An efficient and safe cavity filling technique
Smart Dentin Replacement explained

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Do you remember how a crumbling mixture could turn an otherwise easy and safe amalgam filling into a nightmare? Have you found the stickiness of the material troublesome when placing tooth-coloured fillings with a composite material? Do you loathe constructing a filling using the layering technique?

If your answer to all these questions is “Yes,” it is probably time to think about a more simple solution. The use of flowable composites has gained popularity particularly in cases where a simple and safe initial adaptation is required. However, there is no proof that this generally comes with a reduction in polymerization stress. Researchers at DENTSPLY have developed modified monomers, that, combined with conventional methacrylate-based monomers, leads to significantly reduced polymerisation stress, regardless of the filler load. The idea behind this was to have a flowable material that allows clinicians to use an efficient and safe cavity filling technique. Since flowable consistency is usually not ideal for either occlusal reconstruction or to establish the necessary wear resistance, the occlusal layering with a universal composite was put into consideration from the beginning of the development process. In other words, dentine can now be replaced with Smart Dentin Replacement (SDR).

The chemistry of SDR is based on that of conventional universal composites. Therefore, a certain adhesive or a combination of a special material for occlusal coverage is not required. The key differentiator is a modulator that is incorporated into a urethane-based dimethacrylate. From this, a conventional network structure can be built from conventional monomers as well as the SDR monomer (Fig. 1). Instead of only becoming a part of the polymerised network, the modulator also influences its development and, in particular, influences how quickly the network is built. This way, there is less polymerization stress from the very beginning. Researchers at the University of Munich, who conducted measurements of the contraction force during polymerization at 0.2 sec. intervals, were able to demonstrate how SDR differs from other materials, even after polymerization (Figs. 2 & 3). In addition to low polymerization stress, it is important also to have a high depth of cure, which can be achieved with a universal shade providing sufficient translucency. Using a curing time of 20 seconds, samples prepared with different layer thicknesses have been tested. It was found that successful curing can be achieved when the hardness of the lower side of a sample reaches a minimum of 80 per cent of the upper side.

Applied in increments of up to 5 mm, SDR clearly demonstrated a much higher depth of cure compared to other flowable materials (Fig. 4). Combined with its very low polymerization stress, SDR even allows layering in 4 mm increments.

Representing many other studies on the compatibility of SDR with adhesives and composites for the capping layer are the results of a chewing simulation. Here, incrementally layered fillings, consisting of adhesive and composite from the same manufacturer, were compared with simplified filled cavities with regard to their marginal quality using the same bonding agent, composite and also SDR before and after a chewing simulation. All cases demonstrated that using SDR in 4 mm layers and capping with a universal composite provided the same level of marginal quality compared to a restoration using incremental layering.

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Fig. 1: The SDR monomer with modulator establishes a network with conventional monomers. — Fig. 2: Contraction force in the first five seconds after polymerisation (Ilie N, 2009). — Fig. 3: Polymerization stress after five minutes (Ilie N, 2009). — Fig. 4: Relative Knoop hardness of different flowable composites as a measurement for depth of cure.