A printing pen for dentistry:
the cusp-by-cusp method with thixotropic composite

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The intraoral reproduction of the correct occlusal morphology in large composite restorations is challenging. In particular, if one or more cusps have to be replaced, the restoration height must be estimated and the design of the cusp slopes is carried out without guiding structures such as cavity walls on which the material can be adapted. In principle, such restorations can be built up too high and the correct height and morphology can be subsequently adjusted using rotary instruments and articulating paper.
However, this procedure is time-consuming and although it usually leads to a functional occlusal morphology, it is not necessarily aesthetic.
With G-ænial Universal Injectable, GC has a highly filled, flowable composite that is suitable for use in load-bearing areas on the market for several years already. In addition to the injection technique, the material can also be used for direct, freehand shaping of the occlusal surfaces, including cusp replacement. The procedure is analogous to the wax-up of a restoration in the dental laboratory. The use of modelling instruments can be largely or even completely dispensed with.
A prerequisite for the successful use of this technique is good knowledge of occlusal morphology, i.e. the course of the fissures and the cusp-cusp relationship.
The case presented here illustrates the procedure for this "composite wax-up" technique, discusses material-specific questions and gives recommendations for the appropriate indication area.

Clinical case

In the present case, the entire restoration was layered with G-ænial Universal Injectable A3 / AO3, completely eliminating the use of modelling instruments.

Fig. 1 shows the initial situation with a large composite restoration on tooth 16, which had to be replaced because of detachment and leakage in the mesial area. After removal of the old restoration and preparation of the cavity (Fig. 2), a sectional matrix system (Palodent, Dentsply) (Fig.3) was applied. The enamel was selectively etched for 15 s (Fig. 4). After rinsing off the phosphoric acid, a universal adhesive was applied. Even if manufacturers release universal adhesives for all etching protocols (total-etch, self-etch or selective etch), selective enamel etching is preferred whenever possible[1-3].

Next, the missing cavity walls were built up step by step with G-ænial Universal Injectable. The viscosity of the material lies between a classic flow and a conventional composite, so the material wets the surface well, but is stable enough to be modelled directly from the syringe (Fig. 5-8). Prerequisite for the use of G-ænial Universal Injectable in the technique described here is the knowledge of the correct anatomy of the occlusal surfaces of the concerned teeth. In an upper first molar, the cusp slopes are connected as shown in Figure 9.

Fig. 1. Initial situation.

Fig. 2. After absolute isolation and preparation.

Fig. 3. Whenever possible, sectional matrix systems are preferred.

Fig. 4. Selective enamel etching for 15 s.

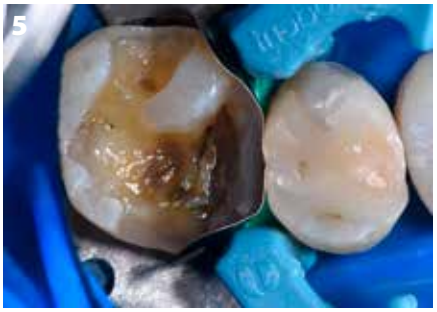

Fig. 5. First, the proximal wall was built.

Fig. 6. After building up the proximal wall, the matrix was removed for a better overview.

Fig. 7. The material stays well in place so that the remaining walls can be built up without a matrix.

Fig. 8. Before the modelling of the cusp slopes begins, the cavity floor should always be entirely covered with composite. In the case of discoloured dentine, an opaque colour (AO3) is particularly suitable.

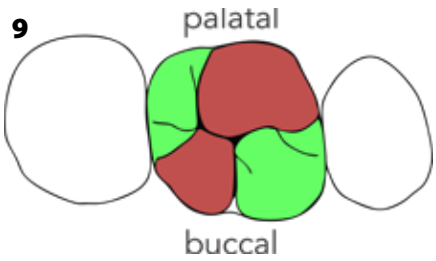

Fig. 9. The chewing surface of an upper first molar is composed of four cusps. The mesiopalatal cusp as the largest one always connects with the disto-buccal cusps. The slopes converging diagonally across the tooth form the crista transversa and separate the two remaining cusps from each other.

The modelling starts with the largest cusp, which is the mesio-palatal one (Fig. 10). The permissible layer thickness specified by the manufacturer is between 1.5 and 2.5 mm, depending on the darkness and translucency of the shade. As with most composites, the actual achievable layer thickness is slightly higher[4]. However, there is a linear relationship between the curing depth of the composite and the logarithm of the applied absorbed dose[5,6]. Doubling the curing time or doubling the light intensity of the polymerization lamp does not lead to a doubled curing depth. Here, a multiple of the energy would have to be used. For this reason, it is important to polymerize the cusp with the highest layer thickness first, as it is exposed again with each polymerization of the other layers of the remaining cusps. In this way, exceeding the permissible layer thickness can be compensated within certain limits.

In the next step, the disto-buccal cusp is created (Fig. 11). This essentially defines the crista transversa and thus the occlusal morphology. In contrast to conventional composites, with G-ænial Universal Injectable, the cusp slopes can be modelled with the application tip; no further modelling instruments are required.

Fig. 10. The mesiopalatal cusp is always restored first. Being the largest of the four cusps, its correct design is crucial.

Fig. 11. Thereafter follows the disto-buccal cusp, thus determining the occlusal morphology.

Fig. 12. With the remaining two cusp slopes, the restoration of the occlusal surface is completed.

Fig. 13. Condition after removal of buccal and palatal excesses.

The design of the remaining two cusp slopes is now simple. (Fig.12).

After restoration of the occlusal surface, the buccal and palatal excesses are removed with rotating discs (e.g. Sof-Lex, 3M) (Fig. 13).
Any approximate excess should be removed, e.g. with a scalpel № 12 or an oscillating file system (Proxoshape, Intensive)[7].

After checking and adjusting the occlusion (Fig.14), the final polishing took place (Diatech ShapeGuard Composite Polishing Plus, Coltene). Correct occlusal adjustment can be very time-consuming, especially with cusp involvement. Here, morphologically correct layering pays off from the outset, as this usually leads to an almost perfect occlusion even before elaboration. The thixotropic consistency of G-ænial Universal Injectable results in a very smooth surface, even upon the application, so that polishing is simple (Fig. 15).

Fig. 14. Occlusion control.

Fig. 15. Finished restoration.

Discussion

In general, flowable composites are not used for occlusal load-bearing restorations. This is because these materials usually do not have sufficient flexural strength to meet the mechanical requirements in this area.

With a flexural strength of 173 MP, G-ænial Universal Injectable is significantly stronger than the majority of conventional posterior composites commonly used today.

Being of flowable nature, G-ænial Universal Injectable has a fairly high shrinkage. Although there is no direct correlation between shrinkage and shrinkage stress, other factors, such as the C-factor of the cavity and the modulus of elasticity of the material, have a decisive influence here, one could assume that the material likely exhibits higher shrinkage stress than paste-like composites[8]. For the first increments in deep cavities, this could possibly be disadvantageous, but due to the low C-factor of the increments, it does not matter when cusps are restored. The clinical procedure presented here could be further optimized by restoring the deep areas of the cavity with a flowable bulk fill composite (e.g. everX Flow) and building only the occlusal areas and cusps with G-ænial Universal Injectable. Here, the material shows its unbeatable strength and makes it considerably easier to build large, complex composite restorations.

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