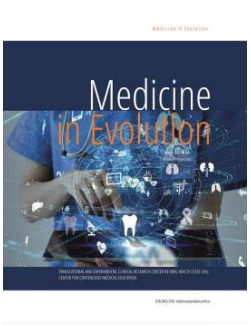
Alternative methods in the treatment of white spot lesions



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Abstract

Dental caries are considered to be one of the most most widespreaded diseases, affeecting 90% of world's population. Caries can be classified according to their clinical appearance into non-cavitary lesions and cavitary lesions. In this article will detail the subject of non-cavitating carious lesions. White spot lesions appear as a result of enamel demineralization. Various risk factors such as acid-producing bacterias, fermentable carbohydrates, poor oral hygiene, reduced salivary volume and sugary diet, sustain the development of these early lesions. Dental white spot lesions occur due to enamel hypomineralization. Factors causing hypomineralization such as fluorosis, traumatic hypomineralization, molar-incisor hypomineralization, genetic defects, as well as environmental factors, must be considered during the differential diagnosis. Many technologies can be used to diagnose early caries, including traditional visual inspections, radiographs, transillumination methods, fluorescence methods, electrical conductivity, ultrasound methods and other recently developed technologies. The goal of modern dentistry is to implemement a non-invasive management of carious lesions. This can be achived by both motivating and educating patients in order to have a correct oral hygiene.

Keywords: White spot, demineralization, prevention, enamel, caries

INTRODUCTION

Oral health represents more than healthy teeth (1). Dental caries are considered to be the most widespreaded disease, affecting 90% of the world's population. It is a reversible, episodic, dynamic and asynchronous pathological process, which in early stages (in the enamel and even in the dentin) can be cured with the help of preventive and therapeutic methods (2). The main cause of dental caries is the presence of bacterial plaque. In the absence of the right treatment, tooth decays evolve progressively and cumulatively. Caries prevention is very important and it is much cheaper from a financial point of view than complex caries treatments. The best way is to prevent and not wait for the lesions to grow to the stage where it is necessary to remove a significant layer of dental tissue (3). Unfortunately, in our country, despite the progress made in the prevention and prophylaxis of dental caries, children and adolescents do not give great importance to this (4). Parents are not aware of the specific methods of preventing dental caries, and dentists do not apply them enough. As a rule, the prophylactic approach is neglected because it takes time to explain its methods and we are often more concerned with the restorative means of treatment. Presenting, to periodic check-ups, in the absence of symptoms, is the key to the success of any preventive program. Dental caries can be classified according to clinical appearance into non-cavitary lesions and cavitary lesions (5). In this article we will detail the subject of non-cavitating carious lesions, also called white spots.

THE MAIN FACTORS THAT DETERMINE THE APPERANCE OF WHITE SPOT LESIONS

White spot lesions appear as a result of enamel demineralization. The reason for their presence are the changes in the optical properties of light scattering of demineralized enamel. Various risk factors such as acid-producing bacteria, fermentable carbohydrates and many other host factors such as poor oral hygiene, reduced salivary volume and a sugary diet, sustain the development of these early lesions (6). A review of the literature showed that white spots develop as a result of dental plaque build-up on affected tooth surfaces, particularly due to inadequate oral hygiene. Under these conditions, acids penetrate the surface of the enamel and the demineralization continues in the depth of the enamel. Undetected and untreated in time, these lesions cause the "collapse" of the enamel and the appearance of cavitated caries. It has been shown that these lesions can appear in up-to 4 weeks (7). The concept of the formation of dental caries was explained as follows: pH fluctuations caused by bacteria that are always metabolic active in the biofilm or dental plaque cause irregular losses and gains of minerals ("demineralization" and "remineralization"). These enamel demineralization and remineralization processes, result in the dissolution of hard dental tissues and in the development of caries lesions (8). In the first stage when the defect is located in the enamel, there is a smaller mineral distribution and also a lower interprismatic mineral content in the surface layer. It is important to understand how these lesions develop and what the risk factors are. Since it is a great challenge to make an early detection of early caries that allows clinicians to apply preventive measures to control the demineralization process before the lesions progress, we need to know how to treat them before they become cavitary lesions. White spot lesions are opaque, white, soft lesions characterized by demineralization on the tooth surface. Early diagnosis and treatment of these lesions can prevent the formation of clinical dental caries (6).

