

specialfeature

A fast and comfortable way of restoring teeth

Tetric EvoFlow® Bulk Fill, Tetric EvoCeram® Bulk Fill



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Esthetics and efficiency in the restoration of posterior teeth



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Intelligent direct restorative technique for posterior restorations

Large posterior cavities can be filled with few increments by skilfully combining bulk-fill composites with two different viscosities. Given their high depth of cure, these composites enable a rational and reliable restorative technique in the posterior region.

If a conventional incremental technique is used to place direct composite fillings, the composites are applied in single increments of a maximum thickness of 2 mm and the individual increments are light-cured separately for 10 to 40 s [1] depending on the light intensity of the curing light and the shade and degree of translucency of the composite material used. This application protocol can be a very time-consuming and technique sensitive procedure, particularly when it is used to fill large and voluminous cavities in the posterior region. For this reason, most practitioners have been looking for a practice-friendly alternative for this complex multi-layer technique. They want to use a procedure that is less time-consuming and therefore more economical and offers increased reliability and safety [2, 3, 4, 5]. A material combining the low technique sensitivity and proven clinical longevity of amalgam with the stabilizing effect of the adhesive technique is therefore required to enable the efficient restoration of posterior cavities. The requirements placed on such a material are outlined below:

- Fast and easy application, incl. finishing / polishing
- Low technique sensitivity
- No need for time-consuming shade selection procedures
- Preserving and stabilizing natural tooth structure
- Adhesion to tooth structure and no, or only very limited, negative effects on polymerization (Polymerization shrinkage and polymerization stress)

These requirements have led to the recent development of bulk-fill composites. These materials feature optimized depth-of-cure capabilities (increments of 4 –5 mm) and, at the same time, they can be light-cured in short exposure times of 10 to 20 s if a curing light capable of emitting an appropriately high light intensity is used (usually ≥ 800 mW/cm²). The result is a streamlined

application protocol that allows cavities to be restored more rapidly without necessitating a complex multi-shade incremental technique [3, 6, 7, 8, 9].

Bulk-fill composites:

As regards their chemical composition, bulk-fill composites are based on a similar monomer matrix and filler technology as the proven conventional hybrid composites [1, 10]. They are available in two degrees of viscosity. Both of these viscosities require a different application technique:

1) Low-viscosity, flowable composites. These bulk-fill composites require the application of an additional occlusal capping layer made of a conventional posterior hybrid composite to protect the restoration surface. This capping layer is required to improve the mechanical properties of the stress bearing occlusal surface [1, 11, 12, 13] and assists in creating a functional anatomical occlusal surface, which would be nearly impossible or very difficult to achieve with a flowable material.

2) Regular- to high-viscosity variants featuring a stable mouldable consistency. These bulk-fill composites can be used up to the occlusal surface. They do not require a covering layer and therefore do not require an additional composite material.

For both versions, their maximum layer thickness is restricted to 4 to 5 mm because of the limits on the depth of cure. This means that only the high-viscosity representatives applied in cavity depths that do not exceed their maximum depth of cure can be considered bulk-fill materials in the true meaning of the word. If a defect is deeper than the maximum curing depth or if a flowable variant is used, an additional layer of material will always be required.

In 2011, Ivoclar Vivadent launched the high-viscosity composite Tetric EvoCeram® Bulk Fill, followed by the flowable version Tetric EvoFlow® Bulk Fill in 2015. The two products complement one another very well. In terms of material technology, they are closely related to the universal nanohybrid composite Tetric EvoCeram, which has been successfully competing in the market for over ten years. Both products additionally contain the highly reactive and optimized Ivocerin light initiator, which has been patented by Ivoclar Vivadent. This innovative polymerization booster, which is based on dibenzoyl germanium derivatives, features an absorption spectrum similar to that of the widely used camphorquinone. However, it shows improved quantum efficiency due to its higher light absorption rate and therefore higher light-reactivity [14, 15]. As a result, even very little light (photons) can trigger polymerization and achieve a high depth of cure of 4 mm at a short exposure time [14, 16].

Given its beneficial wetting properties, Tetric EvoFlow Bulk Fill demonstrates an excellent surface affinity and smoothly adapts to the walls, inner edges and line angles of clinical cavities. It is additionally characterized by a self-levelling consistency. Given these attributes, the material can be easily and quickly applied into the cavity as an initial layer to replace lost dentin (volume replacement). Formulated with the Aessencio technology developed by Ivoclar Vivadent, Tetric EvoFlow Bulk Fill reduces its translucency from 28% to a dentin-like translucency of <10% as it polymerizes. It thereby effectively masks discoloured dentin areas. Tetric EvoFlow Bulk Fill should be covered with an occlusal capping layer of at least 1 mm thickness using a suitable posterior hybrid composite. This is best achieved with the proven Tetric EvoCeram Bulk Fill, which features an enamel-like translucency and integrates well into the surrounding tooth structure. It therefore



Fig. 1: Initial situation: defective composite filling on the first lower molar with no proximal contact in the distal region



Fig. 2: Situation after removal of the old filling. The depth of the cavity was measured.



Fig. 3: Conditioning the cavity with phosphoric acid



Fig. 4: The tooth structure was conditioned with Adhese® Universal (reaction time 20 s).



Fig. 5: Light polymerization of the adhesive for 10 s with Bluephase Style



Fig. 6: Volume replacement of lost dentin with Tetric EvoFlow® Bulk Fill



Fig. 7: Smooth adaptation to the cavity walls due to the self-levelling properties of the flowable bulk-fill composite



Fig. 8: Light polymerization of the composite for 10 s with Bluephase Style

ideally complements the flowable bulk-fill composite. Both composites are available in the three universal shades ^{IV}A, ^{IV}B and ^{IV}W and can be light-cured in as little as 10 s per 4-mm increment if a high-intensity curing light ($\geq 1.000 \text{ mW/cm}^2$), e.g. Bluephase® Style, is used.

Clinical case:

A male patient presented with the wish to have the restoration of one of his lower first molars replaced because the existing composite filling failed to provide a distal proximal contact and, as a result, food particles kept being trapped in the interdental gap (Fig. 1). After the patient had been informed about the treatment options and the corresponding costs, he decided in favour of a bulk-filled composite filling made of a combination of Tetric EvoFlow Bulk Fill and Tetric EvoCeram Bulk Fill.

Since these two composites are available in three universal shades (^{IV}A, ^{IV}B, ^{IV}W), the need for a detailed shade selection procedure is eliminated. After the tooth had been cleansed, the existing composite material was completely removed. Next, the operating field was isolated with a rubber dam and a sectional metal matrix band was placed around the cavity. The deepest area of the cavity was measured using a scaled periodontal probe. This was a vertical length of 7 mm in the distal box (Fig. 2). The enamel and dentin in the entire area of the cavity were etched with phosphoric acid using the etch & rinse technique (Fig. 3) and then conditioned Adhese® Universal bonding agent according to the manufacturer's instructions. Adhese Universal is an advanced single-component adhesive that is compatible with all etching techniques: self-etch techniques and phosphoric acid etch techniques (selective enamel etch and total etch & rinse techniques involving the enamel and dentin). Figure 4 shows the application of a generous amount of Adhese Universal adhesive onto the enamel and dentin. The material was carefully scrubbed into the tooth structure for at least 20 s using the brush cannula of the VivaPen® delivery form. Next, the solvent was dispersed with a gentle stream of compressed air until a glossy immobile adhesive film resulted. Subsequently, the bonding agent was light-cured for 10 s using a Bluephase Style curing light (Fig. 5). The result was a shiny cavity evenly and completely covered with adhesive.

At the next step, lost dentin was built up swiftly with the help of a volume replacement technique. This was achieved by injecting a 4-mm-thick layer of Tetric EvoFlow Bulk Fill in shade ^{IV}A into the cavity, measured from the deepest point of the cavity (Fig. 6). Figure 7 shows the excellent surface affinity and self-levelling properties of the flowable composite, which appears highly translucent prior to the light-curing process. The composite was light-cured for 10 s using a Bluephase Style LED curing light (Fig. 8). Given the high light intensity of the curing light ($1,100 \text{ mW/cm}^2$), suitable composites can be adequately polymerized using short exposure times. The shortened light probe facilitates access to posterior cavities and the filling material can be illuminated at an ideal angle to ensure a reliable cure.

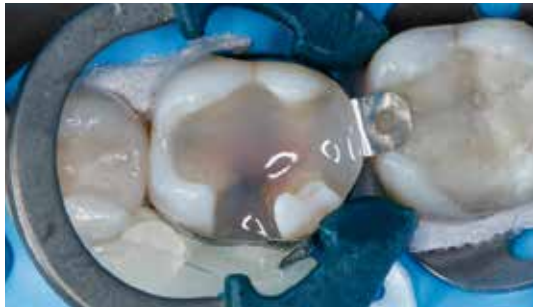


Fig. 9: Once polymerized, Tetric EvoFlow Bulk Fill shows a dentin-like translucency (Aessencio technology).



Fig. 10: Contouring the lingual cusps with Tetric EvoCeram® Bulk Fill



Fig. 11: Light polymerization of the composite for 10 s with Bluephase® Style



Fig. 12: Sculpting the buccal cusps using Tetric EvoCeram Bulk Fill



Fig. 13: Completely contoured occlusal morphology



Fig. 14: Situation after removal of the matrix band



Fig. 15: Checking and adjusting the static and dynamic occlusion



Fig. 16: Final situation: completed restoration made of a bulk-fill composite and polished to a high gloss. The tooth has regained its function and appearance.

Once polymerized, Tetric EvoFlow Bulk Fill shows a dentin-like translucency of < 10 % (Aessencio technology). The discoloured dentin areas that had previously been visible were now largely masked (Fig. 9).

Subsequently, the lingual cusps were reconstructed with an increment of Tetric EvoCeram Bulk Fill in shade Farbe [®]A (Fig. 10). The filling material was light-cured with Bluephase Style for 10 s (Fig. 11). Subsequently, the buccal extension of the cavity and the buccal cusps were built up using Tetric EvoCeram Bulk Fill (Fig. 12) and the occlusal morphology was completed (Fig. 13). Once the metal matrix was removed, the restoration was checked for imperfections (Fig. 14) and then the rubber dam was removed.

