Clinical application of a new flowable base material for direct and indirect restorations

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Summary

This article aims to provide clinicians with a protocol on how to use SDR (Dentsply) as a flowable base material for direct and indirect restorations, by means of a pictorial essay illustrating the benefit of this new innovative restorative material.

Introduction

Recent developments in composite resin materials and bonding technology have made possible the routine use of these materials in posterior teeth (Van der Vyver & Bridges, 2002). Direct posterior composite resin restorations are now predictable and durable, and in many instances their superior aesthetic and tooth-supporting properties make them the optimal treatment option when restoring the posterior dentition (Liebenberg, 1997). The main shortcomings of composite resin materials are polymerization shrinkage (Dietschi, Magne & Holz, 1994) and polymerization stress. Polymerization stress can result in contraction forces on the cusps that can result in cuspal deformation (Pearson & Hegarty, 1989), enamel cracks and ultimately decrease the fracture resistance of the cusps (Wieczkowski et al, 1988).

Cavity configuration and the method of insertion of composite resin into the cavities can influence the gaps at the interface between the dentine/enamel and the restoration (Walshaw & McComb, 1998). According to Davidson and De Gee (1984), the parallel walls of a boxshaped cavity may restrict the flow of composite during polymerization, causing stresses at the resin dentine interface (Feilzer, De Gee & Davidson, 1987).

The present generation of chemically or light activated flowable composites undergo free volumetric shrinkage of 4-9% as compared to regular viscosity and packable composites at 2-5%, with an average of 3.5%. According to Jensen and Chan (1985), polymerization shrinkage stresses have the potential to initiate failure of the composite-tooth interface which could cause deformation of the tooth which might result in post-operative sensitivity and which could even open pre-existing enamel micro-cracks (Jensen & Chan, 1985).

SDR is marketed as a low stress flowable base material that can be placed in layers of up to 4mm in thickness and each bulk increment light-cured for only 20 seconds, as long as you leave at least 2mm on the occlusal surface for regular viscosity composite resin. According to the manufacturer, a polymerizable modulator was chemically embedded into the flowable resin material that allows extended polymerization without a sudden increase in cross-link density. This extended "curing-phase" maximizes the overall degree of conversion, minimizing the polymerization stress by up to 60% compared to conventional flowable composite resins (Inside Dentistry, 2009). The volumetric shrinkage is 3.6% but more importantly, the stress generated during the polymerization is only 1.4 MPa, whereas many other flowable composites are above 4 MPa. The material is available in only one universal shade and can be used with any dentine bonding system.

Figures 1-19 outlines a clinical case report that illustrate the benefits and clinical application of this new innovative flowable base material for direct posterior composite resin restorations.

Base materials are mainly indicated to reduce the volume of filling material (Lutz et al., 1986) or to create adequate geometry to the cavity preparation for inlay / onlay preparation techniques (Dietschi & Spreafico, 1997).

The shape of the cavity preparation will depend on the extent of the decay or the geometry of the restoration to be replaced. The removal of decay often creates unwanted undercuts which are not compatible with the principles of cavity preparation design for inlays/onlays. In order to

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Case Report 1 -SDR as base material under posterior composite restoration

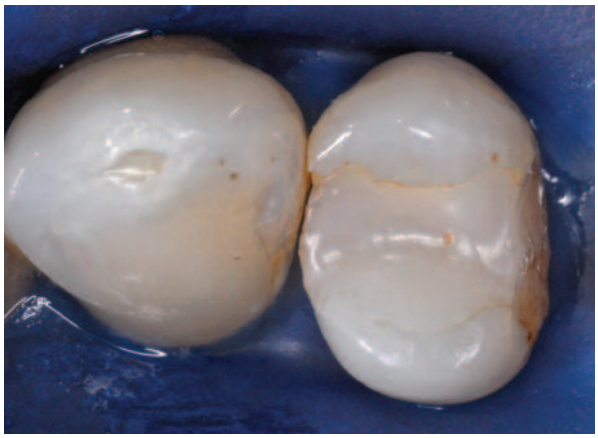

Figure 1: Pre-operative view of an isolated upper right maxillary sextant. Examination of the upper right first premolar revealed a defective composite restoration. Note the poor interproximal contact between the premolar and canine as well as the inadequate contour on the distal aspect of the existing composite restoration.

Figure 2: Initial cavity preparation after removal of the defective composite restoration.

