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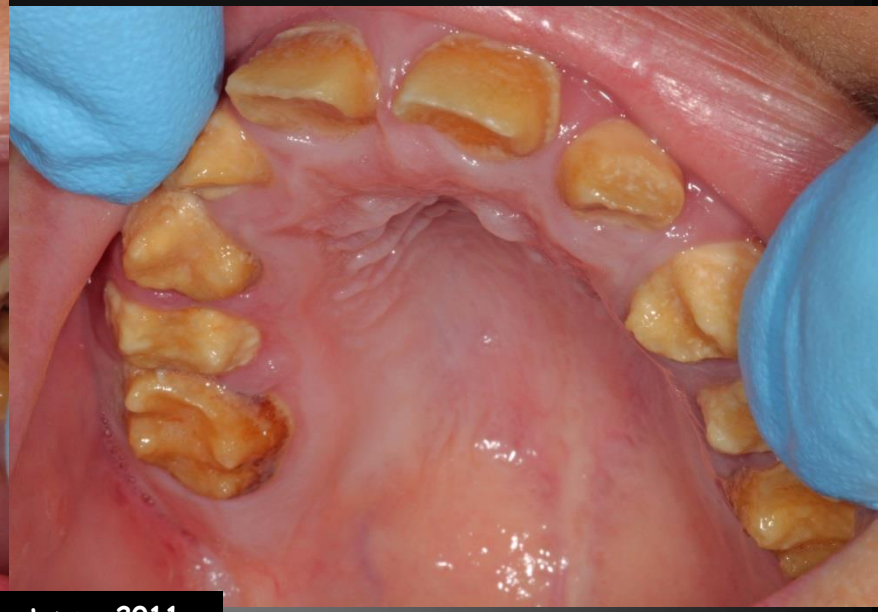
20 juin 2019

Journées de santé dentaire publique du Québec

HYPOMINÉRALISATION DE L'ÉMAIL DES INCISIVES ET DES MOLAIRES PERMANENTES

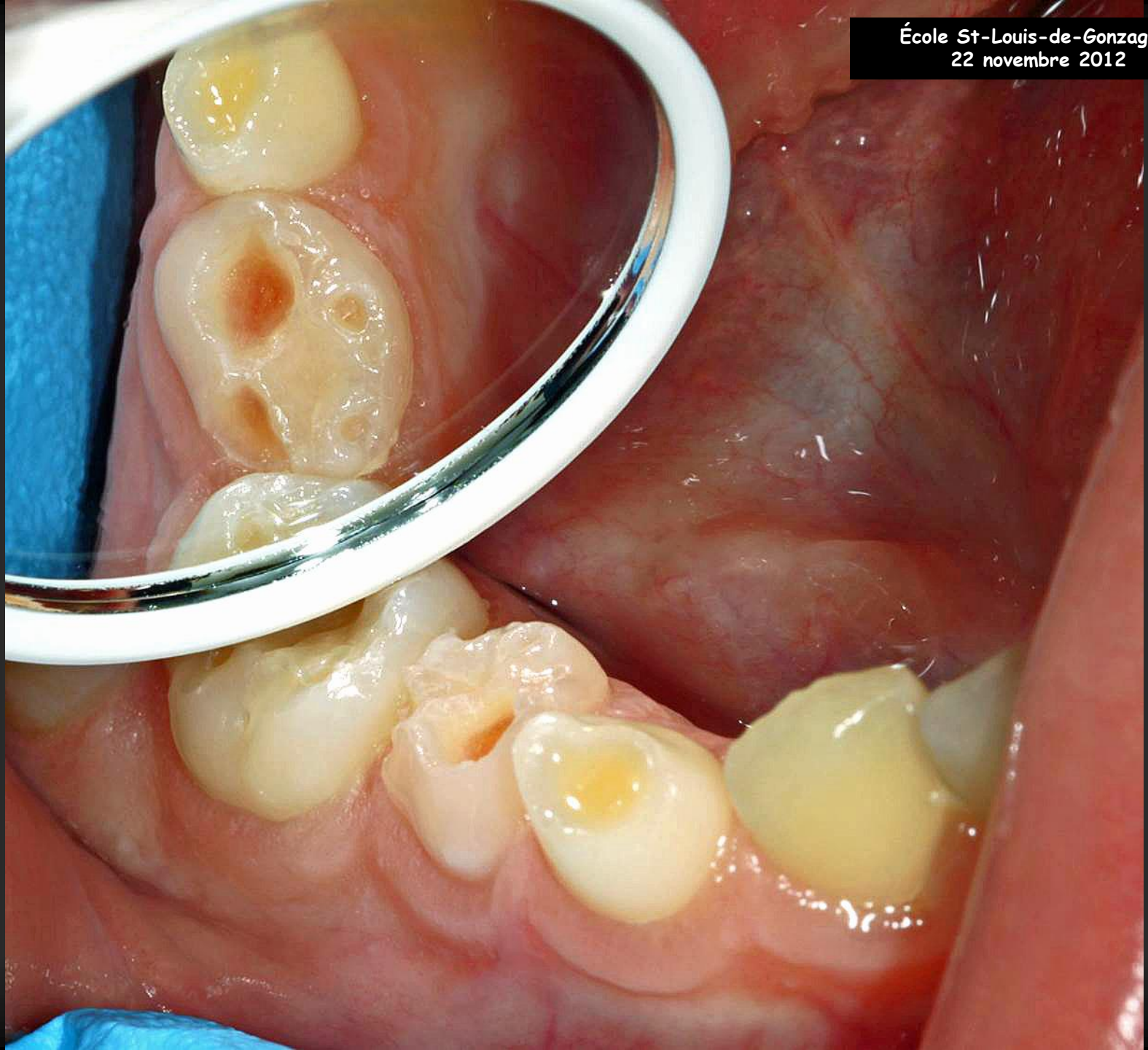
PLAN

1. Introduction
2. Importance relative de ce problème de santé buccodentaire
3. MIH … mythes et réalités
4. Observations cliniques intrigantes
5. Étiologie et facteurs de risque
6. MIH … Rôles possibles de la santé publique



École Katimavik, automne 2011


École Simonne Desjardins, 04 mai 2010


École St-Louis-de-Gonzague,
22 novembre 2012

École Simone Desjardins, 10 octobre 2011

PLAN

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CONSÉQUENCES

GARVITÉ

Conséquences pour l'enfant atteint

1. Hygiène buccodentaire plus complexe
2. Risque accru de carie dentaire (10 X ↑)
3. Hypersensibilité dentinaire … douleur … au chaud, au froid, à la mastication et lors du brossage des dents !
4. Handicap esthétique
5. Faible pronostic des traitements préventifs et curatifs (obturations)
6. Fracture d'émail
7. Risque accru de perte des dents impliquées
8. Fonction masticatoire affectée
9. Besoin de traitement orthodontique
10. Besoin de consulter un ou des spécialistes
11. Extractions compensatoires … après consultation avec un spécialiste
12. Mésialisation de la dent distale
13. Distalisation de la dent mésiale
14. Usure des dents antagonistes
15. Croissance parodontale / éruption active
16. Besoin de traitement accru
17. Nombre de rendez-vous chez le dentiste / disponibilité et absentéisme du travail
18. Inégalité sociale / coût des traitements / Accessibilité financière
19. Anesthésie locale réfractaire
20. Première expérience chez le dentiste « moins » agréable, voire traumatisante

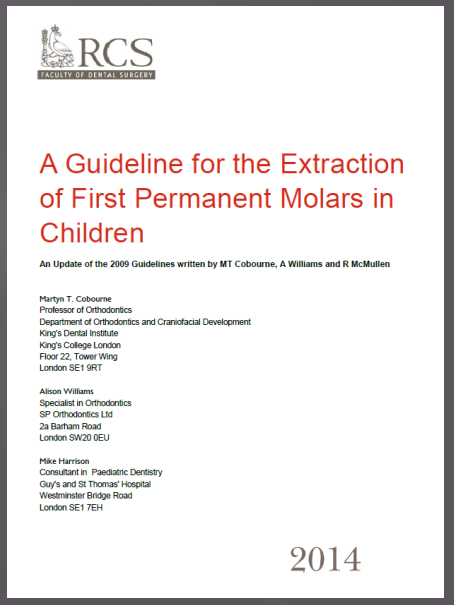
Devrait-on extraire les premières molaires permanentes dont le pronostic est compromis le plus tôt possible ou bien les restaurer temporairement afin de retarder leur extraction ?

Dans les cas où on juge l'extraction préférable, doit-on également extraire d'autres premières molaires permanentes ?

National clinical guidelines for the extraction of first permanent molars in children. M. T. Cobourne, A. Williams and M. Harrison. British Dental Journal, Volume 217 no. 11, DEC 5 2014.


National clinical guidelines for the extraction of first permanent molars in children

The best available evidence


RCS
FACULTY OF DENTAL SURGERY

A Guideline for the Extraction of First Permanent Molars in Children

An Update of the 2009 Guidelines written by MT Cobourne, A Williams and R McMullen

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2014

Conditions qui influencent la gestion clinique des premières molaires permanentes compromises

Molaire maxillaire vs mandibule

Degré de sévérité du chevauchement incisif et de l'occlusion

Désir ou non du patient de recevoir un traitement orthodontique

Âge dentaire (développement de l'occlusion)

Autre dent absente, en déplacement majeur ou au pronostic douteux

IN BRIEF

- Caries is the main reason for the extraction of first permanent molars in children.
- Children who are attending dental hospitals for extraction of first permanent molars tend to be older than the optimal age for achieving space closure.
- There is a need for guidelines advising primary care dentists when to refer children for the extraction of first permanent molars.
- This study highlights the need for extensive prevention programmes targeted at those children with high caries risk.

Extraction of first permanent molar teeth: results from three dental hospitals

S. Albadri,[1] H. Zaitoun,[2] S. T. McDonnell[3] and L. E. Davidson[4]

Objective To evaluate and compare the reasons for and pattern of extraction of first permanent molars (FPMs) in three UK dental hospitals.
Design Prospective multicentre study.
Setting Hospital.
Subjects Three hundred children attending Manchester Dental Hospital, Liverpool Dental Hospital and Charles Clifford Dental Hospital (Sheffield) who required extraction of at least one FPM.
Result The mean age in months was 129 (SD 22.7), 139 (SD 29.4), and 133 (SD 26.8) for Manchester, Liverpool and Sheffield respectively. Forty-five percent and 48% of children had four FPMs extracted at Manchester and Sheffield respectively, compared to 25% in Liverpool. The main reason for extraction was caries with poor prognosis (70%); molar incisor hypomineralisation was the reason for extraction in 11% of cases. General anaesthesia was the main anaesthetic method used in 77%, 55%, and 47% of cases in Manchester, Liverpool and Sheffield respectively. Sixty-eight percent of cases had not received previous treatment for the FPMs and 5% had fissure sealants detected. Forty percent of children had had previous extractions.
Conclusion The children who are attending the hospitals for extraction of FPMs tend to be older than the recommended age for achieving spontaneous space closure. This study highlights the need for extensive prevention programs targeted at those children with high caries risk.

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*British Dental Journal 2007; 203: E14

INTRODUCTION

The first permanent molar tooth (FPM) has been quoted as the most caries-prone tooth in the permanent dentition.[1] In 2003, 43% of 12-year-old children in the UK had some caries experience.[2] In addition, 10-19% of children have some form of hypomineralised FPM as part of a condition known as molar incisor hypomineralisation (MIH).[3-6]

Extraction of FPMs with poor prognosis has been advised in the orthodontic literature.[7,8] However, there are many factors that should be considered when treatment planning for patients with grossly carious FPMs.[9] The ideal time for the loss of a FPM is with the commencement of calcification of the bifurcation of the second permanent molars,[10] which usually occurs at a chronological age of eight to ten years.[11,12] This should facilitate mesial movement of the second permanent molar into the FPM area when hopefully a good contact will be established with the second premolars.[7] Earlier extraction before the age of eight years might result in distal drifting and rotation of the unerupted second premolar, especially in the spaced dentition or when there has been early loss of the second primary molar.[12] Conversely, late extraction (ie during or after the eruption of the second permanent molars) will result in an unsatisfactory space closure.[7]

There is a widely held opinion advocating compensating extraction of the upper FPM when loss of the lower FPM is planned.[14] This is to avoid the potential for over-eruption of the upper FPM preventing mesial movement of the lower second permanent molar. There is, however, little supporting data in the literature.[15] The presence of third molars should also be considered.[9] Knowledge about the outcome of extraction of FPMs in relation to age is still based upon clinical experience and expert opinion.[12,15]

An assessment of the developing dentition should be undertaken before extraction of first permanent molars. Factors such as dental pain, parental attitudes and the ability of the child to tolerate treatment under local anaesthesia may influence the

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Conclusion The children who are attending the hospitals for extraction of FPMs tend to be older than the recommended age for achieving spontaneous space closure. This study highlights the need for extensive prevention programs targeted at those children with high caries risk.

EFFICIENCE EXTRACTION DES PREMIÈRES MOLAIRES EN ALLEMAGNE

ABSTRACT

Objectives: Dentists have a range of options for managing molars with severe molar-incisor hypomineralization (MIH), each with different long-term implications. The cost-effectiveness of managing molars with severe MIH was assessed.

Methods: A mixed public-private-payer perspective within German healthcare was adopted. Individuals with one to four severely MIH-affected molars were followed over their lifetime. We compared: (1) removal of the tooth/teeth and orthodontic alignment of the second and third molars (Ex/Ortho); (2) restoration of the tooth using resin composite (Comp); (3) restoration using an indirect metal crown after temporizing it using a preformed metal crown (PMC/IR). The health outcome was tooth retention years. Transition probabilities were estimated based on the best available evidence. Cost calculations were based on German dental fee catalogues. Monte-Carlo microsimulations were performed for cost-effectiveness-analysis.

Results: If extraction was performed at the optimal age (9.5/11 years for maxillary/mandibular molars), Ex/Ortho was most cost-effective (67 years, 446–938 Euro). Comp (51 years, 1911 Euro) and PMC/IR were dominated (50 years, 2033 Euro). This cost-effectiveness ratio was also determined when > 1 molar was treated. If extraction was performed later, assuming no spontaneous alignment, Ex/Ortho was more costly than Comp, at least when only 1 molar was treated.

Conclusions: For molars with severe MIH, extraction at the optimal age and, if needed, orthodontic alignment can be cost-effective, especially when > 1 molar is affected. For single molars where the chance of spontaneous alignment is low, Comp might also be considered. These findings apply to German healthcare and within the limitations of this study only.

Clinical significance: When deciding how to manage molars with severe MIH, both tooth retention, with lower costs but higher needs for re-treatments, and tooth removal, with possible need for orthodontic alignment, can be considered. Considering cost-effectiveness, the latter may be preferable, especially if the age of extraction is chosen correctly, or several molars are affected.

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Managing molars with severe molar-incisor hypomineralization: A cost-effectiveness analysis within German healthcare

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Clinical significance: When deciding how to manage molars with severe MIH, both tooth retention, with lower costs but higher needs for re-treatments, and tooth removal, with possible need for orthodontic alignment, can be considered. Considering cost-effectiveness, the latter may be preferable, especially if the age of extraction is chosen correctly, or several molars are affected.

1. Introduction

Qualitative, demarcated developmental hypomineralized defects of one or more permanent first molars, with or without signs of lesions on the incisors, are defined as molar-incisor hypomineralization (MIH) [1]. Given the relatively high prevalence of 2–40% [2] of MIH and the associated clinical symptoms (ranging from non-cavitated or cavitated structural defects to hypersensitivity or pain, or esthetic impairment), there is great need for effective management options for MIH [3].

A range of non-invasive, micro-invasive and invasive treatment options is theoretically available. The suitability of those, however, differs depending on the severity (mild to severe) and symptoms (with or without the association of hypersensitivity) of MIH. For severe cases (those with cavitated structural defects in the enamel) dentists can either (1) restore the defects directly (usually using resin composite), (2) restore them indirectly (for example using ceramic or metal restorations), or (3) remove the tooth, followed by spontaneous or orthodontic alignment of the adjacent teeth [4]. Spontaneous alignment has been found in up to 82% and 63% of the adjacent teeth in the maxilla and mandible, respectively, under certain conditions and appropriate extraction timing [5–8].

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Managing molars with severe molar-incisor hypomineralization: A cost-effectiveness analysis within German healthcare.

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If, however, MIH-affected teeth were extracted at the ideal age (maxilla 8–10.5 years, mandible 10.5–11.5 years or when the second permanent molar reaches Demirjian's dental development stage E-F) [4,6], Ex/Ortho was always the least costly and most effective option, whereas Comp and PMC/IR were more costly and less effective. More-

In conclusion and within the limitations of this study, extracting severely affected MIH molars might be highly cost-effective if the timing of extraction is optimal, reducing the need for (expensive) orthodontic therapy. Removal and orthodontic treatment was especially cost-effective for maxillary molars and in cases where more than one molar was affected by MIH. In case the optimal time for extraction had passed, or if extraction and possible orthodontic therapy are not an option, resin composite restorations might be placed. The third strategy assessed, placing indirect restorations after temporizing the tooth, was not cost-effective. Further options might be available and their likely cost-effectiveness should be determined. When deciding how to manage MIH molars, tooth retention, follow-up treatment needs and treatment costs should be considered alongside the expectations and the overall (orthodontic, restorative) needs of patients.

CROISSANCE DU PROCÈS ALVÉOLAIRE

Posterior intrusion is one of the most difficult tooth movements in orthodontics, because of the multiple molar roots. Intrusion requires more alveolar bone reaction as well as a longer treatment time.[38] Therefore, using conventional orthodontic treatment for this movement is a big challenge. Three-dimensional movement control is essential in this therapy. Vertical position, the arch form, the tooth axes, the inclination of the occlusal plane and the posterior torque should be the treatment objectives.[39] The use of orthodontic mini-implants simplified the treatment plan and allowed maximum conservation of tooth structures.

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Complications of untreated molar-incisor hypomineralization in a 12-year-old boy

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Abstract

Complications arising because of untreated molar-incisor hypomineralization (MIH) have received little mention in the dental literature. However, this can be an area of concern, with severe consequences in rare cases. Hence, early recognition and prompt management of MIH is essential for long-term oral health of affected individuals. This paper describes an untreated case of severe MIH that resulted in infection of facial spaces.

Introduction

Molar-incisor hypomineralization (MIH) is a clinical condition of systemic origin characterized by qualitative enamel defects of the first permanent molars and frequently associated with affected incisors.[1] For a patient to be diagnosed as suffering from MIH, at least one permanent first molar must be affected with or without involvement of the incisors. The term molar hypomineralization has been used, sometimes, to distinguish children in whom the incisors are not affected.[1-4]

Due to the developmental history of the permanent first molars and upper and lower anterior teeth, the search for an etiology has focused around the time of birth and early childhood. Several researchers have discussed possible causes, prenatal (maternal infections, metabolic disturbances, etc.), natal (complicated delivery) and postnatal (neonatal viral infections, prolonged antibiotic and other medication usage).[3-5,5,6] However, there is currently insufficient evidence to establish etiological factor(s) relevant to MIH and it has been suggested that MIH is caused by not one but many different factors which may act together, increasing the risk.[5,6]

The defect is clinically presented as demarcated enamel opacities of different color in the affected teeth, occasionally undergoing post-eruptive breakdown due to soft and porous enamel. This may result in atypical cavities or even complete coronal distortion, requiring extensive restorative treatment.[7-9] Post-eruptive breakdown of the defective enamel creates areas more conducive to plaque retention which, combined with improper oral hygiene maintenance by the patient because of profound hypersensitivity of the affected teeth, might collectively result in increased caries susceptibility.[9]

The importance of recognizing and managing MIH cannot be overemphasized. Early identification of the condition and its prompt management is crucial for successful, long-term outcomes in affected children.[10] Failure to address MIH and its related problems such as dental caries can lead to further and severe destruction of tooth structure and ultimately, result in loss of the affected teeth or in rare cases, give rise to a life-threatening situation due to severe infection. This paper presents an untreated case of severe MIH that led to pulpal involvement of one of the affected teeth and consequently, to submandibular and submental space infection.

Case Report

A 12-year-old boy reported to our paediatric dental service with the complaint of pain and swelling in the lower face and jaw since five days, associated with fever and inability to open the mouth or swallow food. The pain was severe and throbbing. The pain and swelling originated in the region of the right lower back tooth and eventually spread to the left side of the mandible. The boy had never sought dental advice until the present time. He had, a few days earlier, consulted a local dental practitioner for the same problem but was only prescribed medication for pain.

The boy appeared pale, lethargic, irritable and highly apprehensive. Examination revealed a diffuse swelling which involved the submental and submandibular areas bilaterally and extended from the angle of the mandible of one side to the other. The swelling was hard and tender, and the overlying skin was stretched, shiny, and reddened (Figure 1). The submandibular and submental lymph nodes of both sides were enlarged and tender. Mouth opening was restricted to less than two centimeters, which allowed only a limited intraoral examination.

It was observed that the mandibular first permanent molars were hypomineralized and badly destructed (Figure 2, picture taken on third day) and the labial surface of the maxillary left central incisor showed the presence of a small, demarcated, opaque-white patch of hypomineralization (Figure 3), findings that are characteristic of MIH. The molar hypomineralization was of the severe type (post-eruptive enamel breakdown) and the incisor hypomineralization of the mild type (white-cream opacity without enamel breakdown).[4,11]

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Key words: molar-incisor hypomineralization, complications, enamel defects, infection, molar hypomineralization.

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The oral hygiene of the patient was poor and halitosis was present; however, this could be due to an inability, caused by restricted mouth opening to perform adequate oral hygiene procedures. Orthopantomograph revealed radiolucencies closely approximating the pulps in both mandibular first permanent molars, periapical radiolucency in relation to the mesial root and widened periodontal space around the distal root of the right mandibular first permanent molar (Figure 4). A diagnosis of space infection involving the submandibular and submental spaces bilaterally was made from the clinical and radiographic findings.

Since the child was highly anxious, he was first counseled along with his parents. Thereafter, the child was offered reassurance and positive reinforcement throughout the treatment period. The dentoalveolar abscess is poly-microbial comprising various facultative anaerobes and strict anaerobes and a vast majority of dental abscesses respond to surgical treatment, such as drainage of pus and elimination of the source of infection, with antibiotic use limited to severe spreading infections.[12] Therefore, following routine blood investigations the patient was put on intravenous analgesics, fluids and empiric antibiotic therapy with amoxicillin and metronidazole. Extraoral incision and drainage was instituted 2 h after initiating antibiotic therapy. After 24 h the patient's mouth opening was found to have increased sufficiently to allow emergency

PRÉVALENCE

15

≤ 10 ans …

I.C. 95 % [12.1, 18.2]

12

> 10 ans

I.C. 95 % [8.0, 16.3]

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The prevalence of molar incisor hypomineralization: evidence from 70 studies

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Objective. A growing number of studies have investigated the prevalence of Molar Incisor Hypomineralization (MIH) around the world. The aim of this study was to systematically estimate the pooled prevalence of MIH.

Methods. A comprehensive literature research was completed in English and Chinese databases. Random effect models were used to calculate the pooled prevalence. To address the heterogeneity, meta-regression, and sensitivity analyzes were conducted. Publication bias was estimated by trim and fill method.

Results. Seventy eligible studies were included. The pooled prevalence of MIH was 14.2% globally. In subgroup analysis, South America (18.0%, 95% CI: 13.8–22.2) and Spain (21.1%, 95% CI: 17.7–24.6) had the highest prevalence. There was no significant difference between males (14.3%, 95% CI: 12.0–16.6) and females (14.4%, 95% CI: 12.8–15.9). The prevalence of MIH among children 10 years of age or younger (15.1%, 95% CI: 12.1–18.2) was much higher than the prevalence of MIH among older children (12.1%, 95% CI: 8.0–16.3). Sample size explained 15.7% heterogeneity.

Conclusion. MIH has a high incidence globally, especially among children <10 years old. It is, therefore, imperative to develop more appropriate dental healthcare strategies to care for these children and to identify the etiology of MIH to prevent it occurring.

Introduction

Structural defects of enamel are common oral diseases, affecting approximately 10 percent of the population and triggering serious sequelae, such as esthetic problems and decay[1]. Non-fluoride-associated developmental defects of tooth enamel were deemed as an increasing clinical problem[2]. Among these disorders, Molar Incisor Hypomineralization (MIH), a form of tooth hypomineralization, is defined as an enamel defect in the mineralization of one to four permanent first molars, sometimes associated with similarly affected permanent incisors according to the European Academy of Paediatric Dentistry (EAPD)[3].

The clinical appearance of MIH affected teeth displays a demarcated opacity on the occlusal and buccal
which varies in color
or brown asymmetr
(greater than one
affected may be mo
stimuli. There is also a report about shooting pain for the children with MIH when they were brushing their
hypomineralized ena
to plaque deposits,
eventual developmer
tion, yellow and bro
reported to be more
white ones[9]. Furth
suggested that MIH
dren's growth inter
childhood illnesses[10,
tal treatments should
dren with MIH[12].

Regarding to its etiology of MIH, pre-natal, perinatal, and post-natal conditions has been studied. Genetic variations[13], preterm[14], and a number of childhood illnesses[15–17] (such as acute otitis media, chicken pox, and respiratory diseases during the first year of life) have

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INTERNATIONAL JOURNAL OF PAEDIATRIC DENTISTRY

70 studies

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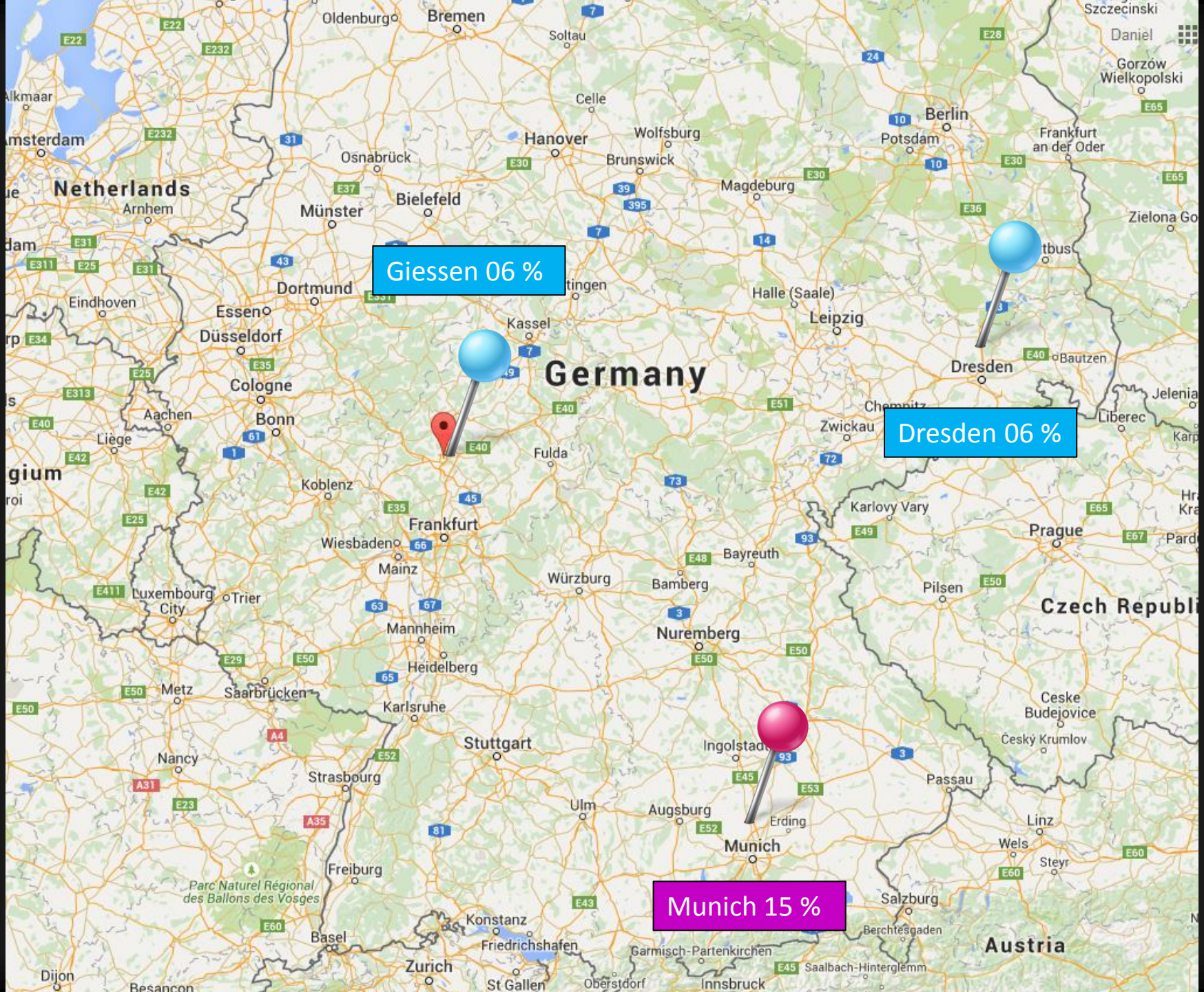
PREVALENCE STUDIES FOR CHALKY 6-YEAR MOLARS


Giessen 06 %
Dresden 06 %
Munich 15 %
Germany
Netherlands
Czech Republi
Austria
Oldenburg
Bremen
Soltau
Celle
Hanover
Wolfsburg
Brunswick
Osnabrück
Münster
Bielefeld
Arnhem
Eindhoven
Dortmund
Essen
Düsseldorf
Cologne
Aachen
Bonn
Liège
Kassel
Fulda
Koblenz
Frankfurt
Wiesbaden
Mainz
Luxembourg City
Trier
Mannheim
Heidelberg
Metz
Saarbrücken
Karlsruhe
Stuttgart
Nancy
Strasbourg
Freiburg
Parc Naturel Régional des Ballons des Vosges
Basel
Konstanz
Friedrichshafen
Zurich
St Gallen
Dijon
Besançon
Magdeburg
Halle (Saale)
Leipzig
Dresden
Bautzen
Berlin
Potsdam
Frankfurt an der Oder
Gorzów Wielkopolski
Szczecinski
Daniel
Zielona Go
Chemnitz
Zwickau
Liberec
Jelenia
Karlovy Vary
Prague
Pilsen
Bayreuth
Bamberg
Würzburg
Nuremberg
Ingolstadt
Augsburg
Ulm
Munich
Erding
Passau
Linz
Wels
Steyr
Salzburg
Berchtesgaden
Garmisch-Partenkirchen
Innsbruck
Saalbach-Hinterglemm
Oberstdorf
Ceske Budejovice
Český Krumlov

Pays-Bas

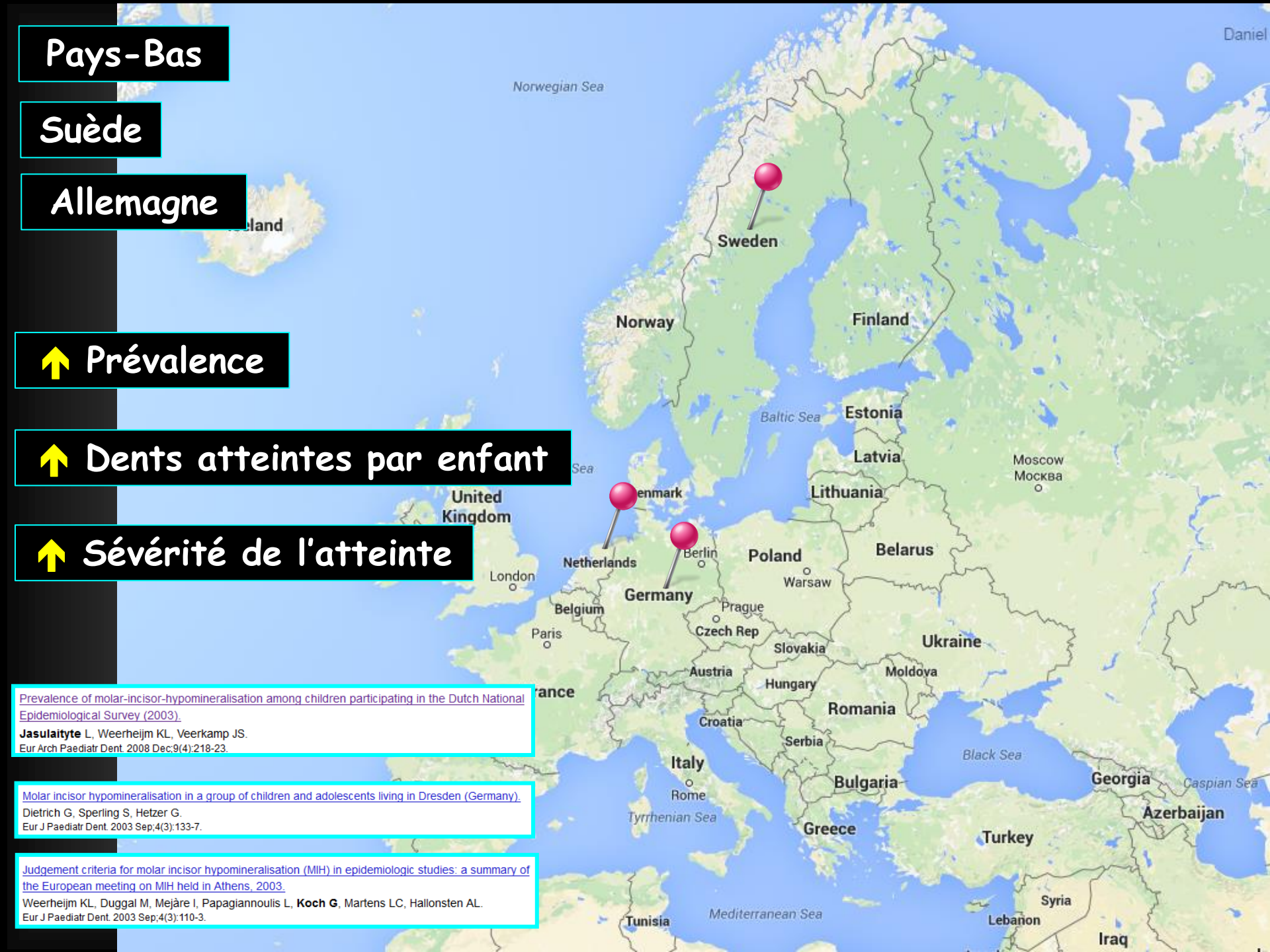
Suède

Allemagne

↑ Prévalence

↑ Dents atteintes par enfant

↑ Sévérité de l'atteinte



Prevalence of molar-incisor-hypomineralisation among children participating in the Dutch National Epidemiological Survey (2003).
Jasulaityte L, Weerheijm KL, Veerkamp JS.
Eur Arch Paediatr Dent. 2008 Dec;9(4):218-23.

Molar incisor hypomineralisation in a group of children and adolescents living in Dresden (Germany).
Dietrich G, Sperling S, Hetzer G.
Eur J Paediatr Dent. 2003 Sep;4(3):133-7.

