UNIVERSIDADE FERNANDO PESSOA

# EVALUATION AND COMPARISON OF CLINICAL PRACTICE GUIDELINES FOR MOLAR-INCISOR HYPOMINERALIZATION (MIH): AN INTEGRATIVE REVIEW

[AVALIAÇÃO E COMPARAÇÃO DE DIRETRIZES DE PRÁTICA CLÍNICA PARA HIPOMINERALIZAÇÃO MOLAR-INCISIVO (MIH): UMA REVISÃO INTEGRATIVA]

Dissertação de Mestrado

Mestrado Integrado em Medicina Dentária

Sofia Stancati

Orientador:

Doutora Cristina Lopes Cardoso da Silva

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A papà, per te è tutto questo e tutto il bello che verrà.

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# ABSTRACT

Molar-incisor hypomineralization (MIH) is a defect in enamel formation, leading to soft and discolored teeth that are more vulnerable to damage and sensitivity, for which therapeutic protocols and management strategies are still evolving. This integrative review aims to identify best practices, highlight variations in treatment approaches and assess the overall effectiveness of these guidelines in enhancing paediatric dental care. For this study, all available clinical guidelines were reviewed by consulting the official websites of major paediatric dentistry societies worldwide. The guidelines considered include those issued by the British Society of Paediatric Dentistry (BSPD), the International Association of Paediatric Dentistry (IAPD), the European Academy of Paediatric Dentistry (EAPD), the American Academy of Pediatric Dentistry (AAPD), the King's College Hospital Guidelines, and the Alliance of Molar Incisor Hypomineralization Investigation and Treatment (AMIT). A comparative analysis of these guidelines was conducted to identify similarities and differences in clinical recommendations. The guidelines analyzed show remarkable convergence regarding the importance of early diagnosis, the adoption of minimal intervention strategies, and the need for conduct based on the clinical severity of MIH. The EAPD stands out for its application of the GRADE methodology, giving greater robustness to its recommendations. The alignment between the associations reinforces the feasibility of adopting an international clinical protocol, with flexibility according to the clinical context and local resources. Standardization of MIH management can contribute significantly to improving clinical outcomes, reducing associated morbidity, and promoting more effective and patient-centered paediatric dentistry.



**Keywords**: "Molar incisor hypomineralisation", "MIH", "Clinical guidelines", "Treatment", "Management", "Clinical protocols"

# RESUMO

A hipomineralização molar-incisivo (HMI) é um defeito na formação do esmalte, resultando em dentes enfraquecidos e descolorados, mais vulneráveis a danos e sensibilidade, para os quais os protocolos terapêuticos e as estratégias de gestão ainda estão em evolução. Esta revisão integrativa tem como objetivo identificar as melhores práticas, destacar as variações nas abordagens de tratamento e avaliar a eficácia global destas orientações na melhoria dos cuidados dentários pediátricos. Para este estudo, todas as guidelines clínicas disponíveis foram revistas através da consulta dos sites oficiais das principais sociedades de odontopediatria do mundo. As orientações consideradas incluem as emitidas pela Sociedade Britânica de Odontopediatria (BSPD), pela Associação Internacional de Odontopediatria (IAPD), pelos Arquivos Europeus de Odontopediatria (EAPD), pela Academia Americana de Odontopediatria (AAPD), pelas Diretrizes do King's College Hospital e pela Aliança de Investigação e Tratamento da Hipomineralização Molar Incisivo (AMIT). Uma análise comparativa destas guidelines foi conduzida para identificar semelhanças e diferenças nas recomendações clínicas. As guidelines analisadas mostram uma notável convergência quanto à importância do diagnóstico precoce, à adoção de estratégias de intervenção mínima e à necessidade de condutas baseadas na gravidade clínica da HMI. A EAPD destaca-se pela aplicação da metodologia GRADE, conferindo maior robustez às suas recomendações. O alinhamento entre associações reforça a viabilidade da adoção de um protocolo clínico internacional, com flexibilidade de acordo com o contexto clínico e os recursos locais. A uniformização da gestão da HMI pode contribuir significativamente para a melhoria dos resultados clínicos, a redução da morbilidade associada e a promoção de uma odontopediatria mais eficaz e centrada no paciente.



**Palavras-chave**: "Hipomineralização molar incisivo", "MIH", "Linhas de orientação clínica", "Tratamento", "Manuseamento", "Protocolos clínicos"

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## LIST OF ABBREVIATIONS

**AAPD** American Academy of Pediatric Dentistry

**AMIT** Alliance of Molar Incisor Hypomineralization (MIH) Investigation and Treatment

**BSPD** British Society of Paediatric Dentistry

**EAPD** European Academy of Paediatric Dentistry

**IAPD** International Association of Paediatric Dentistry

**MIH** Molar incisor hipomineralization

# 1. INTRODUCTION

Molar Incisor Hypomineralization (MIH) is a qualitative defect in enamel development that affects first permanent molars, incisors, second deciduous molars and canine cusps. It presents as demarcated and asymmetric lesions, whitish, yellow or brownish in color and post-eruptive fractures (Garot et al., 2022).

Enamel is produced by ameloblasts, whose cellular activity presents very high metabolic sensitivity (Lacruz et al., 2017). Its fragility allows different factors, exogenous or endogenous, to result in abnormalities on the enamel surface (Santos et al., 2014). These cells are responsible for the formation and mineralization of enamel, being found in a layer that comes into direct contact with the enamel surface in formation (Lacruz et al., 2017).

Enamel formation begins along the amelodentinal junction, during the bell phase of odontogenesis, first constituting the cusps or incisal edges of the teeth and developing towards the cervical region (Elhennawy et al., 2020; Gil-Bona & Bidlack, 2020).

MIH is a pathology whose prevalence varies according to the country and year of birth, being more frequent in the paediatric population, with a low caries rate. The worldwide prevalence varies between 2.4 and 40.2% (Almuallem & BusuttilNaudi, 2018).

Clinically, molars and incisors present opacities of variable size with different colors, from white to yellow-brown, depending on the degree of severity. The typical pattern of MIH is its asymmetric location, which mainly affects the occlusal and/or incisal 2/3 of permanent molars and incisors (Padavala & Sukumaran, 2018). Hypersensitivity is another characteristic of hypomineralized teeth. This is responsible for discomfort and pain, which lead to a decrease in oral hygiene care by children, thus leading to the accumulation of bacterial plaque and the development of dental caries (Garg et al., 2012; Garot et al., 2022).

There are several treatment modalities, from prevention to restoration or even extraction, as a last resort. The decision between restoration and extraction depends on several factors, including: the child's age, orthodontic conditions, severity of MIH, presence of agenesis, socioeconomic context and the child's expectations (Garg et al., 2012).

Generally, children with MIH require frequent and more complex restorative treatments. In cases of hypersensitivity, it is difficult to achieve effective anesthesia, possibly due to

subclinical inflammation of the pulp cells, caused by the porosity of the enamel. Thus, treatment of the affected teeth can be painful, causing fear and anxiety in children, which makes it even more difficult for the dentist to approach the patient (Giuca et al., 2018; Padavala & Sukumaran, 2018).

MIH is a pathology with enormous clinical relevance, and knowledge of its etiology is essential to identify the group of children at greatest risk of developing this pathology. It is essential to know the most effective preventive agents, as well as the most efficient restorative options that allow the problem of adhesion to the enamel to be reduced (Fatturi et al., 2019).

This integrative review aims to identify best practices, highlight variations in treatment approaches and assess the overall effectiveness of these guidelines in enhancing paediatric dental care.

