Micro-invasive treatment of caries – expanding the therapy spectrum in modern pediatric dentistry

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Fissure sealing has been proven for decades to be an effective method for protecting occlusal tooth surfaces from developing carious lesions. Although fissure sealing was initially intended as a purely preventative measure, current studies show that occlusal surfaces already changed by caries can be effectively protected from a lesion progression and the formation of cavitations.[1-2] With limited or no substrate supply any bacteria trapped in a lesion will not have a cariogenic effect on the tooth. Clinical long-term studies on fissure sealing[3-6] suggest that remaining bacteria in a lesion do not constitute a risk factor for a progression of the infiltrated lesion. The foundation for the new approach to treat early caries was laid already in the 1970s. At the time, the research group led by Buonocore conducted first experiments to penetrate low viscosity composites into carious lesions. The principle of caries infiltration is based on the penetration of a low viscous composite (infiltrant) into the porosities of an enamel lesion situated underneath the surface layer. The lesion body is the most extensively demineralized zone and lies below a layer with higher mineral content, the so-called pseudo-intact surface layer. This surface layer hinders the penetration of the infiltrant[7] and must therefore be systematically eroded.[8] Subsequently, within minutes, the infiltrant can penetrate the caries to a depth of several hundred micro meters.[9-11] Several research groups were able to demonstrate the clinical efficacy with regard to preventing a further caries progression with the application of this micro-invasive therapy. The infiltration of proximal and smooth surface lesions with low viscosity light-curing composites thus complements the current spectrum of non-operative (prevention) and operative (restoration) therapy strategies.[12,13]

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The principle of caries infiltration

The first step for the caries infiltration method is to erode the surface layer by means of an HCl gel. Subsequently,

after cleaning and drying the lesion, the infiltrant penetrates into the pores of the lesion. The ability to penetrate into the pore system is made possible by capillary forces and determined by the physico-chemical properties of the infiltrant.

This novel treatment method allows for a specific therapy of early carious lesions without needing to prepare access cavities, thus protecting and fully preserving the hard tissue surrounding the lesion. The treatment is possible "without drilling" and therefore offers many advantages especially in pediatric dentistry. On the one hand it is virtually painless and on the other hand the treatment duration is predictable and can thus positively affect the compliance of the young patients.

The effectiveness of caries infiltration on deciduous teeth was confirmed both in the laboratory[14-16] and in a clinical study[17]. This study conducted in Greenland, a population with high caries experience and activity, revealed that caries infiltration effectively arrests the progression of carious lesions compared to standard therapies (intensified oral hygiene, local fluoride application).

Procedure of a proximal infiltration on a changing dentition

A nine year-old patient first underwent a clinical dental examination, and then bitewingx-rays were taken. To assess his oral hygiene practices a plaque index was taken: plaque deposits were detected on 88.5% of the tooth surfaces. For the plaque index all buccal, oral, mesial and distal, but not the occlusal tooth surfaces were evaluated. The patient exhibited high caries experience with a dmfs of 11. Findings: overall 13 tooth surfaces with active lesions were found of which 11 exhibited cavitations. Inactive lesions were not found. Three areas of permanent teeth revealed lesions, and 10 lesions were found on the surfaces of deciduous teeth. First, the young patient received detailed information about his oral situation, especially about the consequences of excessive consumption of sugar. The patient was then given oral hygiene training during which he was taught correct brushing techniques and proper care of the proximal spaces with dental floss. After his oral hygiene practices and plaque index improved significantly the cavitated lesions were restored with fillings.