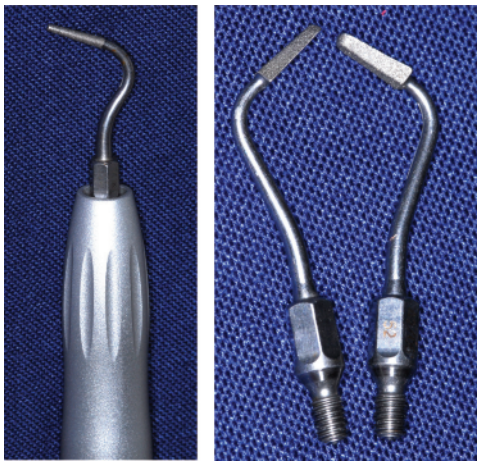

Figure 3: SonicFlex air-driven scaler (KAVO) and SonicSys Prep Ceram Tips (KAVO) that were used to redefine the margins of the proximal boxes.

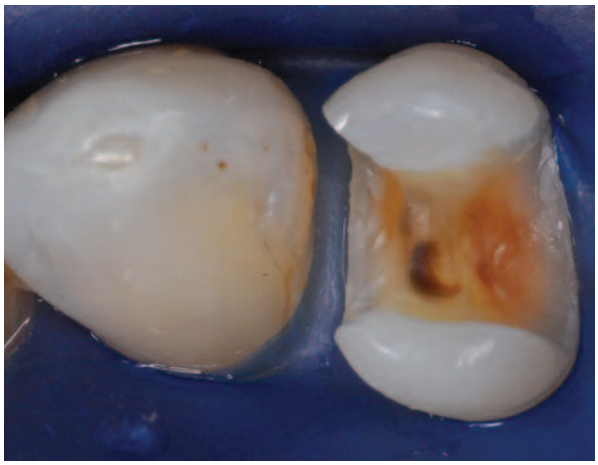

Figure 4: Final cavity preparation after caries removal and the enamel margins of the proximal surfaces prepared with the SonicSys Prep Ceram Tips (KAVO) to ensure removal of any unsupported enamel.

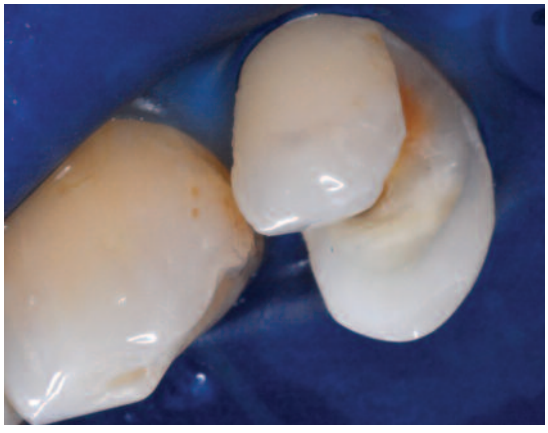

Figure 5: Angulated view of final cavity reparation. Note the extended depth of the distal gingival margin from the occlusal surface.

Figure 6: Hawe Contoured Tofflemire Bands (Kerr) were used in a Tofflemire holder to ensure correct contour of the definitive restoration. A circular matrix was selected above a sectional matrix because of the missing upper first molar.

Figure 7: V-Ring (Triodent) was utilized to create separation between the canine and premolar in order to ensure a tight interproximal contact point.

Figure 8: Different sizes of the Wave Wedges (Triodent) that were utilized to seal the matrix band against the mesial gingival cavity margin to gain a tight marginal seal, reducing the chance for contamination to ensure the establishment of an uncompromised bond strength.

Figure 9: Matrix assemblage: Hawe Contoured Tofflemire Band in a Tofflemire holder, activated V-Ring and small Wave Wedge (white). Note the inadequate adaptation of the matrix band to the gingival mesial margin on the buccal aspect of the cavity preparation. The small wedge was replaced with a larger Wave Wedge (pink)(Fig.12) to achieve improved adaptation of the matrix band against the gingival enamel margin.

Figure 10: Enamel and dentine surfaces were etched for 15 seconds with 36% phosphoric acid, rinsed with water and lightly air-dried. Two coats of XP Bond (Dentsply) were applied to the etched enamel and dentine surfaces, agitated with a micro-brush for 15 seconds, lightly air-dried and light-cured for 20 seconds with a Valo Light-curing unit (Ultradent).

