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REVIEWARTICLE

EVALUATION, PREVENTION AND TREATMENT OF WHITE SPOT LESIONS IN ORTHODONTIC PATIENTS –AN OVERALL REVIEW

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ABSTRACT

White spot lesions or enamel demineralization around fixed orthodontic attachments affect the esthetic outcome of a successfully completed orthodontic case. The purpose of this article is to review the evidence regarding evaluation, prevention and treatment of white spot lesions in orthodontic patients and to provide clinical recommendations useful for both the general dentist and the orthodontist. Apart from routine oral hygiene instructions additional measures including fluoride varnish, xylitol chewing gum, chlorhexidine mouth rinse, dietary modifications and calcium containing remineralisation products are effective in the prevention and treatment of white spot lesions. Treatment of white spot lesions can range from the most conservative to the most aggressive procedures involving tooth reduction and porcelain veneers.

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INTRODUCTION

Poor oral hygiene during fixed orthodontic treatment leads to plaque accumulation and the acidic by products of the bacteria in plaque can cause enamel demineralization or white spot lesions (Ogaard, 1988). There is a decrease in the pH of plaque in orthodontic patients due to higher levels of acidogenic bacteria like streptococcus mutans and lactobacilli. Demineralized enamel surfaces reflect light differently leading to a chalky white appearance. Formation of white spot lesions around orthodontic attachments can occur as early as 4 weeks (Mirzahi, 1982; Mitchell, 1992 and Sangamesh, 2011). The term white spot lesion (WSL) has been defined as "the first sign of caries like lesion on enamel that can be detected with the naked eye." (Sangamesh, 2011), WSL has also been defined as "sub surface enamel porosity from carious demineralization" that presents itself as "a milky white opacity when located on smooth surfaces".

Prevalence

White spot lesions that develop during orthodontic treatment range from 2% to 96% (Mirzahi, 1982; Mitchell, 1992; Gorelick, 1982 and Ogaard, 1988). Mirzahi (1982) in a cross-sectional study of 527 patients found a significant increase in both the prevalence (72.3%-89%) and severity (opacity index 0.125-0.200) with orthodontic treatment. Gorelick (Gorelick, 1982), et al found that individual teeth with fixed appliances had significantly more white spot lesions than the teeth in the control group. They also found that no white spots were present on the lingual surfaces of mandibular incisors and canines and suggested a relationship between the rate of salivary flow and resistance to white spot formation.

Aetiology: White spot lesions develop in orthodontic patients due to the co- existence of four factors namely fermentable carbohydrates, bacterial plaque, susceptible tooth surface and longer treatment duration. The components of fixed appliances like brackets, bands, arch wires etc., limit the self cleansing mechanism of saliva and oral musculature and also create stagnation areas making tooth cleaning difficult. This leads to plaque accumulation and colonization of Lactobacillus and Streptococcus bacteria and over a period of time causes production of white spot lesions which if left untreated may develop into cavitated carious lesion (Lundstrom, 1987 and Rosenbloom, 1991). Impacting the development of white spot lesions are the patients medical and dental history, medication history, diet, levels of calcium, fluoride, phosphate and bicarbonate in saliva, salivary pH, rate of salivary flow including buffer capacity of saliva and genetic susceptibility.

Differential Diagnosis: To differentiate between carious and non-carious white spot lesions the teeth should be cleaned and

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dried. With a periodontal probe gently evaluate the consistency and texture of the surface. Non-carious white spot lesions appear mostly smooth and shiny whereas carious white spot lesions appear porous, rough and opaque. Pores are created between the enamel rods because enamel crystal dissolution begins with sub surface demineralization. Since porous enamel scatters more light than sound enamel a visual opacity is observed in carious white spot lesion (Gorelick, 1982 and Ogaard, 1988). Carious WSL are found on the buccal surfaces and around the periphery of the brackets. The lesions may extend as non-cavitated or cavitated carious lesions. Non carious white spot lesions having genetic and environmental basis such as enamel hypoplasia, developmental enamel hypomineralization and fluorosis are limited to anterior teeth or generalized throughout the dentition and are not associated with orthodontic treatment.

