Predictable restorations using a new nano-ceramic composite – two case studies

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Composite resin materials offer patients a restorative option with excellent aesthetics and acceptable longevity for anterior and posterior teeth.

The advantages of using composite resin materials to restore anterior teeth include:

- Restorations can be placed in one visit;
- Aesthetics and functional results are controlled by the operator;
- Minimally invasive restorative technique;
- The material is biologically compatible to the gingival tissues when it is properly placed and polished;
- Minimal wear on opposing dentition;
- Easy to handle and manipulate the material;
- Easy to repair compared to ceramic materials (Mopper, 2008).

According to Ruiz (2011) Class I and Class II posterior composite restorations are two of the most common restorative procedures performed by general and restorative dentists in private practice. Direct posterior composite resin restorations are 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; Van der Vyver & Bridges, 2002).

Increased utilization of composite resin materials for these applications has drawn increased attention to develop new restorative materials with improved aesthetic and functional properties. The clinical performance of restorations depends however not only on the inherent material properties but to a great part on handling properties as well. The latter could either facilitate or impair the final clinical outcome of any restorative therapy.

Therefore, when developing their latest composite restorative material ceram.x SphereTEC one, Dentsply, the manufacturer, did not only focus on improving mechanical strength but developed an innovative filler technology – namely SphereTEC™ – enabling to improve handling properties as well.

SphereTEC filler technology

To optimize filler load a bi-modal filler size distribution (Figure 1) is a known pathway allowing smaller particles to fill in spaces between the larger ones.

However, large solid glass filler particles are known to decrease the polishability and may adversely influence abrasion resistance. To overcome this technical conflict, larger filler particles are made from smaller primary filler particles.

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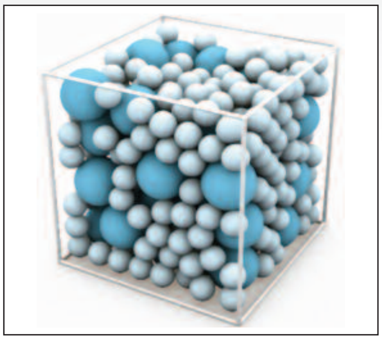

Figure1: Bi-modal filler size distribution for optimal filler load.

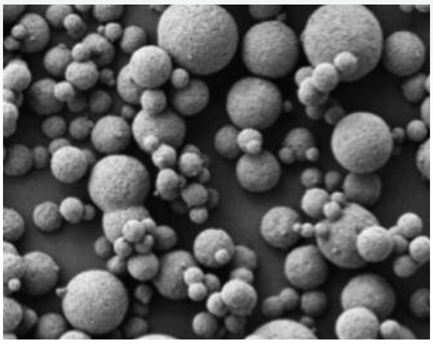

Figure 2: Typical SEM-pictures of SphereTEC fillers (Hagner, 2014).

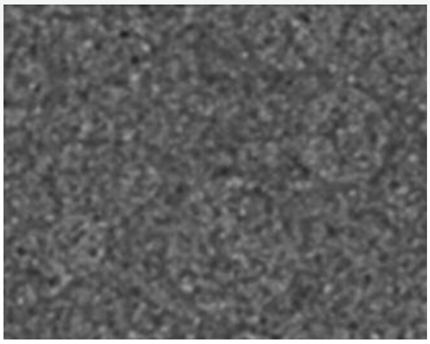

Figure 3: SEM picture of an abraded surface of ceram.x SphereTEC with homogenously embedded (hardly visible) SphereTEC filler particles (Latta, 2015).

The patent applied SphereTEC technology uses primary glass fillers with a mean size of 0.6 μm to create granulates in a mean size of 15 μm. These granulates are produced in a spray drying process resulting in nicely rounded spheres (Figure 2).

In the overall composition of the new ceram.x the same resin formulation and primary glass filler particles are used as in the SphereTEC process allowing the granulates to perfectly blend into the cured composite (Figure 3).

