

MOLAR-INCISOR HYPOMINERALIZATION (MIH): FROM DIAGNOSIS TO TREATMENT - A SYSTEMATIC REVIEW

Anne Caroline Ribeiro Lacerda¹

Beatriz Durando Rebouças²

Clarisse Cirqueira Araujo Telles Nouzinho³

Kádja Alves Freitas Cruz⁴

Laís Cavalcante Carneiro⁵

Livia Jordania Lino Figueredo⁶

Malvina de Souza Pereira⁷

Thaís da Silva Oliveira⁸

Abstract: Introduction: Irregular tooth enamel on one or more molars or even permanent incisors is Incisor Molar Hypomineralization (IMH), a condition that directly affects the experience of the affected person. Objective: This systematic review aims to list the specificities of MIH based on the aim of determining its causes and origins so that it can be understood and treated. Methodology: The databases used were: National Center for Biotechnology Information, U.S. National Library of Me-

1 Graduate in Dentistry by the Sovereign Faculty of Health of Petrolina, 56308-000, Petrolina-PE, Brazil.

2 Graduate in Dentistry by the Sovereign Faculty of Health of Petrolina, 56308-000, Petrolina-PE, Brazil.

3 Graduate in Dentistry by the Sovereign Faculty of Health of Petrolina, 56308-000, Petrolina-PE, Brazil.

4 Graduate in Dentistry by the Sovereign Faculty of Health of Petrolina, 56308-000, Petrolina-PE, Brazil.

5 Graduate in Dentistry by the Sovereign Faculty of Health of Petrolina, 56308-000, Petrolina-PE, Brazil.

6 Graduate in Dentistry by the Sovereign Faculty of Health of Petrolina, 56308-000, Petrolina-PE, Brazil.

7 Master in Pediatric Dentistry from São Leopoldo Mandic- 13045-755, Campinas-SP, Brazil.

8 Graduate in Dentistry by the Sovereign Faculty of Health of Petrolina, 56308-000, Petrolina-PE, Brazil.



dicine (Pubmed), Virtual Health Library (VHL) and Scientific Electronic Library Online (Scielo), in English, Spanish and Portuguese. Totaling 1,680 articles. Of which 1,592 articles were excluded where they did not meet the inclusion criteria, resulting in 88 articles, after a complete reading, 45 articles were selected to compose the study. Results: Treatment modalities for teeth affected by MIH varied widely, depending on the severity, and the presence of complicating factors, such as hypersensitivity, oral hygiene and patient cooperation. Conclusion: MIH has an unresolved etiology with multifactorial characteristics, such as genetic factors, pathologies during pregnancy and even pollution. Incisor molar hypomineralization has a late diagnosis associated with the unskilled knowledge of professionals regarding its manifestations.

Keywords: Developmental Defects of Enamel, Pediatric Dentistry and Maternal and Child Health.

INTRODUCTION

Molar-Incisor Hypomineralization (MIH) This is a condition that impacts the mineral formation of at least one permanent molar, and can also affect the incisors, causing changes in their color, shape and texture (Weerheijm et al, 2001). This circumstance has a significant impact on the oral health of children and young people, as well as affecting their quality of life and self-confidence (Kajihara LYA, 2022).

It is a challenge for dentists to identify the etiology associated with HMI, since there are several factors that predispose to it, in the literature, there are studies on defects in the development of enamel that manifest themselves as a consequence of a range of environmental factors that act at the systemic level. These include factors such as prenatal, perinatal, postnatal and antibiotic use (Garg N. et al, 2012; Juárez-López MLA et al, 2023). However, to date, it has not yet been completely clarified (Lopes LB, 2021), probably due to its complexity, which involves hereditary, environmental, and local factors as possible causes of defects in the structure of deciduous and permanent tooth enamel (Vieira et al, 2016).



Diagnosing HMI requires a thorough evaluation of the affected teeth and their x-rays. Early detection of HMI is crucial for successful treatment, as it enables the identification of lesions in their early stage and the implementation of more uncomplicated preventive and restorative measures (Silva et al, 2020).

The treatment of HMI ranges from preventive measures, such as the application of fluoride, the use of fluoride varnishes, sealants, and oral health education, to interceptive procedures, such as restorative, endodontic, and tooth extractions (Padavala et al, 2018), depending on the level of impairment of the affected teeth. The restorative procedure for HMI consists of removing the demineralized tissue and reconstructing the teeth using restorative materials, such as composite resin or glass ionomer cement (Silva et al, 2020; Bekes K, 2020).

