Composites have been in use for approximately three decades as an aesthetic alternative to metal restorations in the heavy-loaded posterior region. Early clinical data on the posterior region gathered in the early ’80s was not encouraging, primarily due to insufficient mechanical properties. The low abrasion resistance of those composite materials led to loss of restoration contours. Fractures, marginal deterioration and leakage following polymerisation shrinkage were further reasons for the limited longevity of those restorations. Predominantly in recent years, it has been possible to greatly reduce these inadequacies through further developments in the sector of composite materials and adhesive systems. Nevertheless, the negative effects of polymerisation shrinkage (such as poor marginal integrity, insufficient adherence to the cavity walls or cusp deflections) still represent the greatest problem in composite-based materials.

According to the type and size of the inorganic fillers used, the composites can be categorized into:
- Conventional macrofilled composites
- Microfilled composites
- Hybrid composites.

With the introduction of innovative composite derivatives, especially in the last 10-12 years, further classifications, for example by filler content (affects the viscosity of the composite) or by differences in the monomer matrix (classic methacrylates, acid-modified methacrylates, ormocers with inorganic-organic compound matrix, ring-opening silorane systems), have increased in importance.

Composites are processed in the incremental layer technique, usually in single increments with a maximum layer thickness of 2mm. The individual increments are each polymerised separately, with exposure times from 10-40 seconds depending on the light intensity of the curing device and shade/translucency of the respective composite paste.

**Indications for composites**
Direct composite restorations have by now become an essential, integral component in the therapy spectrum of modern restorative dentistry. They are used, among other things, because of the broad range of application, the conservative and adhesive stabilisation of the dental hard tissue, as well as the (in comparison to indirect restoration alternatives) economical and time-saving procedure.

The joint statement of the German Association of Operative Dentistry and the German Scientific Dental Association on direct composite restorations in the posterior region.
Restorative materials have the necessary physical and mechanical properties for the successful production of the glass fillers has consistently improved, a distinction can now be made between:

- Hybrid composites (mean particle size < 10 µm)
- Fine particle hybrid composites (mean particle size < 5 µm)
- Ultrafine particle hybrid composites (mean particle size < 3 µm)
- Submicron-filled hybrid composites (mean particle size < 1 µm).

Due to their filler technology and filler content, hybrid composites on the one hand have the necessary physical and mechanical properties for the successful clinically permanent restoration of even large anterior class IV cavities and load-bearing posterior class I and II cavities. On the other hand, the modern hybrid composites with fine, ultrafine and submicron-filled particles now also ensure excellent polishing properties of the surface with long-term retention of the surface gloss. They can therefore be used for all Black’s classes of cavity, which is why they are also described as universal composites. These composites can either be applied in a highly aesthetic polychromatic multi-layer technique with different dentine, body and enamel shades, or in the incremental single-shade technique.

Clinical case
The following clinical case represents the replacement of an amalgam restoration in the maxilla with the nanoparticle-modified hybrid composite GrandioSO (Voco) in the single-shade layer-technique.

A 39-year-old female patient visited the dental surgery with the request to replace her last remaining amalgam restoration on tooth 16 with a tooth-coloured composite restoration. The tooth was not sensitive to percussion and responded positively to a sensitivity test using cold spray. After thorough cleaning with a fluoride-free prophylaxis paste and a rubber cup (fig 1), the shade is chosen in comparison with the moist tooth, while avoiding strong colour contrasts in the immediate surroundings and before applying the rubber dam (fig 2). Otherwise, the reversible lightening process due to loss of moisture on the tooth surface, and also the strong contrast against the coloured rubber dam would make it impossible to select the correct shade.

Figure 3 shows the situation after the removal of the amalgam restoration. After excavation and the subsequent finishing of the cavity margins, a rubber dam was applied (fig 4). The rubber dam separates the operating site from the oral cavity, facilitates clean and effective work 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 distinctly poorer adhesion of the composite to the dental hard tissue and 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 to simplify the working process and ensure quality in the adhesive technique. The minimal effort required to apply the rubber dam is also compensated for by avoiding the need to change wet cotton rolls and the patient’s requests for rinsing.

The next step of treatment involved the application of the adhesive technique. Figure 5 shows the application of ample amounts of the universal bonding agent Futurabond DC (Voco) onto the enamel and dentine. After 20 seconds of rubbing it in, the solvent was carefully evaporated with compressed air and then the bonding agent was polymerised with light for 10 seconds (fig 6). The result is a shiny cavity surface, evenly covered with adhesive (fig 7). This should be carefully checked before the application of the restoration material, as any areas of cavity that appear dull are an indication that an insufficient amount of adhesive was applied to those sites. In the worst case, this could result in reduced bond strength of the restoration in these areas and, at the same time, in reduced dentine sealing, which may lead to postoperative sensitivity. If such areas
Restorative

are found during the visual inspection, additional bonding agent is again selectively applied to those areas.

The cavity was subsequently restored with the nanoparticle-modified hybrid composite GrandioSO in the single-shade layer-technique. The initial step involved the insertion of a 2mm thick horizontal increment in shade A2 directly from one of the caps into the defect (fig 8), and 10 seconds of polymerisation with an LED curing light (intensity > 800mW/cm²). This created a level cavity floor on which the occlusal relief could then be finalised by further sequential composite increments in the oblique layer technique. First, the mesiopalatal cusp was carefully sculpted and then polymerised for 10 seconds (fig 9). The distopalatal cusp and the palatal extension of the cavity were subsequently built up with composite and also light-cured (fig 10). Next, the mesiobuccal and distobuccal cusp were each carefully shaped in two further increments (fig 11) and, again, each subjected to a 10-second polymerisation cycle (fig 12). When shaping the occlusal anatomy, one should take care to carefully model the surface details and remove excess material while still plastic. This significantly facilitates the subsequent finishing procedure and effectively limits it to just a few steps. After removal of the rubber dam, the composite restoration already showed good occlusal contours. After finishing with fine-grit diamond burs and preliminary polishing with diamond-impregnated polishers (Dimanto, Voco), the dynamic and static occlusion was checked with articulating paper and any remaining slight interferences were adjusted. The subsequent high-gloss polishing was carried out with reduced pressure on the Dimanto polishers and optimised the lustre of the restorative material. Figure 13 shows the final composite restoration: a functionally and aesthetically pleasing restoration of the affected tooth has been achieved.

Outlook
The importance of direct composite-based restorative materials will continue to increase in the future. These are scientifically proven high-quality permanent restorations for the masticatory load-bearing posterior region, whose reliability has been documented in literature. The results of a comprehensive meta-analysis have shown that the annual failure rates are not statistically different to amalgam restorations. Minimally invasive treatment protocols, in combination with the ability to detect carious lesions ever earlier, also have a positive effect on the survival rates of such restorations. However, in order to ensure a high-quality direct composite restoration with good marginal adaptation, a careful matrix technique (where proximal areas are involved), an effective dentine adhesive, correct processing of the restorative material and the achievement of a sufficient level of polymerisation of the composite, continue to be basic prerequisites.

Summary
Composite restorations in the posterior region are an integral component of the range of services in today’s modern dentistry. A distinct increase in aesthetic awareness in recent years means that much of the population are no longer willing to accept metal restorations and request tooth-coloured alternatives. Aside from ceramic inlay restorations, patients can choose direct composite restorations as a permanent treatment. The performance of these, even in the masticatory load-bearing posterior region, has now been proven in many clinical studies.

References available on request.