Clinical guideline for the use of fluorescence-aided caries excavation (FACE)

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Introduction

FACE provides a clinical aid in the detection of bacterially infected hard tooth tissue, particularly infected dentin. This way, caries excavation is more reliable than with traditional tools (probing the hardness, application of staining agents). The traditional tools *only indirectly* permit a conclusion on the bacterial infection of dentin. By contrast, the FACE light probe, together with the FACE filter goggles, form a tool which can be used to *directly* visualize the remaining bacterially infected dentin (referred to below as residual caries) at any time and to evaluate the success of the caries excavation.

Caries excavation step-by-step

1. Preparation of the cavity

In case of limited access to the carious dentin, an access cavity should be prepared prior to caries excavation so that one can view the full extent of the carious dentin and remove it in a controlled manner[1]. The use of water-cooled rotary diamond burs has proven useful in the preparation of the cavity. In this step~~,~~ preceding the caries excavation, the FACE method is not different from the traditional methods for caries excavation. We recommend the complete removal of carious enamel[2].

[1] In principle we recommend the procedure described here for the preparation of adhesive and retentive restorations in equal measure.

[2] The possibility of omitting the surface decalcification of the enamel at the edge of the restoration remains, in principle, as long as the area is caries-inactive and reliable cleaning is ensured as part of home oral hygiene.

2. Diagnosis and excavation of the residual caries

After the cavity preparation (Fig.1) the first check of the extent of the residual caries with FACE is being performed. We recommend preparing the cavity rather carefully at first and enlarging it further only if necessary.

Carious dentin areas exhibit a red fluorescence when using FACE, which is differentiated from the green fluorescence of non-carious areas (Fig. 2). The red fluorescence is emitted by porphyrin compounds, which are generated by bacteria. Red-fluorescing areas exhibit a strong bacterial penetration and should be removed as part of the caries excavation. The residual caries can be removed as usual, such as with a bud bur or hand instruments (excavators). Red-fluorescing areas are removed layer by layer until a green fluorescence appears (Fig. 3). It might be necessary to check the cavity for residual caries using FACE several times during caries excavation. It is not necessary to use the dental probe to check the hardness of the dentin during the caries excavation. It is only necessary to check the dentin hardness around the cavity margin at the end of the caries excavation (see below).

3. End point of caries excavation

In principle, red-fluorescing dentin areas must be completely excavated so that as little bacterially infected dentin as possible is left behind. This procedure can be modified in areas that are near the pulp. In detail, the following procedure is recommended:

Areas away from the pulp

In areas that are away from the pulp, the complete removal of red-fluorescing (= severe bacterial infection) dentin is recommended. In addition to reducing the bacterially infected tissue, this also creates the conditions required for a tight restoration margin and a secure retentive or adhesive anchoring of the subsequent restoration in the hard dental tissue.

Areas near the pulp

In areas that are near the pulp it is possible to deviate from the requirement to remove as much bacterially infected (= red-fluorescing) dentin as possible. This procedure is indicated when a more extensive excavation of the caries near the pulp would be expected to open the pulp. A small amount of red-fluorescing dentin can be left in the areas close to the pulp cavity in order to avoid the root canal procedure that this would necessitate. These localized areas near the pulp

must be covered with a calcium hydroxide substance as in a caries profunda treatment before the restoration of the cavity. Vital pulp conservation is possible in many cases with this procedure.

In some cases, it is possible for the dentin at the foremost front of the spread of the carious lesion to be softened (demineralized) without the bacteria having actually penetrated that far. This bacteria-free dentin appears green with FACE, but when probed is found to be softer than normal dentin. After the caries excavation and final check with FACE, the hardness of the dentin around the cavity margin should thus be tested with a dental probe. If the dentin at the cavity margin is still soft, it is recommended to remove it down to hard dentin. This ensures that the subsequent restoration can be reliably anchored mechanically and adhesively.

Factors influencing the use of FACE

For the correct use of FACE, the cavity should be illuminated as intensively as possible with the FACE light. White ambient light minimizes the red-green contrast for evaluating the tooth fluorescence. We therefore recommend switching off the operating light or turning it to the side and avoiding direct sunlight or bright room lighting.

Direct illumination of the cavity with FACE light is especially important for the correct use of FACE. Indirect lighting reduces the red fluorescence, by casting shadows, for example.

