

# Innovative Treatment of Sub-Surface Carious Lesion

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## ABSTRACT:

The earliest evidence of demineralization on the smooth enamel surface is a white spot lesion. The conventional treatment options for white spot lesions include topical fluoride application, improving the oral hygiene, and use of re mineralizing agents. As more and more patients are demanding for minimally invasive cosmetic enhancement without anesthesia, a micro invasive treatment of smooth-surface white spot lesions is been tried. This article illustrates the use of a novel approach to treat smooth surface non cavitated white spot lesions based on infiltration of enamel caries with low-viscosity light curing resins called infiltrants.

**Key words:** Caries infiltration, Micro invasive treatment, Non cavitated lesion, White spot lesion

## INTRODUCTION

Even after the introduction of many preventive techniques, caries still remains one of the most frequent dental diseases.<sup>1</sup> It occurs as a result of cyclic demineralization and re mineralization of enamel. This cycle is an ongoing phenomenon and takes place in the oral cavity with intake of various foods and drinks. But if the oral protective factors like Salivary buffers, fluorides etc. are unable to keep the balance in favor of re mineralization, then occurs a net loss of mineral leading to incipient caries lesion.<sup>2,3</sup>

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These carious areas lose their translucency because of the extensive subsurface demineralization and become white spot lesions. If this demineralization process is not stopped, the intact enamel surface eventually collapses and cavitates. But these early lesions are amenable to re mineralization or arrest by many preventive measures.<sup>4,5</sup>

Although such lesions can be arrested by preventive measures, they still continue to pose esthetic problems. Sometimes during remineralization of these white spot lesions stains get incorporated into the lesion leading to the formation of brown spots. Hence the treatment of the white spot lesions should aim at prevention of caries progression as well as improving esthetics, by diminishing the opacity.<sup>4,5</sup>

In today's dentistry as soon as cavitation occurs on the enamel surface invasive treatments are indicated which involve the removal of relatively large portions of healthy hard tissue. Especially for proximal caries the ratio of the caries and the healthy hard tissue needing to be removed is very unfavorable.<sup>6</sup> An experimental therapeutic approach for proximal carious lesions is the surface treatment of the demineralized enamel structure with hardening resins similar to fissure sealing in the occlusal region. The objective of this limited invasive therapy is to arrest caries progression in a continuously existing cariogenic environment by obturating the diffusion paths for carbohydrates and organic acids. However, due to the remaining excess material and subsequent plaque deposition it may lead to secondary caries and periodontal irritation.<sup>7,8</sup>

Based on the current knowledge, the infiltration (ICON, DMG) can be used for both vestibular and interproximal non-cavitated lesions. By this method the hard tissue lost due to demineralization is replaced to substantial lesion depths of up to 800 micrometers with a low viscosity resin. The micro invasive treatment method creates a diffusion barrier not on the surface but within the hard tissue thus stabilizing and blocking the caries. For

proximal applications caries infiltration is indicated up to a maximum radiological progression into the outer third of dentine.<sup>6,8</sup>

As a consequence of the caries infiltration the treated enamel lesions lose their whitish opaque colour and resemble healthy enamel. Thus, caries infiltration constitutes a much gentler treatment alternative for vestibular smooth surface lesions. This method therefore allows for a drastic improvement of the esthetic appearance of such lesions and a long term caries arrest in only one visit.<sup>6</sup>

The ICON technique is efficient in cases of demineralization of the enamel layer and of the outer third of the dentin but not for deeper lesions in dentin

#### **THE CLINICAL PROTOCOL**

The product is available in two variants. ICON Proximal, for the treatment of incipient proximal caries and ICON Smooth Surface, for smooth, vestibular and oral surfaces.

