Class IV replacement and tooth morphology enhancement using direct composite resin restoration

Dr Simone Deliperi and Dr David Bardwell from Tufts University School of Dental Medicine in Boston, USA describe a new approach to the class IV build-up of a composite resin restoration.

Abstract

Class IVs are considered more challenging than other anterior composite resin restorations. Patients may be disappointed if a perfect match with the surrounding tooth structure is not achieved or marginal discoloration appears after brief clinical service. This case report describes a new approach to the class IV build-up of a composite resin restoration. The combination of an appropriate layering and curing technique is of paramount importance in achieving an optimal esthetic and functional result. The restoration of the palatal and incisal surface through a silicone matrix is also stressed. In this contest, the selection of a microhybrid composite resin system able to reproduce the optical and mechanical properties of the natural dentition can help to achieve these goals.
Introduction

One of the main aesthetic dentistry goals is to strictly recreate the anatomy, shade and texture of natural teeth. Earlier resin bonded composite (RBC) systems were based on the use of a single enamel and dentin shade that poorly reproduced the optical properties of natural teeth (Magne and Holz, 1996). Lately, vitality and depth of a restoration is achieved by using RBC systems based on the ‘natural layering’ techniques (Dietschi 1997, 2001). These systems are based on the use of dentin masses that reproduce the fluorescence of natural dentin and enamel masses that mimic the opalescence and translucence of natural enamel.

A good looking anterior RBC restoration requires clinician care and knowledge in the selection of an appropriate layering technique; selection of the correct shades and placement in the correct location is also paramount to properly build-up young, adult and geriatric patients’ teeth. The integration of the restoration with the adjacent teeth and surrounding soft tissues is key to obtain a satisfactory final result (Dietschi et al, 2005).

This case report presents a new technique to overcome these issues and introduces an easier and faster method to build-up class IV restorations. The composite build-up technique presented in this paper has numerous advantages: 1) it provides reduced time for finishing and polishing procedures; 2) it avoids colour mismatches previously encountered when removing excess; 3) by building-up the lingual-incisal surface first, enhancement of spacial references is created to better restore the remaining portion of the restoration (Deliperi and Bardwell, 2005). The technique may be considered the treatment of choice for teeth with moderate to severe coronal tooth structure loss.

Case report

Case presentation

A 45 year-old female patient presented with unaesthetic class IV RBC restorations in the upper anterior region (Figure 1). Patient reported that the teeth were restored almost 10 years earlier with RBC, underwent a progressive marginal discoloration and she expressed the desire to replace the existing restorations. However, she was concerned, by replacing these restorations, to dramatically change the shape of her central incisors in a way she wouldn’t have liked the final smile. It was explained to the patient that the goal of the restorative procedure was to reshape the two central incisors and recreate the appropriate dominance of these teeth. The new teeth would have helped to achieve a more juvenile and appealing smile. Once a composite mock-up was performed on the two central incisors, the treatment plan was accepted and an informed consent was secured.

Shade selection was performed before commencing any restorative procedures, avoiding tooth dehydration and creating near perfect match. Texture was analysed along with the spacial references of the teeth to be restored.

A rubber dam was placed and dental floss was used to complete isolation. The existing RBC restorations were completely removed being careful to preserve as much tooth structure as possible. Cavity preparation was completed, rounding sharp angles with a # 2 and 4 burs (Brasseler, Savannah, GA) and placing a 1mm bevel on the facial surface with a # 7104 bur (Brasseler, Savannah, GA). A bevel was not placed on the palatal surface. The cavity preparation was disinfected using a 2% chlorhexidine antibacterial solution (Consepsis-Ultradent Products, South Jordan, UT). Teeth # 8 (11) and 9 (21) and 10 (22) were etched for 15 seconds using a 35% phosphoric acid (UltraEtch-Ultradent Products, South Jordan, UT)-Figure 2; etchant was removed and cavity was water sprayed for 30 seconds being careful to maintain a moist surface. A fifth generation 40% filled ethanol based adhesive system (PQ1- Ultradent Products, South Jordan, UT) was placed in the preparation, gently air thinned until the milky appearance disappeared (Figure 3) and light cured for 20 seconds at 800 mW/cm2 on the facial and palatal aspects using an LED curing light (UltraLume V- Ultradent Products, South Jordan, UT).

To avoid microcrack formation on the facial and palatal surfaces, the authors used a previously described technique which is based on the combination of a pulse curing and progressive curing technique, plus a composite placement technique with wedge shaped increments (Deliperi and Bardwell, 2002, 2005).

This technique was adopted in an attempt to reduce polymerisation shrinkage, thereby decreasing stress at the enamel composite interface.

