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MINIMALLY INVASIVE APPROACH OF VESTIBULAR WHITE SPOT LESIONS

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Keywords: caries infiltration, white spot lesion, minimally invasive dentistry **Abstract:** White spot lesions (WSL) can represent a significant aesthetic problem because it affects our appearance, having a major impact on our social life. Minimally invasive techniques preserve the healthy tooth structure, improve aesthetics and enhance the clinical outcomes of preventive and restorative dental treatments. This is the reason why it is essential for dentists to recognize the cases that are suitable for this method and to be informed about the correct protocol of caries infiltration with DMG Icon (Ridgefield Park, NJ, USA). In this study 20 cases of WSL were diagnosed: traumatic hypomineralization (10%), demineralization due to increased consumption of acidic beverages and/or poor oral hygiene (85%) and systemic hypomineralization (5%). Three cases are presented in the paper, each with different diagnosis and their treatment process are documented with photographs.

INTRODUCTION

Nowadays, when appearance is very important and has a major impact on our social life, white spot lesions (WSL) can represent a significant functional and aesthetic problem. Minimally invasive treatment options are important for the management of WSL, as they preserve the healthy tooth structure, improve aesthetics and enhance clinical outcomes of preventive and restorative dentistry.(1)

The dental enamel has a uniform structure, thus light penetrates through it and is reflected or absorbed in the dentin. A completely mineralized, sound enamel is translucent, and the colour of the tooth is given by the underlying dentin.(2)

The increase of enamel porosity leads to a change in optical properties. In a WSL light scattering is stronger than in the healthy enamel. The penetrating photons change directions more frequently in a carious enamel and are generally reflected before they reach the dentin. Therefore, such lesions appear whiter than the surrounding sound parts of the tooth.(3) The healthy enamel has a refractive index (IR) of 1,62. However, WSL have numerous porosities filled with water (IR = 1,33) or air (IR = 1,00). The difference in IR between the mineralized enamel and the porosities filled with water or air affects light scattering and gives these lesions a white opaque aspect. When the WSL are infiltrated with resin their IR become 1.46, similar to the IR of the sound enamel, they mimic healthy tooth structure. Therefore, resin infiltration significantly decreases the opacity, improves the aesthetics and the surface hardness of the treated area.(4,5)

WSL are the result of dental fluorosis, hypomineralization, hypomaturation, hypoplasia or demineralization. They can be congenital, have systemic causes, or can be acquired later in life, due to trauma or poor oral hygiene.(6,7)

In dental fluorosis the enamel becomes hypomineralized due to an overdose of fluoride during enamel formation.(8) Dental fluorosis usually occurs bilaterally and can vary from a thin and diffuse opacity to a very chalky white overall tooth surface. The lesion can be localized to a few teeth or can include the full dentition. The lesion's depth can vary depending on the severity of the fluorosis.(3)

Hypomineralized and hypomaturated lesions have well-defined margins. It usually affects one or several teeth with symmetrical distribution.

Hypoplasia has an aspect of diffuse opaque white and yellowish discoloration, often associated with indents and loss of enamel structure.(9) After a trauma of a primary tooth, 74.1% of permanent successors present discoloration and/ or hypoplasia.(10) The trauma can be physical (breaking or fracturing the tooth) or chemical (periapical infection of the primary tooth). Traumatic hypomineralization usually occurs asymmetrically, affecting only one tooth. It can have the aspect of a punctiform lesion in the incisal third of the tooth.(11) Many studies suggest external bleaching followed by resin infiltration works most effectively for traumatically hypomineralized lesions.(6,11-14)

The molar-incisor hypomineralization (MIH) is a dental lesion with systemic origin, presenting as delimited, qualitative defects of the enamel, frequently with opaque aspect. It affects from one to four first permanent molars. The lesion has a high carbon content, but 20% lower calcium and phosphate concentrations.(15) This hypomineralization begins at the enamel- dentine junction. Clinically, MIH can have the aspect of white-creamy or dark yellow opacities and/or post- eruptive breakdown of at least one first permanent molar.(6)

Demineralized lesions are usually associated with poor oral hygiene and prolonged plaque accumulation. Frequently it appears during orthodontic treatment, its prevalence is 46– 73%.(16) The outer third of the enamel that is covering the WSL has a high fluoride concentration, what came from the precipitation of the mineral content of the saliva and by the crystal diffusion from the body of the lesion. This surface layer has a protective effect, it prevents further demineralization of

