Crown and post-free adhesive restorations for endodontically treated posterior teeth: from direct composite to endocrowns

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Abstract

Coronal rehabilitation of endodontically treated posterior teeth is still a controversial issue. Although the classical crown supported by radicular metal posts remains widely spread in dentistry, its invasiveness has been largely criticized. New materials and therapeutic options based entirely on adhesion are nowadays available. They allow performing a more conservative, faster and less expensive dental treatment. All clinical cases presented in this paper are solved by using these modern techniques, from direct composite restorations to indirect endocrowns.

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Introduction

Endodontically treated teeth (ETT) are more prone to fracture.\(^1\) One of the key reasons for this increased weakness is the lack of tooth substance following the pathological process and endodontic treatment of the tooth in question. This biomechanical alteration inflicts a negative impact on the long-term prognosis of the tooth.\(^2,3\) Therefore, when considering the restoration of devitalized teeth, dental materials should be able to replace the loss of tooth substance in order to ensure mechanical and functional properties, esthetics and coronal seal.

Traditionally this function is fulfilled by a porcelain fused to metal (PFM) or a full-ceramic crown, which is usually cemented onto a core fixed to the root by an endodontic post. Although some long-term retrospective studies have demonstrated its good reliability,\(^4,5\) this kind of approach may be invasive both in the crown and in the root. In case of failure, the invasive nature of such procedures often excludes the possibility of a re-intervention due to the poor quantity of the remaining dental tissues; in addition, it exposes the tooth to a higher risk of irreversible fractures.

Moreover, the fabrication of a crown may involve many technical steps (crown lengthening, post cementation, core fabrication and temporary crown), which increase the time and cost of treatment. All these intermediary stages may also favor bacterial infiltration and cause endodontic re-infection. However, in the past, crowning of devitalized teeth was considered a must to protect the remaining tooth substance. Tooth-destructive fricative elements such as prefabricated metallic posts have been widely and wrongly suggested in presence of an extensive tissue loss, not only to retain the crown but also to recover the stiffness of the tooth. Contrary to this preconceived idea, it is largely proved today that these elements do not reinforce the tooth but contribute to its weakness.\(^6\)

During the last 30 years, the development of the adhesive philosophy in dentistry and the high bonding performances achieved by modern adhesive systems have gradually changed the dogma “devitalized tooth = crowned tooth” and many classical indications for a crown restoration are nowadays questioned.\(^7\) Modern clinical procedures to restore ETT are rather based on the principles of the minimally invasive dentistry, which attempts to conserve sound tissues. This kind of conservative dentistry is accomplished by using adhesive techniques, as adhesion ensures sufficient material retention without the need of aggressive macroretentive techniques. Consequently, restoration of devitalized teeth follows in many cases the same principles as the restoration of vital teeth.

The aim of this article is to show a modern therapeutic approach based entirely on adhesive dentistry. The fabrication of direct and indirect adhesive restorations on ETT is illustrated in some representative clinical cases. A new rationale is also presented to help the operator in choosing the correct adhesive restoration according to the tooth cavity configuration and the tooth’s esthetic needs.
Treatment plan

The choice of the therapeutic option when restoring a devitalized tooth is based on several factors. Certain factors such as the geometry of the tooth cavity, the tooth localization in the mouth, as well as esthetics, are essential in establishing objective and simple guidelines. Others, like the presence of parafunc-
tions in the occlusal context, the age of the tooth and its endodontic/periodontal prognosis, and the financial aspects are important factors but should be consid-
ered separately as special single cases.

Loss of substance
(tooth cavity configuration)

The major changes in the biomechanics of an ETT are caused by the loss of tissue due to the previous pathology (caries, fracture, cavity excavation), to the endodontic treatment (access cav-
ity, root canal shaping) and to some invasive restorative procedures (post placement, crown fabrication). All these factors may contribute to a con-
sistent removal of coronal and radicular tissues, which enhances the weakness and the risk of fracture of an EET. In the coronal part of the tooth, a few partic-
cular cavity configurations seem to be more at risk. Several in vitro studies show that the conservation of the mar-
ginal ridges is a fundamental factor in limiting abnormal cuspal deflection and breakdown. Thus, an occlusal (O) cav-
ity and a mesial-occlusal-distal (MOD) cavity are on the opposite side of a hypo-
thetical safety scale (Fig 1). Further-
more, the loss of the parapulpal dentin – the dentin above and near the pulp chamber – as a natural consequence of an endodontic treatment is another major weakening factor. As a con-
sequence, the deepest MOD cavities on an ETT should be considered as the worst cavities in terms of fracture risk. In those cases, scientific literature agrees that a cuspal coverage of the tooth has to be planned in order to avoid extreme flexure of the cusps and balance the oc-
clusal forces (Figs 2a and 2b).

