molar regions can present difficulty with regard to moisture control. Use of rubber dam with a single hole and a versatile winged molar clamp (*Hygenic 12A*, Coltène-Whaledent, Switzerland)) provided rapid isolation, which was completed (Figure 2) by flossing the dam through the mesial contact point. The speed with which this technique achieves isolation and promotes a comfortable experience for the patient and a predicable outcome for the operator cannot be overemphasized. Although the vast majority of practitioners do not routinely use rubber dam,[2] the isolation of a single tooth for an occlusal restoration is a perfect starting point for those wishing to learn and refine rubber dam techniques.

Figure 1. A cavitated Class I carious lesion in an upper second molar.

Figure 2. Isolation.

Occlusal template

As carious demineralization had left the occlusal surface virtually intact, in this case a template was used to facilitate provision of an anatomically accurate final restoration. Fabrication of a template may be achieved using a pre-operative impression gained by injecting a small amount of a clear polyvinyl siloxane material (*Memosil 2*, Heraeus Kulzer, Germany) onto the occlusal surface[3,4] (Figure 3). After waiting for the material to partially set, finger pressure (Figure 4) was applied to accurately capture the occlusal morphology. Once set, the template was removed (Figure 5) and the mesial surface marked with a felt pen to assist orientation when reapplied later.

Louis Mackenzie, BDS, General Dental Practitioner and Clinical Lecturer, **FJ Trevor Burke**, DDS, MSc, MGDS FDS RCS(Edin), FDS RCS(Eng), FFGDP FADM, Professor of Primary Dental Care, Primary Dental Care Research Group and **Adrian CC Shortall**, BDS, DDS, Reader in Restorative Dentistry, University of Birmingham School of Dentistry, St Chad's Queensway,Birmingham B4 6NN, UK.

Figure 3. Template material injected on to the occlusal surface.

Figure 4. Template material adapted to capture occlusal morphology.

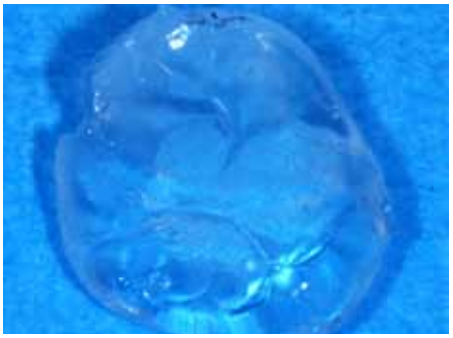

Figure 5. Pre-operative template.

Figure 6. Access to lesion.

Figure 7. Cavity preparation complete.

Figure 8. Acid etch applied.

Figure 9. Etched cavity after washing/drying.

Access

Using a small round bur, access to the carious lesion was gained through the cavitated pit and extended only to allow visualization and assessment of underlying dentinal caries. (Figure 6).

Minimally invasive preparation

Using appropriate burs, peripheral caries excavation was carried out to remove *soft* carious dentine and *fragile* overhanging enamel only. Pulpal caries was then excavated using a hand excavator and extended only until there was moderate resistance to gentle excavation[5,6,7] (Figure 7).

Removal of *only* irreversibly demineralized tooth tissue is a fundamental aim of contemporary caries management,[5–7] as it maximizes the amount of residual healthy tooth tissue[5–9] and improves the prognosis for long-term pulpal health by minimizing trauma to the dentine/pulp complex.[5–7]

Etching

Phosphoric acid (37%) was used to etch the whole cavity and 1mm beyond the margins (Figure 8).

Etch 37 (Bisco Inc, Schaumburg, IL, USA) was chosen as it flows easily into undercut cavity forms. Etching was further optimized by agitating the etchant with an appropriate instrument.

Wash and dry

After 15 seconds the etchant was thoroughly washed off. The cavity was then dried with gentle airflow, taking care not to desiccate the dentine. The aim is to achieve a visibly moist dentine cavity floor (and walls) with no obvious pooling of water.[9] When total etch adhesive systems are employed, careful control of dentine moisture is essential for optimization of adhesion and prevention of post-operative sensitivity. While the 'frosty' appearance of enamel walls is a reassuring sign that a predictable enamel bond (and thus marginal seal) will be achieved (Figure 9), it may also signal an increased likelihood of over dry dentine. If dentine desiccation is suspected it may be rehydrated with water,[9] applied using an appropriate brush.

