



## Micro-invasive caries therapy – Proximal caries infiltration

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Treating proximal caries extending into the dentin without drilling – is that possible? A light-curing resin that is infiltrated into the pore system of the prepared enamel could close a therapeutic gap.

In many cases, non-invasive treatment methods such as fluoridation promise success only for caries of minimal extent. When caries progresses invasive treatments are generally indicated. The minimal-invasive treatment of proximal caries in a closed dental arch usually requires the removal of a tooth's healthy marginal ridge [literature 4, 5]. With a low viscosity, light-curing resin, a so-called infiltrant, it is now possible to treat these localized carious lesions micro-invasively.

### Infiltration principle

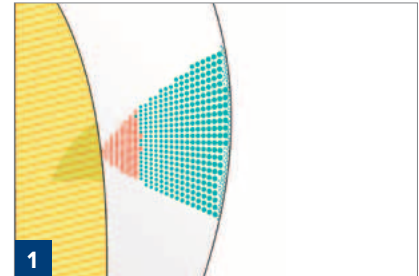
The infiltration principle is based on the penetration of the infiltrant into the lesion body (fig. 1) of a caries, which marks the most extensively demineralized zone of a caries situated under a pseudo-intact surface layer. Due to its high mineral content which would inhibit the penetration of the resin [literature 15] the surface layer must be properly eroded in a preparatory step using an acid gel. With a phosphoric acid gel this would not be possible even if longer setting times are allowed [literature 11]. Subsequently, within minutes, the infiltrant can penetrate the caries to a depth of several hundred micro meters [literature 10, 13, 16].

### Indication of the micro-invasive therapy for proximal surfaces

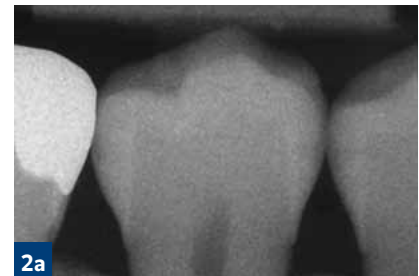
For one, the assessment for indicating a micro-invasive or invasive therapy is based on the extent of the caries, the presence of (micro) cavitations, and the frequency of bio film formations. On the other hand, patient-related factors, such as compliance with regard to regular dental check-ups and caries risk, influence the therapy decision.

Lesions that are radiologically limited to the enamel only exhibit very few clinically relevant micro cavitations [literature 3, 18]. Therefore, for these caries progressions invasive treatments are rarely indicated. However, especially in children and adolescents, some of the lesions that are initially limited to the enamel progress particularly in case of insufficient cleaning of the affected areas [literature 7]. The caries infiltration method can slow down or even prevent the progression of these lesions into the dentin. Therefore, for patients with a high caries risk this micro-invasive therapy is indicated for lesions extending into the inner half of the enamel. Once the caries reaches the enamel-dentin junction or the first third of the dentin in a radiological exam, there may already be micro-cavitations on the lesion surface [literature 3, 18] based on which, among other factors, an invasive therapy is indicated [literature 5, 6, 14].

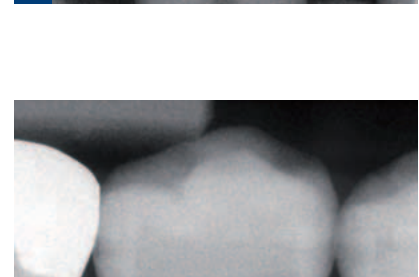
With infiltrants micro-cavitations can be filled, thus limiting the indication of a caries infiltration to a maximum lesion progression up to the first third of the dentin as long as no clinically visible cavitations on the surface are present.



1 After partial removal of the pseudo-intact surface layer (etching) the infiltrant can penetrate into the porous enamel portions (unfilled pores: red) of a caries lesion.



2a The enlargements of bitewing images from 2004 (2 a), 2007 (2 b) and 2009 (2 c) show a progression of the carious lesions distal on teeth 45 and 44 and mesial on 45 over the course of several years.



For information only.



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With the caries infiltration method potentially present bacteria are left in the lesion. Due to the lack of or reduced substrate supply these have no cariogenic effect as can be presumed based on fissure sealing studies [literature 1, 2, 8, 9]. Thus, the presence of bacteria per se does not pose a risk for the lasting preservation of the tooth.

**Monitoring the treatment success of a proximal caries infiltration**

After an infiltration therapy, similar to fissure sealing, the caries progression should be reviewed with bitewing x-rays in intervals of six to 24 months in order to intervene invasively in case of a progression of the caries (into the middle third of the dentin). When taking x-rays the proximal surfaces should not overlap to ensure an assessment of the caries stage as accurately as possible.

**Latest scientific studies**

A recently published in-vitro study demonstrated a significantly deeper penetration of an infiltrant into a natural lesion compared to an adhesive [literature 13] and thus facilitated a reduced caries progression [literature 12, 17]. Still unpublished results of various work groups from South America, Denmark and Germany confirm the good clinical effectiveness of the proximal caries infiltration with regard to slowing down caries progression after twelve to 18 months. The study conducted in Germany in a split mouth design with digital subtraction radiography found caries progression in 37 percent of the control lesions but in only eleven percent of the infiltrated lesions.