Fig 1  The risk of fracture of an endodontically treated tooth is directly related to the quantity of tissues lost and to the specific cavity configuration.
When considering sound coronal tissues available for adhesion in a devitalized tooth, remaining walls must be sound, free of fissures and at least 1 mm wide to be considered as safe (Fig 3). That estimation should be done during the preliminary steps of the endodontic phase when the cavity is first cleaned and the pulpal tissue is removed. Fissured and thin cavity walls should be detected before the build-up of the pre-endodontic composite resin reconstruction, as a part of this resin is often left in place later as a base for the definitive restoration.

The tooth type
(molars vs premolars)

The anatomical and physiological differences between molars and premolars may be crucial when choosing the therapeutic option. First, molars are larger than premolars and they have a larger pulp chamber. Therefore, they have more surface available for adhesive procedures than premolars. When a considerable amount of tissue is lost, this feature is of high importance. Moreover, molars and premolars are usually submitted to a different set of loads. In a normal occlusal context – class I molar, canine lateral guidance, incisors anterior guidance – posterior teeth (molars and premolars) are more subjected to axial forces while anterior teeth (canines and incisors) are more exposed to shear forces. Despite this ideal situation, more often canine lateral guidance is replaced by a group function where premolars participate in lateral movements. Therefore, premolars’ cusps are subjected to a more complex set of forces that is formed by either axial and shear loads and that could be potentially harmful.

Thus, in most cases molars can be restored by relying solely on adhesion while premolars could ask for a post placement in case of scarce residual tooth structure. Practical guidelines derived from clinical experience for the evaluation of the remaining sound tissues and indications for a post placement have been mentioned previously.3,10

The esthetic factor

Esthetic needs of ETT are critical for the cavity preparation and for the material selection. Those needs are established imperatively at the beginning of the first appointment. The buccal visibility of the treated tooth inside the “smile space” (the virtual space between the upper and lower lips during full smiling of the patient) implies high esthetic needs (Fig 4). Whenever the restoration margins invade this space, in case of cuspal coverage for example, a homogeneous transition between the restoration and the tooth could present a hard esthetic challenge. Three solutions are offered to the operator. First, buccal margins of the restoration can be placed in the cervical third of the crown, close to the gingival line in order to place the transition in a hidden zone. This “crown-like” buccal margin yields appealing esthetic results but is invasive in nature (Fig 5d). As a more conservative alternative – but more challenging from an esthetic point of view – buccal margins can be left in the middle third of the crown, at a distance of 2 to 3 mm from the occlusion plane (Fig 5c). In that case a large amount of enamel and dentin is saved but the esthetic in-
Fig 2a and 2b  Rationale for the choice of the proper therapeutic option for ETT. It is important to underline the schematic aspect of these guidelines: thickness of remaining walls, dimension of the cavity and above all the occlusal context can influence the therapeutic choice.

<table>
<thead>
<tr>
<th>cavity</th>
<th>suggested restoration</th>
<th>cuspal coverage</th>
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<tbody>
<tr>
<td>Class I</td>
<td>Direct composite</td>
<td>no*</td>
</tr>
<tr>
<td>Class II MO/OD</td>
<td>Direct composite Indirect restoration</td>
<td></td>
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* In safe occlusal context

Fig 3  A long vertical fissure in the distal marginal ridge is clearly visible after the preparation of this 3.6. This wall has to be included in the future restoration as it cannot be considered as safe. The geometry of the cavity changes from MO to MOD.

Fig 4  The “smile space”. In some cases, posterior teeth should be considered like anterior ones in terms of esthetic needs.
The integration of the restoration is more challenging. An attractive possibility is to place the visible margins in the incisal third of the buccal cusp, at just 1.5 mm from the occlusion (Fig 5b) conserving the buccal cusp almost entirely. The indicated option, although still experimental and tested just only on vital teeth, is very interesting as it combines minimal invasive dentistry and esthetics. In the case where a part of the buccal cusp is envisioned to be left in place, conforming to this type of configuration, and there is evidence of dentin discolorations, an internal coronal bleaching could be indicated before the placement of the final restoration (Fig 10c).