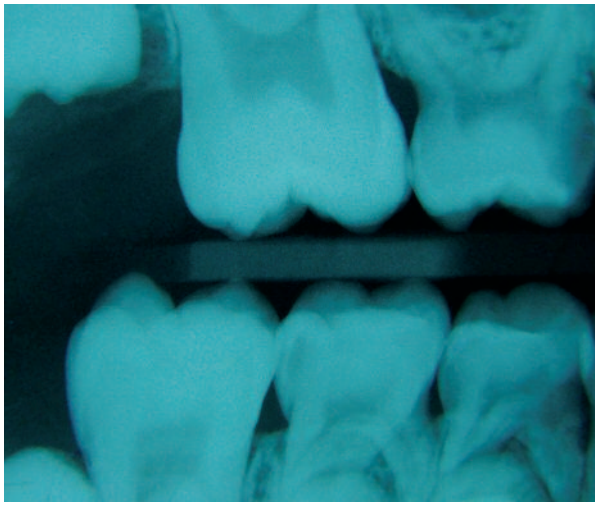

Figure 1: Bitewing x-ray of the patient.

Figure 2: Isolation with rubber dam with ligatures for a cervical fixation of the rubber dam.

Figure 3: Separation of the teeth with a cervically positioned dental wedge which is fully inserted into the interdental space.

Figure 4: Application tip in the interdental space – applying the etching gel onto the lesion surface.

Figure 5: Stepwise dosage of the etching gel by means of the rotary mechanism of the application syringe.

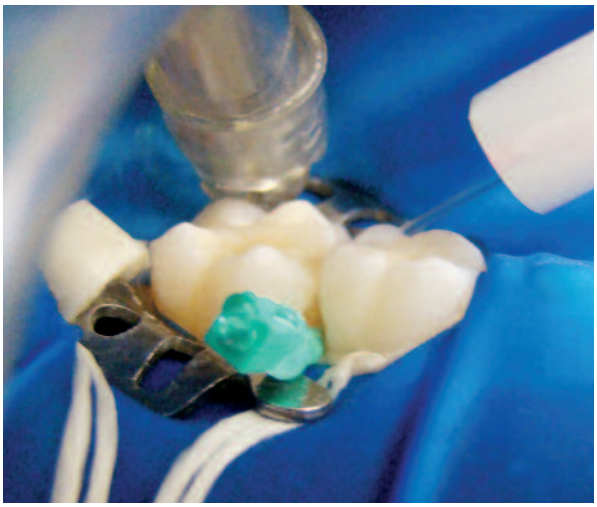

Figure 6: Cleaning the proximal space after the etching step.

Following the caries diagnosis, the evaluation of the bitewing x-rays (figure 1), an in-depth discussion with the patient and his parents and a clear determination of the indication, all teeth are thoroughly cleaned. The proximal spaces to be treated are cleaned with dental floss or interdental brushes.

On tooth 65 a distal bright spot was detected on the x-ray which was classified as a D1 lesion. Upon inspection of the surface no cavitation was detected. Since a progression of the lesion is to be expected a treatment with Icon, the world's first treatment method of infiltrating carious lesions, was indicated.

The teeth to be treated were isolated with a rubber dam in order to obtain a clean and dry working area (figure 2). The placement of a rubber dam is not only required to dry the area but also to ensure that the materials used do not run into the oral cavity, are swallowed by the patient, or come in direct contact with the soft tissues. The use of a ligature made of dental floss that allows a fixation of the rubber dam at the level of the dental neck is helpful. Subsequently, the teeth are separated by means of a specially designed plastic dental wedge. This wedge is specifically designed for a temporary tooth separation and differs in its geometry from conventional dental wedges used for the fixation of matrix bands, i. e. at the proximal contact point the wedge used for the infiltration treatment is flattened to facilitate correct positioning of the applicators. The cervical base of the wedge is a little wider in order to seal the space in a downward direction. After 30 to 60 seconds the teeth are sufficiently separated for the treatment (figure 3). Some patients may perceive this separation as a brief pressure sensation. After this temporary separation etching gel is applied with a foil application tip (figures 4 and 5). It is generally helpful to activate the wedge a little before introducing the applicator, and to loosen it slightly once the applicator is properly positioned in the proximal space to ensure proper fixation of the application tip. The proximal tip is arched in the direction of the proximal space to be infiltrated. Through the perforations on this side of the applicator the etching gel can be applied systematically and the non-perforated side of the applicator protects the opposite proximal surface effectively from coming in contact with the material. The rotary mechanism of the application tip

facilitates a well-aimed and proper dosage.

