A Review

White Spot Lesions in Orthodontics: A Review

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Abstract

White spot lesions (WSLs) are a major side effect of orthodontic fixed appliance therapy, despite vast improvement in preventive dental techniques and procedures. The purpose of the article is to review the current evidence regarding diagnosis, risk assessment, prevention, intratreatment management, and post-orthodontic treatment of WSL, and to provide clinical recommendations useful for both the orthodontist and the general dental surgeons. Initial orthodontic patient evaluations should include a Caries risk assessment, and risk-specific prevention and management protocols can help reduce or eliminate this clinical problem. Depending on the severity of the lesions, a variety of treatment options are available for WSL, ranging from conservative to invasive techniques.

Introduction

Patients undergoing orthodontic therapy are exposed to a higher risk of enamel demineralization or white spot lesion. A white spot lesion (WSL), as defined by Fejerskov et al.[1], isthe first sign of caries occurring on enamel, which can be seen with the naked eye. The opaque, white, chalky appearance of WSL is due to an optical phenomenon caused by mineral loss in the surface and subsurface enamel and is exaggerated by drying. These lesions also tend to appear rough and porous compared with noncarious white spots that are generally smooth and shiny. White spot lesions begin to appear no later than one month following bracket placement, although they may take longer to develop. These lesions are commonly seen on the facial surfaces of teeth around the brackets, especially in the gingival region.[1]

Epidemiology

According to reports, the prevalence of WSL can range from 2% to 96%.[2–5] This large range is probably caused by different research' differing operational definitions of a WSL. The technique of detection affects a WSL's sensitivity in terms of discrimination. Lesions are reported to be more prevalent in investigations using quantitative light-induced fluorescence (QLF) than in studies where these lesions are identified through a visual assessment.[6]

The prevalence of WSL before receiving orthodontic treatment has been estimated to be between 15.5% and 40%[2,7,8], however the majority of research indicate that between 30% and 70% of patients have new, clinically evident WSL while receiving orthodontic treatment[3,4,7]

Aetiology

Host

Not every person exhibits the same caries risk. The dynamic process of caries advancement is brought on by an imbalance in the natural cycle of enamel demineralization and remineralization. From initial demineralization to non-cavitated carious lesions to cavitated lesions, enamel diseases can advance.[1] The potential for fast development, with clinically apparent lesions forming in as little as 4 weeks, is one of WSL's most clinically important characteristics. Caries risk in an individual is multifaceted.[5]

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It can be perplexing to see a patient with what seems to be acceptable oral hygiene still develop WSL while someone with extremely poor hygiene may not.

Cariogenic Bacteria

The fundamental culprits in the development of caries have long been recognised as acidogenic bacteria. The main microorganisms involved in the development of caries are specifically Lactobacilli and Streptococcus mutans. There are constantly changing types and populations of bacteria in tooth biofilms. more thorough analysis of pH's effects. Orthodontic white spot lesions (WSL) were present next to labial fixed orthodontic appliances on the enamel surfaces.The subsurface enamel's altered refractive index is what gives the surface a white, opaque appearance.Understanding the dynamic nature of the caries process requires an understanding of the ecological shift in dental biofilms.The biofilm becomes more often and intensely acidified as a result of repeated contact to fermentable carbohydrates. As a result, the biofilm is adaptively and deliberately changed to favour microorganisms that are more acidogenic and aciduric. Due to this detrimental change of the biofilm, the cycle of demineralization and remineralization shifts in favour of a net mineral loss[9].It has been shown that orthodontic patients have higher levels of cariogenic bacteria in their plaque than non-orthodontic patients, which causes caries to progress more quickly in them than in people who don't use fixed appliances.[10]

Environment

Fixed orthodontic devices increase plaque's surface area and make it more difficult to maintain proper oral hygiene. The capacity of saliva, lips, tongue, and cheeks to self-clean themselves is also diminished by the gadgets' asymmetrical designs. These barriers may make tooth surfaces that are generally resistant to carious attack more likely to acquire caries.

An outstanding example of this phenomenon is the lower incidence of WSL in orthodontic patients using lingual appliances, where the tongue and saliva flow are better able to self-clean the tooth surfaces adjacent to the fixed appliances.[11]

Diagnosis

Visual

In fact, the visual diagnosis of WSL might start even before the start of orthodontic therapy. Before starting orthodontic treatment, it is crucial to identify any non-developmental WSL that already exists. When such lesions are found in a patient without a prior orthodontic appliance history, it is important to include this in the dental history as it raises the patient's risk level.For WSL, intratreatment evaluation is crucial so that the appropriate management strategies can be put into place as soon as a visual diagnosis has been made. Unless arch wires, ligatures, elastomeric chains, or other auxiliaries are removed, teeth are clear of plaque and dirt, and they have been dried, it is simple to overlook early WSL. It can also be challenging to see WSL during treatment if there is gingival inflammation that reduces the quantity of visible enamel between the bracket and gingival edge. Due to this, many WSL are not discovered until after fixed equipment has been taken out of service. It is advised that the orthodontist check high-risk teeth at each appointment to try and spot lesions early so that lesions that have already started can be treated more easily[12]

