

EFFECT OF TWO REMINERALIZING ANALOGUES ON TREATMENT OF POST ORTHODONTIC ENAMEL WHITE SPOT LESIONS USING LASER FLUORESCENCE-BASED CARIES DETECTOR (AN IN VIVO STUDY)

Dina Mohamed Ali Ismail¹, Ahmed Fawzy Abo-Elezz², Mohamed Adel Nadim³,
Ola Mohamed Ibrahim Fahmy⁴

DOI: 10.21608/dsu.2022.121080.1106

Manuscript ID: DSU-2202-1106

KEYWORDS

*Amorphous calcium phosphate varnish,
Diagnodent,
Postorthodontic treatment
Remineralization,
White spot lesion.*

- E-mail address:
dina_dental@yahoo.com

- Assistant Lecturer of Operative Dentistry, Faculty of Dentistry, Suez Canal University
- Assistant Professor of Operative Dentistry, Faculty of Dentistry, Suez Canal University
- Professor of Orthodontics, Faculty of Dentistry, Suez Canal University
- Professor of Operative Dentistry, Faculty of Oral and Dental Medicine, Misr International University

ABSTRACT

Introduction: Aesthetic dentistry has developed in the recent decades. Orthodontic treatment has become one of the more popular ways for alignment of crowded teeth. However, when braces are removed, white spot lesions (WSLs) may have a detrimental impact on the patient's aesthetics and pleasure. **Aim:** this research aimed to evaluate the clinical effect of Self assembling peptides and Amorphous calcium phosphate varnish on the treatment of post orthodontic enamel WSLs. **Materials and methods:** A total of 40 patients teeth were enrolled in this prospective single-blinded randomized clinical study categorized into four groups (10 per group); Control group, Self assembling peptide P11-4 group (Curodont™ Repair /Regenamel®), Amorphous Calcium Phosphate varnish group (Enamel Pro® Varnish 5% Sodium Fluoride Premier Dental) and combination group in which the two analogues were combined with each other. Enamel white spot lesions were evaluated quantitatively using Diagnodent® (KaVo Dental Corporation, USA). **Results:** A quantitative increase in remineralization of post orthodontic WSLs in all the groups and over time intervals. However, the WSLs recovery was significantly better in the combination group followed by the self-assembling peptide group, than control group which showed the least values of remineralization. **Conclusion:** Combining self-assembling peptide P11-4 with other inorganic remineralizing analogues provides additional benefits of accelerating and enhancing the remineralization process, allowing for significantly faster and improved regenerative repair for post orthodontic WSLs.

INTRODUCTION

Aesthetic dentistry has developed in the last several decades. Focusing on improvement of natural looking of the patient smile than ever before, through a variety of dental treatments. Orthodontic treatment has become one of the most essential and popular methods for improving the aesthetics and position of misaligned, projecting, or crowded teeth, as well as correcting bite disorders. However, when braces are removed, white spot lesions (WSLs) might have a detrimental effect on the patient's aesthetics and satisfaction. White Spot Lesions should be treated in a multifaceted manner. In fixed orthodontic patients, effective oral hygiene is the cornerstone of preventative interventions, followed by secondary prevention and reversing lesions with remineralizing agents such as topical fluoride, casein phosphor peptides-amorphous

calcium phosphate (CPP-ACP), Galla-Chinensis, Nano-hydroxyapatite, enamel matrix derivatives, or self-assembling peptide P11-4. After the fixed orthodontic appliances are removed, minimally invasive procedures such as bleaching, micro-abrasion, or resin infiltration can be utilized to conceal and improve the aesthetic look of the teeth⁽¹⁾. Fluoride-based caries prevention and treatment techniques are the gold standard, and the beneficial function of fluoride in preventing WSL has been established. The fluoride ion helps to prevent tooth cavities by altering bacterial metabolism in dental plaque by inhibiting certain enzyme pathways⁽²⁾. It was felt that an investigation into the clinical effect of self and Amorphous Calcium Phosphate varnish on the treatment of white spot lesions after orthodontic treatment 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 study was performed on forty teeth of individuals ranging in age from 16 to 25 years, recruited from a pool of treated orthodontic patient at Suez Canal University, Faculty of Dentistry, Department of Orthodontics according to inclusion criteria for patient⁽³⁾ and lesions⁽⁴⁾ standardization. In this prospective single-blinded randomised clinical research, 40 patients' teeth were divided into four groups; Control group where patients were instructed for only proper oral hygiene. two remineralizing analogue was used for the treatment of the post orthodontic WSLs; ; Selfassembling peptide P11-4 (Curodont™ Repair /Regenamel®) and Amorphous Calcium Phosphate varnish (Enamel Pro® Varnish 5% Sodium Fluoride Premier Dental). The two analogues were used combine to form the forth group; through