Based on scientific evidence, there was a need to carry out a systematic review, with the objective of understanding its etiology, observing its clinical particularities, in order to identify and diagnose HMI early. Also emphasizing the importance of understanding the types of treatments and their compatibility with such a condition.

METHODOLOGY

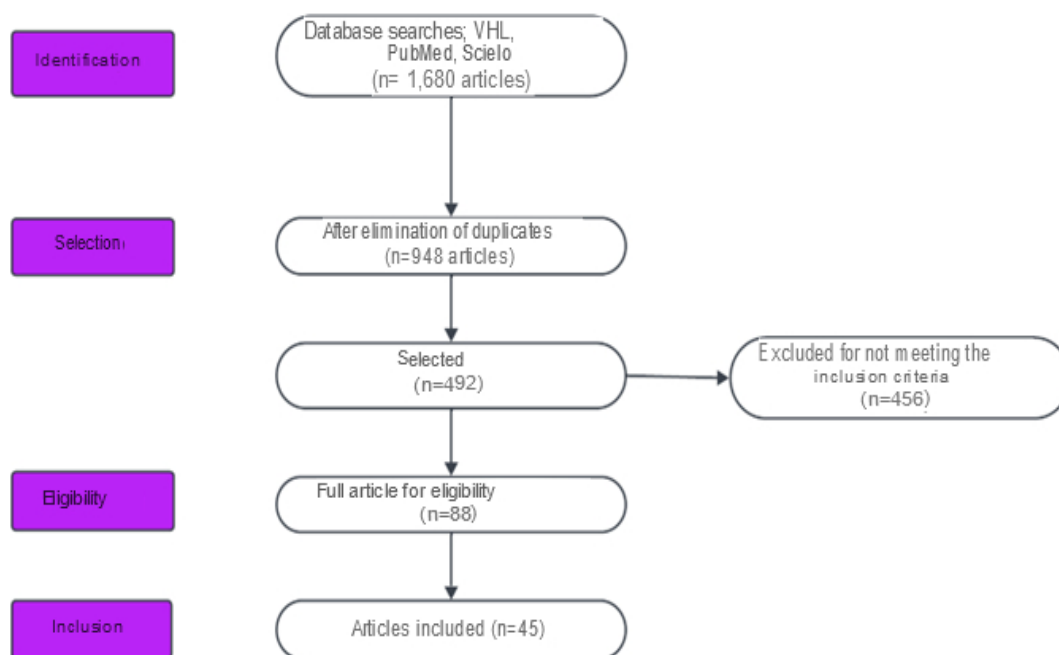
As it is a systematic review, this is more in-depth and thorough, with the objective of demonstrating that the author searched for several articles in the literature to support his theory. In the systematic review, we begin by identifying the concept of interest, taking into account the inclusion and exclusion criteria of the articles to be reviewed and made available, to form the numbers of final articles (GUIRAO, G. S. J. Adolf, 2015).

In the present research, data were collected between the months of February, March, and April 2024. The databases used were: National Center for Biotechnology Information, U.S. National Library of Medicine (Pubmed), Virtual Health Library (VHL) and Scientific Electronic Library Online (Scielo), in English, Spanish and Portuguese. For the inclusion criteria, studies were used



from 2001, when the term HMI was proposed, to 2024, which were related to the theme guided. The descriptors in Health Sciences (DeSC): “Developmental Defects of Enamel”, “Pediatric Dentistry” and “Maternal and Child Health”. Theses, monographs, articles not accessible online, articles outside the period presupposed by the inclusion criterion, and indexed in other databases were excluded.

A total of 1,680 articles were obtained from the databases. Of which 1,592 were articles, being excluded where they did not meet the inclusion criteria, as they were Theses, Monographs, articles that did not meet the theme, full text not available. They resulted in 88 articles, after a complete reading, 45 articles were selected, thus composing the flowchart presented below:



Source: developed by the authors.

DISCUSSION

WHAT IS HMI?

Incisor molar hypomineralization (IMH) is due to the abnormal development of enamel in the



first or most permanent molars, then associated with the permanent incisors. The term molar-incisor hypomineralization (HMI) was suggested by Weerheijm et al (2001) to explain dental anomalies.

