

Molar Incisor Hypomineralisation: An Overview

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Abstract

Molar incisor hypomineralisation is an entity to describe enamel defects of the first permanent molars with involvement of one or more incisors due to an underlying systemic cause. Etiological factors include genetics, environmental, medical conditions and systemic factors. These teeth often present as white chalky enamel with post eruptive breakdown. In severe cases, there is a complete loss of enamel. There are other enamel defects which can mimic the appearance of MIH making it difficult to diagnose. Diagnostic criteria have been established by the European Academy of Paediatric Dentistry (EAPD). Early diagnosis is the key to protect and prevent the deterioration of the condition. Children pose with behavioural problems which must be addressed. Preventive strategies in conjunction with restorative therapy can preserve these teeth. Challenges encountered in treating these teeth are improper cavity design, inadequate anesthesia and choice of restorative material. Thus, a deeper understanding of the micro structural changes occurring during amelogenesis will aid in better understanding of the etiology. Upgrading knowledge and skill in using the newer materials will improve the survival rates of the restorations. The purpose of this paper is to highlight the etiology, prevalence, diagnosis, differential diagnosis, challenges faced in treating and management options for successfully dealing with MIH.

Keywords: Molar Incisor Hypomineralisation, Etiology, First Permanent Molars.

1. INTRODUCTION

Weerheijm in 2001 described the term molar-incisor hypomineralisation (MIH). It is defined as 'hypomineralisation of systemic origin, presenting as demarcated, qualitative defects of enamel involving at least one first permanent molar (FPMs) and/or incisors.'¹This condition has been previously described by numerous terms such as non-fluoride enamel opacities, internal enamel hypoplasia, non-endemic mottling of enamel, non-endemic stained enamel, idiopathic hypomineralisation of the enamel of the first molars, idiopathic enamel opacities and cheese molars. In 2003, at the 6th annual conference of the European Academy of Paediatric Dentistry (EAPD), it was agreed that the term 'Molar-Incisor Hypomineralisation' would be used. Molar Incisor Hypomineralisation is a deficit in the mineralisation process of permanent first molars and, less frequently, incisors, resulting from a lack of incorporation of calcium and phosphate in the matrix formed by the ameloblasts. The resultant enamel is poorly mineralised, causing yellowish brown, hypersensitive enamel, with little resistance. The

worldwide prevalence of MIH shows a wide range between 2.8 to 40.2%.²

2. ETIOLOGY

MIH is a multi-factorial entity. It is caused by an interplay of genetic, environmental, medical conditions and systemic factors:³

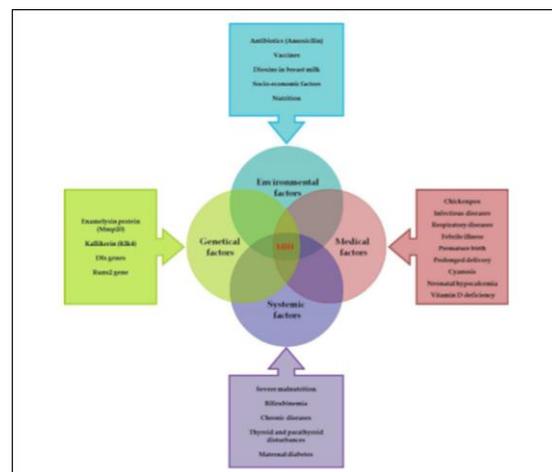


Fig. 1 Factorial entities for MIH

3. DIFFERENTIAL DIAGNOSIS

MIH may be particularly difficult to diagnose when the molars are grossly broken or have multi surface restorations. The masticatory function and caries can further damage these fragile teeth making it grim to arrive at the diagnosis. The conditions which can be included in the differential diagnosis of MIH are:

