

## EFFECT OF TWO REMINERALIZING ANALOGUES ON TREATMENT OF POST ORTHODONTIC ENAMEL WHITE SPOT LESIONS USING SPECTROPHOTOMETER (AN IN VIVO STUDY)

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### KEYWORDS

*Amorphous calcium phosphate varnish, Remineralization, Self-assembling peptide P11-4, Vita Easy® Shade spectrophotometer, White spot lesion.*

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### ABSTRACT

**Introduction:** Patients seeking orthodontic treatment are mainly targeting improving their esthetic, but they are faced with an unfavorable side effect of fixed orthodontic treatment, which is enamel demineralization manifested as white spot lesions (WSLs). As a result, it's critical to alter caries risk factors and focus on therapeutic options that emphasize remineralization of lesions. **Aim:** The purpose of this study was to assess the clinical effect of self-assembling peptides and amorphous calcium phosphate varnish on the treatment of post orthodontic enamel WSLs. **Materials and methods.** In this prospective single-blinded randomized clinical investigation, a total of 40 patients' teeth (10 per group) were enrolled in four groups; first the control group, two remineralizing analogue groups; Self-assembling peptide P11-4 group (Curodont™ Repair /Regenamel®), and Amorphous Calcium Phosphate varnish (Enamel Pro® Varnish 5% Sodium Fluoride Premier Dental). The combination of the two analogues were used to form the fourth group; through combining Self-assembling peptide containing a considerable quantity of calcium phosphate and fluoride ions. WSLs were evaluated using Vita Easy® Shade spectrophotometer (Vita Zahnfabrik, Germany) to calculate ( $\Delta E$ ) of shade changes, immediately after de-bonding of the orthodontic brackets. Follow ups were done after one, three, and six months. **Results:** WSLs recovery was significantly better in the combination group followed by the s combine Self-assembling peptide group, than the control group, which had the lowest remineralization levels. **Conclusion:** Combining organic and inorganic remineralizing analogues showing the highest remineralizing potential reflected by the increase in Vita Easy® Shade readings.

### INTRODUCTION

Patients seeking orthodontic treatment are mainly targeting improving their esthetic appearance but unfortunately they clash with an unfavorable side effect of fixed orthodontic treatment, enamel demineralization, which manifests as WSLs. As a result, it's critical to alter caries risk factors and focus on therapeutic options that emphasis remineralization of lesions. Such approaches are the topical uses of different re-mineralizing agents alone or combined. Furthermore, masking lesions with bleaching, micro-abrasion, or the camouflage effect provided by resin infiltration would improve the aesthetic aspect of teeth<sup>(1)</sup>. Fluoride-based caries prevention and management strategies

are the gold standard, the favorable role of fluoride in preventing WSL has been documented. The fluoride ion helps to prevent tooth cavities by altering bacterial metabolism in dental plaque by inhibiting certain enzyme pathways<sup>(2)</sup>. It was felt that an investigation into the clinical effect of self-assembling peptide P11-4 group and Amorphous Calcium Phosphate varnish on the treatment of the post-orthodontic enamel white spot lesions might be of value to dental literature.

## MATERIALS AND METHODS

In this study; After the approval of Ethical Committee of the Faculty of Dentistry Suez Canal University (74/2018), this research was carried out on forty teeth of individuals ranging in age from 16 to 25 years recruited from a pool of treated orthodontic patient at Department of Orthodontics, Faculty of Dentistry, Suez Canal University, according to inclusion criteria for patient<sup>(3)</sup> and lesions<sup>(4)</sup> standardization. In this prospective single-blinded randomized clinical investigation, a total of 40 patients' teeth (10 each group) were enrolled and categorized into four groups; Control group where patients were instructed for only proper oral hygiene. Self-assembling peptide group; patients were taught how to brush their teeth properly, in addition to the application of (Curodont™ Repair / Regenamel®). The amorphous calcium phosphate varnish group; patients were trained how to brush their teeth correctly in addition to the application of (Enamel Pro® Varnish). The Combination group: patients were educated how to brush their teeth properly in addition to the application of (Curodont™ Repair /Regenamel®) and (Enamel Pro® Varnish) according to their manufacturer instructions. The assessment method for WSLs is of paramount importance to the accurate identification

or measurement of lesions intensity. In the current study, Enamel white spot lesions (WSLs) were evaluated qualitatively using Vita Easy® Shade spectrophotometer (Vita Zahnfabrik, Germany) which is a portable spectrophotometer that measures the specimen's spectral reflectance or transmittance curve. Management of post-orthodontic WSLs requires the evaluation of the aesthetic aspect using Vita Easy® Shade to assess the change in color ( $\Delta E$ ), before and after application of the remineralizing analogue. The change in color ( $\Delta E$ ) was calculated and recorded at each time interval in each of the treatment group.