As expected from a material with mainly spherical particles, ceram.x SphereTEC one can be easily extruded from syringes. Due to the combination of the spherical granulates with irregular shaped primary glass particles the material easily adapts to cavity walls but then can be nicely sculpted as well.

The aim of this article is to introduce the clinical application of the new ceram.x SphereTEC one nano-hybrid composite material that the clinician can utilize for the restoration of anterior and posterior teeth.

Case Report 1: Replacement of a discolored Class V restoration

The patient, a 44 year old female presented with discolored Class V restoration on her upper right canine (Figure 4) and requested a more aesthetic restoration. The tooth was anaesthetized and the previously placed composite restoration was removed with a diamond bur. Figure 5 shows the final cavity preparation and placement of retraction cord for gingival isolation. The enamel and dentine was etched with 36% phosphoric acid for 15 seconds, rinsed with water and air-dried. Two coats of Prime&Bond one Etch&Rinse (Dentsply) were applied to the etched enamel and dentine surfaces, agitated with a micro-brush for 15 seconds, lightly air-dried to evaporate the excess solvent and light-cured for 20 seconds. Ceram.x SphereTEC one composite resin material was sculpted using the yellow and red Sculp Condensor instruments (Coltene). The distinct chameleon effect of ceram.x SphereTEC one provides excellent shade match at both, the cervical and the coronal cavity margin. Final contour was achieved by using an artist brush lubricated with Composite Primer (GC) to refine and smooth the contour of the composite increment, before the material was light-cured for 40 seconds.

Figure 4: Pre-operative view of upper right canine with discolored class V restoration.

Figure 5: Final cavity preparation and placement of retraction cord.

Figure 6: Post-operative result illustrating the superb finish and luster that was obtained with the Enhance multi finishing and polishing points.

Figure 7: Class V ceram.x SphereTEC one restoration after 3 month in service. Its distinct chameleon effect provides for excellent shade match at both, the cervical and the coronal cavity margin.

Figure 6 shows the post-operative result illustrating the superb finish and luster that was obtained with the Enhance® Multi finishing and polishing points (Dentsply), and Figure 7 demonstrates the aesthetically pleasing result after 3 months.

Case report 2: Replacement of insufficient Class II restorations

A 35-year-old male patient reported with a main complaint of sensitivity on his upper right maxillary sextant. Clinical examination revealed a poorly placed occlusal distal restoration with breakdown of the mesial marginal ridge on the maxillary first premolar (Figure 8). The maxillary second premolar presented with an occlusal mesial restoration that showed evidence of marginal leakage as well as large occlusal distal restoration. There was also a poor contact point between the distal aspect of the first premolar and the mesial aspect of the second premolar, which resulted in continuous food impaction between the teeth. Initially the patient gave consent to replace only the defective restoration on the first premolar. The tooth was anaesthetized and a rubber dam placed (Figure 9).

A Palodent V3 WedgeGuard® was placed to protect the distal aspect of the canine against iatrogenic damage during cavity preparation. The composite restoration, secondary caries and mesial marginal ridge were removed (Figure 10).

Cavity preparation was finalized with ultrasonic instruments. Due to the anatomy of maxillary first premolars, the mesial, gingival margin ended up with a concave margin (Figure 11) that often result in difficulty to get good matrix adaptation in this area.

Two modified Palodent V3 tab matrices (5.5 mm) (Dentsply) were placed and secured with Palodent V3 wedges (size large on mesial and size medium on distal box preparation). A narrow Palodent V3 ring was placed between the upper canine and first premolar teeth to ensure adequate separation. The adaptation of the matrix at the gingival margin was improved by packing a small piece of Teflon tape between the plastic wedge and the matrix band (Figure 12). Failure to ensure excellent adaptation of the matrix band at the proximal margins can result in excess composite on the margin that is very difficult and time consuming to remove.