- Enamel hypoplasia: It is a quantitative defect of enamel that occurs during the secretory phase of amelogenesis which results in reduced thickness of enamel. Teeth with MIH may also resemble enamel hypoplasia in terms of loss of enamel structure but, the borders around healthy enamel remains regular and smooth in enamel hypoplasia which indicates a pre eruptive, developmental defect. Whereas, in MIH, irregular and sharp borders are found due to post-eruptive breakdown of friable enamel.
- Amelogenesis imperfecta: It is a generalised entity of genetic origin affecting all the primary or permanent teeth wherein there is a qualitative and quantitative defect of enamel. Enamel can be hypoplastic, hypomineralised or hypomature. Often, there is a familial history associated with amelogenesis imperfecta. Amelogenesis imperfecta involve all the teeth whereas MIH involves the first permanent molars and incisors, not the other teeth.
- Tetracycline staining: Administration of tetracycline causes a grey-brown stain in primary and permanent teeth if administered during pregnancy or to children under the age of six years. This can be distinguished from MIH by the breakdown of enamel that can be seen with MIH along with a discoloured enamel.
- Dental fluorosis: This condition occurs as an incorporation of excess fluoride during tooth mineralisation. It is usually symmetrical and involves all the permanent teeth. In fluorosis, the tooth is resistant to caries whereas in MIH, the teeth are susceptible to caries.
- White spot lesion: This represents an early carious lesion. It appears chalky and opaque than the surrounding tissue. This condition differs from MIH because they mostly appear

in areas where plaque can stagnate such as the cervical margin of the tooth.

- Dental caries: Extensive caries causing breakdown of enamel can mimic the appearance of MIH. But, the presence of hypoplasia with caries on all molars can direct the diagnosis towards MIH.

4. DIAGNOSIS

According to EAPD placed in Athens in 2003.⁴The scoring of MIH ranges from 0 to 10 as given below in Table 1 and Table 2

Table 1. Severity Grades of MIH

Severity grade of MIH	Definition
Mild	Demarcated enamel opacities without enamel breakdown. Occasional sensitivity to external stimuli (e.g., air) but not brushing mild aesthetic concerns on discoloration of incisors
Severe	Demarcated enamel opacities with breakdown caries persistent/spontaneous hypersensitivity affecting function (e.g., brushing) strong aesthetic concerns that may have socio-psychological impact

MIH: Molar incisor hypomineralisation, EAPD: European academy of pediatric dentistry

Table 2. Scoring of MIH

Code	Criteria
0	Enamel defect free
1	White/creamy demarcated opacities, no PEB
1a	White/creamy demarcated opacities, with PEB
2	Yellow/brown demarcated opacities, no PEB
2a	Yellow/brown demarcated opacities, with PEB
3	Atypical restoration
4	Missing because of MIH
5	Partially erupted (i.e., less than one-third of the crown high) with evidence of MIH
6	Unerupted/partially erupted with no evidence of MIH
7	Diffuse opacities (not MIH)
8	Hypoplasia (not MIH)
9	Combined lesion (diffuse opacities/hypoplasia with MIH)
10	Demarcated opacities in incisors only

MIH: Molar incisor hypomineralisation, PEB: Posteruptive enamel breakdown, EAPD: European academy of pediatric dentistry

Examination for MIH should be performed on wet teeth after removing debris with cotton roll and the following diagnostic criteria and clinical appearance of the defects have been considered for the diagnosis:⁵

- First permanent molars and incisors: At least one first permanent molar must be involved with or without involvement of incisor. The molar shows hypomineralisation of the enamel. The defects can concomitantly be seen in primary canine tips, primary second molars and incisors. More the number of molars involved, greater the severity of MIH.

- Demarcated opacities: The involved teeth show demarcated opacities on the occluso-bucco surfaces of the crown. There can be a variation in the colour and size of the defects. The colour can range from white to yellowish-brown. Defects can be isolated opacities or involve the entire crown surface compromising the structure. Defects which are less than 1 mm are not reported under MIH.
- Enamel disintegration: Since there is defective enamel formation, the degree of porosity of the hypomineralised opaque areas varies. When subjected to masticatory forces, this severely affected enamel breaks down and exposes the dentin. It also paves way for rapid development of caries in the unprotected dentin.
- Atypical restorations: If the Incisors and FPM are found with extensive restorations, along with a defective structure, these teeth are recommended to be judged as affected with MIH.
- Hypersensitivity: Often, there is a complaint of sensitivity in the affected teeth which can be due to an external stimuli causing a mild response or a spontaneous hypersensitivity. It is difficult to achieve anesthesia in these teeth.
- Extracted teeth: If teeth have been extracted then a documentation of the same due to MIH or presence of demarcated opacities on other first permanent molars alone can constitute a diagnosis of MIH.
- Severity of the defects: The clinician must record the degree of the affected teeth as mild or severe. In mild cases, there are demarcated enamel opacities without enamel breakdown, sensitivity to external stimuli like air or water but, brushing does not evoke hypersensitivity.
- In severe MIH, the teeth show demarcated enamel opacities with enamel breakdown, spontaneous hypersensitivity, caries development which affects the overall functioning during brushing, mastication, etc. There is also a strong esthetic concern regarding the incisors which impacts the psycho-social feeling of the patients.