## 2. METHODOLOGY

For this study, all available clinical guidelines were reviewed by consulting the official websites of major paediatric dentistry societies worldwide. The guidelines considered include those issued by the British Society of Paediatric Dentistry (BSPD) (www.bspd.co.uk), the International Association of Paediatric Dentistry (IAPD) (iapdworld.org/clinical-practice-guidelines), the European Academy of Paediatric Dentistry (EAPD) (Lygidakis et al., 2022), the American Academy of Pediatric Dentistry (AAPD) (www.aapd.org), the King's College Hospital Guidelines (www.kch.nhs.uk), and the Alliance of Molar Incisor Hypomineralization (MIH) Investigation and Treatment (AMIT) (Gaballah, 2023). A comparative analysis of these guidelines was conducted to identify similarities and differences in clinical recommendations.

Furthermore, a systematic literature search was performed using major scientific databases such as PubMed, ScienceDirect, B-On and Web of Science, to identify additional sources relevant to the topic. The search focused on peer-reviewed articles published in the last ten years, without language restrictions. The following search terms were used: "Molar Incisor Hypomineralization," "MIH," "clinical guidelines," "treatment," "management," and "clinical protocols" combined with the Boolean operator AND.

# 3. THEORICAL FUNDAMENTATION

## 3.1. Enamel formation

Enamel is the hardest biological element in the body, serving as a coating for the dental crowns. It plays important roles in protecting against thermal, physical and chemical aggressions, which are harmful to vital pulp tissue (Lacruz et al., 2017). Enamel differs from other tissues in the human body due to its unique properties, being the most mineralized and acellular tissue (Berkovitz et al., 2018).

The enamel formation is called amelogenesis, which consists of several phases, according to the activity of the ameloblast: pre-secretion, secretion, transition and maturation. The initial stages involve the secretion of enamel matrix proteins (PMEs), followed by enamel mineralization and maturation (Domingos et al., 2019; Seow, 2014).

The pre-secretion phase is characterized by the activity of ameloblasts prior to the secretion of enamel matrix components. The main characteristics of this phase are the differentiation of pre-ameloblasts, as well as the formation and reabsorption of the basal lamina (Berkovitz et al., 2018).

In the second phase, there is the secretion of a high amount of PMEs, such as amelogenin (AMELX), ameloblastin (AMBN) and enemelin (ENAM), which leads to the formation of hydroxyapatite crystals (Berkovitz et al., 2018). These crystals are organized into long ribbons parallel to each other. Their transformation into enamel prisms occurs due to the presence of Tomes extensions on the secretory surface of the ameloblasts, allowing their development, mainly in length (Alaluusua, 2010; Gil-Bona & Bidlack, 2020).

In the transitional phase, ameloblasts cease to have a secretory action and begin to have a maturation action. During this phase, the number of ameloblasts is reduced by half, thus initiating matrix degradation (Alaluusua, 2010; Berkovitz et al., 2018).

The maturation phase follows, with continuous degradation and reabsorption of the matrix. At the same time, the enamel prisms continue to develop in width and thickness, reducing the space between them, hardening the enamel layer. Reaching its maximum level of development, it presents 95-96% mineral matter. At the end of this phase, the tooth is ready to erupt (Alaluusua, 2010; Berkovitz et al., 2018).

## 3.2. Molar-incisor Hypomineralization (MIH)

*Definition*

Different names have been used for molar teeth with irregularities in color and opacity (Weerheijm, 2003). It was concluded that this enamel defect would be caused by a decrease in mineralization and inorganic components of the enamel, resulting in discoloration of the enamel and, consequently, in fractures of the affected teeth (Almuallem & Busuttil-Naudi, 2018).

Therefore, in 2001, the name MIH was coined by Weerheijm et al (2001), describing this qualitative enamel development defect, of unknown etiology, with a decrease in mineralization of one to four first permanent molars, which may also affect the permanent incisors (Weerheijm et al., 2001).

In 2003, at the European Academy of Paediatric Dentistry (EAPD) congress, a consensus was reached to name it MIH, so that it could be discussed in detail to obtain the best possible approach and treatment. With this congress, the global awareness of health professionals regarding this defect increased, leading to an increasing number of studies to improve knowledge of MIH (Elfrink et al., 2015; Weerheijm et al., 2003). However, MIH continues to be one of the clinical conditions of greatest concern in the community of general dentists and paediatric dentists, not only because of its complexity, but also because of the failure of treatments (Lygidakis et al., 2010). Although MIH is a defect that dentists encounter, studies show that there is still great difficulty in diagnosing and treating this condition. Still, when correctly diagnosed, it should be considered a priority treatment (Almuallem & Busuttil-Naudi, 2018; Americano et al., 2017).

*Etiology*

Unlike hereditary enamel defects such as amelogenesis imperfecta or acquired defects such as fluorosis, the etiology of MIH is still not completely known (Weerheijm et al., 2003; Lygidakis et al., 2022). However, its clinical appearance, with localized and asymmetric lesions in the first permanent molars and incisors, suggests a disorder that occurs during the initial phase of mineralization, or later in the secretory phase of amelogenesis (Almuallem & Busuttil-Naudi, 2018).

Amelogenesis of the first permanent molars begins in the 8th month of gestation, continuing until 4 years of age, and that of the permanent incisors occurs from 3 months

to 5 years of age. Thus, for hypomineralization defects to exist, it is likely that the changes occurred during these periods (Mast et al., 2013; Weerheijm et al., 2001).

Cases of children with MIH appear to be frequently associated with conditions that alter the function of ameloblasts during the prenatal, perinatal and postnatal periods (Almuallem & Busuttil-Naudi, 2018; Ghanim et al., 2012).

During the prenatal period, prolonged nausea and vomiting cause the mother to lose fluids and electrolytes, affecting her nutritional status and potentially causing fetal changes. Changes in the perinatal period, more specifically conditions associated with premature birth or with complications, hypoxia or hypocalcemia, may also be associated with MIH. Furthermore, during the postnatal period, infectious diseases such as otitis and pneumonia, high fever, administration of certain drugs, some toxins from breastfeeding and the use of fluoride, may be associated with the presence of hypomineralization in the first permanent molars (Garg et al., 2012; Fatturi et al., 2019).

The lack of oxygen in active ameloblasts and their consequent failure can result in MIH or opacities in molars and permanent incisors. This lack of oxygen can result from hypoxia problems that occur due to premature birth, respiratory stress or a very prolonged labor. And, in fact, certain authors refer to the association of premature babies and lesions similar to MIH (Alaluusua, 2010).

Despite the existence of numerous studies aimed at finding the etiology of MIH, they remain inconclusive and controversial (Hočevar et al., 2020). Therefore, more studies are needed to effectively understand the etiology and factors involved in MIH (Alaluusua, 2010). To date, in general, evidence indicates that MIH appears to have a multifactorial and systemic etiology (Almuallem & BusuttilNaudi, 2018).

*Prevalence*

Over time, several studies have emerged with the intention of determining the prevalence of MIH. However, it is necessary to take into account that the difficulty in comparing different studies results in an underestimation of prevalence data, since teeth with hypomineralization that have been extracted or that have atypical restorations are often excluded from the data (Almuallem & BusuttilNaudi, 2018).

According to several authors, the prevalence of MIH covers a wide range of values, varying between 2.8% and 40.2%. This great disparity is due to the lack of standardization

between epidemiological studies, making it essential to create viable criteria for studies carried out worldwide (Almuallem & Busuttil-Naudi, 2018; Jälevik, 2010).

*Clinical features*

Clinically, hypomineralization lesions in the first permanent molars and incisors affected by MIH vary in severity, presenting well-defined enamel opacities and distinguishing themselves in a spectrum of colors from creamy white to brownish yellow (Weerheijm et al., 2003). White lesions are the most common clinical feature in MIH, followed by yellowish and brownish lesions (Silva et al., 2017).

The defects can be identified by their alteration in enamel translucency (Domingos et al., 2019). The opacities vary in size and have a normal thickness. The limits are well defined, with clear and well-demarcated edges, making it possible to clearly identify healthy enamel from hypomineralized enamel (Americano et al., 2017).