## RESULTS

Data was collected, tabulated and statistically analyzed. In each test, the mean and standard deviation values were computed for each group. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to check for normality, and the results revealed a parametric (normal) distribution. To assess the interaction between different factors, two-way ANOVA and post-hoc testing were used. Different groups had a statistically significant influence (P-value 0.001), however time had no statistically significant effect. Regarding the effect of time (T); The Post-Hoc test revealed that there was no statistically significant difference between the time intervals after one (T1), three (T2) and six (T3) months in control group (M1) and self-assembling peptide group (M2) where ( $p=0.696$ ) and ( $p=0.549$ ) respectively. However, there was a statistically significant difference between (T1) and each of (T2) and (T3) groups where ( $p=0.039$ ) in amorphous calcium phosphate varnish group (M3). But, There was no statistically significant difference between (T2) and (T3) groups where ( $p=0.671$ ). Also, it was found that there no statistically

**Table 1.** Comparison between mean and standard deviation values for different groups at different time intervals.

Variables	(ΔE)								p-value
	M1		M2		M3		M4		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
T1	1.50 aB	0.57	5.58 aA	3.80	3.80 bAB	0.79	5.79 aA	2.24	0.012*
T2	1.78 aB	0.59	4.50 aAB	1.31	6.15 aA	1.45	6.19 aA	3.26	0.009*
T3	1.32 aB	0.47	5.83 aAB	2.87	5.68 aAB	1.58	8.49 aA	4.07	0.003*
p-value	0.696ns		0.549ns		0.039*		0.107ns		

\*, significant ( $p < 0.05$ ) ns; non-significant ( $p > 0.05$ ).

significant difference between (T1), (T2) and (T3) groups where ( $p = 0.107$ ) in combination group (M4). Regarding the effect of type of treatment; the results of the Post-Hoc test revealed a statistically significant difference between the two groups. (M2) and (M4) over (M1) where ( $p = 0.012$ ) after one month (T1). There was a statistically significant difference between (M1) and each of (M3) and (M4) where ( $p = 0.009$ ) after three months (T2). The change in shade ( $\Delta E$ ) after six months (T3), showed that the difference between the (M4) and (M1) groups was statistically significant where ( $p = 0.003$ ) (table .1).

Substantial difference is shown by means with different small letters in the same column, and significant difference is indicated by means with different capital letters in the same row.

## DISCUSSION

In the current study, Enamel white spot lesions (WSLs) were evaluated qualitatively using Vita Easy® Shade spectrophotometer (Vita Zahnfabrik, Germany) which is a portable spectrophotometer.

The change in color ( $\Delta E$ ) was calculated and recorded at each time interval for each treatment group <sup>(5)</sup>. Optically there are two types of scatters in enamel; small enamel crystallite and large enamel prism (uniaxial) they are responsible for translucency appearance of the enamel <sup>(1)</sup>. Demineralized enamel appears whitish in colour due to the difference in refractive indices (RIs) between faulty and sound enamel. The existence of micro-porosities in affected enamel lesions explains for this difference. Unlike sound enamel, which has a RI of 1.62, these micro-porosities are filled with either water (RI=1.33) or air (RI=1.0). When these pores are filled with water, the lesions look opaque as compared to healthy tissue, but when they are dry, they fill with air, making the lesion more visible. Thus, the colour difference is thought to be caused by a difference in RIs between enamel crystals and the medium inside the porosities, which causes light to scatter, resulting in a whitish opaque appearance of such lesions, especially when dried. <sup>(6)</sup>. The colorimetric change ( $\Delta E$ ) using spectrophotometer measured in artificial white spot lesions, while there are few recorded clinical studies evaluated the color change after Self-assembling peptide P11-4

