ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 11 | November - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

MOLAR INCISOR HYPOMINERALISATION : REVIEW

Dental Science

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ABSTRACT

Molar incisor hypomineralisation (MIH) describes the hypomineralisation of systemic origin affecting one or more first permanent molars (FPMs) and are associated with affected incisors. Etiological associations with systemic conditions or environmental insults during the prenatal, natal and postnatal times have been implicated. The comprehensive care involved in treating affected children must address their behaviour and anxiety, aiming at early diagnosis, remineralization and desensitization, prevention of caries and post eruption breakdown; restorations and extractions under pain-free conditions and maintenance. Restorations in hypomineralised molars appear to fail frequently and also the high prevalence of MIH indicates the need for research to clarify etiological factors and improve the durability of restorations in affected teeth. This article aims to highlight different aspects related to MIH, from its prevalence, etiological factors, clinical features to treatment options in young patients.

KEYWORDS

INTRODUCTION

Developmental defects of tooth enamel are not uncommon, both in the primary and permanent dentitions and can be divided into hypomineralisation and hypoplasia. Enamel hypomineralisation can be observed visually because of a different translucence that is known as opaque enamel. The opacity may be diffuse or sharply defined, whereas in cases of hypoplasia parts of the enamel are absent or very thin with smooth borders adjacent to normal tissue. The causes of developmental enamel defects may be congenital, acquired or unknown. Molar Incisor Hypomineralisation (MIH) is an example of an acquired defect of unknown aetiology. Molar incisor hypomineralisation is defined as the developmentally derived dental defect that involves hypomineralisation of permanent first molars that is frequently associated with similarly affected permanent incisors. Hypomineralisation of permanent teeth has been described in the literature since 1970s but it was in 2001 Weerheijm, et al. suggested the term molar incisor hypomineralisation for this developmental disorder teeth. It was first noted in Sweden in 1970.

Initially, the condition was described as affecting the FPMs and incisors but more recently it has been noted that these defects could affect any primary or permanent tooth.[2] In MIH, the FPMs show rapid caries progression starting shortly after eruption in the majority of cases, which causes serious problems to patients as well as treatment challenges to dentists.[1] Although this condition is frequently encountered in dental clinics,[3] recent studies[4,5] have shown that dentists experience significant difficulties in diagnosis and management. Therefore, the aim of this article is to highlight the most important aspects of MIH from its prevalence to treatment options in young patients.

Prevalance

Today, abundant data on the prevalence of MIH are available. The prevalence of MIH has been shown to range from 2.8% to 44% in different studies[6]. Among studies with more than 1000 subjects, the prevalence of MIH ranges from 2.8% to 21%. Overall, the prevalence of MIH varies by country, region, and age group studied.[7]

Etiology

The causative mechanism of MIH is still unclear,[8] but the clinical presentation of localised and asymmetrical lesions suggests a systemic origin with the disruption in the amelogenesis process most probably occurring in the early maturation stage or even earlier at the late secretory phase.[1] In general, the condition seems to be multifactorial and systemic factors such as acute or chronic illnesses or exposure to environmental pollutants during the last gestational trimester and first three years of life have been suggested as causative or contributing factors.[8,9] The number of affected teeth was associated with the time when the potential systemic disturbance occurred; children with prenatal, perinatal and postnatal problems showing more affected teeth in increasing order.[9] Multiple possible causes have been suggested in the literature, for instance, respiratory tract infections, perinatal complications, dioxins, oxygen starvation, low birth weight, calcium and phosphate metabolic disorders, frequent childhood diseases, use of antibiotics and prolonged breast feeding.[2] In addition, some studies[10,11] raise the possibility of a genetic role in the aetiology of MIH, indicating that a genetic variation may interact with systemic factors leading to MIH.

Diagnosis

The ideal time to diagnose MIH is as soon as it is clinically apparent either in primary or permanent dentition. The examination should be performed on clean wet teeth. The clinical presentation of MIH depends on its severity and can range from white-creamy opacities, yellow-brown opacities, post-eruptive enamel breakdown to atypical caries located on at least one FPM with or without incisor involvement[1].The lesions should be larger than 1 mm to be recorded as MIH.[12] When such clinical signs exist during examination, the dentist should ask the parents about any illness that occurred in prenatal, perinatal, postnatal or the first three years of life to support the diagnosis. Mathu-Muju and Wright[13] had classified MIH into three severity levels:

1. Mild MIH: the demarcated opacities located at non-stress bearing areas, no caries associated with the affected enamel, no hypersensitivity and incisor involvement is usually mild if present.
2. Moderate MIH: the demarcated opacities present on molars and incisors, the post-eruptive enamel breakdown limited to one or two surfaces without cuspal involvement, atypical restorations can be needed and normal dental sensitivity
3. Severe MIH: post-eruptive enamel breakdown, crown destruction, caries associated with affected enamel, history of dental sensitivity and aesthetic concerns.