The restoration was carefully finished and the static and dynamic occlusion adjusted (Fig. 15). Subsequently, the restoration was polished to a shiny smooth surface using a diamond-impregnated single-step silicone polisher system (OptraPol[®]) and Astrobrush silicon carbide brushes. Figure 16 shows the completed direct composite filling, restoring the original tooth shape including an anatomical and functional occlusal surface, physiological proximal contact point and an esthetically pleasing appearance. To complete the treatment, a fluoride varnish (Fluor Protector S) was applied to the teeth using foam pellets.

Conclusion

The clinical workflow does not change with the bulk-fill technique. However, the combination of Tetric EvoFlow Bulk Fill and Tetric EvoCeram Bulk Fill enables practitioners to restore posterior cavities more efficiently than with conventional composites whilst providing esthetic results that are similar to those achieved with a conventional composite layering technique. The importance of composite-based direct restorative materials will continue to grow in the future. These materials are designed for high-quality permanent restorations in the stress bearing posterior region. They are based on scientific evidence and their reliability is documented in the literature [17, 18, 19, 20, 21, 22]. The results of an extensive review have shown that the annual failure rate of composite restorations in posterior teeth (2.2%) is not statistically different from that of amalgam restorations (3.0%) [19].

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Bulk-fill materials: Efficient and esthetic restoration of posterior teeth

The following article focuses on the latest developments in dental composite technology. Ivoclar Vivadent has taken bulk filling to the next esthetic level with the introduction of a flowable bulk-fill composite to complement its sculptable posterior composite Tetric EvoCeram® Bulk Fill. The esthetic properties of these new materials compare very favourably with those of conventional layered composites.

Today, composite resins are routinely used as posterior restoratives in dental clinics [1–2]. That is why dentists have been eagerly awaiting improvements related to these materials and the associated techniques which will allow them to offer their patients more efficient treatment modalities. In response to these expectations, conventional composites have been further developed. Materials known as bulk-fill composites have lately entered the market. These restoratives are placed using a simple protocol to produce very attractive results in posterior teeth [3].

The marginal adaptation of bulk-fill restoratives is similar to that of layered composites [4]. In addition, these materials show similar/lower shrinkage compared with conventional composite resins and they offer a high depth of cure in increments of up to four mm [5]. Nevertheless, in order to obtain successful results, it is important to observe the light-curing instructions of the manufacturer [6]. The flowable bulk-fill composites are generally used as a base layer in Class I and II restorations [7, 8, 9]. They are subsequently covered with a layer of conventional or bulk-fill composite. Due to their stiff consistency, sculptable bulk-fill composites are suitable for recreating fissures and building up cusps.

The next level

Tetric EvoCeram Bulk Fill, which was introduced in 2011, is a sculptable posterior composite that can be placed in layers of up to four millimetres. Its chemical composition is based on that of the time-tested Tetric EvoCeram universal composite, which has an excellent 10-year clinical track record [10].



Fig. 1: Class II restoration in tooth 36 and 37 showing leakage on the mesial and distal sides



Fig. 2: Cavity depth of more than five millimetres



Fig. 3: Selective enamel etching with Total Etch for 30 seconds



Fig. 4: Application of Adhese Universal to the tooth structure



Fig. 5: Placement of Tetric EvoFlow Bulk Fill on the mesial and distal sides and subsequent polymerization of the composite with Bluephase Style for 10 seconds

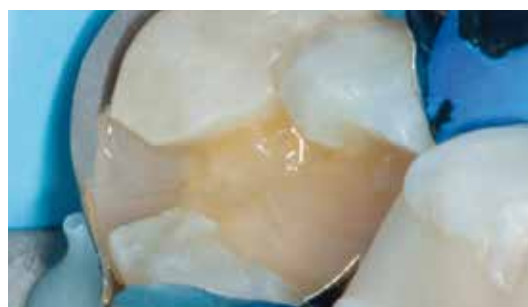


Fig. 6: Visible change of the translucency of the material during the polymerization process due to the Aessencio technology. This promotes the integration of the restoration in the surrounding tooth structure.



Fig. 7: Tooth 37 was built up layer by layer ...



Fig. 8: ...with the highly esthetic IPS Empress® Direct

The patented light initiator Ivocerin® contained in these products sets these materials apart from other bulk-fill composites [11–13]. Due to Ivocerin, composite layers of up to four millimetres can be reliably cured.

The new Tetric EvoFlow Bulk Fill takes the esthetics of bulk-fill composites to the next level. This flowable posterior composite can be placed in increments of up to four millimetres. It can be used as a base layer in Class I and Class II restorations as well as a filling material without a capping layer in deciduous teeth.

As a result of the patented light initiator Ivocerin in combination with the Aessencio technology developed by Ivoclar Vivadent, up to four-millimetre increments of this composite can be reliably light cured. During the polymerization process, the translucency of the restorative drops from 28 % to a low <10 % which is very similar to that of natural dentin. Consequently, even stained dentin tooth structure can be successfully concealed. Furthermore, this new material has convenient self-levelling properties, and it optimally adapts to cavity walls. [14]

Both types of composites show reduced shrinkage stress, since they contain an elastic resinous filler, also known as a “shrinkage stress reliever”, in addition to the standard fillers. Consequently, the features of these composites are similar to those of conventional layered composites [15].

The highly reactive light initiator and the light sensitivity filter, both of which have been patented, impart these two restoratives with a longer working time compared with other composites [16] under the usual light conditions of the dental office. Nevertheless, they require only short polymerization [17].

Clinical case:

IPS Empress Direct vs Tetric EvoCeram Bulk Fill as a capping layer

The patient presented with Class II restorations in tooth 36 and 37 showing leakage on the mesial and distal sides (Fig. 1). The treatment plan entailed restoring tooth 36 with an initial layer of Tetric EvoFlow Bulk Fill and a covering layer of Tetric EvoCeram Bulk Fill. The highly esthetic composite IPS Empress Direct was chosen as a covering layer for tooth 37 in order to assess the esthetic and process-related differences.

The old restoration was removed from tooth 37 and the lesion was cleaned. A cavity depth of more than five millimetres was established in the process (Fig. 2). Next, the dental enamel was etched with phosphoric acid (Total Etch) for 30 seconds (Fig. 3). The Adhese® Universal bonding agent was applied with the brush tip of the VivaPen® (Fig. 4). Subsequently, the bonding agent was distributed with blown air and then polymerized with Bluephase® Style for 10 seconds. Then, a layer of Tetric EvoFlow Bulk Fill was applied on the mesial and distal sides of the cavity and polymerized for 10 seconds with Bluephase Style (Fig. 5). As a result of the Aessencio technology, the translucency of the material changed during the polymerization process. This improved the integration of the restoration and maximized the esthetic effect from within the restoration (Fig. 6). Next, the restoration was built up in layers using IPS Empress Direct. OptraSculpt® instruments were used to shape the composite (Figs 7 and 8).



Fig. 9: High-gloss finishing with an Astrobrush polishing brush



Fig. 10: Completed Tetric EvoFlow Bulk Fill/IPS Empress Direct restoration in tooth 37. The cavity in tooth 36 was more than five millimetres deep.

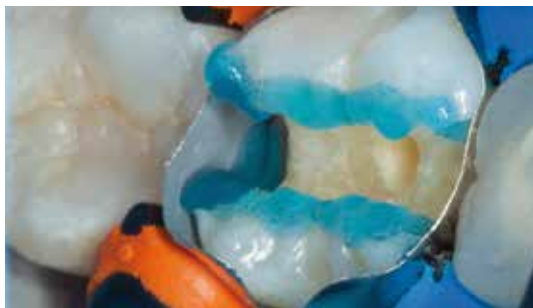


Fig. 11: Enamel etching with Total Etch for 30 seconds



Fig. 12: Application of Adhese Universal on the tooth structure



Fig. 13: Dispensing of Tetric EvoFlow Bulk Fill on the mesial and distal sides of the cavity and subsequent polymerization with Bluephase Style for 10 seconds



Fig. 14: Placement of a base layer using Tetric EvoCeram Bulk Fill



Fig. 15: OptraSculpt® was used to shape the occlusal surfaces ...



Fig. 16: ... until the desired anatomy was obtained.



Fig. 17: Result: Comparable esthetics of the two types of restorations



Fig. 18: Fluor Protector S was applied as a preventive measure at the end of the treatment.

The restoration was polished to a high-gloss finish with Astrobrush silicon carbide brushes (Fig. 9). The old composite restoration in tooth 36 was removed. The resulting cavity was also more than five millimetres deep (Fig. 10). The tooth was pretreated in the same way as tooth 37 (Figs 11 and 12). Subsequently, the flowable Tetric EvoFlow Bulk Fill was applied to the mesial and distal sides of the cavity (Fig. 13). The restoration was cured with Bluephase Style for 10 seconds. The sculptable Tetric EvoCeram Bulk Fill was applied as the last volume replacement layer. OptraSculpt instruments were used to shape the desired occlusal anatomy (Figs 14 to 16). The restorations showed comparable results when they were polished to a high-gloss finish with Astrobrush (Fig. 17). Topical fluoride (Fluor Protector S) was applied as a preventive measure as soon as the restorations were completed (Fig. 18).

Conclusion

The restorative materials Tetric EvoFlow Bulk Fill and Tetric EvoCeram Bulk Fill can be reliably used in the posterior region. Their clinical application protocol is easy and efficient. The esthetic properties of the bulk-fill restoratives are comparable to those of conventional composites. Dentists and patients are thrilled with the results.

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Modern composite therapy

The requirements placed on modern restorative dentistry have risen considerably over recent years. Patients expect esthetic results that should last for the longest possible period of time; practitioners require materials that allow them to achieve optimum quality in the fewest sessions possible. The aim is to master this balancing act.

Since a long time, patients have been giving the thumbs-down to dark amalgam restorations in favour of esthetic white restorations that blend well with the natural dentition. Practitioners have two options to meet the demand for esthetic restorations: direct restorations made of composite or indirect restorations made of ceramic. With the introduction of the bulk-fill technology, composite materials can now be processed even more efficiently than before. Restorations can be placed in a surprisingly short time by using the 4-mm incremental technique, without any loss in quality or function.

As conventional composite restorations are generally built up using a meticulous layering technique, small errors can easily occur and these imperfections may affect the final result. Bulk-fill materials minimize this source for error because only one or two increments are required to place the restoration. Furthermore, they enable practitioners to benefit from substantial time savings and increase their effectiveness in their day-to-day work.

The clinical cases presented below have been chosen on the basis of the minimally invasive treatment options offered by today's composite materials.