Vit-l-escence microhybrid RBC (Ultradent Products, South Jordan, UT) was considered the material of choice to restore these teeth be-
cause of its variety of enamel shades. However, different microhybrid composites based on the natural layering technique (Dietschi, 2000, 2001) may also be utilised (Esthet-X - Dentsply/Caulk, Milford, DE; Point 4 - Kerr, Orange, CA; Amelogen Plus - Ultradent Products, South Jordan, UT). A silicone matrix was obtained from the mock-up and sited before commencing composite stratification. Layering was started using 1 to 1.5 mm triangular shaped (wedge shaped), gingivo-incisal placed layers of Opaque White (OW) to reconstruct the palatal surface. This uncured composite was condensed and sculptured against the silicone index and each increment was pulse cured for two seconds at 800 mW/cm2 to avoid microcrack formation. Final polymerisation of the composite OW palatal wall was then completed at 800 mW/cm2 for 20 seconds (Figure 4). Placement of wedge shaped increments of composite resin is of paramount importance because it helps in decreasing the C-factor ratio (Feitzer et al, 1987). The C-factor is defined as the ratio between bonded and unbonded surfaces; increasing this ratio, results in increased polymerisation stresses. Stratification of the proximal walls was initiated using 1 to 1.5 mm wedge shaped increments of Pearl Frost, which was cured utilising the same protocol as the palatal layer (Figure 5). The dentinal segment of the restoration was filled using a higher chroma in the middle portion of the preparation (A3.5, A3) and lower chroma (A2, A1) in the incisal third as seen in the stratified layering technique (Klaff, 2001, Vanini 1996) (Figure 6). Each dentin increment was cured using a progressive ‘curing through’ technique (40 seconds at 800 mW/cm2 through the incisal and lingual walls instead of a conventional continuous irradiation mode of 20 seconds at 800 mW/cm2 from the facial surface) (Deliperi and Bardwell, 2002, 2005). An enamel layer of Pearl Frost was applied to the final contour on the facial surface (Figure 7). This final layer was pulse cured for two seconds at 800 mW/cm2. A waiting period of 3 minutes was observed to allow for stress relief, before a final polymerisation at a higher intensity (20 seconds at 800 mW/cm2) - Table I. Composite layering of tooth #10 (22) was also completed.

Rubber dam was removed, occlusion checked, and each restoration polished using the Jiffy Composite Polishing System (Ultradent Products, South Jordan, UT). Figure 8. Figure 9 shows a close-up view of the restored central incisors with re-establishment of a correct form and proportion of incisor teeth.

(subheading) Discussion

Resin bonded composite (RBC) has undergone continuing development of physical and mechanical properties in the last decade (Vanini, 1996, Denehy, 1999). As a consequence, clinical indication for anterior RBC restorations has progressively expanded. Patients’ expectation for invisible restorations is increasing as well as the need for ultra-conservative treatments.

Using earlier generations of adhesive systems and RBCs, class IV RBC restorations debonding and/or progressive aesthetic profile declination could occur. With the introduction of modern adhesive systems, based on the total etch technique, the clinical performance of class IV restorations has improved. However, a common occurrence is a mismatched class IV restoration. Traditionally, the average clinicians have used various types of celluloid matrix systems to build-up Class IV restorations. One to two shades of composite resin have been layered and polymerised to approximately reproduce tooth anatomy; then, the RBC restoration is shaped to contour using finishing burs and polishing discs and/or cups. Although this technique is rapid, it does not reproduce the chromatic characteristic of the natural dentition.

Manufacturers now provide the clinicians with composite systems including a wide variety of dentin and enamel shades. Similar to ceramic with porcelain, clinicians can reproduce the multichromatic layering found in natural teeth with composite resin if an appropriate stratification technique is selected.

The intra-oral mock-up is becoming a useful tool to build-up both direct and indirect restorations in the aesthetic zone (Magne and Belser, 2002). It helps the patient to better picture out the functional and aesthetic benefits of the restorative therapy thus facilitating the treatment plan approval. Silicone putty impression materials are used to fabricate a mould of the mock-up (lingual matrix) (Denehy, 2005). The lingual matrix becomes a guide for the clinician and/or the ceramist because it provides a framework to properly
shape and layer the final restoration. Once the
linguo-incisal contours and length desired in
the final restoration are created, more spacial
references are available for the clinician to re-
produce the different dentin and enamel layers
in the appropriate thickness and facilitate the
placement of either the incisal halo or translu-
cency. Minimal finishing is required thus sav-
ing time and reducing the potential formation
of composite microcrack on the composite.