THE DIFFERENTIAL DIAGNOSIS OF WHITE SPOT LESIONS

Stains appear translucent when the surface is wet and white-opaque when we dry the surface of the tooth with the air spray. Other hypomineralized lesions are often white-opaque when the surface is moist (11). Fluorosis is a hypomineralization that occurs as a result of excessive incorporation of fluorides during enamel formation. Histopathologically, hypermineralization occurs in the superficial layer of teeth with dental fluorosis and hypomineralization occurs in the outer enamel subunit. Then, a brown color change occurs, due to the infiltration of exogenous chromophore proteins (12). Traumatic hypomineralization occurs as a result of periodontal trauma affecting the temporary teeth. The severity of the trauma is not related to the level of hypomineralization. Even a simple, discrete shock can cause these defects to form. Periapical inflammation after trauma affects mineralization. Traumatic hypomineralization can appear in different forms, locations and colors. They often appear as point lesions in the incisal third. It usually affects one tooth asymmetrically in relation to the corresponding contralateral teeth. Although the history of trauma provides an idea for the diagnosis of these injuries, it is sometimes difficult to recall simple shocks, so the diagnosis of these injuries is often made by excluding other causes (11). MIH syndrome (molar incisor hypomineralization) is the least known lession thet can be included in the differential diagnosis. Clinically, at least one of the four permanent first molars has a qualitative enamel defect. Permanent incisors can also be affected. The enamel of the affected teeth is yellow, brown, cream or white. It is important to note that although there is a difference in the translucency of the enamel of the affected teeth, there should be no changes in the thickness of the enamel (13). Genetic factors causing enamel hypoplasia and hypomineralization include amelogenesis imperfecta, congenital erythropoietic porphyria, ectodermal dysplasia, tricho-dento-ossosis syndrome, etc. Maternal smoking habits, low birth weight, celiac disease and vitamin D deficiencies (such as Rickets disease) can also cause hypomineralization. Infections such as congenital syphilis, chicken pox, rubella, measles, mumps and cytomegalovirus can cause enamel defects (6).

METHODS AND TECHNOLOGIES USED TO DIAGNOSE INCIPIENT DENTAL CARIES

Many technologies can be used to diagnose early caries, including traditional visual inspections, radiographs, transillumination methods, fluorescence methods, electrical conductivity, ultrasound methods and other recently developed technologies. The simplest method of detecting white spots is visual inspection. Enamel demineralization and microporosity affect the light transmission. In this way, the layer loses its bright color and an opaque white appears due to optical refraction. Using a standard examination light and mirrors, opaque white lesions can be detected by the clinician's visual examination. The addition of conventional radiographs to the visual examination increases the precision of diagnosis. However, exposure to ionizing radiation is the most obvious disadvantage. Other possible disadvantages are cases where the outer layer of enamel is intact and cases where occlusal lesions without macroscopic damage are difficult to diagnose. Previous studies have shown no difference in diagnostic effectiveness between conventional and digital bitewing radiographs. With a computerized diagnosis, we can interpret radiographs in order to distinguish between healthy, demineralized and decayed teeth. The Logicon System (Carestream Dental LLC, Atlanta, GA) is an example of this technology. The program matches radiographs with clinical images, compares them and provides a graphical representation of the tooth density (9). The rapid development of imaging technology is beginning to aid in the early detection of caries. Methods include fiber optic trans-illumination and digital fiber optic trans-illumination of the image, where light transmission

is used. The use of fiber optic light makes it possible to see smaller superficial white lesions. In the digital optical fiber trans-illumination method of imaging, focused images can be taken using a CCD camera installed in the system. The images can be analyzed with the help of a computer, and the diagnosis of interproximal, occlusal and soft surface caries can be made simultaneously. This method allows the documentation of the lesion and the tracking of the progression. The fiber optic method can detect demineralization as early as 2 weeks, but it fails to measure the depth of the lesion (6). There are also systems that use the natural fluorescence that occurs in tooth enamel. The light emission coefficient of a carious lesion is higher than the light emission coefficient of healthy enamel, resulting in less fluorescence in carious lesions. A method that uses the characteristic fluorescence of the teeth is laser fluorescence (DIAGNOdent – KaVo, Germany). Laser beam fluorescence is lower in demineralized enamel tan in healthy enamel. Çınar et al. compared DIAGNOdent with visual examination and bitewing radiographs for the detection of occlusal caries. They found that for enamel lesions, the DIAGNOdent has a higher sensitivity than radiographs (10). Another method used in the early diagnose of dental caries is the study of electrical conductivity. The difference occurs in the electrical transmission of solid and demineralized enamel surfaces due to porosity. Saliva penetrates the enamel and increases the electrical permeability of the tooth. This electrical conductance is measured by a connector placed on a region of high conductivity, such as the gum or skin, and a probe placed in the fissure (6). Today, the most important device used for this purpose is the electronic caries monitor (ECM) (LODE Diagnostic, Groningen, The Netherlands). ECM has limited ability on the occlusal surface in general, being more successful on smooth surfaces. Compared to clinical visual methods, the sensitivity of this system is higher, but the specificity is lower (6). High-frequency pulse-echo ultrasound waves (18 MHz) have been shown to produce different echoes in healthy and demineralized enamel (6). Studies have shown that ultrasound is a successful method in deep dentin lesions, but it is even more useful in evaluating remineralization. A study comparing ultrasound with radiography and histology in mandibular molars for the detection of white spots reported the sensitivity and specificity of the method to be 88% and 86%. It was concluded that ultrasound was a useful tool for detecting these lesions (6).

