SIOI Policy on Molar Incisor Hypomineralisation

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Context

Molar-Incisor Hypomineralisation (MIH) is a prevalent enamel defect of systemic origin, often leading to hypersensitivity, post-eruptive breakdown, and complex management in children. Its multifactorial aetiology and early onset demand prompt diagnosis and targeted intervention. In the absence of preventive measures, the Italian Society of Paediatric Dentistry (SIOI) promotes early detection, minimally invasive strategies, and personalised, severity-based care—supporting clinicians in preserving function, reducing symptoms, and addressing the broader impact on children and families.

Briefly

Developmental Defect: Systemic, qualitative enamel anomaly affecting FPMs and often incisors; characterised by increased porosity, hypersensitivity, and high susceptibility to PEB and caries.

Aetiopathogenesis: Multifactorial origin involving early postnatal stressors (e.g. respiratory infections, fever, antibiotics), genetic predisposition, and potential exposure to environmental toxicants (e.g. BPA, dioxins); no preventive protocols validated.

Diagnostic Framework: Clinical identification based on demarcated opacities (≥1 mm), PEB, atypical restorations, and hypersensitivity; MIH-TNI and severity-based classifications guide therapeutic decisions.

Minimally Invasive Approach: Focus on early diagnosis, preservation of pulp vitality, and symptom management through bio-interactive, adhesive, and behaviourally sustainable strategies.

KEYWORDS: Molar-Incisor Hypomineralisation, Enamel developmental defects, Paediatric dental treatment planning, Post-eruptive breakdown, Minimally invasive treatment.

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PURPOSE The Italian Society of Paediatric Dentistry (SIOI) is committed to encourage all dental practitioners to provide safe and updated prevention and treatment strategies for oral diseases in paediatric patients. SIOI promotes quality communication and information to parents and caregivers for prevention and awareness of oral diseases in the paediatric population.

METHODS This Policy is based on a comprehensive review of the highest-quality scientific literature available over the past 20 years, including systematic reviews, meta-analyses, evidence-based guidelines, expert recommendations, manuscripts and best clinical practices. A bibliographic search was conducted using PubMed®/MEDLINE, using keywords such as: molar-incisor hypomineralisation, molar hypomineralisation, enamel defect, hypomineralised molars, hypomineralised second primary molars, dental developmental defects. Search filters included: publication date (since 2001), language (English), full-text availability, study type (systematic review, meta-analysis, clinical trial, evidence-based guidelines, manuscripts), species (humans), and age (child: birth-18 years). Additional references were obtained through citation tracking of key publications. Final recommendations were developed by combining the best available scientific evidence with clinical expertise and consensus from a multidisciplinary panel of paediatric dental specialists.

Introduction

The Italian Society of Paediatric Dentistry (SIOI) endorses a modern, evidence-based approach to the management of developmental enamel defects, particularly Molar-Incisor Hypomineralisation, promoting early diagnosis, personalised care, and minimally invasive interventions.

Definition

Molar-Incisor Hypomineralisation (MIH) is a developmental enamel defect of systemic origin that affects at least one first permanent molar (FPM), often involving permanent incisors [Weerheijm et al. 2001]. The enamel appears of normal thickness but presents altered mineral content, increased porosity and reduced mechanical resistance [Giuca et al. 2020; Lagarde et al. 2020].

Clinically, MIH is characterised by asymmetrical, well-demarcated opacities ranging from white to yellow-brown. Yellow or brown opacities are associated with higher porosity and an increased risk of structural breakdown. Up to 41.8% of such opacities can progress to dentin exposure [Lygidakis et al. 2022; Neves et al. 2019, Weerheijm, 2003].

Affected teeth often exhibit hypersensitivity, poor anaesthetic response, and increased caries risk, which complicate both diagnosis and treatment [Jälevik et al. 2002; Joshi et al. 2022; Elhennawy et al. 2016; Neves et al. 2019, Villani et al. 2023].

