Smart dentin replacement

Dr Ludwig Hermeler presents a clinical case study using SDR

SDR, developed by Dentsply, is the first posterior composite for dentin replacement combining the handling properties of a flowable composite with minimal shrinkage stress. As a result, it can be placed in increments of up to 4mm. The 'Smart Dentin Replacement' layer is applied as a base in Class I and II cavities following the use of a conventional dentin/enamel adhesive. It is chemically compatible with all methacrylate-based universal/posterior composites used to replace the occlusal enamel layer and complete the adhesive filling. SDR offers interesting advantages in everyday practice, because it allows dentists to provide their patients with high-quality aesthetic posterior restorations in a cost-effective way.

Product technology

Dentsply's new restorative is based on 'Stress Decreasing Resin' technology. This means that a substance described as a 'polymerisation modulator' is chemically embedded in the backbone of the polymerisable resin. The polymerisation modulator synergistically interacts with the camphorquinone photo-initiator to result in a slower elasticity modulus development, allowing for stress reduction without a decrease in the rate of polymerisation or degree of conversion. SDR has the required physical and mechanical properties for use as a posterior bulk-fill flowable base. Moreover, the integration of these modifications in the well-proven methacrylate chemistry makes SDR compatible with methacrylate-based adhesives and composites, which are widely used in dental practice.

Clinically relevant in-vitro properties

In 2004, the polymerisation stress of a prototype of SDR and several conventional flowable and universal/posterior composites was measured using a National Institute of Standards and Technology (NIST) Tensometer[1]. The data obtained show the stress developed by SDR to be significantly lower than that of all other materials tested. In 2009, Professor Ernst performed photoelastic stress measurements at the University of Mainz, Germany[2]. He confirms the shrinkage stress of SDR is lower than that of the reference composites and states that the material seems to have clinical advantages in terms of handling properties, particularly in cavities with undercuts. In tests using a Stress-Strain-Analyzer[3], SDR also showed the lowest stress build-up – consistently with the other two independent trials. The ATR-NIR method was used to evaluate SDR's degree of conversion at various increment thicknesses. Both this and a similar study[4] show the conversion of SDR to be excellent, even at a thickness of 5 or 6mm. These results prove that SDR will be optimally polymerised when bulk-placed in increments of up to 4mm, as recommended. Marginal integrity tests after thermo-mechanical fatigue[5] also show that SDR will be a good base material in the filling technique.

Clinical Case

Figures 1 and 2 document the initial situation, with unsatisfactory restorations in teeth 14 and 16. The filling in tooth 15 was not associated with any pathology in the bitewing radiograph (Figure 3) nor with any marginal defects on staining with a caries detector dye, so it was left in situ. The removal of the old fillings revealed undercuts in the proximal boxes (Figures 4 and 5). After caries excavation with the aid of a detector dye and prior to final cavity preparation, BiTine rings of the Palodent Sectional Matrix System were applied (Figure 6) and left in place during definitive margin finishing with fine-grit diamonds, so that the separation needed for the sectional matrices was ensured without prolonging the treatment. Figures 7 and 8 show the final cavity preparation after the removal of the BiTine rings. Sectional matrices were adapted to the proximal tooth circumferences as far as possible by bending them with the fingers. Hence, they could easily be inserted with tweezers from occlusal. The gingival margin was closed with anatomical wedges. The BiTine rings were repositioned in the proximal plane, to stabilise the matrices and wedges. For optimal adaptation and contouring, the matrices were slightly smoothed with a ball plugger. Proximal matrix management is successful if the matrix fits tightly and, after concave pre-contouring, the proximal contact is located about one millimeter apical to the highest point of the marginal ridge (Figures 9 and 10). This minimises the need for proximal finishing of the restoration. Then the actual restorative procedure began: the cavity was gently air-dried and the one-bottle adhesive Xeno V was applied (Figure 11), rubbed in for 20 seconds and also gently air-dried. The adhesive was light-cured for 10 seconds. SDR was dispensed directly from the Compula Tip (Figure 12) into the cavity at a light, steady pressure, starting at the deepest point of the cavity and filling it up to an increment thickness of 4mm (Figures 13 and 14). The slender design of the metal cannula of the Compula Tip ensures good visibility and allows the user to reliably and quickly fill up proximal boxes even if there are undercuts. SDR self-levelled easily to a homogeneous surface (Figures 15 and 16) and was placed approximately up to the level of the dentin-enamel

