Review Article

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White Spot Lesions And Its Management In Orthodontics

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ABSTRACT

Background: White spot lesions is a common untoward outcome in fixed orthodontic therapy that presents a challenge in obtaining esthetic excellence if left untreated. thus, the assessment of risk factors, adherence to proper oral hygiene measures, its prevention and management starting from the most conservative to invasive treatment depending on the severity of the lesion and patient desire of esthetics is an imperative part of fixed orthodontic therapy to achieve the required esthetics of the smile.

Keywords: Subsurface enamel porosity, demineralisation, remineralisation.

INTRODUCTION

A major drawback in fixed orthodontic treatment is the enamel decalcification or demineralisation that occurs around the bonded orthodontic appliances. The areas around the bands or brackets become areas for plaque retention that when compounded with difficulty in maintaining oral hygiene form an area of low pH around the band or bracket hindering remineralisation and promoting decalcification. Thus, resulting in the formation of white spot lesions (WSLs).[1]

The term white spot lesion refers to the area of demineralisation or caries around orthodontic appliances (localised) , The area of demineralisation or initial carious lesion (localised) in non orthodontic patients and certain developmental enamel lesion (enamel hypoplasia, flurosis etc).[2] According to Fejerskov and Kidd[3], white spot lesion is defined as the " first sign of a caries lesion on enamel that can be detected with the naked eye." It has also been defined as "subsurface enamel porosity from carious demineralisation that presents itself as a milky white opacity when located on smooth surfaces".[1]

EPIDEMIOLOGY

White spot lesion have a reported prevalence ranging from 2 to 96%.[4,5] This variation in prevalence can be attributed to the tools employed to assess the prevalence, the type of enamel lesion (demineralisation, developmental or idiopathic) taken into account, local environmental factors and the use of a fluoride regimen were taken into consideration or not.[6]

Quantitative laser fluorescence (QLF) has been found to be most sensitive to detect WSLs and studies employing this diagnostic tool have reported a higher incidence of WSLs.[7] Prior to orthodontic treatment, the reported prevalence of WSLs was in the range of 15.5% to 40% and the incidence of new WSL occurring during the treatment was in the range of 30 to 70%.[6-9]

LOCATION

Although all teeth have the potential risk of being affected by WSLs, but maxillary anterior teeth are most affected with lateral incisors being most prevalent followed by canines, premolars an central incisors. Samawi[10] in his study concluded that the

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upper anterior teeth showed greater demineralised surface area than the lower anterior and the distogingival quadrant of the upper lateral incisors was most commonly affected. Mizrahi[11], in his study using opacity index scoring system found increased incidence of WLSs on the vestibular surfaces of teeth following orthodontic treatment with a significant prevalence increase on the middle and cervical third of the crown surface of both maxillary and mandibular first molars, maxillary lateral incisors and canines.

The risk factors include - age, caries , poor oral hygiene maintenance pre and intra treatment, increased missing, filled and decayed teeth, the etching time and surface area involved. [8,12-15]

CLASSIFICATION OF WHITE LESIONS ON ENAMEL:

White discolorations on enamel are broadly categorised as opacities, WSL or dental fluorosis. To differentiate between fluorosis and opacities, Russell has established certain criteria's. According to Russell, fluorosis presents as ill-defined white/yellowish lesion that may blend with normal enamel and are symmetrically distributed in the oral cavity. Opacities and WSL are well defined and well differentiated from surrounding enamel and are randomly distributed in the oral cavity. They are generally located in the middle third of the tooth. In patient undergoing Orthodontic treatment, WSL are detected around the bracket periphery, under loose bands and the difficult to access areas by the toothbrush. [16]

FORMATION OF WHITE SPOT LESION IN ORTHODONTIC PATIENTS:

The application of fixed orthodontic appliance in oral cavity leads to substantial increase in the dental plaque volume due to plaque retention on the orthodontic appliance which further increases the risk of cariogenic attack. Due to plaque retention, the levels of S.mutans are elevated. In the presence of adequate carbohydrate supply, the bacterias will produce acid by-products that will further lower the plaque pH and carious decalcification/ demineralization occurs which is evident within four weeks. These lesions are important to detect early to prevent further progression of the lesion. As the general time gap between orthodontic treatment appointment is four weeks, the clinician should check the occurrence of any WSL in every appointment and employ the required treatment protocol. [17,18]

ETIOLOGY

The formation and progression of WSLs depends on a multiple factors, namely - the host, environment, bacteria, carbohydrates and time.