The enamel and dentine were etched with 36% phosphoric acid for 15 seconds before application of Prime&Bond one Etch&Rinse (Dentsply) according to the manufacturer's instructions. A 4 mm increment of SDR, posterior bulk fill flowable base (Dentsply) was applied into the mesial box preparation to 0.5 mm lower that the anticipated contact point and light-cured for 20 seconds, followed by a 2 mm increment of ceram.x SphereTEC one was applied into the mesial box preparation. The mesial proximal margin was build-up using ceram.x SphereTEC

Figure 8: Pre-operative situation: deficient DO restoration of tooth 14 and deficient MO restoration of tooth 15.

Figure 9: Pre-operative situation after placement of rubber dam.

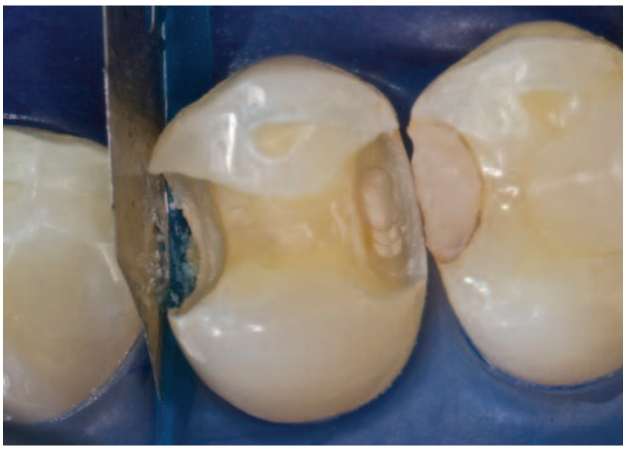

Figure 10: Tooth 14, Palodent V3 WedgeGuard placed, deficient composite restoration, secondary caries and mesial marginal ridge removed.

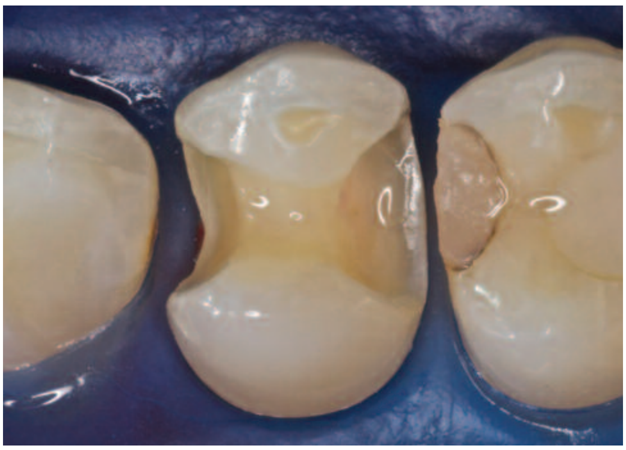

Figure 11: Concave gingival margin of the mesial box after cavity preparation of tooth 14.

one, and sculpted using the Sculp Condensor instruments (Coltene) and Occlusal Sculp Carvers (Coltene) before it was light-cured for 40 seconds, using the centripetal build-up technique (Bichado, 1994), (Figure 13).

The narrow Palodent V3 ring was removed and placed between the first and second premolar. Again, Teflon tape was used to improve the adaptation of the matrix band to the proximal cavity margin on the disto-lingual aspect. A 3mm increment of SDR, posterior bulk fill flowable base (Dentsply) was applied into the distal box preparation (Figure 14) to 0.5 mm lower that the anticipated contact point and light-cured for 20 seconds. A 2mm increment of ceram.x SphereTEC one was applied into the distal box preparation, sculpted using the sculpting instruments, and light-cured for light-cured for 20 seconds (Figure 14).

Note the anatomically contoured marginal ridges that were obtained by using a combination of a contoured Palodent V3 Sectional matrix band and manual contouring of the composite material using the sharp point of Occlusal Sculp Carvers. The narrow Palodent V3 ring was removed and the matrix band edges deflected away from the cavity preparation margins to allow more visibility and access to the remaining Class I preparation (Figure 15).