Each kit of ICON contains:

A 0.3 ml screw syringe with demineralizing gel (ICON Etch - 15% hydrochloric acid);

A 0.45 ml screw syringe with dessicant (ICON Dry - 95-100% ethanol);

A 0.45 ml screw syringe with infiltrant (yellow liquid acrylic resin);

6 proximal tips

4 interdental wedges

The clinical procedure involves the following steps,

Firstly, all teeth are polished with a fluoride-free polishing paste using a rubber cup. Then, the soft tissues of the affected teeth are isolated. For white spot lesions in the cervical areas, a light-curing resin barrier material can be used. In order to prevent overlapping of the white spots in the cervical regions, the barrier material is applied

carefully in the following way. First, by leaving the marginal gingiva free, the attached gingiva and alveolar mucosa are covered with the light curing barrier material using a 20-gauge micro-tip. Then the barrier material is applied directly onto the marginal gingiva with a finer micro-tip, and light cured. Thus, the barrier material can be precisely applied along the gingival margin without overlapping the white spots. After successful isolation of all surrounding soft-tissue areas, the application of the resin infiltration (ICON Caries Infiltrant - Smooth Surface) is followed. During the first step of the infiltration treatment, the pseudo-intact surface layer was eroded using a 15% HCl gel, Icon-Etch. The etching step requires two minutes of contact time to remove the surface layer sufficiently. For older, more inactive or heavily discoloured lesions, it may be necessary to repeat the etching procedure for another two minutes. Adjacent teeth, which are not going to be treated with Icon, can be protected with a Mylar strip or Teflon tape. In order to obtain a homogenous etching pattern, the etching gel was stirred in circular movements with a microbrush during the contact time. Then the etching gel is thoroughly rinsed off with water spray and the teeth are air-dried. After the etching, to remove water from the inside of the microporosities, which would inhibit the penetration of the infiltrant, the lesion surface is wetted with 99% ethanol (Icon-Dry) for a minimum of 30 seconds and then air-dried. Just 5 - 10 seconds after application of Icon-Dry, white spots become invisible or reduce in intensity. This step provides an excellent intermediate indication of the possible aesthetic result of the infiltration treatment. However, should discoloration of the white spot persist at this point, the etching and drying step should be repeated. With the evaporation of the ethanol and following the air-drying, the lesions should turn to a chalky white appearance again. In total, the etching step can be performed three times.<sup>9</sup>

Then, with a new applicator attached to the Icon-Infiltrant syringe the resin infiltrant is applied.

This is a two step procedure. The first infiltration step requires a contact time of three minutes, after which excess on the surface has to be carefully removed with cotton rolls and dental floss, then the infiltrant was light-cured for 40 seconds.<sup>9</sup>

Now the infiltrant is applied for a second time, but for only one minute, followed by lightcuring for another 40 seconds. The purpose of the second infiltration step is to optimise the surface by filling any irregularities. Any remaining excess material is removed with a scaler or sickle-shaped scalpel blade. Then the infiltrated surface is polished. It shows a perfect aesthetic result following the infiltration treatment after one month.<sup>9</sup>

## DISCUSSION

White spot lesions are a common problem and may be a concern for those who bother about esthetics. So far, many techniques have been tried to improve the appearance of these white spot lesions. Among these, re mineralization is the main technique that aims at partial reversal of what is an early carious lesion. According to Willmote D R, who studied the effect of fluoride and saliva after removal of fixed orthodontic appliance, the difference in percentage reduction of the white spot lesion size showed a reduction in lesion area of about a third after 12 weeks and a half after 26 weeks. However, remineralization of white spots takes a long time, and the lesions may be left to some degree. And it can inhibit the mineralization of subsurface lesions.<sup>10</sup>

