



Management of White Spot Lesion: A Literature Review

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Abstract

Decalcification of enamel after several years of treatment remains highly problematic. Therefore, prevention and treatment of WSLs is very important in fixed mechanotherapy. Recent advances are emerged to respond to this situation, including new microinvasive approaches for WSL infiltration and camouflage. Despite many preventive strategies are under development, they failed to prevent WSL formation completely. To prevent the formation of white spot lesions, orthodontist should do the caries risk assessment before during and after treatment. Thus, the goal of modern dentistry is to prevent the white spot lesion and improve the esthetic outcome of the patient.

Keywords: White spot lesion, Prevention, Remineralization

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1. Introduction

Enamel translucency is basically due to the presence of inter-crystalline space. It is quantitatively defined by enamel refractive index (ERI). The variation of ERI is determined by any clinical situation where there is an alteration of the enamel organization [1]. A lesion with a milky white opaque appearance is found when there is a difference in refractive index between the healthy enamel and the demineralized area. This is clearly distinguishable from the surrounding healthy enamel [2]. Prolonged bacterial plaque accumulation causes white spot lesions (WSLs), which are commonly seen on smooth surfaces of the enamel. WSLs associated with orthodontic appliance are surface softened lesions. Pathogenesis of white spot lesions (WSLs) may be influenced by various factors. Patients with malocclusions usually have plaque retention sites, which creates WSLs [3]. The probability of WSLs occurrence around the orthodontic brackets can be reduced by salivary flow, fluoridated toothpastes & mouthwashes. This way, further esthetic treatment won't be necessary [4]. Management of WSLs include preventing demineralization and methods to encourage remineralization of existing lesions which is a natural repair process. Usually, the conventional treatment approach is quite invasive as it involves restoration of defective enamel. The need of this literature is to emphasize prophylactic approach instead of invasive restoration of carious defects.

2. Management of white spot lesions

2.1. Maintenance of oral hygiene

Oral hygiene influences pH level of the patients. Patients undergoing orthodontic treatment can have a decrease in pH level around the braces. During initial stages of acid attacks, the pH level will not reduce beyond the critical level when there is a good oral hygiene. When the patient has a poor oral hygiene, permanent loss of mineral can be found around braces as a result of reduced pH level for a long time [5]. An effective method to prevent caries formation is to reduce the amount of plaque on the tooth surface. Dental plaque can be removed either mechanically or chemically. The most common mechanical method of controlling plaque is tooth brushing. Plaque control using chemical method is done usually with mouthwashes involving different ingredients. It doesn't damage the surrounding oral tissues and is an effective agent that reduce bacterial count by 99.9%. The most effective mouthwash is the one that contains chlorhexidine. It is generally advised that patients should brush with fluoridated dentifrice for minimum of three times a day. Patients should be demonstrated with brushing and flossing technique. With the presence of fixed appliance, electric toothbrush is recommended over manual tooth brushing as it will result in lower amount of plaque formation. It has been observed that scaling at regular intervals can help reducing the formation of WSLs.

2.1. Fluoride

Fluoride application can reduce the demineralizing property of the enamel. The presence of fluoride in saliva and plaque can prevent demineralization and helps

remineralization. Cariogenic bacteria release organic acids. Organic acids reduce the pH level of plaque resulting in diffusion of fluoride from plaque & saliva into the enamel. Fluorapatite crystals which are more resistant to acids are created by the displacement of hydroxyl ions with fluoride [6]. Hence caries formation & activities of cariogenic bacteria is affected by fluoride. Low solubility of fluoride results in lesser penetration in enamel surface. So the surface of the enamel contains higher fluoride level. Fluoride works more effectively when pH level is between 4.5-6 [7].

2.3. Fluoride toothpastes

It is the most commonly used form of fluoride to provide a consistent and low volume of fluoride in oral environment. Fluoride compounds like sodium fluoride, sodium monofluorophosphate, amine fluoride and stannous fluoride have been included in the toothpaste either solely or in various formulated combinations. WHO recommends 1000 to 1500 parts per million (ppm F) of fluoride concentration [8]. In most countries, toothpaste with low fluoride with 450 to 500 ppm are recommended for children. For adults at higher caries risk, toothpaste more than 1500 ppm upto 5000 ppm is usually prescribed. Toothpaste with higher fluoride content gives more protection against caries. According to American Academy of Pediatric Dentistry (AAPD), usage of smear or rice size and a pea-size volume of fluoridated toothpaste is recommended for 3-year old and 3–6-year-old children respectively. Marinho et al recommends only pea size amount of toothpaste for children upto 6 years of age. To have a better effect, it is usually advised to brush twice a day. There is a huge plunge in the tooth caries incidence owing to enlarged use of fluoride-containing toothpastes. An amino acid, called arginine, that's naturally present in a range of food products & in the saliva is now brought in to toothpastes as well. Ammonia is produced when arginine gets deaminated by the arginine deaminase system in saliva. This ammonia, which has high levels of alkaline increases the pH in oral biofilm. Zero et al states that to decrease oral fluoride retention, it is advised to rinse with tap water followed by tooth brushing as this has been seen as a widely seen practice.