MIH defects have a smooth but porous appearance (Allazzam et al., 2014). They are most frequently located on the occlusal and vestibular surfaces of the affected teeth, with the cervical third rarely being affected (Americano et al., 2017; Silva et al., 2017).

The expression of this defect varies from patient to patient, but also in the affected teeth of the same patient (Bekes & Weerheijm, 2020). The greater the number of affected first molars and affected incisors, the greater the severity of MIH, and the greater the predisposition to post-eruptive fractures (Silva et al., 2017).

The hardness of hypomineralized enamel is lower than that of normal enamel, since it has a decreased mineral content (less than 45%) and a higher protein content (Americano et al., 2017; Silva et al., 2017). This difference in content is reflected in the color of MIH defects. Yellow and brown lesions have a higher protein content, and brown lesions are the only ones that have residual ameloblastin from the amelogenesis process. On the other hand, serum albumin, alpha-1-antitrypsin and antithrombin III concentrations are more present in yellow and brown lesions than in whitish lesions (Elhennawy et al., 2020). The mineral density in darker colored lesions is lower when compared to the mineral density of cream or white lesions (Allazzam et al., 2014). Due to masticatory forces and reduced enamel resistance, this enamel development defect makes affected teeth susceptible to post-eruptive fractures, causing tooth sensitivity and a risk of dental caries (de Oliveira et al., 2015; Weerheijm et al., 2003). These fractures result in non-carious cavities causing rapid tooth destruction and consequent exposure of dentin (Rao et al., 2016).

Whether the defects are mild or severe, the invasion of cariogenic bacteria is facilitated by the porous characteristics of hypomineralized enamel. These agents affect the enamel and, consequently, the dentin that is protected by it (Americano et al., 2017). For this reason, it is very important to assess the patient's caries risk, distinguishing caries lesions associated with MIH from caries lesions associated with risk factors, such as poor hygiene and high sugar consumption (Silva et al., 2017).

Teeth with MIH may be very sensitive to cold temperatures, even when post-eruptive fractures have not occurred. Oral bacteria find it easier to overcome hypomineralized enamel and reach dentin, creating an inflammatory response in pulp cells, which contributes to hypersensitivity. These teeth are a challenge for many patients and dentists. For patients, since it makes it impossible to brush properly, and for dentists, due to the difficulty in controlling pain due to hypersensitivity (Americano et al., 2017; Teixeira et al., 2017).

On the other hand, managing the behavior of these patients is also a challenge, since the pain they experience during dental appointments can result in fear and anxiety (Rao et al., 2016). This pain is also associated with difficulty in local anesthesia, resulting from chronic pulp inflammation associated with bacterial penetration through porous enamel (Ghanim et al., 2012, 2017). Thus, the variation in the appearance and clinical characteristics of MIH makes the treatment of teeth with MIH a constant challenge for dentists (Schwendicke et al., 2017).

*Diagnosis*

Early diagnosis is essential for the treatment of defects to be effective and conservative (Almuallem & Busuttil-Naudi, 2018). In the presence of a well-defined opacity in a first permanent molar that is still erupting, the dentist must pay special attention to the possibility of involvement of other teeth, such as other molars and incisors. Therefore, the patient's development must be monitored until all first permanent molars erupt (da Costa-Silva & Mialhe, 2012).

The diagnosis of MIH is only valid in the presence of one of the four first permanent molars with enamel hypomineralization, although it can affect both incisors and second deciduous molars and canine cusps (Lygidakis et al., 2010). However, upper incisors are more frequently affected than lower incisors, and the risk of having affected incisors

increases with the number of first molars with hypomineralization defects (Weerheijm et al., 2001).

The clinical examination should always be performed with the patient's teeth clean and with the moist tooth surface (Almuallem & Busuttil-Naudi, 2018). To diagnose MIH, the examiner must look for first permanent molars and incisors with well-defined opacities, post-eruptive fractures, restorations of atypical shape and location, extracted and/or impacted molars (Bekes & Weerheijm, 2020).

According to the AAPD, MIH can be classified into three categories: mild, moderate, or severe. In mild MIH, the demarcated opacities of the first permanent molars are located on the buccal or lingual surfaces, with no associated caries, no hypersensitivity, and slight involvement of the incisors. In moderate MIH, the opacities are already present in the incisors and first permanent molars, with post-eruptive fractures and some tooth sensitivity. In severe MIH, there is significant destruction of the crown by post-eruptive fractures, with hypersensitivity and high aesthetic concerns (Americano et al., 2017; Elhussein & Jamal, 2020).

# 4. RESULTS

This integrative review considered six guidelines. Table 1 summarizes the characteristics of these guidelines. The information was systematized for a better comparation between the guidelines.

For IAPD (IAPD, 2022), MIH refers to qualitative enamel defects affecting at least one first permanent molar, with or without involvement of the incisors. The primary objective is early diagnosis and preventive or restorative interventions to prevent progressive deterioration, pulp inflammation, and hypersensitivity. Diagnosis is primarily made through visual examination, looking for demarcated defects, posteruptive breakdown (PEB), and hypersensitivity in the affected teeth. The reported prevalence of MIH varies widely, with estimates ranging between 2% and 40%, depending on the population and region studied. Several risk factors contribute to the development of MIH, including genetic predisposition, systemic illnesses, environmental factors, and developmental disturbances during tooth formation. Preventive measures include frequent dental check-ups, topical fluoride applications, and dietary counseling aimed at reducing the risks of caries and enamel breakdown. Management of MIH depends on the severity of the condition. For mild MIH, conservative treatments such as etching, bleaching, and sealing are typically sufficient. In cases of moderate MIH, composite restorations and glass-ionomer cement (GIC) are used as interim solutions for functional and structural rehabilitation, especially when there is enamel loss affecting cusp structures. Severe cases may require more invasive treatments, such as stainless-steel crowns, extractions, or orthodontics. Aesthetic concerns can be addressed with microabrasion, resin infiltration, bleaching, and composite veneers. Extraction may be necessary for severely affected molars, and the timing of this procedure is crucial to ensure proper molar substitution and alignment. Frequent evaluations every 3-6 months are essential to monitor the progression of caries, sensitivity, and restorative success. The overall management approach should focus on individualized care, addressing sensitivity, restoring function, enhancing aesthetics, and minimizing the long-term treatment burden for the patient.

For EAPD (Lygidakis et al., 2022), MIH is a developmental enamel defect affecting the first molars and permanent incisors. The objective of managing MIH is to provide updated best clinical practice guidelines for clinicians working with children affected by this condition. Diagnostic methods involve visual inspection, intraoral X-rays, and specific EAPD criteria for clinical signs, such as demarcated opacities, post-eruptive breakdowns,

atypical restorations, and extractions. The global prevalence of MIH ranges between 12.9% and 14.2%, with variations depending on regions and countries. Several risk factors are associated with MIH, including genetic predisposition, certain systemic illnesses, environmental factors, perinatal hypoxia, and prematurity. Preventive care strategies for MIH include regular dental check-ups, fluoride varnish applications, and enhanced oral hygiene practices. Management of MIH varies based on the severity of the condition. In mild cases, the focus is on prevention and aesthetic care. For moderate MIH, fluoride varnishes, fissure sealants, and minimally invasive restorations are commonly used. In more severe cases, preformed metal crowns, advanced restorative techniques, and extractions may be necessary. Aesthetic management for MIH may involve microabrasion, resin infiltration, and composite restorations to address discolored incisors. Scheduled extractions are recommended for severely affected teeth with poor prognosis, followed by orthodontic evaluation for optimal alignment. Regular follow-ups every 3-6 months are essential to monitor the progression of MIH and assess the effectiveness of treatments. The general recommendation for managing MIH is an holistic approach that emphasizes minimally invasive treatments, patient comfort, and interdisciplinary care.