Case 1:



Fig. 1: Initial situation of teeth 23 to 26 in need of repair



Fig. 2: Following endodontic treatment, the cusps were covered to prevent fractures.



Fig. 3: Situation after placement of a rubber dam and excavation of caries



Fig. 4: Adhese® Universal was scrubbed into the tooth surface for 20 s using the VivaPen



Fig. 5: Light-curing of the bonding agent for 10 s with Bluephase Style



Fig. 6: Tetric EvoFlow® Bulk Fill in its liquid state before light-curing



Fig. 7: Polymerization of the flowable material results in a dentin-like translucency due to the Aessencio technology.



Fig. 8: Two increments were enough to replace almost the entire volume.

A coordinated range of products

A 30-year-old female patient presented with pain that initially could not be attributed to a specific tooth. An X-ray examination revealed several deep carious lesions on teeth 23 to 26 (Fig. 1). The teeth were treated in a single session to achieve an optimum workflow and ensure a minimally invasive treatment. At the first step, the old restorations were removed and the existing caries excavated from all four teeth.

It became evident that tooth 26 was in a gangrenous condition and required immediate endodontic treatment. The mesial wall was quickly rebuilt with the help of Tetric EvoCeram® Bulk Fill; this step was essential to establish dry conditions. Following microscopic endodontic treatment under rubber dam isolation, the root canals were prepared down to the apical area using a reciprocating VDW file and then disinfected. Once the endodontic treatment was completed, the tooth had to be rebuilt in its entirety. Since endodontically treated teeth are susceptible to fracturing, the cusps were covered with a composite onlay (Fig. 2). The onlay enhances the distribution of forces on the tooth surface and prevents fractures. After a rubber dam and a Garrison matrix system had been placed, the matrix was sealed in place using a light-curing OpalDam resin barrier to attain a natural tooth shape (Fig. 3). In line with the total-etch technique, the tooth was etched with phosphoric acid. Then, Adhese® Universal was applied and scrubbed into the tooth surface for 20 s (Fig. 4) and dispersed until an immobile adhesive film resulted. Subsequently, the bonding agent was light-cured for 10 s using a Bluephase® Style curing light (Fig. 5). The dentin-like translucency of the Tetric EvoFlow® Bulk Fill composite masked the dark areas of the preparation. Only two increments were required to reach the top surface of the tooth (Figs 6 to 8). Tetric EvoCeram A2 was applied to the cusps to achieve an esthetic high-quality result.



Fig. 9: Covering of the cusps with Tetric EvoCeram A2 and customization of the fissures with IPS Empress Direct Color ochre

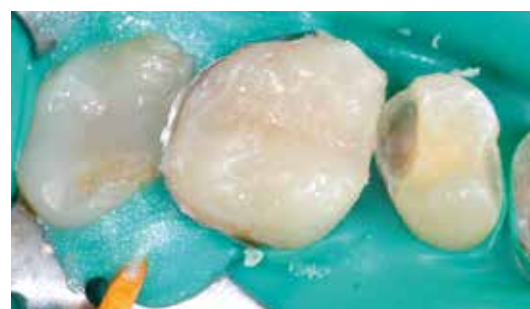


Fig. 10: Conventional layering technique with Tetric EvoCeram A2



Fig. 11: Final polishing with OptraPol



Fig. 12: View of the teeth after completion of the treatment

The distal wall was rebuilt using Tetric EvoCeram Bulk Fill to obtain a reduced level of translucency and impart a natural appearance to the tooth. Customization of the fissures was achieved with IPS Empress Direct® Color in shade ochre.

Teeth 23 to 25 were restored using the same method. The restorations were finished with diamond burs and polishing discs. The occlusal height was adjusted and the mediotrusion contacts were removed by grinding. High-gloss polishing was achieved with OptraPol (Fig. 11).

The advantages of the individual products were particularly beneficial in this clinical case and were instrumental in achieving an effective esthetic result (Fig. 12).

Restoration accomplished with only two increments

The demands placed on modern dentistry were also met in the second clinical case presented here. A 25-year-old female patient was diagnosed with two carious lesions, one on tooth 36 and the other on 37 (Fig. 13). Thanks to Tetric EvoFlow Bulk Fill and Tetric EvoCeram Bulk Fill, the restorations were completed with only two increments.

After excavating the carious tissues and finishing the enamel margins, a rubber dam was placed (Fig. 14) to ensure a dry operating field. Cavity conditioning was achieved with phosphoric acid etching using the total etch technique. Adhese Universal was again used as the bonding agent. Reaching the distal cavity on tooth 36 created no difficulty at all due to the VivaPen delivery form. As usual, the bonding agent was gently dispersed and light-cured for 10 s using a Bluephase Style curing light. Subsequently, the cavity was filled with a 4-mm thick increment of Tetric EvoFlow Bulk Fill. To ensure a reliable cure of the flowable composite in this hard-to-reach location, a 20-s light-cure was performed. Occlusal contouring was achieved with Tetric EvoCeram Bulk Fill. This final layer was light-cured for 10 s. Tooth 36 was restored using the same two-increment method, taking advantage of the bulk-fill technology (Fig. 15). As in the case above, finishing was performed with diamond burs and OptraPol polishing discs.

Case 2:

Fig. 13: Initial situation: proximal carious lesions on teeth 36 and 37



Fig. 14: Placement of a rubber dam after excavation of carious tissues



Fig. 15: Restoration accomplished with a layer of Tetric EvoFlow Bulk Fill and a layer of Tetric EvoCeram® Bulk Fill

Conclusion

Modern composite materials have paved the way for new treatment strategies in dentistry. Teeth that previously required an indirect restoration can now be restored with a direct composite without any difficulty. Even large cavities can be restored esthetically and, above all, functionally using composite materials. Practitioners have the opportunity to reconstruct the tooth directly on the patient and do not always have to order a crown as soon as substantial repair work is necessary. Patients benefit from restorations that can be completed in a single session and can save money over indirect restorations. The results measure up with indirect restorations: In my opinion, the advantages that direct composite restorations offer to patients and practitioners prevail. With the introduction of the bulk-fill technology, the time-consuming incremental technique has been streamlined. Flowable materials such as Tetric EvoFlow Bulk Fill round out the range of products. Dark areas can be masked due to the dentin-like translucency of Tetric EvoFlow Bulk Fill. The results are esthetically pleasing, occlusally stable restorations that can be fabricated using comparatively little time. In conclusion, bulk-fill materials can stand up to any comparison with conventional composites. It is rather a coordinated interplay between conventional composite materials and the new bulk-fill composites. Practitioners can benefit from these new options in their day-to-day work in terms of esthetics, effectiveness and economic efficiency.

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Efficiency and esthetics in the posterior region

Since bulk-fill composites have been on the market for a number of years, the time has come to take a look back at the introduction, development, current trends and future options of these materials.

When bulk-fill composites first hit the market, they were considered a true innovation. We had been layering posterior composites for more than 40 years, yet many of us were not quite sure for what reasons the layering technique was mandatory. Understanding the reasons why a certain technique is applied is crucial for the correct assessment of the pros and cons of any technique.

Basically, the reasons were four:

1. Esthetics: It is obvious that a layering technique involving dentin, enamel and effect shades leads to a better final outcome than a technique that uses only a single layer in a standard translucency. As regards the bulk fill technique, this reason can easily be rejected because, objectively, most posterior restorations are almost always placed using one shade only and most patients are satisfied with the result.

2. Reduction of volumetric shrinkage: The less composite we place, the smaller the volumetric shrinkage.

3. Reduction of shrinkage stress: This reason makes sense and is based on the configuration factor. It is said that the shrinkage stress is reduced if the unbonded surface area of a layer is larger than the bonded surface area. Although there is enough *in-vitro* evidence on the relevance of the C-factor [1], a clinical correlation has not yet been shown. This point can be easily illustrated by the fact that Class-I restorations have an unfavourable C-factor but a high survival rate while Class-V restorations have a favourable C-factor but a low survival rate. This example shows that the C-factor is only one of many factors that determine the success of a direct restoration - and frequently not the most important one [2].

4. Depth of cure This is probably the most important factor because increments of only 2 mm could be applied before the advent of bulk-fill composites. Some studies suggest that the depth of cure of certain composites is even lower than 2 mm [3]. This was the reason why all layers were restricted to a maximum thickness of 2 mm. If not, the composite material placed in the deeper areas of the cavity would never receive enough light to cure adequately.

Having discussed all these factors, we may realize that we are not so far from the bulk-fill technique. If a composite is capable of reducing the stress when applied in thick layers and, at the same time, offers an increased level of translucency and a more effective light-curing process, the bulk-fill technique is feasible. In most cases, shrinkage stress relievers are responsible for the reduction of shrinkage stress. Shrinkage stress relievers are fillers with a lower modulus of elasticity. Their function is to release the stress as the composite polymerizes [4]. The second aspect, i.e. the depth of cure, was achieved by making the composites more translucent with the effect of enhancing the passage of light through the material. As a result, the depth of cure was increased. This point has also been proven to be true [5, 6]. In addition, some companies such as Ivoclar Vivadent improved the polymerization process in deeper areas by adding newly developed initiators (e.g. Ivocerin) to the formulation.

Nowadays, all major dental manufacturers offer bulk-fill composites. Bulk-fill composites can basically be categorized into two main groups: first, flowable bulk-fill composites requiring a final capping layer and, second, sculptable bulk-fill composites. Generally, these materials increase the efficiency of the restorative workflow as they allow the fillings to be placed with either a single-increment technique (sculptable composite) or a two-increment technique (dentin replacement with flowable composite and capping layer with sculptable composite). These methods are obviously faster and easier to perform than conventional layering procedures. However, this advantage is undermined by the fact that bulk-fill materials are generally too translucent and allow discolourations to shine through the restorations, especially if they are used to replace an amalgam filling. Nevertheless, clinical evidence has shown that the results achieved with the new bulk-fill methods are comparable to the results achieved with conventional multi-layer techniques [7, 8].