The condition has a significant impact on oral health-related quality of life [Joshi et al. 2022]. As no preventive measures currently exist, early identification, symptom control, and conservative management are essential.

Similar lesions in second primary molars—termed Hypomineralised Second Primary Molars (HSPM)—are considered predictive of MIH, although their presence does not necessarily indicate that the condition will develop in the permanent dentition [Elfrink et al. 2008].

Epidemiology

MIH prevalence varies widely, from 3% to 44% globally, with pooled estimates near 13.5% [Zhao et al. 2018; Schwendicke et al. 2019]. In Europe, rates between 10% and 20% were reported [Lygidakis et al. 2008]. Variability is mainly due to differing diagnostic criteria, study populations, and methodologies.

Aetiology

The aetiology of MIH is multifactorial and not yet fully understood. The most accepted theory points to systemic disturbances during the early maturation of enamel, especially within the first three years of life [Caruso et al. 2016; Giuca et al. 2020]. Although prenatal factors have been widely studied, recent systematic reviews conclude that their association with MIH is weak or inconsistent [Silva et al. 2016]. Perinatal events (e.g., caesarean delivery, neonatal complications) and especially early postnatal conditions (including respiratory infections, high fever, and antibiotic use during the first three years of life) have been more consistently linked to increased MIH risk [Garot et al. 2022; Lygidakis et al. 2022; Bagattoni et al. 2022].

Recent studies also suggest a genetic or epigenetic predisposition. Twin and family studies support heritability, while candidate genes related to enamel formation, immune response, and oxidative stress have been investigated [Alaluusua et al. 2010; Vieira et al. 2016]. Additionally, exposure to environmental toxicants such as bisphenol A (BPA), dioxins, and heavy metals has been proposed as a contributing factor, though conclusive evidence is still limited [Giuca et al. 2020; Lagarde et al. 2020].

The developmental window of first permanent molar (FPM) and incisor enamel formation—from birth to around age four—overlaps with many of these potential risk exposures, reinforcing the concept of MIH as the result of complex interactions between environmental insults and individual susceptibility.

Involvement of Other Teeth

Similar enamel defects have also been reported in teeth other than FPMs and incisors, indicating a broader phenotypic spectrum. Clinical studies have documented involvement in 33.7% of second permanent molars, 25.7% of canines, 23.6% of first premolars, and 17% of second premolars in individuals affected by MIH [Kevrekidou et al. 2021]. These findings suggest that MIH may reflect a wider systemic disturbance in enamel development [Jeremias et al. 2013].

In the primary dentition, HSPMs are a strong predictor of MIH, associated with a six-fold increase in risk. Hypomineralised primary canines, observed in 2–11% of cases, also show a relevant association with subsequent MIH [Jeremias et al. 2013]. Given the overlap in mineralisation periods between second primary molars and FPM, these findings support the role of HSPM and primary canines as early clinical markers, warranting closer monitoring during FPMs' eruption [Elfrink et al. 2008].

Diagnosis

Diagnosis of MIH relies on identifying demarcated enamel opacities affecting at least one FPM, with or without incisor involvement. It becomes evident during the early mixed dentition phase (ages 6-8), as FPMs and incisors erupt, often prior to post-eruptive breakdown (PEB). Clinical examination should be conducted on clean, moist teeth under adequate lighting. Recent guidance discourages the routine use of compressed air—especially in anxious children—to preserve cooperation. Visual inspection in wet conditions is generally sufficient to distinguish MIH from caries and to ensure accurate diagnosis [Lygidakis et al. 2022].

Diagnostic Criteria

MIH is characterised by the following clinical signs:

- Demarcated opacities: well-defined white, cream, yellow, or brown discolorations with normal enamel thickness but altered translucency, usually not involving the cervical third of the crown. Opacities greater than 1 mm in diameter are clinically relevant.
- PEB: enamel loss after eruption, unrelated to trauma or caries.
- Hypersensitivity: triggered by cold, air, or brushing.
- Atypical restorations: restorations that deviate in shape or position from caries-related age typical patterns.
- Unexplained FPM extraction.
- Incisor involvement, though not essential.