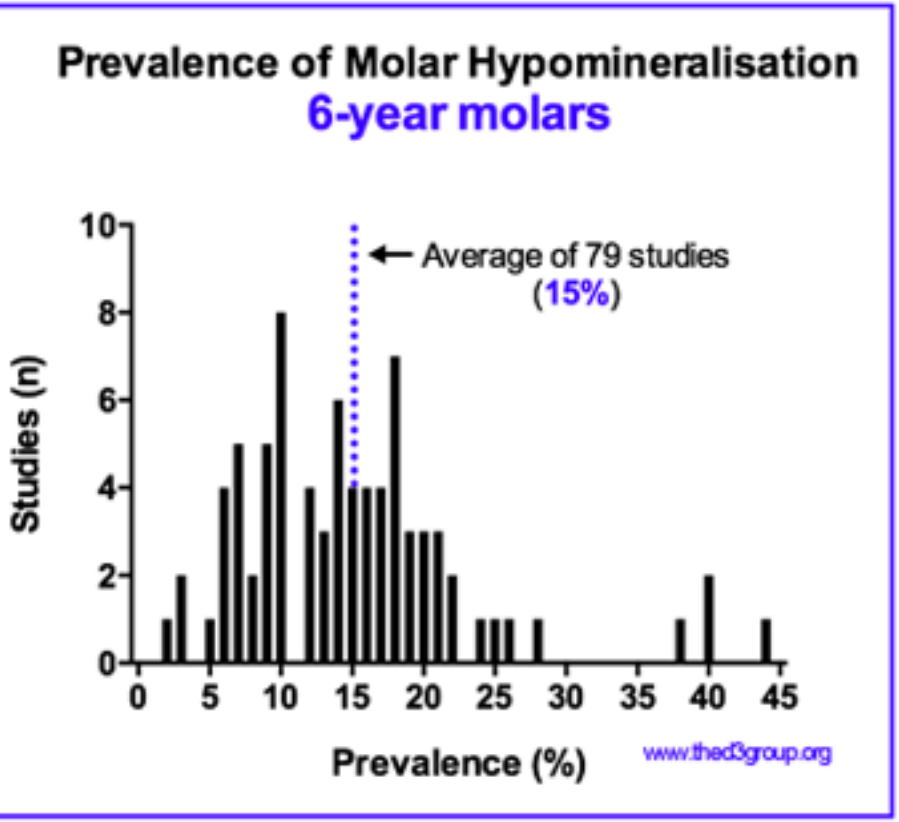
Judgement criteria for molar incisor hypomineralisation (MIH) in epidemiologic studies: a summary of the European meeting on MIH held in Athens, 2003.
Weerheijm KL, Duggal M, Mejàre I, Papagiannoulis L, **Koch G**, Martens LC, Hallonsten AL.
Eur J Paediatr Dent. 2003 Sep;4(3):110-3.

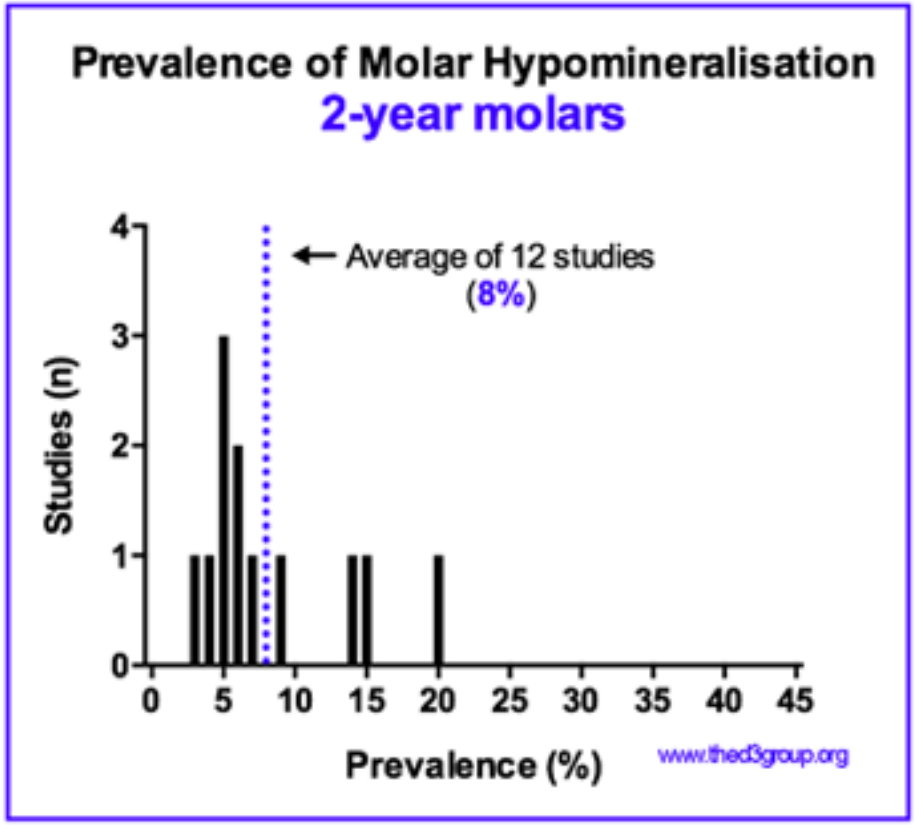
15

Prévalence moyenne au niveau mondial au niveau des premières molaires permanentes

8

Prévalence moyenne au niveau mondial au niveau des deuxièmes molaires permanentes





Sydney	44%	Balmer et al, 2005 Prevalence of enamel defects and MIH in non-fluoridated and fluoridated communities.

Eur J Paediatr Dent. 2005 Dec;6(4):209-12.
Prevalence of enamel defects and MIH in non-fluoridated and fluoridated communities.
Balmer RC[1], Laskey D, Mahoney E, Toumba KJ.

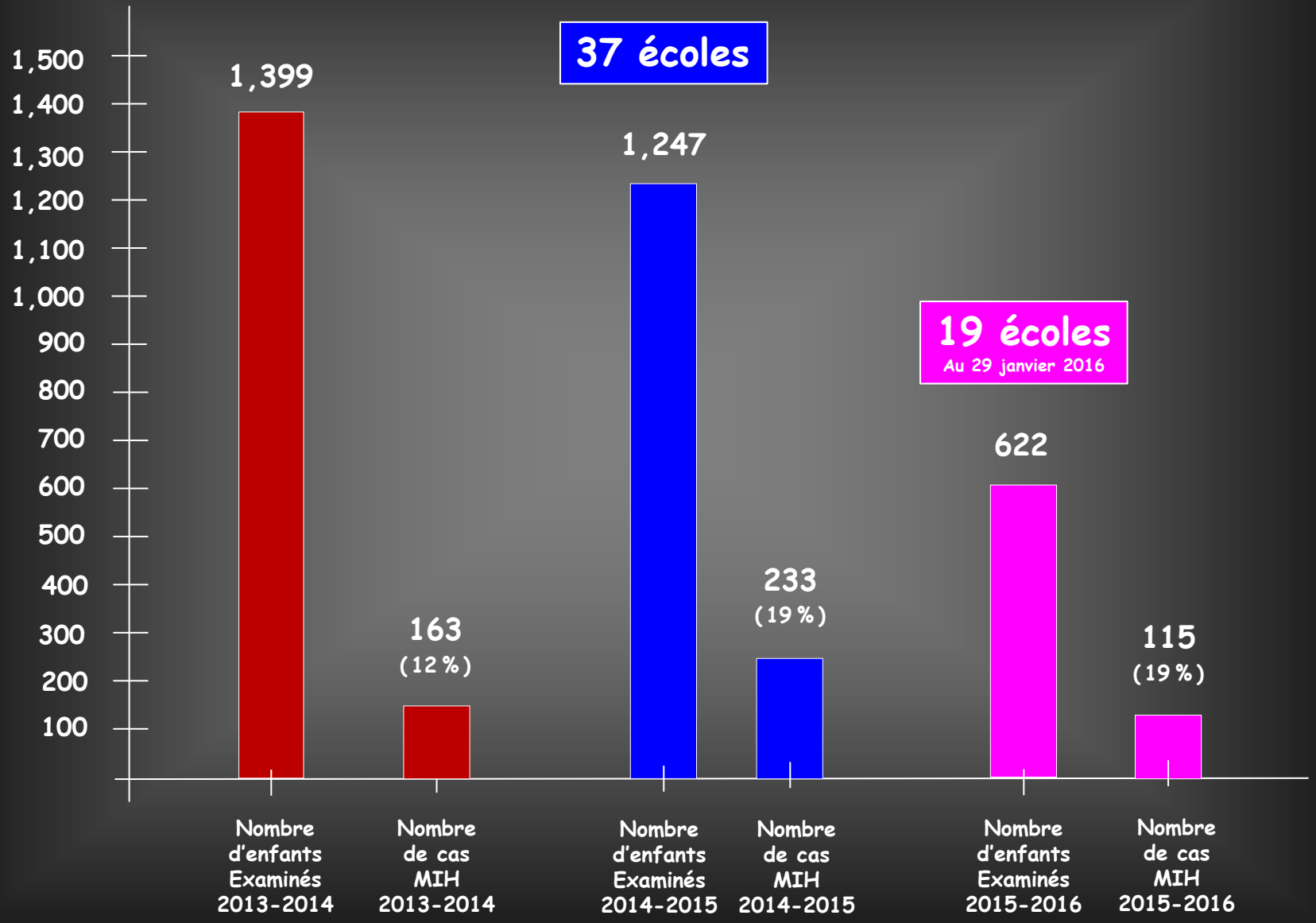
Leeds	40%	Balmer et al, 2005 Prevalence of enamel defects and MIH in non-fluoridated and fluoridated communities.

Brazil Rio de Janeiro	40%	Soviero et al, 2009 Prevalence and distribution of demarcated opacities and their sequelae in permanent 1st molars and incisors in 7 to 13-year-old Brazilian children.

http://www.thed3group.org/prevalence.html

DONNÉES MONTRÉALAISES

Évolution du nombre et pourcentage (%) de cas de MIH à Montréal



19

Pourcentage de cas MIH parmi les enfants que j'ai examiné en 2014-2015

31

Pourcentage de non ordonnance sur les dents avec hypominéralisation

9

Pourcentage de BÉT ou déjà obturée sur les dents avec hypominéralisation

Année scolaire 2015 – 2016 … au 29 janvier 2016

Nombre d'enfants examinés (examens dentaires) :	622	
Nombre d'enfants avec au moins 1 dent MIH :	115	
Pourcentage (%) de cas de MIH :	18,5 %	
Nombre total de faces avec MIH :	587	
Nombre total de faces saines, sans ordonnance:	161	31,2 %
Nombre total de faces saines avec une ordonnance:	263	
Nombre total de faces avec une carie d'émail, sans ordonnance :	22	49,9 %
Nombre total de faces avec une carie d'émail, avec une ordonnance :	30	
Nombre total de faces avec un BÉT-carie dentaire	27	8,5 %
Nombre total de faces déjà obturées :	23	
Nombre total de faces déjà scellées :	61	10,4 %

BIAIS POSSIBLES

1

DONNÉES CONSERVATRICES, CAR SEULEMENT

LES PREMIÈRES MOLAIRES PERMANENTES

ONT ÉTÉ CONSIDÉRÉES

2

L'ORIGINE ETHNIQUE DES ENFANTS MONTRÉALAIS

EXAMINÉS EST RAREMENT NORD-AMÉRICIANE,

MAIS EST SOUVENT EUROPÉENNE

AUTRES PREUVES DE SON IMPORTANCE CROISSANTE

THE D3 GROUP

http://www.thed3group.org/

THE D3 GROUP

Better understanding and care of people with Developmental Dental Defects

DONATE SITE MAP

KIDS
Help for D3 kids

FAMILIES
Help for D3 families

COMMUNITY
Help for public health sector

PRACTITIONER
Help for dentists & medicos

RESEARCHER
Help for research workers

HOME | ABOUT US | NEWS & EVENTS | FORUM | JOIN / CONTACT D3G

THE D3 GROUP FOR DEVELOPMENTAL DENTAL DEFECTS

Welcome to The D3 Group (D3G) and our Online Education Resource. Formally we are a translational research and education network spanning the **Developmental Dental Defects (DDD = D3)** sector originally in Australia and New Zealand (the Hub) and increasingly around the world. But actually we are an eclectic bunch of individuals whose lives have been touched by D3 problems one way or another.

Some of our families have experienced D3 first hand, many of us care for people with D3 either as dental practitioners or public health professionals, and many others are engaged in D3 research and education. We are also pleased to have a growing number of medicos and D3-savvy folk from industry amongst us.

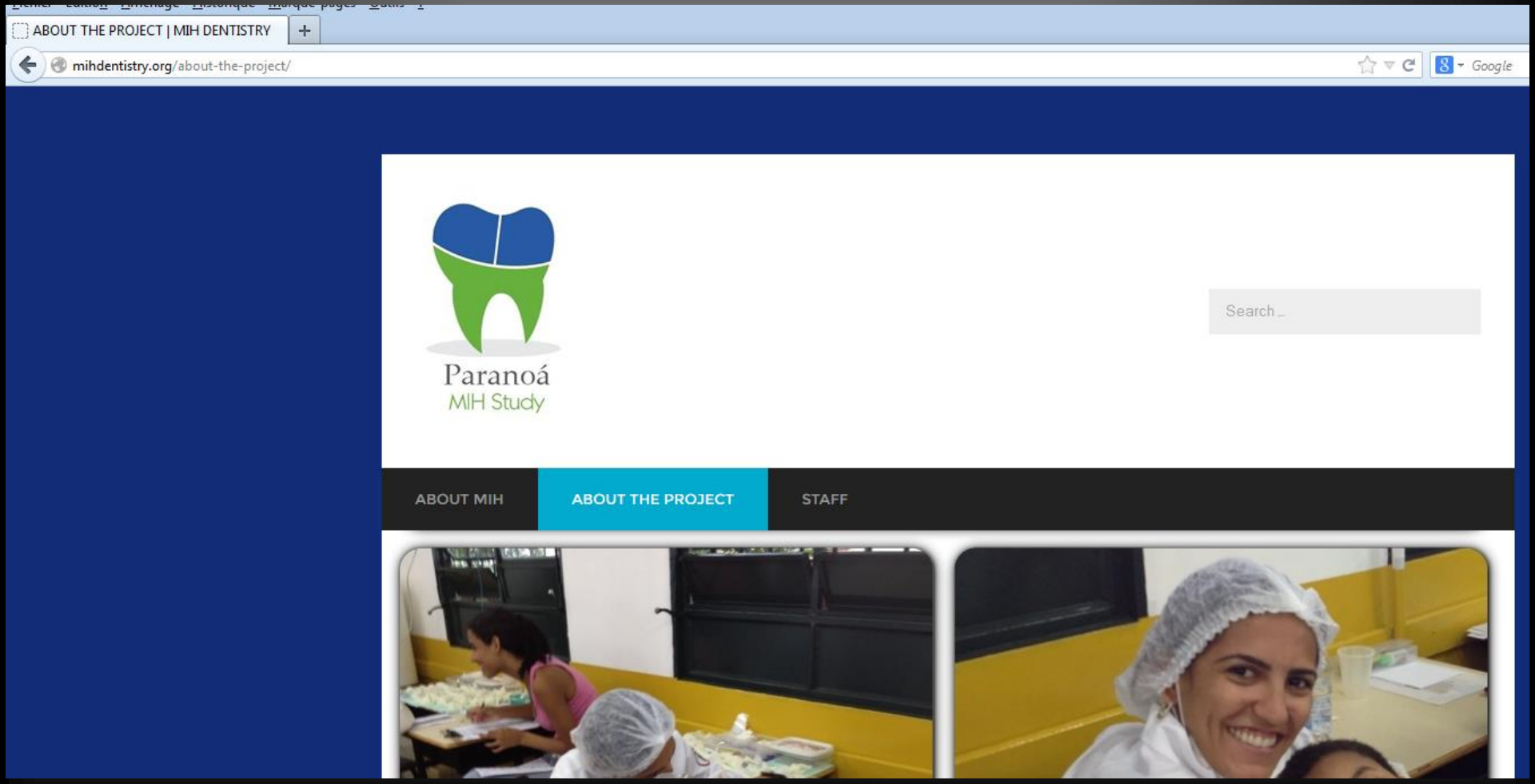
All of us believe that teaming up and pulling together in a "D3 family" effort will help get "chalky teeth" problems such as Molar Hypomin and AI recognised better, understood better, and cared for better. Our ultimate goal is to make many of these problems go away through prevention... read more >>

NEW | CE PODCAST & WEBINAR | ARTICLES ABOUT D3G | BECOME A D3G MEMBER

http://mihdentistry.org/about-the-project/

ABOUT THE PROJECT | MIH DENTISTRY
mihdentistry.org - 149 × 197 - Search by image
MIH DENTISTRY

Paranoá
MIH Study



EAPD | LUGANO

2018

11.45 – 13.15	**3M Oral Care Meeting: MIH – Management approaches across regions and cultures** Professor Monty Duggal, Singapore Prof. Dr., MME Katrin Bekes, Vienna Dr. Dina Debaybo, Dubai Dr. Richard Steffen, Zurich	Parallel Sessions: **Oral presentations** **Poster presentations**

https://www.eapd2018.org/programme/programme-main-congress/

https://www.eapd2018.org/programme/programme-main-congress/

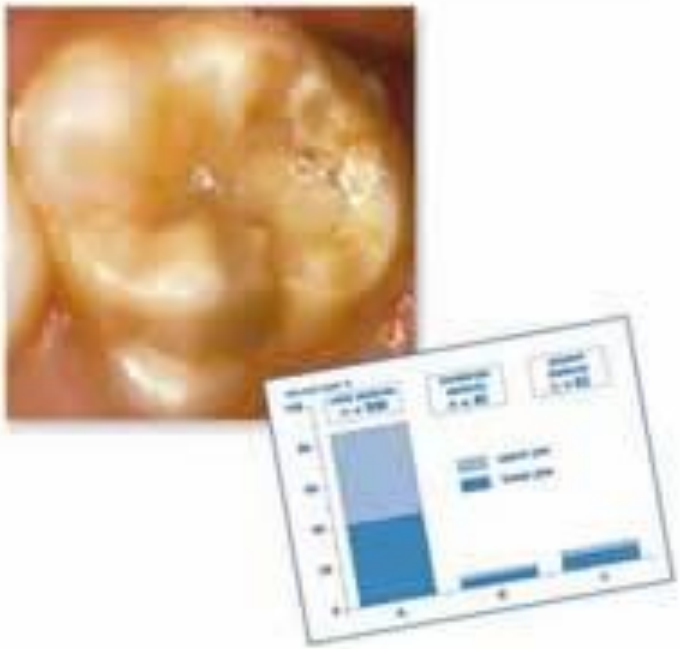
EUROPEAN JOURNAL OF

PAEDIATRIC DENTISTRY

JOURNAL OF THE EUROPEAN ACADEMY
OF PAEDIATRIC DENTISTRY

Volume 4 September 2003 3

MIH - Special Issue



Journal of the European Academy of Paediatric Dentistry (EAPD)
in collaboration with the Italian Society of Paediatric Dentistry (SIOI)

Guest Editorial

Molar hypomineralization

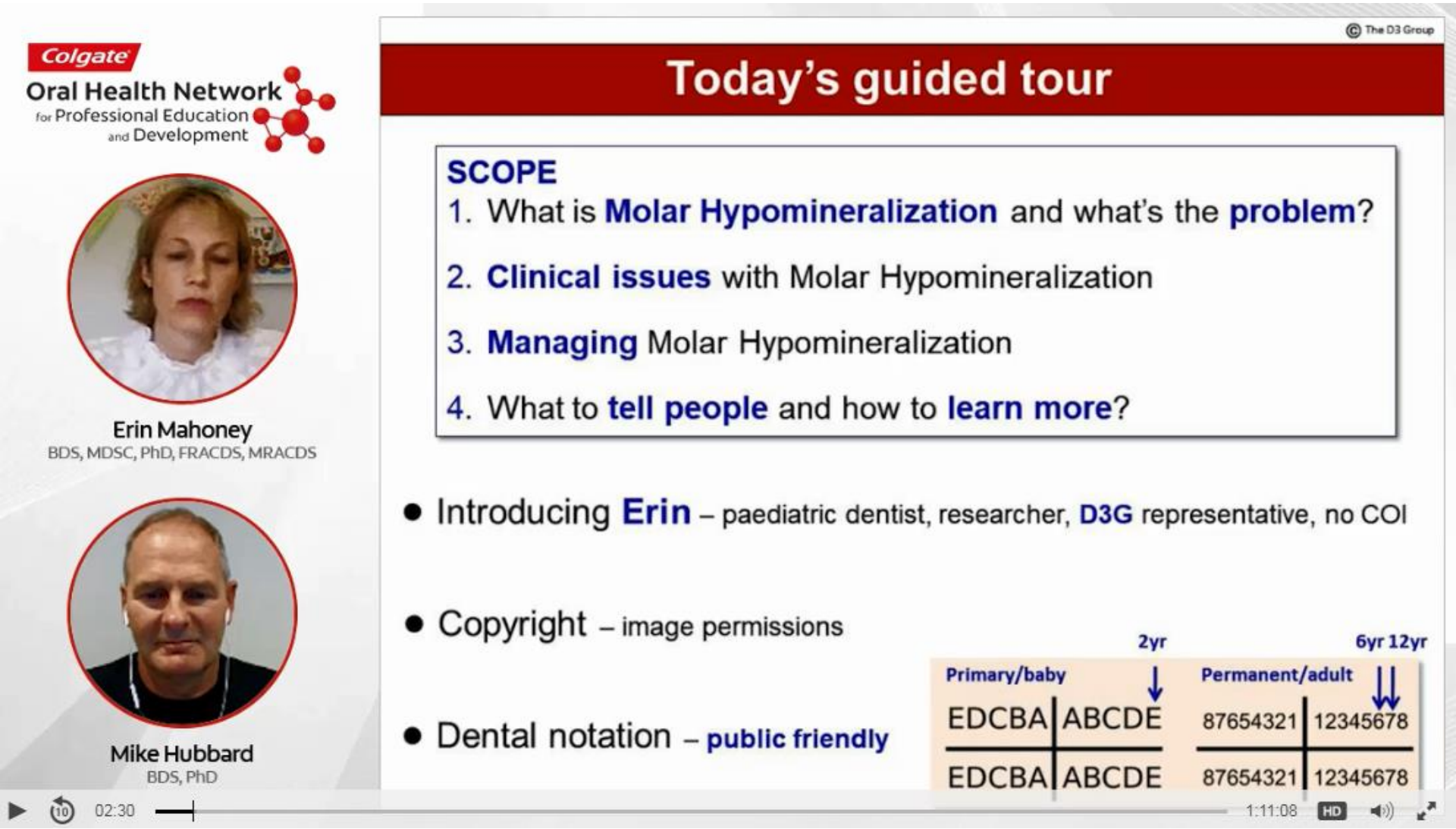
What is the US experience?

Michael J. Hubbard, BDS, PhD

Molar hypomineralization (MH) has been the subject of more than 75 prevalence studies worldwide over the past 30 years, yet none of these reports emanated from the United States.[1] Why has this oral health problem received so little attention in the US dental literature? Could it be because the nature of the condition and its cause remain unclear or that the lingering epidemic of childhood caries has preoccupied dentistry in the United States? Given that MH is a medicodental condition with many complexities, is it not time to focus attention on this problem and to bolster American participation in an international campaign to promote the need for research into chalky teeth?[2,3]

Molar hypomineralization: What is the US experience?
Hubbard MJ.
J Am Dent Assoc. **2018** May;149(5):329-330. doi: 10.1016/j.adaj.**2018**.03.013.


Commentary
Guest Editorial
Molar hypomineralization
What is the US experience?
Michael J. Hubbard, BDS, PhD
It seems fair to say that there is gross ignorance about molar hypomineralization worldwide, numerous exceptions notwithstanding.



https://www.colgateoralhealthnetwork.com/dental-ce-courses/on-demand-webinars/?utm_source=iContact&utm_medium=email&utm_campaign=colgate-oral-health-network&utm_content=

https://oasisdiscussions.ca/2016/10/14/mped/

CDA Oasis

CDA @ Work | Issues & People | News & Events | Supporting Your Practice | CE Showcase | CDA Essentials | Upload Your Content

CDA Oasis Webinar: Managing Patients with Enamel Defects

October 14, 2016

PLAN

1. Introduction
2. Importance relative de ce problème de santé buccodentaire
3. MIH … mythes et réalités
4. Observations cliniques intrigantes
5. Étiologie et facteurs de risque
6. MIH … Rôles possibles de la santé publique

- [x] Zone d'opacité de l'émail clairement délimitée
- [ ] Atteint seulement les molaires et incisives permanentes
- [ ] Étiologie ou cause (uniquement) systémique

Hardness measurements[20–24] revealed that hypomineralized areas in enamel were associated with a reduction in the mechanical properties of the regions affected by MIH. When the clinical and histological appearances of MIH were compared by polarization microscopy[5], yellow/brown opacities were shown to be more porous than lighter opacities. Furthermore, hardness values[25] and mineral density[26] were related to colour change in hypomineralized demarcated opacities, with yellow lesions being softer than white[25]. The higher porosity of darker opacities may contribute to lower mechanical resistance that facilitates PEB. There are however no prospective data available yet to provide evidence of the higher risk for structural loss from areas of darker enamel opacity.

20 Mahoney EK, Ismail FSM, Kilpatrick NM, Swain M. Mechanical properties across hypomineralized/hypoplastic enamel of first molar teeth. *Eur J Oral Sci* 2004; **112**: 497–502.

21 Mahoney EK, Rohanizadeh R, Ismail FSM, Kilptrick NM, Swain MV. Mechanical properties and microstructure of hypomineralized enamel of permanent teeth. *Biomaterials* 2004; **25**: 5091–5100.

22 Xie ZH, Mahoney EK, Kilpatrick NM, Swain MV, Hoffman M. On the structure-property of sound and hypomineralized enamel. *Acta Biomat* 2007; **3**: 865–872.

23 Xie Z, Kilpatrick NM, Swain MV, Munroe PR, Hoffman M. Transmission electron microscope characterization of molar-incisor-hypomineralization. *J Mater Sci Mater Med* 2008; **19**: 3187–3192.

24 Fagrell TG, Wolfram D, Jälevik B, Norén JG. Chemical, mechanical and morphological properties of hypomineralized enamel of permanent first molars. *Acta Odontol Scand* 2010; **68**: 215–222.

25 Suckling GW, Nelson DGA, Patel MJ. Scanning electron microscopic appearance and hardness values of developmental defects in human permanent tooth enamel. *Adv Dent Res* 1989; **3**: 219–233.

26 Farah R, Drummond B, Swain M, Williams S. Linking the clinical presentation of molar-incisor hypomineralisation to its mineral density. *Int J Paediatr Dent* 2010; **20**: 353–360.

Increase in severity of molar-incisor hypomineralization and its relationship with the colour of enamel opacity: a prospective cohort study.

Da Costa-Silva CM, Ambrosano GM, **Jeremias F**, De Souza JF, Mialhe FL.

Int J Paediatr Dent. 2011 Sep;21(5):333-41. doi: 10.1111/j.1365-263X.2011.01128.x. Epub 2011 Apr 6.

MACROSCOPIC AND SCANNING ELECTRON MICROSCOPIC APPEARANCE AND HARDNESS VALUES OF DEVELOPMENTAL DEFECTS IN HUMAN PERMANENT TOOTH ENAMEL

G.W. SUCKLING, D.G.A. NELSON, AND M.J. PATEL
Dental Research Unit, Medical Research Council of New Zealand, P. O. Box 27007, Wellington, New Zealand

Adv Dent Res 3(2):219-233, September, 1989

ABSTRACT

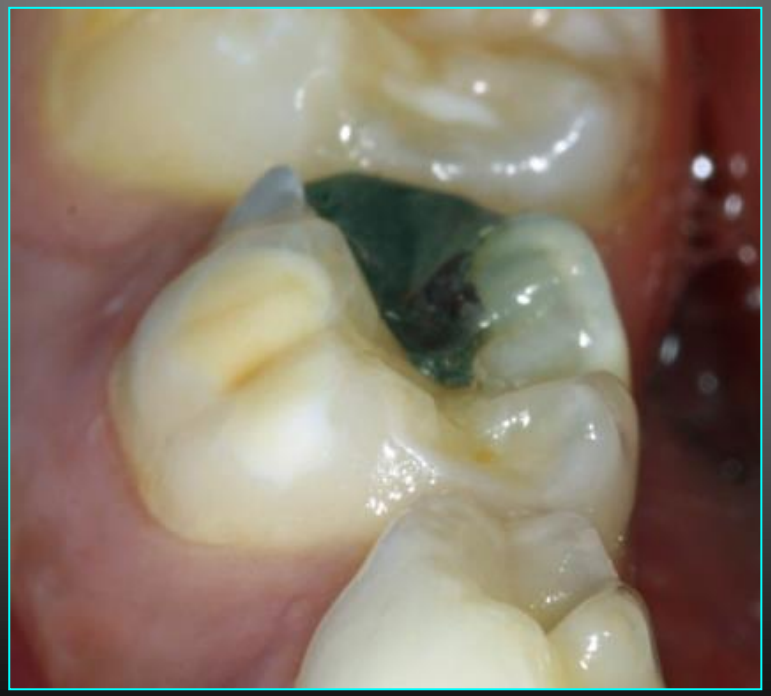
Defects present in 12 human permanent teeth were classified on the basis of their macroscopic appearance as hypoplasia (three teeth), diffuse opacities (three teeth), white demarcated opacities (one tooth but two defects), or yellow demarcated opacities (five teeth but six defects). The hardness values and SEM appearance of the defective enamel were determined after the teeth were sectioned through the lesion(s) and were distinctive for each type of defect. The thin enamel of the hypoplastic lesions was either opaque (with reduced hardness values) or translucent (with near-normal hardness values and sometimes a change in prism orientation external to an incremental line). The enamel of the diffuse and demarcated opacities was of normal thickness. The changes in the macroscopic and SEM appearance, and the reduced hardness values of the diffuse patchy opacities, were restricted to the outer 150 μm of the enamel. The demarcated opacities varied in position and depth, and in places had a clearly marked boundary with the adjacent normal enamel. Hardness values were related to color change, with yellow lesions being softer than white. Although prism direction was normal within demarcated opacities, prism outlines were less distinct. The findings suggest that temporary and permanent dysfunction of ameloblasts can occur in both secretory and maturation phases, influencing the final appearance of the lesion.

Zone d'opacité de l'émail clairement délimitée

Atteint seulement les molaires et incisives permanentes

Étiologie ou cause (uniquement) systémique

2008



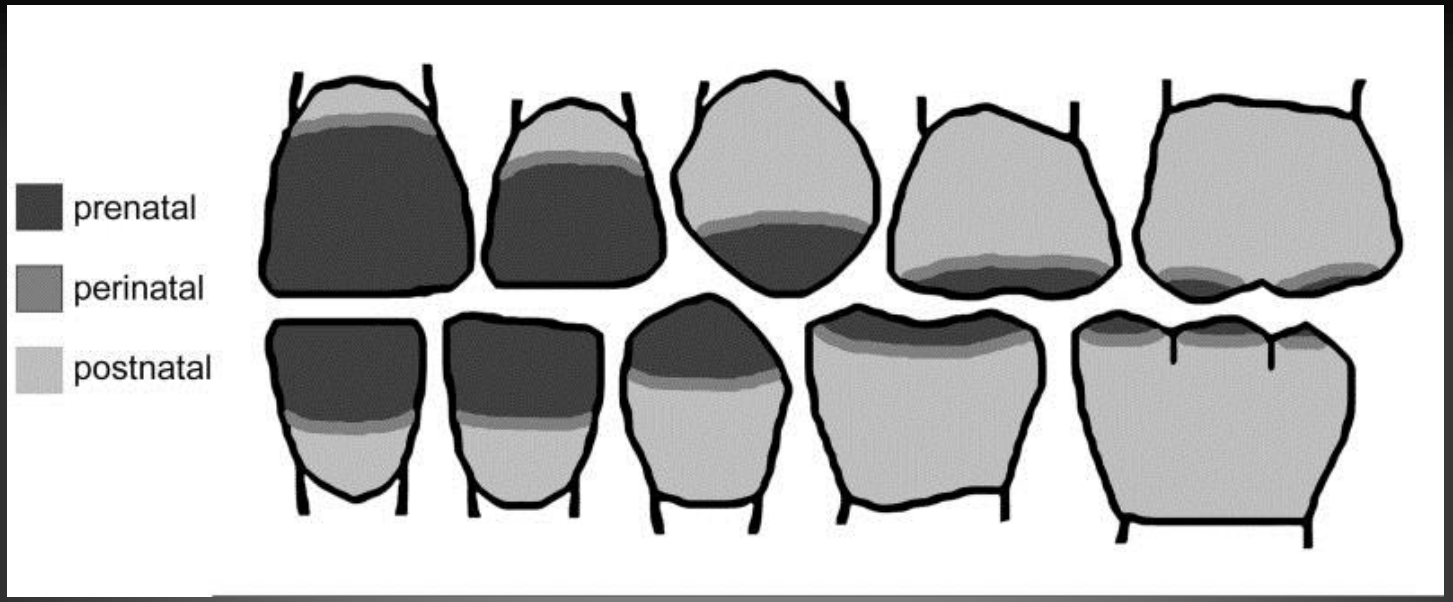
Researchers introduced the term molar hypomineralisation (MH), as a subset of MIH (Chawla et al. 2008; Mangum et al. 2010; Oliver et al. 2014; The D_3G website 2014). Although the first permanent molars are the most commonly and severely affected hypomineralised teeth, these molars are incorporated in the definition of MIH. Further to this, due to the temporal association in coronal mineralisation of the second primary molar with that of the first permanent molar and incisors, diagnosis of MIH-like opacities in the second primary molars (SPM) affecting one to four second primary molars affects up to 9 % of SPM and has been denominated as hypomineralised second primary molar (HSPM) (Elfrink et al. 2008, 2012; Ghanim et al. 2013a).

Deuxièmes molaires primaires également considérées

Association temporale très plausible

Prévalence estimée : 9 %

A practical method for use in epidemiological studies on enamel hypomineralisation.
Ghanim A, Elfrink M, Weerheijm K, Mariño R, Manton D.
Eur Arch Paediatr Dent. 2015 Jun;16(3):235-46. doi: 10.1007/s40368-015-0178-8. Epub 2015 Apr 28.