combining self-assembling peptide using a rich source of fluoride ions and calcium phosphate, rather than using them alone, could have good results. On the dental chair, the visual clinical examination was performed under regular lighting conditions. ICDASII assessment criteria (0-2) were used because we were dealing with non-cavitated lesions on the enamel surface. Enamel white spot lesions (WSLs) were evaluated qualitatively using Vita Easy® Sha The Quantitative evaluation of WSLs using Diagnodent® (KaVo Dental Corporation, USA) which is based on the laser fluorescence principle; The initial stage of a non-cavitated lesion can be recognised, and the lesion depth (LD) and mineral loss can be quantified (Gomez in 2015)⁽⁵⁾. Management of post-orthodontic WSLs requires the evaluation of the structural aspect using Diagnodent, to assess the change in change in fluorescence (ΔF), before and after application of the remineralizing analogues. The change in Fluorescence (ΔF) was calculated and recorded at each time interval for each treatment group. Data was collected, tabulated and statistically analyzed.

RESULTS

The mean and standard deviation values were computed in each test for each group. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to check for normality, and the results revealed a parametric (normal) distribution.. Two-way ANOVA and Post-hoc tests were used to test the interaction between different variables. The results showed that different groups had a statistically significant effect at P-value <0.001. Also, time had a statistically significant effect at P-value <0.001. The interaction between the two variables also had a statistically significant effect at P-value <0.001. regarding the effect of time in the change in Fluorescence (ΔF) (Figure 1), the Post-Hoc test

showed that there was a statistically significant difference after three (T2) months in control group (M1) where ($p=0.011$). While, there was found that there was a statistically significant difference of one (T1) and three (T2) months in Self assembling peptide P11-4 group (M2) where ($p=0.013$). Also, a statistically significant difference was found after one and six (T3) months in Amorphous Calcium Phosphate varnish group (M3) where ($p=0.013$).

and there was statistically significant difference after one (T1) month in combination group (M4) where ($p=0.016$). concerning the Effect of type of treatment on the Change in fluorescence (ΔF) after one (T1), three (T2) and six (T3) months, the Post-Hoc test showed that there was a statistically significant difference of control group over the other groups where ($p<0.001$) (**Table 1**).

Table (1) The mean and Standard deviation values of change in enamel fluorescence after applications of different types of treatments through different times.

Variables	(ΔF)								p-value
	Control group		Self-assembling peptide		Amorphous calcium phosphate		Combination group		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
After 1 month	150.60 ^{ba}	6.93	70.60 ^{ab}	19.28	61.65 ^{bb}	3.35	73.97 ^{ab}	11.58	<0.001*
After 3 months	206.00 ^{aa}	14.70	55.60 ^{ab}	34.35	58.03 ^{abb}	27.78	53.44 ^{bb}	24.01	<0.001*
After 6 months	115.40 ^{ca}	11.38	32.98 ^{bc}	8.71	73.73 ^{ab}	8.09	42.21 ^{bc}	17.34	<0.001*
<i>p-value</i>	0.001*		0.013*		0.013*		0.016*		

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.

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

DISCUSSION

Regarding the quantitative Change in fluorescence (ΔF), the results of all the remineralizing analogues, whether organic (self-assembling peptide P11-4.) or inorganic (Amorphous calcium phosphate varnish) used alone or in combination were statistically significant higher than (control group) after one and three months. This finding was in agreement with Alkilzy et al.,⁽⁶⁾ and Jablonski-

Momeni et al.,⁽⁷⁾ who investigated the effectiveness of a self-assembling peptide treatment in avoiding caries and remineralizing enamel around orthodontic brackets on the occlusal surface of a first permanent molar. Moreover, further proof was provided by Alkilzy et al.,⁽⁸⁾ via quantitative analysis using Diagnodent, in which there was a statistically significant reduction in laser fluorescence readings in the test group (combination of self-assembling