Adhesive

Adhesive (*XP Bond*, Dentsply International Inc, York, PA,USA) was applied to the whole cavity and just beyond the margins, using a *Microbrush* (Microbrush international Grafton, US). Gentle airflow was then used until no ripples were evident. This reduced the likelihood of adhesive pooling and confirmed that the solvent had evaporated. The adhesive was then light-cured for 40 seconds with the light tip as close to the cavity as possible. The cavity was inspected to ensure that a uniform glossy/shiny adhesive layer coated the entire cavity[9] (Figure 10).

Figure 10. Adhesive applied.

Figure 11. Bulk-fill restoration of 'dentine layer' using SDR™.

Figure 12. SDR™ compule.

Figure 13. 'Enamel' increment of hybrid composite applied.

Figure 14. Template re-applied to adapt final composite increment.

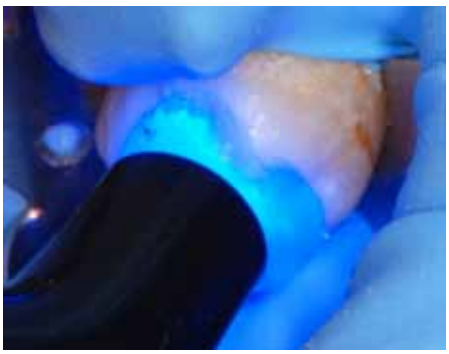

Figure 15. Composite light-cured through template

Placement ('dentine layer')

In this case, the entire 'dentine layer' was restored in one increment, using a flowable composite designed for this purpose (SDR™, Smart Dentine Replacement, Dentsply International Inc, York, PA, USA) (Figure 11).

SDR™ (Figure 12) is an innovative flowable posterior composite offering a number of potential benefits with regard to reducing placement technique sensitivity:

- Flowable consistency and 'self-levelling' property optimizes marginal adaptation into undercut cavities;
- Cannula delivery obviates the need for instrumentation, thus reducing the tendency for marginal voids and layers between increments;
- Translucency of the material facilitates depth of cure up to 4 mm in one increment;
- Reported low polymerization shrinkage stress[10] reduces the risk of post-operative sensitivity that is usually associated with bulk-fill techniques;
- Restoration of the majority of the cavity in one increment has a significant time-saving benefit;[11]
- The technique is easy to learn and simple to use;[11]

The SDR™ layer was then light-cured for 20 seconds.

Placement ('Enamel layer')

A single increment of a traditional hybrid composite was then placed over the layer of SDR™, which is not designed to restore right up to the occlusal surface as a result of:

- Inferior optical properties conveyed by the material's translucency;
- Wear resistance lower than that of a conventional hybrid composite.

Care was taken to apply just the right amount of hybrid material (Figure 13) to minimize excess and prevent under fill that would increase the tendency for poor marginal adaptation and void formation.

Use of the template

To facilitate adaptation and shaping of the final increment, the pre-operative occlusal template was applied to the unset material (Figure 14). The light tip was then firmly applied to the translucent template during a (minimum) 60 second light cure (Figure 15).

This technique has three main benefits:[4]

- Application of the template may reduce the potential for oxygen inhibition of the polymerization reaction occurring on the surface of the restoration;
- The morphology of the original occlusal surface is accurately reproduced;
- A significant amount of time may be saved when this technique is employed. (Although this may be cancelled out by the time taken to make the template[3]).

Light cure

Once the template was removed the restoration received a further 60 seconds light-cure to maximize polymerization (Figure 16).