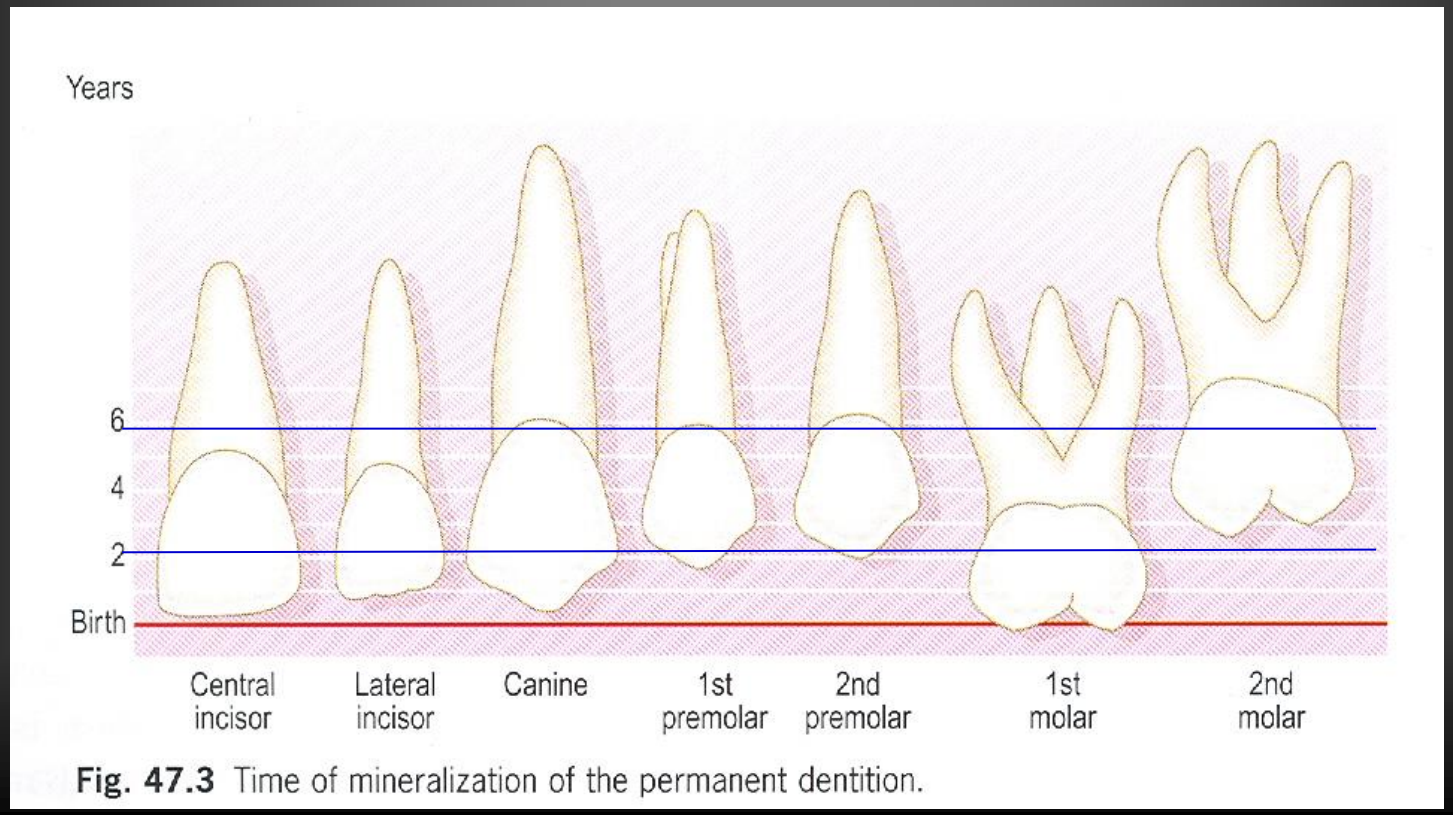
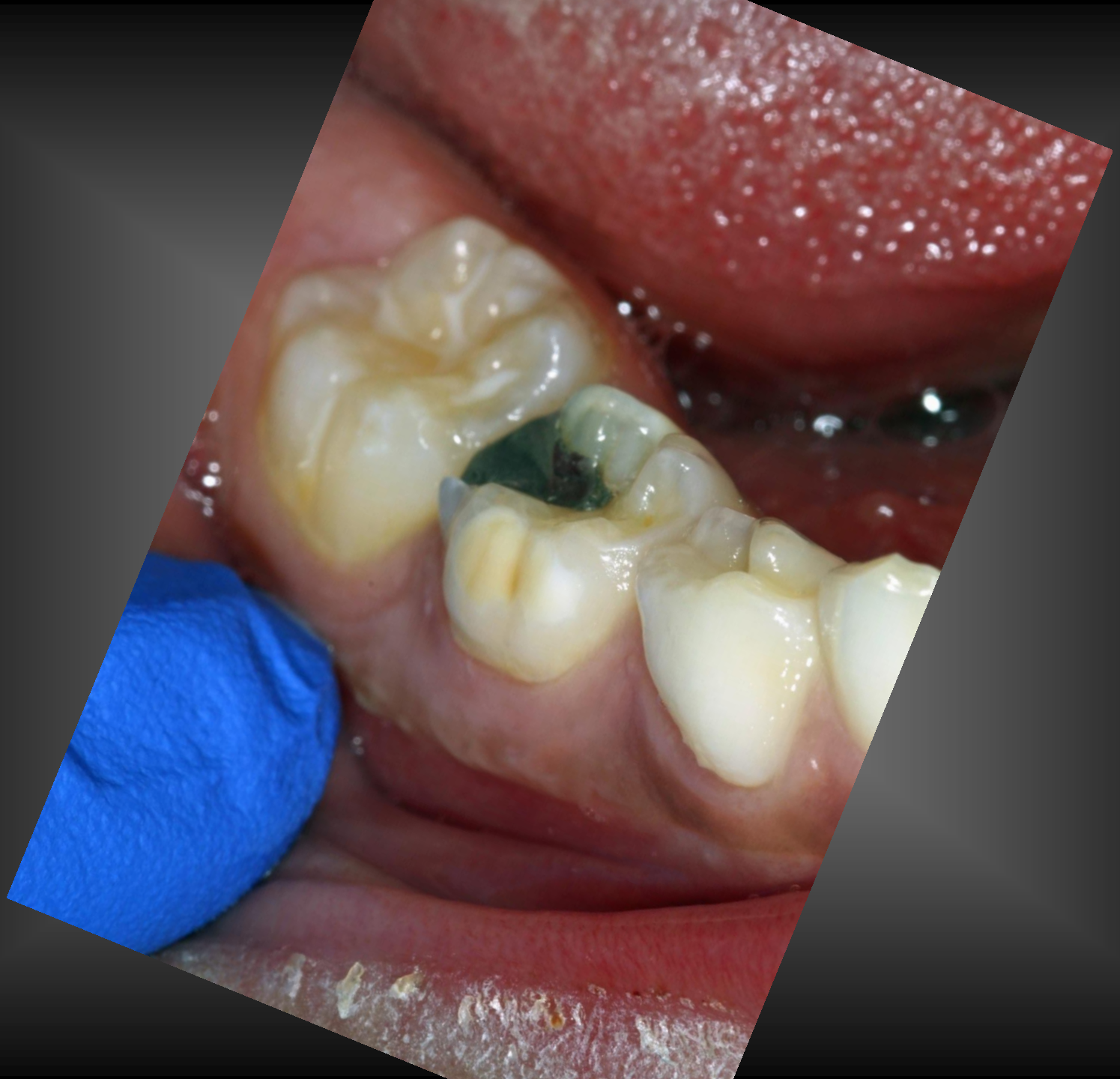
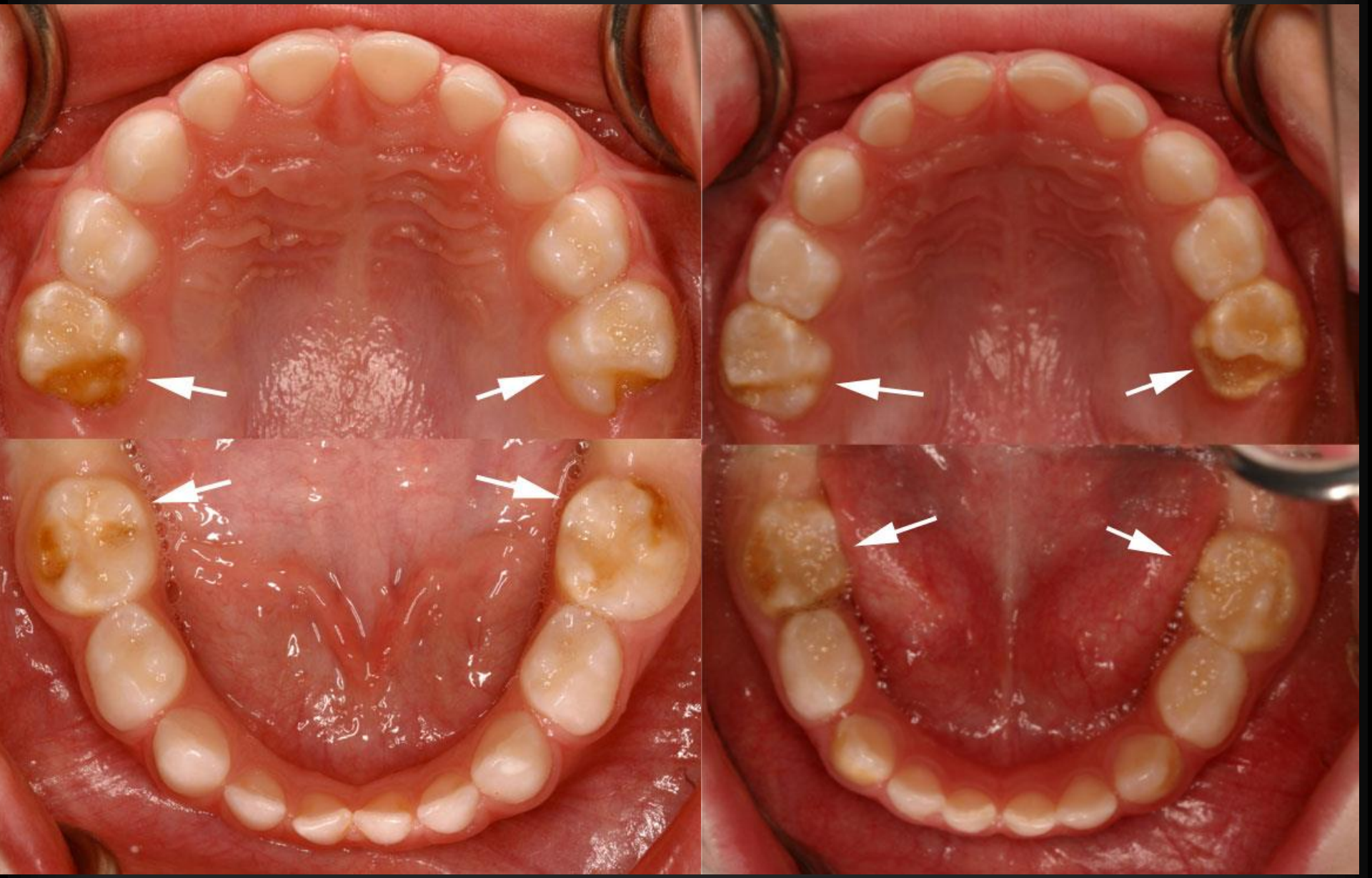


Fig. 47.3 Time of mineralization of the permanent dentition.





http://aapd.org.au/articles/wonky-teeth-molar-hypomineralisation

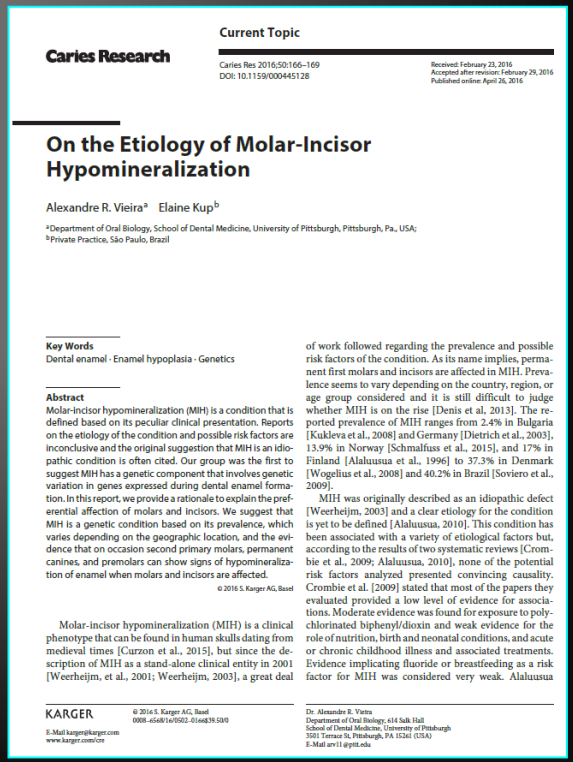
We suggest that

MIH is a genetic condition based on its prevalence, which varies depending on the geographic location, and the evidence that on occasion second primary molars, permanent canines, and premolars can show signs of hypomineralization of enamel when molars and incisors are affected.

On the Variable Clinical Presentation of Molar-Incisor Hypomineralization.

Vieira AR, Manton DJ.

Caries Res. 2019;53(4):482-488. doi: 10.1159/000496542. Epub 2019 Apr 3.



Current Topic

Caries Research

Caries Res 2016;50:166–169
DOI: 10.1159/000445128

Received: February 23, 2016
Accepted after revision: February 29, 2016
Published online: April 26, 2016

On the Etiology of Molar-Incisor Hypomineralization

Alexandre R. Vieira[a] Elaine Kup[b]

[a]Department of Oral Biology, School of Dental Medicine, University of Pittsburgh, Pittsburgh, Pa., USA; [b]Private Practice, São Paulo, Brazil

Key Words
Dental enamel · Enamel hypoplasia · Genetics

Abstract
Molar-incisor hypomineralization (MIH) is a condition that is defined based on its peculiar clinical presentation. Reports on the etiology of the condition and possible risk factors are inconclusive and the original suggestion that MIH is an idiopathic condition is often cited. Our group was the first to suggest MIH has a genetic component that involves genetic variation in genes expressed during dental enamel formation. In this report, we provide a rationale to explain the preferential affection of molars and incisors. We suggest that MIH is a genetic condition based on its prevalence, which varies depending on the geographic location, and the evidence that on occasion second primary molars, permanent canines, and premolars can show signs of hypomineralization of enamel when molars and incisors are affected.

Molar-incisor hypomineralization (MIH) is a clinical phenotype that can be found in human skulls dating from medieval times [Curzon et al., 2015], but since the description of MIH as a stand-alone clinical entity in 2001 [Weerheijm, et al., 2001; Weerheijm, 2003], a great deal of work followed regarding the prevalence and possible risk factors of the condition. As its name implies, permanent first molars and incisors are affected in MIH. Prevalence seems to vary depending on the country, region, or age group considered and it is still difficult to judge whether MIH is on the rise [Denis et al, 2013]. The reported prevalence of MIH ranges from 2.4% in Bulgaria [Kukleva et al., 2008] and Germany [Dietrich et al., 2003], 13.9% in Norway [Schmalfuss et al., 2015], and 17% in Finland [Alaluusua et al., 1996] to 37.3% in Denmark [Wogelius et al., 2008] and 40.2% in Brazil [Soviero et al., 2009].

MIH was originally described as an idiopathic defect [Weerheijm, 2003] and a clear etiology for the condition is yet to be defined [Alaluusua, 2010]. This condition has been associated with a variety of etiological factors but, according to the results of two systematic reviews [Crombie et al., 2009; Alaluusua, 2010], none of the potential risk factors analyzed presented convincing causality. Crombie et al. [2009] stated that most of the papers they evaluated provided a low level of evidence for associations. Moderate evidence was found for exposure to polychlorinated biphenyl/dioxin and weak evidence for the role of nutrition, birth and neonatal conditions, and acute or chronic childhood illness and associated treatments. Evidence implicating fluoride or breastfeeding as a risk factor for MIH was considered very weak. Alaluusua

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On the Variable Clinical Presentation of Molar-Incisor Hypomineralization.

Vieira AR, Manton DJ.

Caries Res. 2019;53(4):482-488. doi: 10.1159/000496542. Epub 2019 Apr 3.

2017

Abstract: ***Purpose:*** *The purpose of this study was to evaluate the prevalence of and relationship between hypomineralized second primary molars (HSPM) and hypomineralized primary canines (HPC) with molar-incisor hypomineralization (MIH) in 1,963 schoolchildren.* ***Methods:*** *The European Academy of Paediatric Dentistry (EAPD) criterion was used for scoring HSPM/HPC and MIH. Only children with four permanent first molars and eight incisors were considered in calculating MIH prevalence (n equals 858); for HSPM/HPC prevalence, only children with four primary second molars (n equals 1,590) and four primary canines (n equals 1,442) were considered. To evaluate the relationship between MIH/HSPM, only children meeting both criteria cited were considered (n equals 534), as was true of MIH/HPC (n equals 408) and HSPM/HPC (n equals 360; chi-square test and logistic regression).* ***Results:*** *The prevalence of MIH was 14.69 percent (126 of 858 children). For HSPM and HPC, the prevalence was 6.48 percent (103 of 1,592) and 2.22 percent (32 of 1,442), respectively. A significant relationship was observed between MIH and both HSPM/HPC (P<0.001). The odds ratio for MIH based on HSPM was 6.31 (95 percent confidence interval [CI] equals 2.59 to 15.13) and for HPC was 6.02 (95 percent CI equals 1.08 to 33.05).* ***Conclusion:*** *The results led to the conclusion that both hypomineralized second primary molars and hypomineralized primary canines are associated with molar-incisor hypomineralization, because children with HSPM/HPC are six times more likely to develop MIH.* *(Pediatr Dent 2017;39(7):445-9) Received May 2, 2017 | Last Revision July 17, 2017 | Accepted July 18, 2017*

children with HSPM/HPC are six times more likely to develop MIH.

PEDIATRIC DENTISTRY V 39 | NO 7 NOV | DEC 17

CROSS-SECTIONAL STUDY

Are Hypomineralized Primary Molars and Canines Associated with Molar-Incisor Hypomineralization?

Maria Jose da Silva Figueiredo Sé, DDS, MS[1] • Ana Paula Dias Ribeiro, DDS, MS, PhD[2] • Lourdes Aparecida Martins dos Santos-Pinto, DDS, MS, PhD[3] Rita de Cassia Loiola Cordeiro, DDS, MS, PhD[4] • Renata Nunes Cabral, DDS, MS[5] • Soraya Coelho Leal, DDS, MS, PhD[6]

Abstract: ***Purpose:*** *The purpose of this study was to evaluate the prevalence of and relationship between hypomineralized second primary molars (HSPM) and hypomineralized primary canines (HPC) with molar-incisor hypomineralization (MIH) in 1,963 schoolchildren.* ***Methods:*** *The European Academy of Paediatric Dentistry (EAPD) criterion was used for scoring HSPM/HPC and MIH. Only children with four permanent first molars and eight incisors were considered in calculating MIH prevalence (n equals 858); for HSPM/HPC prevalence, only children with four primary second molars (n equals 1,590) and four primary canines (n equals 1,442) were considered. To evaluate the relationship between MIH/HSPM, only children meeting both criteria cited were considered (n equals 534), as was true of MIH/HPC (n equals 408) and HSPM/HPC (n equals 360; chi-square test and logistic regression).* ***Results:*** *The prevalence of MIH was 14.69 percent (126 of 858 children). For HSPM and HPC, the prevalence was 6.48 percent (103 of 1,592) and 2.22 percent (32 of 1,442), respectively. A significant relationship was observed between MIH and both HSPM/HPC (P<0.001). The odds ratio for MIH based on HSPM was 6.31 (95 percent confidence interval [CI] equals 2.59 to 15.13) and for HPC was 6.02 (95 percent CI equals 1.08 to 33.05).* ***Conclusion:*** *The results led to the conclusion that both hypomineralized second primary molars and hypomineralized primary canines are associated with molar-incisor hypomineralization, because children with HSPM/HPC are six times more likely to develop MIH.* *(Pediatr Dent 2017;39(7):445-9) Received May 2, 2017 | Last Revision July 17, 2017 | Accepted July 18, 2017*

KEYWORDS: TOOTH DEMINERALIZATION, CHILD, ORAL HEALTH, DECIDUOUS TOOTH

Molar-incisor hypomineralization (MIH) is defined as a developmental enamel defect that affects at least one permanent first molar. Affected anterior teeth might also be observed.[1] MIH prevalence varies according to the population studied, ranging from very low values (2.5 percent) in China[2] to a prevalence higher than 40 percent in Australia[3] and Brazil.[4] Such differences cannot be explained only by differences in the population studied; they are also affected by the lack of standardization in the research protocols.[5]

MIH is characterized by demarcated opacities that vary from white to a brownish color and which may progress to a posteruptive enamel breakdown.[6] In the most severely affected individuals, dentin will be exposed. Histologically, the MIH opacity is more porous than sound enamel[7] because of its lower mineral density, and porosity increases from white to brown according to the opacity color.[8] Clinically, this porosity makes MIH opacities more prone to breakdown; also, the treatment is more challenging, because the porous enamel is a barrier to optimal bonding to adhesive materials.[9] To make treatment even more complicated, hypersensitivity is a frequent complaint of patients affected by MIH.[1] A subclinical, but constant, pulp inflammation is present under the opaque area[10] because of that, pain control using local anesthesia might fail.

Children who are affected by MIH receive more invasive treatments than those who are not affected.[11] Therefore, as soon as MIH is diagnosed, children should be placed under a strict preventive program to avoid cavity development in any posteruptive enamel and the necessity for more complex restorative procedures. Therefore, if the clinical characteristics of the primary dentition could predict the occurrence of MIH in the permanent dentition, the dentist might be able to control recall intervals and advise parents of the importance of seeing the child as soon as the permanent first molar erupts.

The prevalence of hypomineralized second primary molars (HSPM) shows a great variation ranging from zero percent[12] to 21.8 percent[13] and an association with MIH.[14,15] However, most studies were conducted in Europe, and there is no information about prevalence of MIH in primary teeth in children from North or South America. Moreover, whether the presence of demarcated opacities in the primary canines is also associated with MIH is unknown, as the studies available report only on primary second molars.

Therefore, the purposes of this study were to: (1) determine the prevalence of hypomineralized second primary molars and hypomineralized primary canines (HPC); and (2) investigate whether an association existed between their occurrence and the occurrence of molar-incisor hypomineralization in a group of Brazilian schoolchildren.

Methods

This study was approved by the Research Ethics Committee of the Faculty of Health Science of the University of Brasília, Brasília, Brazil and authorized by the Department of Education of the local government.

A cross-sectional epidemiological study was carried out among six- to 11-year-olds from all six public schools located in a suburban area of Brazil's Federal District (n equals 1,963). Children and their parents were invited to participate, and all those who signed the informed consent were included in

Drs. Sé and Cabral are PhD students and Dr. Leal is a full professor, Department of Dentistry, Faculty of Health Sciences, University of Brasília, Campus Darcy Ribeiro, Asa Norte, Brasília, Brasil; Dr. Ribeiro is a clinical assistant professor, Department of Restorative Dental Sciences, College of Dentistry, University of Florida, Gainesville, Fla., USA; and Drs. Santos-Pinto and Cordeiro are full professors, Department of Pediatric Dentistry and Orthodontics, Araraquara School of Dentistry, Universidade Estadual Paulista, Araraquara, São Paulo, Brasil.
Correspond with Dr. Leal at sorayacl@yahoo.com

Are Hypomineralized Primary Molars and Canines Associated with Molar-Incisor Hypomineralization?

da Silva Figueiredo Sé MJ, Ribeiro APD, Dos Santos-Pinto LAM, de Cassia Loiola Cordeiro R, **Cabral RN**, Leal SC.

Pediatr Dent. **2017** Nov 1;39(7):445-449.

Methods: A total of 693 children enrolled in an ongoing birth cohort study (GINIplus-10) were examined at their 10-year follow-up. Enamel hypomineraliza-

Allemagne

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Proportion and extent of manifestation of molar-incisor-hypomineralizations according to different phenotypes

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2 Helmholtz Zentrum of Munich, German Research Centre for Environmental Health, Institute of Epidemiology, Neuherberg, Germany
3 Institute of Medical Data Management, Biometrics and Epidemiology, Ludwig-Maximilians-University of Munich, Munich, Germany
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8 Bioscience Research Center, College of Dentistry, University of Tennessee, Memphis, TN, USA

Keywords
molar incisor hypomineralization; tooth hypomineralization; dental enamel; epidemiology; proportion.

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doi: 10.1111/j.1752-7325.2012.00365.x

Journal of Public Health Dentistry **74** (2014) 42–49

Abstract

Objective: This epidemiological study aimed to assess the proportion and extent of manifestation of enamel hypomineralization, including molar-incisor-hypomineralization (MIH), in the permanent and primary dentition.
Methods: A total of 693 children enrolled in an ongoing birth cohort study (GINIplus-10) were examined at their 10-year follow-up. Enamel hypomineralization was scored in the primary and permanent dentition on a tooth- and surface-related level based on the criteria of the European Academy of Paediatric Dentistry (EAPD). Children were grouped according to their distribution pattern of enamel hypomineralization: children with a minimum of one hypomineralized tooth in the primary dentition (ht ≥ 1) and permanent dentition (HT ≥ 1); with a minimum of one hypomineralization on at least one first permanent molar (MIH); and with hypomineralization on at least one first permanent molar and permanent incisor (M + IH). For each group, the mean values of hypomineralized primary teeth (ht), permanent teeth (HT), and permanent surfaces (HS) were calculated.
Results: The proportion of affected children was 36.5 percent (HT ≥ 1), 14.7 percent (MIH), and 9.4 percent (M + IH); 6.9 percent of the subjects had a minimum of one affected primary tooth (ht ≥ 1). The mean number of hypomineralized permanent teeth and surfaces were 2.3HT/2.9HS (HT ≥ 1), 3.4HT/4.8HS (MIH), and 4.2HT/5.9HS (M + IH). The mean number of hypomineralized primary teeth amounted to 0.1ht in the entire study population.
Conclusions: Enamel hypomineralization can be detected frequently in this study sample. Children with M + IH showed the highest number of affected teeth and surfaces followed by those with MIH.

693 enfants

Dentition permanente

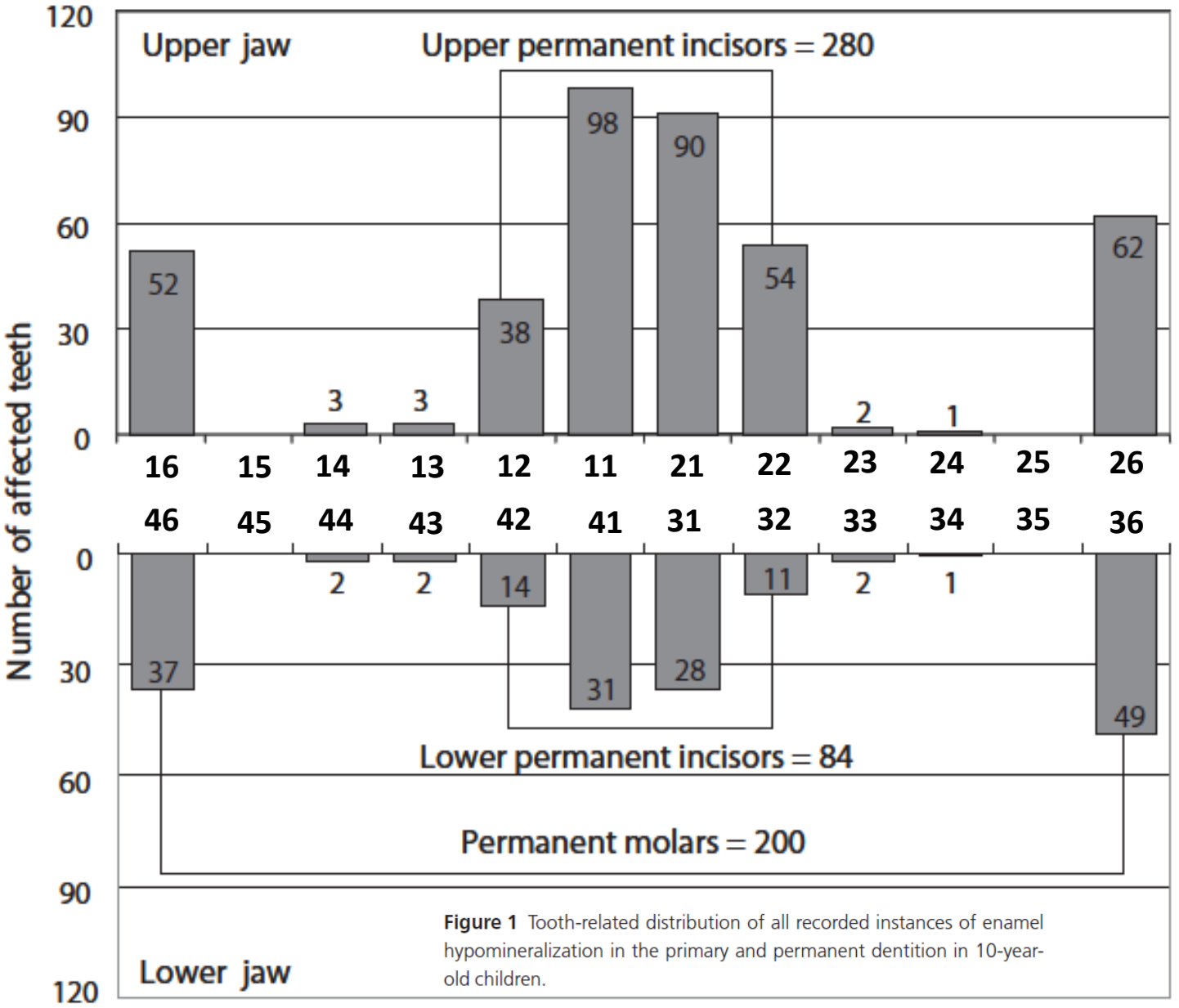

Figure 1 Tooth-related distribution of all recorded instances of enamel hypomineralization in the primary and permanent dentition in 10-year-old children.

693 enfants

Dentition primaire

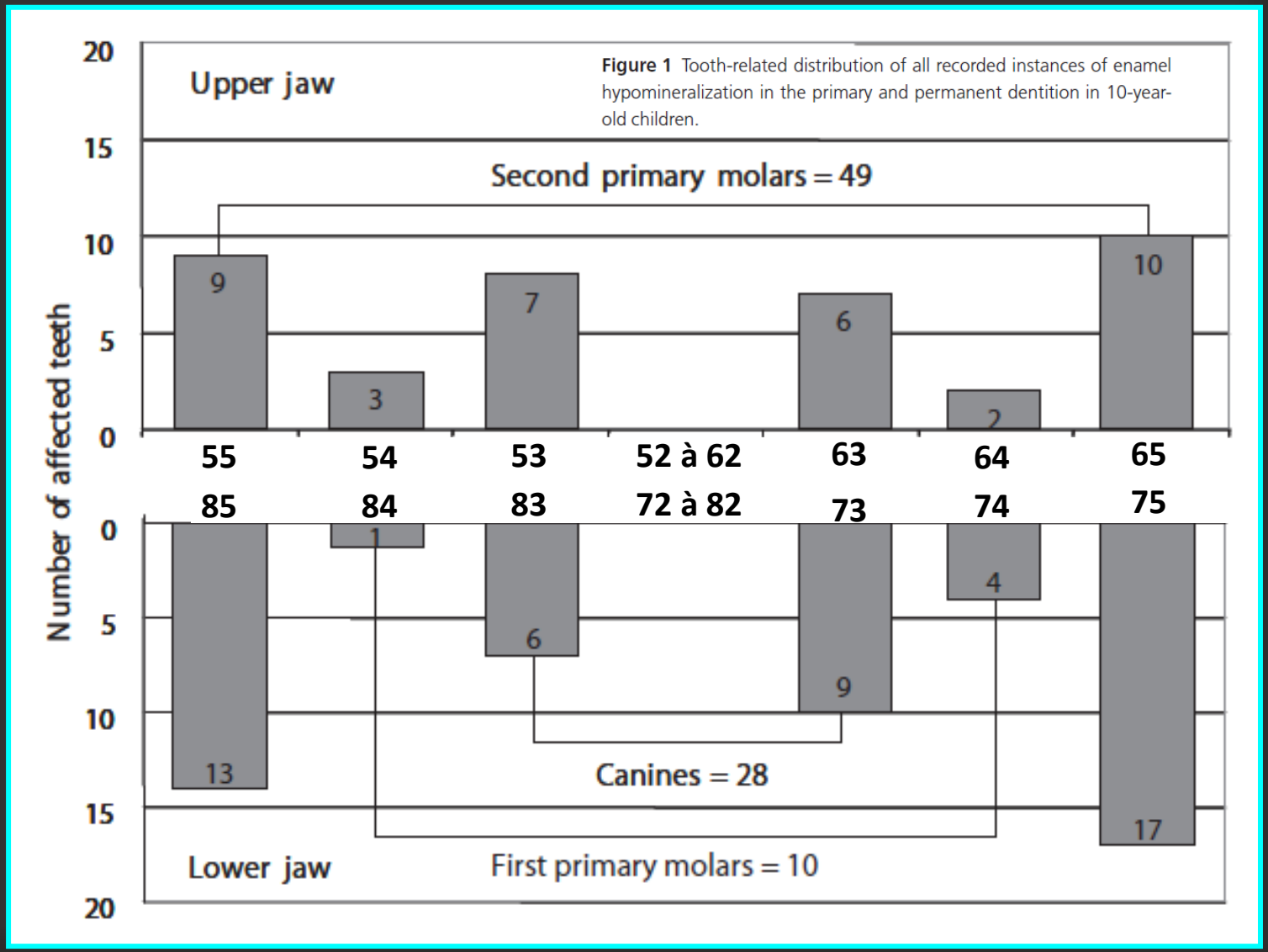

Figure 1 Tooth-related distribution of all recorded instances of enamel hypomineralization in the primary and permanent dentition in 10-year-old children.

Phenotypes of Enamel Hypomineralization and Molar Incisor Hypomineralization in Permanent Dentition: Identification, Quantification and Proposal for Classification

Neeti Mittal*

The study population comprised of 12-16 year old school children of optimally fluoridated area (1 ppm) Gautam Budh Nagar, Uttar Pradesh, India[10].

employed t-test, chi square tests and ANOVA. Results: Overall prevalence of affected subjects was 13.21% (228/1726) and 9.79% (169/1726) for enamel hypomineralization and MIH respectively. A total of 4.36±3.45

Study Design: *This cross sectional observational study recruited a random sample of 1726, 12-16 year olds. Enamel hypomineralization was scored on all teeth by a calibrated examiner using the*

MIH severity

Conclusion: *Enamel hypomineralization can manifest in any tooth in five phenotypic variations in permanent dentition with varying extent and severity.*

(FPMs) and frequently involving permanent incisors (PIs) as well.[2] According to European Academy of Paediatric Dentistry (EAPD 2003) diagnostic criteria MIH is diagnosed if either of demarcated opacity, enamel breakdown or atypical restoration is identified on any of the FPMs.[3] The index teeth include FPMs and PIs while rest

*Neeti Mittal is Assistant Professor at Department of Pediatric and Preven-

Phenotypes of Enamel Hypomineralization and Molar Incisor Hypomineralization in Permanent Dentition: Identification, Quantification and Proposal for Classification.

Mittal N.

J Clin Pediatr Dent. **2016**;40(5):367-74. doi: 10.17796/1053-4628-40.5.367.

Atelier lors du 12e Congrès de l'EAPD tenu à Sopot, Pologne, en 2014

Eur Arch Paediatr Dent. 2015 Jun;16(3):235-46. doi: 10.1007/s40368-015-0178-8. Epub 2015 Apr 28.

A practical method for use in epidemiological studies on enamel hypomineralisation.

Ghanim A[1], Elfrink M, Weerheijm K, Mariño R, Manton D.

Examination Date __/____/_____

Subject's ID_____Subject's Name _____Age_____DOB____/____/_____Gender_____

	MAXILLA RIGHT		55	54	53	52	51	61	62	63	64	65	MAXILLA LEFT	
Surface	17	16	15	14	13	12	11	21	22	23	24	25	26	27
Buccal (labial)														
Occlusal (incisal)														
Palatal														

	MANDIBLE RIGHT		85	84	83	82	81	71	72	73	74	75	MANDIBLE LEFT	
Surface	47	46	45	44	43	42	41	31	32	33	34	35	36	37
Buccal (labial)														
Occlusal (incisal)														
Lingual														

Eur Arch Paediatr Dent. 2015 Jun;16(3):235-46. doi: 10.1007/s40368-015-0178-8. Epub 2015 Apr 28.

A practical method for use in epidemiological studies on enamel hypomineralisation.

