Clinical

A bulk-fill technique

Jürgen Manhart presents the world's first nanohybrid ormocer for the bulk-fill technique in the posterior region

Figure 1: Condition before treatment: amalgam filling in tooth LR6

Figure 2: Situation following removal of the amalgam filling

Figure 3: After excavation, the cavity was finished and isolated with a rubber dam

Figure 4: Demarcation of the cavity with a sectional matrix

Summary

Direct composites in posterior teeth are a part of the standard therapy spectrum in modern dentistry. The excellent performance of this form of restoration in the masticatory load-bearing posterior region has now been demonstrated in numerous clinical studies.

The procedure is usually carried out in an elaborate layering technique. Aside from the possibilities that highly aesthetic composites offer in the application of polychromatic multiple-layer techniques, there is also great demand for the most simple and quick to use, and therefore more economical, composite-based materials for posterior teeth.

This demand can be met with ever more popular composites with increased depths of cure (bulk-fill composites).

Introduction

The range of products available in the field of direct composites has expanded greatly in recent years (Ferracane, 2011; Kunzelmann, 2007; Kunzelmann, 2008). In addition to the classic universal composites, the enormous rise in patients' aesthetic expectations has resulted in the launch of a large number of so-called 'aesthetic composites' on the market, which are characterised by composite materials in a sufficient number of different shades and different grades of translucency and opacity (Manhart, 2006).

Opaque dentine shades, translucent enamel pastes and, if required, body shades make it possible to achieve highly aesthetic direct restorations using the multicoloured layering technique. They are practically indistinguishable from the dental hard tissue and they rival the aesthetics of all-ceramic restorations.

Some of these composite systems comprise more than 30 different composite materials of different shades and degrees of translucency. It is, however, essential to have appropriate experience in the handling of these materials, which are primarily used in the anterior region with a layering technique employing two or three different opacities and translucencies (Manhart, 2006; Manhart, 2009).

Due to their polymerisation properties and limited depth of cure, light-curing composites are generally used in a layering technique with individual increments of no more than 2mm in thickness. Each individual increment is polymerised separately, with exposure times from 10 to 40 seconds, depending on the power of the curing light and colour/translucency of the composite paste (Ilie and Hickel, 2011).

With the materials available up until recently, thicker composite layers resulted in insufficient polymerisation of the composite resin and thus to poorer mechanical and biological properties (Caughman et al, 1991; Ferracane and Greener, 1986; Tauböck, 2013).

Applying the composite in 2mm increments can be an extremely time-consuming procedure, especially in large posterior cavities. Consequently, there is considerable demand in the market for composite-based materials that are simple and quick to use, and therefore more economical, for this range of indications (Burtscher, 2011).

Developments

To satisfy this demand, bulk-fill composites have been developed over recent years, which, given a sufficiently powerful curing light, can be placed more quickly in the cavity, using a simplified application technique, in layers 4-5mm thick and with short increment curing times of 10-20 seconds (Czasch and Ilie, 2013; Finan et al, 2013; Ilie and Stawarczyk, 2014; Manhart, 2010; Manhart, 2011).

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Taken literally, 'bulk fill' means that they can be used to fill the cavity in a single step lege artis without the need for a layering technique (Hickel, 2012). With plastic restorative materials this is currently only possible with cements and chemically activated or dual-curing core build-up composites.

However, the former do not possess adequate mechanical properties for restorations that are clinically stable in the long term in the masticatory load-bearing posterior region of the permanent dentition, and are consequently only suitable for use as interim restorations/long-term temporaries (Frankenberger, 2009; Hickel et al, 2005; Lohbauer, 2010).

The latter are neither approved as restoratives nor suitable for such indications from a handling perspective (eg, shaping of occlusal surfaces). The bulk-fill composites currently available for the simplified filling technique in the posterior region are not actually 'bulk' materials in the true sense, when examined more precisely, as the approximal extensions of clinical cavities, in particular, are generally deeper than the maximum depth of cure specified for these materials (4-5 mm) (Frankenberger et al, 2012; Frankenberger et al, 2012). This said, it is possible to fill cavities with depths of up to 8mm in 2mm increments if a suitable material is selected – and this covers the majority of defect dimensions encountered in routine clinical practice.

Figure 5: Selective enamel etching with 35% phosphoric acid

Figure 6: Situation after rinsing the acid and carefully drying the cavity

Figure 7: Application of the bonding agent Futurabond M+ to the enamel and dentine

Most composites contain organic monomer matrices based on conventional methacrylate chemistry (Peutzfeldt, 1997). Silorane technology (Guggenberger and Weinmann, 2000; Ilie and Hickel, 2006; Ilie and Hickel, 2009; Lien and Vandewalle, 2010; Weinmann et al, 2005; Zimmerli et al, 2010) and ormocer chemistry (Hicke et al, 1998; Manhart et al, 1999; Manhart et al, 2000; Wolter, 1995; Wolter and Storch, 1992; Wolter et al, 1995; Wolter et al, 1994; Wolter et al, 1998) present alternative approaches.