Severity Classification

MIH severity is categorised to guide treatment decisions [Lygidakis et al. 2022; Somani et al. 2022; Schwendicke et al. 2019]:

- Mild: Demarcated opacities only; no hypersensitivity or PEB; incisor involvement is purely aesthetic.
- Moderate: Limited PEB and mild hypersensitivity; conservative restoration may be required.
- Severe: Extensive PEB, pronounced hypersensitivity, caries or atypical restorations; behavioural issues may occur.

In addition to this commonly used classification, tools such as the Würzburg MIH Treatment Need Index (MIH-TNI) offer refined assessment based on clinical and behavioural complexity and may support treatment planning in both clinical and research settings [Steffen et al. 2017; Bekes et al. 2023].

Regular clinical follow-up is recommended for MIH-affected teeth. Supportive tools include photographic records to monitor lesion progression, plaque indices to evaluate oral hygiene and compliance and sensitivity assessments to guide symptom management.

Differential Diagnosis

The clinical presentation of MIH may resemble other enamel defects or dental conditions. A precise differential diagnosis is essential for appropriate management. Key conditions to consider include:

- Dental fluorosis: a systemic enamel defect caused by chronic ingestion of excessive fluoride during tooth development. It typically presents as diffuse, symmetrical opacities affecting teeth whose enamel was forming simultaneously during the exposure period. The opacities are poorly demarcated, range from whitish to brown in color depending on severity, and PEB is not a typical feature.
- Amelogenesis imperfecta: A hereditary condition affecting all teeth in both dentitions, often associated with a family history. Amelogenesis imperfecta may involve generalised hypoplasia or hypomineralisation, unlike MIH's localised pattern.
- Enamel hypoplasia: A quantitative defect marked by reduced enamel thickness or pits, as opposed to the qualitative changes typical of MIH.
- White spot lesions: the initial stages of dental caries, tipically located in plaque-retentive areas, does not result from systemic causes and are not present at tooth eruption.

Diagnosis should rely on clinical history, lesion morphology, symmetry, and the presence of enamel defects already visible at the time of tooth eruption. Photographs and longitudinal monitoring can aid in distinguishing subtle or borderline cases.

Clinical Management

Management of MIH requires an individualised, severity-based approach that takes into account the extent, location, and severity of opacities, as well as patient age, cooperation, symptomatology, and long-term prognosis [William et al. 2006; AAPD, 2024]. Beyond clinical complexity, MIH places a substantial emotional and financial burden on patients and families. Affected children often experience hypersensitivity, pain, dental anxiety, and aesthetic concerns, all of which can compromise cooperation and increase the need for frequent, costly interventions [Jälevik et al. 2002; Joshi et al. 2022; Elhennawy et al. 2016].

Treatment can be particularly challenging due to chronic subclinical pulpal inflammation associated with porous enamel, which also contributes to difficulties in achieving effective local anaesthesia [Dixit et al. 2018; Ozgul et al. 2022]. To manage these issues, clinicians may adopt behavioral strategies, preemptive analgesia (e.g., ibuprofen), and conscious sedation (e.g., nitrous oxide/oxygen) [Somani et al. 2022; Contac et al. 2024; Arcari et al. 2025]. A child- and family-centered approach remains essential [Beretta et al. 2023]. Empathetic communication and shared decision-making are key to building trust and ensuring adherence. Socioeconomic factors should also guide the choice of minimally invasive, cost-effective strategies aimed at maintaining pulp vitality and supporting root development [Gatòn-Hernandèz et al. 2020; Al-Batayneh et al. 2022].

Early diagnosis is crucial—not only to plan timely intervention and reduce the risk of caries and PEB, but also to provide families with clear information about the condition, help manage hypersensitivity, and anticipate future care needs. Collaboration among paediatricians, general dentists, and paediatric dental specialists can enhance early detection and intervention.