**Other areas of application for caries infiltration**

An infiltration of the enamel portions of a lesion can also be applied to other smooth surfaces - most notably vestibularly in the anterior region. Lesions on these surfaces occur frequently after orthopedic treatments with fixed appliances usually due to insufficient hygiene on the part of the patient. After the removal of the appliances, lesions located on the surface often remin-



3a

After placing a rubber dam the lingual view (3 c) shows some carious changes on the proximal surfaces while the occlusal (3 a) and buccal view (3 b) does not reveal any irregularities.



3b



3c



4

The tooth is cleaned with a rubber cup and dental floss.



5

After the tooth is separated using a flat dental wedge the application tip for the first treatment step (etching) can be inserted.



6

Acid gel application in situ (step 1).



7

Pre-cleaning with air-water syringe and suction unit with the application tip in situ.



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eralize completely because of improved oral hygiene while this is only rarely the case with deeper seated lesions. These rather stand out as so-called white spots and constitute a more esthetic than cariologic problem. The infiltrant exhibits similar optical properties as healthy enamel therefore lesions can be masked with the infiltration method.

The indication of the caries infiltration method is currently still limited to the described caries-induced changes on proximal and other smooth surfaces. An infiltration of occlusal lesions has not been researched to date and is therefore not recommended with the available treatment set. Because of the high water content in the affected dentin root caries cannot be penetrated by the relatively hydrophobic infiltrant.

**Case study**

The following case study describes the treatment of a lesion without noticeable cavitation on the distal proximal surface of a lower second premolar.

The generally medically healthy 30-year old patient had received restorative treatments on several of his lateral teeth. Detail enlargements of bitewing x-rays revealed increasingly extensive translucencies on tooth 45 (mesial and distal) and 44 (distal) compared to those taken in 2004 (fig. 2a) and 2007 (fig. 2b).

The image taken in 2009 (fig. 2c) showed a translucency extending to the enamel-dentin junction. Clinically irregularities were not detectable (fig. 3a-c). For the proximal caries infiltration with the corresponding treatment set 'Icon' (DMG, Hamburg) which has recently become available, teeth in physiological contact do not have to be separated for several days which makes a treatment in one sitting possible.

**Step 1: Separation and etching**

After cleaning the teeth (fig. 4) and placing a rubber dam, the application tip was introduced into the proximal space following the minimal separation of the teeth. The application tip consists of a screw syringe to which a double tip with perforation on one side is attached and which can be rotated 360°. In the first step the etching gel (HCl 15 %; Icon-Etch) was applied to the proximal space to be treated by turning the syringe – here the green side was facing the lesion – and let set for two minutes (fig. 6).

The adjacent tooth was protected by the application tip to prevent inadvertent contamination. Subsequently, the area was cleaned (suction unit and air/water syringe) (fig. 7) and the application tip removed.

**Step 2: Drying**

Following a second cleaning and drying step ethanol (Icon-Dry) was applied for approx. 30 seconds, and the area was thoroughly dried with a blower (fig. 8). After these two procedural steps, the surface layer of the carious lesion was sufficiently eroded and the lesion was dry enough for the infiltrant to penetrate into the capillaries of the caries.

**Step 3: Infiltrant application and light-curing**

The infiltrant was applied to the lesion area with the described screw syringe using a new applicator attachment (Icon-Infiltrant) (fig. 9). After a three minute setting time excess was blown off and removed with the suction unit and dental floss. The infiltrant in the lesion was then light-cured, preferably from all sides for 40 seconds (fig. 10). This third treatment step was repeated once, whereby for the second application a setting time of one minute suffices. After removal of the rubber dam the treated areas were inspected for the presence of excess



8 The application of Ethanol (Icon-Dry) displaces any remaining water and facilitates better drying of the lesion with air (step 2).



9 The infiltrant was applied by turning the syringe, and let set for three minutes in situ (step 3). Subsequently, excess is removed with the air syringe and suction unit.



10 Light-curing for 40 seconds from all sides.



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material, which, if necessary, can be removed with a scaler. Polishing was not necessary; the treated teeth did not exhibit any macroscopically visible changes (fig. 11). Subsequently, the lesions on 44 distal and 45 mesial were infiltrated.

Since the infiltrant is not radiopaque a post-operative determination of the infiltrant's penetration depth is not possible. The mid-term and long-term treatment success can therefore be rated merely on the radiologically assessable arrest or slowdown of the caries progression, similar to fissure sealing treatments. In order to prevent infiltrated areas from being treated immaturely in case of a change of dentist the patient receives a treatment chart (fig. 12) in which the treated teeth are recorded with their respective radiological extent.

**Conclusion**

In consideration of the present clinical results the described novel caries infiltration treatment method for 'active' proximal lesions extending at maximum into the first third of the dentin can be recommended. Clinically the lesions should not exhibit palpable or visible surface cavitations.

This micro-invasive therapy thus facilitates a hard tissue-preserving and painless method for treating proximal cariogenic lesions that, until now, were largely restored invasively. In addition, the infiltration method can also be applied to other smooth surfaces. Here, the application is mainly geared for treating esthetically relevant lesions in the anterior region, which, due to the optical properties of the infiltrant, can be masked successfully.

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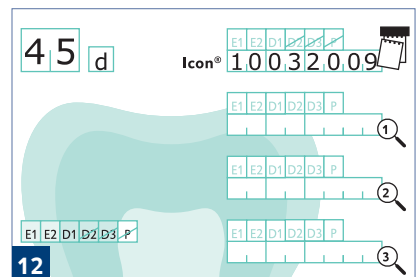
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11 The final situation does not show visible changes of the treated areas.



12 The radiological extent of the lesion and the treatment date is recorded in the patient chart enclosed in the set.