Ormocers

Ormocers ('organically modified ceramics') are organically modified, non-metallic, inorganic

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Figure 8: Careful drying of the solvent from the adhesive system with an air stream

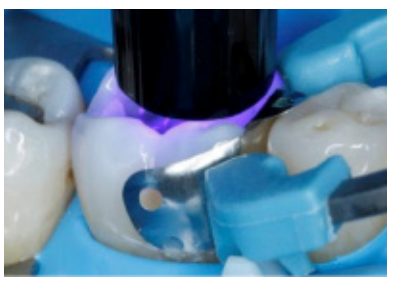

Figure 9: Light curing of the bonding agent for 10 seconds

Figure 10: Once the adhesive has been applied, the entire sealed cavity has a shiny surface

Figure 11: The first increment of Admira Fusion x-tra fills the mesial area of the cavity and shapes the approximal wall up to the level of the marginal ridge

Figure 12: Light curing of the restorative material for 20 seconds

composites (Greiwe and Schottner, 1990). Ormocers can be classified between inorganic and organic polymers and possess both an inorganic and an organic network (Moszner et al, 2008; Moszner et al, 2002; Wolter et al, 1998). This group of materials was developed by the Fraunhofer Institute for Silicate Research (ISC), in Würzburg, and marketed for the first time as a dental restorative material in 1998 in collaboration with partners in the dental industry (Wolter et al, 1994; Wolter et al, 1994).

Since then there has been considerable further development of the ormocer-based composites for this range of applications. However, the use of the ormocers is not limited to dental restoratives. These materials have been successfully employed for years in fields such as electronics, microsystems technology, plastic refining, preservation, anti-corrosion coatings, functional coatings for glass surfaces and highly resistant, scratch-proof protective coatings (Ciriminna et al, 2013; Schmidt and Wolter, 1990; Wolter and Schmidt, 1990).

Ormocer-based dental restorative composites are currently available from two dental companies (Admira product range, Voco; Ceramx, Dentsply).

In the dental ormocer products to date, additional methacrylates were added to the pure ormocer chemistry (in addition to initiators, stabilisers, pigments and inorganic fillers) in order to improve workability (Ilie and Hickel, 2011). Therefore, it is better to speak of ormocer-based composites here.

According to the manufacturer, the new bulk-fill ormocer Admira Fusion x-tra (Voco), launched in 2015, no longer contains any conventional monomers in addition to the ormocers in the matrix. It features a nanohybrid filler technology with an inorganic filler content of 84% by weight. It is available in a universal shade and displays polymerisation shrinkage of just 1.2% by volume and simultaneously low shrinkage stress.

Admira Fusion x-tra can be applied in layers of up to 4mm, with each increment being cured in 20 seconds (curing light intensity > 800 mw/cm²).

The malleable consistency and the material data of Admira Fusion x-tra allow the dentist to restore cavities using the bulk technique with a single material; an occlusal covering layer with an additional composite – as required when flowable bulk composites are used – is no longer necessary.

Clinical case

A 47-year-old patient presented at our clinic requesting to have his remaining amalgam fillings replaced gradually with tooth-coloured restorations. In the first treatment session we replaced the old amalgam filling in tooth LR6 (Figure 1).

The tooth responded sensitively to the cold test without delay and the percussion test was also normal. Having been informed of the possible treatment alternatives and their costs, the patient elected to have a composite restoration with the ormocer Admira Fusion x-tra (Voco) in the bulk-fill technique.

Treatment started with thorough cleaning of the tooth with a fluoride-free prophylaxis paste and a rubber cup to remove external deposits. As Admira Fusion x-tra is only available in a universal shade, there is no need for detailed determination of the tooth shade. After administration of local anaesthesia, the amalgam was carefully removed from the tooth (Figure 2). Following excavation, the cavity was finished with a fine-grit diamond bur and a rubber dam placed to isolate the tooth (Figure 3). The rubber dam separates the operating site from the oral cavity, facilitates clean and effective working, and guarantees that the working area remains clean of contaminating substances such as blood, sulcus fluid and saliva.

Contamination of the enamel and dentine would result in considerably poorer adhesion of the composite to the dental hard tissue and would endanger the long-term success of a restoration with optimal marginal integrity. Additionally, the rubber dam protects the patient from irritating substances such as the adhesive system.

The rubber dam is thus an essential aid in ensuring quality and facilitating work in the adhesive technique. The minimal effort required in applying the rubber dam is also compensated by avoiding the changing of cotton rolls and the patient's requests for rinsing.