After the setting time of 2 minutes the applicator is removed from the proximal space and the latter is thoroughly rinsed with water and dried (figure 6). Subsequently, the area is dried thoroughly with alcohol for 1 minute (figure 7). This step removes any remaining moisture from the lesion and prepares it for the infiltration steps. The application tip is introduced into the proximal space also with the concave side facing the lesion. With a slow rotary motion the infiltrant is loaded into the tip of the applicator attachment and applied onto the lesion surface through the perforations (figure 8). The infiltration composite requires a setting time of 3 minutes after which excess material can be removed with non-fluoridated dental floss (figure 9). In the next step, the infiltrant is light-cured for 40 seconds (figure 10). The infiltration step is repeated with a new application tip and let set for 1 minute. The second infiltration is light-cured as well. Any excess material can be removed carefully with a fine scaler. The proximal space is then cleaned with dental floss (figure 11) and the rubber dam removed.

The patient (figure 12) receives an individual patient card in which all relevant data is recorded: treatment date, tooth and surface, radiological lesion progression at the beginning of the treatment and at the follow up exams. A radiological check should be scheduled 12 months after the treatment.

Figure 7: Drying the lesion surface with Icon-Dry.

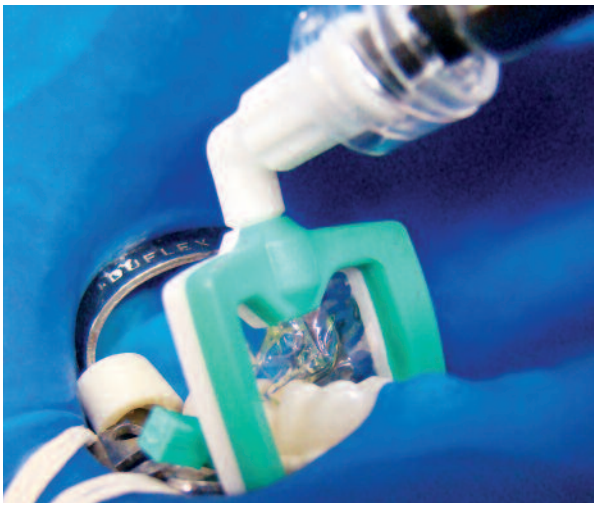

Figure 8: Applying the infiltrant.

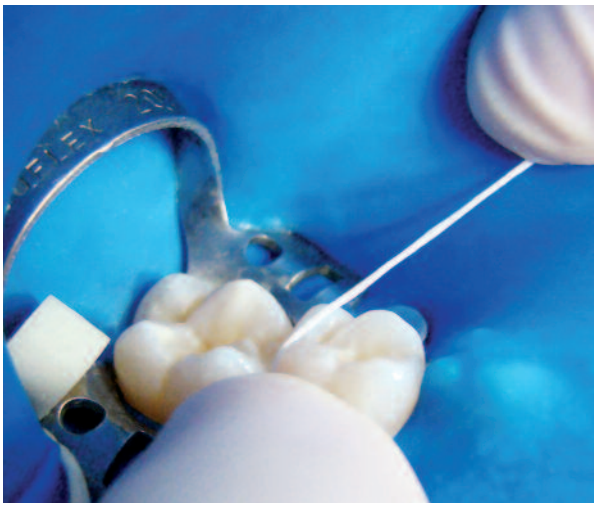

Figure 9: Removing excess material.

Conclusion

The micro-invasive therapy of caries by means of composite infiltration facilitates an early, virtually painless treatment of proximal lesions gentle on the hard tissue. The "no drilling" procedure, and, with that, expected improved compliance on the part of the patient allows for an early and effective intervention particularly in pediatric dentistry. With this treatment approach filling therapies can be fully prevented in many cases until the physiological change of dentition.

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Figure 10: Light-curing the infiltrant for 40 s; this step is repeated after the 2nd infiltration.

Figure 11: Cleaning the proximal space.

Figure 12: Satisfied patient at the conclusion of the treatment.

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