For AAPD (www.aapd.org), MIH refers to qualitative enamel defects that primarily affect the first permanent molars, and often the incisors. The objective of managing MIH is to ensure the wellbeing of the patient by addressing the dental needs of affected teeth through a comprehensive, multidisciplinary approach. Diagnosis is made through clinical assessment of the qualitative enamel defects. The prevalence of MIH varies globally, ranging from 3% to 44%, with an estimated global prevalence of 13.5%. The condition has several risk factors, including gene-environment interactions, maternal illnesses, low birth weight, lead exposure, high fever, antibiotic use, and childhood diseases, all of which contribute to its development. Preventive care for MIH includes regular dental check-ups, brushing twice daily with fluoride toothpaste, and the use of fluoride varnish or silver diamine fluoride (SDF). Additionally, dietary counseling to minimize sugar intake is critical in reducing the risk of further enamel damage and caries. The management of MIH emphasizes early diagnosis to prevent caries, post-eruptive enamel breakdown, pulpal inflammation, and hypersensitivity. In cases of mild MIH, treatments such as pit and fissure sealants, resin infiltration for affected enamel, and periodic reviews every six months for professional fluoride treatments are typically used. For moderate

MIH, defective enamel is removed and restored with GIC or resin-modified GIC. Composite restorations are used for structural repairs, and if necessary, microabrasion and bleaching are employed to improve the appearance of the affected teeth. Severe MIH requires more extensive treatment, including removal of defective enamel followed by restoration with reinforced GIC, composite materials, or stainless-steel crowns (SSC). In some cases, intracoronal restorations reinforced with orthodontic bands may be used, along with pulpal therapy when needed. Aesthetic management of MIH can include microabrasion, resin infiltration, bleaching, composite restoration, and veneers to improve the appearance of the affected teeth. Extraction may be indicated for non-restorable first permanent molars, and timing should be carefully planned to support molar substitution and the eruption of second permanent molars, as well as orthodontic alignment. Periodic evaluations, every 3-6 months, are essential to monitor restoration durability, manage caries, and prevent post-eruptive breakdown. For complex cases, particularly when considering extractions or severe MIH, referral to paediatric dentists is recommended. Patient education, dietary counseling, and sensitivity management are crucial to minimize the long-term treatment burden and ensuring patient comfort.

In the case of AMIT guidelines (Gaballah, 2023), hypomineralization of systemic origin, affecting one to four first permanent molars, and often associated with affected incisors, is known as Molar-Incisor Hypomineralization (MIH). The primary objective of managing MIH is to provide practical guidelines for practitioners to ensure optimal care for affected patients. Diagnosis is typically made through the application of MIH criteria from the European Academy of Paediatric Dentistry (EAPD), which helps to identify the condition based on the appearance and severity of enamel defects. The estimated global prevalence of MIH is approximately 6.8%. Several pre-, peri-, and postnatal factors are considered risk factors for MIH, including maternal smoking, hypertension, low birth weight, prematurity, delivery complications, need for incubation, lack of breastfeeding, antibiotic use, fever, and childhood asthma. These factors can contribute to the systemic origin of the enamel hypomineralization, which can affect one or more molars and frequently involves the incisors as well. Preventive care plays a significant role in managing MIH, and includes regular prophylaxis, the use of fluoridated toothpaste twice a day, and topical fluoride varnish applied in the office two to four times a year, depending on the patient's caries risk. In addition, the use of mineral-containing agents is recommended for hypomineralized lesions to aid in remineralization and improve enamel

quality. Management of MIH typically involves prophylactic and regenerative approaches, with both non-invasive treatments and restorative solutions available. Temporary and permanent restorations may be necessary, and extractions are considered in more severe cases. For mild MIH, management usually includes prophylaxis and sealing of affected areas to prevent further enamel breakdown. For moderate MIH, sealing and temporary glass ionomer cement (GIC) restorations are often used, along with the potential use of preformed crowns to restore function and structure. In severe cases, extensive restorations, prefabricated crowns, or even extractions may be required to manage the condition effectively. Aesthetic management of MIH may involve techniques such as microabrasion, infiltration, bleaching, or restorative procedures with or without enamel removal to improve the appearance of affected teeth. For cases where significant breakdown or pulp involvement is present, extraction of the affected molars may be necessary to prevent further complications and support overall dental health. Periodic evaluations are essential, and in-office topical fluoride treatments should be applied every 3 to 6 months, regardless of the severity of the condition, to help manage enamel breakdown and prevent caries. The general recommendation for MIH management is to focus on early diagnosis and create tailored treatment plans for each patient to address the specific needs and severity of the condition, ensuring optimal outcomes for long-term dental health.

For King's College (www.kch.nhs.uk), MIH is a condition where teeth enamel is softer than normal, which can lead to increased susceptibility to dental decay or even cause the tooth to become crumbly. The diagnosis of MIH typically involves visual examination, with affected teeth often appearing discolored—creamy, yellow, or brown—and potentially showing sensitivity or crumbliness. X-rays may also be necessary for a more thorough evaluation. MIH is a worldwide problem, with studies showing that approximately 1 in 8 children in the UK are affected. Risk factors for MIH include disturbances in tooth development around the time of birth or during the first few years of life, which may be caused by severe childhood illnesses, high fever, or traumatic events during the birth period. Preventive care for MIH includes regular application of fluoride varnish, ideally every 3 months, to help strengthen the enamel. Children over the age of 10 can benefit from high-strength fluoride toothpaste, and those over 8 years old may use fluoride mouthwash as an additional measure. Management of MIH involves different approaches for front and back teeth. For front teeth, treatments include the application of

fluoride varnish, microabrasion, resin infiltration, tooth whitening, and aesthetic fillings to address cosmetic and functional concerns. For back teeth, fluoride varnish and fissure sealants are used to protect the teeth, and preformed metal crowns may be necessary for more extensive damage. While specific strategies for mild and moderate MIH are not explicitly mentioned, severe cases may require extraction, with careful planning of timing to ensure proper replacement by second molars. Aesthetic management for MIH focuses on improving the appearance of affected teeth, with treatments like microabrasion, resin infiltration, tooth whitening, aesthetic fillings, and fluoride varnish. Periodic evaluation is essential to monitor the condition of the affected teeth and ensure the success of preventive care. Regular dental check-ups are crucial for managing MIH, and dietary counseling is recommended to minimize sugar intake and reduce the risk of further decay. This comprehensive approach to MIH helps in managing the condition and improving the quality of life for affected children by addressing both aesthetic and functional concerns.

Finally, for BSPD (www.bspd.co.uk), MIH is a dental condition that affects the enamel of permanent teeth, with the first permanent molars being the most commonly affected. In some cases, incisors and adult canines may also be involved. The primary objective is to build awareness of the condition and support the dental profession in diagnosing and managing MIH effectively. The affected teeth are characterized by poor-quality enamel that exhibits discoloration, which can range from white to yellow or brown. MIH affects about 15% of Caucasian children, and an estimated 1 in 8 children in the UK is affected by this condition. While the exact cause of MIH is not fully understood, its development may be linked to various genetic and environmental factors. However, the specific reasons for its occurrence remain unclear. Preventive care for MIH includes regular dental appointments starting from the eruption of the first teeth or by the age of one. Using fluoride toothpaste and maintaining a healthy diet, which limits sugary foods and drinks to mealtimes, are essential steps to minimize the risk of further enamel damage and decay. In terms of management, most children with MIH can be treated in primary care. For mild cases, fissure sealants are applied to protect the affected back teeth, and regular monitoring is needed to check for potential decay or enamel breakdown. In cases of moderate MIH, tooth-colored fillings are used to protect and repair the affected teeth, while fluoride varnish is frequently applied to manage sensitivity and strengthen the teeth. Severe MIH may require more intensive treatments, such as crowns or special protective restorations for highly damaged teeth. If molars need to be extracted, orthodontic

planning may also be necessary to ensure proper tooth alignment. Aesthetic management for MIH can include bleaching, masking the discoloration with a veneer made of special plastic filling material, and polishing to improve the appearance of the teeth. In cases where molars are severely affected, extraction may be recommended. Children with MIH may require more frequent dental visits, often more than once a year, to monitor their condition. Regular dental check-ups are crucial for early diagnosis and effective intervention. For more complex cases, especially those requiring extractions or specialized care, it is advisable to refer the child to a paediatric dentist by the age of 8 or 9. This ensures that children receive the necessary care and support for managing MIH effectively, minimizing the long-term impact on their oral health.