1.ENVIRONMENT:

The appliances used in fixed orthodontic creates a greater area for plaque adherence as maintaining good oral hygiene becomes difficult due to the hindrances it causes. The self cleansing property of tongue, lips, cheeks and saliva is severely limited due to the irregular appliance shape. These hindrances increase the risk of cariogenic attack. [19]

2.HOST:

Enamel is maintained in the oral cavity in a stable cycle of demineralization and remineralization. Caries progresses in a dynamic process due to imbalance in this cycle of demineralization and remineralization. There are several host factors that determine the overall caries risk. Immune response, diet, medication history, genetic susceptibility, enamel solubility are some of the determinants. [2]

3. CARIOGENIC BACTERIA:

The causative bacteria responsible for the carious process is namely Streptococcus mutans and Lactobacillus, which are acidogenic bacteria. The healthy enamel microflora is mostly composed of non mutans Streptococci biofilm that face mild and infrequent acidification. When this biofilm is subjected to frequent fermentable carbohydrate exposure, there is an adaptive and negative selective modification to accommodate the acidogenic bacteria. This modification creates an imbalance in the demineralization - remineralization cycle resulting in mineral loss. [20]

DIAGNOSIS

The diagnosis of WSL can be done by visual examination. The clinician should carefully evaluate

presence of WSL before initiating treatment and in the visits during treatment. This will help the clinician to implement treatment modalities at the earliest.

Intra treatment visualization of WSL can be difficult due to the presence of the appliance or gingival inflammation of present. Auxiliary diagnostic tools have to be relied on for coming to a proper diagnosis. QLF is a highly sensitive diagnostic tool with limited practical use but definite research application. A high intensity blue light causes autofluorescence of the teeth. The intensity of fluorescence is related to the mineral content of the enamel that allows quantification of the demineralization. [21] Diagnodent (Laser fluorescence) is another highly sensitive tool for early WSL detection.

REMINERALIZATION AND REGRESSION OF WHITE SPOTS:

WSLs are generally surface demineralization and not subsurface lesion which have an intact surface zone. Remineralization or partial reversal of early carious lesion can occur naturally. In the natural non carious state demineralization and remineralization go hand in hand, where the mineral content of the enamel is in equilibrium in the oral environment with saliva having the necessary elements for hydroxyapatite crystal growth. [22] Studies indicate an average of 20 to 30% remineralization over a period of two weeks. [23] After removal of appliances, studies have indicated a rapid decrease in the size of the lesion in the first twelve weeks. The lesions reduced by one-third of its initial size after twelve weeks and half after twenty six weeks. [24] Small lesions studied using light induced fluorescence have shown rapid improvement in six weeks after debonding. [25]

MANAGEMENT OF WSLs :

I .PREVENTION -

1. DISRUPTION OF BACTERIAL BIOFILM :

Firstly, before placing the appliance the baseline plaque scores must be improved. Proper and detailed oral hygiene instructions must be given regarding tooth brushing and other home care modalities with special emphasis on how to clean around each bracket and the area between the gingiva and the bracket. The oral hygiene protocol must include a preliminary prophylaxis, patient education, diet counselling, oral hygiene instructions and floridation. For patients with high plaque score an electric toothbrush may be recommended with more frequent (every three months) prophylaxis along with chlorhexidine irrigation of pockets if present, and flouride application. [15,26]

2. FLUORIDE TOOTHPASTE:

Traditional fluoride toothpaste (1,000ppm) has been routinely recommended but higher fluoride concentration (1,500 - 5,000ppm) toothpaste have shown an increased efficiency in inhibiting demineralization. A modified technique to reduce the incidence of caries in orthodontic patients involves brushing twice daily with higher concentration of fluoridated toothpaste for two minutes and vigorous swishing of the toothpaste slurry for thirty seconds without rinsing with water and avoiding food or water intake for two hours. [27] Fluoride concentration below 0.1% is not recommended. [28]