Fig. 1: Pre-op situation. Occlusal view. Defective amalgam filling on tooth 14



Fig. 2: Pre-op situation. Frontal view



Fig. 3: Situation after placement of a rubber dam, matrix, wedge and ring (OpraDam® and V4 System)

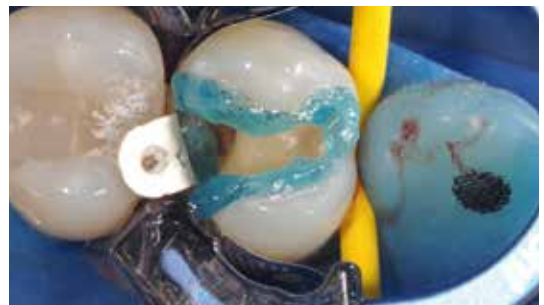


Fig. 4: Enamel etching for 30 s with Total Etch

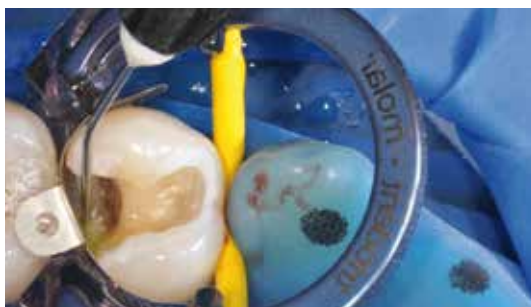


Fig. 5: Adhese® Universal was used as the bonding agent. The product offers the user the choice between self-etch, selective enamel etch and the total-etch technique.



Fig. 6: Once dispersed, Adhese Universal was light-cured for 10 s using a Bluephase® Style third-generation LED curing light. Notice the wide coverage of the 10-mm light guide.



Fig. 7: Tetric EvoFlow Bulk Fill was applied.



Fig. 8: Tetric EvoFlow Bulk Fill before light-curing. The high translucency facilitates the penetration of light.

Fortunately, new developments often pave the way for new technologies. By this I mean the Aessencio technology developed by Ivoclar Vivadent. The Aessencio technology allows a composite to be highly translucent prior to being light-cured and causes a drop in translucency as it polymerizes. Once polymerized, the material exhibits a dentin-like translucency and is capable of effectively masking most discolourations. Practitioners can follow a very efficient procedure to accomplish fillings due to the Aessencio technology of Tetric EvoFlow® Bulk Fill and the combination with Tetric EvoCeram® Bulk Fill as the final capping layer. Two steps will be enough in most clinical situations. At the same time, patients will receive a sufficiently esthetic restoration. In addition, the entire adhesive restorative protocol has become more predictable with the recent introduction of universal adhesives, as they have eliminated the need for dentin etching. Dentin etching was one of the reasons for the variability and sensitivity of the adhesive technique in the past years. A recently published meta-analysis showed the importance of predictable clinical protocols as the correlation between *in-vitro* tests and clinical performance is poor [9].

Furthermore, there is growing evidence in clinical trials and elsewhere that self-etch protocols show a favourable performance [10].

The clinical case below demonstrates how these materials are used.

Clinical case

A 33-year-old patient presented with a failing amalgam restoration on tooth 14 with no interproximal contact (Figs 1, 2). After the amalgam filling had been removed and a rubber dam placed (OptraDam®), a matrix, wedge and ring were inserted (Fig. 3) (V4 Triodent). The enamel was etched with phosphoric acid (Total Etch) and then rinsed with water (Fig. 4). Subsequently, the adhesive (Adhese® Universal) was applied with the help of the new VivaPen delivery form and carefully scrubbed into the tooth structure of the entire cavity for 20 s (Fig. 5). Next, the solvent was evaporated until a shiny immobile film resulted. Then, the material was light-cured using a Bluephase® Style third-generation curing light (Fig. 6). Tetric EvoFlow Bulk Fill was applied to the proximal box and cavity floor (Fig. 7). Initially, the material was as translucent as most other flowable bulk-fill materials. This translucency makes it difficult to mask discolourations (Fig. 8).



Fig. 9: Once cured, Tetric EvoFlow Bulk Fill exhibits a dentin-like translucency, masking discolourations.



Fig. 10: Tetric EvoCeram® Bulk Fill was applied as a final layer.

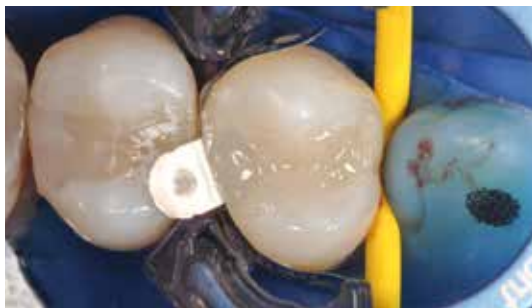


Fig. 11: All excess was removed before curing.



Fig. 12: The restoration was polished with OpraPol®.



Fig. 13: After that, Fluor Protector S was applied.



Fig. 14: Completed restoration after 1 week. Frontal view



Fig. 15: Completed restoration after 1 week. Occlusal view



Fig. 16: X-ray images before and after the restoration. Both the flowable and sculptable variants offer adequate radiopaque properties.

Figure 9 shows how the translucency altered in the course of the curing process and the material started to mask the discolourations underneath it. Then, a final composite layer of Tetric EvoCeram Bulk Fill was applied (Fig. 10). Excess composite was carefully removed and the filling contoured to an adequate anatomical shape prior to undergoing final polymerization (Fig. 11). This was all accomplished in a single step, as most of the cavity had already been filled before with Tetric EvoFlow Bulk Fill. After final curing, the restoration was polished with OptraPol (Fig. 12). Then, Fluor Protector S was applied (Fig. 13). The completed restoration rather closely resembles the natural tooth structure. It is virtually impossible to detect the margins from the occlusal and frontal view (Figs 14, 15). The X-rays show the excellent radiopaque properties of both materials, i.e. the flowable and sculptable variant (Fig. 16).

Conclusion

To sum up, the "bulk-fill technique" using Tetric EvoFlow Bulk Fill and Tetric EvoCeram Bulk Fill allows us to be more efficient with almost no compromises compared to the conventional layering technique. The C-factor is no longer an issue due to the shrinkage stress relievers. As expected, marginal gaps do not occur more frequently and are not larger compared to the conventional layering technique. Application is clearly quicker and the esthetic effect is in most cases similar to that of conventional composites. The differences in the translucency of materials for conventional posterior composite restorations are no longer of relevance due to the Aessencio technology. This sets a new standard in this group of composite.

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Efficient restorative therapy in the deciduous dentition using Tetric EvoFlow® Bulk Fill

The effort required to place composite materials in posterior primary teeth was long considered too difficult compared with other materials. This perception has fundamentally changed with the development of the bulk-fill technology. Time-consuming composite layering procedures can be reduced to the application of a single increment to fill the entire cavity in most cases. The newly developed Tetric EvoFlow® Bulk Fill is predestined for this purpose. In combination with other components of the Ivoclar Vivadent range, it enables us to give our young patients effective restorative care.

The ways and means we use for the restorative treatment of adults cannot be automatically applied to children with deciduous teeth. In addition to the psychological requirements of patient management in children - which can take up a large part of the treatment - the difference in the micromorphology between the deciduous dentition and the permanent dentition plays an essential part. The uppermost enamel layer of primary teeth appears as an aprismatic surface zone (30–100 µm); this layer cannot be etched with phosphoric acid. However, if the tooth surfaces are lightly abraded before the etchant is applied [1], acid-etch conditioning is a sufficient measure to achieve a retentive pattern.

Primary dentin contains larger dentin tubules and the mineral content of the intertubular dentin is lower than that of the permanent dentition [1]. Because of its structure, primary dentin should be in contact with phosphoric acid for no longer than 10 s. If left in contact for a longer time, demineralization will progress into deeper areas, which the primer will no longer be able to neutralize. Self-conditioning adhesives such as Adhese® Universal meet the requirement of this situation and have been shown to produce favourable bond strength values on primary teeth [2].

The importance of the adhesive should not be underestimated. The adhesive plays a decisive part in the success of a restorative treatment [3]. In this context, the application of Adhese Universal via the brush cannula of the VivaPen ensures ideal handling conditions when restoring primary teeth.

What about the filling material?

Similar to compomers, composites are suitable for use in deciduous teeth [1].

A clinical study conducted in 2006 on Class II cavities in primary molars showed that Tetric Flow produces acceptable results [4]. Primary teeth are less resistant to attrition than permanent teeth. The lower wear resistance of flowable composites therefore plays a subordinate role.

With Tetric EvoFlow® Bulk Fill, a flowable composite that can be applied in single increments of up to 4 mm is now available. If used in primary teeth, the material does not require the application of a capping layer. Consequently, most cavities in the primary dentition can be filled in a single step. This is made possible by the newly developed light initiator Ivocerin. Investigations have shown that a complete depth of cure can be achieved even under difficult conditions, e.g. if the curing light is held at an angled position [5]. This is almost like a built-in safety feature especially designed for paediatric dental care.

Yet, the composite does not cure prematurely under operatory light conditions. A chemical light sensitivity filter allows practitioners to take advantage of long working times of over 4 minutes without having to dim the light (8000 lux). Unlike most flowable bulk-fill materials, Tetric EvoFlow Bulk Fill exhibits a dentin-like translucency after it has polymerized and blends astonishingly well with the shade of the surrounding primary teeth. Of the three shades available, shade ^W is especially suitable for paediatric dental care.

What is it like to use the material in the practice?

Our young patients do not always share the same enthusiasm for fillings as we do - and so are not always willing to cooperate. In such circumstances, treatment must be swift. Below follows the description of how a primary tooth can be restored using Tetric EvoFlow Bulk Fill (Fig. 1).

An OptraGate® lip and cheek retractor assists in keeping the mouth of young patients open and retracting the soft tissues from the tooth to be restored. Cotton rolls may additionally assist in isolating the working field. After preparing the tooth and excavating the carious tissue, a matrix is placed (Fig. 2).

Adhese Universal is applied as bonding agent, evaporated and light-cured (Fig. 3). Subsequently, the cavity is filled with Tetric EvoFlow Bulk Fill (Fig. 4). To do so, the cannula is placed on the cavity floor, the material is dispensed and then the cannula is slowly pulled to the surface while remaining in the material. In this way, air trappings can be avoided. Tetric EvoFlow Bulk Fill is characterized by excellent surface affinity.



Fig. 1: Preoperative situation: distal caries on tooth 54



Fig. 2: Cavity preparation and matrix in situ (Cervical Matrix acc. to Fust)



Fig. 3: Adhese® Universal was applied for 20 s with the VivaPen and then evaporated with air and light-cured for 10 s.



Fig. 4: The cavity was filled with Tetric EvoFlow® Bulk Fill. Excess can be removed with a probe before the material is light-cured.



Fig. 5: Light-curing with Bluephase Style for 10 s



Fig. 6: Light-cured restoration after removal of the matrix



Fig. 7: Polishing was achieved with OptraPol®.