Management Objectives

- Ensure early diagnosis, which is essential for interceptive treatment and for preventing complications.
- Stabilise FPMs during eruption to prevent PEB and dental caries.
- Control hypersensitivity to improve comfort, cooperation, and home oral hygiene.
- Preserve affected teeth whenever feasible, or plan strategic extractions of severely compromised FPMs in collaboration with an orthodontist, based on long-term prognosis.
- Engage families in treatment planning, balancing clinical goals with emotional and financial impact, with a view to long-term care.
- Maintain ongoing clinical monitoring to minimise the risk of secondary caries, progressive structural breakdown, and repeated restorative interventions. This process should involve dental hygienists trained in the management of MIH.

Available Treatment Options for Molars

Home-based treatments

- Use of toothpastes with high fluoride content (≥1000 ppm) is recommended to reduce hypersensitivity and prevent PEB. Toothpastes with 8% arginine and calcium carbonate occlude dentinal tubules, providing short-term relief from hypersensitivity [Bekes et al. 2017].
- Remineralising agents such as Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) or Casein Phosphopeptide-Amorphous Calcium Phosphate with Fluoride (CPP-ACPF) containing mousse promote mineral uptake and can reduce sensitivity. They are suitable for home-care protocols in mild or moderate MIH, and their use should ideally begin during the early stages of tooth eruption. Sustained application is required for lasting clinical effects [Baroni et al. 2011].

Preventive in-office treatments

- Fluoride varnishes are effective in mild cases. By reducing hypersensitivity, fluoride varnish application supports improved home oral hygiene. Regular application is recommended to prevent lesion aggravation [Schwendicke et al. 2019; Jeremias et al. 2013].
- Silver diamine fluoride (SDF) is effective in arresting cavitated lesions and reducing hypersensitivity. Due to its characteristic dark staining, it is most suitable for posterior teeth or as an interim treatment in uncooperative children [Elfrink et al. 2013; Mittal et al. 2015; Ballikaya et al. 2022].
- Sealants (resin-based or glass ionomer-based) protect against caries. In partially erupted, hypersensitive molars where isolation is difficult and patient cooperation is limited, glass ionomer cements (GICs) can be used as a temporary sealant

due to its moisture tolerance and ease of placement. In fully erupted molars, resin-based sealants may be applied; however, adhesion to MIH-affected enamel can be compromised, so the use of a bonding agent was suggested to improve retention [Elfrink et al. 2013; Fragelli et al. 2015; Bekes et al. 2022; Bekes et al. 2023].

Provisional and interim restorative treatments

- GICs are indicated for temporary restorations, particularly when moisture control is challenging. They chemically bond to enamel, release fluoride, and are easy to apply, although their durability in multi-surface restorations is limited [Fragelli et al. 2015; Bekes et al. 2022]. In MIH-affected teeth with structural enamel loss but no caries, GICs can also be used for protective restorations without removing the hypomineralised enamel. This technique is particularly useful in uncooperative children or when access to routine dental care is limited, either prior to definitive treatment or age-planned extractions [Fragelli et al. 2015; Linner et al. 2020].
- Silver Modified Atraumatic Restorative Treatment (SMART), combining selective caries removal, 38% SDF application, and restoration with GIC, represents an effective interim management option for moderate and severe MIH molars. This minimally invasive approach significantly reduces hypersensitivity, preserves tooth structure, and showed high survival rates over a 12-month period, making it suitable especially before full molar eruption [Saad et al. 2024].
- Orthodontic bands cemented with GIC are used as interim protection for erupting FPMs during the early mixed dentition phase. This approach is particularly valuable in uncooperative patients. It can help prevent PEB in FPMs with extensive hypomineralisation involving multiple surfaces and cusps. The use of orthodontic bands may also improve the retention of GIC restorations by providing mechanical stabilisation, allowing preservation of the tooth until comprehensive rehabilitation is possible. This treatment is versatile, as the bands can later be replaced with functional orthodontic bands if orthodontic treatment is initiated [Bagattoni et al. 2025]. The patient should undergo regular follow-up visits to monitor oral hygiene, evaluate band retention, and reapply cement where it has been lost.
- Stainless steel crowns (SSCs) are the treatment of choice in severe MIH with significant enamel loss. They offer full coverage, durability, and are quick and cost-effective to place—ideal for young patients. Placement requires minimum tooth preparation and a moderate level of patient cooperation [Lygidakis et al. 2022; Singh et al. 2022].