a. Fluoride mouth rinses

For prevention of dental caries and management of WSLs in children, fluoride mouth rinses have been used. Marinho et al. suggests that regular use of fluoride mouth rinse by children & adolescents helps in reducing caries increment in permanent teeth. Mouth rinsing is not advised for children under 6 years old as there is a risk of fluoride ingestion [9].

b. Fluoride varnishes

To increase the contact time and for prevention of immediate loss of fluoride after application, fluoride varnishes were found. Thus, they act as a reservoir to enable slow release and provide greater fluoride uptake. Fluoride varnish application is thought to be safe because the exposure is kept under control. Fluoride is released gradually by the varnish application and thus can be applied fast and effortlessly. For varnish application, dental prophylaxis is not required [7]. Therefore, chairside time is reduced and there would be no need for patient compliance. In order for the fluoride varnish to be more effective, patients should not eat

for 2-4 hours post application and should avoid brushing their teeth in the night of varnish application. Application of fluoride varnish should be at-least twice a year for deciduous teeth and 2 to 4 times a year for permanent teeth. Limitation of varnish involve teeth discoloration, increased frequency of application, prolonged chairside time and increased cost.

c. Fluoride gel

Application of fluoride gel can be done professionals and also by patients themselves. There are multiple methods for professional application. One of such methods being application of fluoride using a mouth tray involves placing of fluoride gel into a mouth tray and applied to entire dental arch at the same time [10]. This method is easily accepted by children. Cotton balls and toothbrushes are the other methods. Most commonly used gels are 1.23% sodium fluoride gel (12,300 ppm F) and acidulated phosphate fluoride (APF) gel [11]. The acidulation of this form is composed with phosphoric acid having pH 3.0. Usage of fluoride vehicle with a lower pH value may prolong the infusion of mineral ions into the body of lesion resulting in occurrence of remineralization of lesion [12,13]. Addition of phosphate to an acid fluoride solution was used to reduce calcium fluoride formation and increase fluoro apatite formation. Professional application of fluoride gel is done upto 4 times a year for 4 minutes. The use of fluoride gel in children under 6 years old is not recommended owing to the risk of swallowing [12].

d. Fluoride foam

APF foam having same concentrations (1.23%) and pH (3-4) of APF gel is applied in the same manner as APF gel [13]. Since foam has a much lighter specific weight compared to a gel, the tray will take far less weight when filled with foam. Thus, it reduces the volume of excess fluoride ingestion. APF foam has been observed to be a beneficial alternative. It is professionally applied for 4 minutes and 2 times a year. This is considered to be effective in the prevention of dental caries in primary teeth. AAPD recommends professional fluoride treatment for children with increased caries risk at least every 6 months. The methods and intervals of preventive interventions might change based on the risk categories.

e. Fluoride releasing orthodontic materials

Advantage and disadvantage of fluoride releasing materials are being not dependent on compliance and release of large amounts of fluoride respectively. However, the levels drop down to sub-therapeutic levels throughout orthodontic treatment [14]. During treatment, Glass ionomer cement (GIC) and resin modified glass ionomer cement (RMGIC) can prevent de-mineralisation around orthodontic brackets when compared to resin adhesives. Reduced shear and tensile strengths in GIC adhesives is the reason why its usage is not widespread when compared to resin adhesives [15]. Even though fluoride releasing composite resin has been developed, it doesn't release more than RMGIC and GIC adhesives. Fluoride releasing elastomers haven't seen wide use in orthodontics. This is because of drastic reduction in fluoride release after initial placement and its ineffective force levels compared to regular elastomers.

f. Casein phosphopeptide-amorphous calcium phosphate

Both CPP-ACP and CPP-ACFP have remineralising effects on the enamel surface. The additional advantage of fluoride in CPP-ACPF has shown more remineralisation [16,17]. The mechanism involves forming nano-complexes of CPP-ACP to serve as a reservoir in a soluble form for calcium and phosphate ions adjacent to the tooth's surface to reduce demineralisation and increase remineralisation [18]. CPP-ACP can be included to various products such as GIC, chewing gum, mints and topical gels for its beneficial impact. A benefit of CPP-ACP over fluoride is not causing fluorosis because of high doses. Therefore, the risk of fluorosis gets reduced by the usage of CPP-ACP as it reduces the need for fluoride [19,20].