Clinical Problems in MIH

The following are the most commonly reported clinical problems for patients with MIH:[3,12,14]

- Post-eruptive enamel breakdown leading to dentine exposure and this makes the tooth at risk of pulp involvement.
- Tooth sensitivity, which might lead to poor oral hygiene and therefore, caries susceptibility increases.
- Local anaesthesia problems which are possibly related to chronic pulp inflammation.
- Behavioural management problems due to dental fear and anxiety which is related to the pain experienced by the patients during multiple treatment appointments.
- Aesthetic problems in anterior teeth
- Tooth loss
- Occasional eruption difficulties of molars due to enamel roughness.
- Negative impact on the child's school performance due to the absence from school.
- Financial concerns for families.

Management

A very useful 6-step management approach for MIH has been proposed by William, et al. [15]

a) Risk identification,
b) Early diagnosis,
c) Remineralisation (a better term may be mineralisation; the tooth

was never 'completely' mineralised during development although there may also be an element of demineralisation from enamel caries, superimposed upon the hypomineralised areas) and desensitisation

d) Prevention of dental caries and post eruptive enamel breakdown,
e) Restorations or extractions
f) Maintainence

Risk Identification And Early Diagnosis

With increased awareness it is possible to trace patients at risk much earlier and initiate preventive treatment more rapidly. Children at risk for MIH should be identified prior to PFM eruption. In the studies it is seen that children with MIH fell ill more frequently in the first four years of life than children in the same age group with normal molars. It appears that diseases concerning the head and neck area were relatively frequent. Therefore, based upon a relevant history, in children with repeated illnesses in the first four years it seems useful to increase the frequency of dental check-up's during the period when the permanent first molars erupt. This would be a means to detect the clinical symptoms as early as possible and from careful study under magnification of the unerupted molar crowns on any available radiographs

Preventive Management

The oral hygiene strategies that could be given to parents or patients in cases where tooth-brushing is difficult due to sensitive, poorly mineralized surfaces of affected molars are as follows:

1. Brush affected molars gently with a desensitizing toothpaste (preferably containing fluoride) on a soft toothbrush;
2. Apply a CPP-ACP topical creme daily using a cotton bud; and
3. Apply a low concentration fluoride treatment gel regularly using a cotton bud.

Remineralization therapy should commence as soon as the defective surface is accessible. Remineralization and desensitization may be accomplished with Topical Fluoride treatment and casein phosphopeptide- amorphous calcium phosphate (CPP-ACP) oral care products is recommended.

Restorative Management

1. Restoration of the permanent first molars : The porous exposed subsurface enamel or dentin may promote chronic inflammation of the pulp, complicating anaesthesia.[16,17] The choice of materials will depend on the defect severity and the age and cooperation of the child.

a) Adhesive materials : These are usually chosen due to the atypical cavity outlines following removal of hypomineralized enamel. With physical properties superior to GIC and RMGIC, the Resin Components are esthetic materials with high wear resistance and adhesion when used with resin-based adhesives. The RCs are materials of choice in MIH where defective enamel is well demarcated and confined to 1 or 2 surfaces with supragingival margins and without cuspal involvement. Resin composites are not successful in large defects because the etch pattern shows preferential dissolution of rod peripheries, loss of inter rod enamel resulting in enlarged inter rod space and inter crystal space is minimal probably reducing surface area available for bonding. The enamel adhesive interface of hypomineralised enamel is porous with cracks without a uniform hybrid layer. Failures with composite restorations have been thought to be due to these reasons. Hence it is recommended to remove all the hypomineralised enamel prior to placement of resin composite restorations and it is also suggested to pretreat the enamel with 5% sodium hypochlorite to remove the protein encasing the hydroxyapatite prior to etching .

b) Full coronal coverage restorations : When PFMs have moderate to severe PEB, preformed SSCs are the treatment of choice. Properly placed, SSCs can preserve PFMs with MIH until cast restorations are feasible. Compared to SSCs, cast restorations require minimal tooth reduction, provide high strength for cuspal overlay and maintain periodontal health due to their supragingival margins.

c) Extraction of severely hypomineralized first permanent molars: When PFMs are severely hypomineralized, restorations may be impossible and extraction must be considered. In such cases, early orthodontic assessment is recommended. Since PFMs are rarely an orthodontist's choice for extraction, later orthodontic treatment may be complicated. Factors affecting molar prognosis-such as vitality and restorability, dental age, buccal segment crowding, occlusal relationships, and the condition of other erupted and unerupted teeth-all need to be assessed when considering molar extraction. If restorative treatment is a major problem, or if it fails, the optimal timing of extractions and follow-up of tooth eruption and development of occlusion can be managed.

