

THE EFFECT OF RESIN INFILTRATION ON THE COLOR OF WHITE SPOT LESIONS AFTER ORTHODONTIC TREATMENT OVER ONE YEAR PERIOD (*IN VIVO STUDY*)

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ABSTRACT

Objectives: This study was carried out to evaluate the effect of a resin infiltrant in changing the color of white spot lesion clinically, in addition to the color stability of the treated lesion over one year period.

Methods: Fifteen post-orthodontic treated patients. For each patient the white spot lesion was treated with resin infiltrant system (Icon). Assessment of color was done using digital clinical photography before, immediately after the treatment, after 6 months and after 12 months.

Results: Icon resin infiltrant showed statistically significant change in mean (ΔE) immediately after treatment, after 6 months, and after 12 months.

Conclusions: Icon resin infiltrant is effective in changing the color of white spot lesion.

INTRODUCTION

Fixed orthodontic appliances create stagnation areas for plaque and make tooth cleaning difficult ⁽¹⁾. The irregular surfaces of brackets, bands, and wires limit the naturally occurring self-cleansing mechanisms of the oral musculature and saliva which encourages plaque accumulation and the colonization of aciduric bacteria ⁽²⁾. Figure (1)

Enamel loss due to bonding and debonding procedures may result from acid etching,

debonding forces, and mechanical removal of residual adhesives by rotary instruments ⁽³⁾. All the previous could result in enamel incipient carious lesions which are characterized by a loss of mineral beneath an apparently intact surface layer ⁽⁴⁾. The increased porosity within the lesion body causes the characteristic whitish appearance of these lesions if not treated, a cavitated caries lesion can develop. The presence of these white spot lesions represent a common adverse effect compromising the esthetic appearance of teeth ⁽⁵⁾. Figure (2)

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Fig. (1): Orthodontic appliance in a noncompliant patient



Fig. (2). White spot lesions.after orthodontic treatment

After removal of orthodontic appliance, if white spot lesions had occurred during treatment, it is preferred to allow natural tooth remineralization at first. If the lesions persist, professional bleaching of the teeth to diminish the contrast between the white spot lesion and the rest of the enamel surface should be considered ^(1&2). Microabrasion is another option. if the effect of bleaching is less than desired. In the micro-invasive technique, the carious enamel lesion is infiltrated with low viscosity light curing resin ⁽⁶⁾. The resin matrix could strengthen the enamel structure thereby preventing cavitations or break down of the enamel surface ⁽⁷⁾.

The current study was carried out to evaluate the effect of resin infiltrant technique in changing the color of incipient enamel caries clinically, in addition to the color stability of the treated lesion over one year clinical service.

MATERIALS AND METHODS

1. Materials

Resin infiltrant Icon (DMG, Hamburg, Germany) was used for the treatment of incipient enamel lesions. It comprises 3 steps for resin infiltration of demineralized incipient enamel lesions:

Icon-Etch: (hydrochloric acid; 0.3 ml syringe), *Icon-Dry*: (ethanol; 0.45 ml syringe) and *Icon-Infiltrant*: (Resin; 0.45 ml Syringe). The material, composition and manufacturer are presented in table (I).

2. Methods

The study was conducted in Faculty of Oral and Dental Medicine, Fayoum University. Ethical approval was obtained from the ethical committee (Faculty of Oral and Dental Medicine, Fayoum

Table I: Material, composition and manufacturer of the materials:

Material	Category	Composition	Manufacturer
Icon	Resin infiltrant	<i>Icon-Etch</i> : Hydrochloric acid, pyrogenic silicic acid, surface-active substances. <i>Icon-Dry</i> : 99% ethanol. <i>Icon-Infiltrant</i> : Methacrylate-based resin matrix, initiators, additives.	DMG, Hamburg, Germany Email: info(at)dmg-dental.com

University). The patients allocated in the study had received orthodontic treatment with fixed appliances for at least 1.5 years at the debonding appointment and had a clinically visible, white spot lesions in their anterior teeth .

From more than 40 screened individuals, a total of 15 subjects agreed to participate in the study. For every patient, appropriate isolation was achieved using rubber dam. The Resin infiltrant Icon (DMG, Hamburg, Germany) was applied according to manufacturer's instructions.

Icon-Etch was applied onto the lesion site and left for 2 minutes, rinsed with water for at least 30 seconds, dried with oil-free, water-free air for 30 seconds. The Icon-Dry was applied onto the lesion site and left for 30 seconds then dried with oil-free and water free air. Icon-Infiltrant was applied on the etched surface by turning the shaft and left for 3 minutes. Icon-Infiltrant was applied for a second time and the material left for 1 minute and then light-cured for 40 seconds by light emitting diode curing unit (Dentsply, Woodbridge, Canada).

A Canon powershot G12 digital camera was used to capture images of this study, standardized at an Aperture value (AV) mode with "f" = 8, "ISO" setting was "100" and the light source was the built in flash of the camera. A shade guide with "A2" selection was included in all the captured images to act as reference color guide for normalization of the shades of the treated teeth.