QLF

QLF is a diagnostic technique that depends on the teeth's ability to fluoresce when they are subjected to intense blue light. The mineral content of the enamel has a strong correlation with the fluorescence of the tooth, with demineralization exhibiting decreased fluorescence. Early enamel decalcification or initial caries in quantified result of Delta F, and Delta R score, these scores indicate the degree of mineralization and biofilm activity respectively. At a specific period or over time, demineralization or remineralization may occur. Although QLF is a highly sensitive diagnostic test, its use has mostly been restricted to research purposes.It might not be useful for routinely diagnosing WSL in individuals getting orthodontic care[13].

Risk Assessment

A risk assessment should be carried out before the placement of appliances, and patients should be divided into two categories based on their level of risk: low risk and high risk. There is no one approach to risk assessment due to the multidimensional character of WSL. One can determines the risk category by identifying both protective and risk characteristics. A patient will be labelled as high risk if they exhibit two or more characteristics from the high-risk group. A patient will be automatically categorised as high risk if they experience a WSL during treatment.

Prevention

In order to identify high-risk patients and guide them towards the proper preventive regimen, the orthodontist and general dentist are crucial players. There are various ways to prevent WSL, and combining all of the methods could result in maximum success.[14]

Disruption of Bacterial Biofilm

Fixed orthodontic appliances make maintaining good dental hygiene more difficult and provide plaque more surface area to attach.Irregular shapes of the appliances also reduce the ability of saliva, lips, tongue, and cheeks to self-clean themselves. These barriers may raise the likelihood of developing caries on dental surfaces that are typically resistant to carious attack.

Patients with fixed appliances find it more difficult and time-consuming to clean their teeth and floss, thus thorough oral hygiene instructions are essential for teaching patients how to maintain proper at-home care. Teaching patients to clean each individual bracket, especially the space between them and the gingival borders, should receive extra attention. Electric toothbrushes may be advantageous for people with higher plaque scores, even if they are not necessary for maintaining optimal hygiene[15]. An oral hygiene programme that includes an initial prophylaxis, nutritional counselling, ongoing oral hygiene teaching, patient education, and fluoride is probably sufficient to prevent demineralization in patients who have a normal to low risk of developing WSL.High-risk patients, however, may gain from a more comprehensive hygiene regimen that should include more regular prophylaxis (every 3 months as opposed to every 6 months), which involves scaling, fluoride administration, and irrigation of subgingival pockets with chlorhexidine.[15,16]

The reduced incidence of WSL in orthodontic patients receiving lingual appliances, where the tongue and saliva flow are able to better self-clean the tooth surfaces next to the fixed appliances, serves as an excellent illustration of this phenomenon.

Inhibition of Demineralization/Promotion of Remineralization-
Fluoride Toothpastes

Despite widespread reports of the effectiveness of ordinary fluoride toothpastes (1,000 ppm), toothpastes with higher fluoride concentrations (1,500–5,000 ppm) have been found to have a stronger capacity to block demineralization and promote remineralization[17]. A modified fluoride toothpaste technique that calls for vigorously swishing the toothpaste slurry for 30 seconds without rinsing with water after two minutes of twice-daily brushing,It has also been demonstrated that delaying eating or drinking for two hours helps minimise the occurrence of new caries in orthodontic patients[18].

Fluoride Rinses

The most popular fluoride regimen suggested by orthodontists may consist of a daily 0.5% sodium fluoride rinse and fluoridated dentifrice.The data supporting this statement is inadequate and contradictory when it comes to the effectiveness of fluoride rinses in preventing WSL in orthodontic patients, despite research showing this method to considerably lower caries rates in non-orthodontic adolescent patients. Fluoride rinses must be used consistently in order to prevent WSL, and there is evidence to suggest that compliance with such rinses is low.[19,20]

Fluoride-Releasing Bonding Materials

Glassionomers (GIs) and GIs with Resin may offer some resistance to WSL when compared to composite resins based on acrylic, but other research have found no discernible difference between the materials' ability to offer protection. It is known that GIs release fluoride in an early burst before it quickly declines to levels that are unlikely to have a clinically significant impact on the prevention of caries.

Although there is considerable potential in this strategy, there is still conflicting evidence regarding the effectiveness of WSL prevention[21].