Figure 1: Initial situation

Figure 2: Occlusal mirror image of initial situation

Figure 3: Bitewing radiograph on the right

Figure 4: Situation after the removal of insufficient fillings

Figure 5: Occlusal mirror image of the situation after filling removal

Figure 6: Separation with Palodent BiTine rings

Figure 7: Final cavity preparation

Figure 8: Occlusal mirror image of the final preparation

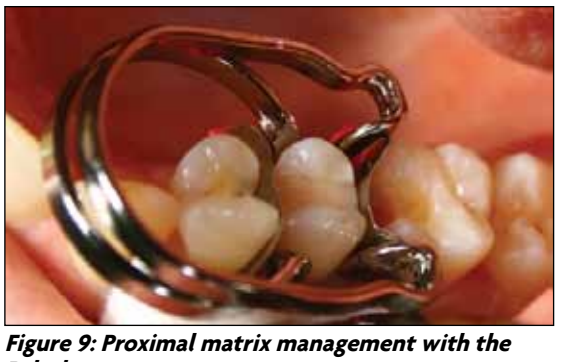

Figure 9: Proximal matrix management with the Palodent system

Figure 10: Occlusal mirror image of the applied matrices

Figure 11: Application of Xeno V

Figure 12: Compula Tip for direct application of SDR

Figure 13: Application of SDR at the deepest point of the cavity

Figure 14: Occlusal mirror image of SDR application

Figure 15: Homogeneous surface of the self-leveling SDR layer

Figure 16: Occlusal mirror image of the self-levelling layer

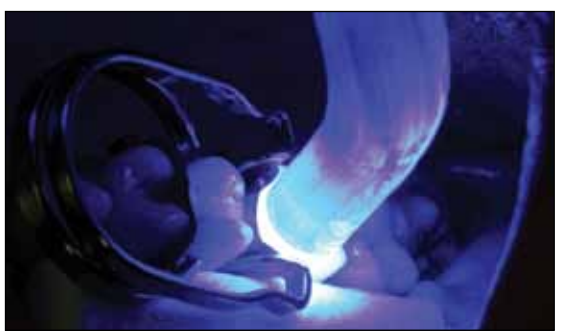

Figure 17: Light-curing of SDR for 20 seconds

Figure 18: Application of CeramX as a capping material

Figure 19: Occlusal mirror image of the first CeramX increments

Figure 20: Restorations in teeth 14 and 16 prior to polishing

Figure 21: Occlusal mirror image of the restorations prior to polishing

Figure 22: Polishing with the Enhance system

Figure 23: Final restorations in teeth 14 and 16

Figure 24: Occlusal mirror image of the final restorations in teeth 14 and 16

junction. The SDR layer was light-cured for 20 seconds at a light intensity of at least 550mW/cm2 (Figure 17). To complete the restorations, the shade M2 of CeramX Mono plus was applied; this improved version of the nanocomposite CeramX greatly facilitates anatomical contouring (Figures 18 and 19). After the removal of the matrix system, the fillings already had a good anatomical and aesthetic appearance (Figures 20 and 21), so that the subsequent finishing and polishing with Enhance (Figure 22) and PoGo cups and points could be done with a minimum of time and effort. Figures 23 and 24 show the final restorations in comparison with the adjacent teeth; the aesthetic result fulfilled the expectations of both patient and dentist. The almost invisible transition from the SDR layer (universal shade) to the occlusal capping made of CeramX Mono was particularly esthetic.

Conclusion

SDR is characterised by a remarkably low polymerisation stress, in combination with a low polymerisation shrinkage and a high depth of cure. Thanks to the 'stress decreasing resin' technology, it is the first flowable composite that can be used as a bulk-fill base material in increments of up to 4mm in Class I and II cavities. SDR's self-leveling consistency ensures optimal adaptation to the cavity walls. Its compatibility with methacrylate-based adhesives and composites and its availability in one universal shade in Compula Tips help to optimise the workflow in clinical practice

References

1. Eichmiller F.C., 2004; Lu H. et al., 2004
2. Ernst C.-P. et al., 2009
3. Ilie N., 2007
4. Reis A., 2009
5. Frankenberger R., 2008

Dr Ludwig Hermeler earned his doctorate (University of Münster, Germany) and was licensed to practise in 1988, established his own dental practice in Rheine, Germany, in 1991. Publications in the fields of aesthetic dentistry, endodontics and implantology.