Definitive restorations

- Composite resin restorations are a predictable option in moderate MIH cases, provided adequate moisture control is achieved. In many clinical situations, the composite restoration is performed after an initial transitional restoration with GIC. This step may be necessary when absolute isolation is not feasible, such as during the early stages of eruption, in the presence of significant hypersensitivity, or in children with limited cooperation. Once definitive treatment becomes possible, complete removal of hypomineralised enamel is recommended to optimise adhesion and long-term success [Lygidakis et al. 2009], as bonding to MIH-affected enamel shows reduced strength [Lagarde et al. 2020]. When the defective enamel is well demarcated, confined to one or two surfaces, with supragingival margins and no cuspal involvement, resin composites are the elected restorative materials [Fayle et al. 2003]. In MIH-affected permanent teeth, adhesive strategy should be tailored to the degree of enamel alteration: etch-and-rinse systems demonstrate superior retention in mildly affected enamel, whereas self-etch adhesives are preferred in severely hypomineralised enamel, which structurally resembles dentin and may benefit from reduced postoperative hypersensitivity [Luppieri et al. 2025].
- It is important to consider that, when partial removal of hypomineralised enamel is performed, the altered porosity of the remaining demineralised tissue reduces bonding effectiveness and increases the risk of restoration fracture compared to sound enamel. This can significantly impact the longevity of the restoration, and parents should be clearly informed about the need for strict and regular follow-up visits [Sönmez et al. 2017; Linner et al. 2020; Beretta et al. 2020].
- Zirconia crowns provide an esthetically pleasing alternative to SSCs, especially suitable for older or esthetically sensitive patients. They require more extensive preparation but offer excellent gingival response and long-term outcomes [Talekar et al. 2023; Casián-Adem et al. 2021].
- In the permanent dentition stage, long-term restorative options may include onlays, overlays, or indirect restorations such as CAD-CAM fabricated ceramics or laboratory-made crowns, depending on the extent of structural loss and aesthetic considerations.

Tooth extraction

- In cases of poor prognosis with extensive destruction, extraction of FPMs may be indicated. The optimal timing is between 8 and 10 years of age, ideally before the eruption of second molars. Early orthodontic consultation is essential to ensure favourable occlusal outcomes [Lygidakis et al. 2022].

Management of Incisors

Treatment planning for MIH-affected incisors must consider multiple clinical and psychosocial factors. Discolouration of front teeth can significantly impact a child's self-esteem and social well-being [Rodd et al. 2011] so aesthetic concerns often predominate. Given the anatomical characteristics of young permanent teeth—such as large pulp chambers, prominent pulp horns, and immature gingival tissues—a conservative approach is strongly recommended.

Histopathological studies show that the defect originates at the amelodentinal junction [Almuallem et al. 2018]. In mild cases, the hypomineralised enamel is confined to the inner third and is covered by a superficial layer of normal enamel. The less severe the MIH, the deeper the lesion is located. In severe cases, the hypomineralisation involves the entire enamel thickness [Denis et al. 2013].

Given the variability in lesion depth and presentation, from mild white opacities to more severe brown defects, no single technique is universally effective. A personalised combination of minimally invasive treatments, tailored to lesion severity, often provides the best aesthetic and functional outcomes [Lygidakis et al. 2022].