g. Usage of antimicrobial agents

Chemotherapeutic agents will not prevent dental plaque formation. However, it can be useful in removing microorganisms. Microorganisms are one of the main factors that can cause enamel demineralization [21,22]. The most preferred antimicrobial agents for this purpose are chlorhexidine & benzalkonium. Studies show that these agents reduce streptococcus mutans levels significantly especially when these are responsible for demineralization and caries formation [23]. However frequent usage of these antimicrobial agents as in twice a day can cause teeth discoloration. Thus, in order to reduce its side effects in the process of orthodontic treatment it is said that 0.2% chlorhexidine mouthwash can be used [24].

h. Polyols

Polyols which are alcoholic derivatives of sugars are metabolized even more slower than sucrose by oral bacteria. It reduces risk of caries formation. It was initially found to be used in diabetic products but in recent times they have been used in sugar free products such as chewing gum, chocolate, boiled sweets & biscuits. Polyols (bulk sweeteners) contain xylitol, sorbitol, mannitol, maltitol & lactitol [27]. Xylitol causes cell death by reducing mutans streptococci level. It also increases the salivary flow and enhance the mineralization process. Xylitol is recommended only in lozenge form, not as chewing gum mainly in patients who are undergoing orthodontic therapy.

i. Chlorhexidine

A broad range of antiseptic effect is seen in chlorhexidine. Acid production in bacterial plaque is inhibited by bacteriostatic and bactericidal effects of chlorhexidine on streptococcus mutans. Remineralization potential of chlorhexidine is due to precipitation of phosphate salts on demineralized enamel surface [28,29]. Chlorhexidine along with fluoride was found to be more effective in treating active WSLs than the use of one alone [30,31].

j. Sealants

Acid attacks are protected by means of surface shield created by sealants. There are two types of sealants, chemical and light curing. Initially Chemical-curing sealants were used. But it has the disadvantages of uncured layers, which was increased over time. Better polymerization and a better barrier for demineralization was seen in light curing sealants [34]. But they have low wear resistance and they are

easily abraded by toothbrushes and therefore re-application is needed. Patient compliance is not needed.

k. Bonding Technique

Area of 1 mm protection is given by fluoride releasing brackets, whereas fluoride free adhesives cannot prevent demineralization around and under brackets. So, it is always better to use a fluoride releasing adhesive. Bonding material should not be exceeded beyond the bracket as they can permit a plaque retention site [35]. Orthodontic band should be properly contoured otherwise it may results in leakage and decalcification.

l. Dental bleaching

White spot lesions can be camouflaged bleaching following natural remineralization which occurs by itself. They can be applied either by the patient at home or by a professional in dental office. Various dosages of hydrogen peroxide is incorporated in a gel and can be applied to the patients with the help of transparent trays [36]. The effect of bleaching on inactive white spot lesions and intact enamel was examined by Knosel et al and he concluded that a distinct color was seen in both of them. It was reported that greater amount of whitening was found in intact enamel surface.

m. Micro-abrasion

Controlled removal of enamel surface can be achieved by microabrasion. Greater amount of fluoride is seen in the outer surface of enamel and therefore small amount of enamel is removed in the first step of microabrasion [37,38]. It can be done by polishing labial/buccal surface of teeth with 18% hydrochloric acid (HCl) and pumice. Interprismatic spaces are filled with calcium and phosphate as a result of microabrasion and more resistant to external factors is created in the enamel [39].

n. Resin infiltration

The appearance of WSL can be improved by resin infiltration technique. Resin seals the pores in the enamel and prevent penetration of acid into the lesion. It also prevent the cavitation or breakdown of enamel surface and strengthen the enamel [40]. It slowed down or even arrest the progression of lesion. 15% hydrochloric acid gel applied for 2min will permit the resin to reach deeper into the lesion. Desiccation of lesion can be occurred by applying ethanol, as it removes water from the lesion and resin penetration into the pores is facilitated by increased surface free energy [41]. Meyer et al. suggested that excessive resin can create a retention sites for biofilm and new caries lesion. As a positive side effect, resin lose their whitish-opaque color appearance and look similar to sound enamel. Hence, this treatment improves the esthetic appearance of buccal WSLs [42].

o. Ozone

Ozone application can reduce the microorganisms by breaking up the cell walls of bacteria, viruses, and fungi, and also kills the acid producing bacteria causing decay [43]. Micro-organisms can be removed by this method and demineralization activity is stopped only in the outer half of enamel lesions [44,45].

3. Conclusions

Decalcification of enamel after several years of treatment remains highly problematic. Therefore, prevention and treatment of WSLs is very important in fixed mechanotherapy. Recent advances are emerged to respond to this situation, including new microinvasive approaches for WSL infiltration and camouflage. Despite many preventive strategies are under development, they failed to prevent WSL formation completely.

To prevent the formation of white spot lesions, orthodontist should do the caries risk assessment before, during and after treatment. Various literatures are available for treating white spot lesion, but only few literature focuses on prevention of white spot lesion. Thus, this limitation should be overcome by concentrating more on prevention of white spot lesion.

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