Figure 11. SDR- Smart Dentine Replacement (Dentsply) compula tip, which incorporates a fine, needle like nose for precise dispensing of the material with the attached micro dispensing tip.

Figure 12: After the bonding protocol, the SDR material was dispensed using slow, steady pressure from the deepest portions of the mesial and distal proximal box preparations. After a 4mm increment was dispensed, the material was left undisturbed for a few seconds to self level before it was light-cured for 40 seconds from the occlusal aspect.

Figure 13: Another 4mm increment of SDR was dispensed on top of the previous layer up to approximately 3mm from the cavosurface margin. The material was again left undisturbed to allow for self leveling before it was light-cured for 40 seconds.

Figure 14: The remaining part of the cavity preparation was filled with Tetric N Ceram (Vivadent), a regular viscosity composite resin.

Figure 15: The Class II cavity was transformed into a Class I cavity according to the Bichacho technique (Bichado, 1994) : mesial and distal marginal ridges were built up with a regular viscosity composite resin, one at a time and light-cured.

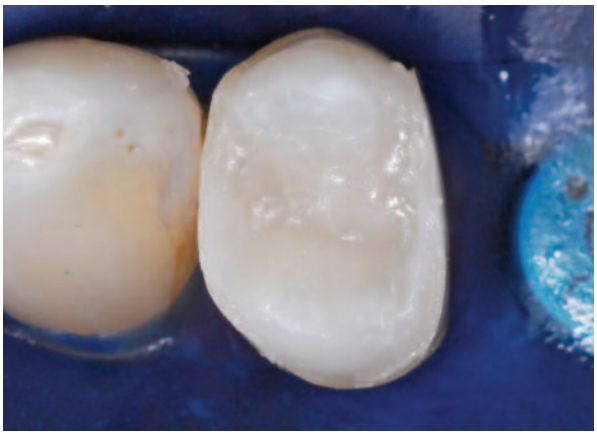

Figure 16: Successive increments of composite were applied in an oblique layering technique, sculpted with a pointed composite instrument and light-cured for 40 seconds. The inclination of the remaining cavo-surface slopes were used as indication to reconstitute the occlusal morphology.

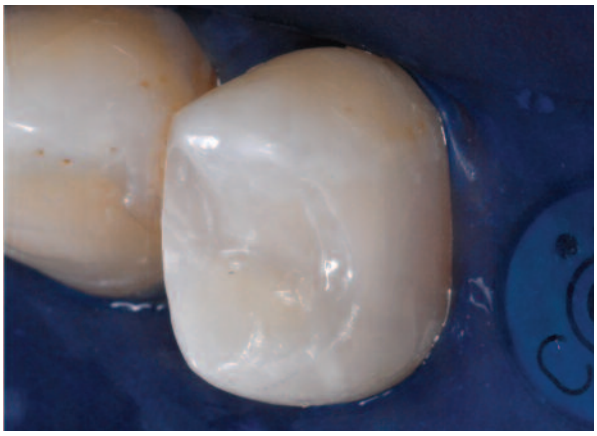

Figure 17: Completed restoration after finishing and polishing with an eggshaped 30 fluted carbide finishing bur (Endenta) and sequential finishing with OptiDiscs (Kerr).

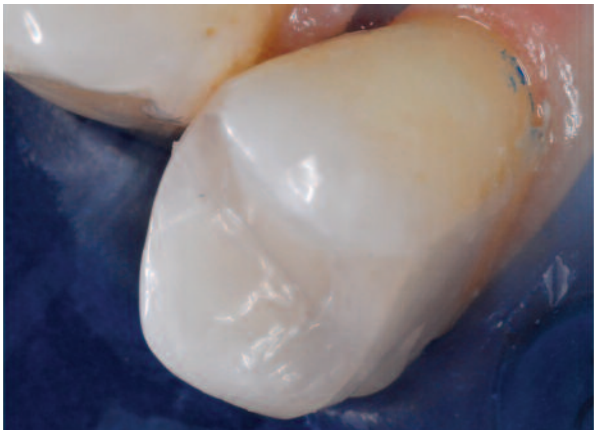

Figure 18: Angulated view of the buccal cusp demonstrating no signs of enamel cracking that could have been caused by polymerization shrinkage of the bulk fill flowable SDR base material.

