JODR
VOLUME 7, Issue 1, 2020

Chlorhexidine Effect on Color of Treated White Spot Lesion with Remineralization Materials (Fluoride Varnish, Tooth Mousse)

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Received December 20, 2019.
Accepted for publication February 16, 2020.
Published March 21, 2020

ABSTRACT
Background the white spot lesions represent subsurface enamel demineralization, manifested as white opacities which considered as esthetic problem. **Objectives** to evaluate the color improvement of white spot lesions and stability against discoloration following, fluoride varnish, tooth mousse treatments with immersion in chlorhexidine. **Materials and Methods** artificial white spot lesions created on the gingival third of buccal surface of premolar tooth (N=90) using demineralization solution; PH (4-4.5) at room temperature for 4 weeks, specimens were treated with fluoride varnish, tooth mousse and untreated group (control). Groups were immersed in chlorhexidine for 1 hour. Color change was measured with vita easy shade device at baseline, after white spot lesions formation, after treatment and after immersion in chlorhexidine. **Results** the mean of color change in deionized distilled water and chlorhexidine increased after formation of white spot lesions then decreased with the application of fluoride varnish and tooth mousse, there was a significant difference between the white spot lesions, fluoride and Mousse group in deionized distilled water and chlorhexidine, there was non-significant effect of chlorhexidine on color of white spot lesions treated with fluoride varnish. **Conclusion** the fluoride varnish and tooth mousse could return mineral to subsurface enamel of white spot lesions and might improve esthetics and color stability when the use of chlorhexidine with tooth mousse.

Key words: Chlorhexidine; fluoride varnish; tooth mousse; white spot lesions.

Introduction

Most orthodontic patients concern about maximize dental aesthetics during and after orthodontic treatment to improve the psychological state. One of the aesthetic aspects that concerned by the patient after removal of fixed orthodontic appliance is the integrity and color of the enamel that might affected due to larger accumulation of bacterial plaque with fixed orthodontic appliance and, hence, predisposes patients to enamel demineralization resulting from dissolution of the enamel, that appear within only a few weeks after appliance placement (Derks et al, 2004; Bergstrand and Twetman, 2011) and the favored sites for such demineralization area are around the cervical margins of the teeth (Featherstone, 2000). These subsurface enamel demineralization areas can vary from microscopic alterations to visible "white spot lesions" (WSL) that may represent the early phase of caries formation (Gorelick et al 1982; Bergstrand and Twetman, 2011).

The presence of these lesions affect enamel translucency that mainly attributed to the degree of the mineralization of the enamel structure and its mineral content, the translucency of enamel and underlying dentin determine the color of the tooth which varies from yellowish white to grayish white, WSL manifest themselves as white opacities visually which considered as esthetic problem (Bergstrand and Twetman, 2011).

The treatment protcols used to prevent WSL in orthodontic patient included oral hygiene instruction, application of fluoride and use of antimicrobial moth rinses which require patient compliance and was found effective in reducing the demineralization during orthodontic treatment and significant reduction in the enamel white spot lesions could be achieved during orthodontic therapy using l0 ml of neutral sodium fluoride rinse (Geigar et al, 1992). Other treatment modalities that not require patient compliance was remineralization by topical fluoride, casein phosphopeptide amorphous calcium (CAPP-ACP) and Resin infiltration or use invasive modality such as micro abrasion or adding antimicrobial agent to orthodontics material. (Andersson, 2007; Paris et al, 2013). Fluoride varnishes were developed to prolong the contact time between fluoride and enamel, so current concept of caries preventive mechanism of fluoride varnish is based on the formation of calcium fluoride on enamel surface permits significantly more incorporation of fluoride than with other fluoride applications, e.g. Acid phosphate fluoride gel, monofluoride phosphate dentifrices, home fluoride rinses (Demito et al, 2004; Vivaldi et al, 2006).

For instance, a three-monthly application of fluoride varnish resulted in a reduction in WSL incidence and the application of a fluoride varnish can be easily adapted to current orthodontic bonding; this reduction was about 35% in demineralized lesion depth by (Todd et al, 1999; Petersson et al, 2000). Other techniques proposed to mask the appearance of white spot lesions and some authors demonstrated that treatment for white spot lesions by improvement of remineralization using a complex of casein phosphopeptides and amorphous calcium phosphate (CCP-ACP), In vivo study investigated the effect of a dental cream containing CPP–ACP and compared with fluoride mouth rinses on remineralizing white spot lesions using laser fluorescence, where the regression of white spot lesions was seen following the application of CPP–ACP cream. (Anderson, 2007). Another in vivo study used sugar free chewing gum containing CPP–ACP also showed increase acid resistance and promotes remineralization of enamel (Ijima et al, 2004). The twice daily application of 10-fold diluted CPP–ACP paste resulted in preventing dentin demineralization (Oshiro et al, 2007).