Fig. 8: Completed Tetric EvoFlow Bulk Fill restoration after application of Fluor Protector S to the distal surface of tooth 54

After the composite has been light-cured for 10 s (Fig. 5) and the matrix taken out (Fig. 6), excess is removed using rotating instruments (fine-grain diamonds, Arkansas stone) and the surface reduced and adjusted. Once the occlusion has been checked, the filling is polished – done. The OptraPol polishing system has proven very beneficial for this step (Fig. 7). The silicone polishers are highly filled with micro-fine diamond particles and quickly produce a smooth high-gloss finish (Fig. 8).

Conclusion

Enabled by a smooth interplay of components, the treatment concept impresses practitioners with its efficiency (Fig. 9). Fillings can be placed expeditiously, the critical phase of the treatment is reduced to a minimum due to the short application and curing times.



Fig. 9: Components that enable the efficient restoration of primary teeth: OptraGate®, Bluephase Style, Adhese Universal, Tetric EvoFlow Bulk Fill, Cervix-Matrisen, Fluor Protector S and OptraPol

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Improving treatment success in challenging cases

The rising expectations of patients regarding the esthetics of dental restorations have recently made the composite resins the most commonly used restorative materials [1].

Dentists expect modern technology to deliver a composite material with high esthetic value, low polymerization shrinkage, perfect marginal integrity and relevant physico-mechanical properties. They also expect an easy protocol and a short placement time.

Optimizing the results in complex cases

Achieving reliable results in complex cases is a big challenge. Success relies on respecting the protocol and having materials with a high technique tolerance. As far as the longevity of restorations is concerned, I consider the non-invasive technique to be a reliable option. It provides the restored teeth with much better mechanical and physical properties. Strict adherence and observance of every step of the protocol is the only condition to reach this positive result.

The protocols for successful adhesive restorations have been extensively described in the literature. However, how can we optimize the workflow in challenging cases, for example, in the fabrication of Class II and Class V direct composite restorations or indirect inlays and onlays made of pressed ceramic or laboratory composite?

A survey among dental practitioners has shown that 78% of the dentists use a liner [2]. It has been proven that in challenging cases, the use of a flowable composite as a liner can minimize micro-leakage and reduce the risk of infiltration. As a clinical result, we will have less post-operative sensitivity, less discoloration and a lower risk of secondary caries.

Various categories of composite resins

Flowable composites first came onto the market about 20 years ago. The only requirement of flowable composites is that they be applied in a thin layer in order to avoid high shrinkage (≤ 2 mm in the case of translucent shades and ≤ 1.5 mm in the case of dentin shades). This category of materials is called the “conventional flowable composites”. Recently, however, a new type of flowable composite that can be applied in thicker layers of up to 4 mm has been launched. The materials of this category are called “bulk-fill flowables”. Just like conventional flowable composites, they require a capping layer of sculptable composite material.



The flowable Tetric EvoFlow® Bulk Fill is available in syringes and Cavifils.

When it comes to “conventional flowable composites,” applying a thin layer in deep cavities seems to be something that is not very easy to control in daily practice.

More in control through composite courses

In order to find out how well the layer thickness can be controlled during application, we carried out a verification test simulating the clinical procedure.

During composite training sessions organized by Ivoclar Vivadent in various countries, the trainers first explained the proper use of conventional flowable composites and highlighted the maximum thickness that had to be observed. After a demonstration on a training model, the 580 participating dentists were asked to start the hands-on course by filling a deep Class II cavity on their training models.

After placing a sectional matrix and applying the adhesive Adhese® Universal using the selective-enamel-etch technique, they applied a dentin shade of the conventional flowable composite Tetric EvoFlow in a layer of 1.5 mm thickness. With the sculptable bulk-fill composite Tetric EvoCeram® Bulk Fill, the dentists first rebuilt the mesial part of the cavity and then filled the entire remaining cavity in one step. For each step, the light curing time and intensity indicated by the manufacturer were observed. Light-curing was performed with the Polywave® LED curing light Bluephase® Style.

At the end of the workshop the restored teeth were removed from the training models and collected. Then a digital caliper was used to measure the thickness of the layer of flowable composite placed in order to check if the dentists had been able to ensure the correct layer thickness.

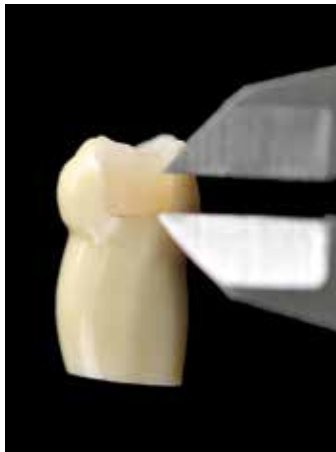


Fig. 1: Class II restoration with flowable composite liner

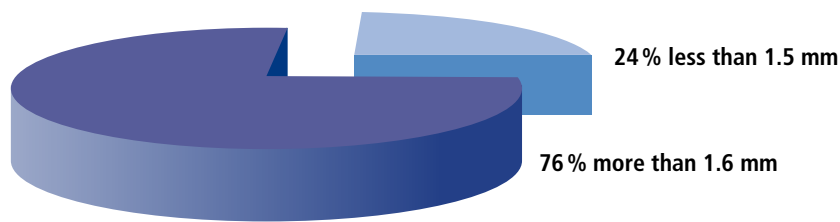


Fig. 2: Measurement of the thickness of the liner layer with a digital caliper

The results of the test were divided in three categories:

- Layer thickness less than 1.5 mm: 24% of the participants
- Layer thickness between 1.6 and 2.5 mm: 63% of the participants
- Layer thickness of more than 2.6 mm: 13% of the participants

Even though the dentists who participated were experienced and accustomed to placing composite fillings, 76% of them (almost two-thirds of every group) applied the conventional flowable composite in a thickness of more than 1.6 mm.



Result of the study involving 580 dentists

76% of the dentists applied the conventional flowable composite in a dentin shade in a layer of more than 1.6 mm thickness.

This shows that it is extremely difficult to control the thickness of the flowable composite layer or to check this thickness when placing a restoration in a deep cavity. The clinical consequences of a thicker layer include inadequate polymerization, high shrinkage, as well as an increased risk of infiltration and all the related implications.

Tetric EvoFlow® Bulk Fill – the next stage of development

The new bulk-fill flowable composite Tetric EvoFlow Bulk Fill gives us a very interesting solution to the problem of thickness control. This new material enables us to use it without any fear, as it offers a much higher level of reliability. No matter whether this composite is applied in layers of 1 mm or 4 mm – it always offers the advantage of a thorough cure.

With the Tetric EvoFlow Bulk Fill, Ivoclar Vivadent has taken just another decisive step forward in the development of the bulk-fill technology. Due to the patented light initiator Ivocerin, this composite resin is 10 times more reactive to the blue light emitted by curing lights than conventional composites. Consequently, it can be applied and cured in increments of up to 4 mm.

With respect to improving the esthetic result, Ivoclar Vivadent has also developed a new technology named Aessencio technology. Therefore, the high translucency of Tetric EvoFlow Bulk Fill before light-curing diminishes to a dentin-like translucency during the curing process. Thanks to this effect, dentin discoloration can be reliably masked and the esthetics of the final result is maximized from within (see Case 2, Figs 8–10).

As a result of the “shrinkage stress relievers” included in the formula, the shrinkage forces that build up in this bulk-fill flowable are comparable to those occurring in a conventional flowable composite with a layer thickness of 1.5 mm. Therefore, optimum marginal integrity can be achieved.

Clinical cases

Two clinical cases are presented below which involved the use of the new Tetric EvoFlow Bulk Fill.

Case 1:



Fig. 3 and 4: Class II cavity with discoloured cavity floor



Fig. 5: Application of Adhese® Universal using the total-etch technique. Phosphoric acid was applied to the enamel for 10 s and then rinsed off and dried. Adhese Universal was applied to the enamel and dentin, allowed to react for 30 s, dried and light-cured for 10 s with Bluephase® Style.



Fig. 6: Tetric EvoFlow Bulk Fill in shade [®]A was applied. After only 10 seconds of light curing, the translucency changed and the composite became opaque, effectively masking the discoloration (the Aessencio effect).



Fig. 7: Application in one increment of the sculptable bulk-fill composite Tetric EvoCeram Bulk Fill in shade [®]A. OptraSculpt® instruments were used to adapt the composite to the wall of the cavity and create the final occlusal anatomy. The final polishing step was performed with the one step polishing system OptraPol®.

Case 2:

Fig. 8: Discoloured cavity which has been prepared for the placement of an onlay



Fig. 9: Tetric EvoFlow Bulk Fill is applied in order to block out the undercut and to mask the discoloration.



Fig. 10: Onlay made of IPS e.max® Press cemented with Multilink® Automix

Conclusion

Seventy-eight per cent of the dentists surveyed used a liner [2]. The results of the test conducted show that Tetric EvoFlow Bulk Fill offers these dentists the opportunity to manage challenging cases. Even when used in a thick layer, the shrinkage of Tetric EvoFlow Bulk Fill is comparable to that of conventional flowable composite. With the development of Ivocerin and the Aessencio technology, Ivoclar Vivadent has succeeded in taking a further step towards optimizing the esthetics and reliability of flowable bulk-fill materials.

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The meaning and impact of efficiency in modern dentistry

New product trends aim at streamlining the complexity of workflows and reducing material waste. In modern dentistry, the need to work efficiently has become a must. I can now treat three patients in the same time as I used to do two. It proves that it is not only possible but also necessary to measure and increase the efficiency of your dental practice.

Modern dentistry holds many challenges. In particular, economic considerations have been continuously rising in the past 10 to 20 years and this trend is set to continue. Health systems have undergone far-reaching changes due to political interventions. Consequently, efficiency is playing an increasingly important part in the dental practice. The importance of economic factors increases with increasing uncertainty. This explains the increasing number of large dental offices with several dentists and a professional management structure. However, focusing only on costs can be dangerous and may have an adverse effect on quality. The long-term effects may annihilate any initial efforts and cost savings. Therefore, cutting costs is not the whole solution; the aim should also be to optimize procedures, streamline workflows and shorten treatment times while maintaining or even increasing the quality of the outcome. In a nutshell: the aim is to be efficient. Doing the right thing and achieving high-quality treatment results is all very good, but a truly successful outcome can only be attained by choosing the "right" way to achieve these goals. In relation to dentistry, the question is: How can I obtain the same (or even better) high-quality treatment results without wasting time or materials?