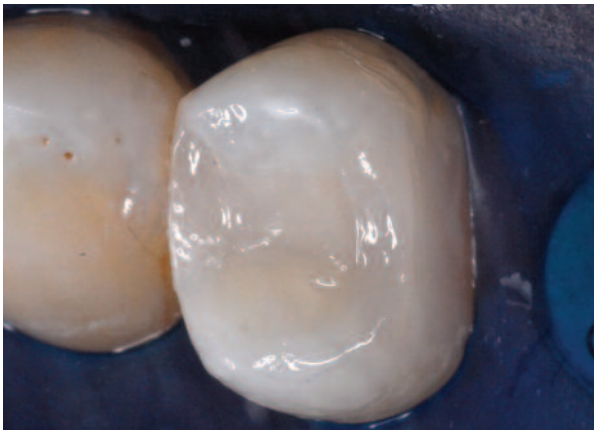

Figure 19: Immediate post-operative occlusal view after polishing with diamond polishing paste (Ultradent) illustrating the optimal aesthetics, improved interproximal contour and the shape of the composite restoration. Note the optical integration of the composite resin and SDR with the surrounding tooth structure.

Case Report 2 - SDR as base material under posterior ceramic inlay restoration

Figure 20: Pre-operative view of the upper right maxillary sextant. Clinical and radiographic examination of the upper right first molar revealed a previously placed occluso-palatal amalgam restoration and interproximal decay on the mesial aspect of the tooth.

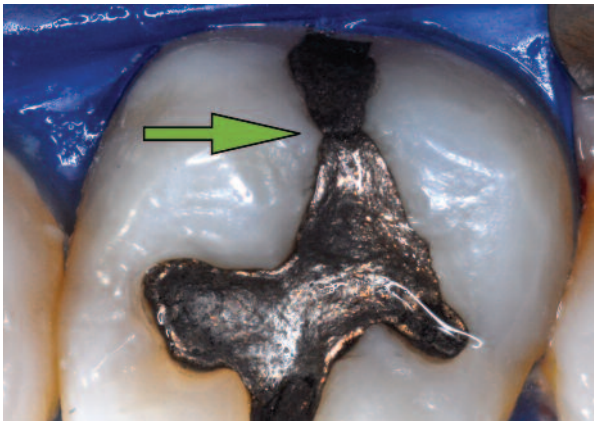

Figure 21: Pre-operative view of the isolated upper right maxillary molar. This magnified view revealed a fracture in the amalgam restoration (arrow) and extensive creep of the restoration margins.

Figure 22: Cavity outline after removal of the defective amalgam restoration and decay on the mesial marginal ridge. Caries Indicator (Ultradent) was ultilized to identify some caries infected tooth structure.

Figure 23: Final cavity preparation after removal of caries left undercuts on axial wall preparations and an irregular pulpal floor plane.

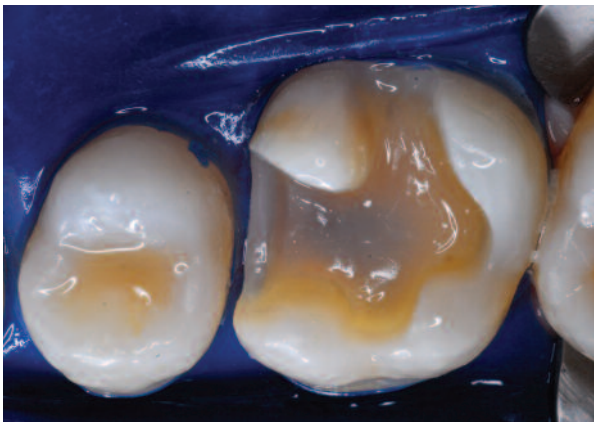

Figure 24: After etching with phosphoric acid and application of XP Bond (Dentsply) (Fig. 10) according to the manufacturer's instructions, the SDR flowable base material (Fig. 11) was applied to the treated tooth structure. The objective was to block out undercuts on the axial wall preparations and to level the pulpal floor plane. After light-curing, the ideal cavity preparation was achieved by using a medium grit diamond bur.