During tooth formation, the enamel undergoes changes in its mineralization process, with the compromise or interruption of the process of supplying components, such as hydroxyapatite, secreted by the ameloblasts, the minerals do not reach the tooth properly, which results in the presence of enamel areas with fewer minerals than usual, more susceptible to cavities, hypersensitivity and coloration variations from white to yellow to brown (Alaluusua S, 2010).

Affected patients have variability of complications ranging from tooth wear to psychosocial impacts (Bekes K, 2020).

Severity Classification - HMI

Severity Level	Signs and symptoms
Light-HMI	It involves small areas of opacity or spots in enamel.
Moderate-HMI	It presents more extensive opacities in enamel and can affect more than one tooth surface.
Severe-HMI	It presents diffuse and extensive opacity or stains on the enamel and can affect multiple teeth.



Source: developed by the authors.

AETIOLOGY

The etiology of Molar-Incisor Hypomineralization is in the process of being defined, however, it is considered systemic and probably has a multifactorial character, not linked only to an isolated or specific factor (William V et al, 2006). There is also the probability of an association of the action of genetic and environmental factors, such as pollution, pathologies present during the gestational period, complications associated with childbirth, such as prolonged or premature birth, and also in the perinatal period, as well as early childhood interfering with the normal development of the enamel in its maturation phase, generating different types of alterations in this tooth structure (Fernandes AS et al, 2012; Assunção CM et al, 2014; Jeremias F et al, 2016; Jan J et al, 2007; Portella PD FF et al, 2018; Koruyucu M, Ozel S, Tuna EB, 2018; Rai A et al, 2018; Jeremias F et al, 2016).

Thus, when linked to modifications in genetic factors, which is what directly determines the process of amelogenesis, especially in the secretory phase, these changes generate a defect in the shape, thickness, and hardness of the enamel, resulting in hypoplasia (Jeremias F et al, 2016).

In theory, Allazzam et. al (2014) states that pathologies can affect the ameloblastic activity and pH of the enamel matrix, generating this defect, as they prevent the action of proteolytic enzymes and the development of crystalline hydroxyapatite. Still following the theory of this study, there is no relationship between HMI and birth history, from complications during low birth weight to the durability of breastfeeding. On the other hand, Elfrink et al identified that children born with normal weight appear to have a lower risk of enamel defects than those born with low weight, as it is possible that they have connections with other factors associated with maternal health status to generate these enamel malformations. Also in this study, asthma, high fever and medical infections were considered correlated with HMI, but low weight, duration of breastfeeding and urinary infections were not correlated. Therefore, they found no link between Molar-Incisor Hypomineralization during the



duration of breastfeeding and preterm birth.

On the other hand, RESENDE AND FAVRETTO (2019) allege that complications in the prenatal period, whether smoking or pathologies during pregnancy, in the perinatal period, such as neonatal complications, premature birth, and low body weight at birth, and in the postnatal period, such as malnutrition, respiratory diseases, and frequent childhood diseases with a history of high fever, seem to strongly influence the appearance of HMI. Corroborating RESENDE AND FAVRETTO (2019), among the prenatal complications, maternal diabetes, the use of illicit substances, and lack of vitamin D stand out as common reports among patients with HMI (Allazzam S.M et al, 2014; Elfrink M.E et al, 2014; Lygidakis et al, 2009; FRAGELLI, C.M.B. et al, 2013; Da Silva-Júnior et al, 2018).

In relation to the early childhood period, diseases such as respiratory diseases, such as asthma, otitis, tonsillitis, gastrointestinal diseases, such as malnutrition, chickenpox, rubella and measles, corresponding to the first three years of children's lives, are also related. A period in which there is simultaneously the development of the incisors and first molars, with an interrelationship between both events in this period (Mast P et al, 2013; Vilani PNL et al, 2014). Thus, it was believed that there was a link between this malformation and the use of antibiotics in children, however, there are some studies on the non-existence of this interconnection, considering that enamel defects are probably related to the underlying disease and not to the use of antibiotic therapy. Since this class of drugs is widely used in cases of respiratory infections and there is a strong association between Molar-Incisor Hypomineralization and respiratory diseases, there is a greater probability that it is related to these underlying diseases and not specifically to the antibiotic (O.O. Kuscu et al, 2014; Willmott NS et al, 2008; Kuscu OO, Caglar E, N. S., 2008).

HOW TO DIAGNOSE HMI?