Excess removal

The restoration was inspected for marginal excess (Figure 17), which was easily removed from unetched enamel using a

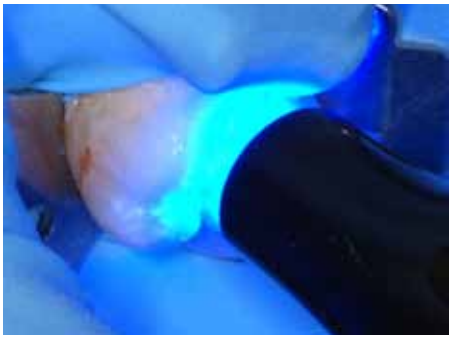

Figure 16. Further light-curing.

Figure 17. Minimal excess for removal.

Figure 18. Occlusal check.

sharp hand instrument. (Note: Careful volume estimation of the final increment will reduce or even eliminate this stage).

Occlusal check

Articulating paper was used to confirm that the restoration conformed precisely to the patients pre-existing occlusal scheme, in both the intercuspal position and all excursions (Figure 18).

Finished restoration

The restoration was inspected (Figure 19). At this stage the surface may be refined, polished or coated with a solvent-free surface sealer, depending on operator preference.[9]

Figure 19. Completed restoration.

Figure 20. Review.

Review

At review (interval based on caries risk or, as in this case, need for further dentistry) all aspects of the completed restoration were studied (Figure 20).

Discussion

Direct posterior composite restorations offer many benefits to both patient and dentist that go far beyond the fact that the restorations are tooth-coloured. New materials, equipment and techniques will continue to improve the quality, predictability and success of direct composite restorations. Such methods will also promote minimally invasive caries management, maximizing the amount of tooth tissue preserved. This will increase the longevity, not of just the fillings placed, but of the teeth that they restore.

Precise notation of the materials employed during each restorative procedure will provide each dentist with an invaluable evidence base for the long-term audit of their successful operative techniques.

With patient consent, photographic images taken before, during and after operative procedures may be used as a powerful motivational tool to help explain the disease process when encouraging patients to reduce their caries risk and to demonstrate the benefits of modern minimally invasive dentistry.

References

1. Diniz M, Lima L, Eckert G, Zandona AF, Cordeiro R, Pinto LS. *In vitro* evaluation of ICDAS and radiographic examination of occlusal surfaces and their association with treatment decisions. *Oper Dent* 2011 Mar-Apr; **36**(2): 133–142.
2. Gilbert GH, Litaker MS, Pihlstrom DJ, Amundson CW, Gordan VV. Rubber dam use during routine operative dentistry procedures: findings from the Dental PBRN. *Oper Dent* 2010 Sep-Oct; **35**(5): 491–499.
3. Hamilton JC, Krestik KE, Dennison JB. Evaluation of custom occlusal matrix technique for posterior light-cured composites. *Oper Dent* 1998; **23**: 303–307.
4. Geddes A, Craig J, Chadwick RG. Preoperative occlusal matrix aids the development of occlusal contour of posterior occlusal resin composite restorations – clinical rationale and technique. *Br Dent J* 2009 Mar; **206**(6): 315–317.
5. Banerjee A, Watson TF, Kidd EA. Dentine caries excavation: a review of current clinical techniques. *Br Dent J* 2000 May; **188**(9): 476–482.
6. Banerjee A, Kidd EA, Watson TF. *In vitro* validation of carious dentin removed using different excavation criteria. *Am J Dent* 2003 Aug; **16**(4): 228–230.
7. Banerjee A, Watson TF, Kidd EA. Dentine caries: take it or leave it? *Dent Update* 2000; **27**(6): 272–276.
8. Ericson D, Kidd E, McComb D, Mjör I, Noack MJ. Minimally Invasive Dentistry – concepts and techniques in cariology. *Oral Health Prev Dent* 2003; **1**(1): 59–72.
9. Mackenzie LM, Shortall ACC, Burke FJT. Direct posterior composites: a practical guide. *Dent Update* 2009; **36**: 71–95.
10. Ilie N, Hickel R. Investigations on a methacrylate-based flowable composite based on the SDR™ technology. *Dent Mater* 2011 Apr; **27**(4): 348–355.
11. Burke FJT, Crisp RJ, Mackenzie L. Handling evaluation of Dentsply SDR. *The Dentist* 2010 Oct; **26**(9): 94–100.