An oblique increment of ceram.x SphereTEC one composite resin was placed and adapted in an oblique layer using the Sculp Condensor, extending from the palatal cusp sloping towards the middle of the pulpal floor (Figure 16). A second oblique increment of ceram.x SphereTEC one composite resin was placed extending from the buccal cusp to slightly overlap the first oblique increment. The final

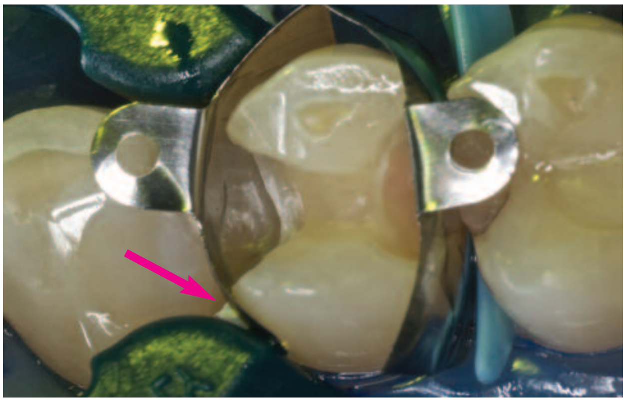

Figure 12: Narrow Palodent V3 ring between tooth 13 and 14. Improvement of adaptation of the matrix at the gingival margin of the mesial box by packing Teflon tape (arrow) between wedge and matrix.

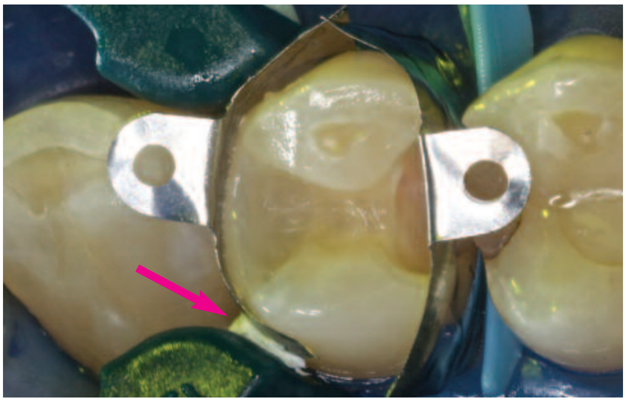

Figure 13: Build-up of the mesial wall using the centripetal technique, Teflon tape (arrow) between the plastic tine of the ring and the matrix band improves matrix adaptation on the mesio-palatal aspect of the cavity margin.

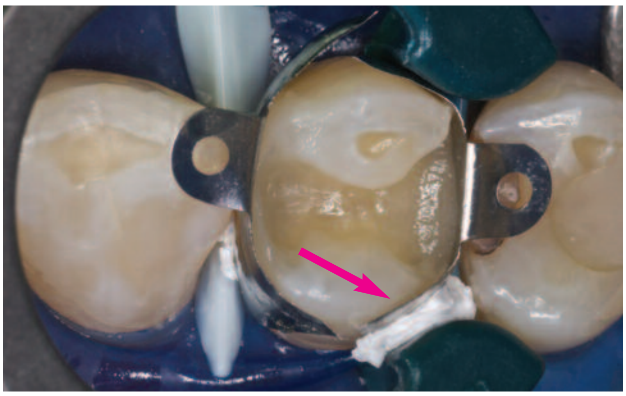

Figure 14: A 3 mm increment of SDR was placed and light-cured in the distal box preparation. Improvement of adaptation of the matrix at the proximal margin of the distal box by packing Teflon tape (arrow) between ring and matrix.