Increased interest and attention has been
reported with regard to contemporary light
curing techniques as a possible method in
controlling stress (Kanca and Suh, 1999, Suh,
1999, Uno and Asmussen, 1991, Feilzer et al,
Resin composite goes from a pre-gel state
(early setting) to a post-gel state (final setting)
during polymerisation. During the early set-
ting, polymerisation shrinkage is compensated
by flow of composite particles in the direction
of cavity walls; once the gel point is achieved,
flow cannot occur because of increased stiff-
ess of RBC.

Composite polymerisation shrinkage can
be controlled by the rate of polymerisation
and the composite placement technique. It
was demonstrated that a pulse-curing tech-
nique was able to reduce enamel microcracks
that may be particularly relevant when enamel
is not supported by the underlying dentin
(Kanca and Suh, 1999). Lower light inten-
sity and increased curing periods have dem-
onstrated improved marginal adaptation and
composite physical properties (Miyazaki at al,
1996, Sakaguchi and Berge, 1998). A progress-
ive curing technique may, therefore, be critical
in reducing stress at the cavosurface margins
during polymerisation of dentin increments.
To decrease the C- factor ratio, it is critical to
place strategic layers of wedge-shaped com-
posite increments to a single surface, or to the
minimal number of bonded surfaces, without
contacting opposing cavity walls (Liebenberg,
2000).

It is worth noting that there is an increasing
trend in realising a fast cure strategy by reduc-
ing curing times and increasing light intensity.
The introduction of high intensity LED (Light
Emitting Diodes) lights has hampered efforts
to employ a low intensity strategy. LED curing
lights have a spectral pattern that matches the
absorption peak of camphoroquinone much
better than traditional QTH (Quartz-Tungsten
Halogen) lights (Kurachi et al, 2001, Hoffman
et al, 2002). The result is that the physical
properties of RBCs may be improved, but the
gel point is further anticipated with the result-
ing RBCs not having enough time to flow and
release internal stress.

**Conclusion**
The clinical case presented is considered a
common situation in the everyday clinical
practice. Improvement of adhesive and RBC
systems have fostered the development of
aesthetic dentistry. Clinicians should keep in
mind an appropriate placement technique to
improve their skill when placing class IV resto-
rations. Particular attention should be focused
on the photo-polymerisation process and un-
derstanding its potential and limitations. Only
in this way, can the restorative dentists provide
both functional and aesthetic care to their pa-

tients.

**References**
Magne P, Holz J. Stratification of composite
restorations. Systematic and durable repli-
cation of natural aesthetics. Pract Periodont
Aesthet Dentistry 1996; 8: 61-68
Dietschi D. Free-hand bonding in the esthetic
treatment of anterior teeth: creating the illu-

<table>
<thead>
<tr>
<th>Build up</th>
<th>Composite shade</th>
<th>Polymerisation technique</th>
<th>Intensity (mW/cm2)</th>
<th>Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palatal Enamel</td>
<td>OW</td>
<td>pulse</td>
<td>800 + 800</td>
<td>3 + 20</td>
</tr>
<tr>
<td>Dentin</td>
<td>A4 to A1</td>
<td>progressive curing</td>
<td>800</td>
<td>20* +20</td>
</tr>
<tr>
<td>Facial Enamel</td>
<td>PS/PF</td>
<td>pulse</td>
<td>800 + 800</td>
<td>1 + 30</td>
</tr>
</tbody>
</table>

* ‘Curing through’
Deliperi S, Bardwell DN. An alternative method to reduce polymerization shrinkage in direct posterior composite restorations. J Amer Dent Assoc 2002; 133:1387-1398
Klaff D. Blending incremental and stratified layering techniques to produce an esthetic posterior composite resin restoration with a predictable prognosis. J Esthet Restor Dent 2001; 13: 101-113
Vanini L. Light and color in anterior composite restorations. Pract Periodont Aesthet Dent 1996; 8: 673-82
Denehy GE. Simplifying the class IV lingual matrix. J Esthetic & Restorative Dentistry 2005;17:312-319
Suh BI. Controlling and understanding the polymerization shrinkage-induced stresses in light cured composites. Comp Cont Edu Dent 1999, 20: s34-s41
Sakaguchi RL, Berge HX. Reduced light energy density decreases post gel contraction while maintaining degree of conversion. J Dent 1998, 26: 695-700
Liebenberg WH. Assuring restorative integrity in extensive posterior resin composite restorations. Pushing the envelope. Quintessence Int 2000;31(3):153-164

Figure 7: Restoration on teeth # 8, 9 and 10 were completed by layering a PF shade to the final contour

Figure 8, 9: Post-operative facial view of final restorations