The latest trends

Patients want to be treated quickly and effectively. This means: effective and efficient solutions have become a necessity. In most countries, public health and insurance policies have undergone far-reaching changes. Rising uncertainty and the increasing financial burden require that we dentists balance costs against treatment times carefully. While the costs of time and material invoiced to the patients have always been carefully defined, similar approaches are usually less common when defining the correct choice of material. In the past, cost-cutting measures usu-

ally meant that the staff member in charge of ordering the materials was instructed to look for the lowest priced options. Although a pricier product will cost you more upfront, if it substantially increases the efficiency with which treatments can be completed, it may end up reducing overall costs because shorter treatment times mean that more patients can be seen. Awareness of this interdependence is growing as the number of large dental practices or small private dental clinics under professional management continues to rise. Optimum allocation of existing resources such as time, material and staff can only be achieved if efficient working methods are employed. This results in streamlined workflows, optimized deployment of staff and minimized material waste.

Dental manufacturers have begun to realize that the possibilities to differentiate their products from those of the competition by raising the quality are fading. Against such a background, some manufacturers have identified the combination of quality, esthetics and efficiency as a promising future trend. For this reason, new products have been developed with the aim to increase efficiency, provide high-quality results, streamline working procedures and workflows and, as a result, reduce treatment times. In addition, innovative and optimized delivery forms reduce material waste and enhance user friendliness in particular.

Measuring efficiency

Treatment time and complexity may greatly differ from patient to patient. For this reason, efficiency can only be measured by relying on average values. Measuring and monitoring your own efficiency is, however, possible – and advantageous. Without doubt, time is the resource that is easiest to measure as you can clock it with a stopwatch. However, a more elegant way of measuring treatment time is by combining treatment documentation with time measurement. Photographic documentation is possibly the easiest way to achieve this. By taking a photograph before and after the treatment, the time is automatically recorded as each digital image will contain the exact date and time when the picture was taken.

Ways to increase efficiency while maintaining quality

In a nutshell, there are two ways to increase efficiency without any loss of quality: First, efficiency can be improved by streamlining the workflow, which will reduce the complexity of the procedure and therefore minimize the amount of time required to complete the treatment. Second, the number of materials required to perform the treatment can be reduced, which will minimize material waste. The first measure offers a high savings potential. In particular, the placement of adhesive restorations (e.g. composite restorations) involves a number of working steps which can be streamlined or even eliminated if the right kind of materials and instruments are used. Manufacturers have discovered this opportunity and developed products that facilitate the workflows involved in adhesive dentistry. These improvements are either related to the actual materials required to place a restoration – such as composites and adhesives (e.g. sculptable Tetric EvoCeram® Bulk Fill, Adhese® Universal) – or to accessories such as lip and cheek retractors, modelling instruments and polishers (e.g. OptraGate®, OptraDam® Plus and OptraSculpt® Pad).

Increase in efficiency due to process streamlining

I performed an analysis in my practice to evaluate the increase in efficiency I gained by using an optimized procedure rather than a conventional procedure to place adhesive fillings. The investigation included 119 cases in total. For each case, the treatment time was worked out from the photographic documentation. Two treatment protocols (Table 1) were defined for three different restoration classes (Black 1889) (see Table 2 for number of patients per group). Average treatment times were calculated and compared. Table 3 shows the results.

	Protocol 1 (conventional)	Protocol 2 (efficiency-optimized)
Isolation	Rubber dam (OptradDam® Plus)	Rubber dam (OptradDam Plus)
Etching	Total etch	–
Bonding	3-bottle adhesive system (Syntac®, Heliobond)	1-bottle adhesive system (Adhese® Universal)
Light-curing	Polywave® LED; 1100 mW/cm ² (Bluephase® Style (10 s))	Polywave LED; 1100 mW/cm ² (Bluephase Style (10 s))
Filling	Conventional composite (4–11 increments; 1–2 mm each) (IPS Empress® Direct)	Bulk-fill composite (2–4 increments; 4 mm each) (Tetric EvoCeram® Bulk Fill)
Contouring	Metal instruments (sphere, Heidemann spatula)	Non-stick instruments (Optrasculpt®; Optrasculpt® Pad)
Light-curing	Polywave LED; 1100 mW/cm ² (Bluephase Style (10 s))	Polywave LED; 1100 mW/cm ² (Bluephase Style (10 s))
Finishing / Shaping	Diamond finishing burs (15–40 µm)	Tungsten carbide finishing burs
Polishing	Astropol® 3-step polishing system	Optrapol® 1-step polishing system
Recall	6 months after treatment	6 months after treatment

Table 1: Comparison of conventional and efficiency-optimized treatment protocol

Restoration type	Number of patients	Number of teeth
Class I	15	21
Class II (MO/OD)	55 (25/30)	71 (29/42)
Class II (MOD)	22	27

Table 2: Number of cases per treatment group

Restoration type	Ø Duration Protocol 1	Ø Duration Protocol 2	Ø Time savings	Increase in efficiency %
Class I	14 minutes	8 minutes	6 minutes	43%
Class II (MO/OD)	37 minutes	26 minutes	11 minutes	30%
Class II (MOD)	41 minutes	30 minutes	11 minutes	27%

Table 3: Results

The results clearly show: Efficiency-optimized treatments can reduce average treatment times by up to 43%, which is almost half of the average total treatment time. If converted into opportunity costs due to the possible use of that time to treat another patient, this makes a big difference. I used to schedule 45 minutes for a Class II MOD filling. Due to the gain in efficiency, I now only need 30 minutes to complete the same treatment. Thus, assuming that I only perform Class II MOD treatments all day long, I could now treat 16 patients instead of 10 a day. This means: I can now treat three patients in the same time that I used to treat two. This would greatly increase my turnover.

Optimizing your efficiency does not automatically mean a loss of quality

The quality of the treatment outcomes were similar with both protocols. Figures 1–2 show the before and after pictures of the cases performed with Protocol 1 (conventional) and Figures 3–4 show the before and after pictures of the cases restored using Protocol 2 (efficiency-optimized).



Fig. 1: Insufficient Class II amalgam filling (occlusal-mesial; MO) on tooth 26 before treatment



Fig. 2: Permanent Class II restoration made of IPS Empress Direct (occlusal-mesial; MO) on tooth 26 after treatment according to Protocol 1



Fig. 3: Proximal caries on teeth 25–27 (distal-occlusal, MOD and mesial-occlusal) before treatment



Fig. 4: Permanent restoration of Class II cavities on teeth 25–27 using Tetric EvoCeram Bulk Fill (distal-occlusal, MOD and mesial-occlusal), treatment according to Protocol 2

Increase in efficiency due to less material waste

Another way to increase efficiency, or to generate more output with the same input of resources, is to optimize the usage of materials. New dispensing systems such as the VivaPen enable an efficient application of adhesive (e.g. Adhese Universal). Although the VivaPen only contains 2 ml of material, it offers enough material for 192 single-tooth applications on average. By comparison, the bottle contains 4.7 ml adhesive but, in my experience, only generates 145 single-tooth applications. This is an almost 3-fold increase in applications per millilitre of adhesive material. In addition, new delivery forms such as the VivaPen facilitate the workflow because the process of material application becomes more intuitive and requires fewer working steps. Using a conventional adhesive in a bottle system involves the use of a separate dish and at least one separate applicator to carry the adhesive from the dish to the oral cavity. In most cases, some surplus material remains in the dish or on the applicator and this material is then discarded. This results in adhesive material being wasted. By contrast, the VivaPen includes brush cannulas that can be attached to the tip of the pen. The material can be applied directly to the tooth and there is no excess material remaining on a separate dish. This is also a promising way of optimizing the efficiency and thus the profitability of the dental practice.

Conclusion

Working efficiently means that less resources (e.g. time) are required to achieve the same high quality. This results in a reduction of costs. Applied to dentistry, efficiency means that procedures are optimized, workflows streamlined and treatment times shortened. New dental products achieve these requirements by affording shorter treatment times or by reducing material waste due to new dispensing forms. Both approaches help save money and considerably facilitate daily routines in ways that are measurable (e.g. with the help of photographic documentation). The potential for saving time and reducing the amount of material waste is high. Optimizing efficiency by streamlining workflows is a promising trend that everyone should check out.

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Esthetics and efficiency in the restoration of posterior teeth

By pairing up the sculptable posterior composite Tetric EvoCeram® Bulk Fill with a flowable variant, Ivoclar Vivadent has ushered in the next step in the esthetic optimization of bulk-fill materials. The report below assesses to what extent the bulk-fill materials of different manufacturers differ from one another. It explores the distinctive innovations of the new product and looks at the efficiency of bulk-fill materials in general. In addition, the report provides an overview of the studies carried out on bulk-fill materials. It draws the conclusion that bulk-fill materials, especially Tetric EvoCeram Bulk Fill and Tetric EvoFlow® Bulk Fill, are safe for clinical applications.

Bulk-fill materials differ quite considerably

It is important to note that the bulk-fill materials of different manufacturers differ quite substantially. Today, bulk-fill materials are available in low-viscosity (flowable), and high viscosity (packable) form. If dental practitioners choose to use a flowable bulk-fill material, they cannot produce the entire restoration with it. Rather, they have to place a final occlusal capping layer made of a high-viscosity composite to cover the filling. On the one hand, this is required due to purely practical reasons: Flowable composites are difficult to sculpt. On the other hand, technical reasons are involved: Because of their high monomer content, flowable composites are quite soft [1], and they wear and degrade quite easily [1, 2]. By contrast, high-viscosity bulk-fill materials do not need to be covered by a capping layer.

In order to achieve a high depth of cure, the bulk-fill materials of most manufacturers are highly translucent (Fig. 1). Therefore, the light of polymerization devices can penetrate and polymerize deep areas of the composite materials. Furthermore, most of the manufacturers incorporate coarse fillers into their materials, which provide fewer surfaces from which light can refract, compared with smaller particles. Nevertheless, this approach has a number of drawbacks: poor esthetics, inadequate masking of dentin areas and insufficient polishing properties (Fig. 2).