Fig 1. White spot lesion

Risk Factors

- Inadequate oral hygiene,
- High DMFS
- History of recent carious lesions.
- Geiger et al[9] found significant association of white spot lesions in orthodontic patients not complying with preventive procedures.
- Dietary habits like frequent exposure to sugared beverages and candy.
- Decreased salivary flow.

Evaluation: It is important to accurately evaluate the demineralized white spot lesions during orthodontic treatment. An opacity that may have been present before appliance placement must be differentiated from white spots caused due to mineral loss from enamel by acid demineralization during orthodontic treatment.QLF and digital intra oral photography are commonly used methods for evaluation of white spot lesions. Other diagnostic methods available include visual/tactile methods, fibre optic trans illumination, electric conductance and laser fluorescence (Bader, 2002). The use of magnifying visual aids such as loupes with a minimum of 2.5 times enlargement improves the detection. Due to an increase in the backscatter of light a demineralised lesion in enamel is white in colour. Light photon travels an average distance of 0.1mm before being scattered when it enters sound enamel (Angmar-Mansson, 1987). Enamel becomes porous due to loss of minerals. There is an increased difference in refractive index between demineralized and sound enamel, because the mineral in demineralized enamel is partly replaced by water. Rather than penetrating to dentin most photons are scattered within the lesion and the backscatter is greater resulting in the clinical appearance of a white spot. Water is replaced by air when the lesion is dried and the average refactive index declines more leading to an even whiter appearance.

Optical non fluorescent methods: Demineralized enamel leads to more scattering of light, resulting in a more sideward displacement of light. This can be measured by using the optical caries monitor(OCM) first described by Ten Bosch and co-workers (Ten Bosch, 1980). They measured backscatter with a densitometer and used a 100-watt white light as a light source and showed a good correlation between the OCM readings and other more direct but destructive methods of measuring mineral loss (Ten Bosch, 1984).

Advantages of Optical caries monitor:

- It enables a non-destructive and convenient quantification of enamel demineralization.
- It has been correlated with established methods of studying mineral loss.
- Can be applied in the clinical environment.

Disadvantage of optical caries monitor:

- It is particularly technique sensitive and results can vary with the degree of dryness or wetness of the tooth.

Optical Fluorescent Methods: The property of fluorescence is a function of light absorption.[11]Materials absorbing light are more fluorescent than materials that reflect light. With fluorescent techniques areas of demineralization exhibit lower intensity of fluorescence due to less light absorption. The different techniques for producing fluorescence in enamel are fluorescent dyes, ultraviolet light, laser and QLF (quantitative light induced fluorescence).

Fluorescent Dye Uptake: To highlight carious enamel various fluorescent and non fluorescent dyes have been used[14].After applying the fluorescent dye a suitable light source should be used to examine the specimen.

Ultra Violet Light: Ultra violet light has been used for early detection of carious lesions on smooth surfaces but special precautions are required to protect from the harmful effects on the eyes and skin (Shrestha, 1980).

Laser: De Josselin de Jong and co-workers[16] developed the technique of quantitative laser fluorescence for use in the mouth by using an argon-ion laser producing light in the blue-green range of the electromagnetic spectrum (440-570nm) and the demineralised lesions appeared as dark areas. The equipment was used to quantify mineral loss and lesion size by calibrating to calculate the difference in fluorescence between the surrounding sound enamel and the demineralised area.

Laser Fluorescence: Laser fluorescence is a quantitative method of caries detection based on the emission of light with a wavelength of 655nm from a diode laser and the recording of fluorescence emitted from teeth.There is evidence that the use of laser fluorescence may be appropriate in diagnosis and grading of white spot lesions in orthodontic patients (Aljehani, 2006). Most commonly used laser fluorescence device is Diagnodent Pen (Kavo, Germany).

Quantitative Light induced fluorescence or QLF: QLF is a smaller portable system with a new light source and filter system and has been developed for intra oral use and is the most promising method of measuring demineralization (Al-Khateeb, 1997). It employs an arc lamp with a liquid light guide. The light is passed through a blue filter in front of the lamp, with a peak intensity of 370nm. The yellow high pass filter (<540nm) is maintained in front of the detecting camera to exclude scattered blue light and the combination is optimised to avoid reflections. The images are stored, processed and analysed with a custom software. QLF is an exciting technique that not only enables early detection of demineralized lesions but also detects changes in the mineral loss and size over time.