5. CLINICAL DIFFICULTIES

- Teeth hypersensitivity: This is a potential problem due to the breakdown of enamel. Changes in temperature or contact with teeth accentuates this problem. Brushing is avoided particularly by children due to the sensitivity, thereby increasing the risk of plaque build-up. Some preoperative management strategies such as application of desensitising agent⁶, fluoride varnish⁷ have been suggested.
- Rapidly progressing caries: Immaturely formed dental tissues, fragile enamel, avoidance of brushing due to sensitivity contributes to the development of rapidly progressing caries frequently involving pulp and causing an irreversible damage to it. The irregular surfaces on the enamel are plaque retentive areas which upsurge the risk of caries progression.
- Anaesthetic difficulties: A combination of hypersensitivity and rapidly progressing caries causes chronic inflammation of the pulp, preventing effective local anesthesia. The hypomineralised enamel doesn't provide adequate insulation to the underlying pulp from external thermal stimuli. As a result, the tooth is hyper responsive to thermal changes.⁶ Thus; this hypersensitive tooth is not amenable to anesthesia even with increasing doses of local anesthetic solution. To overcome this problem, the use of anaesthetic adjuncts has been suggested.
- Adhesion of restorative material: Because of the porous and friable enamel structure, the adhesion of the restorative material is poor which results in the early loss of restorative material increasing the chances of secondary caries in the teeth.
- Behavioural problems: Children often display negative behaviour which makes it difficult for the clinician to render treatment. Due to multiple appointments combined with severe pain, most children will require additional behaviour modification techniques to be managed on the dental chair.

6. MANAGEMENT OF MIH

Management of Incisors: Aesthetic concerns are common with incisors. Restoring the aesthetics

with conservative techniques is difficult as these teeth have large sensitive pulp. The defects on incisors are not as severe as that on the molars. But if the incisal edge is involved, it frequently breaks down post eruption. Thus, it is a challenge to clinically manage these defects. The options for incisors are:

- Microabrasion- Microabrasion is a viable option when there is brown mottling and the defect is restricted to the outer enamel.^{7,9} It involves removing less than 0.1mm of enamel surface. The procedure involved is etching the enamel surface with 18% hydrochloric acid or 37.5% phosphoric acid. This process abrades the surface enamel. It also provides superior aesthetics by improving the optical properties of enamel rendering a polished surface to the enamel.¹⁰
- Bleaching- This is a treatment of choice during adolescence where the opacities are camouflaged thereby increasing the brightness of teeth. Bleaching causes sensitivity, enamel surface alterations and mucosal irritation. Therefore, at home bleach throughout the day with 10% carbamide peroxide which is the mildest form of bleaching is recommended in conjunction of tooth mousse containing CPP-ACP. Use of this CPP-ACP will aid in protecting the enamel and remineralising the defects without hindering bleaching.¹¹
- Etch-bleach-seal technique- This technique was popularised by Wright. The affected tooth is etched for 60 seconds with 37% phosphoric acid, 5% sodium hypochlorite (bleaching agent) is continuously applied for a period of five to ten minutes. The tooth is etched again and is coated either with a bonding agent or a clear fissure sealant to protect the enamel surface. Use of this technique masks the yellow-brownish stains and makes the enamel esthetically acceptable.¹²
- Resin infiltration- This technique is a good option to improve the esthetics of incisors as the refractive index of the infiltrant used is 1.52 which matches that of the enamel which is 1.62. Resin infiltration improves the translucency and optical property of enamel. This technique is not effective for mild cases of MIH where the defect is beneath 2/3rd of

healthy enamel structure. A modified deep resin infiltration technique given by Attal et al can be employed that involves preparing the tooth by a sand blasting technique ensuring that the infiltrant reaches deep and fills the full extent of the lesion.¹² The use of sand blasting should not remove more than 500 µm of surface enamel. Finally the tooth can be finished and polished with a layer of composite.¹³

