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Treatment of Post-Orthodontic whitespot Lesions By Resin Infiltration

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Abstract
Objective: *The aim of the study is to evaluate the effectiveness of resin infiltration in the treatment of post-orthodontic white spot lesions.*
Materials and Methods: *This was clinical trial. 9 subjects with mean age 18.25 with multiple white spot lesions in incisors and premolars area were included in this study. Lesions (44 lesions) were treated by ICON-Infiltrant with assessment of the lesions before, after application, after 3 months and after 6 months. Visual assessment of white spot lesions was done using International Caries Detection and Assessment System (ICDAS-II) for scoring dental caries. The scoring criteria according to the ICDAS-II system for Coronal Smooth Surface Caries are graded from 0 to 6. Patient satisfaction score was recorded according to patient's own selection for each quadrant before, after intervention, after 3 months and after 6 months follow up.*
Results: *there was a statistically significant decrease in caries scores at T1. From T1 to T2 as well as from T2 to T3; there was no statistically significant change in mean caries scores. However, T1, T2 and T3 scores showed statistically significantly lower mean scores than T0. Concerning the patient satisfaction there was a statistically significant increase in satisfaction scores at T1. From T1 to T2 as well as from T2 to T3; there was no statistically significant change in mean satisfaction scores. However, T1, T2 and T3 scores showed statistically significantly higher mean scores than T0.*
Conclusions: *Icon resin infiltration improved esthetics of demineralized lesions.*
Icon resin infiltration improves the esthetic appearance of demineralized teeth significantly immediately after application. Esthetic outcomes of icon resin infiltration showed adequate stability for 6 months.

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I. Introduction

In spite of the advances in orthodontic materials and techniques in recent years, development of enamel demineralization around the brackets remains the most undesirable and common complication of fixed orthodontic appliance therapy. The overall prevalence in orthodontic patients ranges from 2-96 %.[1-3] Nearly 50% [2,4,5,6] of orthodontic patients exhibit clinically visible white spot lesions (WSL). High prevalence of white spot lesions after orthodontic treatment is explained by difficulties in performing oral hygiene procedures on teeth with braces and arch wires.

Cariogenic bacteria from dental plaque on elements of fixed orthodontic appliance trigger the process of white spot lesions formation. The process starts with dissolution of enamel crystals by organic acids, resulting into changes of its optical characteristics. As a result enamel becomes opaque (visible for naked eye or "white") due to the excessive light dispersion. Demineralization around brackets can be an extremely rapid process with visible white spot lesions developing within four weeks after bonding [2,6-11]. The treatment of the unsightly WSL is often costly and time consuming. The first line of treatment is remineralisation. Topical remineralisation treatments such as fluoride therapy, casein–phosphopeptide–amorphous calcium phosphate, Novamin (calcium sodium phosphosilicate) are applied in the form of gels, creams or pastes. A minimally invasive technique for treating WSL is resin infiltration. Other more invasive approaches include microabrasion (alone or combined with acids), conventional bonding and various types of veneers. Non-invasive treatment of early carious lesions by resin infiltration is considered a major advancement in clinical management of the disease. During the development of subsurface caries lesions, minerals are dissolved out of the enamel, resulting in increased porosities that appear clinically as white spots. The low porous surface layer of enamel caries lesions acts as a

diffusion barrier (12). By means of a new virtually painless method, the caries infiltration product, Icon, was introduced in Germany. This product utilizes a special resin to fill and seal diseased enamel without unnecessary loss of healthy hard tissue. Icon is an innovative product for the micro invasive treatment of early cariogenic lesions in the proximal and vestibular regions. It can be used to treat caries in a timely manner without drilling. (12)

Many studies have been conducted regarding Icon, and those have shown promising results. However, it is still not confirmed whether this relatively expensive resin infiltration system will behave differently than regular systems that are routinely available in clinics. (13-15)

II. Materials And Methods

A clinical trial was designed to evaluate the effect of resin infiltration using Icon. All subjects were informed about the nature, and benefits of the study and a written informed consent was obtained before the start of treatment. Ethical approval on 6/5/2013 was obtained from the Faculty of oral and dental medicine Cairo University ethical committee before enrolling the subjects consenting to participation.9 subjects (age 18.25 ± 5.3) with multiple white spot lesions in incisors and premolars area were selected from out-patients clinic of the Orthodontics Department Cairo University.Inclusion criteria: Patients with non-cavitated white spot lesions after finished orthodontic treatment.Exclusion criteria: cavitated lesions, restored teeth, deciduous teeth and teeth with other enamel defects as enamel hypoplasia and dental fluorosis.