- Remineralising agents (e.g. CPP-ACP): improve enamel appearance and reduce sensitivity in mild cases.
- Etch–Bleach–Seal technique: a minimally invasive three-step protocol (etching with 37% phosphoric acid, bleaching with 5% sodium hypochlorite, and sealing with a clear resin) indicated for yellow-brown opacities. Especially useful in young permanent incisors to improve aesthetics, preserve enamel, and prevent restaining [Wright et al. 2002].
- Microabrasion: this technique involves the superficial removal of discolored enamel using an abrasive compound and acid (18% hydrochloric acid or 37% phosphoric acid), aiming to improve esthetics without the need for restorative materials.
- Resin infiltration: for masking opacities, it is recommended to use a 15–20% hydrochloric acid etchant, ethanol, and TEGDMA monomer infiltrant. This technique is minimally invasive and effective, especially in young patients; however, infiltration alone may be insufficient and should be combined with additional techniques (e.g., microabrasion or enhanced etching) for optimal results.
- Bleaching: can be used in adolescents to camouflage opacities by increasing the overall whiteness of the teeth. It is commonly available as hydrogen peroxide (up to 6%) or carbamide peroxide (10% or 16%) gels, typically applied using custom-made trays; however, bleaching alone may be insufficient in some cases and is often more effective when combined with other techniques (e.g., resin infiltration or microabrasion).
- Composite restorations or veneers: indicated in moderate-to-severe cases with visible defects, balancing aesthetics, function, and long-term maintenance.

Conclusion

MIH represents a frequent and challenging condition in paediatric dentistry, with implications for diagnosis, treatment planning, and long-term care.

This Policy, developed by the Italian Society of Paediatric Dentistry (SIOI), aims to support clinicians with practical, evidence-based recommendations to improve early detection, reduce disease burden, and guide individualised, minimally invasive management strategies. Promoting awareness and clinical consistency is essential to improve outcomes for affected children and their families.

Policy statement

The Italian Society of Paediatric Dentistry (SIOI) provides the following key recommendations regarding MIH to support clinicians in early detection and effective management:

- MIH is a qualitative enamel defect of systemic origin, typically affecting first permanent molars (FPMs) and often permanent incisors.
- Diagnosis is clinical and should be performed on clean, moist teeth. The use of compressed air is not routinely recommended, especially in younger or anxious children due to increased sensitivity.
- Key diagnostic signs include demarcated opacities, PEB, hypersensitivity, atypical restorations, and unexplained extractions of FPMs.
- MIH must be differentiated from fluorosis, amelogenesis imperfecta, enamel hypoplasia, and white spot lesions.
- The presence of HSPMs and hypomineralised primary canines may indicate increased risk of MIH and requires closer follow-up.
- MIH should be classified by severity (mild, moderate, severe) to guide treatment decisions and prognosis.
- Clinical follow-up should include photographic documentation, assessment of hypersensitivity, and evaluation of oral hygiene status.
- Management must be individualised, taking into account enamel fragility, symptom severity, patient cooperation, and long-term dental development.
- Early diagnosis is crucial to ensure timely management, prevent complications, and guide appropriate treatment planning. Collaboration between paediatricians, general dentists, and paediatric dentists can facilitate this process.
- Stabilisation of FPMs during eruption is a clinical priority to prevent PEB and preserve arch integrity. Early protective strategies reduce the risk of structural damage and long-term restorative or orthodontic complications.
- Implement interim treatments when appropriate, particularly in early eruptive phases, in cases of hypersensitivity, or when cooperation is limited. These transitional approaches aim to stabilise the condition, relieve symptoms, and preserve dental structure until definitive treatment can be performed.
- Comfort techniques—such as premedication with anti-inflammatory drugs, relative analgesia, and adequate local anaesthesia—are essential to improve cooperation during treatment.
- In severe cases, full-coverage crowns or strategic extraction of FPMs may be required in coordination with orthodontists.
- Aesthetic treatment of anterior teeth should balance patient expectations, clinical indications, and psychosocial considerations.

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