Amorphous Calcium Phosphate (ACP)

In patients with a high risk of developing caries, amorphous calcium phosphate (ACP) may have the ability to both prevent and treat enamel demineralization. Casein phosphopeptide ACP, a milk-derived protein that aids in promoting significant enamel remineralization, is a component of MI Paste (GC Japan). The same product, MI Paste Plus, also has 900 ppm of fluoride in it. According to a recent randomised controlled research, orthodontic patients who used MI Paste Plus nightly in a fluoride delivery tray for 3 to 5 minutes after brushing had fewer and milder WSL than controls[22].

Although some research suggests there is little benefit to using ACP in addition to regular oral care, it has been claimed that it may help in the remineralization of WSL after orthodontic treatment is complete. In other words, there was no discernible difference between patients who used MI Paste and those who utilised standard dental care, including 1,000-ppm toothpaste, in the reduction of WSL size[23,24].

Favourable Modification of Oral Environment
Modification of Biofilm pH

In order to change the microflora towards fewer acidogenic and aciduric strains and so lower the risk of caries, the oral environment's pH, and in particular the pH of the dental biofilm, may be useful. By raising pH, products like Carifree rinses (Oral Bio Tech, Albany, OR, USA) and Cavistat mints (Oretek Therapeutics, Inc., Roslyn, NY, USA) try to change the biofilm in a positive way. Although there isn't any published data to support employing this strategy to prevent WSL, it is possible that it could be a useful addition to the therapy of high-risk patients[25,26].

Diet

Simple diet evaluation and counselling may be helpful ways to explain to patients the need to reduce exposure to refined carbohydrates, especially sugared beverages like soft drinks, sports drinks, and juices. The role of refined carbohydrates in the progression of caries has been well documented. In addition to providing cariogenic bacteria with fermentable carbohydrates to feed on, many of these drinks are also extremely acidic[27]. The pH of various well-known soft drinks and sports drinks ranges from 2 to 3, and research has shown that enamel demineralization starts when the pH falls below 5.5. Even diet soft drinks may have a pH below 3 despite the absence of fermentable carbohydrates. Low pH and high sugar content together provide for a very unfavourable modulator of the oral environment in terms of the possibility of WSL formation. Sucrose appears to be the fermentable carbohydrate that has the greatest potential to harm dental biofilm, making it the most troublesome[28]

Xylitol

Xylitol, a polyol carbohydrate, cannot be metabolised by S. mutans and is not cariogenic as a result. Additionally, it seems to possess antibacterial qualities that aid in preventing S. mutans from adhering to tooth surfaces. Chewing gum has been shown to increase the production of stimulated saliva, which has higher phosphate and calcium concentrations than no stimulated saliva. It has also been shown that chewing gum can reduce the risk of caries when compared to gums containing sucrose or sorbitol[29,30,31].

High-risk patients may benefit from chewing xylitol gum three to five times a day for at least ten minutes each, however this possible advantage must be balanced against the danger of increased bracket bond failures brought on by gum-chewing[30]

Probiotics

Although the practise of using probiotics in dentistry is still relatively new, the idea is to introduce noncariogenic microorganisms into the oral cavity in order to reduce the number of periodontal infections and compete with cariogenic bacteria. Preliminary reports suggest that products like ProBiora 3 (Oragenics, Tampa, FL, USA) have the potential to improve the oral environment by lowering S. mutans and specific periodontal pathogens, despite the fact that there is a dearth of data on the subject and none with specific application to WSL prevention[32].

Carbamide Peroxide

This rise in pH and hydrogen peroxide's antibacterial properties may prevent plaque from formingthe patient's perception of additional benefits from tooth whitening may increase patient compliance with the periodic use of carbamide peroxide whitening treatments during orthodontic treatment. Although there isn't any published data to support the use of carbamide peroxide products to prevent WSL in orthodontic patients, it seems like this strategy may have some promise[33].

Protective Barrier for Enamel

Several materials are available that are made to adhere to etched enamel and act as a physical deterrent to enamel's acidic attack. The formation of WSL may be prevented by bonded resin barriers, such as pit and fissure sealants, according to some data. Due to their greater wear resistance when compared to unfilled resin sealants, filled resin sealants like Pro Seal (Reliance Orthodontic Products, Itasca, IL, USA) may have the potential to offer even greater protection as a physical barrier[34]. However, their removal following orthodontic treatment can be time-consuming and requires the use of a high-speed rotary instrument.[35]

Management of WSL during orthodontics

To determine whether certain changes in lifestyle, including nutrition, may have aided in the emergence of WSL, a thorough re-evaluation of the risk variables is required. To allow the orthodontist to track the development of new lesions, it is advised that oral hygiene instructions be reinforced continuously and that recall appointments be made more frequently in between routine adjustments. A more stringent fluoride regimen should be used, one that calls for the prescription of toothpaste or gel with 5,000 ppm fluoride and in-office fluoride varnish applications every three months or perhaps at each orthodontic appointment. Chlorhexidine rinses can be administered in conjunction with a fluoride programme for patients who haven't followed other oral hygiene regimens to lower the number of cariogenic bacteria and further impede demineralization. Before going to bed, the patient is advised to swish for 30 seconds while using these rinses as part of a 2-week programme. Patients should be made aware of the potential for extrinsic staining of teeth, a risk associated with all chlorhexidine preparations.

