The use of adhesively attached post and cores in esthetic dentistry

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Abstract
The concept of all-ceramic restorations is based on strict clinical criteria, which apply to all procedures ranging from the type of initial preparation up to the final attachment of the dentures to the teeth that have been suitably prepared for the restoration. In keeping with that approach, a careful examination must be carried out before the actual clinical procedure is performed. One of the principal aims of this examination is to assess the future shade of the prepared stumps. This shade can be heavily influenced by previous treatments or by corrosion from old restorations. The choice of a ceramic with a high degree of light transmission would result in immediate failure in these clinical cases whatever the opacity of the bonding agent might be. In these special cases an opaque fitting must be selected. If, however, the clinical situation is favorable, the fabrication of an adhesively luted glass fiber post and core allows the light transmission effect, which is made possible by glass ceramic fittings, to be exploited to full advantage. This clinical article gives a step-by-step account of the procedure for carrying out such a procedure in dental practices.

Owing to the growing demand for improved esthetic standards, dentists have been obliged to rethink their clinical procedures. We now need to supplement our therapeutic arsenal of conventional dental procedures with reconstructions using adhesive techniques. This approach is called for not on economic grounds but in order to provide sound biomechanical conditions as well as medical benefits for the patient (Braun, 2003; Franchisone, D’Alpino, Garcia et al, 2003; Kurbad, Muller, 2007).

These treatments were described in a report about indications and contraindications for crown-root reconstructions submitted in 2003 by a group of experts to the French National Agency for Accreditation and Evaluation (ANAES) in Health. The following observations in the report are of particular relevance: The aim of crown-root reconstructions is the retention of a superstructure [crown, bridge anchorage, anchor for a removable partial denture (RPD)]. A tooth whose pulp has been removed can be reconstructed in one of two ways: cast restorations, inlay cores and inlay cores with an additional wedge, and restorations using a material inserted in a plastic phase (www.has-sante.fr).

The first group in this classification, which is widely used in France, comprises pin-retained inlay cores and inlay cores with additional wedge or cast post and core build-ups, which are fabricated in the laboratory using the direct or indirect casting process. The second group comprises post and core build-ups fabricated in one session at the dental practice using a plastic material (e.g. composite, glass ionomer cement or resin-reinforced glass ionomer cement). Despite the fact that a rigorous evaluation method (critical analysis of the international literature) had been applied, the group of experts came to the conclusion that it was not possible, on the basis of the data analyzed, to define indications and contraindication for the two methods of treatment. This at least confirms how difficult it is to construct a decision algorithm in order to select such reconstruction techniques on a systematic basis (Bolla, Muller-Bolla, Borg et al, 2007; Reissmann, Heydecke, 2008).

Confronted with a given clinical situation, dentists must therefore take into account not only the clinical and radiographic criteria of the affected tooth but also its occlusal environment.

The cast post and core build-ups are fabricated from metal alloys that display different mechanical behavior, depending on their classification (precious, semiprecious and non-precious metal alloys). They are suitable in most cases for larger dental hard tissue defects (two residual walls or fewer) and loss of substance at the gingival level.

The general consensus of opinion about post and core build-ups with plastic material now seems to be in favor of the use of glass-fiber-reinforced posts in combination with a composite material. The indication for this method is limited mainly by the constraints imposed by the adhesive techniques (procedures that have to be followed to the letter, use of a rubber dam).

The indication should be restricted to teeth with sufficient dental hard tissue (three or four walls) as well as a dentin height of at least 2mm above the preparation margin (Dikbas, Tanalp, Ozel et al, 2007). The insertion of a post and the preparation in the dentin, as described above, guarantee the barrel hoop effect in the cemented crown, enabling it to withstand the high shearing loads arising during mastication, especially in the anterior region. Thanks to the use of the adhesive technique, root posts can be dispensed with in the posterior region where there is a small or moderate degree of destruction of the clinical crown (Bitter, Kielbassa, 2007).

Figure 1: Preoperative condition: tooth 16 with occlusal discoloration
Additional advantages of post and core build-ups with glass-fiber-reinforced posts, which have a modulus of elasticity comparable to that of dentin, are immediate coronal sealing and a reduction in the number of treatment sessions (Freedman, 2001). A further advantage, though one that is often overlooked, is that these build-ups meet the light scattering requirements of translucent all-ceramic restorations (Ahn, Lee, 2008; Edelhoff, Sorensen, 2002; Heffernan, Aquilino, Diaz-Arnold et al, 2002; Li, Yu, Wang, 2009; Spear, Holloway, 2008).

Using clinical examples, we shall now give a step-by-step explanation of the fabrication of an all-ceramic crown on an adhesive post and core build-up restoration in which scientific findings have been exploited to the full in order to guarantee function and esthetics.

**Clinical case one**

A 41-year-old female patient complained of the poor aesthetic quality of tooth 16 which had been restored with a composite filling 10 years ago (Figure 1). The discolorations observed on the restoration had been present for a long time and had been caused by diverse factors, making it unlikely that bleaching would lead to a satisfactory result. Accordingly, it was decided in agreement with the patient to fit an all-ceramic crown.

The restorative material was removed at the first session, followed by a root canal treatment (old pulpotomy), which provided optimum sealing of the root canal. In the second session the tooth was prepared, starting with the occlusal reduction. Checks had to be made after the circular preparation to ensure that the adhesive reconstruction could be carried out under optimum conditions.

The tooth was sealed with the rubber dam, a procedure that was facilitated by a supragingival preparation. The palatine canal was prepared with the help of a standard drill. The post had to sit completely passively to prevent friction developing in the canal (Figure 2).

A radiographic check confirmed that the root canal cement had been completely removed, which ensured that the luting composite would cure completely.

