Review Article

WHITE SPOT LESIONS – REVISITED

Manisha Yadav[1], Simerpreet Kaur Bagga[2], Prateek Jain[2], Harmeet Singh[3]

[1]Ex Senior Resident, Department of Orthodontics, AIIMS, New Delhi,
[2]B.D.S. Private Practice,
[3]Dept of Conservative Dentistry & Endodontics, Institute of Dental Sciences, Sehora, Jammu

Abstract:
Demineralized white spot lesions of enamel occur disturbingly around fixed orthodontic appliances, as oral hygiene becomes difficult to maintain, which induces a low resting pH plaque. If WSLs are left untreated, they can become esthetic problem or carious cavitations. Hence prevention is better than cure of WSLs, to minimize tooth decay.
Keywords: Tooth whitening, Esthetics, Hydrogen peroxide, Peroxide toxicity

Corresponding author: Dr. Manisha Yadav, Ex Senior Resident, Department of Orthodontics, AIIMS, New Delhi.

This article may be cited as: Yadav M, Kaur S, Jain P, Singh H. White Spot Lesions – Revisited. J Adv Med Dent Scie Res 2014;2(4):141-146.

INTRODUCTION

White spot lesion on the enamel surface is one of the important iatrogenic effects of fixed orthodontic appliance treatment. Patients with malocclusions have irregular sites and also attachments of fixed appliances acts as retention areas, which make oral hygiene more difficult to carry out. WSLs can be prevented or reduced by maintaining good oral hygiene, also by using fluoridated dentifrice, mouth rinses and varnishes. It would be advantageous to use bonding system which releases fluoride for less compliant patients. Orthodontist should take the precaution from the starting of treatment, by motivating patient and by avoiding or limiting their development. The banding and bonding of orthodontic appliances to teeth increases the number of plaque retention sites and, as a result, oral hygiene becomes more difficult. The low pH of plaque adjacent to orthodontic brackets hinders the remineralization process, and decalcification of enamel can occur.[1] Treatment of WSLs should begin with most conservative approach, but, if problem is not resolved then aggressive approach has to be done.

Types of white lesions on enamel

Differentiating white tooth discolorations and accurate diagnosis can be challenging. Russell has classified white discolorations of enamel as dental fluorosis, opacities, or WSLs.[2]

Fluorosis: white/yellowish lesions that are not well defined, blending with normal enamel, and having symmetrical distribution in the mouth.

Opacities: have a more defined shape, are well differentiated from surrounding enamel, often located in the middle of the tooth, and randomly distributed.

WSLs: are often seen under loose bands, around the periphery of the bracket base, and in areas that are difficult for the toothbrush to access.

DEVELOPMENT OF WHITE SPOT LESIONS WITH ORTHODONTIC TREATMENT

Incidence

A study from northern part of Norway concluded that 50% of the orthodontic patients developed WSLs and 5.7% teeth were affected, compared to non- orthodontic in whom, 11% developed WSLs and 0.4% teeth were affected.[3]

Boersma and coworkers used quantitative light-induced fluorescence (QLF) technique and observed that 97% of all subjects and 30% of buccal surfaces were affected and also 40% of the surfaces in males and 22% in females showed white spot lesions.[4]

Teeth more commonly get affected are, first molars, upper lateral incisors and lower canines. Distogingival quadrant of upper lateral incisor is commonly affected.

Mechanism for development of WSLs

Fixed orthodontic treatment increases rapid increase in dental plaque volume (Figure 1), it can be attributed to

1. Complex appliance design like, loops, coils, springs, auxiliary arch wires and some class II correctors, which makes cleaning impossible in some areas,
2. Excess bonding material around bracket which causes pocket formation
3. Elastic modules or e- chains
4. Less compliance from patient.

This increased volume of dental plaque following orthodontic treatment has lower pH, also there is elevation in the levels of S. *mutans*, which is acidic bacteria and produces organic acids in the presence of fermentable carbohydrates which further does lowering of pH of plaque. As the pH drops below the threshold for remineralization, carious decalcification occurs.