The results of studies concerning the color properties of dental materials with increasing awareness of white spot lesions treatment and subsequent screening their color stability or the staining potential of different agents like chlorhexidine are meaningless unless they are based on reliable methods of color assessment, so studies frequently use colorimeters, digital cameras, spectrophotometers or portable digital spectrophotometer for example Vita Easy Shade Compact to assess color alterations. (Leonard et al, 2001; Eliades et al, 2004; Alline et al, 2011; Enver et al, 2014).

Chlorhexidine is the most effective antimicrobial cationic agent for the control of periodontal pathologies in the orthodontic patient (Sari and Birinci, 2007). However, the evidence regarding the effectiveness of chlorhexidine in controlling WSL is inconclusive (James et al, 2010). It is well known that chlorhexidine inhibits acid production in biofilm and thus reduces the fall in pH during sucrose challenges (Rolla and Melsen, 1975). Some authors concluded that one of the ways to prevent initial lesions in enamel is to protect the body of the lesion from microorganisms, by the application of antimicrobial agents (Yazio˘glu and Ulukapi, 2014). Color of enamel in areas of the teeth that are less accessible to brushing tend to stain and is often promoted using certain cationic agents such as chlorhexidine or metal salts (Joiner, 2004; Yuana et al, 2014). Few in vitro studies have evaluated the effects of cationic agents such as chlorhexidine on the color of remineralization dental materials of WSL; therefore, the aim of the present in vitro study was to evaluate the color stability of WSL, remineralization treatment materials in distilled water and Chlorhexidine.

Materials and methods

Sample Preparation

Ninety human permanent premolars were selected as sample according to the selection criteria from 115 premolar teeth extracted from 67 male and 48 females for orthodontic treatment who attend oral surgery department at the Baghdad College of dentistry and some private clinics in Baghdad city. The sample was evaluated within two weeks from extraction time by means of a reflecting spectrophotometer (VITA Easy shade, Zahnfabrik, Switzerland) to equalize the shade, exclusion selection criteria were: presence of stain, demineralization (white spot lesion), caries, Fluorosis, Enamel cracks, restorations in teeth (Enver et al, 2014).

After extraction, the teeth cleaned in tap water for 1 minute each and stored in 0.05% of thymol solution at room temperature in closed container within two weeks until their use to minimize brittleness of enamel and microbial growth. Each sample tooth was fixed on a glass slide in a vertical position with carving wax block, then each tooth was polished with non–fluoridated pumice slurry and rubber cup bur attached to a low speed hand piece for 10 sec (Ostby et al, 2007), The white spot lesions (WSL) was created at the gingival third of buccal surface of sample tooth about 6 mm×6 mm dimension window by using adhesive tape, The other surfaces of tooth coated by acid resistance nail varnish around the gingival window(Issa et al, 2003). The sample teeth were immersed in the demineralization solution with PH (4 - 4.5) at room temperature in closed container to prevent dehydration for 4 weeks where the solution changed every two days (48 hours) to keep the pH constant. After demineralization, specimens were washed thoroughly with distilled deionized water (DDW), and the nail varnish was removed by using acetone then the teeth washed in DDW again. After this procedure each tooth displayed an artificial WSL of 6 mm× 6 mm (Issa et al, 2003).

WSL and Treatment Group

After WSLs formation; 90 teeth were randomly divided into three groups each group was 30 teeth as following:

WSL Group

Specimens with untreated white spot lesion, stored in DDW.

Fluoride Treatment Group

The tooth surface was treated with fluoride varnish (5% sodium fluoride varnish contained CAPP-ACP), (GC Corporation, Tokyo, Japan) according to manufacture instruction, teeth cleaned and dried first before application of fluoride varnish then varnish applied on the tooth surface by using disposable brush.

Tooth Mousse Treatment Group

Tooth mousse (GC Corporation, Tokyo, Japan) applied according to manufacture, in brief as following:

1. Enough tooth mousse applied to the tooth surface using a disposable artistic brush for minimum 3 mins.

2. Tooth mousse leaved if possible an additional three minute undisturbed and kept on tooth for thirty minutes following application.

Immersion in chlorhexidine Procedure

Chlorhexidine(Corsodyl®Chlorhexidine digluconate 0.2% W\V,(GlaxoSmithKline, UK) was used as an immersion media in the study and was started after formation of WSL and treatment procedure;remineralization; finished. The samples immersed in chlorhexidine in closed container for one hour in at 37°c in the incubator (Ostby et al, 2007).

Sample Screening and Evaluation

The artificial WSL of each tooth was evaluated by means of a reflecting spectrophotometer (VITA Easy shade, Zahnfabrik, Switzerland). Baseline comparisons performed by measuring the color change (ΔE) of the WSL compared to the adjacent sound enamel. The device was calibrated before each session on the white table supplied with it, the treated artificial WSL (fluoride varnish, tooth mousse) of each tooth evaluated again by means of a reflecting spectrophotometer. Then after immersion in chlorhexidine, again the artificial WSL and treated WSL of each tooth were evaluated by means of a reflecting spectrophotometer.