MANAGEMENT OF WHITE SPOT LESIONS

The goal of modern dentistry is to implement a non-invasive management of carious lesions. Oral hygiene is very important in protecting teeth against white spots. This can be achieved by both motivating and educating patients. It is known that tooth brushing is an effective way to remove dental plaque from tooth surfaces and prevents oral diseases such as caries, gingivitis and periodontitis. (6). Mechanical cleaning is ensured by brushing the teeth with fluoride toothpaste and dental floss. Effective plaque removal from the tooth surface through proper brushing is well known to prevent tooth decay. Technique and frequency vary depending on the patient's disease pattern and oral hygiene needs. It is recommended to remove dental biofilm twice a day to prevent tooth decay. Although manual tooth brushing is a very simple and effective method, a number of studies have stated that the time and effectiveness of tooth brushing is inadequate. Most children brush their teeth regularly, but only for 30-45 seconds. Depending on age and manual skills, teeth may be insufficiently cleaned (14).

1.Fluoride

The initial stage of white spots can be successfully treated with good oral hygiene, topical application of fluoride and/or another caries remineralizing agent. Topical application of fluoride is the first choice of many clinicians to treat incipient lesions. During topical application of fluoride, a calcium fluoride-like material (CaF_2) develops in plaque, on the

surface of the tooth, or in the initial caries lesion. When the pH value drops during a caries attack, CaF2 is used as a reservoir of fluoride ions ready to be released. Also, when there is fluoride on the enamel surface, fluoroapatite is formed, which has a more durable structure than hydroxyapatite. It is believed to be a major mechanism of fluoride action in enamel remineralization. In addition, topical application of fluoride increases plaque pH and inhibits bacterial metabolic pathways indirectly, in this way it reduces enamel demineralization and it incfreses emineralization (15). Low-dose topical fluoride is recommended for long periods of time with frequent exposures to avoid dental fluorosis. Applications of high fluoride concentrations in order to treat early lesions are usually preferred to be done in the clinical practice. However, highly concentrated fluoride leads to hypermineralization of the surface layer. Therefore, the penetration of calcium and phosphate ions into the body of the lesion is blocked. This is called lamination and can have some undesirable aesthetic consequences (12). Slow penetration of calcium, phosphate, and fluoride ion from saliva or low fluoride concentrations into lesions should be allowed. In this way, more aesthetically pleasing results will be achieved. This type of treatment can easily remineralize incipient lesions from the deeper parts of the lesion to the outer surface layers of the enamel. Therefore, the chance of achieving a successful and more aesthetic treatment result increases (6). Frequent exposure to low levels of fluoride is the most important part of caries prevention and remineralization. This can be achieved by using fluoride toothpaste, fluoride mouthwash, and fluoride varnish (6).

A. Toothpastes

Fluoride toothpaste is the most commonly used form of fluoride to provide a constant and small amount of fluoride in the oral environment. Various fluoride compounds have been added to toothpaste, including sodium fluoride, sodium monofluorophosphate, amine fluoride, and stannous fluoride. The concentration of fluoride in toothpaste recommended by the WHO (World Health Organization) is between 1000 and 1500 parts per million (ppm). In many countries, low-fluoride dental products (typically 450-500 ppm fluoride) are marketed to children. Toothpaste with an increased concentration of fluoride, 1500 to 4500 ppm, is especially recommended for adults at high risk of tooth decay (16). The American Academy of Pediatric Dentistry (AAPD) recommends using a pea-sized amount of fluoride toothpaste for children up to 3 years of age and a pea-sized amount for children between 3 and 6 years of age. However, children up to 6 years should be supervised when brushing their teeth. Teeth should be brushed twice a day for the toothpaste to have a better effect (6).

B. Mouthwashes

Mouthwashes have been used successfully to prevent tooth decay and manage early lesions in children. Regular use of fluoride mouthwash by children and adolescents has been shown to significantly reduce the occurrence of dental caries. Both daily use of 0.05% NaF (sodium fluoride) mouthwash and weekly rinsing programs with 0.2% NaF (sodium fluoride) mouthwash were found to decrease the incidence of enamel demineralization. Due to the risk of fluoride ingestion, they are not recommended for children under 6 years of age (6).