Clinical cases

Class I (4-walls cavity)

In this cavity configuration, the EET presents a wide and deep occlusal cavity inserted in 4 remaining walls. If these walls are sound and thick enough, this cavity is considered the safest in terms of fracture risk. In a well known study Reeh et al have measured a loss of tooth stiffness of about 20% associated to an occlusal endodontic access cavity, compared to a 63% for a MOD endodontic cavity. Later, other laboratory tests have confirmed this hypothesis. Few studies exist in literature describing the clinical effectiveness of direct composite resin for Class I cavities in EET. The scientific opinion is generally positive towards this kind of restoration even if the results of the clinical trials are frequently confounded either with other kind of cavities inside the wider category of direct composite resins or with other materials like amalgams within the group of Direct Restorations.

The Class I case presented is an endodontically treated maxillary first molar (Figs 6a to 6c). Once the provisional res-
toration is removed, the cavity is isolated with a rubber dam and adhesively treated with a self-etch or an etch-and-rinse adhesive system (Table 1). Then, small amounts of hybrid composite resin are directly inserted in the cavity and polymerized. The aim is to fill the cavity and limit the resin polymerization shrinkage. The highest configuration factor (C factor) of this kind of cavity imposes that strategy. To that purpose, the composite resin is progressively stratified into the cavity by applying 2 to 3 mm oblique increments. Each layer is polymerized for 40 seconds with the LED lamp as close to the surface of the resin as possible. Then, the restoration is finished and polished with silicone points and fine abrasive disks. A final touch of polymerization under glycerin gel avoids any oxygen-inhibition layers. Finally, the rubber-dam is removed and the occlusion checked, and adjusted if necessary.

Class II MO/OD (3-wall cavity)

In this kind of 3-wall cavity configuration, the mesial or distal remaining marginal ridge protects the tooth from catastrophic mesio-distal fractures. In the past, several studies have shown the protective role performed by a sound and tight marginal “third wall”. Reeh et al\(^9\) found that the loss of tooth stiffness in these kinds of cavities is about 45% compared to a 63% of an MOD cavity. Panitvisai et al\(^{13}\) found that the buccolingual cuspal movement in the 3 walls of MO cavities is about 7.5 mm instead of 16.5 mm observed in 2-wall MOD cavities. These results was also confirmed by Gonzalez-Lopez et al\(^{11}\) who showed that removal of both marginal ridges in
devitalized premolars led to a dramatic increase in cuspal deflection, above all under extreme loads (from about 10 mm for a MO cavity to 56 mm for a MOD cavity under 100 N load and from about 14 mm to 114 mm respectively under 150 N load). Recently, Salameh et al\textsuperscript{16} found that MO cavities in endodontically treated molars restored by direct composite resins demonstrate a fracture resistance superior to MOD cavities, with and without fiber posts. However, in another similar study on devitalized premolars, Sorrentino et al\textsuperscript{17} found no differences in fracture strength between 3- and 2-wall cavities. An \textit{in vitro} study\textsuperscript{18} has focused on the adequate thickness of this remaining marginal ridge. Results of this study prove that sound marginal walls of a thickness superior to 1 mm in devitalized premolars restored by direct composite resins have fracture strength similar to that of intact teeth.

The clinical relevance of all this laboratory research is that under the aforementioned conditions and in the absence of parafunctional stresses, a full occlusal coverage in this type of cavity configuration can be avoided. Hence, the preservation of the lingual and buccal cusps ensures a more conservative and esthetic approach. Furthermore, frequently 3-wall cavities without cuspal coverage can be easily restored with composite resins using a direct technique.