**Table 1**. *Results of selected Guidelines*

| | IAPD (1) | EAPD (2) | AAPD (3) | AMIT (4) | KING'S COLLEGE (5) | BSPD (6) |
|---|---|---|---|---|---|---|
| **DEFINITION** | Qualitative enamel defects affecting at least one first permanent molar, with or without incisors. | Developmental enamel defect affecting first molars and permanent incisors. | Qualitative enamel defects affecting first permanent molars and often incisors. | Hypomineralisation of systemic origin of one to four permanent first molars, often associated with affected incisors. | Tooth condition where the enamel is softer than normal. This can lead to dental decay or a crumbly tooth. | Dental condition which affects the enamel of permanent teeth. The affected teeth are likely to be molars, incisors and sometimes the adult canines can be affected too. |
| **OBJECTIVE** | Early diagnosis and preventive/restorative intervention to avoid progressive deterioration, pulp inflammation and hypersensivity | To provide updated best clinical practice guidelines for clinicians managing children with MIH. | To manage teeth affected by MIH and ensure patient wellbeing through a comprehensive and multidisciplinary approach. | To provide practical guidelines to practitioners. | Not mentioned | To build awareness of the condition and also to support the dental profession in the diagnosis and management of MIH. |
| **DIAGNOSTIC METHODS** | Visual examination for demarcated defects, posteruptive breakdown (PEB), and hypersensitivity. | Visual inspection, intramural X-rays, and specific EAPD criteria for clinical signs such as demarcated opacities, post-eruptive breakdowns, atypical restorations, and extractions. | Clinical assessment of qualitative defects | Application of MIH-criteria from the EAPD | Visual examination, front and/ or back teeth may be discoloured or appear creamy, yellow or brown. The teeth may be sensitive and even crumbly. X-rays are also necessary. | The affected tooth are characterized by poor-quality enamel with white, yellow or brown discoloration. |
| **EPIDEMIOLOGY** | Reported prevalence varies between 2% and 40%, depending on the population and region studied | Global prevalence ranges between 12.9% and 14.2%, with variations across regions and countries. | Variable prevalence from 3% to 44%. Global prevalence is estimated at 13.5. | Estimated worldwide prevalence of 6.8%. | MIH is a worldwide problem. 1 in 8 children in the UK have MIH. | It affects 15% of Caucasian children. An estimated 1 in 8 children in the UK is affected by MIH. |

**Table 1**. *Results of selected Guidelines (cont.)*

| | IAPD (1) | EAPD (2) | AAPD (3) | AMIT (4) | KING'S COLLEGE (5) | BSPD (6) |
|---|---|---|---|---|---|---|
| **RISK FACTORS** | •Genetic predisposition<br>•Systemic illnesses<br>•Environmental factors<br>•Developmental disturbances. | •Genetic predisposition<br>•Certain systemic illnesses<br>•Environmental factors.<br>• Perinatal hypoxia<br>• Prematurity | •Gene-environment interactions<br>•Maternal illnesses<br>• Low birth weight<br>• Lead exposure<br>• High fever<br>• Antibiotic use<br>• Childhood diseases. | • Potential pre-, peri-, and postnatal factors:<br>•Maternal smoking<br>• Hypertension<br>• Low birth weight<br>• Prematurity<br>•Delivery complications<br>• Need for incubation<br>• Lack of breastfeeding<br>• Antibiotic use<br>• Fever<br>• Childhood asthma | • Disturbance in tooth development around the time of birth or in the first few years of life<br>•Severe childhood illnesses<br>• High fever<br>•Traumatic birth period | Why it happens and what causes it is not fully understood. |
| **PREVENTIVE CARE** | •Frequent check-ups<br>•Topical fluoride applications<br>• Dietary counseling to reduce caries and enamel breakdown risks. | • Regular dental check-ups<br>•Fluoride varnish application<br>•Enhanced oral hygiene. | • Regular dental check-ups.<br>•Twice daily brushing with fluoride toothpaste<br>•Use of fluoride varnish or silver diamine fluoride (SDF)<br>• Dietary counseling to minimize sugar intake | • Prophylaxis<br>• Use of fluoridated toothpaste twice a day.<br>•Topical fluoride varnish applied in office 2/4 times a year depending on caries risk.<br>•Additional use of mineral containing agents are recommended to hypomineralized lesions with mineral deposits. | • Regular application of fluoride varnish (every 3 months)<br>•High-strength fluoride toothpaste for children over 10 years old<br>•Use of fluoride mouthwash (>8 years) | •Regular appointments throughout childhood starting from when their first teeth come through or by the age of one<br>• Fluoride toothpaste<br>• A healthy diet which limits sweet foods and drinks to mealtime. |
| **MANAGEMENT** | Strategies depend on severity, involving preventive, restorative and surgical approaches.<br>Adhesive preparations should extend into sound tissue. | Management varies based on severity and includes preventive, restorative and surgical options. | Early diagnosis to prevent caries, post-eruptive enamel breakdown of affected areas, pulpal inflammation and hypersensitivity.<br>Management approaches vary from preventive therapies to restorative interventions. | •Prophylactic and regenerative approaches<br>•Non-invasive treatments<br>•Temporary and permanent restorations<br>• Extractions | **Front teeth management**<br>• Fluoride varnish<br>•Microabrasion<br>• Resin infiltrant<br>• Tooth whitening<br>• Aesthetic fillings<br>**Back teeth management**<br>• Fluoride varnish<br>• Fissure sealant<br>•Preformed metal crowns | Most children with MIH can be managed in primary care |

**Table 1**. *Results of selected Guidelines (cont.)*

| | IAPD (1) | EAPD (2) | AAPD (3) | AMIT (4) | KING'S COLLEGE (5) | BSPD (6) |
|---|---|---|---|---|---|---|
| **MILD MIH** | •Conservative treatments like etching, bleaching and sealing. | •Management focuses on prevention and aesthetic care. | •Pit and fissure sealants.<br>•Resin infiltration for affected enamel.<br>•Periodic reviews every 6 months for professional fluoride treatments. | •Management includes prophylaxis and sealing. | Not mentioned. | •Fissure sealants to protect affected back teeth.<br>•Regular monitoring for potential decay or breakdown. |
| **MODERATE MIH** | •Composite restorations and glass-ionomer cement (GIC) are utilized as interim solutions for functional and structural rehabilitation, particularly in cases of enamel loss involving cusp structures. | • Fluoride varnishes<br>• Fissure sealants<br>•Minimally invasive restorations. | •Remove defective enamel and restore with glass ionomer cement (GIC) or resin modified GIC<br>•Composite restorations for structural repair<br>•If necessary, micro abrasion and bleaching. | • Sealing<br>•Temporary glass ionomer cement (GIC)<br>• Preformed crowns. | Not mentioned | • Use of tooth-colored fillings to protect and repair affected teeth<br>•Apply fluoride varnish frequently to manage sensitivity and strengthen teeth. |
| **SEVERE MIH** | •Stainless steel crowns<br>•Extractions<br>•Orthodontics. | •Preformed metal crowns<br>•Advanced restorative techniques.<br>•Extractions | •Remove defective enamel and restore with reinforced GIC, composite or stainless-steel crowns (SSC).<br>•Intracoronal restoration reinforced with orthodontic band<br>•Pulp therapy if needed. | • Extensive restorations<br>• Prefabricated crowns<br>• Extractions. | Not mentioned | •Crowns or special protective restorations for highly damaged teeth.<br>•Orthodontic planning may be necessary if molars are extracted. |
| **AESTHETIC MANAGEMENT** | •Micro abrasion<br>•Resin infiltration<br>•Bleaching<br>•Composite veneers. | •Micro abrasion<br>•Resin infiltration<br>•Composite restorations for discolored incisors. | •Micro abrasion<br>•Resin infiltration<br>•Bleaching<br>•Composite restoration<br>•Veneers. | •Micro abrasion<br>•Infiltration<br>•Bleaching<br>•Restorative techniques with or without enamel removal | •Micro abrasion<br>•Resin infiltrate<br>•Tooth whitening<br>•Aesthetic fillings<br>•Fluoride varnish. | •Bleaching<br>•Masking with a veneer of special plastic filling material.<br>•Polishing |