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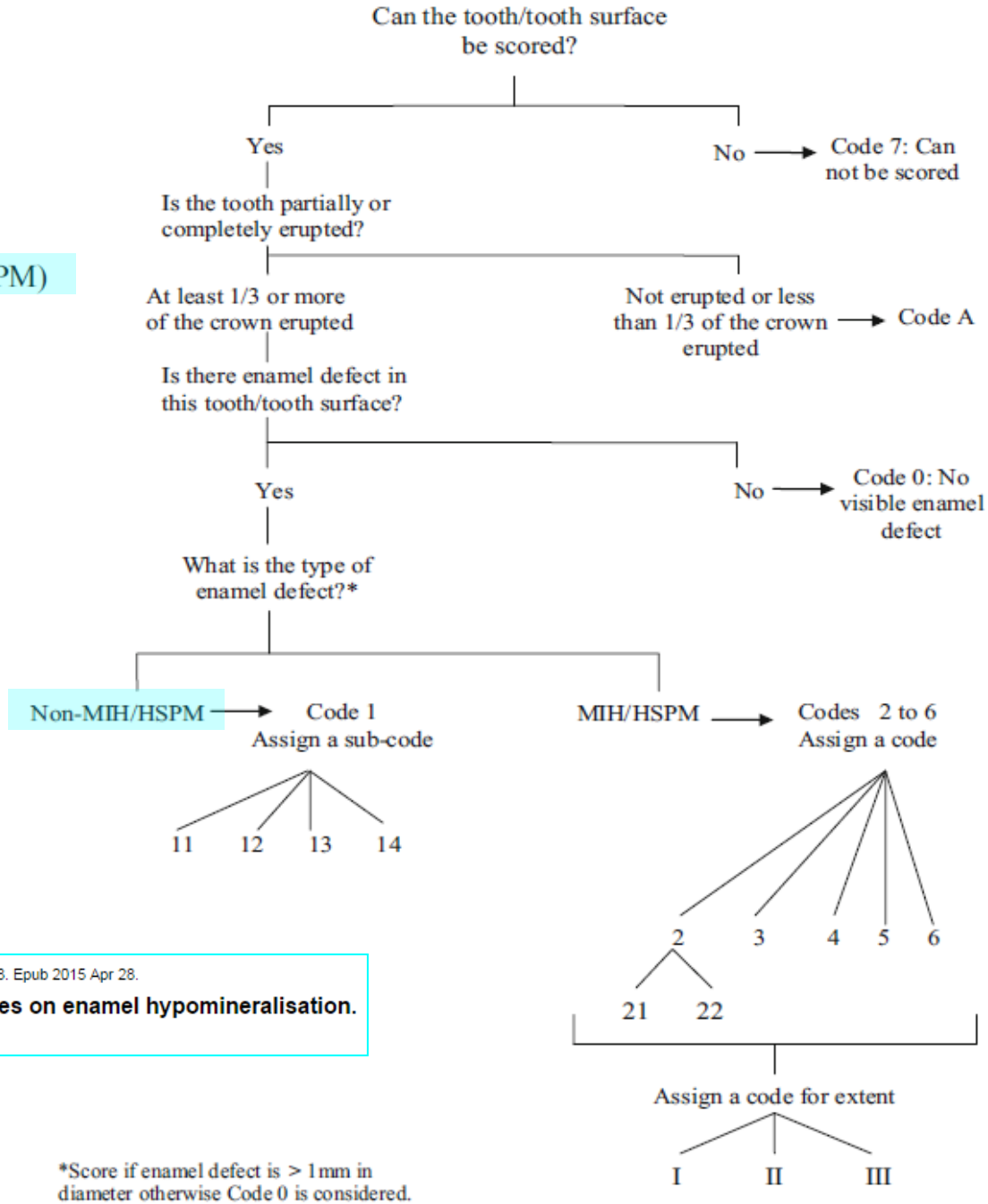
Clinical status criteria

0 = No visible enamel defect.
1 = Enamel defect, non-MIH/HSPM
  11 = diffuse opacities
  12= hypoplasia
  13 = amelogenesis imperfecta
  14= hypomineralisation defect (not MIH/HSPM)
2 = demarcated opacities
  21 = White or creamy demarcated opacities
  22 = Yellow or brown demarcated opacities
3 = Post-eruptive enamel breakdown (PEB)
4 = Atypical restoration
5 = Atypical caries
6 = Missing due to MIH/HSPM
7 = Cannot be scored*



*Score if enamel defect is > 1mm in diameter otherwise Code 0 is considered.

Eur Arch Paediatr Dent. 2015 Jun;16(3):235-46. doi: 10.1007/s40368-015-0178-8. Epub 2015 Apr 28.

A practical method for use in epidemiological studies on enamel hypomineralisation.

Ghanim A[1], Elfrink M, Weerheijm K, Mariño R, Manton D.

Avantages

1. Tous les défauts de l'émail dont l'apparence est identique aux cas de MIH sont considérés

2. Permet une classification distincte des défauts de l'émail dont l'apparence est identique aux cas de MIH

3. Permet d'apprécier la sévérité des cas de MIH en termes de niveau de destruction de l'émail et de l'étendue de surface atteinte

4. Deux versions utiles : l'une abrégée, l'autre très détaillée

5. Toutes les dents, primaires et permanentes, sont considérées

Désavantages

1. Validité et fiabilité de cet indicateur à valider suffisamment

2. Calibrage complexe … voire problématique ?

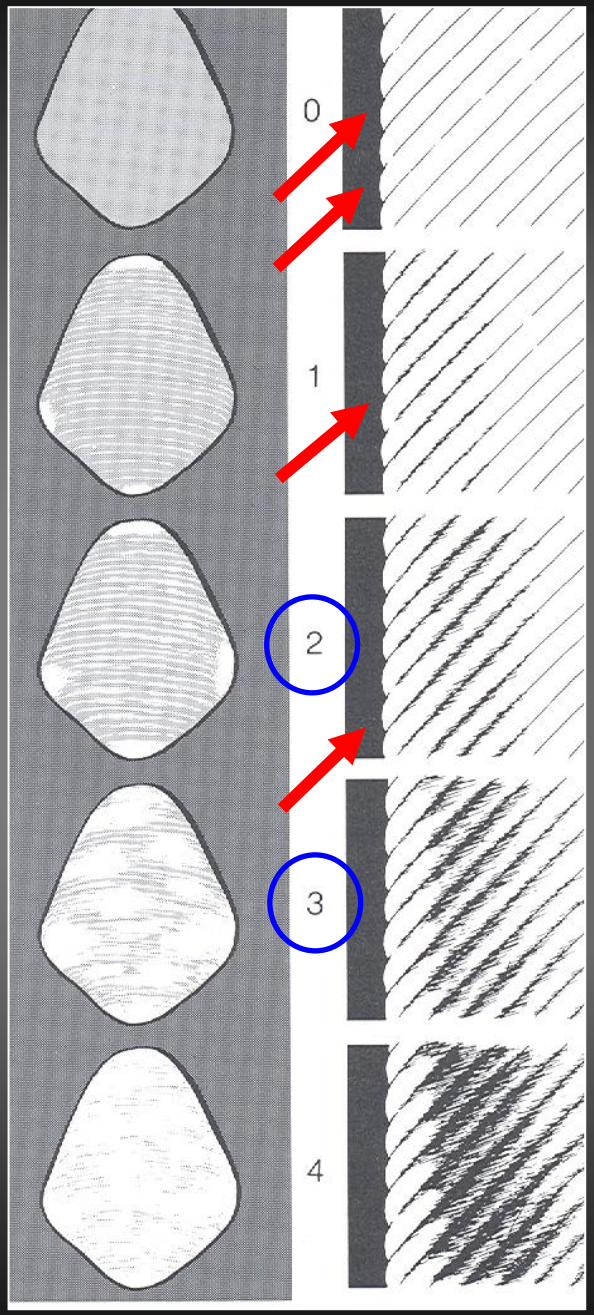
- Zone d'opacité de l'émail clairement délimitée
- Atteint seulement les molaires et incisives permanentes
- Étiologie ou cause (uniquement) systémique

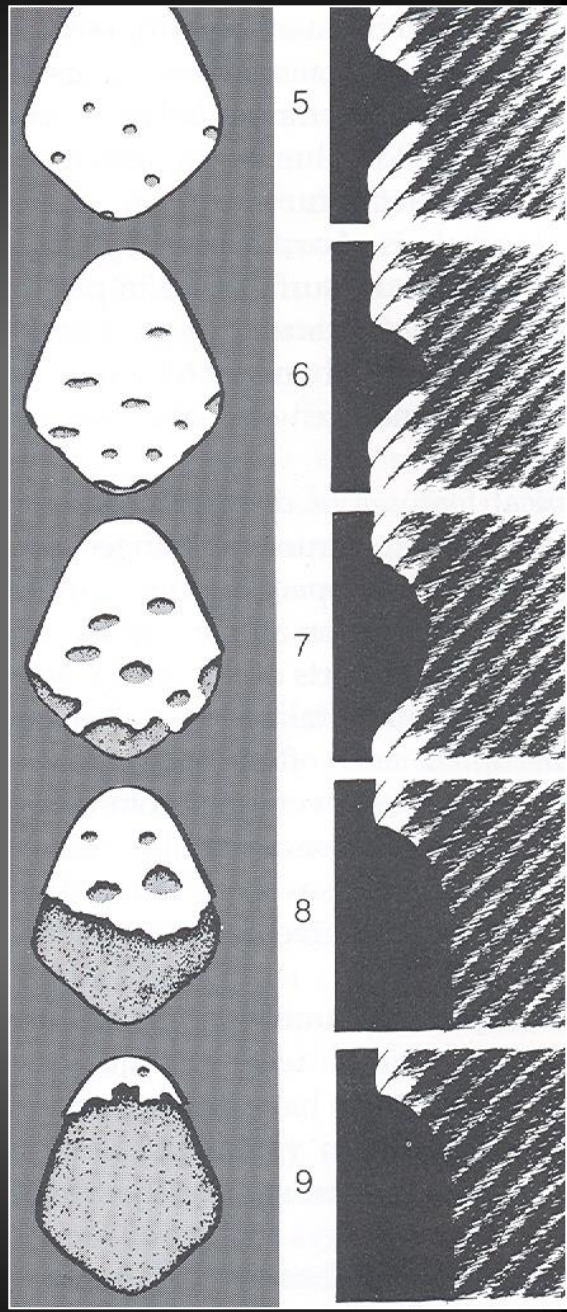
FLUOROSE DENTAIRE

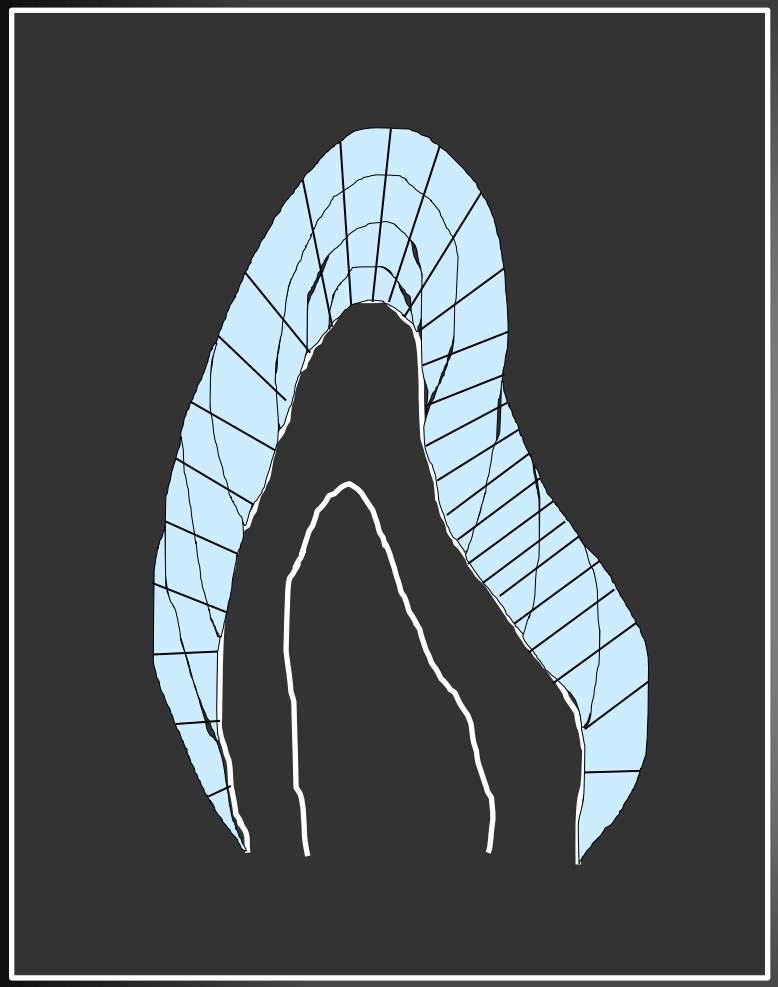
En dentirion permanente, la fluorose dentaire suit les lignes de périkématies

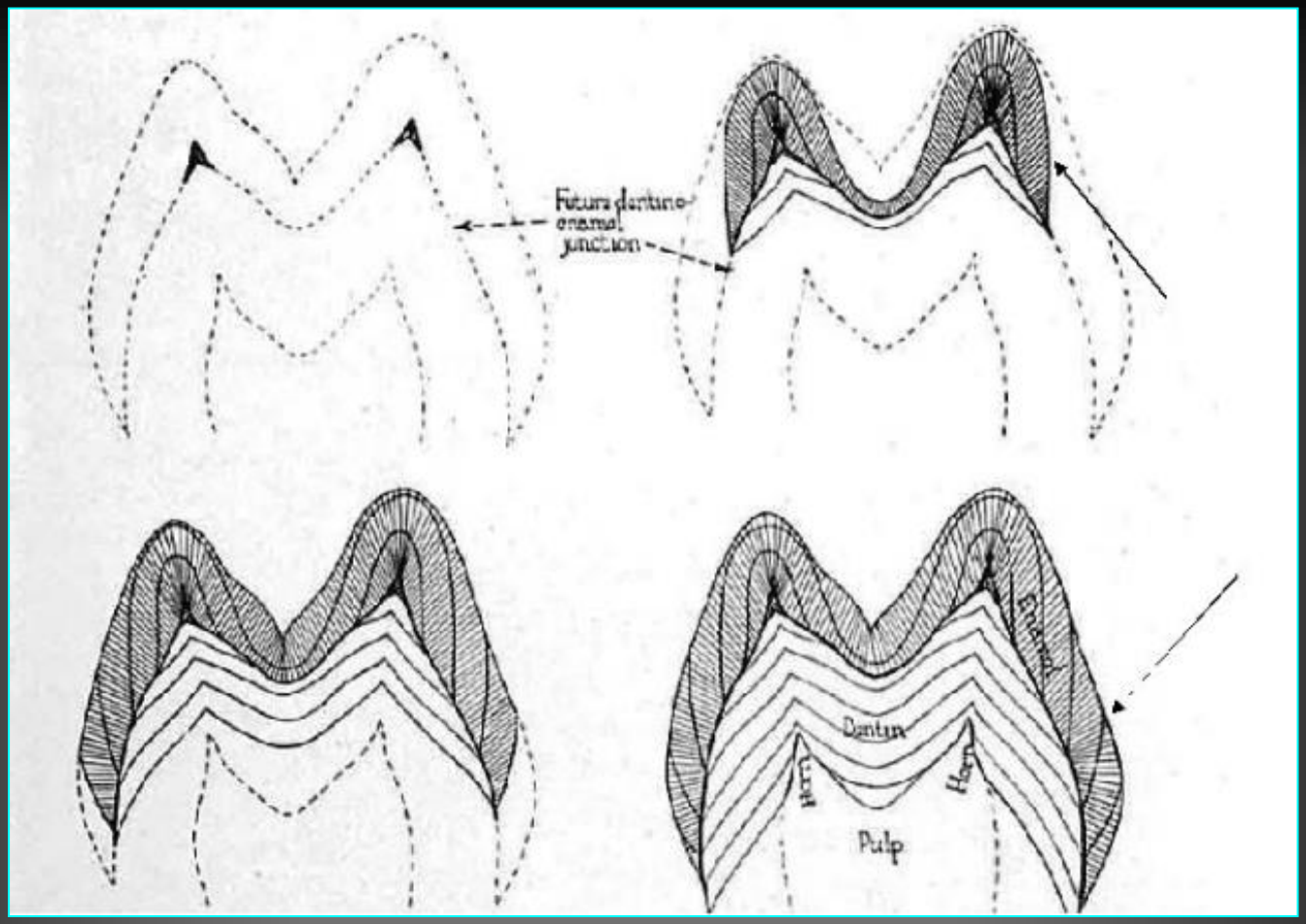
The opaque white lines are more pronounced and frequently merge to form small cloudy areas scattered over the whole surface. "Snow-capping" of incisal edges and cusp tips is common.

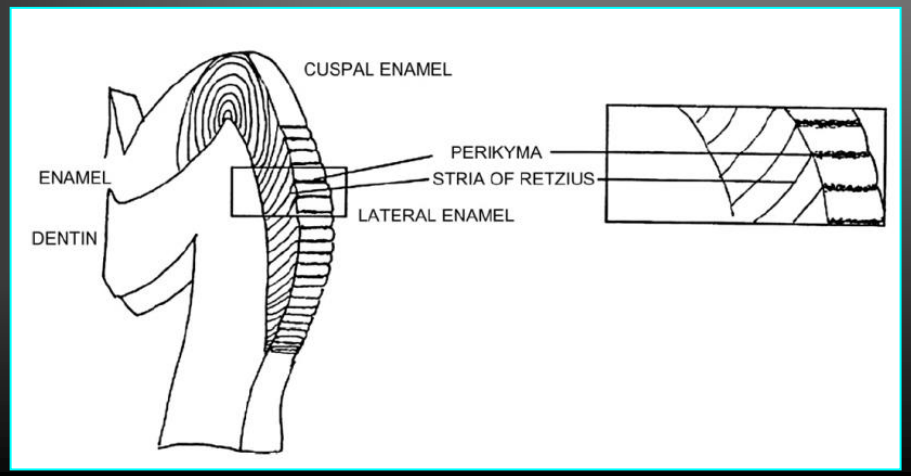
Merging of the white lines occurs, and cloudy areas of opacity occur spread over many parts of the surface. In between the cloudy areas white lines can also be seen.

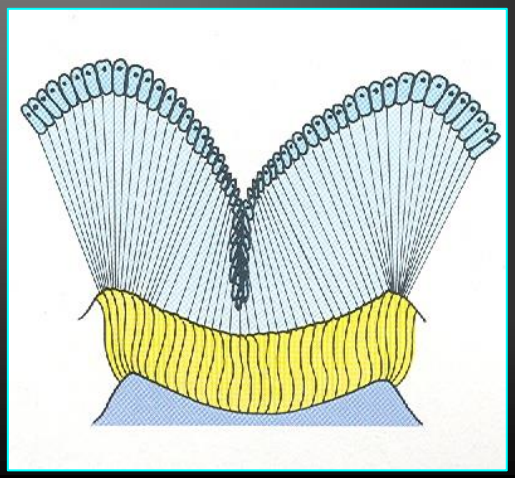






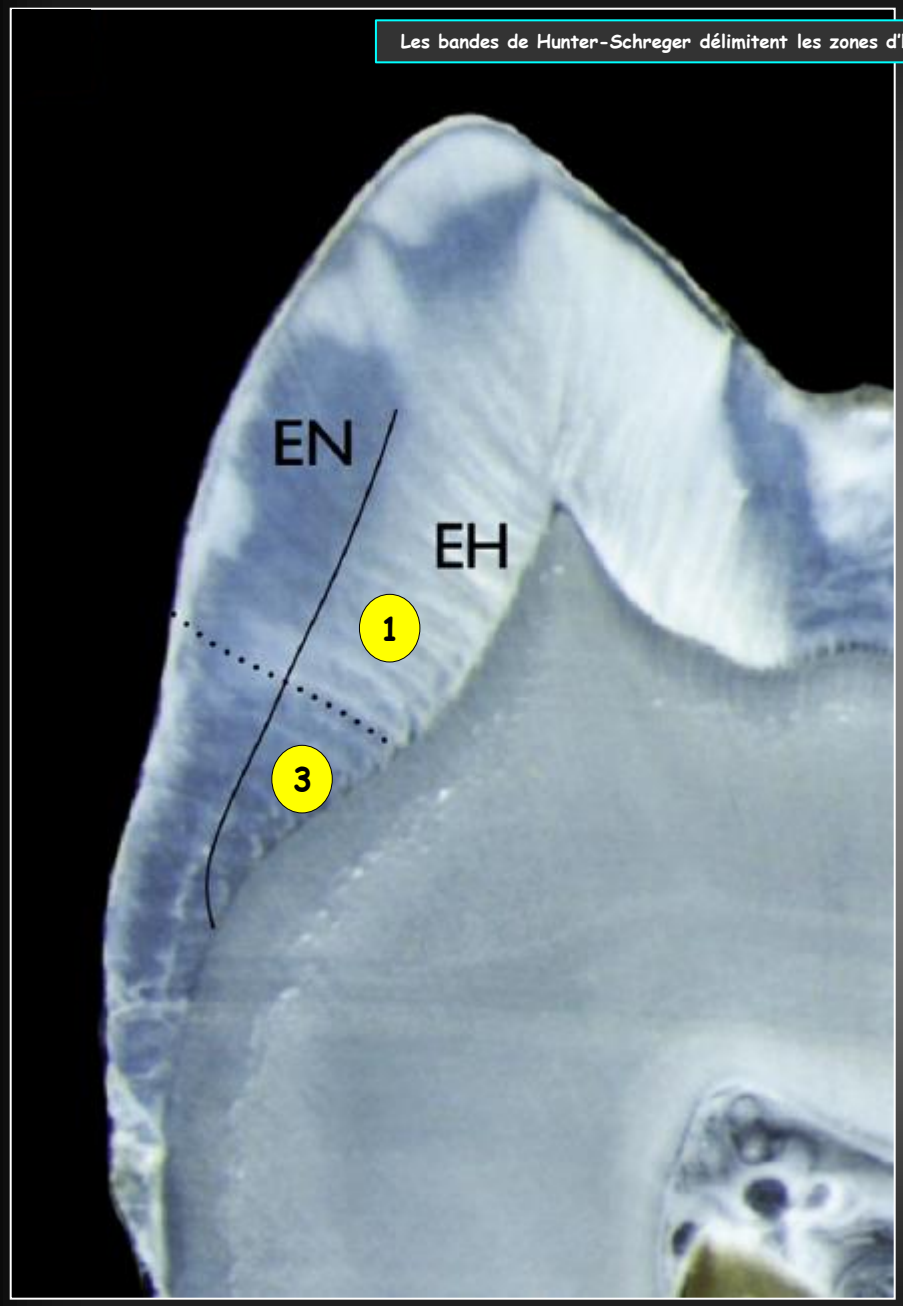

Future dentino-enamel junction
Enamel
Dentin
Horn
Horn
Pulp


CUSPAL ENAMEL
ENAMEL
DENTIN
PERIKYMA
STRIA OF RETZIUS
LATERAL ENAMEL

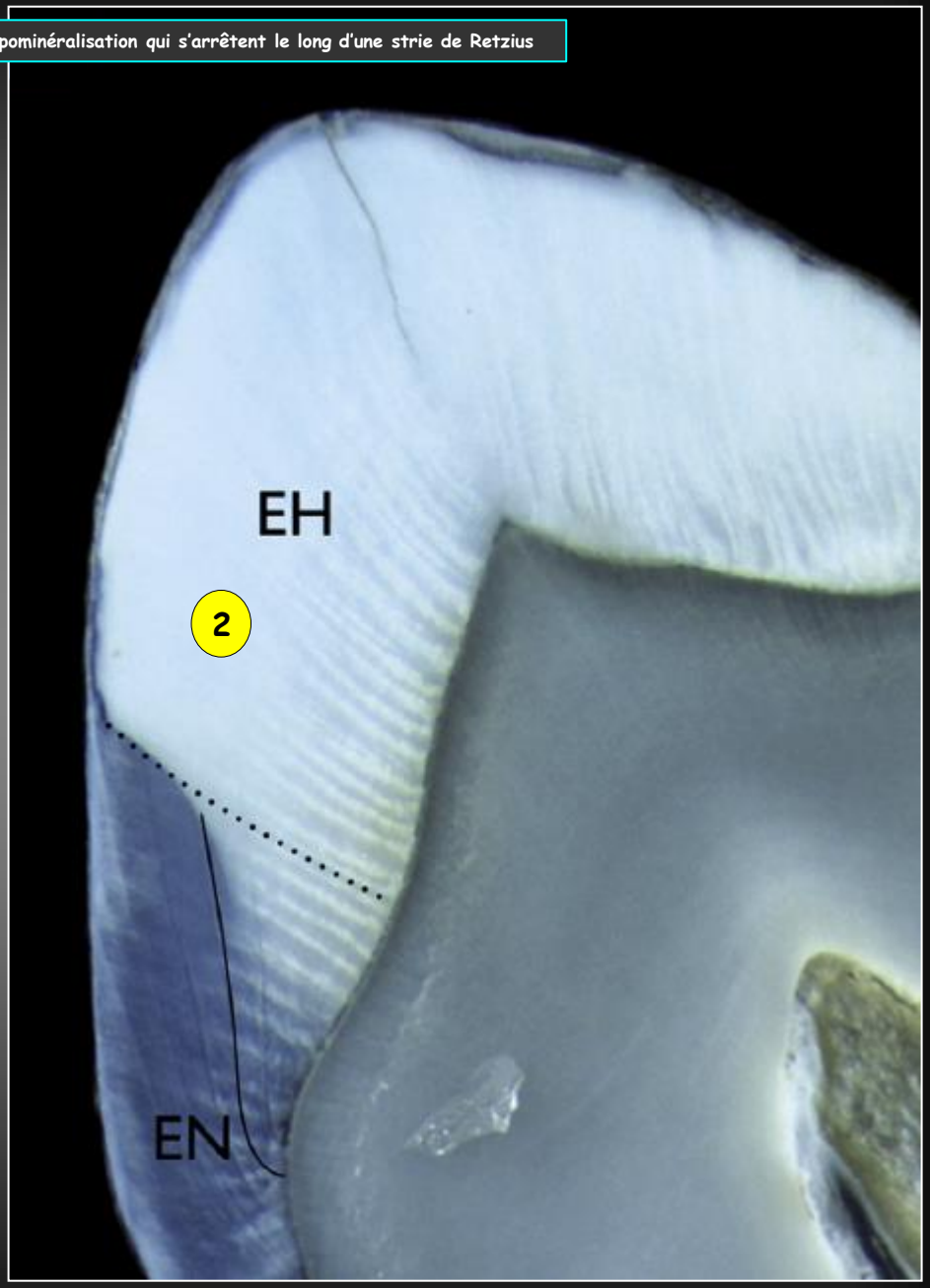


EN = Émail Normal EH = Émail Hypominéralisé (> 5 %) ..... Bandes de Hunter-Schreger ——— Strie de Retzius

Les bandes de Hunter-Schreger délimitent les zones d'hypominéralisation qui s'arrêtent le long d'une strie de Retzius



Lorsque l'impact esthétique est léger, seul les couches profondes de l'émail sont hypominéralisées



Lorsque l'impact esthétique est élevé, la majeure partie de l'émail est hypominéralisé

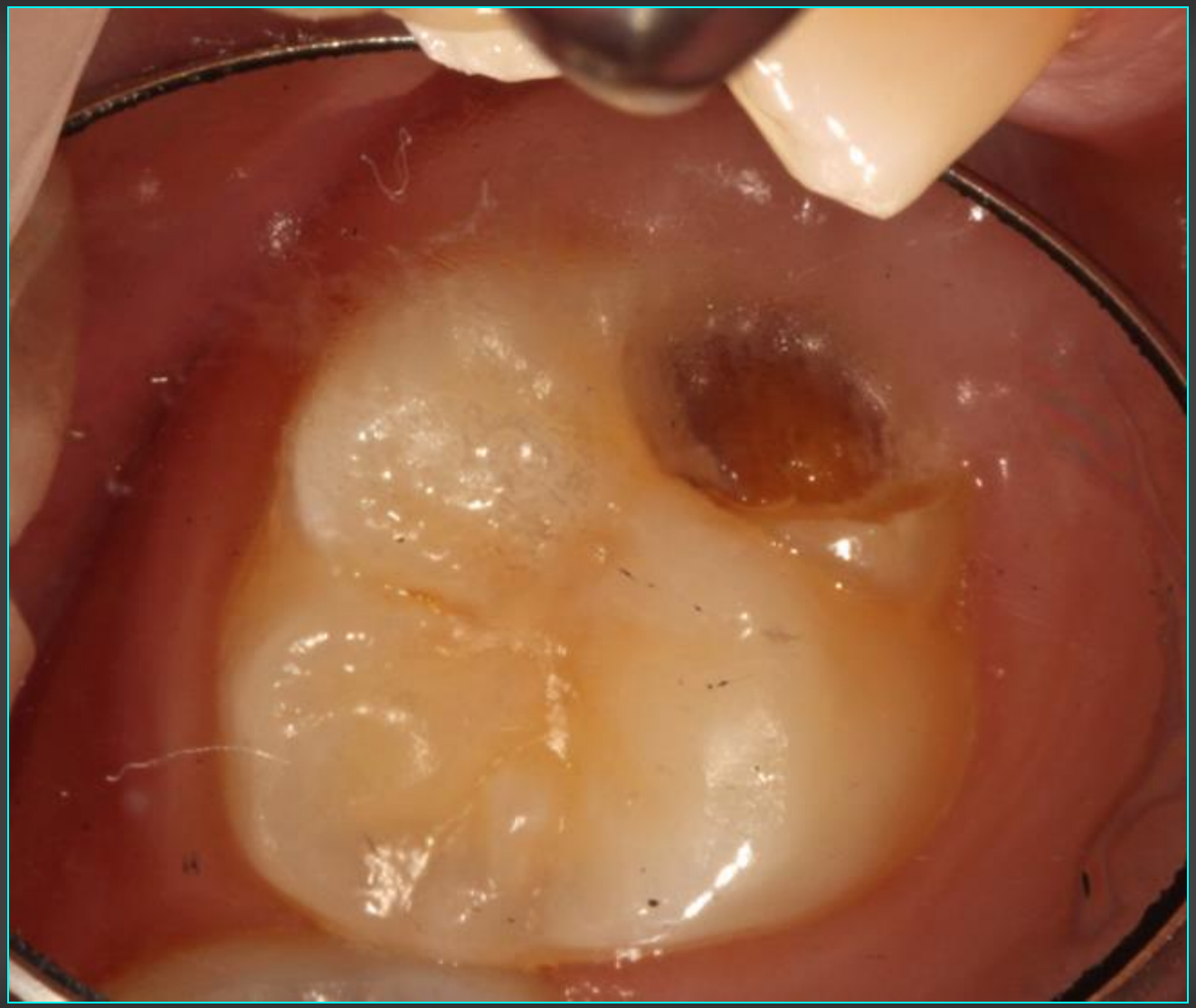
PLAN

1. Introduction
2. Importance relative de ce problème de santé buccodentaire
3. MIH … mythes et réalités
4. Observations cliniques intrigantes
5. Étiologie et facteurs de risque
6. MIH … Rôles possibles de la santé publique

QUELLE PHOTO VOUS INTRIQUE LE PLUS ?

POURQUOI ?


1

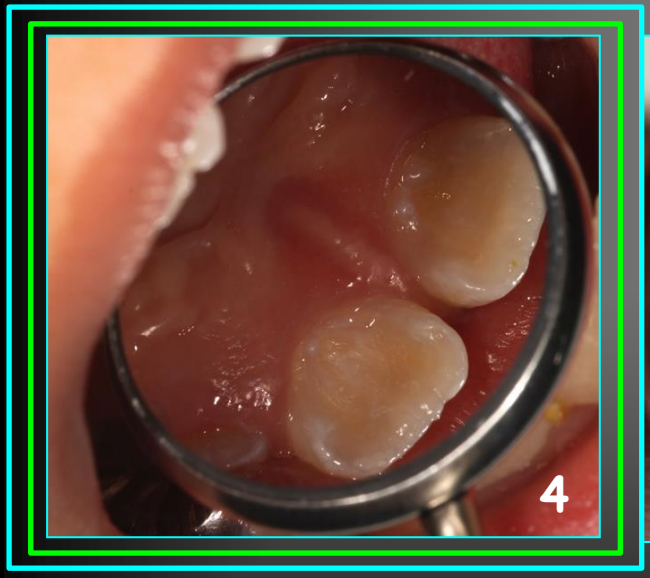



5


1

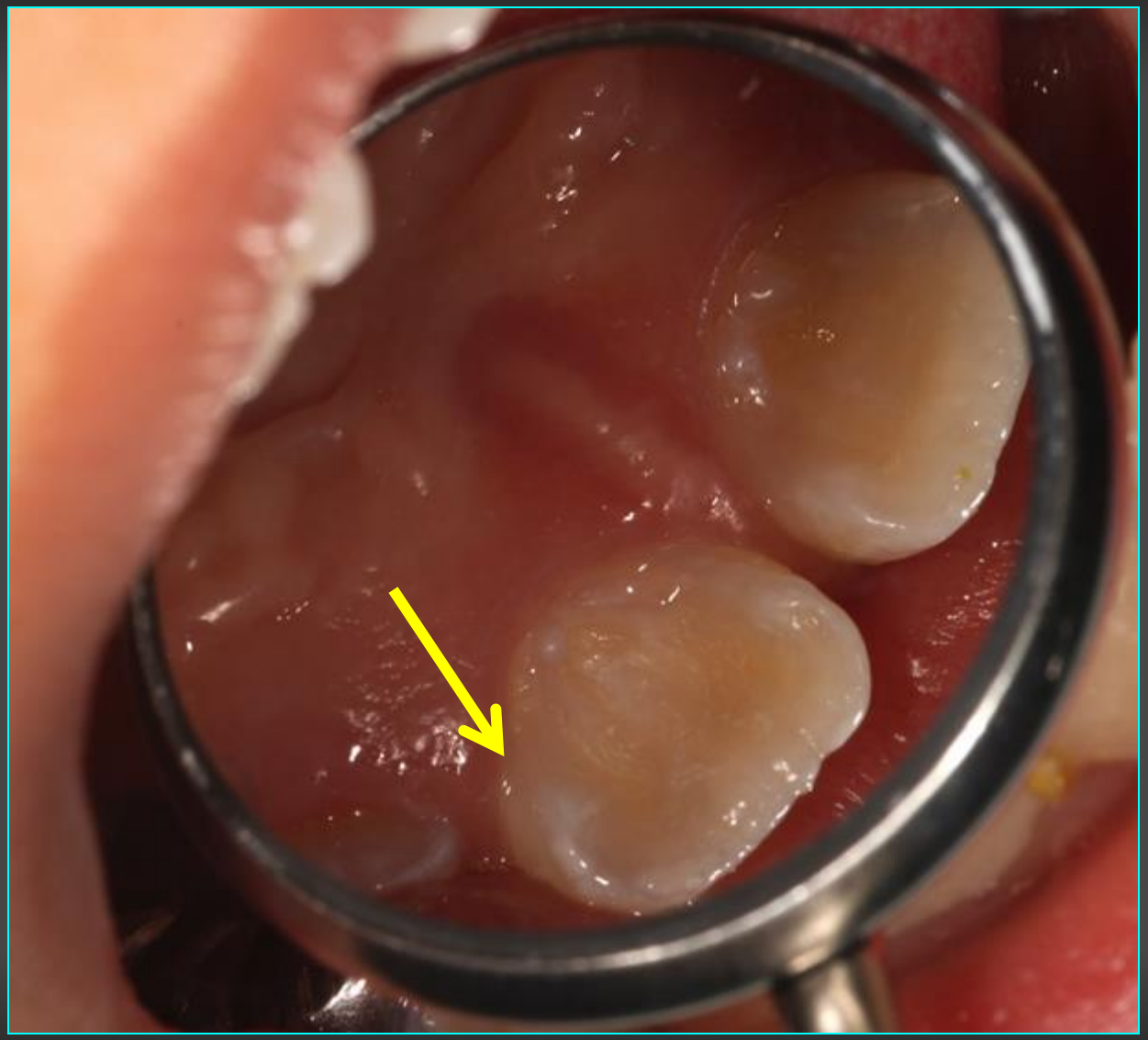

2


3


4


5


6



Another intriguing aspect of the condition is the consistency of the buccal surface being affected.