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the lesion body, but it also blocks its remineralization.(3)

AIM

Considering the various causes of WSL, it is very important to establish the correct aetiology and diagnosis. This should be based on a rigorous review of dental and medical history, and clinical examination evaluating the location, outline form, symmetry, depth and opacity of the lesion. The information gathered must include a history of neonatal or early childhood illnesses, past infections or trauma of the deciduous teeth and the use of drugs and medications.(17)

The goal of the Icon treatment is to prevent further progression of the decay by obstructing the microporosities within the lesion. This technique uses a light-curing and lowviscosity resin monomer, triethylene glycol dimethacrylate (TEGDMA), as the active ingredient to fill the demineralized porosities of the affected area, thereby slowing down the progression of the lesion and masking the opacity of WSL.(18-21) Therefore, the infiltration technique will prevent demineralization and change the refractive index of the affected enamel to a similar value as the sound enamel's.(6)

When noninvasive or minimally invasive approaches (remineralization, tooth whitening, microabrasion and resin infiltration) are unsuccessful in removing or masking the WSL, restorative treatment is indicated.

MATERIALS AND METHODS

20 cases of WSL were diagnosed and treated with DMG Icon (Ridgefield Park, NJ, USA). The diagnosis of the lesion was made based on a thorough clinical examination combined with a complex inquiry of the patient's medical and dental history.(11) These questions and information were included in the medical history: which region is the patient from; did they intake fluor supplements; did caries or trauma affect the deciduous teeth in the interested area; did the patient have orthodontic treatment; were carbonated soft drinks and other acidic beverages consumed frequently; type and frequency of carbohydrate ingestion; the level of oral hygiene kept; medication history.

The following infiltration protocol was used: before the treatment, the affected tooth and the adjacent teeth were cleaned and washed with water spray. A dry working field was created using rubber dam. It is very important that the surface layer of the lesion is completely removed in order for the infiltrant material to have access to the lesion body for the successful elimination of WSL. Icon-Etch was applied onto the lesion site for 2 minutes. In some cases, this step can be repeated up to three times. The acid was rinsed with water for at least 30 seconds and dried with air spray. Icon-Dry was applied and allowed to set for 30 seconds. At this point, a preview of the final result is shown: the whitish-opaque coloration on the etched enamel should decrease. If not, then the etching step should be repeated once or twice for 2 minutes. The Icon-Infiltrant was applied and allowed to penetrate for 3 minutes. In deeper lesions this period can be extended to 6 minutes. The excess was removed with a cotton wad and dental floss, followed by light-curing for 40 seconds. The application of Icon-Infiltrant was repeated for 1 minute, the excess was eliminated and it was light- cured for a minimum of 40 seconds. The rubber dam was removed and the dental surface was polished.

RESULTS & DISCUSSIONS

The statistical results obtained from the 20 cases of the treated WSL were presented descriptively or graphically, as following:

From the twenty diagnosed people, 13 were females

and 7 were males. This ratio coincides with the results obtained in other similar studies.(22-24)

Figure no. 1. Graphical representation of the age groups



Figure no. 1. shows the age groups of the treated patients. The young, between ages 18-24 were the most represented. Under 18 years there were 3 cases, between the ages of 25 and 34 there were 5, between the ages of 35 and 45 were 2 and over 45 years old there was one patient.

Other studies presented similar findings: that incipient dental caries are most frequent in the age group of 21-25 years.(24)

The patients were from Romania, where the tap water is not fluoridated. Probably this is the main reason why there were no cases of fluorosis found. Two people (10%) had traumatic hypomineralization from accidents involving their deciduous teeth. No patient had molar-incisor hypomineralization (MIH). The most frequent cause (85%) of WSL was the demineralization, due to increased consumption of acidic beverages and/or poor oral hygiene. One patient (5%) was diagnosed with systemic hypomineralization of her teeth.

Hereinafter, three cases will be presented. Each treatment step is documented photographically and described under each image. The patients signed a written consent that they agree to using their anonymized data and pictures for this article and academic purposes.

 1^{st} case: A 35-year-old patient wanted a solution for her unaesthetic upper right central incisor. The tooth presented a 3-4 mm² white spot lesion in the middle third of its vestibular surface.

The aspect of the lesion and the information gathered during the examination suggested that the WSL appeared due to a childhood bicycle trauma of the upper right central primary incisor. Minimally invasive composite resin infiltration was presented as the method of choice in this case and the patient agreed to proceed.

