

Pre-endodontic build-up – an essential component of endodontic therapy

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The focus of modern dentistry is to preserve patients' teeth, preferably for their entire life time. In the pursuit of this goal, endodontics has the decisive role of prognostic therapy for teeth that have already been damaged by a pulp complex infection. Particularly significant scientific and technical progress has been achieved in the field of endodontics in the last few years. The establishment of pulpitis or apical periodontitis as part of the further development of the disease is always linked to the presence of bacteria in the complex root canal system.¹ The bacteria may be freely movable in planktonic form, i.e. in the tissue fluid.² However, a large number of different bacterial species is organized in a much more complex structure: the biofilm. The biofilm is a conglomerate of different bacterial species that are connected by an extra-polysaccharide matrix, which the bacteria species involved build themselves.³ This biofilm stubbornly adheres to the surface and is always proven to be present in the advanced stages of infections of the canal system.⁴

The central focus of modern endodontic therapies is therefore the maximum possible eradication of micro-organisms, infected tissue residue and infected dentine as well as the final antibacterial sealing of the resulting cavity.⁵ The prerequisite for successful endodontic therapy is strict adherence to an antimicrobial treatment concept from the first step of endodontic therapy to the sealed post-endodontic build-up.

Pre-endodontic build-up - the prerequisite for an antimicrobial treatment concept

Teeth that are subject to endodontic therapy generally demonstrate more or less a distinctive loss of structure. The exception are trauma teeth, which often have not been subject to dental treatment up until the time of the accident. The loss of structure may be due to existing carious lesions, large fillings, fractures, bruxism or previous prosthetic restoration. An important building block in the endodontic therapy concept is the use of a pre-endodontic build-up in order to create an antibacterial seal and prevent the entry of bacteria in the oral cavity into the pulp chamber and the root canal system.^{6,7}

After anesthetizing the patient, the first step, wherever possible, should be to isolate the affected region using a rubber dam. When doing so it is advisable to use the rubber dam not only on the tooth to be treated, but also on the neighboring teeth (Fig. 1). Only in this way is it possible to place a matrix cleanly. This in turn makes it possible to achieve the optimum isolation of the proximal contact point and to ensure the filling fits the edges of the cavity precisely. Furthermore, the inclusion of multiple teeth allows improved orientation when creating the trepanation opening and the decisive shaping of the access cavity.⁸ Teeth that initially cannot be isolated using a rubber dam should be subject to a critical examination with regard to the subsequent prosthetic value.

After positioning the rubber dam, all existing restorative materials must be removed (Fig. 2 and 3). In the case of a prosthetic restoration, the trepanation is primarily performed via the existing prosthetic restoration. However, this course of action can only be continued if a complete intracoronary caries excavation takes place. If not, it must be removed and replaced with a suitable long-term transitional prosthesis. This and all other steps should take place using a magnifying aid and preferably using a dental microscope. Using a dental microscope can lead to huge improvements in the precision of all relevant endodontic treatment steps.⁹

As soon as the rubber dam is in place, all carious hard tooth tissue structures must be removed. As caries is a bacterial infectious disease,¹⁰ the removal of all carious lesions at this early stage of therapy is crucial. This is the only way to prevent reinfection of the pulp chamber system by the bacteria that cause caries. The use of caries detectors can help the accuracy of displaying any existing carious areas. The complete removal of all old restoration materials and carious hard tooth tissue makes it possible to accurately assess the existing remaining tooth structure. Only then it is possible to classify the tooth in terms of its prosthetic value (Fig. 4).¹¹ Furthermore, the removal of any restorative materials makes it possible to discover and assess any existing fracture lines.



The caries is removed using a long-shaft round bur with very sharp cutting heads of different diameters. The use of a long-shaft round bur makes it possible to view the caries directly, as the angled head does not lie in the direct field of vision. The presence of healthy tooth structure then makes it possible to repair the hard tooth tissue defects with a restoration that adheres to the dentine and provides an antibacterial seal. This is crucial for all further steps in an antimicrobial endodontic treatment concept. It is the only way to protect the pulp chamber and canal systems that are to be treated from the penetration of bacteria from the oral cavity.¹²

If the cavity edges are covered by the gingiva, it is advisable to conduct a gingivectomy after local infiltration of an anesthetic with an adrenaline concentration of 1:100,000. Any bleeding can be controlled by antihemorrhagics, local anticoagulants or the use of mechanical aids such as teflon tape, retraction cords, etc.

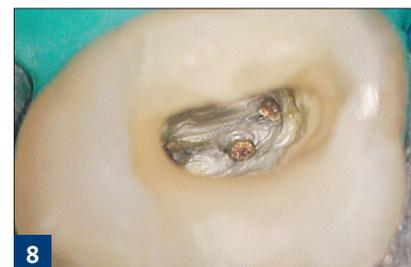
If there are no proximal contacts, a matrix system must be created before a dentine-adhesive build-up. There are many modern partial matrix systems available, as well as the classic Tofflemire matrix (Fig. 5). In any case, it is important to ensure that the matrix is applied to the cavity edge with a tight seal and that there is good proximal contact to the neighboring tooth.

