

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



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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 context, 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 linguo-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



Figure 1: Preoperative facial view showing unaesthetic restorations of tooth # 8 and 9



Figure 2: Facial view of tooth # 8 and 9 after placing the rubber dam; etching was performed using Ultra Etch 35% phosphoric acid

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 un-



Figure 3: Facial view of the preparations after PQ1 was applied



Figure 4: A silicone matrix was placed and the palatal surfaces were built-up using an OW shade

dergone 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 ceramist 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

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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 reproduce the different dentin and enamel layers in the appropriate thickness and facilitate the placement of either the incisal halo or translucency. Minimal finishing is required thus saving 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, 1995, Goracci et al, 1996, Mehl et al, 1997). Resin composite goes from a pre-gel state (early setting) to a post-gel state (final setting) during polymerisation. During the early setting, 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 stiffness 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 technique 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 intensity and increased curing periods have demonstrated improved marginal adaptation and composite physical properties (Miyazaki et al, 1996, Sakaguchi and Berge, 1998). A progressive 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



Figure 5: The mesial proximal surfaces of tooth #8 and 9 were built-up using a PF shade



Figure 6: A4 to A1 shades were used to layer the missing dentin structure

place strategic layers of wedge-shaped composite 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 reducing 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 resulting 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 restorations. Particular attention should be focused on the photo-polymerisation process and understanding its potential and limitations. Only in this way, can the restorative dentists provide both functional and aesthetic care to their patients.

References

- Magne P, Holz J. Stratification of composite restorations. Systematic and durable replication 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 illusion. *J Esthet Dent* 1997;9: 156-164

Build up	Composite shade	Polymerisation technique	Intensity (mW/cm ²)	Time (seconds)
Palatal Enamel	OW	pulse	800	3
			+ 800	+ 20
Dentin	A4 to A1	progressive curing	800	20* +20
Facial Enamel	PS/PF	pulse	800	1
			+ 800	+ 30

* 'Curing through'



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

Dietschi D. Layering concepts in anterior composite restorations. *J Adhesive Dent* 2001;3:71-80

Dietschi D, Ardu S, Krejci I. Exploring the layering concepts for anterior teeth. In JF Roulet, M Degrange: *Adhesion the Silent Revolution in Dentistry*. Quintessence Publishing books, Chicago IL; 2000

Deliperi S, Bardwell DN. Two-year clinical evaluation of non vital tooth whitening and resin composite restorations. *J Esthetic & Restorative Dentistry* 2005;17:369-379

Deliperi S, Bardwell DN. An alternative method to reduce polymerization shrinkage in direct posterior composite restorations. *J Amer Dent Assoc* 2002; 133:1387-1398

Feilzer A.J., De Gee A.J., Davidson C.L. Setting stress in composite resin in relation to configuration of the restoration. *J Dent Res* 1987; 66:1636-9

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. The importance of direct resins in dental practice. *Pract Periodont Aesthet Dent* 1999; 11: 579-82

Magne P, Belser U. *Bonded porcelain restorations in the anterior dentition*. Quintessence Publishing, Berlin 2002.

Denehy GE. Simplifying the class IV lingual matrix. *J Esthetic & Restorative Dentistry* 2005;17:312-319

Kanca J, Suh BI. Pulse activation: reducing resin-based composite contraction stresses at the cavosurface margins. *Am J Dent* 1999, 12: 107-112

Suh BI. Controlling and understanding the polymerization shrinkage-induced stresses in light cured composites. *Comp Cont Edu Dent* 1999; 20: s34-s41

Uno S, Asmussen E. Marginal adaptation of a restorative resin polymerized at reduced rate. *Scand J Dent Res* 1991;19: 440-444

Feilzer AJ, Dooren LH, De Gee AJ, Davidson CL. Influence of light intensity on polymerization shrinkage and integrity of restoration-cavity interface. *Eur J Oral Sci* 1995;103:322-326

Goracci G, Mori G, Casa de Martinis L. Curing light intensity and marginal leakage of resin composite restorations. *Quintessence Int* 1996; 27:355-362

Mehl A, Hickel R, Kunzelman KH. Physical properties and gap formation of light cured composites with and without soft start polymerization. *J Dent* 1997; 25:321-330

Miyazaki M, Yoshida Y, Moore K, Onose H. Effect of light exposure on fracture toughness and flexural strength of light-cured composites. *Dent Mater* 1996;12:328-332

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

Kurachi C, Tuboy AM, Magalhaes DV, Bagnato VS. Hardness evaluation of a dental composite polymerised with experimental LED based devices. *Dent Mater* 2001; 17: 309-15

Hoffman N, Hugo B, Klaiber B. Effect of irradiation type (LED or QTH) on photo-activated composite shrinkage strain kinetics, temperature rise and hardness. *Eur J Oral Sci* 2002; 110:471-479



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