**Table 1**. *Results of selected Guidelines(cont.)*

| | IAPD (1) | EAPD (2) | AAPD (3) | AMIT (4) | KING'S COLLEGE (5) | BSPD (6) |
|---|---|---|---|---|---|---|
| **EXTRACTION** | Extraction is considered for severely affected molars, with timing crucial to ensure proper molar substitution and alignment. | Scheduled extractions for severely affected teeth with poor prognosis, followed by orthodontic evaluation. | Interceptive extractions for non-restorable first permanent molars to reduce treatment burden. Plan timing carefully to support molar substitution (favor the eruption of secondary molars) and orthodontic alignment. | Recommended for severe cases where the pulp is involved, or significant breakdown is present. | Severe cases may necessitate extraction; timing planned for optimal replacement by second molars. | When molars are severely affected, extraction may be recommended. |
| **PERIODIC EVALUATION** | Frequent evaluations every 3-6 months are essential to monitor caries, sensitivity, and restorative success. | Regular follow-ups every 3-6 months to monitor progression and efficacy or treatments. | Regular evaluation every 3-6 months to monitor restoration durability, manage caries and prevent post eruptive breakdown. | In-office topical fluoride treatments should be applied every 3 to 6 months, regardless of the severity of the condition. | Regular dental check-up to monitor affected teeth and ensure preventive care. | Children with MIH may need to be seen more than once a year by their dental team. |
| **GENERAL RECOMMENDATIONS** | Focus on individualized care, addressing sensitivity, restoring function and aesthetics and minimize long term treatment burden. | Holistic approach emphasizing minimally invasive treatments, patient confort and interdisciplinary care. | Refer to paediatric dentists for complex cases, especially when considering extractions or severe MIH.<br>Patient education, dietary counseling and sensitivity management. | Focus on early diagnosis and tailored treatment plans. | Dietary counseling to minimize sugar intake and reduce decay risk. | Dental check-up to ensures that children with MIH can be early diagnosed.<br>Refer to paediatric dentist by age 8-9 if extractions or complex care are required. |

# 5. DISCUSSION

The main objective of all the guidelines previously presented is to provide updated best clinical practice guidance for clinicians treating children with MIH, through early diagnosis and early intervention.

Molar-Incisor Hypomineralization (MIH) is a developmental enamel defect that primarily affects the first permanent molars, and often the incisors. Across different guidelines, the definitions and diagnostic methods for MIH share similarities, although there are key differences in the management approaches.

The IAPD (2020) and AAPD (2021) define MIH as a condition affecting at least one first permanent molar, with or without involvement of the incisors. These guidelines stress that MIH is a qualitative enamel defect that must be diagnosed primarily through visual inspection. Both the EAPD (2022), King's College (2023) and AMIT (2023) guidelines place more emphasis on the developmental nature of the condition and suggest using additional diagnostic methods like intraoral X-rays. King's College guidelines (2023) additionally recommend the use of X-rays when necessary to evaluate the extent of enamel defects. The EAPD (2022) also includes specific clinical criteria, such as demarcated opacities and post-eruptive breakdown, which are essential in making a correct diagnosis.

The reported prevalence of MIH varies globally. The IAPD (2020) estimates the prevalence of MIH to range from 2% to 40%, depending on the population and region. In contrast, the AAPD (2021) reports a global prevalence of 13.5%. The EAPD (2022) and AMIT (2023) guidelines report similar figures, with a prevalence of 12.9% to 14.2% and 6.8%, respectively. The BSPD (2020) aligns closely with these figures, suggesting that approximately 15% of Caucasian children are affected. These studies highlight the significant variation in prevalence rates based on geographic and demographic factors (Lygidakis et al., 2022).

The risk factors for MIH include genetic, systemic, and environmental components. The IAPD (2020) emphasizes genetic predisposition, systemic illnesses, and environmental disturbances during tooth formation as key contributors. The EAPD (2022) adds perinatal hypoxia and prematurity as additional factors. The AMIT guidelines (2023) highlight prenatal and postnatal factors such as maternal smoking, low birth weight, and childhood diseases. AAPD (2021) also includes a broader range of systemic factors, such as lead

exposure, antibiotic use, and childhood diseases. These comprehensive guidelines suggest that MIH has multifactorial origins, which can influence how clinicians approach treatment.

Preventive care strategies across the guidelines largely align, emphasizing regular dental check-ups, fluoride toothpaste use, and dietary counseling. EAPD (2022) and AAPD (2021) recommend the application of fluoride varnish and SDF as preventive measures, with the AAPD (2021) suggesting additional applications in high-risk populations. AMIT (2023) suggests even more frequent fluoride treatments, recommending varnish application 2-4 times per year, depending on the caries risk. King's College (2023) and BSPD (2020) emphasize using high-strength fluoride toothpaste for older children and recommend dietary modifications to minimize sugar intake. These preventive measures are supported by studies showing that fluoride and dietary management significantly reduce the risk of further enamel breakdown (Dulla & Meyer-Lueckel, 2021; Lygidakis et al., 2022; Rodd et al., 2021; Somani et al., 2022).

The management of MIH is based on the severity of the condition, with most guidelines recommending similar treatments. For mild MIH, treatments include fissure sealants, resin infiltration, and regular fluoride treatments. Both the EAPD (2022) and AAPD (2021) emphasize the use of resin infiltration to address aesthetic concerns. In moderate cases, composite restorations and GIC are commonly used for structural rehabilitation, while severe cases often require preformed metal crowns or stainless-steel crowns. The IAPD (2020) and AMIT (2023) guidelines align with these approaches but also suggest orthodontic planning for molar extractions. King's College (2023) provides more detailed aesthetic management recommendations, including microabrasion, resin infiltration, and tooth whitening. The guidelines across the board emphasize the importance of a tailored approach depending on the severity of MIH (Dulla & Meyer-Lueckel, 2021; Lygidakis et al., 2022; Rodd et al., 2021).

Aesthetic management is a significant focus across all guidelines, especially for discolored incisors. The IAPD (2020), AAPD (2021), EAPD (2022), and AMIT guidelines (2023) recommend microabrasion, resin infiltration, and bleaching as treatment options for discolored incisors. The BSPD (2020) and King's College (2023) emphasize composite restorations and veneers as effective ways to mask the discoloration. These guidelines underscore the importance of addressing both functional

and cosmetic concerns in MIH management (Dulla & Meyer-Lueckel, 2021; Lygidakis et al., 2022).