Another option for a more rigorous programme to boost remineralization is to utilise MI Paste, MI Paste Plus, or comparable products.

After cleaning your teeth, use these products in a pea-sized amount all over your teeth and orthodontic devices. When using 5,000-ppm fluoride gels or pastes, MI Paste Plus is advised rather than the more common 1,000-ppm fluoride toothpaste, which calls for MI Paste.[10,17]

Early Removal of Appliances

Even if the orthodontic goals have not yet been fully attained, removing all obstacles to better home care should take precedence if WSL are forming in the middle of treatment despite all efforts to prevent and manage them. Patients should be made aware that in these situations, there is a greater danger of enamel damage than benefit from continuing orthodontic treatment at this time. Patients may be put on retention and told they can restart orthodontic treatment once their motivation to maintain excellent home care increases.

Micro abrasion

Microabrasion has been used to treat WSL that have developmental origins as well as those connected to orthodontic treatment. This method, which effectively removes surface stains or flaws, includes creating surface disintegration of enamel using a slurry of pumice or silicon carbide particles and hydrochloric acid.[36]If the lesion is only 0.2 to 0.3 mm deep, it is possible to successfully remove WSL using this method.[37]

Natural remineralization

In contrast to arrested lesions, which frequently have a shiny white surface and may even appear brown due to the development of a remineralized layer in the outer part of the enamel, active lesions are more porous and make it easier for calcium and phosphorous to infiltrate the enamel during the remineralization process.

High-concentration fluorides are crucial for prevention, but using them on active WSL could stop the lesions from spreading and actually discolour the enamel.

Even though some of the lesions may still be active at the end of therapy, it is likely that some remineralization has already taken place in the majority of WSLs that are present following orthodontic treatment[38,39,40].

Whitening

A frequently recommended method for enhancing the enamel is vital bleaching of the teeth with inactive WSL, which is successful in eradicating surface stains or flaws. If the lesion is only 0.2 to 0.3 mm deep, it is possible to successfully remove WSL using this method[41].

Resin Restorations/Indirect Restorations

Patients with more severe WSL or cavitated lesions may benefit from the preparation of the affected tooth surfaces and restoration with either direct resin restorations or indirect porcelain restorations if they have already tried more conservative aesthetic treatments without seeing a significant improvement.

Resin Restorations/Indirect Restorations

The preparation of the affected tooth surfaces and restoration with either direct resin restorations or indirect porcelain restorations may be beneficial for patients with cavitated lesions or more severe WSL who have already tried more conservative aesthetic treatments without seeing a significant improvement.

Resin Infiltration

A relatively recent technique called resin infiltration of developing carious lesions has the potential to enhance the visual appeal of WSL. The contrast between the refractory index of healthy enamel and that of demineralized enamel, which is left with cavities filled by water or air, causes an optical phenomenon that causes WSL to look white and opaque. The theory behind resin infiltration is that a low-viscosity resin can infiltrate into the previously demineralized enamel matrix and fill in many of the holes with resin rather than air or water since active WSL is porous.

The lesion looks better as a result of producing a refractory index that is more comparable to healthy enamel. Currently, Icon (DMG America, Englewood, NJ, USA) is the only product available that employs this strategy.

The clinical protocol calls for thoroughly rinsing, desiccating the enamel lesion with an ethanol drying agent, applying the very low-viscosity resin, removing any obvious excess, and light-curing for 40 seconds after the WSL has been etched with 15% hydrochloric acid for two minutes under rubber dam isolation. Lesions that have not been fully arrested seem to respond better to this strategy. Early investigations indicate that this approach is successful in improving or hiding WSL, even though there is currently a dearth of information on its effectiveness.[42,43]

Conclusion

Excellence in clinical orthodontics is seriously threatened by WSL. However, despite our best efforts, it is unlikely that we will be able to entirely eradicate this issue. Instead, the risk-assessment techniques and suggestions for prevention and intratreatment management of WSL presented in this review may assist to minimise this widespread issue in your patients.

Since caries risk assessment, prevention, intra-treatment management, and treatment of WSL are all crucial, it is essential that orthodontists and general practitioners follow the same practices. Clinicians should be careful to discuss WSL risk as part of any orthodontic informed consent procedure, and careful documenting of preventive measures as well as assessment of compliance with oral hygiene are necessary.

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