\textit{Direct technique}

Simple 3-wall cavities in ETT can be restored by direct composite resins. The case presented in this paper is a devitalized maxillary first molar with a medium/large MO cavity (Figs 7a to 7e). The presence of a thick and sound distal wall allows for the entire conservation of the buccal and palatal cups and avoids a further loss of substance. A radiographic examination must always confirm the clinical diagnosis (Fig 7b). From an esthetic point of view, the possibility to conserve the buccal wall almost entirely is

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Adhesive systems</th>
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<td><strong>Dentin</strong></td>
<td><strong>Self-etch System</strong></td>
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<tr>
<td><strong>Conditioning</strong></td>
<td>Self-etching primer (10 sec and dry)</td>
</tr>
<tr>
<td><strong>Priming</strong></td>
<td>Primer solution (10 sec and dry)</td>
</tr>
<tr>
<td><strong>Bonding</strong></td>
<td>Bonding resin (10 sec and dry)</td>
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a great advantage. Despite large cavity dimensions, a direct composite resin is chosen to restore this molar instead of an indirect solution. This choice is above all dictated by a simple clinical/practical feasibility more than future restoration's dimensions. Once the adhesive system is applied, composite resin is stratified into the cavity by applying 2 to 3 mm oblique increments, starting from the interproximal mesial wall in order to transform the Class II cavity into a Class I cavity. Details
concerning the technical procedures for direct composite have been already described previously for Class I (Fig 6).

Indirect technique
Indirect restorations are a good alternative to direct composite resins in the case of large 3 wall cavities, especially in situations when clinical feasibility becomes too complex for a direct technique. Such a case is illustrated in Figs 8a to 8o, where a maxillary second premolar presents with a large occlusal-distal-palatal cavity including sub-gingival distal margins. During the first appointment, the indirect technique allows the relocation of the intracrevicular margins, and the ideal interproximal and occlusal anatomy is achieved later with the lab-made restoration.

By programming two appointments, a conventional indirect composite technique is thus accomplished. During the first appointment, the cavity is cut under local anesthesia. Once the cavity is properly isolated an adhesive system is applied on whole dentin and on the distal thin subgingival portions of enamel margins and light cured. Next a thin composite resin layer is applied on dentin and light cured. The goal is to fill the pulp chamber, cover all the dentin and to arrive at an ideal geometry of the cavity: correct taper, minimal undercuts, cervical margins relocated supragingivally and adequate interocclusal space. For that purpose, a low shrinking hybrid composite resin is suitable. Finishing the enamel margins with fine diamonds instruments is the
last step before impression. The preparation of a small pit in the middle of the pulp chamber composite and/or flat distal margins will help the positioning of the restoration during luting (Fig 8d). After the impressions, a soft composite resin temporary material (eg, Fermit, IvoclarVivadent) is inserted into the cavity and light cured without cementation. Then, the composite resin workpiece is fabricated in-lab on a cast model (Fig 8e). During the second clinical session the workpiece is tried in the mouth. The anatomy, esthetic integration, interproximal surface contact and fit of the margins are verified. Next the internal surface of the indirect composite resin restoration is adhesively treated and then left under light protection (Table 1) (Figs 8f to 8h). The next step is the adhesive treatment of the cavity (Table 1) (Figs 8i to 8l). The procedure is simplified by the presence of enamel and composite resin only, as there is no exposed dentin20. A conventional photopolymerizable hybrid composite resin is used as luting cement. Before the insertion into the cavity, this composite resin should be heated up to a temperature of about 50°C to decrease its viscosity. Immediately thereafter, the restoration is inserted into the cavity and is first forced in place manually and then with the help of ultrasonic energy. The use of a metallic plugger is contraindicated when the thickness of the restoration is thin because it may introduce fractures. Excess of luting composite resin at the margins are removed with a probe and interproximal floss. A first light polymerization is performed with a high power LED unit 5 s per surface, which serves to fix the sur-
**Fig 8d** Before impression enamel is finished. A flat distal margin will help the positioning of the restoration during luting.

**Fig 8f** Adhesive preparation of the workpiece: the inner surface is sandblasted with 27–50 microns Al₂O₃ particles at a distance of about 5 mm.

**Fig 8h** Application of a hydrophobic light-curing bonding resin. The restoration is then put under light protection.

**Fig 8e** The indirect composite restoration on the cast model.

**Fig 8g** The conditioned surface is successively “primed” with an organic silane.
**Fig 8i**  Adhesive preparation of the cavity. The composite layer is sandblasted.

**Fig 8j**  Orthophosphoric acid etching of enamel margins.

**Fig 8k**  Application of silane coupling agent on composite resin. The accidental application of silane on conditioned enamel does not have any negative effect on enamel adhesion.

**Fig 8l**  A light-curing bonding resin is applied onto the entire cavity surface and spread in a very thin layer with a gentle air jet, without being pre-cured.