Figure no. 2. The undesired white spot lesion visible during a relaxed smile



We proceeded to the isolation of the upper teeth with rubber dam (NicTone heavy) to protect the dental surfaces from saliva. The recommended treatment protocol is the following: 2-

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CLINICAL ASPECTS

minutes of Icon-Etch, 30 seconds of washing and drying, 30 seconds Icon-Dry, 3 minutes of Icon-Infiltrant, 40 seconds of photopolymerization, 1 minute of Icon-Infiltrant, 40 seconds of photopolymerization and polishing.

Figure no. 3. The first step of the infiltration protocol is the demineralization of the affected area with the Icon Etch solution (15% hydrochloric acid)



Figure no. 4. The aspect of the infiltrated lesion, before polishing



Figure no. 5. The final result, right after taking off the rubber dam



In the last photo the patient is smiling and happy with the outcome of the minimally invasive treatment. The picture was taken right after the isolation was removed, with the teeth still dried out. After rehydration, the final aspect of the tooth's surface will be more even and aesthetic.

 2^{nd} case: A 24-year-old patient presented multiple enamel defects on the apical third of her upper incisors. These white spot lesions appeared during the 2-year long period, while the patient wore braces, probably due to poor oral hygiene.

The patient presented active caries lesions on the proximal surfaces of 1.1. and 1.2 which will be treated in the future appointment. Moreover, the patient agreed to change the two old obturations between the teeth 2.1 and 2.2.

Figure no. 6. The initial situation, after positioning the rubber dam.



The outline of the dental braces is clearly visible. It is evident that above the brackets, in the apical third of the teeth, it was more difficult to keep a good oral hygiene. If the dental plaque is not eliminated completely for multiple days, the local

pH drops under the critical value and the demineralization process begins. This is how the white spot lesions appear.

Figure no. 7. Using the Icon-Etch with the special applicator for the vestibular surface



Figure no. 8. Mimicking the final outcome with Icon-Dry on the right upper central incisor



Figure no. 9. After applying Icon-Infiltrant and photopolymerization



Figure no. 9. shows the vestibular surface of the treated teeth right after the enamel infiltration. In 24 hours, the teeth will rehydrate in the oral cavity, and the final aesthetics will be even better. If the patient is not pleased with the outcome, the infiltration process can be repeated.

 3^{rd} case: A 18-year-old patient presented multiple demineralized lesions on the upper front teeth. Most of them were white but the ones on the canines were yellow coloured. The WSLs have a symmetrical distribution, this indicates a systemic aetiology. The patient could not relate to a high fluor intake in her childhood that is the reason why the diagnosis of hypomineralization was given.

Figure no. 10. The initial aspect of the frontal teeth



Figure no. 11. Applying the Icon-Etch



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Figure no. 12. After etching, the teeth were washed and dried. The aspect of the demineralized lesions was more remarkable than before



Figure no. 13. The infiltration of the white spot lesions was successful, but the yellow patches remained visible



Figure no. 14. The final aspect of the treated and rehydrated teeth



The patient was pleased with the result although the yellowish spot on her left canine was still visible. It was recommended another infiltrating session in the future to improve the aspect of the upper left canine.

Recent studies show that resin infiltration inhibits the evolution of enamel demineralization and improves aesthetics compared to a control group or placebo.(1,5,17,18,20) Enan et al. reported that resin infiltration enhanced the surface resistance of demineralized enamel against acidic challenge.(21)

In the previously presented cases, all of the patients were pleased with the outcome of the treatment and were happy about the fact that it was minimally invasive and did not require the damage of their healthy tooth structure.

CONCLUSIONS

The early diagnosis and treatment of initial dental caries is very important in minimal invasive dentistry. The key is to know when, how and with which materials and techniques should the white spot lesions be treated. It is essential to dental practitioners to understand the aesthetic requirements of their patients and they should be able to offer treatment plans without damaging the sound dental tissues.

Hopefully this technique will be more acknowledged and used by the dentists before they would choose the classical drill-and-fill method.

Conflict of interest for each author

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Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of U.M.F. IULIU HATIEGANU CLUJ-NAPOCA (271/30 July 2019).

Author Contributions

Substantial contributions to the conception of the work: A.K.; interpretation of data for the work: A.K.; statistical analysis: I.C.; revising the work critically for important intellectual content: I.C.; final approval of the version to be published M.E.B.; Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved: A.K., I.C., M.E.B.

All authors critically revised the manuscript, approved the final version to be published, and agreed to be accountable for all aspects of the work.

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