On the Variable Clinical Presentation of Molar-Incisor Hypomineralization.
Vieira AR, Manton DJ.
Caries Res. 2019;53(4):482-488. doi: 10.1159/000496542. Epub 2019 Apr 3.

Phenotypes of Enamel Hypomineralization and Molar Incisor Hypomineralization in Permanent Dentition: Identification, Quantification and Proposal for Classification

Neeti Mittal*

Objectives: To report the extent, pattern, clinical presentation and phenotypes of enamel hypomineralization

Most commonly affected surfaces were buccal surfaces while lingual surfaces were least commonly affected (p =0.000).

prevalent phenotype was M+IH while the least prevalent was IH. Maximum severity i.e. number of affected surfaces and surfaces with PEB were reported for MIHO (p<0.001). Conclusion: Enamel hypomineralization can manifest in any tooth in five phenotypic variations in permanent dentition with varying extent and severity.

Key words: Enamel defects, enamel hypomineralization, molar incisor hypomineralization, MIH phenotypes, MIH severity

INTRODUCTION

Enamel hypomineralization is a qualitative defect of enamel owing to poor mineralization of developing enamel, identified visually as a creamy-white/yellowish/yellowish-brown opacity with/without post-eruptive breakdown (PEB).[1] Molar incisor hypomineralization (MIH) is a type of enamel hypomineralization defined as hypomineralization of one or more first permanent molars (FPMs) and frequently involving permanent incisors (PIs) as well.[2] According to European Academy of Paediatric Dentistry (EAPD 2003) diagnostic criteria MIH is diagnosed if either of demarcated opacity, enamel breakdown or atypical restoration is identified on any of the FPMs.[3] The index teeth include FPMs and PIs while rest of the teeth are usually not scored.

Though following introduction of EAPD 2003 criteria reporting of MIH has got uniform and standardized, data on extent and clinical presentation of enamel hypomineralization of teeth other than index teeth (FPMs and PIs) are lacking. Employing the EAPD 2003 criterion which is currently an accepted and standard diagnostic criterion for recording and reporting MIH, only two phenotypes

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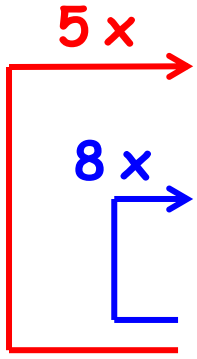
E-mail: dr.neetipgi@gmail.com

Table 1: Overall defect characteristics of Enamel Hypomineralisation in study population†

Characteristic	Mean±SD (n= 228)
Affected Occlusal surfaces	2.04±2.31
Affected Buccal surfaces	3.54±3.40
Affected Lingual surfaces	0.43±1.09



†data expressed for mean values/subject

The study population comprised of 12-16 year old school children of optimally fluoridated area (1 ppm) Gautam Budh Nagar, Uttar Pradesh, India[10]. A random selection of schools was done to ensure entire geographical coverage of study location. The targeted sample size was 2000.

PLAN

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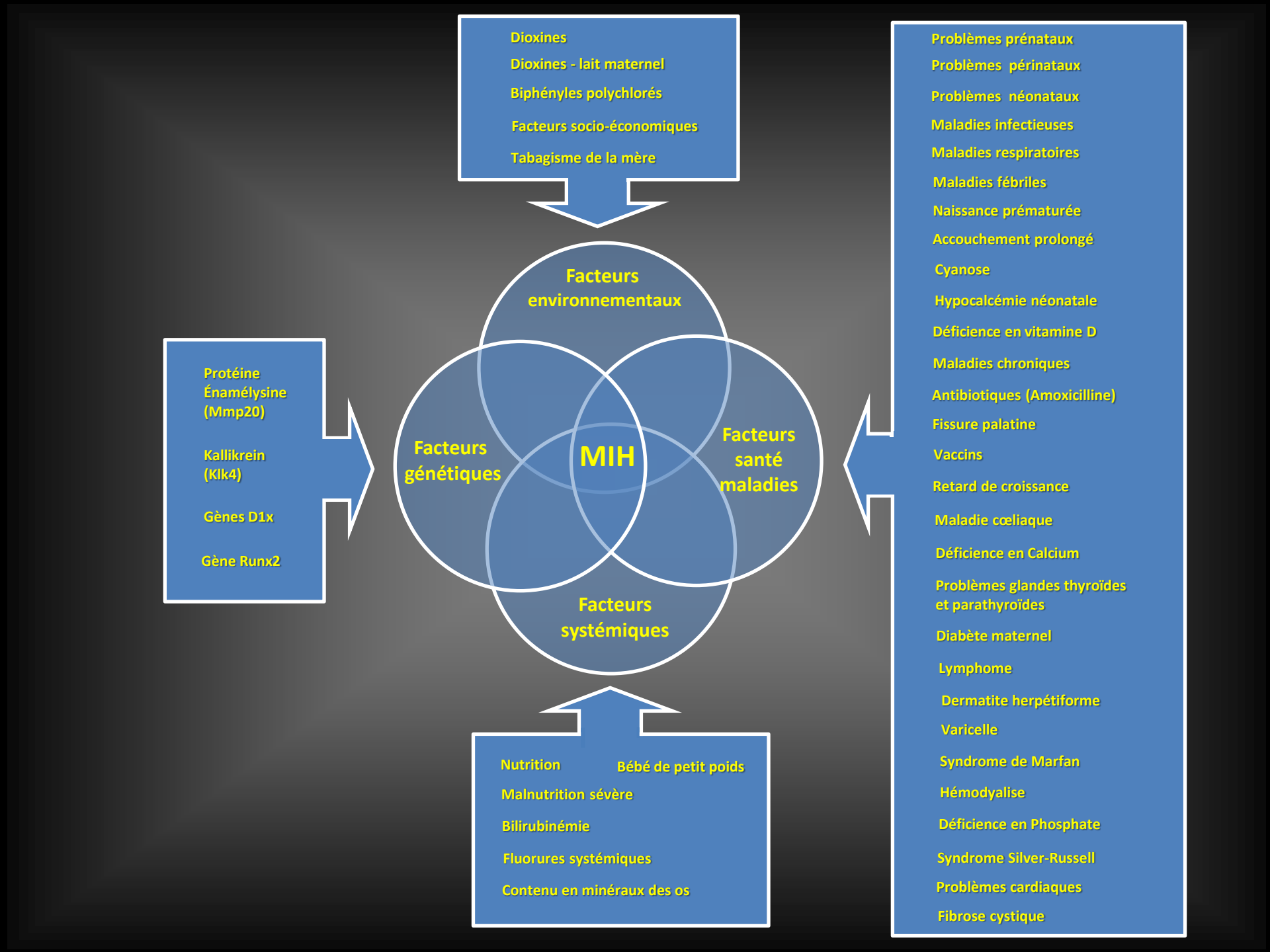
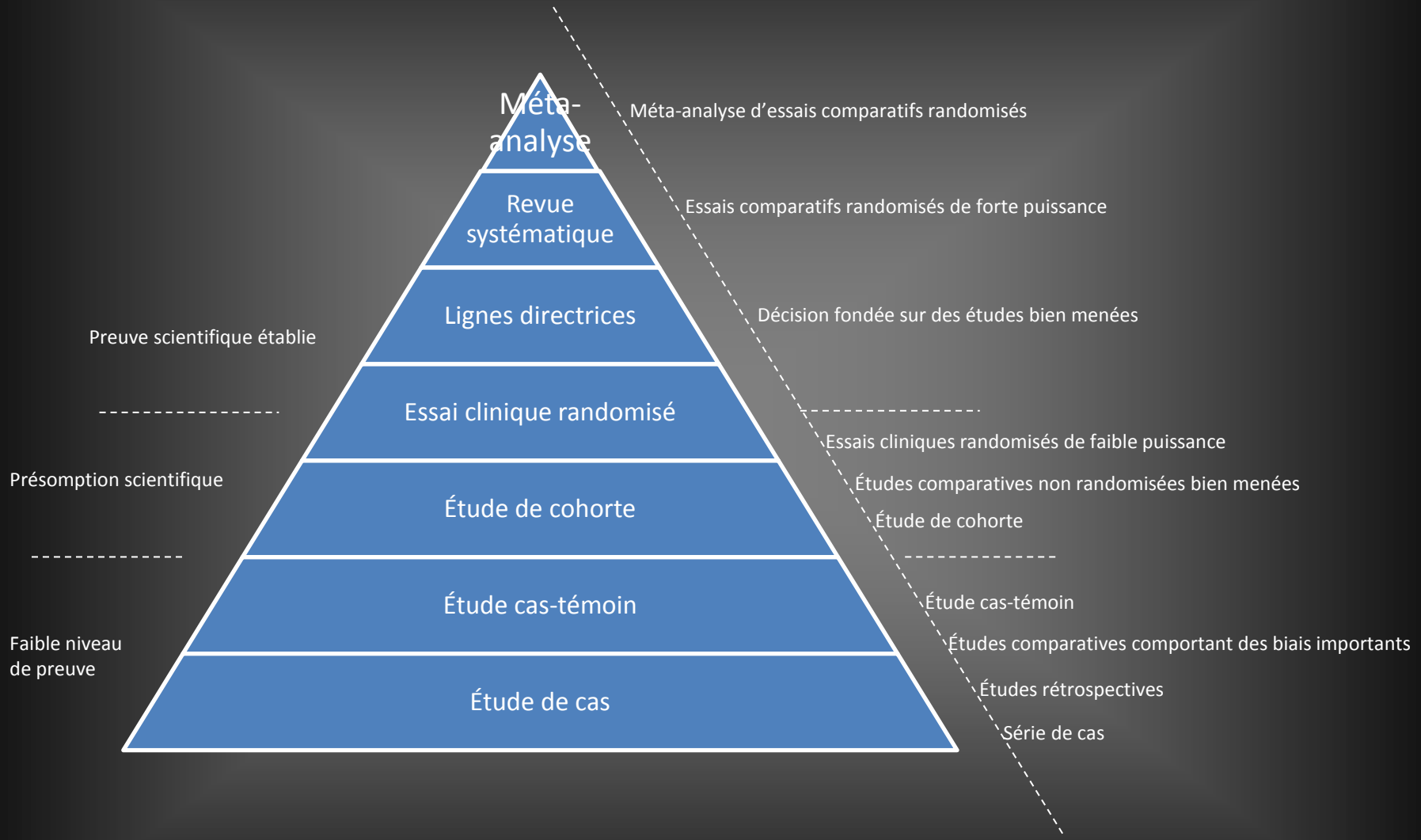
6. MIH … Rôles possibles de la santé publique


Dioxines
Dioxines - lait maternel
Biphényles polychlorés
Facteurs socio-économiques
Tabagisme de la mère
Problèmes prénataux
Problèmes périnataux
Problèmes néonataux
Maladies infectieuses
Maladies respiratoires
Maladies fébriles
Naissance prématurée
Accouchement prolongé
Cyanose
Hypocalcémie néonatale
Déficience en vitamine D
Maladies chroniques
Antibiotiques (Amoxicilline)
Fissure palatine
Vaccins
Retard de croissance
Maladie cœliaque
Déficience en Calcium
Problèmes glandes thyroïdes et parathyroïdes
Diabète maternel
Lymphome
Dermatite herpétiforme
Varicelle
Syndrome de Marfan
Hémodyalise
Déficience en Phosphate
Syndrome Silver-Russell
Problèmes cardiaques
Fibrose cystique
Protéine Énamélysine (Mmp20)
Kallikrein (Klk4)
Gènes D1x
Gène Runx2
Facteurs environnementaux
Facteurs génétiques
MIH
Facteurs santé maladies
Facteurs systémiques
Nutrition
Bébé de petit poids
Malnutrition sévère
Bilirubinémie
Fluorures systémiques
Contenu en minéraux des os


Méta-analyse
Revue systématique
Lignes directrices
Essai clinique randomisé
Étude de cohorte
Étude cas-témoin
Étude de cas
Preuve scientifique établie
Présomption scientifique
Faible niveau de preuve
Méta-analyse d'essais comparatifs randomisés
Essais comparatifs randomisés de forte puissance
Décision fondée sur des études bien menées
Essais cliniques randomisés de faible puissance
Études comparatives non randomisées bien menées
Étude de cohorte
Étude cas-témoin
Études comparatives comportant des biais importants
Études rétrospectives
Série de cas

2006

The term molar incisor hypomineralization (MIH) was introduced in 2001 to describe the clinical appearance of enamel hypomineralization of systemic origin affecting one or more permanent first molars (PFMs) that are associated frequently with affected incisors.[1] Also referred to as "hypomineralized" PFMs,[2] "idiopathic enamel hypomineralization,"[3,4] "dysmineralized" PFMs,[5] "nonfluoride hypomineralization,"[6,7] and "cheese molars,"[8,9] the condition is attributed to disrupted ameloblastic function during the transitional and maturational stages of amelogenesis.[3,10]

LITERATURE REVIEW (Pediatr Dent 2006;28:224-232)

Molar Incisor Hypomineralization: Review and Recommendations for Clinical Management

Vanessa William, BDSc, DClinDent[1] Louise B Messer, BDSc, LDS, MDSc, PhD[2]
Michael F Burrow, BDSc, MDS, PhD, MEd[3]

Conclusion

According to the available evidence in relation to MIH or similar enamel defects, exposure to PCBs/dioxins does appear to be a risk factor for developing MIH-like defects and is worthy of further investigation. Increased duration of breast-feeding, however, does not itself increase the prevalence of MIH, and indeed, may in fact reduce enamel defects. Pre-, peri-, and neonatal problems increase the prevalence of developmental dental defects in general, particularly in the primary dentition; however, a substantial amount of further evidence is required to establish their role in the aetiology of MIH. There is some evidence to link early childhood malnutrition to an increased prevalence of enamel defects, but further research is required to confirm any direct relationship. Fluoride exposure is unlikely to be a risk factor for MIH. Common childhood illnesses and/or their treatment do appear to increase the prevalence of MIH, but again further work will be required to clarify the specific cause/s of this observed effect. The prevalence of dental defects is significantly higher in medically compromised populations; however, improvements in study design are needed to strengthen the evidence, particularly with regard to MIH. It is also likely that, in addition to the environmental exposures so far identified, genetic susceptibility may play a role in the aetiology of this challenging disorder. Long-term prospective epidemiological studies that use clearly defined clinical protocols and indices, and include the collection of comprehensive environmental and genetic information are required.

PROBABLE … OUI

PEUT-ÊTRE

PEU PROBABLE … NON

2009

Aetiology of molar–incisor hypomineralization: a critical review

FELICITY CROMBIE[1], DAVID MANTON[1] & NICOLA KILPATRICK[2]

[1]Melbourne Dental School, University of Melbourne, Parkville Vic., Australia, and [2]Royal Children's Hospital Melbourne and Oral Health Research Unit, Murdoch Children's Research Institute, Parkville, Vic., Australia

International Journal of Paediatric Dentistry 2009; 19: 73–83

Objective. The objective of this study was to assess the strength of evidence for the aetiology of molar–incisor hypomineralization (MIH), often as approximated by demarcated defects.

Method. A systematic search of online medical databases was conducted with assessment of titles, abstracts, and finally full articles for selection purposes. The level and quality of evidence were then assessed for each article according to Australian national guidelines.

Results. Of 1123 articles identified by the database search, 53 were selected for review. These covered a variety of potential aetiological factors, some of which were grouped together for convenience. The level of evidence provided by the majority of papers was low and most did not specifically investigate MIH. There was moderate evidence that polychlorinated biphenyl/dioxin exposure is involved in the aetiology of MIH; weak evidence for the role of nutrition, birth and neonatal factors, and acute or chronic childhood illness/treatment; and very weak evidence to implicate fluoride or breastfeeding.

Conclusion. There is currently insufficient evidence in the literature to establish aetiological factor/s relevant for MIH. Improvements in study design, as well as standardization of diagnostic and examination protocols, would improve the level and strength of evidence.

Int J Paediatr Dent. 2009 Mar;19(2):73-83. doi: 10.1111/j.1365-263X.2008.00966.x.

Aetiology of molar-incisor hypomineralization: a critical review.

Crombie F[1], Manton D, Kilpatrick N.

2013

The American Journal of Pathology, Vol. 183, No. 1, July 2013

ELSEVIER

The American Journal of PATHOLOGY

ajp.amjpathol.org

BIOMARKERS, GENOMICS, PROTEOMICS, AND GENE REGULATION

Enamel Defects Reflect Perinatal Exposure to Bisphenol A

Katia Jedeon,*†‡§ Muriel De la Dure-Molla,*†‡§¶ Steven J. Brookes,‖ Sophia Loiodice,*†‡ Clémence Marciano,*†‡ Jennifer Kirkham,‖ Marie-Chantal Canivenc-Lavier,** Sofiane Boudalia,** Raymond Bergès,** Hidemitsu Harada,†† Ariane Berdal,*†‡§¶ and Sylvie Babajko*†‡

From Laboratory of Molecular Oral Pathophysiology, INSERM UMRS 872, Cordeliers Research Center, Paris, France; the Université Paris-Descartes,† Paris, France; the Université Pierre et Marie Curie-Paris,‡ Paris, France; the Faculties (UFR) of Odontology,§ University of Paris-Diderot, Paris, France; the Center of Rare Malformations of the Face and Oral Cavity (MAFACE),¶ Hôpital Rothschild, Paris, France; the Leeds Dental Institute,‖ Department of Oral Biology, University of Leeds, Leeds, United Kingdom; the Formation Team of the Dynamics of Food Behavior,** Center for Taste and Feeding Behavior, UMR 1324 INRA, University of Bourgogne, Dijon, France; and the Division of Developmental Biology and Regenerative Medicine,†† Department of Anatomy, Iwate Medical University, Iwate, Japan

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The ASCP designates this journal-based CME activity ("ASIP 2013 AJP CME Program in Pathogenesis") for a maximum of 48 AMA PRA Category 1 Credit(s)™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

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Endocrine-disrupting chemicals (EDCs), including bisphenol A (BPA), are environmental ubiquitous pollutants and associated with a growing health concern. Anecdotally, molar incisor hypomineralization (MIH) is increasing concurrently with EDC-related conditions, which has led us to investigate the effect of BPA on amelogenesis. Rats were exposed daily to BPA from conception until day 30 or 100. At day 30, BPA-affected enamel exhibited hypomineralization similar to human MIH. Scanning electron microscopy and elemental analysis revealed an abnormal accumulation of organic material in erupted enamel. BPA-affected enamel had an abnormal accumulation of exogenous albumin in the maturation stage. Quantitative real-timePCR, Western blotting, and luciferase reporter assays revealed increased expression of enamelin but decreased expression of kallikrein 4 (protease essential for removing enamel proteins) via transcriptional regulation. Data suggest that BPA exerts its effects on amelogenesis by disrupting normal protein removal from the enamel matrix. Interestingly, in 100-day-old rats, erupting incisor enamel was normal, suggesting amelogenesis is only sensitive to MIH-causing agents during a specific time window during development (as reported for human MIH). The present work documents the first experimental model that replicates MIH and presents BPA as a potential causative agent of MIH. Because human enamel defects are irreversible, MIH may provide an easily accessible marker for reporting early EDC exposure in humans. *(Am J Pathol 2013, 183: 108–118; http://dx.doi.org/10.1016/j.ajpath.2013.04.004)*

The environment has become increasingly contaminated by various pollutants. This contamination has led to an increase in the incidence and gravity of known conditions and/or the emergence of new conditions. Recently, the appearance of a distinct enamel condition was identified and called *molar incisor hypomineralization* (MIH) in recognition that it is most likely to be found affecting permanent first molars with frequent involvement of the permanent incisors.[1,2] MIH is diagnosed in children at approximately 6 to 8 years of age and presents as random white opacities on the enamel of affected teeth. MIH prevalence is highly variable, with 2.4% to 40.2% (mean of approximately 18%) of

Supported by the University Paris-Diderot, the French National Institute of Health and Medical Research (INSERM), the National Research Program on Endocrine Disruptors (CIME), WELMEC (a Wellcome-EPSRC Centre of Excellence in Medical Engineering; S.J.B. and J.K.), the NIHR Leeds Musculoskeletal Biomedical Research Unit (S.J.B. and J.K.) and Wellcome Trust grant 093113 (S.J.B. and J.K.).

http://dx.doi.org/10.1016/j.ajpath.2013.04.004

Consumer Health Information
www.fda.gov/consumer

FDA Continues to Study BPA

BPA It stands for Bisphenol A. It is a chemical used in the production of plastics and resins, such as some water bottles and the coatings of some food cans. It is also used in some consumer goods, such as compact discs and thermal cash register tapes. And it has generated controversy about its impact on human health and development.

Dennis M. Keefe, Ph.D., director of FDA's Office of Food Additive Safety, and other officials at FDA say the agency takes all concerns about BPA seriously and is evaluating them as part of the agency's ongoing oversight of food safety.

Because of some studies in young animals that raised potential concerns about the safety of BPA, there has been particular concern about its use in infant bottles and training (sippy) cups, FDA has been supporting industry efforts to find alternatives to BPA in the manufacture of these and other products, Keefe says.

Potential Concerns About BPA

BPA has been used since the 1960s to make polycarbonate plastics and epoxy resins. These hard, clear plastics are often used in containers that store food and beverages, such as some water bottles. The resins are also used to protect foods from microbial and other contamination by coating the inside of metal products, such as some food cans.

Research has shown that people are exposed to BPA because small amounts can migrate into the food and beverages from their containers. Reports from some animal studies have raised potential concerns that BPA exposure may cause multiple health problems, including reproductive disorders, diabetes and cardiovascular disease.

There have also been studies that contend that BPA is a hazard to people too. But FDA—as well as the European Food Safety Agency (EFSA)—has carefully assessed these studies and finds no convincing evidence to support that belief.

Les BPA ciblent deux gènes (kallikrein – related peptidase 4 (klk4) et enamelin) reponsables de la sécrétion de la matrice de protéines de l'émail et sa dégradation (afin de permettre la croissance des cristaux d'émail)

sive research on BPA, has reviewed hundreds of other studies, and is continuing to address questions

chemical that enter the body, whether it's an adult or a child, are rapidly metabolized and eliminated.

FDA is continuing its research and monitoring of studies to address uncertainties raised about BPA.

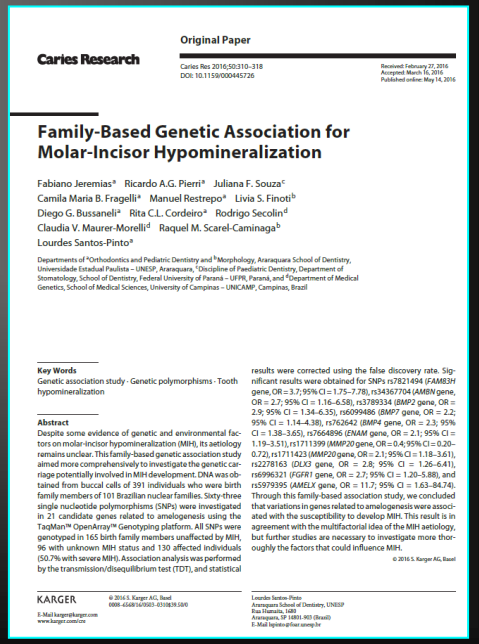
2016

In conclusion, we showed evidence of the genetic influence on MIH. This result is in agreement with the multifactorial idea of the MIH aetiology, but to prove this, further studies enrolling larger, well-diagnosed and different ethnic populations are necessary to expand the investigation of the genetic and environmental factors as well as the gene-environment interactions that might influence the occurrence of MIH.

Family-Based Genetic Association for Molar-Incisor Hypomineralization.

Jeremias F, Pierri RA, Souza JF, Fragelli CM, Restrepo M, Finoti LS, Bussaneli DG, Cordeiro RC, Secolin R, Maurer-Morelli CV, Scarel-Caminaga RM, Santos-Pinto L.

Caries Res. **2016**;50(3):310-8. doi: 10.1159/000445726. Epub **2016** May 14.



Caries Research

Original Paper

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Family-Based Genetic Association for Molar-Incisor Hypomineralization

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Key Words
Genetic association study · Genetic polymorphisms · Tooth hypomineralization

Abstract
Despite some evidence of genetic and environmental factors on molar-incisor hypomineralization (MIH), its aetiology remains unclear. This family-based genetic association study aimed more comprehensively to investigate the genetic carriage potentially involved in MIH development. DNA was obtained from buccal cells of 391 individuals who were birth family members of 101 Brazilian nuclear families. Sixty-three single nucleotide polymorphisms (SNPs) were investigated in 21 candidate genes related to amelogenesis using the TaqMan™ OpenArray™ Genotyping platform. All SNPs were genotyped in 165 birth family members unaffected by MIH, 96 with unknown MIH status and 130 affected individuals (50.7% with severe MIH). Association analysis was performed by the transmission/disequilibrium test (TDT), and statistical results were corrected using the false discovery rate. Significant results were obtained for SNPs rs7821494 (*FAM83H* gene, OR = 3.7; 95% CI = 1.75–7.78), rs34367704 (*AMBN* gene, OR = 2.7; 95% CI = 1.16–6.58), rs3789334 (*BMP2* gene, OR = 2.9; 95% CI = 1.34–6.35), rs6099486 (*BMP7* gene, OR = 2.2; 95% CI = 1.14–4.38), rs762642 (*BMP4* gene, OR = 2.3; 95% CI = 1.38–3.65), rs7664896 (*ENAM* gene, OR = 2.1; 95% CI = 1.19–3.51), rs1711399 (*MMP20* gene, OR = 0.4; 95% CI = 0.20–0.72), rs1711423 (*MMP20* gene, OR = 2.1; 95% CI = 1.18–3.61), rs2278163 (*DLX3* gene, OR = 2.8; 95% CI = 1.26–6.41), rs6996321 (*FGFR1* gene, OR = 2.7; 95% CI = 1.20–5.88), and rs5979395 (*AMELX* gene, OR = 11.7; 95% CI = 1.63–84.74). Through this family-based association study, we concluded that variations in genes related to amelogenesis were associated with the susceptibility to develop MIH. This result is in agreement with the multifactorial idea of the MIH aetiology, but further studies are necessary to investigate more thoroughly the factors that could influence MIH.

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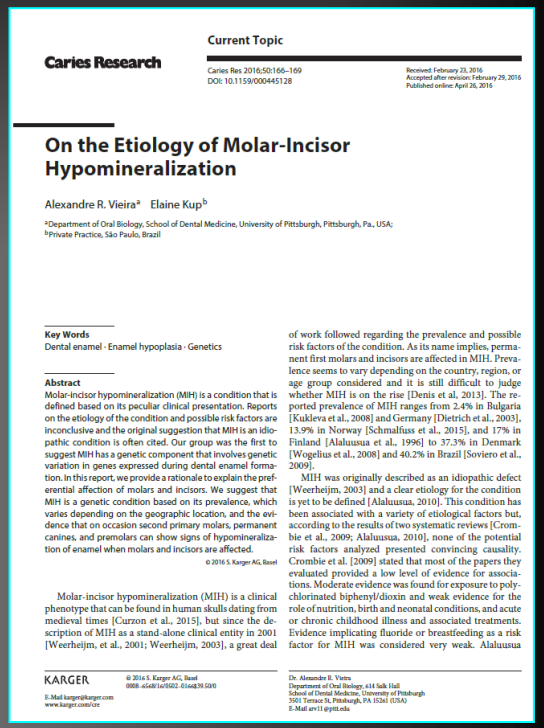
Abstract

Molar-incisor hypomineralization (MIH) is a condition that is defined based on its peculiar clinical presentation. Reports on the etiology of the condition and possible risk factors are inconclusive and the original suggestion that MIH is an idiopathic condition is often cited. Our group was the first to suggest MIH has a genetic component that involves genetic variation in genes expressed during dental enamel formation. In this report, we provide a rationale to explain the preferential affection of molars and incisors. We suggest that MIH is a genetic condition based on its prevalence, which varies depending on the geographic location, and the evidence that on occasion second primary molars, permanent canines, and premolars can show signs of hypomineralization of enamel when molars and incisors are affected.



Caries Research

Current Topic

Caries Res 2016;50:166–169
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On the Etiology of Molar-Incisor Hypomineralization

Alexandre R. Vieira[a] Elaine Kup[b]

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Key Words
Dental enamel · Enamel hypoplasia · Genetics

Abstract
Molar-incisor hypomineralization (MIH) is a condition that is defined based on its peculiar clinical presentation. Reports on the etiology of the condition and possible risk factors are inconclusive and the original suggestion that MIH is an idiopathic condition is often cited. Our group was the first to suggest MIH has a genetic component that involves genetic variation in genes expressed during dental enamel formation. In this report, we provide a rationale to explain the preferential affection of molars and incisors. We suggest that MIH is a genetic condition based on its prevalence, which varies depending on the geographic location, and the evidence that on occasion second primary molars, permanent canines, and premolars can show signs of hypomineralization of enamel when molars and incisors are affected.

Molar-incisor hypomineralization (MIH) is a clinical phenotype that can be found in human skulls dating from medieval times [Curzon et al., 2015], but since the description of MIH as a stand-alone clinical entity in 2001 [Weerheijm, et al., 2001; Weerheijm, 2003], a great deal of work followed regarding the prevalence and possible risk factors of the condition. As its name implies, permanent first molars and incisors are affected in MIH. Prevalence seems to vary depending on the country, region, or age group considered and it is still difficult to judge whether MIH is on the rise [Denis et al, 2013]. The reported prevalence of MIH ranges from 2.4% in Bulgaria [Kukleva et al., 2008] and Germany [Dietrich et al., 2003], 13.9% in Norway [Schmalfuss et al., 2015], and 17% in Finland [Alaluusua et al., 1996] to 37.3% in Denmark [Wogelius et al., 2008] and 40.2% in Brazil [Soviero et al., 2009].

MIH was originally described as an idiopathic defect [Weerheijm, 2003] and a clear etiology for the condition is yet to be defined [Alaluusua, 2010]. This condition has been associated with a variety of etiological factors but, according to the results of two systematic reviews [Crombie et al., 2009; Alaluusua, 2010], none of the potential risk factors analyzed presented convincing causality. Crombie et al. [2009] stated that most of the papers they evaluated provided a low level of evidence for associations. Moderate evidence was found for exposure to polychlorinated biphenyl/dioxin and weak evidence for the role of nutrition, birth and neonatal conditions, and acute or chronic childhood illness and associated treatments. Evidence implicating fluoride or breastfeeding as a risk factor for MIH was considered very weak. Alaluusua

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0008–6568/16/0502–0166$39.50/0

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On the Etiology of Molar-Incisor Hypomineralization.
Vieira AR, Kup E.
Caries Res. **2016**;50(2):166-9. doi: 10.1159/000445128. Epub **20**

ÉTUDE SUR LES JUMEAUX

DOI: 10.1111/ipd.12327

INTERNATIONAL JOURNAL OF PAEDIATRIC DENTISTRY

Exploring the association between genetic and environmental factors and molar incisor hypomineralization: evidence from a twin study

RAFAEL JOSÉ PIO BARBOSA TEIXEIRA[1], NATÁLIA SILVA ANDRADE[1], LISANCA CARVALHO CAVALCANTE QUEIROZ[2], FAUSTO MEDEIROS MENDES[3], MARCOELI SILVA MOURA[1], LÚCIA DE FÁTIMA ALMEIDA DE DEUS MOURA[1] & MARINA DEUS MOURA LIMA[1]

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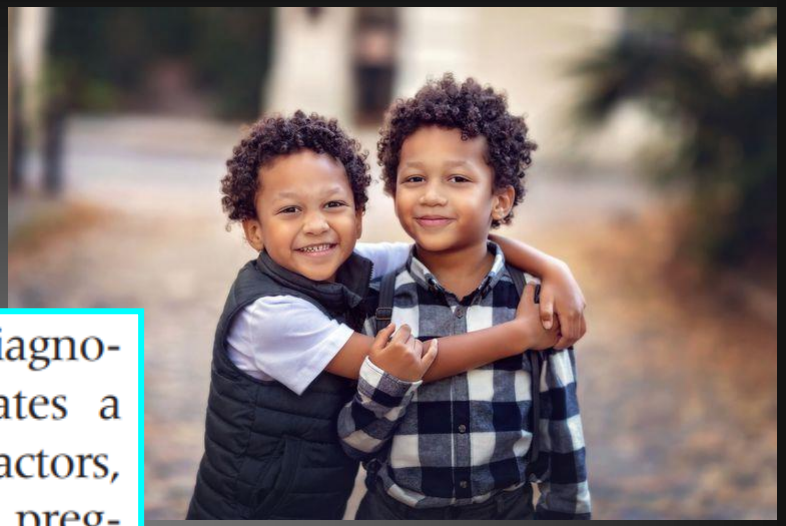

Conclusions. The greater concordance in the diagnosis of MIH among monozygotic twins indicates a genetic influence, although environmental factors, such as family income and hemorrhage during pregnancy, are also associated with the occurrence of MIH.

Aim. This cross-sectional study evaluated the agreement of molar incisor hypomineralization (MIH) between monozygotic and dizygotic twin pairs and the association with environmental factors.

Design. The sample consisted of 167 pairs of twins (8–15 years old), 94 monozygotic and 73 dizygotic. The parents answered a questionnaire on sociodemographic data and pre-, peri-, and postnatal health. A dental examination was performed [PR] = 5.82, confidence interval [CI: 95%] 1.48–10.44), above two wages ($P = 0.007$, PR = 4.60, 95% CI: 1.51–14.05), and gestational hemorrhage ($P = 0.032$, PR = 5.70, 95% CI: 1.16–28.14).

Conclusions. The greater concordance in the diagnosis of MIH among monozygotic twins indicates a genetic influence, although environmental factors, such as family income and hemorrhage during pregnancy, are also associated with the occurrence of MIH.

Introduction

Molar incisor hypomineralization (MIH) is a qualitative defect of dental enamel that affects the permanent first molars, often in association with the permanent incisors[1]. The prevalence of this condition varies from 2.8% to 44.0%[2]. Hypomineralized teeth are more susceptible to post-eruptive disintegrations of the enamel, and area risk factor for hypersensitivity and dental hygiene problems[3]. In addition, this defect has a negative impact on patient quality of life and represents a challenge for dental surgeons[4].

It is assumed that the MIH etiology is multifactorial[5], since several factors have been associated with the condition[6]. Considering that ameloblasts are very sensitive cells and amelogenesis is genetically controlled[7], genetic susceptibility may be associated with the pathogenesis of MIH[8–11]. An association has been observed between variations in the *AMBN*, *ENAM*, *TUFT1*, *TFIP11*[8], and *SCUBE*1 genes and greater susceptibility to MIH[9]; however, environmental factors that act during enamel formation may also interfere with the function of the proteins expressed by these genes[5,6,10].