In principle it is conceivable that the use of antibiotics, antimicrobial mouth rinses (such as chlorhexidine) or ozone might affect the bacterial contamination of the carious lesion (and thus the production of red-fluorescing porphyrin compounds). Studies done so far on the efficacy of oral rinses, antibiotics and ozone, however, show only a slight antibacterial effectiveness within a carious lesion. It can therefore be presumed that the use of these antibacterial agents does not influence bacterial infiltration and thus also the fluorescent properties of the bacterially infected dentin within an existing carious lesion.

It is known that the red-fluorescing porphyrin compounds bleach out under long and intensive illumination with the excitation light and display less red fluorescence (photobleaching). In such a case, the risk would be an inadequate caries excavation. In order to reliably avoid this, it is recommended to limit the illumination of the cavity with the FACE light pen to the time required and thus not to exceed three minutes of illumination.

The use of staining materials can also negatively influence the diagnosis of residual caries using FACE. The staining materials sold for the purpose of residual caries diagnosis generally exhibit a strong fluorescence and in that way distort the visual impression with FACE. Therefore, caries staining materials should not be applied before using FACE.

Final remarks

In conclusion, it can be stated that FACE makes the diagnosis of residual caries more reliable and sets it on a new foundation (based on bacterial contamination rather than hardness). Furthermore, the dentist can make the clinical decision freely, depending on the specific clinical situation, as to the point up to which existing caries must be excavated (the end point of the caries excavation). The important difference from traditional tactile caries excavation, however, is that the treating dentist knows at all times what areas in the cavity are still infected with bacteria. This also puts the dentist in a position to make an “informed decision” for the first time regarding the removal of carious dentin near the pulp.

Photo captions

Fig. 1: Situation after preparation of the cavity on a carious premolar. In the central area of the cavity, the color-changed dentin, which is soft when probed, can be seen. The exact extent of the bacterial infection of the dentin cannot be seen under normal light conditions and by probing.

Fig. 2: Same situation as in Fig. 1, but viewed with FACE. Bacterial dentin infection glows red and is clearly differentiated from the healthy, green-fluorescing dentin.

Fig. 3: Situation after a complete caries excavation with FACE. The red-fluorescing bacterial dentin infection is fully excavated. The entire cavity fluoresces green.

Fig. 4: Same situation as in Fig. 3, but shown under normal light conditions.