44 lesions (scores 1 and 2 on the ICDAS II scale) were treated by ICON-Infiltrant with assessment of the lesions before (T0), after application (T1), after 3 months (T2) and after 6 months (T3)

Application of Icon

After isolation by OptraGate (IvoclarVivadent) and cotton rolls, according to manufacturer instructions Icon-Etch (15% HCL) was applied from the syringe and left for 2 minutes then rinsed off with water for 30 second then air-dried with air syringe. Then, Icon-Dry (99% ethanol) was applied for 30 seconds, and then air dried. Lastly, Icon-Infiltrant was applied for 3 minutes then light-cured for 40 seconds. Then, a second coat of Infiltrant was applied and left for 1 min then light-cured for 40 seconds using light curing unit.

Outcome Assessment

Assessment of each lesion before application (T0), after application (T1), after 3 months (T2) and after 6 months (T3) Each tooth diagnosed by two separate examiners interexaminer agreement calculated and statistically analyzed.

White spot lesions assessment using ICDAS II

Visual assessment of white spot lesions was done using International Caries Detection and Assessment System (ICDAS-II) for scoring dental caries. The scoring criteria according to the ICDAS-II system for Coronal Smooth Surface Caries are :

0- No change in enamel translucency after prolonged air drying (>5 s)

1- Opacity or discoloration hardly visible on a wet surface, but distinctly visible after air drying. Enamel demineralization limited to the outer 50% of the enamel layer.

2- Opacity or discoloration distinctly visible without air drying. No clinical cavitations detectable. Demineralization involving between 50% of the enamel and the outer third of dentin is visible.

3- Initial breakdown in enamel.

4- Underlying dark shadow from dentin.

5- Distinct cavity with visible dentin.

6- Extensive distinct cavity.

Patient satisfaction score was recorded according to patient's own selection for each quadrant before, after intervention, after 3 months and after 6 months follow up.Visual Analogue Scale is graded scale from 1 to 10. Each subject asked to put a circle on the number which represents his satisfaction with teeth on either side

III. Statistical Analysis

Caries and satisfaction scores data were presented as mean, standard deviation (SD), median and range values. Scores data were compared using non-parametric tests; Friedman's test was used to study the changes by time in each group. Wilcoxon signed-rank test was used for pairwise comparisons when Friedman's test is significant. Bonferroni's correction was applied for the pair-wise comparisons.Inter examiner agreement (reliability) was assessed using Kappa statistic. Kappa statistic values are interpreted as follows; 0 – 0.2: weak agreement, 0.2 – 0.4: fair agreement, 0.4 – 0.6: moderate agreement, 0.6 – 0.8: good agreement, 0.8 – 0.99: very good agreement while a value of 1 indicates perfect agreement.

The significance level was set at P ≤ 0.05. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

IV. Results

White spot lesions assessment (by ICDAS II)

Inter-Examiner Agreement ForWsls Assessment:

There was good inter-examiner reliability with Kappa statistic value of 0.738

Changes by time with Icon

There was a statistically significant decrease in caries scores at T1. From T1 to T2 as well as from T2 to T3; there was no statistically significant change in mean caries scores. However, T1, T2 and T3 scores showed statistically significantly lower mean scores than T0.

TABLE (1) Mean, standard deviation (SD) values of caries scores at different time periods

	T0	*T1*	*T2*	*T3*	*P-value*
ICON					
Mean (SD)	1.88 (0.32) [a]	0.28 (0.59) [b]	0.40 (0.74) [b]	0.50 (0.79) [b]	<0.001*
Median (Range)	2.00 (1.00 – 2.00)	0.00 (0.00 – 2.00)	0.00 (0.00 – 3.00)	0.00 (0.00 – 3.00)	

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

Changes of satisfaction score

There was a statistically significant increase in satisfaction scores at T1. From T1 to T2 as well as from T2 to T3; there was no statistically significant change in mean satisfaction scores. However, T1, T2 and T3 scores showed statistically significantly higher mean scores than T0.