The specialists have emphasized that twin child research can help elucidate the possible

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20 % des familles ont au moins un membre supplémentaire avec au moins une dent avec du MIH

Les données obtenues auprès des jumeaux de type monozygotes démontrent une plus grande concordance que celles obtenues à partir de jumeaux hétérozygotes, et ce, autant au niveau du phénotype classique que celui au niveau des dents primaires

Un groupe de chercheurs a estimé qu'environ 20 % de la variation de cas de MIH observés dans la population pouvait être expliqué par un facteur génétique

ÉTIOLOGIE
RÉSUMÉ

Étiologie multifactorielle

… avec une composante systémique

… et une composante environnementale

… et une composante génétique

The plausibility of MIH being a multifactorial condition, with systemic, environmental, and genetic components, is now generally accepted.[31-33]

U.S. Pediatric Dentists' Perception of Molar Incisor Hypomineralization.
Tagelsir A, Dean JA, Eckert GJ, Martinez-Mier EA.
Pediatr Dent. 2018 Jul 15;40(4):272-278.

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PLAN

1. Introduction
2. Importance relative de ce problème de santé buccodentaire
3. MIH … mythes et réalités
4. Observations cliniques intrigantes
5. Étiologie et facteurs de risque
6. MIH … Rôles possibles de la santé publique

Dépistage à la maternelle 5 ans

- ☐ À risque élevé de carie dentaire ?
- ☐ Besoin évident de traitement
- ☐ Hypersensibilité … brossage des dents … douleur à la mastication
- ☐ Évaluation du risque en lien avec l'hypominéralisation
  (triade : hypersensibilité, carie dentaire et destruction post-éruptive)
- ☐ Fluorure Diamine d'argent

SPI - Suivi préventif individualisé

- ☐ Intensité augmentée ou adaptée ? (exemples : > 2 applications de vernis fluoré, > 2 SPI par année)

2e année primaire, sélection des enfants / agents de scellement

- ☐ Scellant conventionnel avec ou sans adhésif hydrophile
- ☐ Scellant conventionnel vs Scellant de verre ionomère
- ☐ Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

Dépistage à la maternelle 5 ans

- [x] À risque élevé de carie dentaire ?
- [ ] Besoin évident de traitement
- [ ] Hypersensibilité … brossage des dents … douleur à la mastication
- [ ] Évaluation du risque en lien avec l'hypominéralisation
  (triade : hypersensibilité, carie dentaire et destruction post-éruptive)
- [ ] Fluorure Diamine d'argent

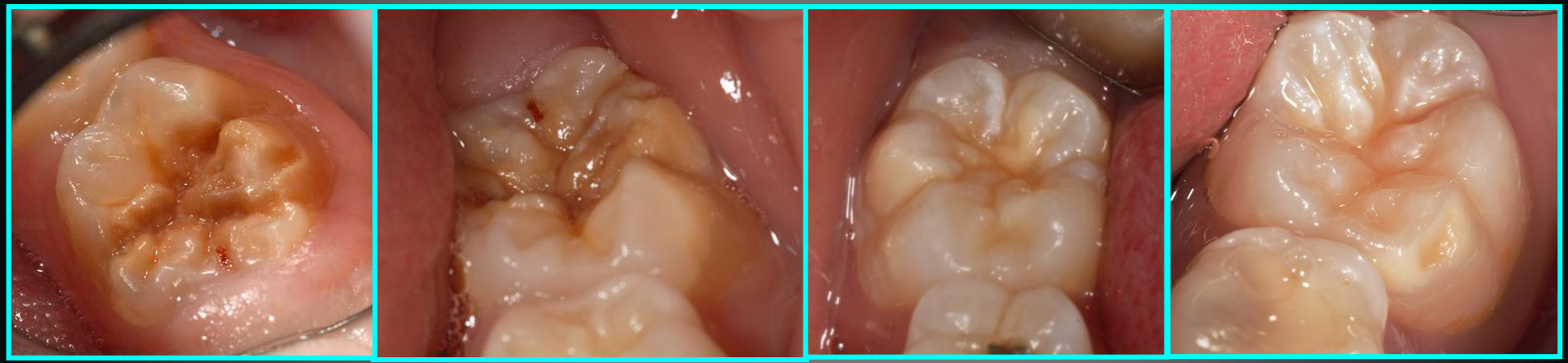
SPI - Suivi préventif individualisé

- [ ] Intensité augmentée ou adaptée ? (exemples : > 2 applications de vernis fluoré, > 2 SPI par année)

2e année primaire, sélection des enfants / agents de scellement

- [ ] Scellant conventionnel avec ou sans adhésif hydrophile
- [ ] Scellant conventionnel vs Scellant de verre ionomère
- [ ] Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

The tooth-surface caries ratio rises as the severity of hypomineralization increases[5]. This could be because opacities in the cream to brown color range are more porous[5] and more susceptible to PEB, and PEB, in turn, exacerbates the caries and increases its severity. Kosma *et al.*[22] observed that the more severe the MIH the greater the caries, which agrees with Pitiphat *et al.*[20], who found that caries lesions are 10 times more frequent in teeth with PEB (severe MIH) than in teeth that only have opacities (mild MIH). Elfrink *et al.*[40] observed that the mean density of the hydroxyapatite in opacities in the yellow to brown color range is 20% to 22% lower than in sound enamel, while the difference is almost nonexistent in white opacities. The results of the present study have also shown that the caries is far greater in surfaces with severe MIH than in surfaces with mild MIH or no MIH.

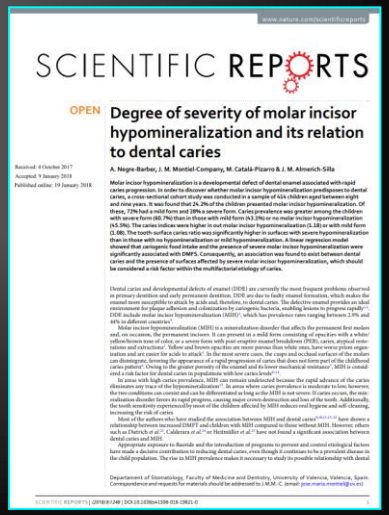


10

Degree of severity of molar incisor hypomineralization and its relation to dental caries.

Negre-Barber A, Montiel-Company JM, Catalá-Pizarro M, Almerich-Silla JM.

Sci Rep. 2018 Jan 19;8(1):1248. doi: 10.1038/s41598-018-19821-0.



SCIENTIFIC REPORTS

OPEN

Degree of severity of molar incisor hypomineralization and its relation to dental caries

Dépistage à la maternelle 5 ans

- [x] À risque élevé de carie dentaire ?
- [x] Besoin évident de traitement
- [ ] Hypersensibilité … brossage des dents … douleur à la mastication
- [ ] Évaluation du risque en lien avec l'hypominéralisation
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- [ ] Intensité augmentée ou adaptée ? (exemples : > 2 applications de vernis fluoré, > 2 SPI par année)

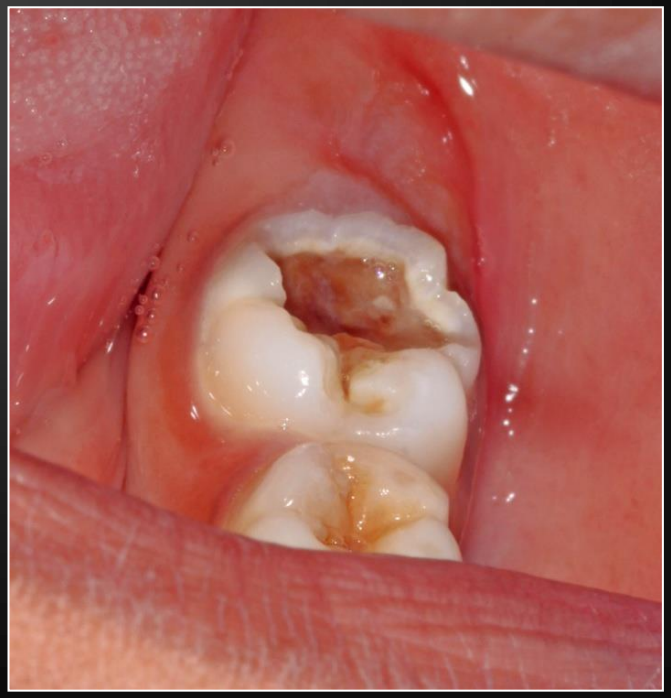
2e année primaire, sélection des enfants / agents de scellement

- [ ] Scellant conventionnel avec ou sans adhésif hydrophile
- [ ] Scellant conventionnel vs Scellant de verre ionomère
- [ ] Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

DONNÉES PROBANTES

Suite à un **examen de dépistage** effectué en début d'année scolaire, à la maternelle, par une hygiéniste du secteur publique, visant à référer chez le dentiste les cas de caries dentaires ayant atteint la dentine et qui nécessitent un besoin évident de traitement … Combien d'enfant ont consulté un dentiste pendant l'année scolaire ?

37 %



Dépistage dentaire scolaire au Québec

Programme public de services dentaires préventifs / Plan d'action de santé dentaire publique 2005-2012

Bilan régional des activités, Montréal – Suivi préventif individuel, maternelle

	1998-1999	2003-2004	2007-2008
BET	45,2 % (1302)	46,8 % (1238)	46,3 % (1356)
Orientés vers le cabinet dentaire	97,7 % (1273)	98,4 % (1218)	99,9 % (1354)
Visite dentaire	44,3 % (564) fin maternelle	29,9 % (364) fin maternelle	35,5 % (453) fin maternelle
Moyenne - 3 années	→	36,6 % fin maternelle	

Généreux, M. 2000, 2005, 2009. www.santepub-mtl.qc.ca/Publication/dentaire/service.html
www.santepub-mtl.qc.ca/Publication/dentaire/activite2003-04.html
www.santepub-mtl.qc.ca/Publication/pdfdentaire/planaction20052012.pdf
Adapté de : Veilleux, G. Le dépistage dentaire scolaire, une activité efficace? Cercle d'étude en santé dentaire publique, 19 janvier 2010

Dépistage à la maternelle 5 ans

- [x] À risque élevé de carie dentaire ?
- [x] Besoin évident de traitement
- [x] Hypersensibilité … brossage des dents … douleur à la mastication
- [ ] Évaluation du risque en lien avec l'hypominéralisation
  (triade : hypersensibilité, carie dentaire et destruction post-éruptive)
- [ ] Fluorure Diamine d'argent

SPI - Suivi préventif individualisé

- [ ] Intensité augmentée ou adaptée ? (exemples : > 2 applications de vernis fluoré, > 2 SPI par année)

2e année primaire, sélection des enfants / agents de scellement

- [ ] Scellant conventionnel avec ou sans adhésif hydrophile
- [ ] Scellant conventionnel vs Scellant de verre ionomère
- [ ] Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

30

MIH-Léger (seulement des opacités)

55

MIH- Modéré (PEB)

MIH-Sévère
(PEB dans la dentine +
restauration atypique)

52

Prevalence of Hypersensitivity in Teeth Affected by Molar-Incisor Hypomineralization (MIH).
Raposo F, de Carvalho Rodrigues AC, Lia ÉN, Leal SC.
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Research Article

Caries Research

Caries Res
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Prevalence of Hypersensitivity in Teeth Affected by Molar-Incisor Hypomineralization (MIH)

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Keywords
Dental hypersensitivity · Molar-incisor hypomineralization · Air blast reaction

Abstract
Aim: This study aimed to investigate the prevalence of hypersensitivity in molar-incisor hypomineralization (MIH)-affected molars through a census carried out in 8-year-old schoolchildren. ***Methods:*** Examinations were conducted by a calibrated examiner, using the Nyvad criteria for caries diagnosis and a new criterion for MIH assessment. For hypersensitivity assessment, all MIH-affected molars were included. Nonaffected molars from the same child were used as controls. Air blast reaction was measured using the Visual Analogue Scale (VAS) and the Schiff Cold Air Sensitivity Scale (SCASS) scale, while tactile hypersensitivity was scored using VAS only. Statistical analysis was performed using the Kruskal-Wallis test followed by Dunn's multiple comparisons test for quantitative data. χ^2 was used for the comparison of categorical data. ***Results:*** In total, 631 children were assessed, of whom 102 had MIH-affected molars (16.1%). Of these, 51.7 and 8.7% presented enamel and dentin carious lesions, respectively. Regarding the number of teeth, 239 molars were MIH affected (59.8%), with 188 (78.7%) being classified as mild (opacities only), 20 (8.4%) as moderate (posteruptive enamel breakdown), and 31 (13%) as severe (posteruptive breakdown involving dentin/atypical restorations). Hypersensitivity was recorded in only one control molar, while the prevalence of hypersensitivity in MIH-affected molars was 34.7%, being of low intensity and more prevalent in moderate (55%) and severe cases (51.6%) than in mild cases (29.8%, $p = 0.008$). An association between hypersensitivity and the presence of mild and moderate cases was observed. Although the same association was observed for severe cases, it was not considered a reliable information as 90% of the MIH-affected molars with posteruptive breakdown involving dentin were affected by carious lesions. It is known that dental caries is a confounding factor for the presence of hypersensitivity. ***Conclusions:*** Hypersensitivity was significantly higher in MIH-affected molars than in nonaffected molars, being associated with MIH teeth presenting opacities and posteruptive enamel breakdown.

Introduction

Molar-incisor hypomineralization (MIH) is a qualitative developmental defect of the enamel that was first described in the literature in 2001 [Weerheijm et al., 2001]. It is clinically characterized by the presence of demarcated opacities that can vary in color from white to yellow-brownish, which asymmetrically affects 1 to 4 first per-

KARGER

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Paranoa, Brésil

632 enfants de 8 ans

6 écoles publiques

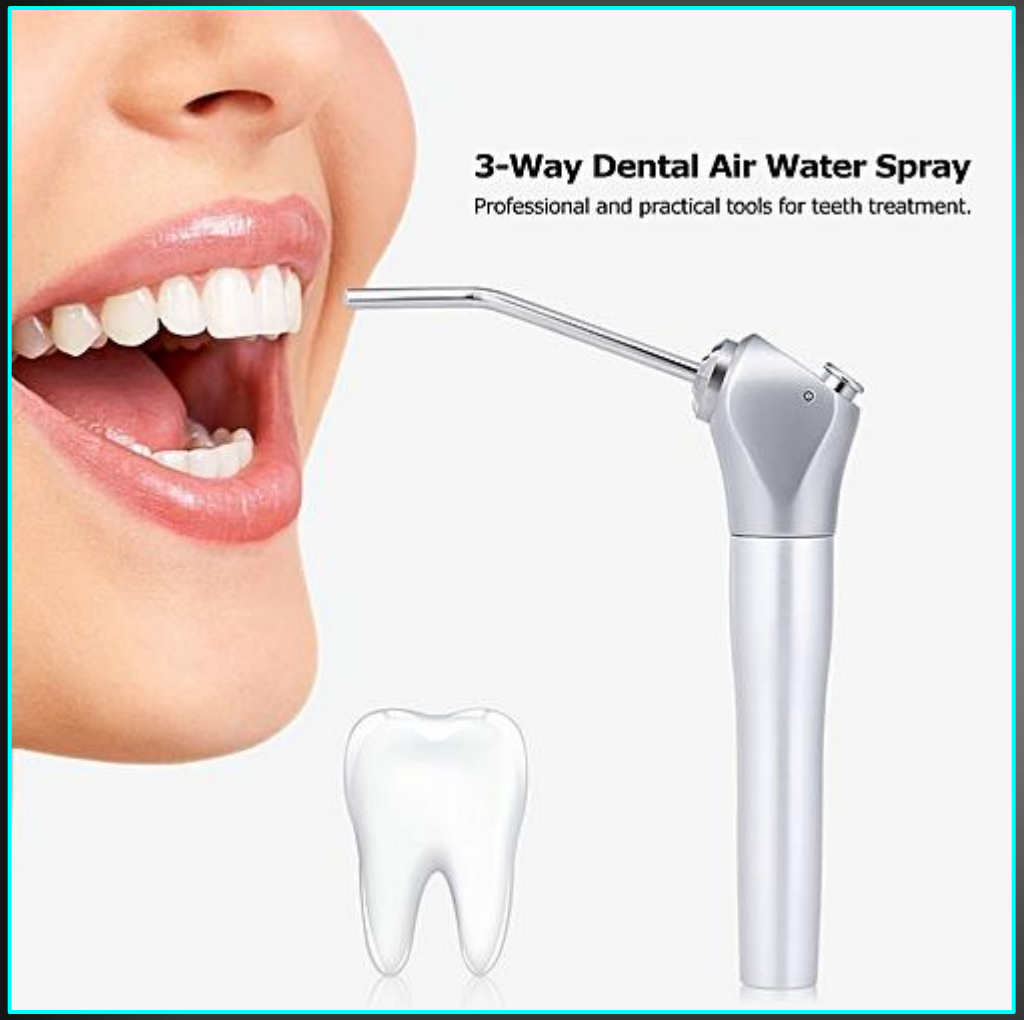
Prévalence MIH : 16 %

Table 1. Prevalence of hypersensitivity according to MIH severity

MIH severity	Hypersensitivity		Total
	yes	no	
Mild (MIH 1)	56 (29.7%)	132 (70.3%)	188
Moderate (MIH 2)	11 (55%)	9 (45%)	20
Severe (MIH 3)	16 (51.6%)	15 (48.4%)	31

- [x] Interroger l'enfant
- [x] Test avec un jet d'air, Échelle SCASS (Schiff Cold Air Sensitivity Scale)
- [ ] Test au toucher avec un explorateur, Échelle VAS (Visual Analog Scale)
- [ ] Présence de plaque dentaire (et gingivite) localisée

Test avec un jet d'air, Échelle SCASS
(Schiff Cold Air Sensitivity Scale)

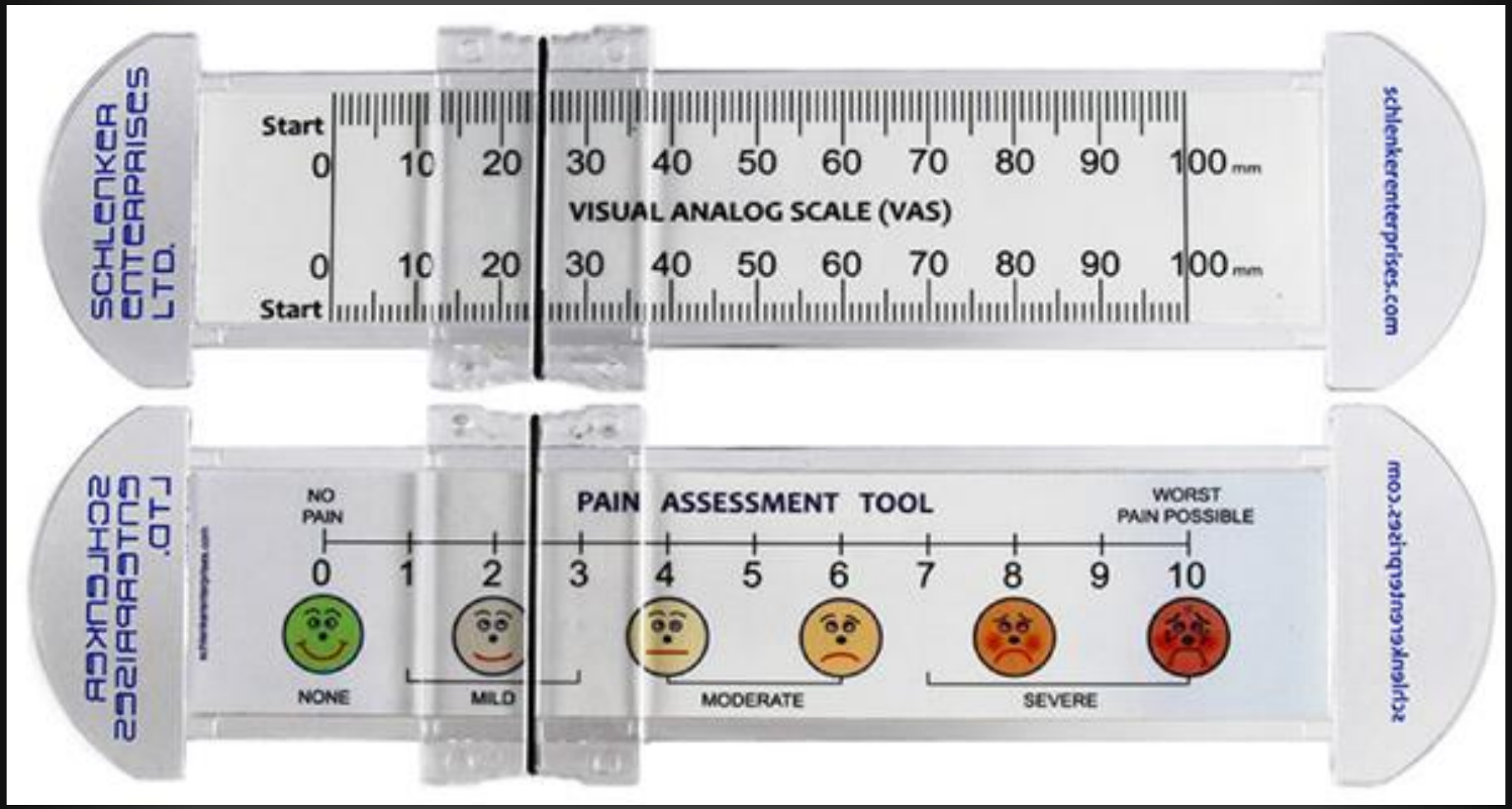


1. 90°
2. 1 cm.
3. 1 seconde

Seulement en présence du compresseur !

- [x] Interroger l'enfant
- [x] Test avec un jet d'air, Échelle SCASS (Schiff Cold Air Sensitivity Scale)
- [x] Test au toucher avec un explorateur, Échelle VAS (Visual Analog Scale)
- [ ] Présence de plaque dentaire (et gingivite) localisée

Test au toucher avec un explorateur, Échelle VAS (Visual Analog Pain Scale)



- Interroger l'enfant
- Test avec un jet d'air, Échelle SCASS
  (Schiff Cold Air Sensitivity Scale)
- Test au toucher avec un explorateur, Échelle VAS
  (Visual Analog Scale)
- Présence de plaque dentaire (et gingivite) localisée

TRAITEMENT HYPERSENSIBILITÉ

CPP-ACP

Casein phosphopeptide – amorphous calcium phosphate

CASEIN ET SES DÉRIVÉS

Molar incisor hypomineralization treatment with casein phosphopeptide and amorphous calcium phosphate in children

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ABSTRACT

BACKGROUND: The purpose of this study was to evaluate the sensitivity of teeth with MIH in children before and after the use of a tooth mousse containing casein phosphopeptide and amorphous calcium phosphate (CPP-ACP).
METHODS: Forty patients, both males and females, aged from 8 to 13 years old that had a molar with MIH hypersensitivity were included in this study. In the test group (20 subjects), a tooth mousse with CPP-ACP was used while fluoride toothpaste was used in the control group. Dental sensitivity to mechanical and thermal stimuli was evaluated before (T0) and 120 days after the beginning of the treatment (T1).
RESULTS: In the test group, the thermal sensitivity decreased significantly ($P<0.05$) from T0 to T1 (2.4±0.6 to 1.1±0.4) while in the control group resulted very similar (from 2.3±0.5 to 2.2±0.4). Similarly, mechanical sensitivity decreased significantly ($P<0.05$) from 7.8±1 to 3.8±0.6 while in the control group decreased not significantly (from 7.5±1.3 to 7.2±0.8). No significant difference ($P>0.05$) was observed by comparing males with females.
CONCLUSIONS: The use of the remineralizing agent containing CPP-ACP resulted in a significant improvement in dental sensitivity in patients with MIH.

(*Cite this article as:* Pasini M, Giuca MR, Scatena M, Gatto R, Caruso S. Molar incisor hypomineralization treatment with casein phosphopeptide and amorphous calcium phosphate in children. Minerva Stomatol 2018;67:20-5. DOI: 10.23736/S0026-4970.17.04086-9)

Key words: Hypomineralization - Dental enamel - Children - Therapy.

n =40 Âges : 8 - 13

120 jours

Observance thérapeutique

Amélioration significative

CONCLUSIONS: The use of the remineralizing agent containing CPP-ACP resulted in a significant improvement in dental sensitivity in patients with MIH.

tion regarding one to four permanent molars, with frequent involvement of the incisors.[1]

However, the definition of MIH specifically excludes the defects of the incisors, when they are isolated without the involvement of the molars.[2]

MIH is a deficit in the mineralization pro-

dental problem and studies of its epidemiology are constantly being published. Its prevalence ranges from 2.4% to 40.2% throughout the world's pediatric population, in relation to the country and age groups in which it is found.[4] The origin of MIH is subject to controversy in scientific literature, and its exact pathogenesis

Though Biondi et al.[40], Ozgul et al.,[45] Bakkal et al.,[38] and Pasini et al.[46] reported positive results after applying CPP-APC pastes, its effectiveness as desensitizing and remineralizing agent has been questioned[74,78–82] and long-term clinical trials with large samples are needed to validate the results before its widespread recommendation.

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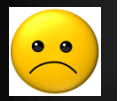

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J Esthet Restor Dent. 2019 Jan;31(1):26-39. doi: 10.1111/jerd.12420. Epub 2018 Oct 4.

Dental hypomineralization treatment: A systematic review.

da Cunha Coelho ASE[1,2], Mata PCM[3], Lino CA[1], Macho VMP[3], Areias CMFGP[3], Norton APMAP[3], Augusto APCM[3].

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VERNIS FLUORÉ

Effect of Fluoride Varnish on Enamel Remineralization in Anterior Teeth with Molar Incisor Hypomineralization

Manuel Restrepo*/ Fabiano Jeremias**/ Lourdes Santos-Pinto***/ Rita CL Cordeiro****/ Angela CC Zuanon *****

Objective: The objective of this study was to investigate the effect of fluoride varnish on remineralization of anterior teeth affected by Molar-Incisor Hypomineralization (MIH) by means of Quantitative Light-Induced Fluorescence- QLF. Study design: Fifty-one healthy 9 – 12- year-old children were selected according to different clinically diagnosed levels of MIH, proposed by the European Academy of Pediatric Dentistry (2003) (considering the most severe lesion per patient, n= 51 lesions), and randomly divided into two groups: (1) four applications of 5% NaF varnish, with one-week interval, and (2) usual home care- control. At each visit, the mean change in fluorescence and area of lesion were measured by QLF. The data were analyzed by repeated measures ANOVA and Tukey's test. Results: All patients showed enamel alterations in first permanent molars and incisors, frequently with two molars affected by MIH (41.1%). There was no statically significant difference in the mean of fluorescence and area of lesion between groups over the studied time. Conclusion: We observed no favorable effect on the remineralization of MIH lesions in anterior teeth after four applications of fluoride varnish.

Key words: Fluorescence; Fluoride; Molar Incisor Hypomineralization; Tooth remineralization.

INTRODUCTION

Molar Incisor Hypomineralization (MIH) is an enamel defect that mainly affects permanent first molars, while permanent incisors are often affected to a lower degree and with variable severity. The etiology is unclear, however, etiological associations with systemic conditions, environmental insults during the child's first 3 years of life, and genetic variations have been implicated. [1-3]

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Clinically, MIH may present as discrete opacities, with color ranging from white to yellow-brown, asymmetrical in appearance and sharp demarcation between sound and affected enamel.[4] Commonly the enamel of one molar can be severely affected whilst the enamel of the contra-lateral molar is clinically unaffected, or has only minor defects.[5] These teeth are porous,[6] impacting on oral health, which can lead to unusual cavitation, enamel disintegration, hypersensitivity, secondary caries, atypical restorative treatments, loss of fillings and extraction of the affected teeth. Consequently, the affected teeth often require repeated treatment.[7]

Treatment of teeth affected by MIH consists of a minimally invasive approach by reinforcing and protecting the existing dental structure.[8-10] Caries remineralizing agents are often recommended for MIH management in order to increase mineral content of the hypomineralized areas, however, scientific evidence of the effectiveness of this treatment is still limited. After over 50 years of clinical success, fluoride serves as the gold standard remineralizing agent. When fluoride is applied on teeth, there is precipitation of minerals (calcium fluoride-like deposits and fluorapatite).[11] Calcium fluoride serves as a source of fluoride for the formation of fluorapatite, thereby inhibiting demineralization and enhancing remineralization.[11]

Researchers have shown an increasing interest in non-destructive methods for the quantitative assessment and longitudinal monitoring of mineral changes in enamel, such as Quantitative Light-Induced Fluorescence- QLF. QLF is a system based on the measurement of loss of fluorescence subsequent to enamel demineralization. QLF has also shown the ability to detect and quantify

51 sujets

1 application par semaine x 4 semaines

TEST : QLF (fluorescence)

Conclusion :

Aucune différence significative

***Conclusion**: The results of this study revealed that gender is an important factor in the sensitivity of teeth with MIH. Desensitizing agents effectively reduced the hypersensitivity of teeth with MIH. CPP-ACP paste was found to be more effective, and ozone therapy prolonged the effect of CPP-ACP paste.*

Clinical Evaluation of Desensitizing Treatment for Incisor Teeth Affected by Molar-Incisor Hypomineralization

Betül Memiş Özgül* / Sinem Saat ** / Hayriye Sönmez*** / Firdevs Tulga Öz****

Background: Sensitivity complaints are commonly observed in teeth affected by MIH (molar incisor hypomineralization). Aim: This study aimed to evaluate the hypersensitivity observed in MIH-affected teeth and the effect of desensitizing agents applied with and without ozone to incisors affected by MIH. Study Design: The first part of the study included 120 teeth from 42 patients with MIH. These 42 patients included 33 children with 92 incisor teeth with a Vas score of ≥30, and these 92 incisors were included in the second part of the study. The patients included in the second part were divided into three main groups and six subgroups. The main groups included the following: fluoride, CPP-ACP and CPP-ACP with fluoride. Each main group was divided into two subgroups: one with ozone use and one without ozone use. Results: Girls exhibited significantly more sensitivity compared with boys ($p<0.05$). There were significant decreases in hypersensitivity compared to baseline in all of the groups ($p<0.05$). There were no differences among the groups at the end of the study ($p>0.05$). Conclusion: The results of this study revealed that gender is an important factor in the sensitivity of teeth with MIH. Desensitizing agents effectively reduced the hypersensitivity of teeth with MIH. CPP-ACP paste was found to be more effective, and ozone therapy prolonged the effect of CPP-ACP paste.

Keywords: Hypersensitivity, MIH, CPP-ACP, Children

INTRODUCTION

The term molar incisor hypomineralisation (MIH) defines a situation in which hypomineralization of one or more first permanent molars is clinically noted and in which incisors are frequently affected.[1] For a clinical diagnosis of MIH, the four first permanent molars and eight incisor teeth should be examined for demarcated opacities.[2]

Sensitivity complaints are commonly associated with MIH. Hot and cold or sweet drinks and meals, toothbrushing and even air flow may lead to hypersensitivity in patients with MIH.[1-3] Due to this sensitivity, patients may have difficulty maintaining adequate oral hygiene, and in severe MIH cases, affected molars face the risk of caries, especially immediately after eruption.[4,5]

To increase mineralization and eliminate sensitivity, remineralization therapy is recommended as soon as an MIH defect is identified.[6,7] Topical fluoride application in either gel or varnish form may be used to inhibit sensitivity and demineralization.[8] Recently, dental products containing casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) have also been recommended for remineralization and inhibition of sensitivity.[1,9] However, to our knowledge, there is no study in the literature addressing the elimination of sensitivity in teeth affected by MIH.

Ozone has been widely used for disinfecting drinking water for over 100 years.[10] More recently, ozone has been used as a disinfecting agent for removable prosthetics[11] and dental units,[12] as an antibacterial agent during caries removal[13] and in root canal treatment.[14,15] Several studies have shown that ozone also increases the diameter of dentin tubules, which could facilitate the ingress of minerals.[16,17]

This study aimed to evaluate the short-term desensitizing effect of desensitizing agents applied with and without ozone to incisors affected by MIH.

MATERIAL AND METHOD

A research protocol was submitted to the Ethics Committee of the Ankara University Faculty of Dentistry in Ankara, Turkey, and oral and written informed consent was given by parents/guardians of the study participants.

The study was conducted in two parts. The first part of the study was conducted on a population of children diagnosed with MIH during a visit to our clinic between January 2011- March 2011. In total, 42 children aged 7-12 with 120 anterior teeth affected by MIH were included in this part of the study. Subjects were grouped according to sex, lesion color (white-cream, yellow-brown) and tooth location (mandible, maxilla). Only patients with one or more pairs of lesions were included. Teeth diagnosed with MIH were evaluated for sensitivity to cold stimuli by two practitioners using a

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Clinical evaluation of desensitizing treatment for incisor teeth affected by molar-incisor hypomineralization.
Ozgül BM, **Saat S**, Sönmez H, Oz FT.
J Clin Pediatr Dent. 2013 Winter;38(2):101-5.

3 mois

2 interventions seulement

At four weeks, following the recording VAS scores, the treatment protocol was repeated, and responses to cold stimuli were recorded immediately and after 8 weeks (three months after the initial treatment).

Group 1:

1A: Fluoride Varnish (n=15): A few drops of Biflorid 12 (Voco, Germany) were applied with a cotton pellet using a gentle but firm rubbing motion. After 120 seconds, excess material was wiped away.

1B: Ozone + Fluoride varnish (n=15): Teeth were treated with ozone gas delivered using an OzonyTronX (Mymed GmbH, Rosenheim, Germany) oxygen activation generator for 120 s at a setting of 1 with the mushroom-tip (GI probe) supplied with the generator. Following ozone application, a few drops of Biflorid 12 were applied as described above.

Group 2:

2A: CPP-ACP Paste (n=15): A small amount of GC Tooth Mousse (Recaldent™, Australia) was applied as described above for fluoride varnish.

2B:Ozone + CPP-ACP paste (n=15): Teeth were treated with ozone gas as described above. Following ozone application, GC Tooth Mousse was applied as described above.

Group 3:

3A: Fluoride-containing CPP-ACP paste (n=16): A small amount of MI Paste Plus (Recaldent™, Australia) was applied as described above for fluoride varnish.

3B: Ozone + Fluoride-containing CPP-ACP paste (n=16): Teeth were treated with ozone gas as described above. Following ozone application, MI Paste Plus was applied as described above.

Restrepo et al.[47] and Ozgul et al.[45] reported the reduction of dental hypersensitivity in MIH-affected teeth after application of fluoride varnish. These results are similar to those found by other authors[73–77] in patients without MIH, who reported a decrease in dental hypersensitivity after the use of fluoride varnishes. Thus, fluoride varnish treatments may be considered a therapeutic option in cases of MIH-related dental hypersensitivity.

J Esthet Restor Dent. 2019 Jan;31(1):26-39. doi: 10.1111/jerd.12420. Epub 2018 Oct 4.

Dental hypomineralization treatment: A systematic review.