Figure 1: Accumulation of plaque around brackets

PREVENTION OF WSLs

Prevention of WSLs starts from the first day till last day by following measures:

1. Good oral hygiene

After bonding, the resting pH is lowered slightly but good oral hygiene keep the pH above the critical point of 4.5 and fluoride prevents lesions by increasing remineralization and inhibiting demineralization. With poor oral hygiene, plaque builds up around the appliance and the resting pH may reach the limit of the fluoride effect at pH 4.5 .At this low pH the liquid phase of the plaque will be undersaturated with respect to both hydroxyapatite and fluorapatite and no redeposition of lost mineral (remineralization) will occur and carious decalcification occurs.[5] (Figure 2)

2. Dentifrices

Dentifrices normally contain either sodium fluoride, monofluorophosphate, stannous fluoride, amine fluoride, or a combination of these compounds. Fluoride concentration below 0.1% in dentifrices is not recommended for orthodontic patients. This is because an appropriate level of fluoride ions is needed to provide an anticaries benefit by promoting enamel remineralization. Stannous fluoride also has plaque-inhibiting effect by interfering with the adsorption of plaque bacteria to the enamel surface[6, 7]. Tin atoms in stannous products also block the

passage of sucrose into bacterial cells, thus inhibiting acid production.

Figure 2: White spot lesion seen on lower left first molar after debanding.

3. Mouth Rinses

Less compliant patients alone with the use of dentifrice cannot prevent demineralization, and supplemental source in the form of mouth rinses is recommended. Fluoridated mouth rinses containing 0.05% sodium fluoride when used daily, showed significant reduction in lesion formation beneath bands. These mouth rinses are generally combined with antibacterial agents such as chlorhexidene, triclosan or zinc to improve their cariostatic effect.

4. Varnishes

The colophonybased varnish is a sticky yellowish-brown substance that hardens on contact with saliva producing a temporary cover over the enamel[8]. Fluoride ions from the edges of brushed off varnish, gets incorporated into enamel as fluoridated hydroxyapatite, which is a less soluble apatite.CaF_2- like deposits by varnish provide fluoride ions that diffuse into the plaque liquid and participate in the remineralization of enamel. Patients with a moderate cariogenic threat may benefit from repeated applications of a fluoride varnish but that increases cost to the patient and increased chair time for the clinician. One disadvantage of varnish application is the temporary discoloration of the teeth and gingival tissues.

5. Sealants

Fluoride releasing sealants have ability to be recharged with fluoride ions. Sealants like, Proseal and Itasca are capable of releasing fluoride ions for 17 weeks, but the level of ions decreased later.[9] As per Ten Cate sub-ppm levels also has significant impact on remineralization.

6. Adhesives

Adhesive releasing fluoride ions would be beneficial for preventing demineralization. Glass ionomer cements were initially introduced because of their fluoride releasing ability but, their lower bond strength, limit them to be used as adhesive for bonding. Later resins particles added in GICs to form Resin Modified GIC, they have higher bond strength but lower shear bond strength (SBS) compared to composite resins.

7. Antimicrobials

Addition of antimicrobials to the adhesive system would eliminate the need for patient cooperation, in patients with high caries risk. Chlorhexidine can be used as a separate varnish layer over sealant but it reduces SBS. Another antimicrobial 2.5% Cetylpyridinim Chloride in adhesive system inhibit bacterial growth for 196 days and also doesn't affect bond strength[10].

EVALUATION OF WSLs

A. MACROSCOPIC METHODS: A demineralized lesion in enamel, backscatter more light due to which it appears white spot, reason being, most photons are scattered within the lesion than penetrating dentine. There are various macroscopic techniques for assessing enamel demineralization.

1. Clinical Examination

Clinicians are trained to perform visual examination to assess demineralization before, during and after orthodontic treatment.

Advantages: simple, inexpensive and clinically valid.

Disadvantages: validity is questionable, risk of bias, inter and intra examiner errors.

2. Photographic Examination

A photographic technique for evaluation of WSLs is used extensively by clinicians, for record purpose, to assess the extent and also for motivating patients.

Advantages: Quick and standardized method, permanent record, mask patients details, no intra- examiner variability, can be digitized and can be assessed by independent expert.

Disadvantages: Lens record differently than what naked eye sees, reflection of flash can over-estimate opacity and standardization becomes difficult keeping wetness and lighting conditions in mind.

3. Optical Nonfluorescent Methods

First described by Ten Bosch and coworkers, they used 100-W white light and measured its backscatter with a densitometer using Optical Caries Monitor (OCM) [11, 12].

Advantages: Convenient and nondestructive quantification.

Disadvantages: Technique sensitive, results vary depending on wetness or drying of tooth.