Extraction is typically considered in severe cases where the molars are beyond repair. The AAPD (2021) and EAPD guidelines (2022) emphasize that timing of extractions is critical to ensure proper molar substitution and alignment of secondary molars (Rodd et al., 2021; Lygidakis et al., 2022). The AMIT guidelines (2023) suggest a similar approach, recommending orthodontic evaluation for cases that require extraction (Somani et al., 2022). King's College (2023) also stresses the importance of careful planning for molar extractions, particularly in ensuring proper eruption of secondary molars.

All guidelines agree that periodic evaluations every 3-6 months are necessary to monitor the progression of MIH, assess restoration durability, and prevent post-eruptive breakdown. Regular follow-ups are essential to manage sensitivity and track the success of restorative treatments (Dulla & Meyer-Lueckel, 2021; Lygidakis et al., 2022).

The general approach across all guidelines advocates for a holistic, individualized treatment plan based on the severity of the condition. The IAPD (2020) and AAPD (2021) highlight the importance of patient education, dietary counseling, and sensitivity management as integral components of the treatment plan (Dulla & Meyer-Lueckel, 2021; Somani et al., 2022). The AMIT guidelines (2023) emphasize preventive measures alongside restorative treatments, while King's College (2023) and BSPD (2020) recommend referrals to paediatric dentists for complex cases involving extractions or orthodontic interventions.

The comparative analysis of the MIH guidelines reveals that while there are some differences in the specific recommendations, all guidelines emphasize early diagnosis, preventive care, and a comprehensive management approach tailored to the severity of the condition. The inclusion of both aesthetic and structural management strategies ensures that patients with MIH receive the most appropriate care. Future studies should continue to refine these guidelines to provide evidence-based recommendations for long-term outcomes and clinical effectiveness.

# 6. CONCLUSION

Molar-Incisor Hypomineralization (MIH) is a complex and increasingly recognized dental condition that affects a significant portion of the paediatric population globally. This dissertation explored the varying guidelines for diagnosing and managing MIH, with a focus on the differing recommendations of the International Association of Paediatric Dentistry (IAPD), European Academy of Paediatric Dentistry (EAPD), American Academy of Pediatric Dentistry (AAPD), Alliance of Molar Incisor Hypomineralization Investigation and Treatment (AMIT), King's College, and the British Society of Paediatric Dentistry (BSPD). Despite the variability in prevalence rates and management protocols, there is a clear consensus among these organizations on the importance of early diagnosis, individualized care, and the necessity of a multidisciplinary approach to MIH.

The comparison of guidelines from the IAPD, EAPD, AAPD, AMIT, King's College, and BSPD highlight both commonalities and variations in the approach to MIH management. The general trend across all guidelines is the emphasis on a tailored, patient-centered approach that considers both the functional and aesthetic impacts of MIH. While aesthetic management techniques, such as resin infiltration and tooth whitening, are recommended across the board, there is also a shared understanding of the need for careful long-term monitoring through periodic evaluations to track the condition's progression and the success of restorations.

Ultimately, this review reinforces the importance of a cohesive, evidence-based framework for the management of MIH. Future research should focus on standardizing diagnostic criteria, exploring the long-term effectiveness of different treatment modalities, and identifying novel preventive strategies. Moreover, there is a need for increased global collaboration to better understand the epidemiology of MIH and to address the challenges faced by both clinicians and patients in managing this condition.

As MIH continues to present a challenge in paediatric dentistry, ongoing education, research, and clinical practice updates are essential to improving outcomes for affected children. This work has provided a thorough review of current guidelines and offers a comprehensive approach to managing MIH based on the most up-to-date evidence, with an eye toward future advancements in the field.

# 7. BIBLIOGRAPHIC REFERENCES

Alaluusua, S. (2010). Aetiology of Molar-Incisor Hypomineralisation: A systematic review. *European Archives of Paediatric Dentistry*, 11(2), 53–58. https://doi.org/10.1007/BF03262713

Allazzam, S., Alaki, S., & El Meligy, O. (2014). Molar Incisor Hypomineralization, Prevalence, and Etiology. *International Journal of Dentistry*, 2014, 1–8. https://doi.org/10.1155/2014/234508

Almuallem, Z., & Busuttil-Naudi, A. (2018). Molar incisor hypomineralisation (MIH) – an overview. *British Dental Journal*, 225(7), 601–609. https://doi.org/10.1038/sj.bdj.2018.814

American Academy of Pediatric Dentistry. (2021). *Best Practices: Restorative Dentistry*. In: AAPD Reference Manual. https://www.aapd.org/research/oral-health-policies--recommendations/restorative-dentistry/

Americano, G., Jacobsen, P., Soviero, V., & Haubek, D. (2017). A systematic review on the association between molar incisor hypomineralization and dental caries. *International Journal of Paediatric Dentistry*, 27(1), 11–21. https://doi.org/10.1111/ipd.12233

Bekes, K., & Weerheijm, K. (2020). Diagnosis, Classifications and Treatment Strategies of MIH-Affected Teeth. In Molar Incisor Hypomineralization (pp. 47–58).

Berkovitz, B., Holland, G., & Moxham, B. (2018). Oral Anatomy, Histology and Embryology (5a edição). Elsevier.

British Society of Paediatric Dentistry. (2020). *MIH Clinical Guidelines – MIH Position Statement*. BSPD. https://www.bspd.co.uk/Professionals/Position-Statements/Molar-Incisor-Hypomineralisation

da Costa-Silva, C., & Mialhe, F. (2012). Considerations for clinical management of molar-incisor hypomineralization: A literature review. *Rev Odonto Cienc*, 27(4), 333–338.

de Oliveira, D., Favretto, C., & Cunha, R. (2015). Molar incisor hypomineralization: Considerations about treatment in a controlled longitudinal case. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 33(2), 152.

Domingos, P., Ricci-Donato, H., Nonato, C., De Souza, É., & Da Silva, V. (2019). Hipomineralização Molar-Incisivo: Revisão de literatura. *Journal of Research in Dentistry*, 7(1), 8. https://doi.org/10.19177/jrd.v7e120198-12

Dulla, J. A., & Meyer-Lueckel, H. (2021). Molar-incisor hypomineralisation: narrative review on etiology, epidemiology, diagnostics and treatment decision. *Swiss dental journal*, *131*(11), Advance online publication. https://doi.org/10.61872/sdj-2021-11-763

Elfrink, M., Ghanim, A., Manton, D., & Weerheijm, K. (2015). Standardised studies on Molar Incisor Hypomineralisation (MIH) and Hypomineralised Second Primary Molars (HSPM): a need. *European Archives of Paediatric Dentistry*, 16(3), 247-255. https://doi.org/10.1007/s40368-015-0179-7

Elhennawy, K., Bekes, K., Dobsak, A., Tangl, S., Shokoohi-tabrizi, H., & Schwendicke, F. (2020). Structural, Mechanical, and Chemical Evaluation of Molar Incisor

Hypomineralization-Affected Enamel. In Molar Incisor Hypomineralization (pp. 12–20).

Elhussein, M., & Jamal, H. (2020). Molar Incisor Hypomineralisation—To Extract or to Restore beyond the Optimal Age? *Children*, 7(8), 91. https://doi.org/10.3390/children7080091

Fatturi, A., Wambier, L., Chibinski, A., Assunção, L., Brancher, J., Reis, A., & Souza, J. (2019). A systematic review and meta-analysis of systemic exposure associated with molar incisor hypomineralization. *Community Dentistry and Oral Epidemiology*, 47(5), 1–9. https://doi.org/10.1111/cdoe.12467

Gaballah, R. (2023). 1 Kongress der Alliance of Molar Incisor Hypomineralization Investigation and Treatment in München. *Oralprophylaxe Kinderzahnheilkd*, 45(2), 12-15.