C. Fluoride varnishes

Fluoride varnishes have been designed to prolong the contact time with enamel and to prevent the immediate loss of the fluoride after application. Therefore, they act as a slow-release reservoir and facilitate greater absorption of fluoride. Although the fluoride concentration in varnishes is very high (5% NaF, 22,600 ppm), the amount of fluoride exposure can be kept under control so that the application of fluoride varnish is safe.In contact with the wet tooth they gradually release flour and they are applied quickly and effortlessly. Dental prophylaxis is not necessary before varnish applications, so the working time is considerably reduced. Patients should avoid eating for 2-4 hours after application and avoid brushing their teeth that night so the varnish can be more effective(17). The American

Academy of Pediatric Dentistry (AAPD) guidelines recommended that the fluoride varnishes should be applied at least twice a year for temporary teeth and two to four times a year for permanent teeth. Using varnishes two to four times a year has been found to significantly decrease the incidence of tooth decay (6).

D. Fluoride gels

Fluoride gels can be applied by both doctors and patients. In offices, there are different methods of applying fluoride. One of them is applying the gel in a special device that covers the entire dental arch and is easily accepted by children. Commonly used gels are 1.23% sodium fluoride gel (12,300 ppm F) and acidified phosphate fluoride (APF) gel.

E. Fluoride foam

Fluoride foam has the same concentration (1.23%) and pH (3-4) as fluoride gels and it is applied in the same way. Fluoride foam is applied in the dental practice for 4 minutes and two times a year. The American Academy of Preventive Dentistry has recommended that children at high risk of caries should undergo professional fluoride treatment at least every 6 months. Because risk categories may change over time, the types and intervals of preventive interventions should be adjusted accordingly (6).

2.Xylitol

Polyols are alcohol derivatives of sugars, which are metabolized more slowly than sucrose by oral bacteria They were first developed for diabetics, but are now used in sugar-free products such as chewing gum, chocolate, baked goods and biscuits. Polyols are sweeteners that include xylitol, sorbitol, mannitol, maltitol, and lactitol. In particular, xylitol provides anti-caries efficacy on dental plaque and cariogenic microorganisms. This reduces the level of S. mutans by disrupting the energy production process and leads to cell death. It also reduces the adhesion and acid production of these microorganisms present in dental plaque and saliva. Xylitol is more unique than other sugar alcohols because it promotes mineralization by increasing saliva flow and is non-fermentable by oral bacteria (18). In a study of remineralization of enamel lesions in vitro, Makinen and Soderling demonstrated that very high concentrations of sorbitol and xylitol can influence the bioavailability of calcium, supporting the remineralization process of enamel lesions (6).

3.Clorhexidine

Clorhexidine is a frequently used cationic agent with a wide range of antiseptic effects. The effectiveness of the solution in controlling and managing biofilms has been proven in gingivitis, but there is insufficient evidence in preventing initial caries lesions or reducing levels of S.mutans. Inconclusive results of some studies have shown that chlorhexidine varnishes are effective in reducing the prevalence of caries, but not during orthodontic treatment. Varnishes are likely to be more effective due to the higher concentration of chlorhexidine and the longer contact time with the tooth surface. Chlorhexidine has bacteriostatic and bactericidal effects on Streptococcus mutans and inhibits the acid production in the bacterial plaque. It has been hypothesized that its remineralizing effect on white spots may be due to electrostatic bonding with the phosphate groups of hydroxyapatite causing the precipitation of phosphate salts on the demineralized enamel surface. The combined use of fluoride varnish and chlorhexidine has been shown to be more effective in active lesions than the use of either alone (17).

CONCLUSIONS

A general conclusion would be that the patients should be aware of the importance of prevention and that they should take care of their teeth, because the difference between a reversible lesion (white spot) and an irreversible carious lesion is small, the irreversible condition requiring dental treatment with removal of dental substance.

The goal of modern dentistry is to implement a non-invasive management of carious lesions. Maintaining a good oral hygiene is one of the most important steps in protecting teeth against white spots. This goal can be achieved by both motivating and educating patients.

The initial stage of white spots can be successfully treated with correct oral hygiene, topical application of fluoride or of anothers caries remineralizing agents.

Xilytol is a common used sweetner that has important positive effects in reducing dental caries. It reduces the level of S. mutans by minimizing the energy production. It also reduces the adhesion and acid production of these microorganisms that are present in dental plaque and saliva. Xylitol supports mineralization by increasing saliva flow and is not fermentable by oral bacteria.

Clorhexidine is a frequently used cationic agent with a wide range of antiseptic effects. The effectiveness of this solution consists in controlling biofilms located in oral plaque and in saliva. The positive effects have been proven in gingivitis, but there aren't sufficient evidences in demonstrating the prevention of initial caries lesions.

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