3. FLUORIDE RINSES:

The recommended regimen by orthodontists is the use of 0.5% Sodium Fluoride rinse daily along with a fluoridated dentrifice. [29] In high risk patients, mouthrinse combined with antibacterial agents such as Triclosan, Chlorhexidine or Zinc is recommended to increase the anticariogenic effect. [30] Studies have shown that the use of fluoride rinses and dentrifice significantly reduces caries in non orthodontic patients, but in orthodontic patients the evidence is weak and mixed, the reason being non-compliance to the recommended regimen. [31]

4. FLUORIDE VARNISH:

Topical fluoride varnish application around orthodontic brackets is recommended in high risk patients as it does not require thorough cleaning of the tooth surface before application, and is effective in the presence of plaque to reduce caries. [32] Regular application of varnish at each appointment is recommended. [2] A study has shown that in less compliant patient topical application of high

concentration fluoride varnish reduce enamel demineralization by 44.3%.[33] In an in-vitro study it was seen that the application of fluoride and chlorhexidine varnish alone or in combination reduce the incidence of WSL by 30% at the time of debonding. [34]

5. USE OF CASEIN PHOSPHOPEPTIDE AMORPHOUR CALCIUM PHOSPHATE (CPP - ACP) :

In 1980s , Reynolds[35] introduced CPP - ACP, a milk casein derivative . CPP - ACP contains free calcium and phosphate ions that attach to the enamel, enter into the enamel rods and form calcium phosphate or apatite crystals. CPP - ACP is available as topical cream, water based mousse, mouth rinses, chewing gums and sugar free lozenges. It is marketed as GC tooth mousse (Recaldent, Newport Pagnell, UK), MI paste (GC America, Alsip,IL,USA) and MI paste plus. A recent study showed that the use of MI paste plus daily at night by a fluoride delivery tray for 3 -5 mins after brushing showed lesser and fewer WSL than control. MI paste plus is similar to MI paste with addition of 900 ppm fluoride. [36] Studies indicate a dose related increase in enamel remineralization in demineralized lesion. [37] There are however, no comparative studies to show whether the regression is higher than what would have occurred naturally.

6. FLUORIDE RELEASING BONDING MATERIAL :

GIC due to its chemical adhesion to tooth and fluoride releasing property was introduced in orthodontics as a bracket bonding adhesive . Resin modified GIC was then introduced to counter the low bond strength of GIC. In Vivo studies have demonstrated similar bracket failure rate between composite and RMGIC adhesives. GIC , though has fluoride release exhibits an initial burst of fluoride release that rapidly decreases with time. This property of GIC is likely to affect caries inhibition over time in the oral cavity. Literature supporting use of GIC or RMGIC adhesive in orthodontics is mixed and inconclusive.[38]

7. PROTECTIVE BARRIER FOR ENAMEL :

Resin sealants act as a physical barrier to acid attack on enamel by bonding to etched enamel. Filled resin sealants like Proseal (Reliance Orthdodontic Products, Itasca , Il, USA) due to their increased wear resistance provide greater protection as barriers than unfilled resin sealants.[39]

8. FAVOURABLE MODIFICATION OF ORAL ENVIRONMENT :

I. DIET :

Proper diet counselling is pertinent. The patient should be informed to reduce the exposure to refined carbohydrates and sugared beverages like soft drinks and juices. These beverages are a source of fermentable sugar for cariogenic bacteria and are acidic as well. The pH of soft drinks are in the range of 2 to 3. When the pH of oral cavity drops below 5.5 enamel demineralization occurs. Thus the combination of high sugar especially sucrose and low pH leads to development of WSL.[40,41]