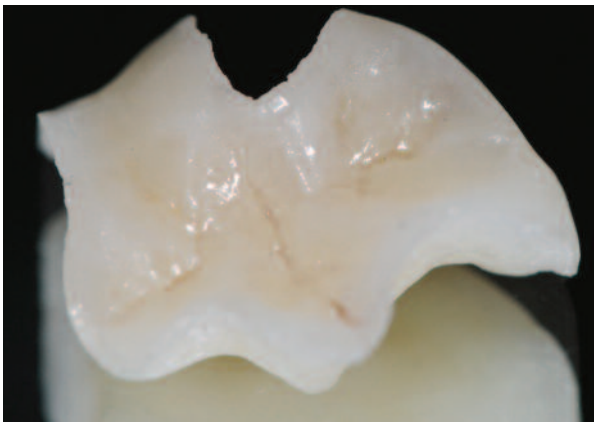

Figure 25: After making an impression with Aquasil soft-putty and Aquasil light body (Dentsply) the tooth was temporized with Integrity (Dentsply). A porcelain inlay fabricated in the laboratory from pressed Emax ceramic (Ivoclar, Vivadent) was etched with 9.5% Hydrofluoric acid (Ultradent) for 20 seconds, rinsed with water and air-dried. Silane Coupling Agent (Dentsply) was applied and left to dry for 1 minute before the treated porcelain surface was coated with a thin layer of XP Bond mixed with Self-cure Activator (Dentsply).

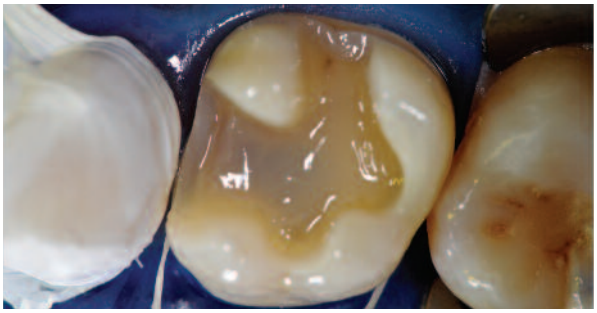

Figure 26: At the cementation appointment the upper right sextant was isolated with rubber dam and the temporary inlay removed. A single floss ligature was utilized around the upper first molar to guarantee optimal isolation. The cavity preparation line angles were cleaned with OptiClean (Kerr) to ensure removal of any remnants of the temporary cement. Plumbers Tape was folded around the upper first premolar to act as an isolation medium during cementation.

Figure 27: The cavity preparation was prepared for bonding using XP Bond mixed with the Self-Cure Activator (Dentsply) according to the manufacturer's instructions. The translucent shade of Calibra Resin Cement (Dentsply) was used as a luting cement for cementation of the prefabricated inlay.

Figure 28: Occlusal view after cementation of the porcelain inlay. Final light-curing of the cement was done from the occlusal and palatal direction for 30 seconds respectively, using a Valo light-curing unit (Ultradent).

Figure 29: Immediate post-operative view after removal of the rubber dam. The final restoration reflects optimal restoration of aesthetics, occlusal anatomy, marginal ridges and interproximal integrity.

preserve sound enamel/dentine as much as possible, the internal tapered design should be obtained by the application of a base material (Dietschi & Spreafico, 1997).

Sherrer et al., 1994 demonstrated that the resistance to fracture for full ceramic crowns is significantly influenced by the elasticity of the core material and luting cement. Because of the favorable properties of the SDR material the author is of the opinion that it might be the ideal material to block out undercuts in order to preserve additional enamel for adhesion and to improve cuspal strength during ceramic inlay cavity preparations.

Figures 20 - 29 depicts a clinical case report to illustrate the clinical application of the SDR flowable base material to allow ideal cavity preparation design for indirect posterior inlay/onlay restorations.

Conclusions

Providing the clinician with a flowable base material for posterior direct and indirect restorations that can be placed and cured in bulk must be one of the most exciting technological advancements in dentistry towards technique simplification for what is generally regarded as a highly technique sensitive procedure.

The fact that SDR exhibits excellent adaptation to the preparation walls due to its flowable nature, reducing the potential for void formation on the margins that could lead to post-operative sensitivity or aesthetic failure of the restoration. Another unique characteristic of the SDR material is the self-leveling feature which eliminates the need to manipulate or sculpt the material before curing. This also creates an ideal surface for the addition of any regular viscosity composite resin to complete direct restorations, providing the desired strength, aesthetics and wear resistance for occlusal surfaces.

The reduced poly-merization stress of the SDR base material on normal and compromised cusps after conventional cavity preparation might provide the clinician with an improved and simplified operative technique to provide patients with more durable posterior restorations.

Acknowledgement

The Author would like to acknowledge Mr Greg Flint for fabrication of ceramic inlay.

Disclaimer: The author has no financial interest in the products described

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