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FLUOR

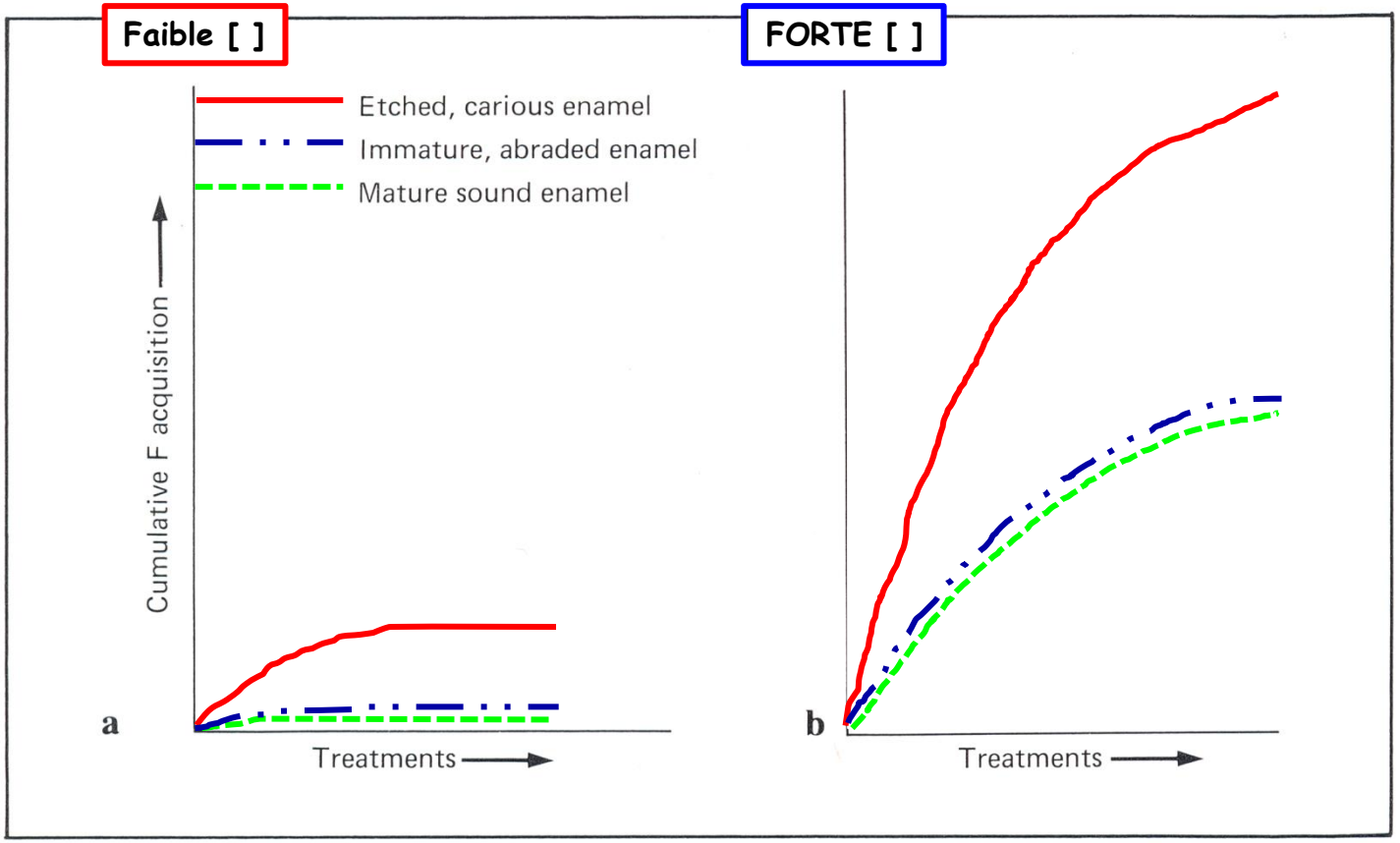
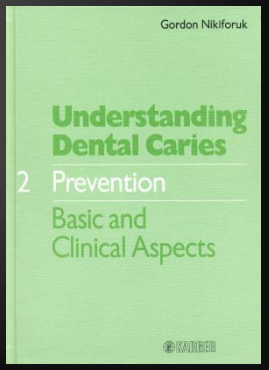


Fig. 4/1. Approximation of fluoride uptake from **(a)** low concentration and **(b)** high concentration of fluoride by etched (carious), immature, abraded and mature sound enamel [courtesy of *Mellberg*, 1982].

Page 64

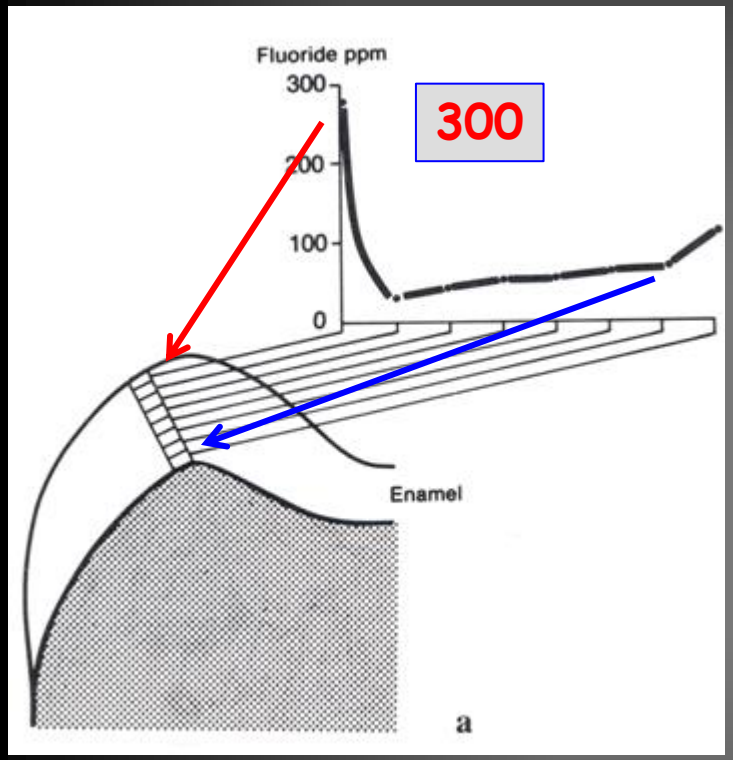
L'émail mature acquiert le moins de F-, l'émail immature un peu plus et un émail carié beaucoup plus

La concentration des Fluorures topiques influence la quantité de F^- qui sera déposé dans l'émail

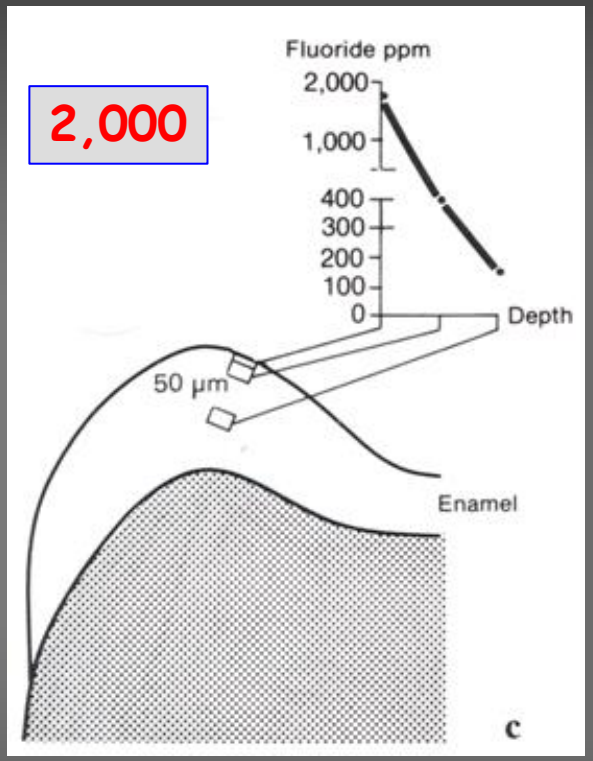


Gradient de concentration de fluor dans l'émail

Dent non encore éruptée



Éruption dans une zone non fluorée



Éruption dans une zone fluorée

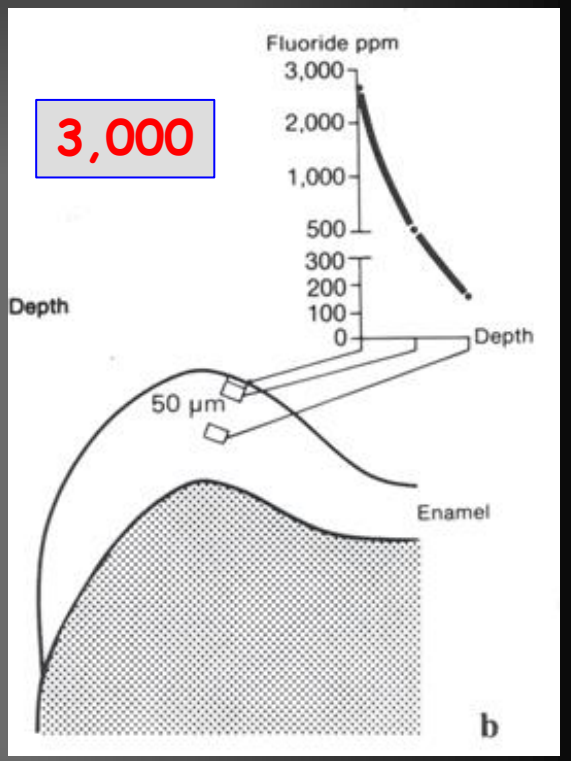
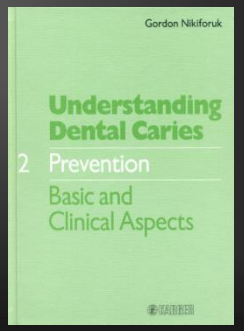


Fig. 3/1. Diagrammatic representation of the gradient concentration of fluoride in enamel. Fluoride concentration is the highest in surface enamel and decreases towards the inner parts. **a** In unerupted teeth. **b** In erupted teeth from fluoride area. **c** In erupted teeth from non-fluoride areas [redrawn from *Weatherell* et al., 1977].



- À pH égal … + grande est la déminéralisation lorsque la [ ] en F^- dans la solution diminue ↓
- À [ ] égale de F^- dans la solution … + grande est la déminéralisation lorsque le pH diminue ↓
- Le pH et la concentration en F dans la solution influencent le niveau de déminéralisation observée

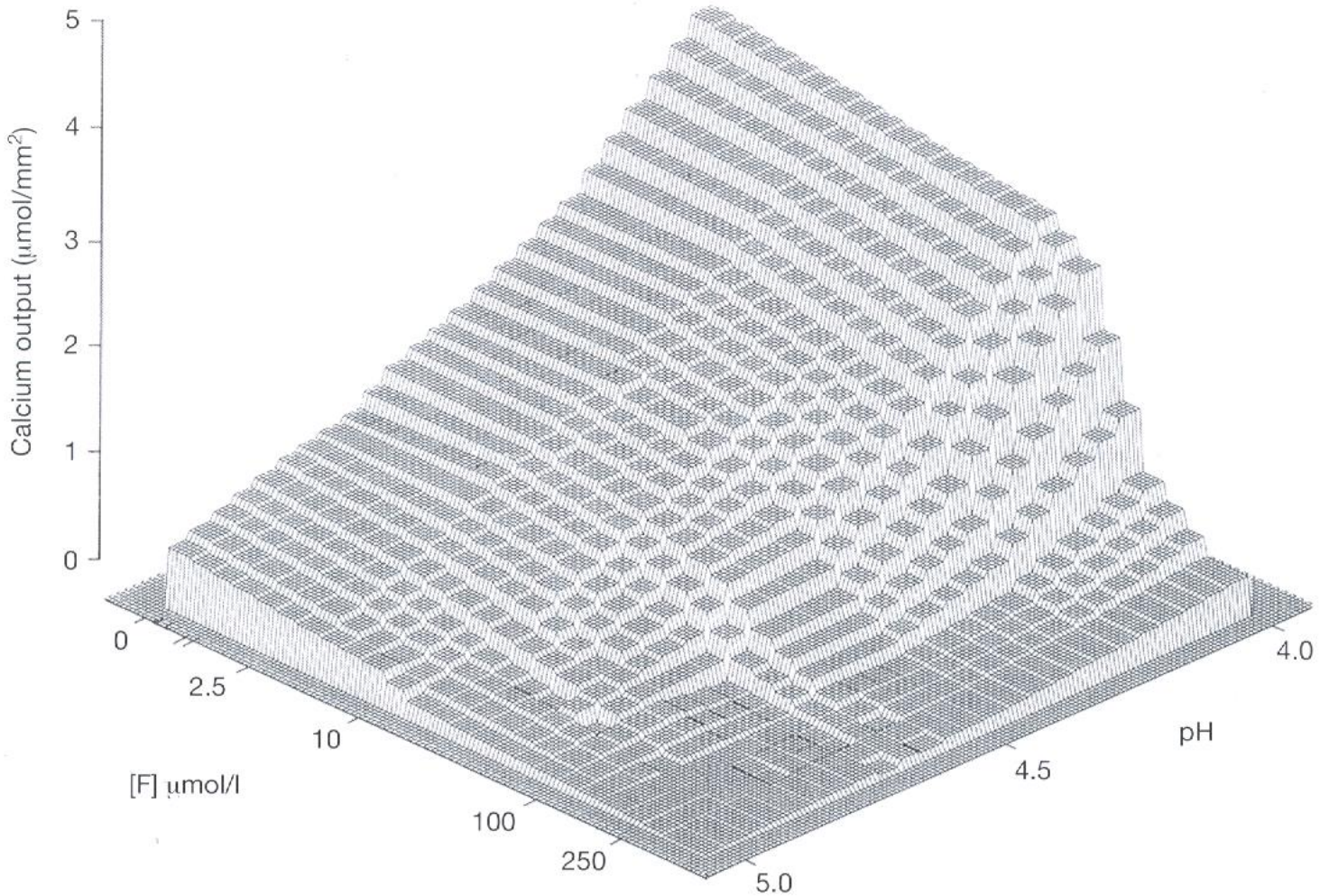


Figure 12.2 Calcium output for enamel during demineralization in solutions initially containing 2.2 mmol/l calcium chloride and 2.2 mmol/l potassium phosphate, adjusted to the pH and fluoride [F] levels indicated. (For original figure refer to ten Cate & Duijsters, 1983a.)

ARGINE


Colgate
Sensitive Pro-Relief
REPAIR + FAIL
Colgate
Fluoride Toothpaste
Sensitive Pro-Relief
Instant
& Lasting Relief
clinically proven PRO-ARGIN FORMULA
ENAMEL REPAIR
22 mL
NPN 80017891

Bekes et al.[39] proposed the application of an arginine paste to MIH-affected teeth in order to reduce the associated hypersensitivity. Arginine promotes the sealing of the dentinal tubules, decreasing the number of sensory afferents exposed, thus blocking the hydrodynamic pain mechanism.[71,72] Yang et al.[72] performed a meta-analysis on the application of arginine toothpaste as a desensitizing agent and concluded that an 8-week use decreased dental hypersensitivity. The results are consistent with Bekes et al.[39] who reported a significant decrease in hypersensitivity 8 weeks after 2 applications of an arginine desensitizing paste on teeth with MIH. Such results suggest that arginine paste can be recommended as a desensitizing agent for teeth affected with MIH.

39. Bekes K, Heinzelmann K, Lettner S, Schaller HG. Efficacy of desensitizing products containing 8% arginine and calcium carbonate for hypersensitivity relief in MIH-affected molars: an 8-week clinical study. *Clin Oral Investig*. 2017;21(7):2311-2317.

71. Sharif MO, Iram S, Brunton PA. Effectiveness of arginine-containing toothpastes in treating dentine hypersensitivity: a systematic review. *J Dent*. 2013;41(6):483-492.

72. Yang ZY, Wang F, Lu K, et al. Arginine-containing desensitizing toothpaste for the treatment of dentin hypersensitivity: a meta-analysis. *Clin Cosmet Investig Dent*. 2016;8:1-14.

J Esthet Restor Dent. 2019 Jan;31(1):26-39. doi: 10.1111/jerd.12420. Epub 2018 Oct 4.

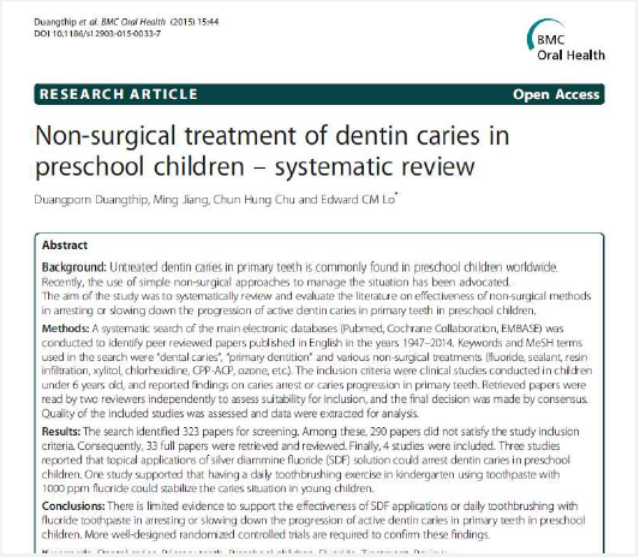
Dental hypomineralization treatment: A systematic review.

da Cunha Coelho ASE[1,2], Mata PCM[3], Lino CA[1], Macho VMP[3], Areias CMFGP[3], Norton APMAP[3], Augusto APCM[3].

Silver Diamine Fluoride SDF

FDA approved as device for dentin desensitization on subjects over 21 years

Silver Diamine Fluoride



Duangthip et al. BMC Oral Health (2015) 15:44
DOI 10.1186/s12903-015-0033-7

BMC Oral Health

RESEARCH ARTICLE Open Access

Non-surgical treatment of dentin caries in preschool children – systematic review

Duangporn Duangthip, Ming Jiang, Chun Hung Chu and Edward CM Lo*

Abstract

Background: Untreated dentin caries in primary teeth is commonly found in preschool children worldwide. Recently, the use of simple non-surgical approaches to manage the situation has been advocated. The aim of the study was to systematically review and evaluate the literature on effectiveness of non-surgical methods in arresting or slowing down the progression of active dentin caries in primary teeth in preschool children.

Methods: A systematic search of the main electronic databases (Pubmed, Cochrane Collaboration, EMBASE) was conducted to identify peer reviewed papers published in English in the years 1947–2014. Keywords and MeSH terms used in the search were "dental caries", "primary dentition" and various non-surgical treatments (fluoride, sealant, resin infiltration, xylitol, chlorhexidine, CPP-ACP, ozone, etc). The inclusion criteria were clinical studies conducted in children under 6 years old, and reported findings on caries arrest or caries progression in primary teeth. Retrieved papers were read by two reviewers independently to assess suitability for inclusion, and the final decision was made by consensus. Quality of the included studies was assessed and data were extracted for analysis.

Results: The search identified 323 papers for screening. Among these, 290 papers did not satisfy the study inclusion criteria. Consequently, 33 full papers were retrieved and reviewed. Finally, 4 studies were included. Three studies reported that topical applications of silver diammine fluoride (SDF) solution could arrest dentin caries in preschool children. One study supported that having a daily toothbrushing exercise in kindergarten using toothpaste with 1000 ppm fluoride could stabilize the caries situation in young children.

Conclusions: There is limited evidence to support the effectiveness of SDF applications or daily toothbrushing with fluoride toothpaste in arresting or slowing down the progression of active dentin caries in primary teeth in preschool children. More well-designed randomized controlled trials are required to confirm these findings.

Silver: antibacterial

Fluoride: remineralizing agent

Use:
Dentin desensitization
caries arrest
caries prevention

	Professionnel	Soins quotidiens	Évidence scientifique	Considérations importantes
CPP-ACP		✓	Questionnable Peu testé pour MIH	Observance thérapeutique 120 jours Coût
Arginine		✓	Recommandé Documenté Peu testé pour MIH	Observance thérapeutique 56 jours 8 semaines / 2 fois par jour Coût
Vernis fluoré	✓		Recommandé Documenté Peu testé pour MIH	Stat … immédiat ? Nombre d'interventions ? Programmation SDP
FDA – Fluorure Diamine d'Argent	✓		Documenté FDA Approved Peu testé pour MIH	Stat … immédiat Programmation SDP Taches Consentement parental

Dépistage à la maternelle 5 ans

- [x] À risque élevé de carie dentaire ?
- [x] Besoin évident de traitement
- [x] Hypersensibilité … brossage des dents … douleur à la mastication
- [x] Évaluation du risque en lien avec l'hypominéralisation
  (triade : hypersensibilité, carie dentaire et destruction post-éruptive)
- [ ] Fluorure Diamine d'argent

SPI - Suivi préventif individualisé

- [ ] Intensité augmentée ou adaptée ?
  (exemples : > 2 applications de vernis fluoré, > 2 SPI par année)

2e année primaire, sélection des enfants / agents de scellement

- [ ] Scellant conventionnel avec ou sans adhésif hydrophile
- [ ] Scellant conventionnel vs Scellant de verre ionomère
- [ ] Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

DESTRUCTION POST-ÉRUPTION

COULEUR

OCCLUSION

DESTRUCTION

PEB – Post Enamel Breakdown



http://dympnadalydentist.com/gallery/

Éruption incomplète, sans occlusion

12 mois

18 mois

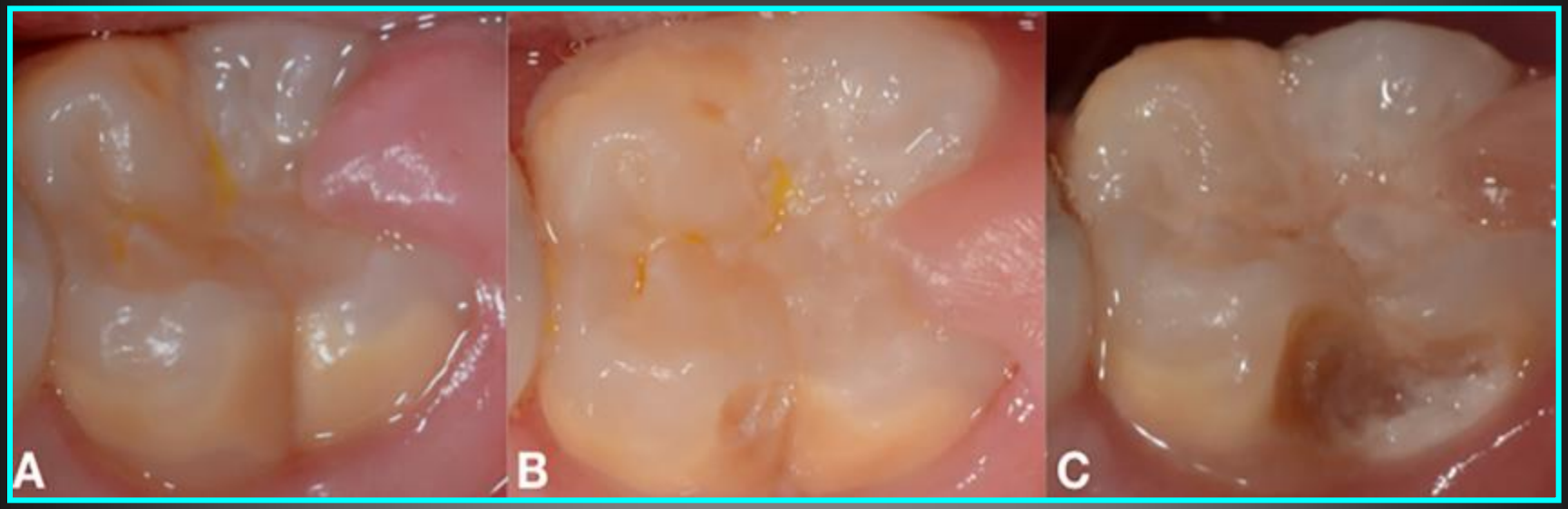


Fig. 4 Progression of MIH severity in the buccal surface of a first permanent molar over 18 months. **a** MIH yellow/brown opacity on the buccal surface at baseline, **b** post-eruptive breakdown of enamel on the buccal surface after 12 months, and **c** the severity of MIH increased to dentin exposure after 18 months

Reliability and validity of a new classification of MIH based on severity.
Cabral RN, Nyvad B, Soviero VLVM, Freitas E, Leal SC.
Clin Oral Investig. 2019 May 25. doi: 10.1007/s00784-019-02955-4. [Epub ahead of print]

Results. Brown and yellow MIH opacities were at higher risk for PEB and atypical restorations than those of white ones, even after adjustment for clinical and demographic variables.

Conclusion. Teeth presenting mild MIH severity associated with yellow and brown enamel opacities were at high risk for increase in severity of MIH than lighter ones. This result could help clinicians determine a risk-based treatment for children with MIH.

Increase in severity of molar-incisor hypomineralization and its relationship with the colour of enamel opacity: a prospective cohort study.

Da Costa-Silva CM, Ambrosano GM, Jeremias F, De Souza JF, Mialhe FL.

Int J Paediatr Dent. **2011** Sep;21(5):333-41. doi: 10.1111/j.1365-263X.**2011**.01128.x. Epub **2011** Apr 6.

INTERNATIONAL JOURNAL OF PAEDIATRIC DENTISTRY

Increase in severity of molar–incisor hypomineralization and its relationship with the colour of enamel opacity: a prospective cohort study

CRISTIANE M. DA COSTA-SILVA, GLAUCIA M. B. AMBROSANO, FABIANO JEREMIAS, JULIANA F. DE SOUZA & FÁBIO L. MIALHE

3

MIH-Lésions blanches

15

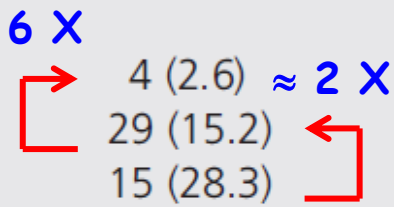
MIH- jaunâtre

MIH-brunâtre

28

Table 3. Adjusted RR for increase in severity of MIH at tooth level after 18 months' follow-up.

Variables	Baseline (*N*)	Increase in MIH severity (FE) *N* (%)	Adjusted values* RR	95% CI	*P*
Colour of MIH opacity					
White	154	4 (2.6)	1.00		
Yellow	191	29 (15.2)	5.37	1.72–16.76	0.0037
Brown	53	15 (28.3)	9.46	2.94–30.44	0.0002
Years of age					
≥10 years	223	19 (8.5)	1.00	1.01–3.06	0.0443
<10 years	175	29 (16.6)	1.76		
Caries increment					
>0	172	39 (17.3)	3.22	1.28–8.33	0.0129
0	226	9 (5.2)	1.00		



*Poisson regression.
RR, Relative Risk; MIH, molar–incisor hypomineralization.

Table 1. Increase in severity of MIH according to the colour of enamel opacity after 18 months.

Type of teeth	Colour of MIH (baseline) *n* (%)	Increase in severity of MIH at follow-up: Mild PEB (limited to enamel) *n* (%)	Extensive PEB (enamel + dentine) *n* (%)	Atypical restorations *n* (%)
Molars	White – 83 (31.5)	4 (3.6)	–	–
	Yellow – 148 (57.4)	8 (4.1)	9 (6.2)	11 (7.6)
	Brown – 31 (11.2)	–	6 (14.3)	4 (17.8)

PEB, posteruptive enamel breakdown; MIH, molar–incisor hypomineralization.

Clinical Oral Investigations
https://doi.org/10.1007/s00784-018-2479-x

ORIGINAL ARTICLE

Breakdown of demarcated opacities related to molar-incisor hypomineralization: a longitudinal study

Aline Borburema Neves[1] · Gabriela Caldeira Andrade Americano[1,2] · Daniella Varela Soares[1] · Vera Mendes Soviero[1,2]

Received: 2 September 2016 / Accepted: 26 April 2018

Abstract

Objectives This prospective longitudinal study aimed to evaluate if the occurrence of post-eruptive breakdown of demarcated opacities in hypomineralized teeth is influenced by the color or location of the opacity.

Materials and methods Patients diagnosed with molar-incisor hypomineralization (MIH) between 2012 and 2014 were eligible. Two calibrated examiners performed the initial and follow-up evaluations according to European Academy of Paediatric Dentistry (EAPD) criteria. Sixty-five patients were included. Fifty-eight (89.2%), with a mean age of 8.8 years (SD: 1.4), were reassessed after 1 year. Two hundred and nine of 1155 tooth surfaces were considered for the study: 86 with white opacity (OP-W), 91 with yellow opacity (OP-Y), and 32 with enamel breakdown (EB).

Results From the OP-W, OP-Y, and EB, 14, 27.5, and 46.9% worsened to breakdown exposing dentin, atypical restoration, or extraction (DB + RA or EXT), respectively. Yellow opacities tended to be more prone to breakdown than white opacities. The occurrence of EB, DB + AR, or EXT was not influenced by the location ($p = 0.25$).

Conclusions The color of the opacity seems to play an important role on the occurrence of fracture and should be considered as a potential predictor.

Clinical relevance Dentists should be aware that demarcated opacities related to MIH tend to fracture over time. Moreover, children with MIH should be seen at shorter intervals.

Keywords Dental enamel hypoplasia · Prognosis · Demarcated opacity · Post-eruptive enamel breakdown

Introduction

Molar-incisor hypomineralization (MIH) is described as an enamel qualitative defect that affects one to four permanent first molars frequently associated with permanent incisors also affected. Clinically, the hypomineralized enamel is characterized by demarcated opacities [1, 2].

The defective enamel has a high content of carbon (C) and low contents of phosphorus (P) and calcium (Ca) when compared with normal enamel [3]. Thus, the hardness of the hypomineralized enamel is lower. Furthermore, this enamel shows prism edges and crystals less distinct, and the interprismatic space more marked resulting in a more porous enamel [3]. The lower strength of the hypomineralized enamel often results in post-eruptive breakdown [1, 4].

The color of the demarcated opacities may reflect the degree of hypomineralization. Studies have shown a correlation between the color of the MIH enamel opacities and the mineral content [5]. Yellow-brownish opacities are more porous than the whitish ones [6] and, consequently, tend to be at a higher risk of fracture after eruption [7, 8]. It has also been suggested that masticatory forces on the hypomineralized enamel have an important role in the occurrence of breakdown [1, 9].

Hence, the aim of this longitudinal study was to evaluate the following two hypotheses: (1) yellow-brownish opacities are more prone to fracture than the creamy-whitish ones and (2) demarcated opacities located in areas of the teeth directly exposed to masticatory attrition are more prone to fracture than those not exposed to the masticatory attrition.

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[2] Dental School, Faculdade Arthur Sá Earp Neto, Petrópolis, Brazil

Published online: 03 May 2018

14

MIH-Lésions blanches

28

MIH- Lésions jaunâtres

MIH-Aggravation PEB

47

Breakdown of demarcated opacities related to molar-incisor hypomineralization: a longitudinal study.

Neves AB, Americano GCA, Soares DV, Soviero VM.

Clin Oral Investig. 2019 Feb;23(2):611-615. doi: 10.1007/s00784-018-2479-x. Epub 2018 May 3.

The present study showed that demarcated opacities in permanent first molars related to MIH might breakdown with time. Yellow-brownish opacities broke more than white-creamy ones. This results are in agreement with previous findings reporting that MIH tend to become more severe in older children [11] and that opacities tend to aggravate over time [8, 12]. It has been already confirmed in microstructural analyses of hypomineralized teeth that the opacities represent areas, where the enamel presents lower mineral content and higher protein concentration in comparison to normal enamel. Therefore, the enamel in these areas might be fragile and prone to breakdown [3, 4, 13, 14].

Blanc < Jaune ou brun

Corrélé avec la composition de l'émail en minéraux

The higher occurrence of breakdown in the yellow-brownish opacities in comparison with the white-creamy ones is supported by in vitro studies showing that the mineral content in the enamel is related to the color of the opacity [5, 15]. Yellow-brownish opacities are more porous, have less mineral, and present lower values of microhardness in comparison with the white-creamy opacities [5, 15].

PEB – Destruction post éruptive s'aggrave avec le temps

Tooth surfaces already showing enamel breakdown at baseline tend to aggravate to breakdown exposing dentin significantly more frequent, although around half of them remained unchanged after 1 year.

Breakdown of demarcated opacities related to molar-incisor hypomineralization: a longitudinal study.
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Clin Oral Investig. 2019 Feb;23(2):611-615. doi: 10.1007/s00784-018-2479-x. Epub **2018** May 3.

	Follow-up							
	No progression to breakdown			EB		DB + AR + EXT		
Baseline	*n*	%		*n*	%	*n*	%	Total
OP-W	72	83.7	16,3 %	2	2.3	12	14	86
OP-Y	53	58.2	41,8 %	13	14.3	25	27.5	91
EB				17	53.1	15	46.9	32
								209

OP-W white-creamy opacity, *OP-Y* yellow-brownish opacity, *EB* enamel breakdown, *DB* dentin breakdown, *AR* atypical restoration, *EXT* extraction

Table 1 Proportion of OP-W and OP-Y detected in permanent first molars at the baseline that progressed to enamel breakdown and OP-W, OP-Y, and EB that progressed to dentin breakdown after 1 year

Breakdown of demarcated opacities related to molar-incisor hypomineralization: a longitudinal study.
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Baseline	Exposed to masticatory forces?		Follow-up: No progression to breakdown *n*	No progression to breakdown %	EB *n*	EB %	DB + AR + EXT *n*	DB + AR + EXT %	Total
OP-W	No	9,1 %	30	90.9	0	0	3	9.1	33
16,3 %	Yes	20,8 %	42	79.2	2	3.8	9	17	53
OP-Y	No	44,0 %	28	56	8	16	14	28	50
41,8 %	Yes	39,0 %	25	61	5	12.2	11	26.8	41
EB	No				7	70	3	30	10
	Yes				10	45.5	12	54.5	22
									209

OP-W white-creamy opacity, *OP-Y* yellow-brownish opacity, *EB* enamel breakdown, *DB* dentin breakdown, *AR* atypical restoration, *EXT* extraction

Breakdown of demarcated opacities related to molar-incisor hypomineralization: a longitudinal study.

Neves AB, Americano GCA, Soares DV, Soviero VM.

Clin Oral Investig. 2019 Feb;23(2):611-615. doi: 10.1007/s00784-018-2479-x. Epub **2018** May 3.

Table 2 Proportion of OP-W and OP-Y detected in permanent first molars at the baseline that progressed to enamel breakdown and OP-W, OP-Y, and EB that progressed to dentin breakdown according to the type of tooth surface after 1 year

Sur 12 mois

Enfants âgés en moyenne de 8,8 ans

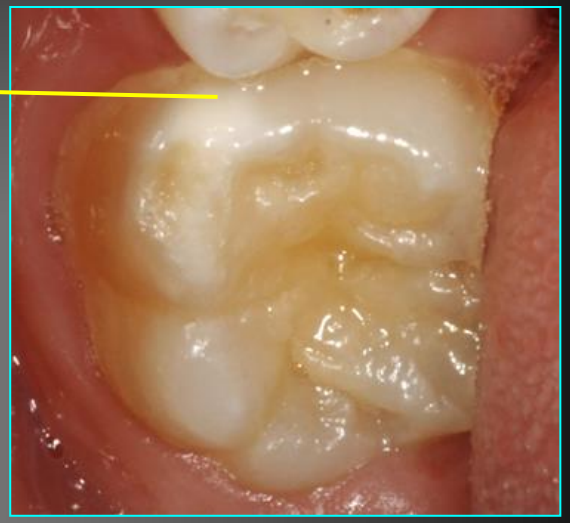
Breakdown of demarcated opacities related to molar-incisor hypomineralization: a longitudinal study.

Neves AB, Americano GCA, Soares DV, Soviero VM.

Clin Oral Investig. 2019 Feb;23(2):611-615. doi: 10.1007/s00784-018-2479-x. Epub 2018 May 3.