On the other hand, Ogaard B, Rolla G, Arends J, Ten Cate JM. warned that concentrated fluoride agents when applied on visible white lesions, tend to re mineralize only superficially which prevents complete repair.<sup>11</sup> Consequently, arrested lesions show thick and highly mineralized surface layers.<sup>12</sup> The underlying lesion body is still porous however, and thus the whitish appearance often persists.<sup>13</sup> Moreover, during re mineralization stains can be incorporated into the lesion, leading to the formation of brown spots, a situation that might be judged as

even more unaesthetic. Therefore, some authors advocated allowing slow and gradual remineralization by saliva or low-concentrated fluoride agents such as fluoride mouth rinse and fluoride containing toothpaste on shallow lesion (< 60  $\mu\text{m}$ ).<sup>11</sup> Other technique followed traditionally is the Enamel microabrasion designed to improve the surface texture, remove the stains and recover remineralization. It removes superficial parts of the lesion by abrasion with slurry of hydrochloric acid and pumice, and the enamel surface becomes smooth and glossy. Both chemical erosion with hydrochloric acid and mechanical abrasion with pumice simultaneously take place and it uniformly removes up to 0.2 mm of enamel surface.<sup>14</sup> According to Murphy, Willmote, Rodd, the mean reduction in white spot lesion size was 83%. However, substantial amounts of enamel often unfortunately have to be eroded to improve appearance with this technique.<sup>15</sup>

DMG's ICON Resin is a new microinvasive technology that will fill, reinforce, stop the caries progression and mask the enamel white spot lesions. This is a resin infiltration treatment aims to occlude the microporosities within the lesion body by infiltration with low-viscosity light-curing resins that have been optimized for rapid penetration into the porous enamel. The resin penetrates into the lesion body, driven by capillary forces. This technique aims to create a diffusion barrier inside the lesion, not on the lesion surface.<sup>16,17,18</sup> Robonson C, Hallsworth A S, Weatherell J A, Kunzel W. reported that about  $60 \pm 10\%$  of the lesion's pore volume had been occupied by resin.<sup>19</sup> According to Kielbassa A M, and Gernhardt CR, resin infiltrates into subsurface lesions and produces resin infiltrated parts of the lesion. And the depth of resin infiltration was over 100  $\mu\text{m}$ . An additional benefit of resin infiltration is that enamel lesions lose their whitish appearance and look similar to sound enamel.<sup>20</sup>

The study performed by the Meyer-Lueckel and Paris, showed that after 3-months follow-up, there was no progression of white spot lesion and there was an improvement in the esthetics on clinical

examination and was also seen that the resin mixtures with high Triethylene Glycol Dimethacrylate concentrations tend to show better inhibition of lesion progression than those with high concentration of Biphenyl A Glycidyl Methacrylate. This was due to better penetration capabilities after the application of ethanol.<sup>16</sup>

Another study conducted by Paris and Meyer-Lueckel showed that infiltrated enamel lesion progression was significantly more slow when compared with untreated lesions in a highly cariogenic environment.<sup>21</sup>

Based on these studies, it is shown that the resin arrests the progression of white spot by occlusion of the microporosities that provide diffusion pathways for acids and dissolve minerals. It also blocks the further introduction of any nutrients into the porous system.

Secondly, the white opaque appearance of the lesion can be masked by using resin infiltration. The principle of masking enamel lesion by resin infiltration is based on changes in light scattering within the lesion, which was proved by the study conducted by Kidd and Fejerskov<sup>22</sup>. They stated that the enamel has a refractive index of 1.62 and in the subsurface lesion, the pores are filled with a watery medium with a refractive index of 1.33. The difference in refractive index between the water and the enamel affects light scattering and makes the lesion look opaque. The microporosities of the enamel caries lesion are filled with either a watery medium (R.I. of 1.33) or air (R.I. of 1.0). The microporosities of infiltrated lesions are filled with resin (R.I. of 1.46) which, in contrast to the watery medium, cannot evaporate. Therefore, the difference in refractive indices between the porosities and enamel is negligible and lesions appear similar to the surrounding sound enamel.

## CONCLUSION

Cosmetics and esthetics are current trends of our society and many patients are demanding for minimally invasive cosmetic enhancement without anesthesia, drilling and with less expenditure. The

micro-invasive therapy of caries by means of composite infiltration facilitates an early and virtually painless treatment. This technique improves the compliance on the part of the patient and allows for an early and effective intervention particularly in pediatric dentistry. However more clinical data is required to establish its long term success.

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