**Fig 8m**  The restoration is inserted into the cavity. A restorative hybrid composite resin is used as luting cement.

**Fig 8n**  Full polymerization is achieved by light curing for at least 90 s per surface.
face of the luting composite resin. Then full polymerization in contact with the irradiated surface is achieved by light curing for at least 90 s per surface. Any composite resin excess is subsequently removed with fine diamonds and re-polished with flexible discs or silicone points with slight pressure. A layer of glycerine gel is finally applied over the entire surface of the restored tooth and the luting composite resin is cured for 5 s per surface through this gel to eliminate the oxygen inhibition layer on the surface of the luting composite resin, if still not polished and removed. Finally, the rubber dam is removed and the occlusion is checked. Any abnormal contact in occlusion and during lateral movements on the restoration is removed.

Class II MOD (2-wall cavity)

Covering all the cusps by at least 2 to 3 mm is mandatory when 2 or 1 walls remain in the cavity of an ETT. As stated before, large and deep MOD cavities are placed in a hypothetical safety scale at the “border line” (Fig 1) from which the danger of severe failures increases drastically.

Bonded restorations with full occlusal coverage or “overlays” are proved to have a beneficial effect on fracture strength of ETT compared to simple MOD restorations.\textsuperscript{14,22,21} The main reason is that bonded overlays show a more homogeneous distribution of biting forces during function. Also, they have a better cavity configuration in terms of C factor, which allows lower polymeriza-
tion shrinkage stresses on marginal adhesive interfaces. Moreover, some studies show a certain protective effect of these restorations against irreversible fractures. However, these results are in contrast with other in vitro tests where the occlusal coverage configuration has no influence on fracture strength of ETT. With regard to materials, in some recent studies a certain emphasis has been made to the fact that composite resin overlays, due to their lower Young modulus display better performances versus ceramic, absorbing and minimizing internal stresses.

**Endocrowns**
Within all bonded indirect restorations, “overlay restorations on ETT” or “endo-crowns” represent a particular category.
The buccal cusp is reduced to 0.5 to 1 mm over the gingival level (see also Fig 5d). An over-gingival margin facilitates rubber dam application during adhesive procedures.

The lab-made glass-ceramic endocrown (IPS e.max Press, IvoclarVivadent).

Adhesive preparation of the ceramic restoration: the inner surface is conditioned with hydrofluoric acid following manufacturer instructions. Then, acid is first aspirated through high speed aspiration and restoration is abundantly rinsed with water spray.

Complete cleaning of the conditioned surface is achieved by a post-etching cleaning using orthophosphoric acid with a brushing motion followed by immersion in an ultrasonic bath of distilled water for 5 min. Then restoration is gently dried with compressed air.

By definition, endocrowns are partial crowns made out of ceramic or composite resin that are bonded by resin cements to the devitalized tooth. They offer a full occlusal coverage and they take advantage of the pulp chamber to increase the available adhesive surface. Different materials can be used to fabricate an endocrown feldspathic and glass-ceramic, hybrid composite resin and the newest computer aided design/computer aided manufacturing (CAD/CAM) ceramic and composite resin blocks. Scientific literature is still uncertain about which material is best indicated for such restorations. The authors
Fig 9i  A silane coupling agent is applied for 60 s and dried. A thin layer of bonding resin is subsequently applied over the silanized surface, without being pre-cured. Note the typical shiny aspect of the inner surface after the bonding resin application.

Fig 9j  Adhesive preparation of the premolar cavity is achieved following the same procedure described from Figs 8i to 8l.

Fig 9k  The light-curing luting composite is inserted into the cavity and spread. High viscosity of conventional hybrid composites can be reduced by pre-heating them outside of the cavity in special ovens and eventually applying ultrasonic energy directly into the composite luting layer.
prefer micro-hybrid composite resins – lab-made or in the form of CAD/CAM blocks – due to their stress-absorbing properties and their practical benefits like the possibility to modify and repair the surface easily.\textsuperscript{26} Reinforced glass-ceramics (eg, IPS e.max Press and CAD, Ivoclar, may be alternatives to this concept.

Several \textit{in vitro} studies have proven the validity of bonded endocrowns for molars and premolars\textsuperscript{7,26-28,30} however, only few \textit{in vivo} trials\textsuperscript{29,30} have been conducted and they report a good clinical performances for molars. However, classical treatments like post, core and crowns must be still kept in consideration for severely damaged premolars, until further clinical tests could prove the possibility to restore them solely by endocrowns.