Molar-incisor hypomineralization is a condition that is still complex to diagnose due to the lack of knowledge of dental surgeons for the correct diagnosis. In many cases, it is confused with other



types of enamel defects such as: fluorosis, amelogenesis imperfecta and hypoplasia, thus making the observation of clinical signs fundamental for the correct diagnosis and consequently management of the patient in relation to the treatment (BORSATTO, T. V. F. S.; FERNANDES, M. L. da M. F., 2022; Da Silva-Júnior et al, 2018).

Clinically, changes in the enamel are noticed that vary in relation to color, from white to yellow or brown, with a clear demarcation in the enamel, which can affect 2/3 of the crown, develop changes in the translucency of the enamel. The terminologies mild, moderate, and severe are used to distinguish the severity of the injury. In the mild and moderate ones, we observed characteristics of enamel porosity, demarcated opacity, color change and sensitivity to stimuli. In severe cases, it has a darker color, there is the presence of fracture in the tooth element, spontaneous sensitivity, the presence of extensive carious lesions, and coronary involvement of up to 2/3 (Nagata AG et al, 2023; Silva et al, 2020).

Generally, patients affected by HMI have related clinical problems. Among them, loss of enamel, increased propensity to caries, rapid tooth wear and dental hypersensitivity (BORSATTO, T. V. F. S.; FERNANDES, M. L. da M. F., 2022; E Telles et al, 2024).

Hypersensitivity is a frequent complication of HMI, making it difficult for the patient to perform oral hygiene and feeding. Molars that have been severely damaged show enamel fragmentation in the occlusals and cusp regions (Carvalho de Souza et al, 2023).

It was found that the best time to obtain the correct diagnosis of HMI is in the eight-year-old age group, when it is expected that all the first permanent molars are already erupted, like most of the permanent incisors (Carvalho de Souza et al, 2023; Zachi et al, 2024).

HMI TREATMENT

There are a variety of treatment options, depending on the stage, the clinical protocol must take into account factors such as the severity of hypomineralization, the patient's age, cooperation,



and also the socioeconomic pattern in which the patient is inserted (ALVES, M. C. DE O. et al, 2021). For this reason, the literature proposes the following techniques, for simpler cases, the use of some preventive materials is appropriate, such as desensitizers, remineralizers, varnish, and topical application of fluoride, when there is no loss of structure and sensitivity (Lygidakis et al, 2022).

In cases where enamel or dentin fractures develop, resulting in exposure, individuals may experience sensitivity to hot and cold temperatures. This sensitivity can cause discomfort during brushing, and it is advisable to use sealants as a preventive measure against cavities caused by inadequate oral hygiene (Fragelli et al, 2017). Glass ionomer (CIV) sealing has been recommended as the first choice, because of its advantages, such as the release of fluoride, which contributes to the prevention of caries and enamel breakage (SCHRAVERUS, M. S. et al., 2021).

For teeth with caries, the treatment must be conservative, with selective removal of decayed tissue, thus avoiding pulp exposure, that is, the removal of tissue only surrounding walls. Hypomineralization presents significant challenges due to the porosity of the enamel, high protein content and low resistance, in view of the difficulty in performing direct restorations, where adhesion is an essential factor, and the use of indirect restorations (onlay) is recommended as a satisfactory clinical protocol, and greater resistance to masticatory forces (ROLIM, T. Z. C. et al., 2021; DHAREULA, A. et al, 2019).

The approaches proposed in the literature range from conservative options to the use of prefabricated metal crowns (posterior teeth) when the tooth does not have sufficient structure to receive direct and indirect restorations. However, tooth extraction is considered the last option, indicated only when previous treatments are not feasible, and there is severe structural loss. In these cases, orthodontic planning is carried out to restore functionality and aesthetics (ELHENNAWY, K.; SCHWENDICKE, F., 2016).



FINAL CONSIDERATIONS

Therefore, molar-incisor hypomineralization (HMI) is the abnormal alteration of tooth enamel due to a modification of its mineralization process. Its etiology has not yet been defined, but it has multifactorial characteristics, such as genetic factors, pathologies during pregnancy and even pollution, thus being linked to genetic mutation. In the process of diagnosing the condition, there is still a lack of preparation on the part of dental surgeons, and it is still very confused with other oral disorders. Therefore, HMI is characterized by its staining and sensitivity to stimuli, and its diagnosis is of paramount importance for the correct treatment. Its conduct will depend on some factors, with the classification of the stage being the most important to ensure the effectiveness of the treatment, making it less traumatic.

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