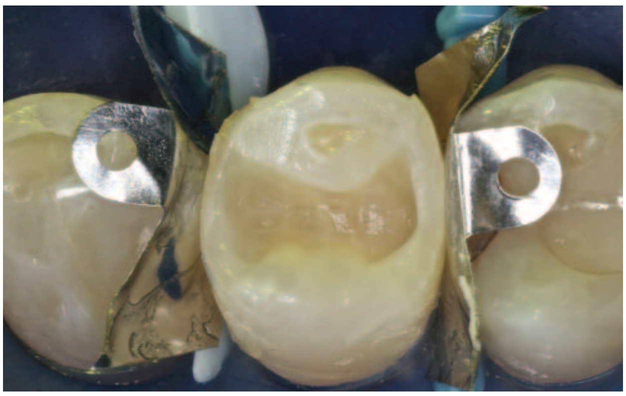

Figure 15: Distal margin build-up with ceram.x SphereTEC one, Palodent V3 ring removed, matrix bands deflected to improve access to the remaining Class I cavity.

Figure 16: Oblique increment of ceram.x SphereTEC one extending from the palatal cusp sloping towards the middle of the pulpal floor.

Figure 17: Final occlusal morphology.

occlusal morphology was developed with the Sculp Carver instruments (Figure 17).

After removal of the Palodent V3 wedges, finishing of the proximal margins was done using a medium grit OptiDisc (Kerr) while the sectional matrices were still in place to ensure protection of the contact points. Note the round anatomical marginal ridge contour that was obtained by using the contoured Palodent V3 tab matrices (Figure 18). Figure 19 shows the final result illustrating the superb finish and luster of ceram.x SphereTEC one that was obtained with the PoGo® diamond micro-polisher point (Dentsply).

After the patient saw the aesthetic appearance of the new restoration he immediately gave consent to replace the poor restoration on his maxillary second premolar. At a subsequent visit the defective MO-restoration as well as the DO-restoration were removed and the same principles for matrix management and bonding protocol was followed as previously described. Figure 20 shows the bulk placement of the SDR material in the distal box preparation. A 4mm layer was dispensed, up to a level just below the anticipated contact point and light-cured for 40 seconds.

The distal restoration was finished with ceram.x SphereTEC one by first building up the marginal ridge, followed by two oblique layers to complete the occlusal anatomy (Figure 21). The narrow Palodent V3 ring was removed and placed on the mesial aspect of tooth 15 to facilitate separation between the two premolar teeth. In the mesial box SDR was again used as a bulk fill dentine replacement and the proximal margin buildup was continued with ceram.x SphereTEC one to convert the Class II into a Class I cavity (Figure 22). The

Figure 18: Result after finishing of the proximal margins. Note the round anatomical marginal ridge contour obtained by using the contoured Palodent V3 tab matrices.

Figure 19: Final post-operative result illustrating the superb finish and luster of ceram.x SphereTEC one obtained with the PoGo diamond micro-polisher points.

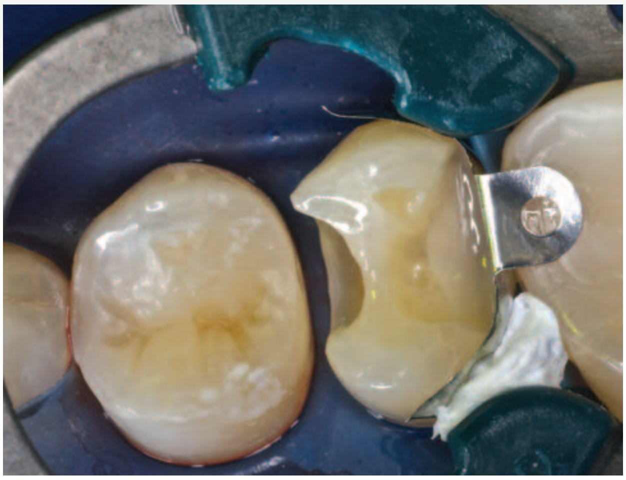

Figure 20: Bulk placement of a 4 mm layer of SDR material in the distal box of tooth 15, up to a level just below the anticipated contact point.

Figure 21: Distal restoration of tooth 15 after first building up the marginal ridge, followed by two oblique ceram.x SphereTEC one layers to complete the occlusal anatomy.

ring was removed and a final layer of ceram.x SphereTEC one was placed to complete the restoration.