Restoration Of Permanent Incisors

Aesthetic concerns are common in patients with MIH with incisor involvement. In young patients, these teeth should be treated in a conservative approach as they have immature anterior teeth with large and sensitive pulp.[14]Therefore, it is preferred to postpone the aesthetic treatment as the enamel opacities often become less profound in the long term. In general, the yellow-whitish defects are less severe than the yellow-brownish defects and the defects on the incisors are milder than those on molars,2 however, the defects on the incisal edge tend to undergo post-eruptive breakdown more than those within the labial surface, and are thus clinically more difficult to manage. The following are some possible treatment options for anterior teeth with MIH, which could be used alone or in a combination of methods to achieve better aesthetic results.

1. Microabrasion: This involves the removal of a small amount of surface enamel (no more than 100 µm (0.1 mm) through abrasion and erosion using 18% hydrochloric or 37.5% phosphoric acid with pumice.[59] The process abrades the surface enamel while also polishing it which leads to changes in optical properties and this may improve the aesthetics[19].Microabrasion is indicated when the discolouration is limited to the outer surface of enamel and it is more effective at eliminating brown mottling.[18,19]This technique was suggested in the literature for aesthetic management of MIH incisors with limited benefit if used alone due to the anatomopathology of MIH lesions.[18] Some researchers suggest this technique to remove a hypermineralised superficial layer of enamel followed by home application of CPP-ACP products as this was found to improve remineralisation outcomes.

2. Tooth Bleaching: The aim is to camouflage white opacities by increasing the overall brightness of the teeth.[22] This option is indicated for adolescents[9] The possible side-effects of bleaching are: sensitivity, mucosal irritation, and enamel surface alterations.[26]Home bleaching through daily placement of 10% carbamide peroxide gel into custom fitted trays is the gentlest bleaching option prescribed by the dentist, but for more protection, the combined use of CPP-ACP Tooth Mousse and bleaching gel is recommended.[22] The CPP-ACP Tooth Mousse will protect the tooth structure and remineralise the MIH opacities during the bleaching process without interfering with bleaching effect.[62]The combined use of hydrogen peroxide and CPP-ACP, could be done with a ratio range from 1:6 to 3:4, depending on the opacity response to the bleaching agent.[22]

3. Etch-bleach-seal Technique This technique was suggested by Wright23 to remove yellow-brown stains. The affected tooth should be etched first with 37% phosphoric acid for 60 seconds, followed by continuous application of 5% sodium hypochlorite as the bleaching agent for five to ten minutes. Then the tooth should be re-etched and covered with a protective layer such as clear fissure sealant or composite bonding agent.[23]. With this technique the yellow-brown stains can be eliminated leaving a white mottled appearance which is more aesthetically acceptable.

4. Resin Infiltration: Since the refractive index of the resin infiltrant (1.52) is close to that of healthy enamel (1.62), this can improve the optical properties by improving the translucency and therefore improving the aesthetics.[24] This technique seems inappropriate especially for mild MIH cases where the defect is located beneath the superficial two thirds of relatively healthy enamel, Attal et al.24 suggested a modification in this technique for aesthetic management of MIH incisors and this was introduced as 'deep resin infiltration technique.' The technique involves preparing the affected tooth by an intraoral sandblasting device to ensure that the infiltration can indeed reach the full extent of the lesion in case of MIH. This should remove no more than 500 µm from surface enamel and after resin infiltration, some composite could be added to tooth surface.[24] The bonding between resin infiltrant and composite is of very good quality. Studies assessing the longevity of the aesthetic result found stable results for at least six months with the main drawback being material discolouration.[28]Paris et al.29 suggest that well-polished infiltrated enamel is resistant to discolouration. However, these findings are related to the regular resin infiltration technique, as in the situation of

deep infiltration the resin infiltrant is not in contact with the external environment.[24] In general, the use of resin infiltration technique in MIH teeth requires further investigation, improvement in material properties and/or technique modifications to be strongly recommended in MIH cases.

4. Composite restorations or veneers Composite restorations involve removal of defective enamel and composite resin build-up using opaque resins to avoid excessive enamel reduction while composite veneers could be a more conservative approach as it can be achieved with no tooth preparation that is, no removal of even defective enamel. These options could be indicated for large enamel defects that require treatment due to exposed dentine or chipped enamel.[26] The bond strength to hypomineralised enamel can be improved significantly by pre-treatment with 5.25% sodium hypochlorite for one minute after etching.[55] The composite resins are susceptible to discolouration, wear and marginal fractures, therefore, long-term maintenance is required.

5. Porcelain Veneers These are indicated for patients aged 18 years and above when the gingival margin has matured. It can be an option when the other techniques failed to produce satisfactory results.

CONCLUSION

Children with poor general health in early childhood or with hypomineralised second primary molars should be considered at risk of MIH. Therefore, they should be monitored more frequently during eruption of the FPMs. Management of these teeth should consider their long-term prognosis, as well as management of the presenting features such as pain. Aesthetic management of MIH incisors should be as conservative as possible and the extent of treatment depends on the patient's age, aesthetic concern and lesion severity. The remineralisation and resin infiltration techniques are possible effective conservative approaches in managing MIH teeth but these treatment modalities require further investigation to introduce the best technique/protocol in using them for MIH cases.

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