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A Spectrophotometric assessment of Icon resin infiltration on the color of White Spot Lesions over one year (An In Vivo Study).

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Abstract

Objective: *The aim of this trial is to assessment of Icon resin infiltration on the color of White Spot Lesions (WSLs) over one year.* ***Material and methods****: 20 participants with 4 WSLs in their anterior teeth (total 80 WSLs) were enrolled in this study. The Icon resin infiltration was applied to WSLs according to the manufacturer's instructions. The WSLs color change (ΔE) was Spectrophotometric assessed by Vita Easyshade V device at the following evaluation periods: before treatment (T0), immediately after treatment, (T1), 3-(T2), 6-(T3), and 12-months later (T4). Data were recorded and statistically analyzed.* ***Results:*** *There was a significant improvement in ΔE after immediate application and in all follow-up periods. However, there was a significant decrease in ΔE with time.* ***Conclusion:*** *The Icon resin infiltration technique is effective in WSLs esthetics improvement. However, Icon resin infiltrated WSLs may become discolored with time.*

Keywords: *Color stability, Esthetic improvement, Icon resin infiltration, White Spot Lesion.*

I. INTRODUCTION

Dental caries is the most common oral disease worldwide [(1)]. Initial caries lesions are known as white spot lesions (WSLs), which clinically appear as an opaque white spot visibly distinct from the surrounding sound enamel due to the differences in the refractive index, which may compromise the esthetics of most of the patients if present in the esthetic zone and might progress to cavitated lesions if not managed adequately [(2)].

WSLs can be managed with noninvasive or invasive treatment options. The noninvasive treatment is the most conservative approach which preserves the tooth structure by remineralization [(3)]. Remineralization with high concentrations of topical fluoride has proven effective in arresting and preventing WSLs [(4)]. However, esthetic improvement is not achieved, since the high concentration of fluoride promotes the remineralization of the superficial enamel layer, leaving the subsurface layer demineralized [(5)].

Some materials were used in WSLs masking, such as resin infiltration material (Icon) which is a micro-invasive technique, it involves the occlusion of microporosities, which inhibits further acidic attacks, and improves esthetics. The Icon is considered the gold standard for WSLs treatment and is highly effective in arresting caries activity and providing good esthetic recovery [6].

The color evaluation was performed visually and with a device. The evaluation by spectrophotometer device may be more consistent and provides an objective color evaluation in addition to the acquired quantitative data. Furthermore, color evaluation by spectrophotometry has been suggested to be the most reliable method for in vivo and in vitro conditions [7,8]. So, this study was conducted to assess the Icon resin infiltration on the color of WSLs by using Vita Easy shade V Spectrophotometric device.

II. MATERIAL AND METHODS

II.1 Materials

Resin infiltrant Icon (DMG, Hamburg, Germany) comprises 3 steps, Icon-Etch: (15% hydrochloric acid (HCL); 0.3 ml syringe), Icon-Dry: (ethanol; 0.45 ml syringe) and Icon-Infiltrant: (Resin; 0.45 ml Syringe). Fig (1).

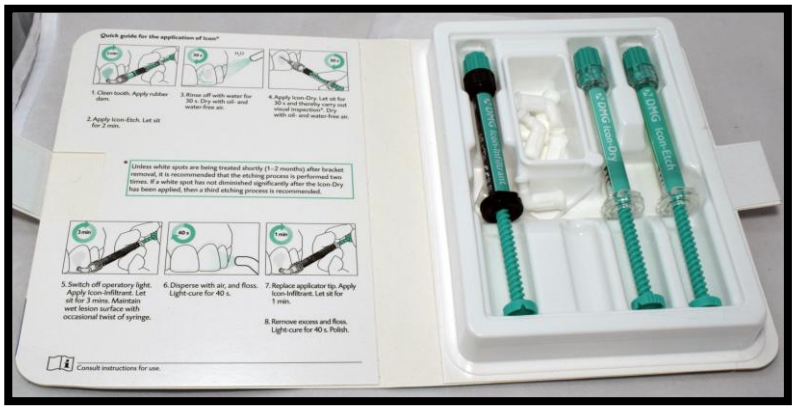

Fig (1) Icon etch, Icon dry and Icon infiltrant.