II. MODIFICATION OF BIOFILM PH :

Increasing the pH of the oral cavity helps in reducing caries risk by making the microflora less acidogenic with less aciduric strains. Products that can modify the microflora by increasing the pH include Cavistat mints (Qretek therapeutics Inc., Rosyln , NY , USA) and carifree rinses (Oral biotech , Albany , OR, USA). They can be a useful adjunct in low compliance patients , even though the published evidence of using these products to prevent WSL is limited.[42,43]

III. PROBIOTICS :

The routine use of probiotics seems to reduce S. mutans and other periodontal pathogens and can thus , positively modify the oral environment decreasing caries risk. Evidence of this finding is limited in literature and further research is ongoing on the potential use of probiotics to reduce caries.[44]

IV. CARBAMIDE PEROXIDE :

It is seen that the salivary and plaque pH is increased by urea. Hydrogen peroxide and carbamide peroxide decompose to form urea as one of the by products. Thus urea from hydrogen peroxide increases the oral pH and the antimicrobial effect of hydrogen peroxide decreases plaque formation. Currently, literature evidence on

the potential of using carbamide peroxide to prevent WSL is limited.[45]

V. XYLITOL :

Xylitol is a polyolcarbohydrate and is non cariogenic as it cannot be metabolised by S. mutans. It also possess antimicrobial properties that prevent the adherence of S. mutans to tooth surface. Xylitol chewing gums increase stimulated saliva production which is high in calcium and phosphate concentration. Thus, high risk patients may benefit by chewing gum for 10 mins, 3 to 5 times a day. The disadvantage of chewing gum is the possibility of increased bracket bond failure.[46-48]

EFFECT OF ADDING FLUORIDE AND OTHER ANTIBACTERIAL AGENTS ON THE SHEAR BOND STRENGTH (SBS) OF ORTHODONTIC ADHESIVES :

To prepare the teeth for bonding, it was seen that the use of either non - fluoridated or fluoridated prophy paste did not change the SBS significantly.[49]

Fluoride containing sealants (Proseal , Reliance Orthodontic products , Itasca, IL) application also does not affect the SBS of orthodontic adhesives.[50] It was recently determined that Proseal was capable of releasing fluoride ions for 17 weeks following which there was a decline in the release. However, these sealants have displayed an ability to be recharged with fluoride ions when acidulated phosphate fluoride is used in a foaming solution.[50] A study conducted to determine the SBS between brackets bonded with fluoride releasing sealant and a conventional primer found no significant difference.[51]

Antimicrobials have been added to adhesives to rule out patient compliance factor. Chlorhexidine combined with bonding primer or applied after bonding resulted in no significant decrease in the SBS.[52] However, other methods of chlorhexidine incorporation into the bonding procedure , such as , chlorhexidine application during bonding without sealant application or the application as a separate layer over the sealant before adhesive placement resulted in significant reduction of SBS when used to bond brackets.[53] A study evaluated Cetylpyridinum chloride (CTC) , another antimicrobial , and found that the difference in the tensile bond strength between the adhesive impregnated with 2.5% CTC and a control was not statistically significant. The adhesive impregnated with 2.5% CTC inhibited bacterial growth for 196 days.[54]

The use of an antimicrobial primer along with a fluoride containing adhesive to bond brackets have shown no significant decrease in SBS.[55] It was also found that a fluoride releasing adhesive used in combination with an antimicrobial self etch primer has stronger SBS than a conventional composite resin used with conventional acid etch / primer procedure.[56]

II. MANAGEMENT OF WSL DURING TREATMENT :

When WSLs are noticed during the orthodontic treatment period, the patient has to be informed first about it following which re-evaluation of the risk factors is undertaken and change in the diet or lifestyle has to be incorporated that has lead to the development of WSLs. The orthodontist needs to monitor the progress of the new lesions by frequent recall of the patient between regular appointments and continuously reinforce the oral hygiene instructions. Prescription of 5000 ppm flouride gel or toothpaste for regular use and in office application of fluoride varnish every 3 months has to be adopted. For non compliant patients , chlorhexidine rinses in combination with te fluoride regimen may be advocated. The patient is asked to rinse for 2 weeks daily by swishing for 30 seconds before bedtime. Due to the tendency of chlorhexidine to cause extrinsic staining other products such as MI paste or MI paste plus can be used. These products are applied in a pea sized amount around teeth and brackets after brushing. MI paste is used if 5000 ppm fluoride gel is used and MI paste plus is used if traditional 1000 ppm fluoride toothpaste is used.[57,58]