Photos

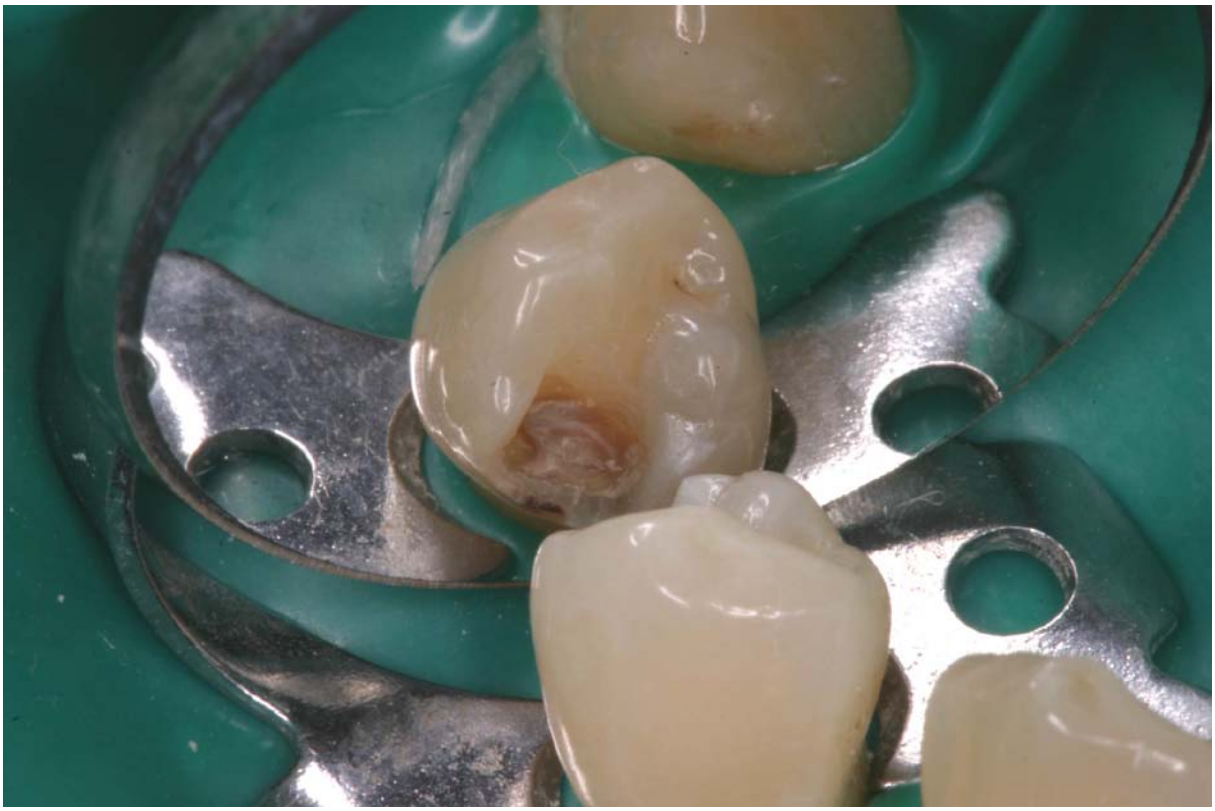

Fig. 1

Fig. 2

Fig. 3

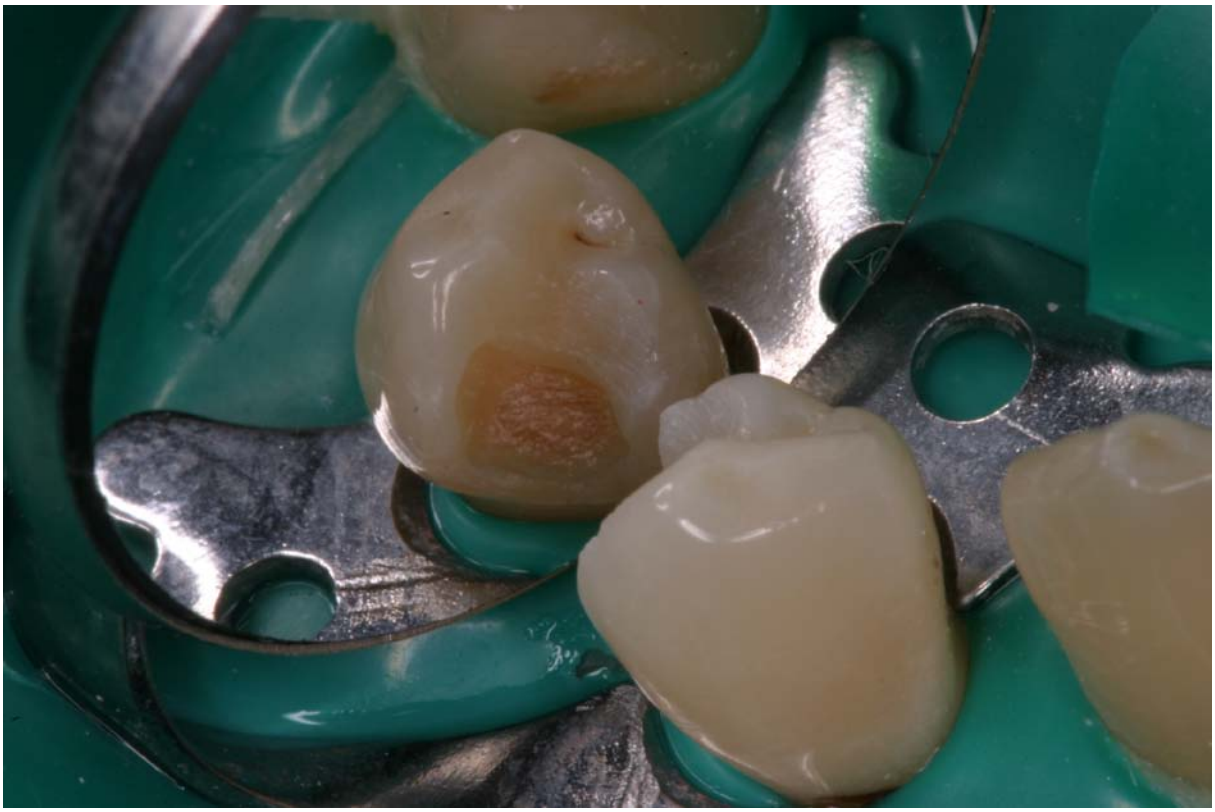

Fig. 4