Statistical Analysis

Statistical analyses were carried out with the statistical package IBM SPSS® System for Windows version 21 (IBM Institute Inc, Armonk, NC, USA) which include Mean, standard error and standard deviation, inferential statistics including: One way analysis of variance (ANOVA) to test any statistically significant difference among groups and Least significant difference (LSD) to test any statistically significant differences between each two subgroups when ANOVA showed a statistical significant difference within the same group, T- test was used to determine whether there was a significant difference in mean of change in color (ΔE) after immersion in chlorhexidine.

Results

The mean values of Colour change (ΔE) for WSL group in DDW increased after formation of artificial WSL; while with the application of fluoride varnish and tooth mousse values of Colour change (ΔE) decreased. The color change (ΔE) mean of WSL immersed in chlorhexidine was increased then decreased after treatment in the tooth mousse and fluoride varnish group (Table 1).

WSL and treated WSL groups in DDW and in chlorhexidine revealed a significant effect for the type of treatment on the color change (ΔE) in one-way ANOVA, there was a statistically significant difference in LSD test between the WSL, fluoride and tooth mousse groups in DDW and in chlorhexidine (Table 2).

The effect of chlorhexidine revealed a significant difference for the effect in the WSL group and the WSL that treated with tooth mousse in T-test while a non-significant difference of the effect of chlorhexidine in the WSL group that treated with fluoride varnish (Table 3).

Table (1): Descriptive statistics of the effect of different treatment on degree of color change of white spot lesions.

		N	Mean	Std. Deviation	Std. Error
White spot lesion groups in DDW	WSL	15	26.33	1.06	0.34
	Fluoride	15	13.06	2.27	0.72
	Tooth mousse	15	14.74	2.67	0.84
White spot lesion groups in CHX	WSL	15	37.84	1.02	0.32
	Fluoride	15	13.09	2.41	0.76
	Tooth mousse	15	23.10	3.38	1.07

Table (2): Inferential analyses of the effect of different treatment modalities on color change of white spot lesions.

Study groups	ANOVA		Treatment	Treatment	LSD	
	F	Sig.			Mean Difference	Sig.
White spot lesion group in DDW	125.35	.000	WSL	Fluoride	12.27	.000
				Tooth mousse	9.59	.000
			Fluoride varnish	Tooth mousse	-2.68	.003
White spot lesion group	188.72	.000	WSL	Fluoride	25.75	.000
				Tooth mousse	14.74	.000

The mean difference is significant at the 0.05 level.

Table (3): Inferential analysis the effect of Chlorhexidine in study groups.

Study groups	T Test			
	Bavarage		T test	Sig.
WSL group	DDW	CHX	13.51	.000
Fluoride varnish group	DDW	CHX	.03	.978
Tooth mousse group	DDW	CHX	8.36	.000

The mean difference is significant at the 0.05 level.

Discussion

In this study, evaluation of color stability by reflecting spectrophotometer (VITA Easy shade) was preferred because it is a sensitive and objective instrument for investigating color change. This method achieves a reproducible means for determining when change in color occurs below visual perception levels.

WSL and treated WSL groups in DDW

The increased mean of color change (ΔE) after formation of artificial WSL was because the air or water in the micro-porosities of WSL which effect the light refraction through the enamel that produce the white opacity and the air or water in the micro-porosities of WSL was replaced with fluoride varnish and tooth mousse treatment material, leading to less light scattering within the enamel and significant decrease of ΔE mean values with a statistically significant difference between the two groups ;WSL and fluoride group, WSL and tooth mousse group.

WSLs and Treated WSLs Groups in Chlorhexidine

The immersion of WSL in chlorhexidine increased the color change (ΔE) mean that might be due to the erosive effect of alcohol of chlorhexidine that increase of WSL porosity and staining effect of chlorhexidine on WSL. The treatment of WSL with tooth mousse or fluoride varnish decreased the ΔE mean value with a significant difference between WSL and tooth mousse group because of the deposition of calcium ions of tooth mousse that enhanced subsurface remineralization, while the non-significant effect of chlorhexidine on WSL treated with fluoride group might due to fluoroapatite crystals that formed by fluoride ions of varnish that prevent the staining effect of chlorhexidine.

Conclusion

• Formation of WSL during Fixed orthodontic treatment is associated with significant tooth color changes. The use of remineralization material (fluoride varnish, tooth mousse) could return mineral to subsurface enamel of WSL and improve esthetics with good color stability.

• Chlorhexidine with tooth mousse can improve the esthetic characteristics of WSL; however, the long-term effect of resin infiltration on WSL in clinical practice should be studied further.

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