The first case of endocrown presented is a maxillary first premolar with esthetic needs (Figs 9a to 9m). Once removed the provisional restoration and cleaned the tooth, the deep and wide MOD cavity configuration supports the full occlusal coverage of this tooth. The palatal cusp is simply reduced by 2 to 3 mm with a butt-margin (Fig 9d). From an esthetic point of view, the buccal margin is placed in the cervical third, 0.5 to 1 mm over the gingival level (Figs 9e and 5d). The cavity is then isolated and prepared for an indirect restoration following the same procedures described before for the case of Fig 8. Regarding materials, a lithium disilicate reinforced glass-ceramic (IPS e.max Press, Ivoclar Vivadent) is chosen in this case for esthetic reasons. It is important to note that the cavity preparation during the first appointment and the adhesive surface treatment of the cavity during the luting appointment follow the same principles and procedures for both ceramic and composite endocrowns. The only difference is the adhesive treatment of the intaglio surface of the workpiece (Table 1 and Figs 9f to 9i) during luting.

The second case of an endocrown presented is a mandibular first molar...
with lower esthetic needs than the previous maxillary case (Figs 10a to 10g). That allows a more conservative design of the endocrown above all in the buccal “esthetic” side, meaning that buccal cusps like lingual ones can be reduced just a few millimeters from occlusion (Figs 10e and 5c). In general, reductions by at least 2 to 3 mm are recommended for ceramic and composite resin restorations. Before the preparation of the cavity for the endocrown, one/two sessions of internal bleaching (sodium perborate and distilled water or 3% hydrogen peroxide) may be planned, in order to reduce the heavy dental dyschromia, which is clearly visible on the buccal side.

**Fig 10a** Initial view of the endodontic treated mandibular first molar. Old and leaked composite restoration is removed and an endodontic retreatment is programmed.

**Fig 10b** Image of the wide MOD cavity during the pre-endodontic composite build-up. The quantity and quality of remaining sound tissues available for the definitive restoration is often evaluated during this preliminary phase.

**Fig 10c** After the endodontic retreatment and before the definitive restoration, one/two internal bleaching sessions can be performed.

**Fig 10d** The first molar some weeks after the bleaching. The tooth is ready to be prepared for the endocrown restoration.
The third case of an endocrown is a maxillary second premolar with a large cavity including the mesio-distal interproximal walls and the palatal cusp (Figs 11a to 11e). In this kind of large MODP cavity on premolars, a full occlusal coverage is currently recommended. Consequently, the buccal cusp is entirely reduced and classical post, core and crown are usually programmed. In that specific case, a new and experimental design of endocrown was indeed realized in which the cuspal coverage was obtained with a minimal invasive reduction of the thick and sound buccal cusp. Some modern studies have recently pointed out that composite resin restorations show enough resistance, even in a thin layer. Thus, the buccal cusp is slightly reduced and restoration margins are placed in the incisal third at a 1.5 mm distance from the occlusal plane and lateral contacts (Figs 11b and 5b). On the contrary, the pre-endodontic composite resin is abundantly reduced in the palatal side as well in the interproximal regions. This “modified” restoration design (Fig 11d) for endocrowns is particularly interesting as a good esthetic can be achieved with a minimal invasive intervention.

Conclusion

This article illustrates how the principles of minimally invasive dentistry can be applied not only to primary restorations, but to the field of re-dentistry as well, in particular on non-vital teeth. Weakened endodontically treated posterior teeth can be restored functionally and esthetically by direct and indirect adhe-
sive techniques, thus avoiding a further sacrifice of sound tissues for fricative and macroretentive elements. By relying on adhesion, radicular posts are no longer necessary on devitalized molars, and at the present moment it is difficult to decide if posts are necessary on premolars and front teeth. If yes, they may only be considered in the case of extreme coronal destruction, without having clear scientific evidence on their necessity and exact indication. If used, adhesive posts in a minimally invasive restorative concept do not represent a macromechanically retentive element. They serve much more as a glass fiber
reinforcement of a short radicular inlay that searches to increase adhesive surface within the root canal to increase adhesive retention. Finally, it is important to note that accurate case selection and rigorous execution of adhesive procedures are essential for the accomplishment of this full adhesive strategy.

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