- Composite restorations- Involves removing the surface of defective enamel and restoring it with composite. Composite veneers can also be done without removing defective enamel or tooth preparation which forms a more conservative approach. But composite resins wear out and discolour over time and hence require long term maintenance therapy.⁸ The hypomineralised enamel can be pre-treated for one minute with sodium hypochlorite following etching which can greatly enhance the bond strength.¹⁴
- Porcelain veneers- This is an option to treat adults once the gingival tissues have matured. Recommended above the age of 18 years. It is generally considered as the last resort when other treatment modalities have failed.^{8,9}
- Management of molars: The mainstay of managing molars is either preserving these teeth or extracting them. This depends on a number of factors such as: age of the patient, severity of the defects, condition of the pulp, presence of third molar, possibility to restore the teeth, prognosis of the teeth and the cost involved in treating these teeth:
- Resin infiltration- Icon is the only material available as a resin infiltrant. A resin with low viscosity is used which can penetrate demineralised enamel. The Icon system consists of: etchant (15% hydrochloric acid), a drying agent (99% ethanol) and infiltrant (Methacrylate-based resin). The etchant (15% hydrochloric acid) removes the intact surface layer and paves way into the body of the defect, and then the resin infiltrant is applied continuously for 3 minutes. In MIH molars, this resin infiltrant can penetrate into the hypomineralised cuspal inclines which are usually susceptible to break down after eruption. It also has an advantage of not hindering the occlusion or fracturing under

occlusal load. Therefore, this resin material can also be used as a pit and fissure sealant. Excellent isolation is prudent while using this material. An added advantage is, it improves bonding by increasing the surface hydrophobicity and the area of the resin-enamel interface when used prior to a composite restoration.¹⁵

- Restorations - These hypomineralised teeth pose a problem during cavity preparation as the cavity margins cannot be defined. Cavity preparation is a critical step in the final placement of a restorative material. It is recommended that all the friable and weak enamel must be removed but the discoloured enamel can be left behind until a resistance is encountered to the bur or probe.^{8,16} The restorative material of choice is composite resin.
- GIC and RMGIC can be considered only as interim materials until a definitive restoration is done. The bond strength can be enhanced by using 5.25% sodium hypochlorite on the enamel prior to treatment.¹⁴
- Partial or full coverage crowns- Porcelain fused to metal crowns show good success in severe MIH with high survival rates.^{8,16} The advantages of these crowns are preservation of the tooth structure, prevention of further breakdown of enamel, lessen hypersensitivity, cost effective, can establish good interproximal and occlusion, require minimal tooth reduction, and can be done in a single appointment.⁸
- Extraction of severely affected molars- Teeth with a poor prognosis are considered for extraction at the age 8-10 years. The rationale of extraction is to facilitate the second permanent molars (SPM) to drift into the position of the first permanent molars (FPM). When the SPM follicle is within the bone, spontaneous mesial drift is more likely to occur. On observing radiographically, the presence of calcification in bifurcation area of the roots is indicative of an ideal time for the extraction of FPM.¹⁷ The possibility of correct positioning of the SPM when extracted at the ideal time has a success of 94% in maxillary arch and 66% in the mandibular arch. A complete space closure can be expected in the maxillary arch

irrespective of the timing of extraction of FPM. Whereas in the lower arch, extraction of FPM at or near the ideal time doesn't close the space in a significant number of patients.¹⁷ Therefore, an orthodontic intervention may be required to manage the remaining space.¹⁷

Table 3. Summary of treatment options according to the age

	Dental Age		
	Early Mixed	Late mixed	Full permanent
MIH	Prevention		
	Adhesive + sealant for restoration		
	Composite restoration		
	Microabrasion, bleach + sealant for anterior		
Low level severity	Prevention & symptom control		
	Adhesive + sealant for posterior		
	Microabrasion, bleach + sealant for anterior		
	Glass ionomer restoration		
	Composite restoration		
	Performed metal crown		
	Orthodontic extraction		
Severe	Cast restoration		

7. CONCLUSION

Children with MIH are often apprehensive due to multiple appointments required for management of these extensive lesions. Appropriate behaviour management techniques need to be employed. A holistic approach to deal with behaviour problems, sensitive teeth, chronically inflamed pulp, ineffective local anesthesia will be needed to enhance the longevity of these teeth. Preventive strategies in the form of tooth mousse and fluoride regimens will greatly protect the teeth and delay the need for extensive treatment. Children with poor general health and hypomineralised second primary molars are considered as risk factors for the development of MIH and hence should be kept under constant supervision. As MIH is a complex problem requiring a combination of treatment modalities, a thorough knowledge of the etiology and treatment strategies will best enable the clinician to render age appropriate treatment.

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