After removal of the wedges, the proximal margins were finished using a medium grit OptiDisc (Kerr) and polished using the Enhance multi-system. Figure 22 shows the final result after removal of the matrix bands and the rubber dam. The superb finish and luster and the chameleon effect of ceram.x SphereTEC one results in invisible restorations of both maxillary premolars.

Discussion

Most clinicians perceive that placing a posterior composite restoration is far more technique sensitive than placing an amalgam restoration (Christensen, 2007, Ruiz, 2011). It is therefore relevant to reduce the technique sensitivity of this procedure. My experience with ceram.x SphereTEC one is in line with the results of User Evaluations conducted by the manufacturer (Dentsply, Scientific Compendium ceram.x SphereTEC one, 2015) which indicate that placement of

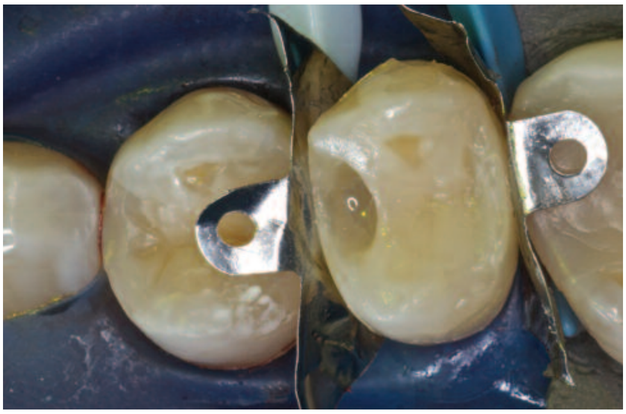

Figure 22: Mesial box of tooth 15: SDR is used as a bulkfill dentine replacement material followed by ceram.x SphereTEC one to build-up the mesial wall to convert the Class II into a Class I cavity.

Figure 23: Final result of the restorative treatment of both premolars. The superb finish and luster and the chameleon effect of ceram.x SphereTEC one results in three invisible restorations, 14 MOD, 15 MO and 15 DO.

ceram.x SphereTEC one is less technique sensitive and is characterized by:

- Easy and fast shade selection
- Simple, controlled application of the composite paste into the cavity,
- Secure adaptation of the composite paste to cavity floor, walls and margins,
- Easy shaping of the uncured composite into the desired anatomical form,
- Fast finishing and polishing procedure to achieve surface luster.

Technique sensitivity of placement of posterior composite restorations is further decreased by combining ceram.x SphereTEC one with the flowable bulk fill composite SDR. This low stress flowable base material can be placed in layers of up to 4 mm in thickness. According to the manufacturer, a modulator was chemically embedded into one of the monomers. The visco-elastic behaviour of this monomer and the overall composition of the flowable composite allows the material to dissipate much more energy than induced during curing by polymerisation of the monomers. This leads to a reduction of remaining polymerisation stress by up to 60% compared to conventional flowable composite resins (Dentsply, Scientific Compendium SDR, 2011). The volumetric shrinkage is 3.6% but, more importantly, the stress generated during the polymerisation is 1.4 MPa, whereas many other flowable composites are above 4 MPa.

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-levelling feature, which eliminates the need to manipulate or sculpt the material before curing. This also creates an ideal surface for the addition of the regular viscosity composite ceram.x SphereTEC one to complete direct restorations, providing the desired strength, aesthetics and wear resistance for occlusal surfaces.

Conclusions

The innovative filler technology SphereTEC, enabling to improve mechanical strength and handling properties of composite materials, and the flowable base material SDR, that can be placed and cured in bulk, are exciting technological advancements in dentistry towards technique simplification for what is generally regarded as a highly technique sensitive procedure.

In this case studies the combination of SDR with ceram.x SphereTEC one delivered an improved and simplified operative technique to provide patients with more durable posterior restorations.

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