II.2. Eligibility criteria

The study population was done on 20 patients, each patient has 4 WSLs in their anterior teeth (total WSLs 80). This trial was approved by the institutional Ethics Committee at the Faculty of Dental Medicine, Al-Azhar University Ethics Committee.

Inclusion criteria were as follows: adult patients aged 18–30 years, each patient had at least four anterior teeth with buccal WSLs, good oral hygiene, and a symmetrical number of permanent teeth in each arch (mesial to second molars). Exclusion criteria were: cavitated lesions, facial surface restorations, intrinsic and extrinsic stains, and patients who have a significant medical history or if they are smoking.

II.3. Icon resin infiltration application

Rubber dam system was used to protect gingival tissues and avoid moisture and the Icon was applied according to the manufacturer's instructions. In the first step, the surface layer of the WSLs was etched with 15% hydrochloric acid (HCL) gel (Icon -Etch) for 2 minutes. Then, the lesions were washed for 30 seconds using water spray, followed by drying with compressed air for 10 seconds. The second step was applying an ample amount of 99% ethanol (Icon -Dry) to the etched area and letting set for 30 seconds and then the lesion dried thoroughly with compressed air for 10 seconds. The last step was resin infiltrant (Icon-Infiltrant) application for 3 min to allow penetration and the excess were removed with dental floss. After that, the resin infiltrate was light-cured for 40 s using a Light emitting diode (LED). That was followed by an application of the second layer of Icon-Infiltrate, for an additional minute and finally light-cured for 40 seconds. Then the treated WSLs were polished.

II.4. Observation

The WSLs were clinically evaluated by objectively assessing the color change (ΔE) using Vita Easyshade V, Fig (2). The device was calibrated according to the manufacturer's instructions before every assessment. The WSLs were evaluated pre-operatively before treatment, and post-operatively at the following time intervals; immediately after treatment (T1), 3 months later (T2), 6 months later (T3), and 12 months later (T4).

Fig (2) Vita Easy shade V device.

II.5. Statistical analysis

Statistical analysis was performed using one-way ANOVA test to compare the efficacy of Icon at different follow-up periods. The post hoc Tukey test was used for multiple comparisons and compared the time intervals. The Significance level was set at P ≤0.05.

III. RESULTS

The statistical analysis of (ΔE) of Icon showed that; the difference was statistically significant in all follow-up periods as indicated by the ANOVA test (P<0.00001). The post hoc Tukey test showed a statistically significant difference between all follow-up periods. Also, there was a significant decrease in the mean value of the color change (ΔE) of Icon with time.

The higher (Mean ± SD) were recorded immediately after application (26.99±0.62), followed by (21.93±0.75) and (9.97±0.48) for 3-month and 6-month respectively. While the lower (Mean ± SD) was recorded for the 12-month (2.75±0.26). Data are summarized in Table (1) and graphically drawn in Fig (2).

Table (1): Effect of Icon on color change of WSL at different periods:

Variable	ΔE (Immediate)	ΔE (3-months)	ΔE (6-months)	ΔE (12-months)	P-value
ICON (Mean± SD)	26.99 ± 0.62^{A}	21.93 ± 0.75^{B}	9.97 ± 0.48^{C}	2.75 ± 0.26^{D}	<0.00001*

*; significant at P < 0.05. ns; non-significant P ≥ 0.05.
; Different uppercase letters mean statistically significant.