EARLY REMOVAL OF APPLIANCE :

When all preventive and treatment measures have been employed and patient is still non compliant to improve the home care then the fixed appliance should be removed and the patient is maintained in retention. The patient is advised proper oral care at home and the treatment is only resumed once proper oral hygiene is maintained.[2]

III. TREATMENT OF THE LESION AFTER ORTHODONTIC TREATMENT :

Once the appliance is removed , treatment options ranging from natural resolution of the lesion to tooth preparation and restoration can be chosen.

1. NATURAL RESOLUTION / REMINERALIZATION :

After orthodontic treatment is completed the visible WSL decreases in size and there is an improvement in the appearance over a period of one to two years after debonding.[59 - 61] The active lesions have a better prognosis than the arrested lesions as they are more porous and thus allow easy penetration of calcium and phosphorous during the remineralization process. The arrested lesion appears shiny white or may discolour to form brownish stains due to the formation of a remineralized layer in the outer surface of enamel.[2] Ogaard and coworkers[62], suggested no to treat WSL with concentrated fluoride agents as it leads to surface hypermineralization which arrests both demineralization and remineralization. These arrested lesions remain the same size and become stained due to deposition of organic debris on it. It is thus recommended to remineralize small lesions with low fluoride preparations.[63,64]

Lee linton[63] demonstrated that a 50 ppm fluoride mouthrinse had greater remineralization efficiency than a regular mouthrinse containing 250 ppm. For lesions present on areas other than the labial surface, concentrated fluoride preparations can be used.[63,64] Acid etching of fluoride treated lesions may facilitate its remineralization by oral fluids.[65]

2. RESIN INFILTRATION :

Resin infiltration is a relatively new approach for treating incipient lesions. WSL appears white and opaque due to difference in the refractory index of healthy and demineralized enamel. An active WSL consists of voids filled with water or air. A low viscosity resin is made to infiltrate into this demineralized enamel and fill the voids by replacing the air or water in the voids by resin. This results in a refractory index similar to that of healthy enamel, thus improving the appearance of the lesion. This low viscosity resin is marketed as ICON (DMG America ,Englewood , NJ , USA). The clinical technique involves etching the enamel under rubber dam isolation for 2 minutes with 15% HCL followed by rinsing. The lesion is then desiccated with an ethanol drying agent followed by application of the low viscosity resin. Gross excess if present, is removed and the resin is then cured for 40 seconds.[66,67]

3. WHITENIING :

In inactive or arrested WSL vital bleaching as a treatment modality is generally recommended. By bleaching both the WSL and the surrounding unaffected enamel become lighter. The unaffected enamel becomes lighter than the WSL that results in less contrast between the lesion and the unaffected surrounding enamel.[14]

4. MICROABRASION:

It has been observed that WSL can be successfully treated with microabrasion only if the lesion does not exceed 0.2 to 0.3 mm depth. The technique involves using a slurry of pumice or silicon carbide particles and 18% HCL to create surface dissolution of enamel, thus removing the surface discoloration.[68,69]

5. RESIN RESTORATION / INDIRECT RESTORATION :

Patients with severe form of WSL or cavitated lesions would require preparation of the affected tooth and restoration with either a direct composite resin restoration or indirect composite resin or ceramic restoration.[2]

CONCLUSION

White spot lesions on enamel around orthodontic appliances is a common iatrogenic effect of the therapy and poses as a challenge for the orthodontist to overcome. Due to the appliance there is an increase in plaque retention sites which makes maintenance of optimal oral hygiene difficult. It is thus imperative for the orthodontist to inculcate stringent oral hygiene practices in the patient. Attention should be given to assessing the caries risk factors and prevention of WSL. Management of WSL should being with the most conservative approach followed by other radical

approaches based on the severity of the lesion and the aesthetic desire of the patient.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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