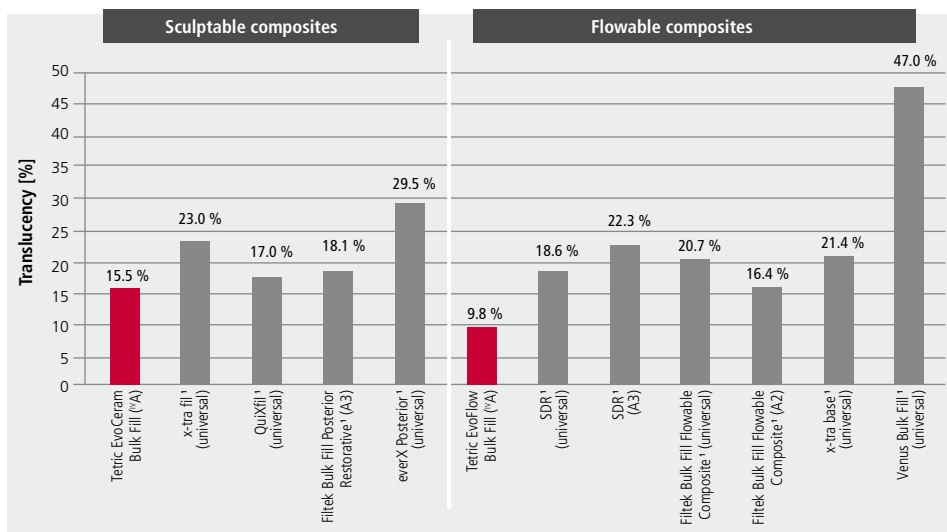


Fig. 1: In order to achieve a high depth of cure, the bulk-fill materials of most manufacturers are highly translucent. Therefore, the light of polymerization devices can penetrate and polymerize deep areas of the composite materials. Measurements: R&D Ivoclar Vivadent AG, December 2014. The measurements were made with the spectrophotometer Minolta CM-5. [†]These trademarks are not registered trademarks of Ivoclar Vivadent AG

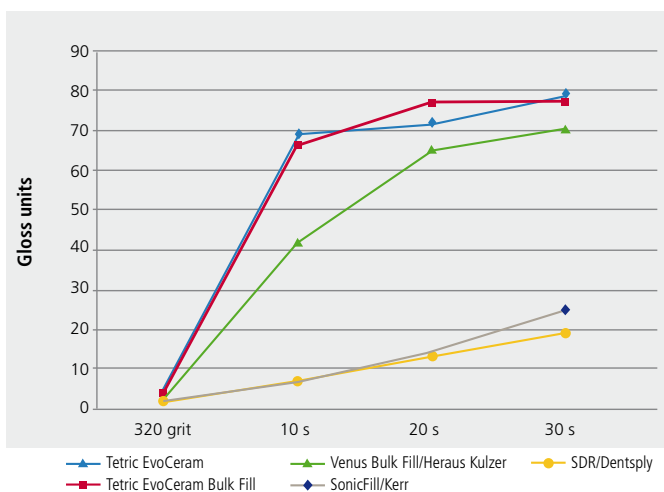


Fig. 2: Tetric EvoCeram and Tetric EvoCeram Bulk Fill contain small fillers. Therefore, they are easy to polish to a high-gloss finish. Mean surface gloss (gloss units) of 4 different composite materials compared to Tetric EvoCeram® Bulk Fill after polishing with the one-step polishing system OpraPol® as a function of the polishing time (R&D Ivoclar Vivadent AG, 2011).

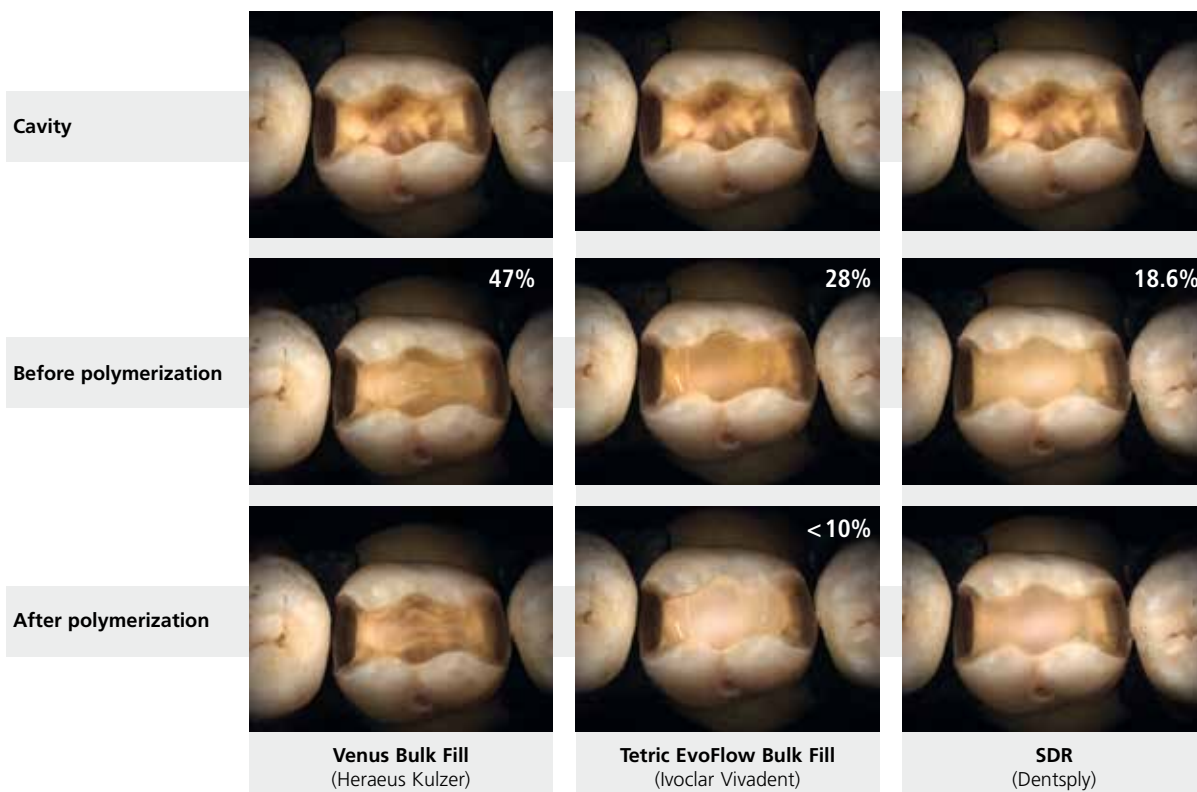


Fig. 3: In one three-surface cavity showing stained occlusal dentin, three different flowable bulk-fill materials were applied for the purpose of studying the masking effect: on the left Venus Bulk Fill, in the middle Tetric EvoFlow Bulk Fill and on the right SDR. The composites are shown before and after polymerization. The adjustment of the translucency in Tetric EvoFlow Bulk Fill is clearly visible (R&D Ivoclar Vivadent AG, 2014).

Apparent contradictions have been harmonized

Ivoclar Vivadent decided to pursue another strategy. Tetric EvoCeram Bulk Fill and Tetric EvoFlow Bulk Fill contain a special patented photo-initiator: a dibenzoyl-germanium compound, named Ivocerin [3]. This initiator absorbs visible light over a relatively wide wavelength range of 370–460 nm [4]. This increases the light reactivity and thus ensures a high depth of cure. Therefore, this new photo-initiator allows the fabrication of composite materials that demonstrate a tooth-like translucency [5] – in contrast to the bulk-fill materials of other manufacturers, which owe their high depth of cure to a high level of translucency. The sufficient depth of cure of 4-mm layers of Tetric EvoCeram Bulk Fill has been established in a large number of studies [4, 5-9]. The flowable Tetric EvoFlow Bulk Fill additionally features what is known as Aessencio technology, which ensures exceptional curing results. Before the material is polymerized, it is highly translucent. Once the monomer has been polymerized, the translucency level drops from 28 per cent to approx. ten per cent. This is achieved due to the sophisticated monomer-filler composition, which takes into account the refractive index change of the monomer matrix as a result of curing. The high-viscosity Tetric EvoCeram Bulk Fill contains small fillers. Therefore, it is easy to polish to a high-gloss finish. The low-viscosity material features larger fillers and is somewhat more difficult to polish. Since flowable composites are not generally used to restore occlusal surfaces and they are usually covered with a high-viscosity composite, the issue of polishability is not regarded as critical in these cases. If this type of material is used in the proximal-cervical margin of two or three-surface fillings, a proximal metal matrix will help to produce a relatively smooth composite surface, which does not have to be polished.

The next development step: lower translucency

Their low translucency compared with other bulk-fill materials makes Tetric EvoCeram Bulk Fill and Tetric EvoFlow Bulk Fill stand out among their competitors. Due to this property, these materials produce enhanced esthetic results. In some cases, they are even capable of masking discoloured dentin. The high-viscosity material exhibits 15 per cent translucency, while the translucency of the low-viscosity material is approx. ten per cent. That is, one millimetre thick samples of the high-viscosity composite will allow 15 per cent light to penetrate and the other material will allow ten per cent light to pass through it. According to a Korean publication, dentin demonstrates a translucency of 16 per cent and enamel of 19 per cent [10]. However, these values may vary somewhat due to the thickness of the tooth structure, the age of the teeth and the measuring method used. In addition, differences can occur between patients, as has been shown by *in vivo* investigations of upper anterior teeth [11]. Nevertheless, despite the different measuring techniques and the variability of the biological substrate, the translucency of Tetric EvoCeram Bulk Fill comes very close to that of natural tooth structure. The very low translucency of the flowable version allows the material to be used for masking certain stains in dentin, for example, those produced by amalgam fillings (Figure 3; also see Figs 10–13).

Case 1:



Fig. 4: Defective amalgam filling in an upper molar



Fig. 5: Cavity



Fig. 6: Tetric EvoCeram Bulk Fill filling directly after its placement



Fig. 7: Filling after two years

Clinical pictures courtesy of Dr Arndt Peschke, Director of R&D Clinic, Schaan

Efficiency when using bulk-filling materials

The bulk-fill materials from Ivoclar Vivadent are available in three shades: ^{IV}A, ^{IV}B and ^{IV}W shades (W = white). The shades of the packable and the flowable version are matched and can therefore be combined easily. Some dentists may regard the small shade range as a drawback. These practitioners are encouraged to try the bulk-fill materials in clinical situations, as practical experience is likely to change their minds. The well-known US test institute Dental Advisor asked 31 dentists to test Tetric EvoCeram Bulk Fill. This group placed a total of 746 posterior fillings with this material. Ninety-seven per cent of the dentists reported that they were generally very satisfied with the product, including its esthetic properties. Therefore, the decision to place a composite resin as a liner or to fill the entire cavity with a high-viscosity composite depends entirely on the preference of the dental practitioner. Bulk-fill composites offer dentists who like to use a liner, the convenience of not having to worry about placing the material in very thin layers of 1.5 to two millimetres. Dentists can layer the composite in thicker increments – however not more than four millimetres – which increases their efficiency (Figs 4–7).