(SAP) application. Besides, the clinical trials about the efficacy of SAP in masking the color of white spot lesions for achieving the patient satisfaction appears to be insufficient for clinical guidance. <sup>(7)</sup> The findings of this investigation revealed that time had no statistically significant impact on the Change in color ( $\Delta E$ ). In agreement with Mohammed, et al.,<sup>(8)</sup> who found that after application, there was no significant difference in the effect of the Self-assembling peptide P11-4 and fluoride-based Varnish treatments, both immediately and three and six months. Also Alsamolly,<sup>(9)</sup> assessed that the remineralization potential of (SAP, phosphorylated chitosan and nano hydroxyapatite paste) increased by increasing the storage time (three month and six months). Concerning the effect of type of treatment on the Change in color ( $\Delta E$ ) after one month, the use of SAP either alone or in Combination improved the results over the control group, this goes with Kamal et al.<sup>(10)</sup>, who assessed the results of the qualitative assessment of the Scanning electron microscope images and stated that combining Self-assembling peptide P11-4 with fluoride had the most apparent remineralized pattern early after 1 week remineralization with quite improvement after 4 weeks. However, the control group showed there has been no major change in morphology in both 1 week and 4 weeks. Also, Hany et al.,<sup>(11)</sup> who claimed that a considerable difference existed between the Self-assembling peptide P11-4 and the control group that received no treatment when comparing the color change after 90 days. Riad et al.,<sup>(12)</sup> also found that there was a better color change after application of Self-assembling peptide P11-4 in treatment of white spot lesion. This can be explained as early enamel lesions have a higher porosity. Causes a noticeable alteration in the damaged enamel surface's optical characteristics. Bonchev et al.,<sup>(13)</sup> in this regard, when SAP is applied to a tooth, the peptide diffuse into the subsurface micropores, forming a three-

dimensional scaffold of tiny fibers. These scaffolds resemble teeth development proteins and promote hydroxyl apatite crystallization around them to restore tooth enamel over a three-month period. Schle et al.,<sup>(14)</sup> on the other hand Wierichs et al.,<sup>(15)</sup> reported that selfassembling peptides P11-4 could not significantly decrease or hide the progression of the lesions. Also, Gozeticic et al.,<sup>(16)</sup> evaluated that when resin infiltration was used instead of SAP or fluoride varnish, the optical improvement was substantially higher. That could be related to the tangentially arrangement de novo hydroxyapatite crystals around the P11-4 scaffold (not in prismatic structure like Enamel. As a result, a more fan-like' structure is to be expected, and the total elimination of the white area after SAP treatment is unlikely. Concerning the control group the net salivary remineralization is a slow process with a tendency for mineral uptake exclusively on the surface of the WSL due to the low ion concentration gradient from saliva into the lesion. Salivary remineralization mediated by fluoride appears to be limited to the outside 30 percent of the mouth. Fluoride-mediated salivary remineralization appears to be limited to the tooth's outer 30 m. This surface-only remineralization has no effect on the sub surface's aesthetics or structural qualities of the Lesion Philip in <sup>(17)</sup> Regarding the Change in color ( $\Delta E$ ) after three months, all the remieralzing analogues, whether organic self-assembling peptide P11-4 or inorganic Amorphous calcium phosphate varnish(ACP) used alone or in combination were statistically significant higher than (control group) This can be explained as ACP was incorporated in a fluoride varnish, this greatly increased the fluoride content of both healthy and demineralized enamel. The ACP technology, which is a non-stabilized calcium phosphate system, is based on amorphous un-stabilized calcium phosphate in which the calcium salt (calcium sulphate) and the

phosphate salt (potassium phosphate) are released separately in the oral cavity via a (double room) type device, releasing calcium and phosphate ions.<sup>(18)</sup> Change in color ( $\Delta E$ ) after six months showed that a statistically significant difference was found between Combination and control group; this goes well Doberdoli et al.,<sup>(19)</sup> who assessed the effect of combination therapy. They concluded that using of SAP with fluoride varnish or twice weekly application of Curodont Protect;(SAP matrix containing P11-4, fluoride and calcium phosphate), had improved the enamel repair and arrest WSLs over fluoride varnish alone. Again this was in agreement with Alkilzy et al.,<sup>(20)</sup> who stated that there was a statistically significant overpowering from the combination of SAP with fluoride, over the use of fluoride alone. Yet both studies used ICDAS-II scoring and Nyvad criteria for qualitative evaluation. Such results could possibly ascribed to the great affinity of selfassembling peptide P11-4 of for Ca<sup>2+</sup> and PO<sub>4</sub><sup>3-</sup> from the body's own saliva forming de novo hydroxyapatite. Thus, adding self-assembling peptide to external source of calcium, phosphate and fluoride ions (acting as a reservoir) might responsible for a favorable result, rather than when each was used alone.

## CONCLUSION

Combining the organic and inorganic remineralizing analogues showing the greatest remineralizing efficacy early after one month and even after six months, compared to when each agent was used alone. The remineralization of post orthodontic WSLs reflected by the increase in Vita Easy® Shade readings. However, this couldn't achieve the complete disappearance of the post orthodontic white spot lesions after treatment.

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