4. Optical Fluorescent Methods

Demineralization leads to more backscattering of light, so it will absorb less fluorescence and appear darker. There are different techniques for producing fluorescence in enamel.

a. ***Fluorescent Dye*:** Once dye uptake takes place, specimen is examined under suitable light source. One of the drawback of this procedure is, procedural variation results in variation in dye uptake also, this procedure is done for detection and removal of carious dentine.

b. ***Ultraviolet Light*:** Few studies have been done by using Ultraviolet light for early detection, but its wavelength is harmful to eyes and skin.

c. ***Laser*:** Bjelkhagen and coworkers, used argon laser to differentiate between the luminescence of carious and intact enamel[13]. In another method, DIAGNODent instrument is used, which gives reading of bacterial activity rather than mineral loss. Disadvantage of this method is the size of the light source equipment.[14]

d. ***Light (Quantitative Light-Induced Fluorescence or QLF)*:** It is a smaller portable system for intraoral use, which has new light source and filter system compared to lasers. It enables early detection of demineralized lesions and also detects changes in mineral loss and size over time.[15]

B. MICROSCOPIC METHODS

1. Caries Models: It is done in extraction cases, where a band or a bracket is bonded on a tooth that is destined for extraction. Drawbacks of this method are lack of availability of teeth, only extraction case can participate and also length of the experiment is limited.

2. The In Situ Caries Model: In this method section of enamel is placed in a specially designed holder and attached to the arch wire. This technique has a number of advantages over the extracted tooth model

- It reproduces the natural caries process.
- Specimen of the same tooth can be kept as a control.
- It gives flexibility for crossover studies.
- It doesn't affect orthodontic treatment.
- It can be used throughout a course of orthodontic treatment.

Main disadvantage of this method is that it is very time consuming.

TREAMENT OF WSLs AFTER DEBONDING

If WSLs are evident immediately after debonding then it is advisable to first allow for a slower calcium and fluoride ion

penetration of the WSL from saliva which produce more esthetically favorable results. If remineralization does not takes place, then rest of the treatment options are tried, depending on the size of lesion.

1. Low Fluoride Mouth Rinses

Lee Linton showed that a 50-ppm fluoride mouth rinse had a higher efficiency for remineralization than a regular mouth rinse containing 250 ppm[16]. Concentrated fluoride agents, arrests both demineralization and remineralization in the lesion by surface hypermineralization. Lesions smaller than 60µm depth, can be remineralized with low fluoride preparation.

2. Use of Casein Phosphopeptide Amorphous Calcium Phosphate (CPP-ACP)

It is a product derived from milk casein; it is capable of absorbing through the enamel surface and can affect the carious process. CPP-ACP allows freely available calcium and phosphate ions to attach to enamel and reform into calcium phosphate crystals. Studies done on the effects of CCP-ACP, shows dose related increases in enamel remineralization within already demineralized lesions.[17] It comes in different forms, like, water-based mousse, topical cream, chewing gum, mouth rinses and sugar free lozenges.

3. Sugar free Chewing Gum

To promote remineralization, CPP-ACP is added in chewing gums, but the remineralization effect is attributed to large salivary stimulation by chewing gums.

4. Microabrasion

Studies done to check microabrasion effect on remineralization using 18% hydrochloric acid and pumice proves that there was significantly reduced visible enamel demineralization and the mean reduction in lesion size after treatment was 83%[18]. Etched enamel exhibited more pronounced lesion reduction than nonetched enamel, especially in the absence of fluoride.

The microabrasion process abrades surface enamel while compacting calcium and phosphate into the interprismatic spaces. This polished surface reflects light differently than natural enamel. Therefore, a portion of the whitened enamel is removed and a portion is camouflaged by the highly polished surface. This new polished surface is less susceptible to bacterial colonization and demineralization than natural nonabraded enamel.

5. Vital Tooth Bleaching

Mild whitened enamel can often be camouflaged by bleaching with standard tray-based whitening systems used overnight or with the hydrogen peroxide- impregnated polyethylene strips. If 2 to 4 weeks bleaching with these regimens is ineffective at camouflaging the whitened enamel then microabrasion followed by bleaching is recommended.

6. Composite Restorations or Porcelain Veneers

If microabrasion and tooth whitening does not eliminate WSLs then the last resort to meet the esthetic objective of the patient and clinician is to have composite restorations or porcelain veneers.

CONCLUSION

Enamel demineralization post orthodontic treatment is one of the major clinical problems faced by clinicians. fixed appliance and its attachments , provide sites for plaque accumulation and makes oral hygiene all the more difficult to maintain. Prevention of formation of WSLs is very important, as complete remineralization is difficult to achieve. Treatment for WSLs should be started in conservative approach, but aggressive treatment modalities can be pursued if the lesion is large and patient is not satisfied by conservative methods.

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Source of support: Nil
Conflict of interest: None declared