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An update on molar-incisor hypomineralization

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Abstract

The management of molar incisor hypomineralization (MIH) is considered challenging for patients, parents and the dentist; it has a systemic origin, it can occur in one or more permanent molars, incisors can be affected simultaneously. These enamel defects occur due to several risk factors during the pre-, peri- and postnatal period.

Objective: To analyze the literature on molar-incisor hypomineralization and its relationship with prenatal risk factors, diagnosis, enamel remineralization techniques and treatment.

Methodology: Using the keywords "molar incisor hypomineralization", "etiology", "diagnosis", "oral manifestations", "enamel remineralization" and "clinical management", the Medline/PubMed and ScienceDirect databases were searched, with emphasis on the last 5 years. It was evaluated with the PRISMA and AMSTAR-2 guidelines.

Results: Postnatal factors are based on childhood diseases and antibiotic intake in the developmental stages of the teeth. In the prenatal period, to diseases during pregnancy. Perinatal factors are related to low birth weight. MIH is evaluated depending on the severity based on defects, color, location and post-eruptive collapse and the extent of the affected surface. Techniques to remineralize the enamel are only efficient to avoid caries progression. Microabrasion is the most commonly used treatment technique.

Conclusion: Most of the risk factors are attributed to the postnatal period during the first three years of life and HMD increases the prevalence of MIH.

Keywords: Hypomineralization, first molar, incisor, remineralization

1. Introduction

The management of molar incisor hypomineralization (MIH) is considered challenging for patients, parents and the dentist [1]. It is an enamel condition characterized by white to brown lesions that show rapid caries progression [2]. However, in healthy tooth enamel, the tissue is highly mineralized and consists of 95% hydroxyapatite crystals, highly ordered units called enamel prisms [3]. A comparison between healthy teeth and teeth affected by enamel defects shows that hypomineralized enamel has low mechanical properties, such as hardness and elasticity [4], so MIH has a systemic origin and can occur in one or more permanent molars. Incisors can also be affected simultaneously [5], therefore enamel defects occur due to low activity of the enamel forming ameloblasts due to several risk factors (such as disease, antibiotic use and excessive fluoride intake) during the pre-, peri- and postnatal period [6]. These include: serious illness or complications during pregnancy, low birth weight or premature birth, problems related to breastfeeding or infections in the first years of the child's life [4]. It is important to note that hypomineralization is considered a cause of tooth loss [7]. We can also find that there is a prevalence of MIH that varies substantially throughout the world, ranging from 2.8% to 40.2% [8].

The objective of this review is to analyze the literature on molar incisor hypomineralization and its relationship with post-, peri- and prenatal risk factors, diagnosis, enamel remineralization techniques and treatment.

2. Materials and methods

Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using PRISMA guidelines, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews (AMSTAR-2) [9].

The search was performed using Boolean logical operators AND, OR and NOT.

It was constructed with the words “molar incisor hypomineralization”, “risk factors”, “diagnosis”, “enamel remineralization”, “treatment”. The keywords were used individually, as well as each of them related to each other. Initially, the titles of all the articles were selected, the abstract of each one was evaluated, and the articles were chosen for a complete reading review.

3. Results & Discussion

3.1 Postnatal Risk Factors

During the postnatal period, potential factors related to MIH include early childhood diseases, some medical problems (parental, postnatal) [10, 11], including respiratory diseases, infections, fever, prolonged breastfeeding, environmental pollution, [12] asthma and pneumonia. These have also been associated with MIH, however, genetic factors and ameloblasts play an important role as they are sensitive to environmental changes such as increased temperature, pH changes and hypocalcemia. In 2013 Sonmez *et al.* examined a large group in which gastrointestinal problems, measles and chickenpox were present and these were associated with MIH [13]. In addition to diseases, the occurrence of hypomineralization has also been attributed to antibiotic exposure during the first year of life, as studies showed an increased probability of defect occurrence more than three times compared to the non-user [14]. One of the antibiotics with more use in the pediatric age is amoxicillin, and it is used for the treatment of upper respiratory tract infections and especially acute otitis media [15]. Its effects can be detrimental in the intake of drugs around 3 years of age on oral health, and the relationship between genes associated with orofacial clefts and the phenotype of MIH [2]. Another risk-increasing factor was that children with deciduous molar hypomineralization (DMH) are at increased risk of developing MIH, because the permanent first molar and primary second molar have a shared period of development and mineralization. DMH is a clinically useful predictor for MIH [16].