peptide P11-4 and fluoride), in comparison to the control group (fluoride varnish only), after three and six months. Also Kamal et al.,⁽⁹⁾ stated that there was a significant increase in surface microhardness values after remineralization, where the highest surface microhardness values were reported in (self-assembling peptide P11-4 with Casein Phosphopeptide-Amorphous Calcium Phosphate with fluoride (CPP-ACPF), followed by (self-assembling peptide P11-4 with fluoride), self-assembling peptide, CPP-ACPF, and artificial saliva. Concerning Change in fluorescence (ΔF), after six months, both the self-assembling peptide P11-4 and the combination groups outperformed the Amorphous calcium phosphate and control groups statistically significantly. These findings were in agreement with Salem, et al.,⁽¹⁰⁾ concluded that the treatment of early enamel lesions using self-assembling peptide p11-4 whether used solitary or in combination with fluoride, showed a positive outcome that was superior to that of fluoride varnish alone. Also Welk et al.,⁽¹¹⁾ recorded a marked decrease in impedance readings (using CarieScan) after three months of application self-assembling peptide P11-4 application and the readings remained stable up to six months from application. On the other hand, Gozeticic et al.,⁽¹²⁾ found that there was no significant difference between self-assembling peptide P11-4 and fluoride test groups using laser fluorescence pen, over the course of six months. Again, Alsamolly⁽¹³⁾ assessed that the highest degree of remineralization recorded by Diagnodent fluorescent reading was for samples treated by Curodont repair after six-month storage time during the evaluation the degree of demineralization and remineralization in sub-clinical carious lesion using different biomimetic remineralizing agent. Finally, the results of this study showed that post-orthodontic WSL remineralization increased quantitatively and qualitatively in all groups and over time intervals. However, the WSLs recovery

was much better in the combination group followed by the self-assembling peptide group, than control group when compared to the administered remineralizing analogue, saliva failed to start the process of boosting calcium and phosphate levels in the lesion's subsurface, resulting in the lowest remineralization values. As a result, the remineralization potential is great of the WSLs the decrease in (ΔF) in both groups ;(the combination and self-assembling peptide P11-4 group) which prove the success of guided enamel regeneration with an end goal to prevent lesion progress, enhance strength of the teeth.

CONCLUSION

Combining the organic and inorganic remineralizing analogues showed more prominent remineralizing efficiency after both one month and six months in comparison to each of them when used alone. Combining self-assembling peptide P11-4 with other inorganic remineralizing analogues provides additional advantages of speeding up and optimizing the process of remineralization, enabling for far faster and more effective regenerative healing for the post orthodontic white spot lesion.

REFERENCES

1. Sonesson M, Bergstrand F, Gizani S, Twetman S. Management of post-orthodontic white spot lesions: an updated systematic review. *Eur J Ortho*. 2017; 39: 116-121.
2. Khoroushi M, Kachuie M. Prevention and Treatment of White Spot Lesions in Orthodontic Patients. *Contemp Clinic Dent*. 2017; 8: 11-19.
3. Sagarika N, Suchindran S, Loganathan SC, and Gopikrishna V. Prevalence of White Spot Lesion in a Section of Indian Population Undergoing Fixed Orthodontic Treatment : An in Vivo Assessment using The Visual International Caries Detection and Assessment System II Criteria. *J Conserv Dent*. 2012; 15: 104-108.

4. Eltayeb M K, Ibrahim Y E, El Karim I, Sanhoury N M. Distribution of white spot lesions among orthodontic patients attending teaching institutes in Khartoum. *BMC Oral Heal* 2017; 17: 88.
5. Gomez J. Detection and diagnosis of the early caries lesion. *BMC Oral Health*. 2015; 15, 3.
6. Alkilzy M, Santamaria RM, Schmoeckel J, Splieth CH. Treatment of carious lesions using self-assembling peptides. *Adv Dent Res*. 2018; 29: 42-47.
7. Jablonski-Momeni A, Nothelfer R, Morawietz M, Kiesow A, Korbmacher-Steiner H. Impact of self-assembling peptides in remineralisation of artificial early enamel lesions adjacent to orthodontic brackets. *Sci Rep*. 2020; 10.
8. Alkilzy M, Tarabaih A, and Splieth C. Safety and Applicability of Curodont™ Repair in Children with Early Occlusal-Caries. Conference Paper Oct.: 10th World Congress on Preventive Dentistry. 2013.
9. Kamal D, Hassanein H, Elkassas D, Hamza H. Complementary remineralizing effect of self-assembling peptide (P11-4) with CPP-ACPF or fluoride: An in vitro study. *J Clin Exp Dent*. 2020; 12 : 161-168.
10. Salem MN, Raneen Ahmed Gohar RA, Hafez SI, Abulnoor B. Classical Versus Non-classical Strategies for Remineralization of Early Enamel Lesions: Systematic Review and Meta-analysis. *J Int Oral Heal*. 2021, IP:156.220.94.86.
11. Welk A, Ratzmann A, Reich M, Krey K, Schwahn C. Effect of self-assembling peptide P11-4 on orthodontic treatment-induced carious lesions. *Sci Rep*. 2020; 10 .
12. Gozeticic B, Ozturk-Bozkurt F, Toz-Akalin T. Comparative evaluation of resin infiltration and remineralization of non-cavitated smooth surface caries lesions: 6-Month results. *Oral Heal Prev Dent* 2019;17:99-106.
13. Alsamolly W. Comparative Assessment of remineralizing potential of recent biomimetic remineralizing agents on sub-surface carious lesions: An in vitro study. *Egy Dent J*. 2021; 67: 1711- 1722.