After applying the matrix system, the tooth enamel and dentine should be etched with 30-40% phosphoric acid. This creates the ideal surface morphology for the micromechanical anchoring of resins.¹³ As with composites, there is continuous development in the case of adhesive systems. Although good adhesion is possible with modern all-in-one systems, the gold standard continues to be the use of multi-bottle systems in the etch-and-rinse technique.¹⁴ If the pulp chamber has already been removed, or if root canal orifices are visible during restoration treatments, a sterilized Teflon film can be used as a placeholder in the pulp chamber. This will reliably prevent unintentional influx of composite into the pulp chamber.

This is followed by the layer-by-layer reconstruction of the missing cavity walls. It is advisable to use a flowable dual-curing composite material.

Dual-curing composites were developed to bypass the limitations of self-curing and light-curing composites. One disadvantage of self-curing composites is the fact that the attending dentist conducting the treatment cannot easily influence the curing time. Air pockets created during manual mixing can also lead to porosity in the cured composites. In the case of light-curing composites, the thickness of the layers should not exceed 2 mm, as a complete polymerization reaction is otherwise not guaranteed.¹⁵ Incomplete polymerization can lead to a reduction of the mechanical properties of the restoration¹⁶ or to microleakage and secondary caries.¹⁷ Dual-curing composites combine the advantages of self-curing and light-curing composites.¹⁸ Due to the light-curing components, rapid light polymerization can take place. This leads to an initial stabilization of the restoration, which means that the subsequent treatment steps can be taken as soon as the material has cured. In the deeper areas of the restoration the curing is chemically controlled. Studies show lower curing in the deeper areas of dual-curing composites.¹⁹ Many studies only address curing up to 24 hours after polymerization begins. Other studies, however, also describe post-curing after 24 hours.²⁰ Some examples of flowable dual-curing composites are Clearfil DC Core Automix (Kuraray, Tokyo, Japan), Core X flow (Dentsply DeTrey, Constance, Germany), LuxaCore Z-Dual (DMG, Hamburg, Germany) and MultiCore Flow (Ivoclar Vivadent, Schaan, Liechtenstein).

LuxaCore Z-Dual is a modern, dual-curing, nano-hybrid composite. It is similar to dentine in terms of cuttability, has a high level of compressive strength and flows well. The fact that it both flows well and has a high level of stability is crucial for pre-endodontic build-up. The fact that it flows well allows the composite to flow up to the edges of the cavity for a precise fit. A high level of stability allows precise application of the composite without the risk of



blocking root canal orifices or pulp areas. The application of the composite takes place layer-by-layer in order to keep the polymerization shrinkage to a minimum.²¹ LuxaCore Z-Dual, which comes with applicators in different widths, can be used for this purpose. A further positive aspect of this is that LuxaCore Z-Dual can be used both for pre-endodontic build-up and for the sealed, dentine-adhesive filling straight afterwards. The fact that it flows well means that adhesive-fixing glass-fiber pins can also be cemented with LuxaCore Z-Dual. The material is available in A3, as well as in blue and light-opaque shades (Fig. 6). The advantage of using this blue shade should not be underestimated in the case of pre-endodontic build-up. In our dental practice, iso- and sub-gingival parts of the filling are always built-up using the blue shade of LuxaCore Z-Dual. In the case of preparation of the tooth for further prosthetic treatment as part of endodontic treatment, this gives the regular dentist, responsible for further treatment, an excellent contrast to the healthy hard tooth tissue (Fig 7). This makes it easier to assess the size of the ferrule for the tooth that is to be prepared.

LuxaBond-Total Etch, a multi-bottle system, is recommended as a suitable adhesive system.

Once the pre-endodontic build-up is complete, fine work on the outer contours is performed using rotating instruments. The tooth is then perfectly prepared for creation of the endodontic access cavity, which is crucial for further therapy (Fig. 8).

In summary, correct structuring of the pre-endodontic build-up is an important component of a complete antimicrobial treatment concept. Creating the pre-endodontic build-up ensures important prerequisites for the further treatment:

- the option of working in a liquid and the long-term effect of NaOCl
- the creation of reproducible reference points for the further course of the treatment
- the creation of slightly conical, smooth cavity walls for the access cavity
- the option of using a tight-sealing, adhesive seal with dual-curing composites between the treatment sessions
- the option of using a time-saving, tight-sealing, post-endodontic seal at the end of the obturation session.

Pre-endodontic build-up is therefore an essential prerequisite for further post-endodontic treatment of the treated teeth (Fig. 9). Exactly the same care should therefore be taken during pre-endodontic build-up as in all other steps of an antimicrobial treatment concept.

Figures:

- Fig. 1: Application of the rubber dam in a complex situation
- Fig. 2: Initial situation after application of the rubber dam
- Fig. 3: Situation after removal of the restoration
- Fig. 4: Situation after complete removal of caries
- Fig. 5: Application of the matrix
- Fig. 6: LuxaCore Z in A3 and blue
- Fig. 7: Easily visible contrast between natural hard tooth tissue and the blue shade of LuxaCore Z-dual
- Fig. 8: Completed pre-endodontic build-up
- Fig. 9: Inspection of the root canal filling

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May 2017