There are a myriad of factors that can intervene for the development of hypomineralization which are very difficult to control, since most of them are based on respiratory diseases or childhood diseases, some of which result in the ingestion of antibiotics during the developmental stages of the teeth.

3.2 Pre- and Perinatal Risk Factors

3.2.1 Prenatal factors

Causes include consumption of canned foods and beverages during pregnancy [17], maternal pyrexia, maternal diabetes, maternal nausea and vomiting, use of myometrial spasmolytics [8], maternal medical problems, urinary tract infection in the third trimester of pregnancy, maternal anxiety and smoking [12]. In the last article published by Lee *et al.* they found that smoking during pregnancy was associated with a higher prevalence of MIH [18]. Stress and anxiety are psychological conditions that are associated with physical

changes, such as changes in nutritional status, sleep disturbances, weight loss and other unknown conditions. These physical changes may favor the association with enamel defects [19]. It is also attributed to maternal lack of protein, vitamin A, D or mineral calcium, phosphorus, iron, etc., which can directly affect tooth development, resulting in abnormal enamel or dentin structure [20]. Vitamin D is intimately involved in tooth development, it maintains plasma concentrations of calcium and phosphate, which are important for healthy bone and tooth development. Therefore, disruption of vitamin D can lead to inadequate levels of calcium and phosphorus in the circulating plasma, resulting in a negative impact on tooth mineralization [21].

3.2.2 Perinatal factors

Perinatal causes are related to neonatal hypocalcemia, birth asphyxia, prolonged or complicated labor, selective cesarean [8], and extremely preterm birth with a very low birth weight can cause a high prevalence [22]. However, there is still controversy regarding cesarean delivery and delivery complications, as some authors mention that these are not significantly associated with MIH [17].

Prenatal factors are due to maternal illnesses during pregnancy, as well as psychological stress, smoking and lack of vitamins A, D, calcium, phosphorus, and iron. While perinatal factors are related to low birth weight and there is still a controversy in terms of cesarean delivery and complications at the time of delivery.

3.3 Diagnosis

The ideal time to diagnose MIH is as soon as it is clinically evident in either the primary or permanent dentition. The examination should be performed with clean and moist teeth [23], it should be noted that the diagnosis can be challenging because the condition can be confused with other hereditary conditions, in particular developmental enamel defects such as amelogenesis imperfecta, fluorosis, white spot lesions, enamel hypoplasia and traumatic hypomineralization [24]. A correct diagnosis will be of great help for treatment because treatment will largely depend on the severity of the enamel defect [25], so the treatment needs of MIH can be used for individual diagnosis and treatment planning [26]. In order to evaluate MIH, certain criteria should be taken into account such as the extent of the defect in a tooth, and this is measured according to the enamel surface affected: less than 1/3 of a tooth surface; at least 1/3 but less than 2/3; at least 2/3 of the tooth surface [27]. In one of them two groups are divided, the first being mild: cases in which all affected teeth have enamel opacity, the second group is represented by moderate/severe: cases that have one or more affected teeth with post-eruptive enamel breakage or atypical fillings that require clinical attention [28]. Therefore, the molar hypomineralization severity index is based on defects, color, location and post-eruptive collapse [29], which are classified according to the score. In mild scores from 3 to 6, there are intact color defects, usually on smooth or occlusal surfaces, in moderate from 7 to 9, with yellow or brown defects on occlusal surfaces or cusps that may have atypical or previous restorations and sensitivity and finally, in severe from 10 to 13, with brown or yellow defects with a combination of post-eruptive collapse, sensitivity and atypical restorations or previous restorations [30].

Early diagnosis is very important to provide good treatment, however there are other conditions that can lead to an erroneous diagnosis, which is why it is necessary to take into

account the evaluation criteria for MIH, where it is evaluated depending on the severity and extent of the affected surface.