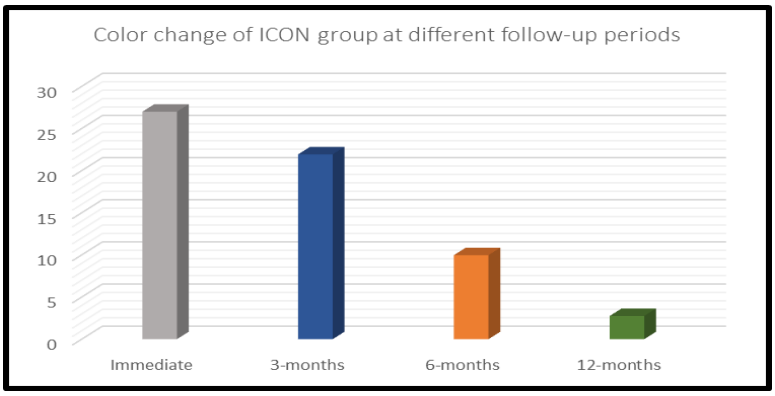

Fig. (2) Bar chart representing the effect of Icon on color change of WSL at different period

IV. DISCUSSION

The WSLs which is the first sign of a carious lesion on enamel that can be detected with the naked eye, is an optical phenomenon due to subsurface tissue loss. WSLs develop because of prolonged plaque accumulation on the affected surface [9]. Treatment modalities aiming to mask the chalky white appearance of WSLs and make them less visible have been developed over the years. The most common modality is the micro-invasive resin infiltration concept which fills the body lesion pores with resins, via capillary action and is based on the application of unfilled, low viscosity resin to the WSLs after surface layer removal by etching [10]. This study was carried out to assess the Icon resin infiltration on the color of WSLs over one year.

Our results revealed that the Icon resin infiltration showed statistically significant color change (ΔE). This result may be explained by the refractive index (RI) of the Icon resin used for infiltration, which is very similar to the RI of healthy enamel. The air or water in the microporosities of WSLs was replaced with resin, leading to less light scattering within the enamel [11]. The principle of WSLs masking by resin infiltration is based on changes in light scattering within the lesions. Sound enamel has a RI of (1.62). The microporosities of lesions are filled with either water (RI 1.33) or air (RI 1.0). The microporosities of infiltrated lesions are filled with Icon resin (RI 1.46). Therefore, the difference in the RI between porosities and enamel is negligible and lesions appear similar to the surrounding sound enamel [12]. Moreover, color improvement of the lesions is attributed to the deep penetration of the resin and the acid etching which gives better access to the resin into the subsurface defects [13].

These results were in agreement with Simon S et al, [14] who found that there was a significant decrease in ΔE immediately after resin infiltration. They explained that micropores of WSLs were infiltrated by resin with RI which is approximated to that of enamel, and the difference in RI between porosities and enamel was decreased to an invisible level.

However, our results showed there was a significant decrease in the ΔE with time. This may be due to the Icon is mainly composed of TEG-DMA (Triethylene glycol dimethacrylate) which has a high-water sorption rate, causing discoloration of resin [15]. Generally, the resinous materials are susceptible to extrinsic and intrinsic pigmentation over time influenced by the rate of water absorption of the material and degree of polymer conversion of the monomers. The aqueous environment found in the oral cavity includes diet and changes in temperature leading to hydrolytic degradation, thereby influencing the optical properties of these materials [16].

In addition, there is an inverse correlation between roughness and color. The reflection and scattering of the light are different on smooth and rough surfaces [17]. Moreover, the Esterases produced by cariogenic bacteria lead to hydrolytic degradation resins and increase surface roughness [18].

Our findings were in accordance with Altarabulsi M et al, [19] who found the infiltrated surfaces showed a significant increase in discoloration after 12 months.

On the contrary, Giudice R et al, [20] who found that there were no significant differences in the color of WSLs treated with Icon after one year. This may be due to their different method to assess the ΔE was between WSL or treated lesions and sound adjacent enamel in every patient at follow-up periods.

V. CONCLUSIONS

It can be concluded that the Icon resin infiltration technique is effective in the aesthetic improvement of WSLs. However, Clinicians should be aware that Icon resin infiltrated WSLs may become discolored with time.

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