How much time do dentists save when they use bulk-fill materials to place fillings?

Ivoclar Vivadent has tried to answer this question. Thirty-two experienced dentists from 21 countries were asked to fill two-surface cavities in acrylic teeth with one layer of Tetric EvoCeram Bulk Fill or with several layers of Tetric EvoCeram. On average, these dentists placed a filling in four minutes with the bulk-fill method and in 10.5 minutes with the conventional technique. In other words, bulk-filling required 60 per cent less time than regular filling (Fig. 8). Nevertheless, these time savings are related only to the actual filling of the cavity. The overall time saved, based on the entire treatment process, is about ten per cent.

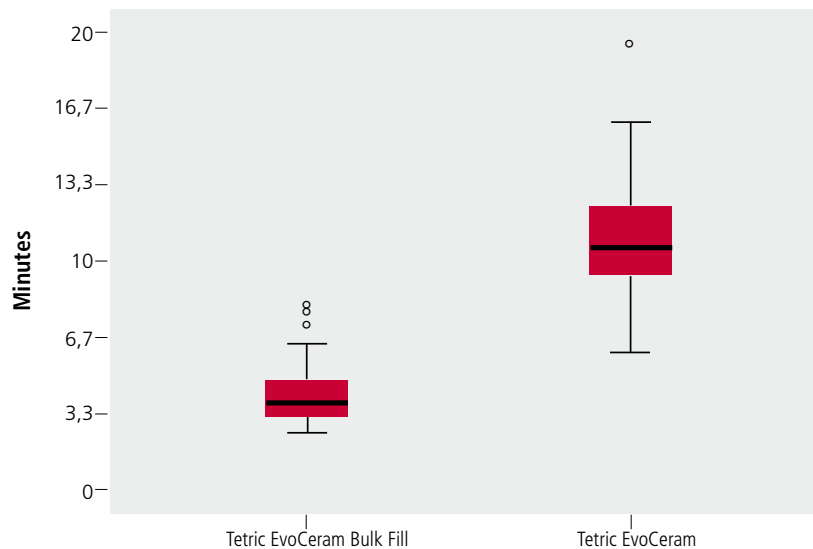


Fig. 8: Box plot diagram of the time needed to place a filling with Tetric EvoCeram Bulk Fill (one layer, n=32) and Tetric EvoCeram (several layers, n=32) in one acrylic tooth. Thirty-two dentists took part in the trial conducted by Ivoclar Vivadent.

Box plot explanation: Fifty per cent of the values are found within the box; the black line is the median, which indicates that 50 per cent of the values are above and 50 per cent below this value. The vertical lines represent the extreme values, and the circles the outliers.

Do clinical studies on bulk-fill materials exist?

To date, only very little clinical data is available on bulk-fill materials, at least with regard to long term evaluation. Since laboratory examinations on mechanical data, shrinkage and marginal behaviour of fillings in extracted teeth usually do not show any significant differences compared with the results of conventional, clinically proven composites, dental manufacturers do not see the need to clinically test new materials many years before their introduction in an effort to have long-term clinical evidence available at the market launch. In the meantime, a number of studies have been published on bulk-fill materials, for example, a clinical investigation of the bulk-fill material SDR, which was introduced in 2011. This material has to be covered with a viscous capping material. In this study, it was compared with a conventionally layered composite [12]. At the beginning of the study, sensitivity which lasted three weeks was reported in a tooth filled with the conventional composite. In the group treated with the bulk-fill material, none of the patients complained about postoperative sensitivity. During the three-year study period, two incidents (one bulk fracture and one cusp fracture) were reported for the conventional composite (n=53), while no special incidents were recorded in the group of patients treated with the bulk-fill material (n=53).

Tetric EvoCeram Bulk Fill is based on the tried-and-tested Tetric EvoCeram

On the basis of laboratory data, therefore, a high probability was established that posterior restorations produced with Tetric EvoCeram Bulk Fill would have a quality similar to that of Tetric EvoCeram fillings. This assumption could be made due to the fact that the composition of Tetric EvoCeram Bulk Fill is largely based on that of Tetric EvoCeram. Clinical results from 840 posterior fillings examined over a period of up to ten years (USA, Sweden, Turkey, Belgium, Italy, Liechtenstein) – which were placed with various adhesive systems - are available for the latter material [13–18].

Thirty-eight of the 840 fillings had to be replaced during the five to eight year study period. This corresponds to a rate of 4.5 per cent (2.2% bulk fractures, 1.2% marginal caries and 0.4% each for cusp fractures, poor esthetics and high rate of wear) (Fig. 9). In one per cent of the cases, patients initially complained of sensitivity. These results are significantly better than those of investigations involving other composite filling materials in posterior dentition [19–21].

What about investigations on Tetric EvoCeram Bulk Fill?

About two to three years ago, clinical studies on this product were started in various countries (Spain, Sweden, France, Turkey, Liechtenstein, USA). To date, however, no data has been published in dental journals, with the exception of the results from the in-house Ivoclar Vivadent study [22]. In addition, The Dental Advisor in the US published the results of its examiners [23]. If the results of these studies are pooled, a total of 399 posterior fillings were placed with Tetric EvoCeram Bulk Fill. In most cases, the material was compared with conventional composites placed using the layering technique. A variety of adhesive systems was used. The current observation period spans one to two years. To date, 360 fillings have been re-examined. So far, only one patient has complained of postoperative sensitivity. After two years, ten fillings (= 2.8%) had to be replaced (1.7% filling fracture, 0.3% cusp fracture, 0.8% filling loss). Marginal caries was not detected in any of the cases (Fig. 9). These results are comparable to or even better than those of other studies performed with conventional composites [19–21].

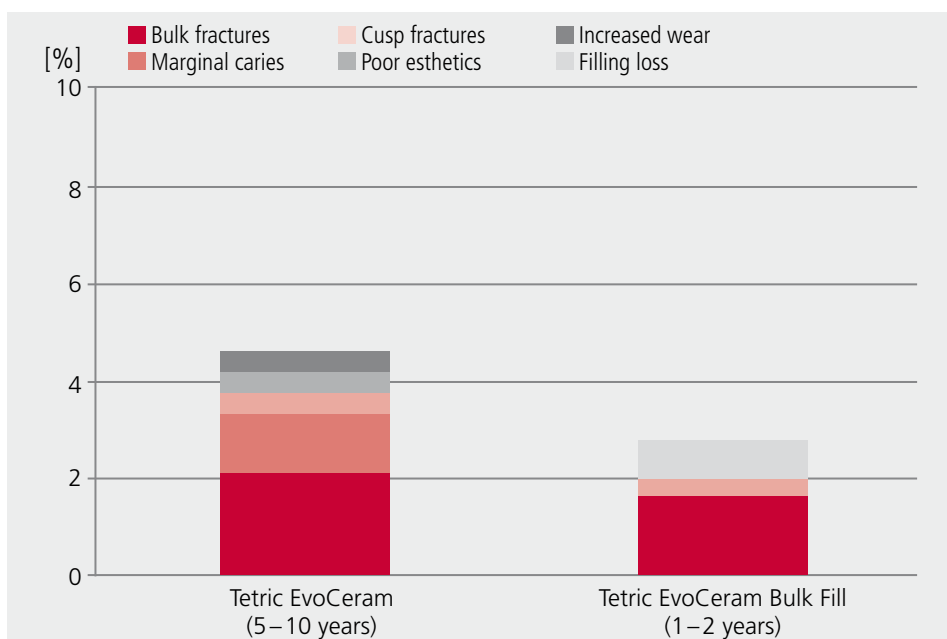


Fig. 9: Summary of the clinical studies on posterior fillings placed with Tetric EvoCeram (observation period of five to ten years). The diagram shows the frequency in per cent of clinical events, which led to the replacement of the fillings (Ivoclar Vivadent Scientific Report 10 Years Tetric EvoCeram, Vol. 01, 2014)

Case 2:



Fig. 10: Two-surface filling in an upper molar



Fig. 11: Tetric EvoFlow Bulk Fill before polymerization



Fig. 12: Tetric EvoFlow Bulk Fill after polymerization



Fig. 13: The finished filling coated with a layer of Tetric EvoCeram Bulk Fill

Clinical pictures courtesy of Dr Ronny Watzke, Department Head of R&D Clinic, Schaan

Conclusion

Bulk-fill materials, Tetric EvoCeram Bulk Fill and Tetric EvoFlow Bulk Fill in particular, offer outstanding clinical reliability. Due to the special germanium-based photo-initiator Ivocerin, the two materials cure sufficiently when placed in increments of up to four millimetres. This gives dentists the possibility of applying the composites in thicker layers, which saves time and increases quality, as practitioners need not focus on the application of thin layers. This also applies to situations where a flowable composite liner has to be applied before the packable and sculptable composite is placed. The liner is available in bulk fill quality (Tetric EvoFlow Bulk Fill – up to four millimetres). No compromises have to be made with regard to esthetics. The translucency of Tetric EvoCeram Bulk Fill is similar to that of natural enamel and the translucency of Tetric EvoFlow Bulk Fill is similar to that of dentin. Stains in dentin can be masked to a certain extent. The dentin-like translucency of Tetric EvoFlow Bulk Fill is achieved via what is known as Aessencio technology. Furthermore, dentists no longer have to make any compromises with regard to the marginal seal of fillings as a result of placing the composite in thick layers. The shrinkage of the materials is no greater than that of the comparable composites Tetric EvoCeram and Tetric EvoFlow. Moreover, the use of bulk-fill composites does not increase the risk of cracks in teeth. The risk of air voids is minimal in both materials, even if dentists apply them in increments of four millimetres. Clinical studies involving more than 300 fillings show that postoperative sensitivity does not occur more frequently than with conventional composites. Are there still any doubts about the clinical reliability of bulk-fill materials? A critical appraisal of all the data gathered from clinical studies and laboratory trials allows the following conclusion to be drawn: The clinical reliability of Tetric EvoCeram Bulk Fill and Tetric EvoFlow Bulk Fill is beyond all doubt – at least based on the information available today.

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