3.4 Enamel Remineralization Techniques

Pastes containing amorphous calcium phosphate or bioactive glasses can be used to enhance remineralization, as well as tricalcium beta-phosphate, which has remineralizing effects on the enamel surface. Its main purpose is to enhance the action of fluoride on the tooth surface, while remineralization is mainly driven by salivary calcium and phosphate ions^[31]. Polycarbonate monofluoride is a graphite-based composite that has a fluoride-containing platelet structure. Recently, graphite has been found to have antibacterial effects, particularly against oral pathogens^[32], however, these strategies cannot prevent the development of lesions, and the esthetic appearance almost always remains impaired^[33]. Three pastes were compared; Duraphat fluoride varnish with calcium ions, Clinpro; which contains varnishes and increases the retention of fluoride and calcium ions in the oral environment and improves mineralization of early lesions and Recaldent; which provides calcium and phosphate bioavailability to promote remineralization. However, Duraphat showed the best results in mild lesions, followed by Clinpro in moderate lesions^[34]. We can also find other pastes which also provide good results, such as Mi paste plus, which provided high concentrations of bioavailable calcium, phosphate and fluoride ions in saliva and produced improved enamel remineralization in subsurface lesions in situ compared to products with fluoride alone^[35]. The efficacy of MI Paste Plus and Remin Pro was compared and both were shown to be effective in increasing mineral content and improving the appearance of demineralized enamel. Therefore, these products could be recommended for the management of white spot lesions^[36], however under normal physiological conditions, fluoride and salivary homeostatic mechanisms are often sufficient to remineralize early lesions, but these are not suitable in highly cariogenic oral environments. Furthermore, in the presence of high topical concentrations of fluoride, the incidence of occult caries (fluoride syndrome) may increase^[37]. Nevertheless, in recent years, laser therapy became another novel modality suggested to provide resistance to tooth structure. The application of fluoride compounds together with laser irradiation minimizes the unfavorable changes caused by laser irradiation^[38].

Techniques to remineralize enamel are only efficient to prevent caries progression since enamel is more prone to develop carious lesions. The use of Mi paste or Remin pro which have minerals and improve the appearance of the enamel is recommended. However, more studies are needed to prove the efficacy of laser therapy with fluoride application.

3.5 Treatment

Treatment includes preventive procedures indicated only in cases where there is no structural tooth loss, or conservative or invasive restorations with removal of the affected area^[39]. There are many restorative options available to the dental surgeon treating these patients: Resin Modified, Glass Ionomer Cements, Polyacid Modified Composite Resins, Composite Resins and Amalgams^[40]. Simple and minimally invasive treatments can provide good clinical and psychosocial outcomes and should be offered to children reporting negative effects^[41]. Likewise, the esthetics of MIH can be improved by treatments such as enamel microabrasion, bleaching, composite resin bonding and combination of some

or all techniques^[42, 43]. Microabrasion represents the most suitable treatment option for very superficial lesions^[33], since improved oral health-related quality of life was demonstrated in children after microabrasion/tooth whitening^[43]. Other techniques used are to employ a combination of 18% hydrochloric acid and abrasives such as pumice or hydrochloric acid with silica carbide, or even 37% phosphoric acid gel with pumice in equal volume proportions^[44]. Resin infiltration is a minimally invasive technique, however, there is a paucity of clinical confirmation on the efficacy of resin infiltration treatment for masking whitish enamel discolorations in patients with MIH^[42]. Fluoride varnish in mild cases is the treatment of choice, as it provides enamel strengthening and can contribute to caries prevention^[44]. As a more invasive treatment technique, preformed metal crowns have been used for many years to cover molars with defective enamel, but it should be emphasized that they are recommended as a treatment option only in posterior teeth with MIH^[40].

Treatment includes both preventive procedures and conservative or invasive restorations. Microabrasion is the most recommended technique and can be combined with other techniques to obtain better esthetic results.

4. Conclusions

Most risk factors are attributed in the postnatal period to childhood illnesses such as fever, asthma or pneumonia during the first three years of life and the intake of medications such as antibiotics. Hypomineralization in infant teeth is also a predisposing factor for MIH, as well as other risk factors are maternal illness during pregnancy or lack of vitamins and low birth weight of the patient. Teeth with MIH are more prone to carious lesions due to the porosity of the enamel, so a detailed examination should be performed taking into account all the evaluation criteria since the treatment will depend on the diagnosis. Microabrasion is the recommended technique for esthetic treatment and we can use remineralizing techniques to avoid the development of carious lesions.

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