The temporary filling was completely removed from the dentin adhesive surface (Figure 3) by sandblasting the cavity with aluminum oxide.

Figure 2: Drill and post were calibrated. It must be ensured that the preparation is carried out in the dentin of the root canal because otherwise firm bonding cannot be guaranteed. The preparation of the root canal is visually checked. However, it must be ensured that the diameter of the post is smaller than that of the root canal so that the post continues to sit passively and is completely covered by composite

Figure 3: The surface was cleaned by sandblasting with aluminum oxide (50μm) and prepared for the adhesive luting

The canal and cavity were then carefully rinsed with a water jet and dabbed with a sponge and paper points (Figure 4) to prevent the dentin drying out.

Different adhesive systems are available for the adhesive luting of the glass-fiber-reinforced composite root post. These comprise Etch-&-Rinse systems with separate acid conditioning and rinsing, and systems with self-etching conditioning. We opted for a self-etching single-stage system.

The self-etching dual-curing adhesive was massaged for 20 to 30 seconds into the root dentin and into the occlusal dentin and enamel surfaces. The use of very fine root canal microbrushes is necessary in most cases (Figure 5). Any surpluses of adhesive in the prepared canal were then removed with a paper point. The solvent was removed by applying a gentle air stream and the adhesive was evenly distributed. Normally, self-conditioning dentin adhesives should not to be

Figure 4: The access cavity was dried with a cotton pellet and the root canal then dried with paper points

Figure 5: The walls of the root canal and the access cavity are wetted with adhesive (Futurabond DC, Voco) by massaging the surfaces for 20 seconds with a microbrush
used in combination with dual-curing composites because they do not then cure completely.

This restriction does not apply to Futurabond DC (Voco, Cuxhaven), which was used in this case and is compatible with the dual-curing build-up material, according to the manufacturer.

The most common source of errors with this procedure involve the adhesive luting of the post, mainly because of the entrapment of air bubbles that result in a reduction of the total adhesive surface. The following action is recommended to prevent the formation of these bubbles: firstly the post, which has been cleaned with alcohol and is to be silanised dependent on the manufacturer’s specifications, should be immediately coated with composite. The composite is then sprayed from apical to coronal into the prepared canal using a fine cannula (Figure 6), ensuring that the tip of the cannula remains immersed in the material at all times.

Finally, a root canal filler with a large diameter should be used manually in order to ensure an even distribution of the composite on the peripheral walls of the access cavity. It is not appropriate to carry out this process mechanically because the heat generated would accelerate the curing of the material (Figure 7).

The post coated with the same composite can now be introduced with a slight rotary movement into the root canal. The composite is then light cured from above for 40 seconds in order to secure the post and to cure the adhesive applied to the occlusal tooth surfaces (Figure 8). The core can then be built up. The use of matrices may be advisable, depending on the amount and viscosity of the composite. Polymerization is carried out in layers (2mm) in the case of a large build-up like this one. The respective layers are light-cured for 40 seconds. If auto-polymerization alone is being carried out, a period of five minutes should elapse before the shape is corrected with rotary instruments. During this period it should be ensured that the material has completely cured in the deep root canal zones as well.

Several essential factors must be taken into account in selecting the build-up composite: dual curing (light and auto-polymerization), the use of a mixing device for minimizing the risk of micro bubbles in the material as well as the need to achieve a dentin shade that meets the esthetic appearance required.

An impression is taken at the same session (Figure 9) and a temporary restoration is fabricated after the preparation has been carried out and the restoration carefully polished. The all-ceramic crown (E-max Press, Ivoclar Vivadent, Ellwangen) is placed in the following session (Figure 10).

Clinical case two
The application of the principles described above applies especially to the anterior region because even higher esthetic standards have to be met in this region and because the favorable mechanical behavior of the glass fiber post and core build-ups with composite becomes evident there.

Restorations of teeth 11 and 21 are required in the case of this 22-year-old female patient (Figure 11) because of the inadequate endodontic treatment and the crown margins. The
clinical indication for an adhesive reconstruction for the permanent restoration is confirmed after removal of the two crowns because it is possible to carry out a barrel hoop preparation (dentin perimeter peripherally > 2mm) (Figure 12). The endodontic treatments are revised and two adhesively luted post core build-ups are carried out the following week (Figures 13a and 13b).

With this reconstruction, both the shade and biomechanics of the stumps are similar to those of natural dentin core. It is therefore advantageous to opt for all-ceramic crowns with a glass ceramic fitting (E-max Press) whose high translucency enhances the appearance of these esthetic reconstructions. The adhesive luting carried out with a Total-Etch system, which increases the durability of glass ceramic, enables this prosthetic restoration to be integrated esthetically and biologically (Figure 14).

Conclusion
Thanks to the combination of ceramic technology without metal support using post and core build-ups and composite, dentists can now offer a biocompatible, solution that is also esthetically and mechanically reliable and that incorporates the latest scientific developments. However, a key factor in the long-term success of the treatment is the selection of suitable materials. Owing to the large number of parameters to be considered, it is not easy to state the indication for a particular restoration system. It therefore remains difficult, if not impossible, to systematize a method for the use of these modern materials. Case-by-case testing remains the rule and has governed our approach.

Acknowledgements
This article was first published in ZWR - Das Deutsche Zahnärzteblatt (2010) 119(10): 508-513.

References
Edelhoff D, Sorensen J (2002) Light transmission through all-ceramic frameworks and cement combinations. 80th IADR. San Diego, USA Abstract #1779

Figures 13a and 13b: The endodontic treatments were carried out afresh in order to ensure sealing of the canal, followed by two reconstructions with adhesive post and core build-ups (Rebilda DC, Voco). Preparation of the gingiva, which was improved by the temporary teeth, was carried out in order to match the tooth necks.