TABLE (2) Mean, standard deviation (SD) values of satisfaction scores at different time periods

	T0	*T1*	*T2*	*T3*	*P-value*
ICON					
Mean (SD)	4.11 (1.45) [b]	7.67 (1.32) [a]	8.00 (1.07) [a]	7.71 (1.11) [a]	0.002*
Median (Range)	4.00 (2.00 – 6.00)	8.00 (5.00 – 9.00)	8.00 (7.00 – 10.00)	7.00 (7.00 – 10.00)	

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

V. Discussion

One of the most accepted definitions by clinicians of white spot lesions is; it is an optical phenomenon due subsurface tissue loss which exaggerates on drying.Surface features of active initial carious lesions show widened inter-crystalline spaces and frequently minor fractures of the perikymata edges which act as diffusion pathways for acids and dissolved minerals.Restoration of initial enamel lesions results in an unfavorable damage of the tooth structure. On the other hand, traditional treatment regimens for initial enamel caries lesions based on fluoride application might not as efficient as expected in many cases. Therefore, instead of removing porous dental hard tissues at later stages of disease progression, filling micro-spaces and micro-porosities of the lesion at a much earlier stage of development has been considered. Thus, the sealing of initial enamel lesions by resins is considered a promisingapproach[16].

The infiltration technique aims to create a diffusion barrier inside the lesion, by replacing lost minerals with resin 17. Icon Resin Infiltration (DMG) is an innovative product for the micro-invasive treatment of cervical and proximal dental lesions. Driven by capillary forces, the infiltrant, a highly fluid resin, penetrates into the enamel caries and blocks the diffusion paths for cariogenic acids, thus promoting the early arrest of caries. Icon closes the gap between preventive therapies and corrective restorations. It comprises three consecutive steps; hydrochloric acid etching, ethanol drying and resin infiltration.Assessment of white spot lesions intraorally is one of the most controversial points.In this study visual assessment by International Caries Detection and Assessment System (ICDAS-II) is used which presents a new paradigm for the measurement of dental caries that was developed based upon the insights gained from a systematic review of the literature on

clinical caries detection system held by Ismail18 previous studies shows interexaminer and intraexaminer reliability and diagnostic accuracy compared to histological sections. [19- 22]

Intraoral photographs is another method for assessment which was not preferred because of extreme difficulty in standardization of day time, backgrounds, location, tooth wetness, angle of taking picture and lightening conditions. Camera might record details differently than the naked eye. Flash reflections are one of the important limitations, which might complicate the WSL evaluation because of an overlapping with the WSL area, thus leading to a malestimation of the WSL which will most likely be an over- rather than an underestimation which affect the accuracy of the evaluation. [23] The Quantitative Light induced Fluorescence QLF measuring method is used in many studies. This technique has the ability to quantify enamel lesions in an objective way, but it has been stated that QLF is not suitable for inter-patient comparison [24] as he amount of fluorescence relates more closely to bacterial presence than to the mineral content of the tooth. [25]

Sound enamel has a refractive index (RI) of 1.62. The microporosities of enamel caries lesions are filled with either a watery medium (RI 1.33) or air (RI 1.0). The difference in refractive indices between the enamel crystals and medium inside the porosities causes light scattering. Microporosities of infiltrated lesions are filled with resin (RI 1.46) that, in contrast to the watery medium, cannot evaporate. Therefore, the difference in refractive indices between porosities and enamel which has refractive index (RI) 1.62 is negligible and lesions appear similar to the surrounding sound enamel immediately.

Because public perception is one of the factors that drive the demand for dental treatment, the perspectives of participants were of special interest in this study. Although it is a subjective method for assessment, patient satisfaction scores give an indication about patient esthetic demand and its improvement by treatment and ensures that research outcome is patient relevant. The classic study by Dr. Ronald Goldstein published in 1969 was the first to correlate dental esthetics and patient perception. [26]

Most of previous in vivo studies were case reports and case series. In this study we evaluated the esthetics and patient satisfaction immediately after application and over 6 months follow up period.

VI. Conclusions

Icon resin infiltration improved esthetics of demineralized lesions. Icon resin infiltration improves the esthetic appearance of demineralized teeth significantly immediately after application. Esthetic outcomes of icon resin infiltration showed adequate stability for 6 months.

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