Prevention: Prevention of white spot lesions is better because remineralization and restorative treatments result in less than ideal esthetic outcome. Perfect brushing, flossing and daily exposure to fluoridated water prevents white spots.

- A demineralization inhibiting tendency has been demonstrated on using higher concentration fluoride tooth pastes and gels (1500 to 5000 ppm) twice a day during orthodontic treatment (Alexander, 2009).
- Benson PE et al (2005) recommended to use 10ml of 0.05%NaF mouth rinse daily before bedtime to prevent enamel demineralization
- Hirschfield (1978) advocated the use of APF mouth rinse to render enamel more resistant to decalcification during orthodontic treatment.
- Many investigators have reported decreased enamel decalcification after using stannous fluoride gels(0.4%) applied twice daily by tooth brush during orthodontic treatment (Stratemann, 1974).
- Boyd (Boyd, 1993) found that daily combined use of a fluoridated tooth paste either with a 0.4% stannous fluoride gel or 0.05% NaF rinse provided additional protection against decalcification compared with the use of a fluoridated tooth paste alone without any combination.
- Demito (Demito, 2011) et al found that there was a 30-50% reduction of white spot lesions in areas where Duraphat (5%NaF varnish) was applied twice annually compared to areas where Duraphat was not applied experiencing 32% increase in demineralization.
- Application of light cured pit and fissure sealants on the enamel surface adjacent to orthodontic brackets were found to be effective in preventing enamel demineralization (Frazier, 1996 and Benham, 2009).
- Fluoride releasing adhesives used for bonding orthodontic brackets and buccal tubes have the capacity to reduce enamel decalcification (Underwood, 1989).
- Cementation of bands with resin modified glass ionomer cements reduces decalcification.
- Reynolds (Reynolds, 1997) reported that products containing Casein Phosphopeptides Amorphous calcium phosphate (CPP-ACP) are effective in remineralization. GC markets CPP-ACP as a cream (Tooth Mousse) for application on tooth surfaces.
- Chewing xylitol gum increases salivary flow aiding in remineralization and causing a reduction in Streptococcus mutans count.
- Resin sealants (Proseal) applied to the enamel before bonding protects the enamel from demineralization.
- Cariostatic effect is enhanced when combining chlorhexidine varnish with a fluoride varnish.
- It has been reported that argon laser irradiation prevents enamel decalcification by creating microspaces in the enamel into which calcium, fluoride and phosphate ions from saliva precipitate increasing the resistance of enamel to demineralization (Oho, 1990; Elaut, 2004 and Anderson, 2002).

Treatment

- After removal of orthodontic appliances allow the teeth to remineralize naturally if the white spot lesions occurred during treatment. There is a significant natural reduction in the size of white spot lesions upto 6 months after appliance removal due to the action of saliva.
- Routine fluoride mouth rinsing enhances remineralization after debonding.
- After natural remineralization process is completed professional bleaching can be considered, but the microhardness of the enamel surfaces might be reduced. During and after bleaching therapy fluoridation should be performed to enhance remineralization.
- If the results of external bleaching are not satisfactory consider the removal of hypomineralized external layer by micro abrasion followed by daily application of CCP-ACP products.
- Micro abrasion with a slurry made of 18% hydrochloric acid and pumice is an effective method of treating long standing white spot lesions. Slurry is applied on the tooth surface and agitated and removed with water air spray. This procedure is repeated on each affected tooth for 3 to 4 times.
- If further esthetic improvement is desired aggressive procedures like veneering can be considered.

Conclusion

It is important to evaluate white spot lesions arising during orthodontic treatment. To minimize the risk of decalcification associated with orthodontic treatment orthodontists have to educate and motivate the patients for excellent oral hygiene practice. Prescribing fluoride containing tooth pastes and mouth rinses and topical application of fluoride containing gels and varnishes are recommended for prevention and treatment of white spot lesions. Natural regression of white spot lesions occur after removal of fixed appliances upto 6 months. Treatment of white spot lesions with bleaching or micro abrasion or veneering should be chosen appropriately.

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