Adobe Photoshop CS (Middle East Version) software was used for measuring the required parameters from the image using the color picker tool. The "L*" "a*" and "b*" values were first measured by calculating the average of five points in the reference guide.

The real values of "L*", "a*" and "b*" of the middle-middle third of the reference color guide was measured by Spectrophotometer (it was 72.2, 0.32 and 11.07 respectively). These values were used to normalize the values of the treated teeth in the image. This was calculated by dividing the real values of the reference guide by the measured values from the software (to determine the error factor) which was multiplied by the measured values of the treated teeth to obtain their real values ⁽⁸⁾.

The color differences ΔE^* were calculated using the equation:

$$\Delta E^* = \{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2\}^{1/2}$$

Statistical analysis

Statistical analysis was performed with IBM (IBM Corporation, NY, USA) SPSS Statistics Version 20 for Windows (Inc., an IBM Company). The significance level was set at $P \leq 0.05$. ANOVA for repeated measures test was used to compare between different treatments as well as different time periods.

RESULTS

Effect of treatment materials on color change over 3 different time periods

Table (II) and figure (3), show the means and standard deviations values of the color change (ΔE) at the different time periods immediately after the treatment, after 6 months and after 12 months for Icon resin infiltrant.

It was found that there was a statistically significant change in mean (ΔE) by time (P -value < 0.001). Pair-wise comparisons between the time periods revealed that there was statistically significant change in mean (ΔE) immediately after treatment, after 6 months, and after 12 months.

TABLE (II): Mean, standard deviation (SD) values and results of comparison between (ΔE) at different time periods.

Treatment	Immediately after treatment		6 months		12 months		P-value
	Mean	SD	Mean	SD	Mean	SD	
Icon resin infiltrant	7.74 ^c	1.38	9.94 ^b	1.40	13.62 ^a	1.58	<0.001*

*: Significant at $P \leq 0.05$, Different superscripts in the same row are statistically significantly different

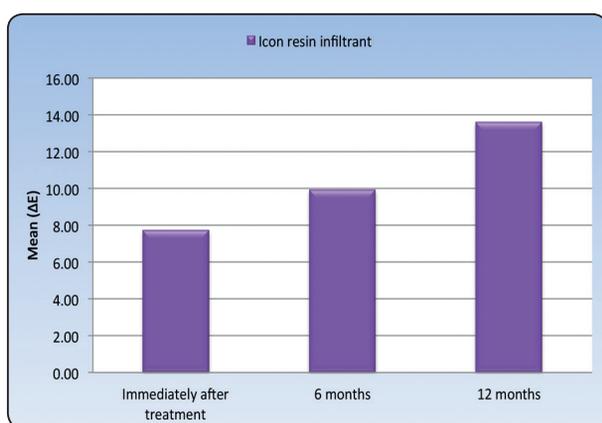


Fig. (3): Bar chart representing mean (ΔE) after using resin infiltrant at different time intervals

DISCUSSION

This study was carried out to evaluate the effect of a resin infiltrant on the color of incipient carious enamel lesions over one year period. The patients selected for this study had received a treatment period with fixed appliances of median 1.6 years before the debonding appointment.

Despite intensive efforts to educate patients about effective oral hygiene procedures, incipient enamel caries associated with fixed orthodontic appliances remains a significant clinical problem ⁽⁹⁾. Appearance of these lesions after the completion of orthodontic treatment can lead to patient dissatisfaction and legal complication ⁽⁵⁾.

The results of this study revealed that Icon resin infiltrant showed a statistically significant color

change. This result may be explained by the refractive index of the resin used for infiltration, which is very similar to the refractive index of healthy enamel. The air or water in the microporosities of incipient enamel caries was replaced with resin, leading to less light scattering within the enamel ⁽⁴⁾.

When the micropores of incipient enamel caries were infiltrated by resin (RI 1.46), which has a similar refractive index as enamel and cannot evaporate, the difference in refractive indices between porosities and enamel was decreased to an negligible level, and the incipient enamel caries lesions regained translucency, appearing similar to that of the surrounding sound enamel ⁽¹⁰⁾.

Similar results, recorded by **Knösel et al.** ⁽¹¹⁾ showed that the treatment had a highly significant influence on the color difference values. Their results showed sufficient esthetic improvement over six months. The results of **Torres et al. in 2011** ⁽¹²⁾ were in agreement with the current study as they proved in their test that the infiltrative resin was an effective treatment for masking white spot lesions. They reported that infiltrative resin resulted in decreased color parameter values after eight weeks.

On the contrary **Knösel et al. in 2013** ⁽¹¹⁾, found that the color of white spot lesions when compared with the surrounding enamel after infiltration was stable with no significant changes over six months. Also, **Paris et al. 2013** ⁽¹³⁾, found that all infiltrants showed significantly better color match with sound

enamel than untreated controls. They concluded that polished infiltrated lesions had good color stability in vitro.

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