The cavity was then demarcated with a sectional matrix made of metal (Figure 4). The universal adhesive Futurabond M+ (Voco) was chosen for the adhesive pre-treatment of the dental hard tissue. Futurabond M+ is a modern one-bottle adhesive which is compatible with all conditioning techniques: the self-etch technique and the phosphoric acid-based conditioning techniques (selective enamel etching or complete etch and rinse pre-treatment of enamel and dentine).

Selective enamel etching technique

In this case we chose the selective enamel etching technique, applying 35% phosphoric acid (Vococid, Voco) along the enamel margins and allowing it to work for 30 seconds (Figure 5). The acid was then rinsed off for 20 seconds with the compressed air and water jet, and excess water carefully removed from the cavity with compressed air (Figure 6).

Figure 7 shows the application of a generous amount of the universal bonding agent Futurabond M+ on enamel and dentine with a microbrush. The adhesive was thoroughly rubbed into the dental hard tissue with the applicator for 20 seconds.

The solvent was then carefully dried-off with dry, oil-free compressed air (Figure 8) and the bonding agent light-cured for 10 seconds (Figure 9). The result was a shiny cavity surface, evenly covered with adhesive (Figure 10).

This should be carefully checked, as any areas of the cavity that appear matt are an indication that insufficient adhesive was applied to those sites. In the worst case, this could result in reduced bonding of the restoration in these areas and, at the same time, in reduced dentine sealing, which may lead to postoperative sensitivity. If such areas are found in the visual inspection, additional bonding agent is again selectively applied to them.

In the next step, the cavity measured in advance with a periodontal probe (6mm deep from the floor of the box to the occlusal marginal ridge) was filled with Admira Fusion x-tra in the area of the mesial box until a residual depth in the whole cavity of no more than 4mm remained. At the same time the mesial approximal surface was built up completely to the level of the marginal ridge (Figure 11).

The restorative material was cured by a polymerisation lamp (light intensity >800mW/cm²) for 20 seconds (Figure 12). The build-up of the mesial approximal surface converted the original class II cavity into an

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'effective class I cavity', and then the matrix system was removed, as it was no longer required (Figure 13).

This facilitates access to the cavity with hand instruments for shaping the occlusal structures in the further course of the treatment and, thanks to the improved visibility of the treatment area, allows improved visual control of the material layers subsequently applied. The second increment of Admira Fusion x-tra filled the residual volume of the cavity completely (Figure 14). Following the shaping of a functional but uncomplicated, occlusal anatomy (Figure 15) – which also helps to ensure rapid finishing and polishing – the restorative material was cured again for 20 seconds (Figure 16).

After removal of the rubber dam, the restoration was carefully finished with rotary instruments and abrasive discs, and the static and dynamic occlusion adjusted. Diamond-impregnated silicone polishers (Dimanto, Voco) were then used to give the surface of the restoration a smooth and shiny finish.

Figure 17 shows the finished, direct ormocer restoration, which reproduces the original tooth shape with an anatomically functional occlusal surface, physiologically shaped approximal contact and aesthetically acceptable appearance. Finally, a foam pellet was used to apply the fluoride varnish (Bifluorid 12, Voco) to the teeth.

Final remarks

The importance of direct composite-based restorative materials will continue to increase in the future. They produce scientifically verified, high-quality permanent restorations for the masticatory load-bearing posterior region, whose reliability has been documented in literature. The results of an extensive review have shown that the annual loss rate for composite restorations in the posterior region (2.2%) is not statistically different from amalgam restorations (3.0%) (Manhart et al, 2004).

The increasing economic pressure in the healthcare sector creates a need for a simpler, faster and thus more cost-effective basic treatment alongside the time-consuming high-end restorations. For some time now there have been composites with optimised depths of cure on the market for this purpose, which can be used to make clinically and aesthetically acceptable posterior restorations using a procedure that is more cost-

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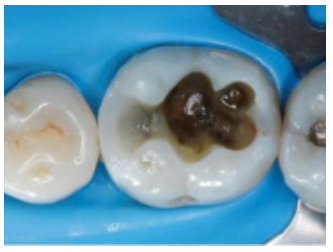

Figure 13: Situation after removal of the matrix

Figure 14: The second increment of Admira Fusion x-tra fills the cavity completely

Figure 15: Shaping of a functional but uncomplicated occlusal anatomy

Figure 16: Curing the m-o restoration. The vestibular cavity was filled in the next step

Figure 17: Result: finished, highly polished restoration. The function and aesthetics of the tooth have been successfully restored

effective compared with traditional hybrid composites (Burke et al, 2009; Manhart et al, 2009).

In addition to the bulk-fill composites with classic methacrylate chemistry, the range of products on offer in the field of composite adhesive materials with a large depth of cure has now been expanded with a nanohybrid ormocer version. D

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