Garg, N., Jain, A., Saha, S., & Singh, J. (2012). Essentiality of Early Diagnosis of Molar Incisor Hypomineralization in Children and Review of its Clinical Presentation, Etiology and Management. *International Journal of Clinical Pediatric Dentistry*, 5(3), 190–196. https://doi.org/10.5005/jp-journals-10005-1164

Garot, E., Rouas, P., Somani, C., Taylor, G. D., Wong, F., & Lygidakis, N. A. (2022). An update of the aetiological factors involved in molar incisor hypomineralisation (MIH): a systematic review and meta-analysis. *European archives of paediatric dentistry : official journal of the European Academy of Paediatric Dentistry*, *23*(1), 23–38. https://doi.org/10.1007/s40368-021-00646-x

Ghanim, A., Manton, D., Morgan, M., Mariño, R., & Bailey, D. (2012). Trends of oral health care and dental treatment needs in relation to molar incisor hypomineralisation defects: a study amongst a group of Iraqi schoolchildren. *European Archives of Paediatric Dentistry*, 13(4), 171–178. https://doi.org/10.1007/BF03262866

Ghanim, A., Silva, M., Elfrink, M., Lygidakis, N., Mariño, R., Weerheijm, K., & Manton, D. (2017). Molar incisor hypomineralisation (MIH) training manual for clinical field surveys and practice. *European Archives of Paediatric Dentistry*, 18, 225–242. https://doi.org/10.1007/s40368-017-0293-9

Gil-Bona, A., & Bidlack, F. (2020). Tooth Enamel and Its Dynamic Protein Matrix. *International Journal of Molecular Sciences*, 21, 1–25. https://doi.org/10.3390/ijms21124458

Giuca, M. R., Cappè, M., Carli, E., Lardani, L., & Pasini, M. (2018). Investigation of Clinical Characteristics and Etiological Factors in Children with Molar Incisor Hypomineralization. *International journal of dentistry*, *2018*, 7584736. https://doi.org/10.1155/2018/7584736

Hočevar, L., Kovač, J., Podkrajšek, K., Battelino, S., & Pavlič, A. (2020). The possible influence of genetic aetiological factors on molar–incisor hypomineralisation. *Archives of Oral Biology*, 118, 1–8. https://doi.org/10.1016/j.archoralbio.2020.104848

IAPD. (2022). *IAPD Foundational Articles and Consensus Recommendations: Management of Molar Incisor Hypomineralization*. http://www.iapdworld.org/2022_16_management-of-molar-incisor-hypomineralization.

Inchingolo, A. M., Inchingolo, A. D., Viapiano, F., Ciocia, A. M., Ferrara, I., Netti, A., Dipalma, G., Palermo, A., & Inchingolo, F. (2023). Treatment Approaches to Molar Incisor Hypomineralization: A Systematic Review. *Journal of clinical medicine*, *12*(22), 7194. https://doi.org/10.3390/jcm12227194

Jälevik, B. (2010). Prevalence and Diagnosis of Molar-Incisor-Hypomineralisation (MIH): A systematic review. *European Archives of Paediatric Dentistry*, 11(2), 59-64. https://doi.org/10.1007/BF03262714

King's College (2023). Molar incisor hypomineralisation (MIH) in children. https://www.kch.nhs.uk/wp-content/uploads/2023/01/pl-1074.1-molar-incisor-hypomineralisation-mih-in-children.pdf

Lacruz, R., Habelitz, S., Wright, J. T., & Paine, M. (2017). Dental Enamel Formation and Implications for Oral Health and Disease. *Physiological Reviews*, 97, 939–993. https://doi.org/10.1152/physrev.00030.2016

Lygidakis, N. (2010). Treatment modalities in children with teeth affected by molar incisor enamel hypomineralisation (MIH): A systematic review. *European Archives of Paediatric Dentistry*, 11(2), 65–74. https://doi.org/10.1007/BF03262715

Lygidakis, N. A., Garot, E., Somani, C., Taylor, G. D., Rouas, P., & Wong, F. S. L. (2022). Best clinical practice guidance for clinicians dealing with children presenting with molar-incisor hypomineralisation (MIH): An updated European Academy of Paediatric Dentistry policy document. *European Archives of Paediatric Dentistry*, 23, 3–21. https://doi.org/10.1007/ s40368-021-00668-5

Mast, P., Tapia, M., Daeniker, L., & Krejci, I. (2013). Understanding MIH: definition, epidemiology, differential diagnosis and new treatment guidelines. *European Journal of Paediatric Dentistry*, 14(3), 204–208.

Padavala, S., & Sukumaran, G. (2018). Molar Incisor Hypomineralization and Its Prevalence. *Contemporary clinical dentistry*, *9*(Suppl 2), S246–S250. https://doi.org/10.4103/ccd.ccd_161_18

Rao, M., Aluru, S., Jayam, C., Bandlapalli, A., & Patel, N. (2016). Molar Incisor Hypomineralization. *The Journal of Contemporary Dental Practice*, 17(7), 609-613. https://doi.org/10.5005/jp-journals-10024-1898

Rodd, H. D., Graham, A., Tajmehr, N., Timms, L., & Hasmun, N. (2021). Molar Incisor Hypomineralisation: Current Knowledge and Practice. *International dental journal*, *71*(4), 285–291. https://doi.org/10.1111/idj.12624

Santos, C., Picini, C., Czlusniak, G., & Alves, F. (2014). Anomalias do esmalte dentário - revisão de literatura. *Arch Health Invest*, 3(4), 74–81.

Schwendicke, F., Elhennawy, K., Reda, S., Bekes, K., Manton, D., & Krois, J. (2017). Global burden of molar incisor hypomineralization. *Journal of Dentistry*, 1–9. https://doi.org/10.1016/j.jdent.2017.12.002

Seow, W. (2014). Developmental defects of enamel and dentine: challenges for basic science research and clinical management. *Australian Dental Journal*, 59, 143–154. https://doi.org/10.1111/adj.12104

Silva, M., Kilpatrick, N., Crombie, F., Ghanim, A., & Manton, D. (2017). What's new in molar incisor hypomineralization? *Dental Update*, 44, 100–106. https://doi.org/10.12968/denu.2017.44.2.100

Somani, C., Taylor, G. D., Garot, E., Rouas, P., Lygidakis, N. A., & Wong, F. S. L. (2022). An update of treatment modalities in children and adolescents with teeth affected by molar incisor hypomineralisation (MIH): a systematic review. *European archives of paediatric dentistry: official journal of the European Academy of Paediatric Dentistry*, *23*(1), 39–64. https://doi.org/10.1007/s40368-021-00635-0

Teixeira, R., Andrade, N., Queiroz, L., Mendes, F., Moura, M., Moura, L., & Lima, M. (2017). Exploring the association between genetic and environmental factors and molar incisor hypomineralization: evidence from a twin study. *International Journal of Paediatric Dentistry*, 28(2), 1–9. https://doi.org/10.1111/ipd.12327

Weerheijm, K. (2003). Molar incisor hypomineralisation (MIH). *European Journal of Paediatric Dentistry*, 4(3), 114–120. http://www.nature.com/articles/6401219

Weerheijm, K., Duggal, M., Mejàre, I., Papagiannoulis, L., Koch, G., Martens, L., & Hallonsten, A.-L. (2003). Judgement criteria for molar incisor hypomineralisation (MIH) in epidemiologic studies: a summary of the European meeting on MIH held in Athens, 2003. *European Journal of Paediatric Dentistry*, 4(3), 110–113. http://www.ncbi.nlm.nih.gov/pubmed/14529329

Weerheijm, K., Jälevik, B., & Alaluusua, S. (2001). Molar–Incisor Hypomineralisation. *Caries Research*, 35(5), 390–391. https://doi.org/10.1159/000047479.

Wurzburg University Dental School. (2019). *MIH Management Protocol – Wurzburg Concept* [Internal clinical guidelines]. Julius-Maximilians-Universität Würzburg