9 %

21 %



39 %

47 %

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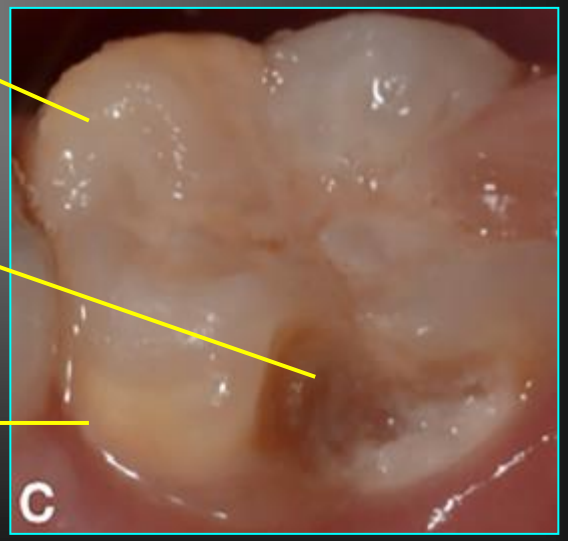

Intervenir tôt

- **Reminéraliser**
  (vernis fluoré, ACP-CPP, Fluorure diamine d'argent, dentifrice 5,000 ppm)

- **Restaurer / recouvrir**
  (CAI, restauration indirecte, composite, scellant dentaire, verre ionomère)

Dépistage à la maternelle 5 ans

- [x] À risque élevé de carie dentaire ?
- [x] Besoin évident de traitement
- [x] Hypersensibilité … brossage des dents … douleur à la mastication
- [x] Évaluation du risque en lien avec l'hypominéralisation
  (triade : hypersensibilité, carie dentaire et destruction post-éruptive)
- [x] Fluorure Diamine d'argent

SPI - Suivi préventif individualisé

- [ ] Intensité augmentée ou adaptée ?
  (exemples : > 2 applications de vernis fluoré, > 2 SPI par année)

2e année primaire, sélection des enfants / agents de scellement

- [ ] Scellant conventionnel avec ou sans adhésif hydrophile
- [ ] Scellant conventionnel vs Scellant de verre ionomère
- [ ] Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

Approuvé par la FDA (Food and Drug Administration) pour traiter l'hypersensibilité

FLUORURE DIAMINE D'ARGENT

Arresting Dentine Caries with Silver Diamine Fluoride: What's Behind It?

Journal of Dental Research
2018, Vol. 97(7) 751–758

DOI: 10.1177/0022034518774783
journals.sagepub.com/home/jdr

M.L. Mei[1], E.C.M. Lo[1], and C.H. Chu[1]

Abstract

Unlike other fluoride-based caries preventive agents, silver diamine fluoride (SDF) can simultaneously prevent and arrest coronal and root dentine caries. The profound clinical success of SDF has drawn many clinicians and researchers to study the mechanism of SDF in arresting dentine caries. This critical review discusses how silver and fluoride contribute to caries arrest, in terms of their effects on bacteria as well as on the mineral and organic content of dentine. Silver interacts with bacterial cell membrane and bacterial enzymes, which can inhibit bacterial growth. Silver can also dope into hydroxyapatite and have an antibacterial effect on silver-doped hydroxyapatite. Furthermore, silver is also a strong inhibitor of cathepsins and inhibits dentine collagen degradation. Early studies proposed that silver hardened caries lesions by forming silver phosphate. However, recent studies found that little silver phosphate remained on the arrested dentine lesion. The principal silver precipitate was silver chloride, which could not contribute to the significant hardening of the arrested lesions. On the other hand, fluoride enhances mineral formation by forming fluorohydroxyapatite with reduced solubility. A significant increase in microhardness occurs with an elevated level of calcium and phosphorus but not silver on the surface layer of the arrested dentine caries lesion following SDF treatment. Fluoride also inhibits matrix metalloproteinases activities and therefore inhibits dentine collagen degradation. The combination of silver and fluoride in an alkaline solution has a synergistic effect in arresting dentine caries. The

The principal silver precipitate was silver chloride, which could not contribute to the significant hardening of the arrested lesions. On the other hand, fluoride enhances mineral formation by forming fluorohydroxyapatite with reduced solubility. A significant increase in microhardness occurs with an elevated level of calcium and phosphorus but not silver on the surface layer of the arrested dentine caries lesion following SDF treatment.

irreversible and could spread rapidly. Hence, the traditional management of dentine caries has focused primarily on treatment via the excision of diseased tissues and the subsequent restoration of the defect. It should be noted that mechanical tooth preparation is a destructive and irreversible procedure in

rium lies within the diamine-silver ion (Chu and Lo 2008b). The stability of the reagent is crucial in arresting the progress of caries. In a study that measured concentrations of fluoride and silver ions in several commercially available SDF products, no significant change in the fluoride and silver ion con-

Mei ML, Nudelman F, Marzec B, Walker JM, Lo ECM, Walls AW, Chu CH. 2017. Formation of fluorohydroxyapatite with silver diamine fluoride. J Dent Res. 96(10):1122–1128.

dental clinicians. SDF's ability to halt the caries process and to simultaneously prevent the formation of new caries makes SDF different from other caries-preventive agents, such as sodium fluoride (5%) and stannous fluoride (2% to 8%) (Rosenblatt et al. 2009). Clinical trials reported the success of using SDF to arrest coronal caries (Chu et al. 2002) and root caries (Tan et al. 2010). A meta-analysis found that the overall caries arrest rate for SDF was 81% (Gao et al. 2016).

SDF solution is composed of diamine-silver ion and fluoride ion. Diamine-silver ion is a complex produced by attaching 2 ammonia molecules to a silver ion. Ammonia is a stronger field ligand than water is in the spectrochemical series.

(Fung et al. 2018). Manufacturers have not disclosed all of the ingredients in their SDF products, so the ingredients of different brands of SDF products may vary. According to the available information, a SDF product (Cariestop 30%; Biodinamica)

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Formation of Fluorohydroxyapatite with Silver Diamine Fluoride

Journal of Dental Research
2017, Vol. 96(10) 1122–1128

DOI: 10.1177/0022034517709738
journals.sagepub.com/home/jdr

M.L. Mei[1], F. Nudelman[2], B. Marzec[2], J.M. Walker[2], E.C.M. Lo[1], A.W. Walls[3], and C.H. Chu[1]

Abstract

Silver diamine fluoride (SDF) is found to promote remineralization and harden the carious lesion. Hydroxyapatite crystallization is a crucial process in remineralization; however, the role of SDF in crystal formation is unknown. We designed an in vitro experiment with calcium phosphate with different SDF concentrations (0.38, 1.52, 2.66, 3.80 mg/mL) to investigate the effect of this additive on the nucleation and growth of apatite crystals. Two control groups were also prepared—calcium phosphate ($CaCl_2 \cdot 2H_2O + K_2HPO_4$ in buffer solution) and SDF ($Ag[NH_3]_2F$ in buffer solution). After incubation at 37 °C for 24 h, the shape and organization of the crystals were examined by bright-field transmission electron microscopy and electron diffraction. Unit cell parameters of the obtained crystals were determined with powder X-ray diffraction. The vibrational and rotational modes of phosphate groups were analyzed with Raman microscopy. The transmission electron microscopy and selected-area electron diffraction confirmed that all solids precipitated within the SDF groups were crystalline and that there was a positive correlation between the increased percentage of crystal size and the concentration of SDF. The powder X-ray diffraction patterns indicated that fluorohydroxyapatite and silver chloride were formed in all the SDF groups. Compared with calcium phosphate control, a contraction of the unit cell in the *a*-direction but not the *c*-direction in SDF groups was revealed, which suggested that small localized fluoride anions substituted the hydroxyl anions in hydroxyapatite crystals. This was further evidenced by the Raman spectra, which displayed up-field shift of the phosphate band in all the SDF groups and

In summary, the present study demonstrated that SDF reacts with calcium and phosphate ions and produces fluorohydroxy-apatite. This preferential precipitation of fluorohydroxyapatite with reduced solubility could be one of the main factors for arrest of caries lesions treated with SDF.

2013); ex vivo studies investigated the collected exfoliated primary teeth from the SDF clinical trials and found that a hardened and highly mineralized zone was formed in the outermost 150 µm of an SDF-treated carious lesion (Chu and Lo 2008; Mei, Ito, Cao, Lo, et al. 2014). Silver has a well-known antibacterial effect, and previous studies demonstrated that SDF inhibited cariogenic biofilm formation (Chu et al. 2012; Mei, Chu, et al. 2013; Mei, Li, et al. 2013).

However, only a few publications report the mode of action of SDF on mineralized tissue. Yamaga et al. (1972) suggested that the formation of calcium fluoride (CaF_2) and silver

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LE FLUORURE DIAMINE D'ARGENT TACHE-T-IL LES DENTS ATTEINTES PAR DE L'HYPOMINÉRALISATION ?

Compendium of Continuing Education in Dentistry

Prevention of Dental Caries by Silver Diamine Fluoride

Jeremy A. Horst, DDS, PhD; and Masahiro Heima, DDS, PhD

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https://cced.cdeworld.com/courses/5183-Prevention_of_Dental_Caries_by_Silver_Diamine_Fluoride

Image 3 of 3
Fig 3. SDF can stain erupting enamel. SDF was applied to the upper incisors while they were still erupting. The enamel at the erupting front (gingival margin) at the time of treatment was immature and porous. Significant amounts of silver penetrated into the enamel and oxidized, becoming apparent. The inciso-gingival extent of the stain shows that only the enamel that had erupted within the previous few weeks took up enough silver to become visible.

Application to erupting teeth in esthetic areas should be considered with caution. It is important to note that permanent teeth crowns can enter the mouth incompletely mineralized. While enamel always goes through a maturation process for years after eruption, in some patients (who do not have amelogenesis imperfecta) the emerging enamel is actually porous and takes at least a few weeks to close.[29] This concern is compounded because enamel hypomineralization increases caries risk, and, thus, the children who would benefit most from the preventive effect are also at the highest risk for stain. Figure 3 shows an example of stain at the gingival margin when SDF was applied. The enamel surface gingival to the dark stain shows by contrast that all other exposed enamel may have been more subtly stained. The inciso-gingival thickness of the stain shows that the enamel was no longer susceptible to stain after being bathed in saliva for a few weeks.

Dépistage à la maternelle 5 ans

- À risque élevé de carie dentaire ?
- Besoin évident de traitement
- Hypersensibilité … brossage des dents … douleur à la mastication
- Évaluation du risque en lien avec l'hypominéralisation
  (triade : hypersensibilité, carie dentaire et destruction post-éruptive)
- Fluorure Diamine d'argent

SPI - Suivi préventif individualisé

- Intensité augmentée ou adaptée ?
  (exemples : > 2 applications de vernis fluoré, > 2 SPI par année)

2e année primaire, sélection des enfants / agents de scellement

- [ ] Scellant conventionnel avec ou sans adhésif hydrophile
- [ ] Scellant conventionnel vs Scellant de verre ionomère
- [ ] Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

Dépistage à la maternelle 5 ans

- [x] À risque élevé de carie dentaire ?
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- [x] Fluorure Diamine d'argent

SPI - Suivi préventif individualisé

- [x] Intensité augmentée ou adaptée ?
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- [ ] Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

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Adhesion to Enamel of Teeth Affected by Molar Incisor Hypomineralization: Literature Review

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SUMMARY

Background/Aim: *Molar incisor hypomineralization (MIH) is a qualitative defect of systemic origin, affecting permanent first molars and often permanent incisors. The treatment modalities can include, amongst others, fissure sealants for prevention of dental caries and composite restorations. Both require adhesion to tooth structure. The aim of this study was to review the literature on the adhesion to enamel affected by MIH.* ***Material and Methods:*** *A search of PupMed/Medline, ResearchGate and Google Scholar was performed and limited between 2003, when the judgement criteria for MIH were set, and 2016. Thirty-three papers were considered relevant to the subject including five in vivo and six in vitro studies. Studies involving less than ten teeth were excluded.* ***Results:*** *A four-year clinical trial showed that the application of a total-etch 2-step adhesive system prior to sealant placement is superior to the etch-seal technique. Despite the high success rate of composite restorations shown in three clinical longitudinal studies, there are conflicting results over self-etch being superior to total etch adhesive systems. Pretreating the enamel surface, prior to the adhesive system, with fluoride preventive solutions could reduce the mikroleakage under orthodontic brackets. Three in vitro studies provide inconsistent data about NaOCl pretreating potentials to improve adhesion of composite restorations. Resin infiltration, prior to resin restorations, could improve the microhardness of defected enamel, which may lead to increased bond strength, especially in combination with NaOCl pretreatment.* ***Conclusions:*** *Adhesion to enamel affected by molar incisor hypomeralization is inferior compared to normal enamel. Sealants applied with the etch-bond-seal technique have greater retention than with the etch-seal technique. Further research is required to provide evidence of the effectiveness of the adhesive system and pretreatment to achieve optimal bonding to MIH.*

Conclusions: *Adhesion to enamel affected by molar incisor hypomeralization is inferior compared to normal enamel. Sealants applied with the etch-bond-seal technique have greater retention than with the etch-seal technique. Further research is required to provide evidence of the effectiveness of the adhesive system and pretreatment to achieve optimal bonding to MIH.*

Conclusions

Adhesion to enamel affected by molar incisor hypomeralization is inferior compared to normal enamel. Acid etching this enamel can cause more enamel loss and exposure of its organic content, leaving an undesirable etching pattern for bonding. The application of total-etch 2-step adhesive system can increase the retention of sealants. There is no evidence to support that self-etching adhesive systems are more effective than total etch systems when placing composite restorations. Deproteinazation of the protein enriched MIH enamel with NaOCl pretreatment could theoretically enhance adhesion. Further prospective randomized clinical trials are required to provide evidence based solutions to the clinician to treat effectively teeth affected by molar incisor hypomineralization.

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Bonding strategies for MIH-affected enamel and dentin

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ABSTRACT

Objectives. Aim of the present study was to evaluate resin composite adhesion to dental hard tissues affected by molar incisor hypomineralisation (MIH).

Methods. 94 freshly extracted human molars and incisors (53 suffering MIH) were used. 68 teeth (35 with MIH) were used for μ-TBS tests in enamel and dentin, 26 (18 with MIH) for qualitative evaluation. Specimens were bonded with Clearfil SE Bond, Scotchbond Universal, and OptiBond FL. For MIH affected enamel, additional OptiBond FL groups with NaOCl and NaOCl + Icon were investigated. Beside fractographic analysis, also qualitative evaluations were performed using SEM at different magnifications as well as histological sectioning.

Results. Highest μ-TBS values were recorded with dentin specimens (ANOVA, mod. LSD, $p < 0.05$). Results were independent of adhesive and dentin substrate ($p > 0.05$). Pre-test failures did not occur in dentin specimens. Sound enamel specimens exhibited significantly higher μ-TBS values than MIH enamel ($p < 0.05$). The two-step self-etch adhesive (Clearfil SE Bond) and the two-step etch-and-rinse adhesive (Scotchbond Universal) showed the lowest values in affected enamel specimens ($p < 0.05$) with most pre-test failures ($p < 0.05$). OptiBond FL on affected enamel showed better results than Clearfil SE Bond ($p < 0.05$). An additional pre-treatment of affected enamel with NaOCl or NaOCl and Icon did not enhance enamel bonding ($p > 0.05$), however, it caused less pre-test failures ($p < 0.05$). Micromorphological analyses revealed that conventional phosphoric acid etching produces a much less pronounced etching pattern in affected enamel and a porous structure as weak link for the resin-enamel bond was identified.

Significance. Bonding to porous hypomineralized MIH enamel is the limiting factor in adhesion to MIH teeth. MIH-affected dentin may be bonded conventionally.

1. Introduction

Restoration of teeth suffering molar incisor hypomineralization (MIH) is problematic due to both micromorphological changes of tooth hard tissues and pain history of respective children [1]. Overall clinical therapy outcome is inferior,

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Bonding to hypomineralized enamel – A systematic review

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ABSTRACT

The aim of this paper was to systematically analyze the published literature on bonding adhesive resin to hypomineralized enamel, in order to answer the questions: "Does resin dental adhesives achieve inferior bonding to hypomineralized enamel when compared to normal enamel?" "Does self-etch dental adhesives bond better to hypomineralized enamel when compared with etch-and-rinse adhesives?" "Does deproteinization with 5% NaOCl before adhesive application procedure enhance bonding performance of resin dental adhesives to hypomineralized enamel?" Three electronic databases (Pubmed, Scopus and ISI web of Science) were searched to identify original studies that evaluated the bond achieved between resin adhesives and hypomineralized enamel. Only articles that met the specific inclusion criteria were included in the review. Among 6 studies included in this review, 4 studies that tested bond strength of resin composite to hypomineralized enamel showed significantly lower bond strength than that to sound enamel. Bonding was not compared between adhesives in 5 included studies as only one adhesive was used. Three out of four studies showed improved bonding performances when deproteinization was performed with 5% NaOCl to hypomineralized enamel before adhesive application. Resin dental adhesives achieve inferior bonding to hypomineralized enamel when compared to normal enamel. There are no sufficient evidences to prove that self-etch dental adhesives bond better to hypomineralized enamel when compared with etch-and-rinse adhesives. Enamel deproteinization with 5% NaOCl before adhesive application procedure may enhance bonding performance of resin dental adhesives to hypomineralized enamel.

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1. Introduction

Enamel is the outermost layer of the crown of a tooth that protects underlying dentin and pulp tissue [1]. Enamel does not have the capacity to regenerate or repair. It is composed predominantly of inorganic structure, making up to 96% by weight and the remaining 4%

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0143-7496/

ABSTRACT

The aim of this paper was to systematically analyze the published literature on bonding adhesive resin to hypomineralized enamel, in order to answer the questions: "Does resin dental adhesives achieve inferior bonding to hypomineralized enamel when compared to normal enamel?" "Does self-etch dental adhesives bond better to hypomineralized enamel when compared with etch-and-rinse adhesives?" "Does deproteinization with 5% NaOCl before adhesive application procedure enhance bonding performance of resin dental adhesives to hypomineralized enamel?" Three electronic databases (Pubmed, Scopus and ISI web of Science) were searched to identify original studies that evaluated the bond achieved between resin adhesives and hypomineralized enamel. Only articles that met the specific inclusion criteria were included in the review. Among 6 studies included in this review, 4 studies that tested bond strength of resin composite to hypomineralized enamel showed significantly lower bond strength than that to sound enamel. Bonding was not compared between adhesives in 5 included studies as only one adhesive was used. Three out of four studies showed improved bonding performances when deproteinization was performed with 5% NaOCl to hypomineralized enamel before adhesive application. Resin dental adhesives achieve inferior bonding to hypomineralized enamel when compared to normal enamel. There are no sufficient evidences to prove that self-etch dental adhesives bond better to hypomineralized enamel when compared with etch-and-rinse adhesives. Enamel deproteinization with 5% NaOCl before adhesive application procedure may enhance bonding performance of resin dental adhesives to hypomineralized enamel.

Composite : Force d'adhésion inférieure en présence de MIH

5 % NaOCl : 3 études sur 4 … augmente la qualité de l'adhésion

Adhésif : Qualité inférieure en présence de MIH

Adhésif auto-mordançant : Évidence scientifique insuffisante

DESTRUCTION POST-ÉRUPTIVE

SCELLANT DENTAIRE

Retention of fissure sealants using two different methods of application in teeth with hypomineralised molars (MIH): A 4 year clinical study

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Dept of Paediatric Dentistry, Community Dental Center for Children, Athens, Greece.

Abstract
AIM: This was to evaluate the retention rate of fissure sealants applied to MIH molars with occlusal enamel opacities, using two different application methods after 4 years. **METHODS:** 54 children exhibiting molars with MIH aged 6-7 years, participated in the study. Selection criteria: presence of at least 2 fully erupted caries-free maxillary or mandibular first permanent molars in the opposite sides of the mouth, both with occlusal enamel opacities without breakdown. Following parental consent, sealants were applied using a half-mouth experimental design. Group A: On a randomly assigned first molar on one side of the mouth sealants (Fissurit®) were placed using a single bottle adhesive system (One-step®) prior to sealant application. Group B: Sealants were applied on the contra-lateral molar using the conventional etch and seal technique. Children were seen biannually when a preventive program was applied, without replacing any lost sealant. **RESULTS:** After 4 years, 47 sets of molars (94 teeth) were available for blind evaluation. Teeth in Group A presented a better retention rate; 70.2% were fully sealed, 29.7% partly sealed and none unsealed (lost sealant). Group

can occasionally undergo post-eruptive breakdown due to soft and porous enamel, resulting in atypical cavities or even to complete coronal distortion. For these reasons hypomineralisation defects cause serious clinical management problems attracting the attention of the dental profession for the last decade [Fayle, 2003; Lygidakis et al., 2003; Marthu-Muju and Wright, 2006].

Lygidakis et al. [2008a] showed that teeth affected in MIH included only permanent first molars in 28.4% of the cases, while both molars and permanent incisors were affected in the 71.6%; mean number of affected molars per child being 3.4. Teeth of older children revealed more severe defects than those of younger, while 62.1% of the affected molars and 95.1% of incisors presented with mild defects [Lygidakis et al., 2008a]. It is therefore important for the clinician to develop the appropriate therapeutic approach for this complex defect in order to minimize repeated interventions to the patients.

Fissure sealants (FS) have been suggested as being useful for FPM with mild defects, which are not sensitive and

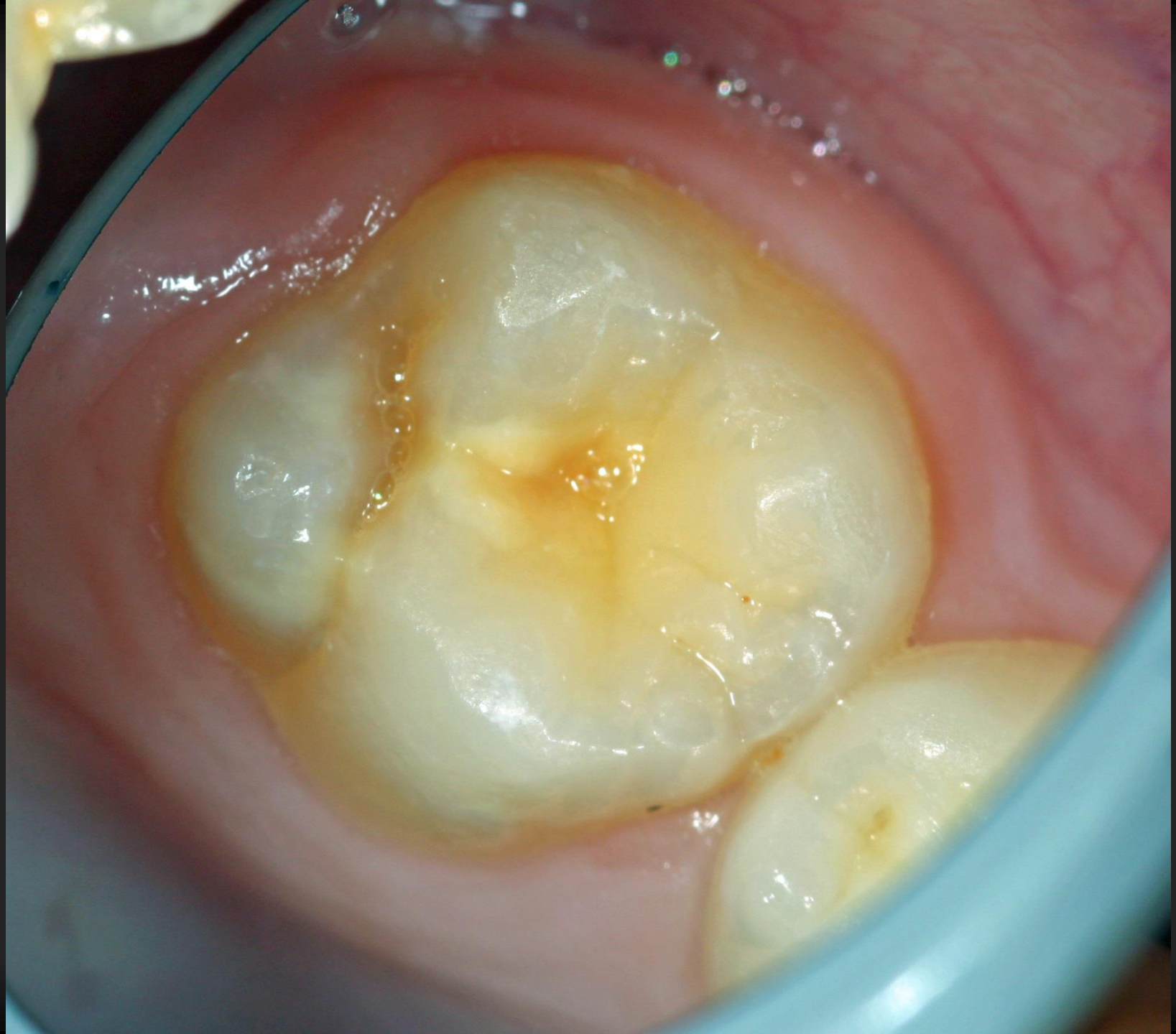
Suivi après 4 années

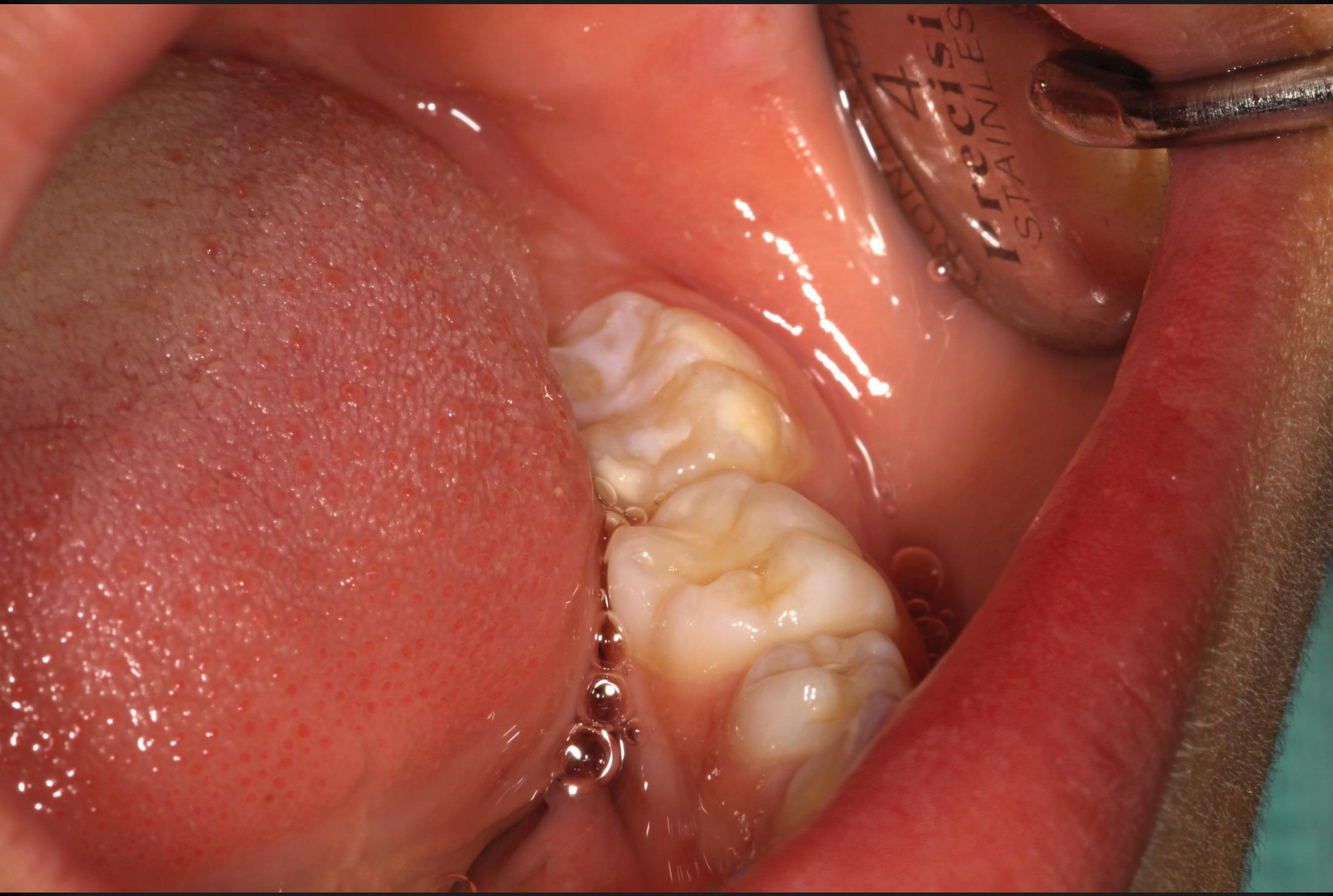
Sans vs. avec adhésif de 5ième génération

Rétention complète :	70,2 % vs.25,5 %
Rétention partielle :	29,7 % vs. 44,6 %
Perte totale :	0,0 % vs. 29,7 %

Conclusions

Substantially increased fissure sealant retention in hypomineralised molars with occlusal opacities was achieved when a single bottle adhesive system was used prior to sealant placement. If such an approach is implemented sealant retention rate in MIH molars approaches that of sound teeth.





Dépistage à la maternelle 5 ans

- [x] À risque élevé de carie dentaire ?
- [x] Besoin évident de traitement
- [x] Hypersensibilité … brossage des dents … douleur à la mastication
- [x] Évaluation du risque en lien avec l'hypominéralisation
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- [x] Fluorure Diamine d'argent

SPI - Suivi préventif individualisé

- [x] Intensité augmentée ou adaptée ?
  (exemples : > 2 applications de vernis fluoré, > 2 SPI par année)

2e année primaire, sélection des enfants / agents de scellement

- [x] Scellant conventionnel avec ou sans adhésif hydrophile
- [x] Scellant conventionnel vs Scellant de verre ionomère
- [ ] Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

VERRE IONOMÈRE

During 7 years of follow-up, the RMGIC restorations proved to be a good option, presenting greater longevity in a molar with minor structural defects and requiring repair or replacement in molars with larger structural defects. Despite some failures and the necessity for new restorations, the patient conveyed satisfaction with the treatment and reported no tooth sensitivity, and there was no recurrence of caries.

Conservative approach for molar-incisor hypomineralization: a case report and 7-year follow-up.

Pessôa CP, Pion L, Reyes A, Matos R, Alencar CF, Novaes TF, **Braga MM**.
Gen Dent. **2018** May-Jun;66(3):e1-e4.

Conservative approach for molar-incisor hypomineralization: a case report and 7-year follow-up

Camila Porto Pessôa, DDS, MSc, PhD ▪ Luciana Pion, DDS, MSc ▪ Alessandra Reyes, DDS, MSc, PhD
Ronilza Matos, DDS, MSc, PhD ▪ Cássio José Fornazari Alencar, DDS, MSc, PhD
Tatiane Fernandes Novaes, DDS, MSc, PhD ▪ Mariana Minatel Braga, DDS, MSc, PhD

Molar-incisor hypomineralization (MIH) can result in minor injuries or major structural loss, especially in incisors and molars. Patients with MIH seek dental treatment early, usually in childhood. Choosing the best treatment option during this stage can be a challenge. Because these patients still present a mixed dentition, the use of prosthetic appliances is not usually the best option. This case report with a 7-year follow-up presents an overview of a conservative approach for the restorative of teeth affected by MIH. A 10-year-old girl presented with permanent molars and incisors that exhibited qualitative defects of enamel characteristic of MIH. During the restoration phase, direct resin-modified glass ionomer cement (RMGIC) restorations were placed in all 4 first molars with the aid of acetate crowns, which were used to facilitate reconstruction of the tooth morphology. The maxillary incisors were previously treated by another dentist, and the mandibular incisors were treated later, since they were not the main complaint of the patient at the time. During 7 years of follow-up, the RMGIC restorations proved to be a good option, presenting greater longevity in a molar with minor structural defects and requiring repair or replacement in molars with larger structural defects. Despite some failures and the necessity for new restorations, the patient conveyed satisfaction with the treatment and reported no tooth sensitivity, and there was no recurrence of caries. During the follow-up period, the defective mandibular incisors were treated first with enamel microabrasion, which proved esthetically unsatisfactory, and then with direct composite resin veneers. The results in this patient suggest that use of RMGIC may be a feasible conservative option for tooth restoration in young patients with a mixed dentition when permanent molars exhibit extensive structural loss associated with MIH.

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Key words: cheese molars, glass ionomer cement, molar-incisor hypomineralization, permanent teeth, restoration

Tooth enamel is a highly mineralized tissue that originates from the cellular activity of ameloblasts, which are highly sensitive to external factors. During enamel formation, the influence of local or systemic genetic factors can cause defects, either in primary or permanent teeth.[1] Incisors and permanent first molars are frequently affected.[2] When defects with unknown etiology affect the permanent first molars or incisors, the enamel alteration is commonly called *molar-incisor hypomineralization* (MIH); the affected molars are sometimes referred to as *cheese molars*.[3] This hypomineralization, which is of systemic origin, can range in severity from demarcated opacity to structural loss and may be associated with carious lesions.[3]

Ideally, enamel defects should be detected as early as possible, given the importance of well-formed enamel for prevention of caries, which is one of the most prevalent diseases in childhood.[4] Different therapeutic modalities may be indicated, depending on the severity of the enamel defect. These interventions may vary from esthetic corrections such as tooth whitening or microabrasion to more advanced reconstructions such as direct restorations, indirect restorations, or prosthetic restoration.[5]

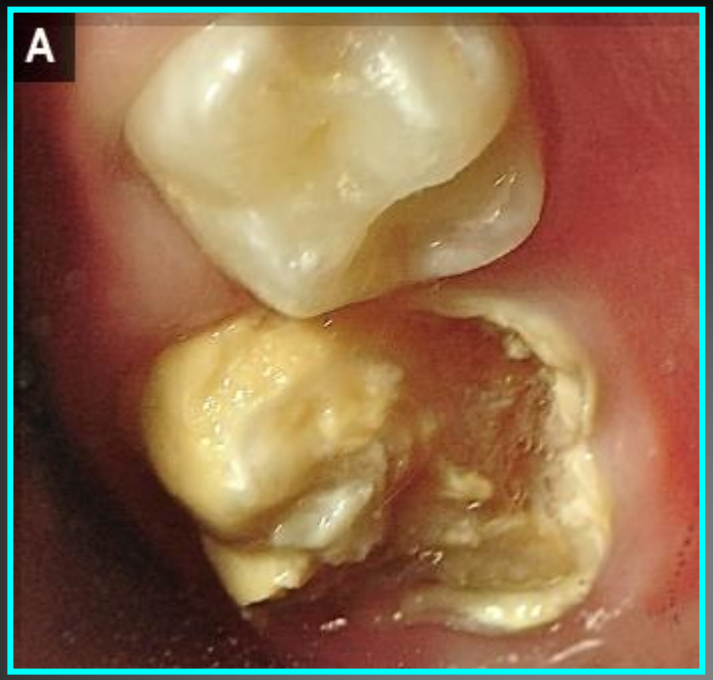
There is no consensus on the best material to use when restoration is needed.[6] This difficulty increases in patients in the mixed dentition due to the changing dental pattern of the patient. In this scenario, the use of glass ionomer cements (GIC) could represent an interesting option.[7] Glass ionomer cements are biocompatible with dental tissues, show strong adhesion, have a thermal expansion coefficient similar to that of natural teeth, promote the release of fluoride, and exhibit satisfactory longevity.[8] The success of GIC restorations in teeth with enamel defects has not been fully explored, however.[9] The present case report describes the use of a resin-modified glass ionomer cement (RMGIC) to restore defective molars in a patient with MIH and presents the results of 7 years' follow-up.

Case report

Diagnostic phase

In 2008, a 10-year-old girl, accompanied by her mother, presented at the pediatric dentistry clinic, University of São Paulo, São Paulo, Brazil, complaining of "severe pain in the molars." During the history taking, the mother did not report any history of trauma, hereditary disorders, health disorders, or manifestations of early childhood infectious diseases.

The patient had a mixed dentition with fully erupted permanent incisors and partly erupted permanent first molars. Clinically, extensive loss of tooth structure was detected in the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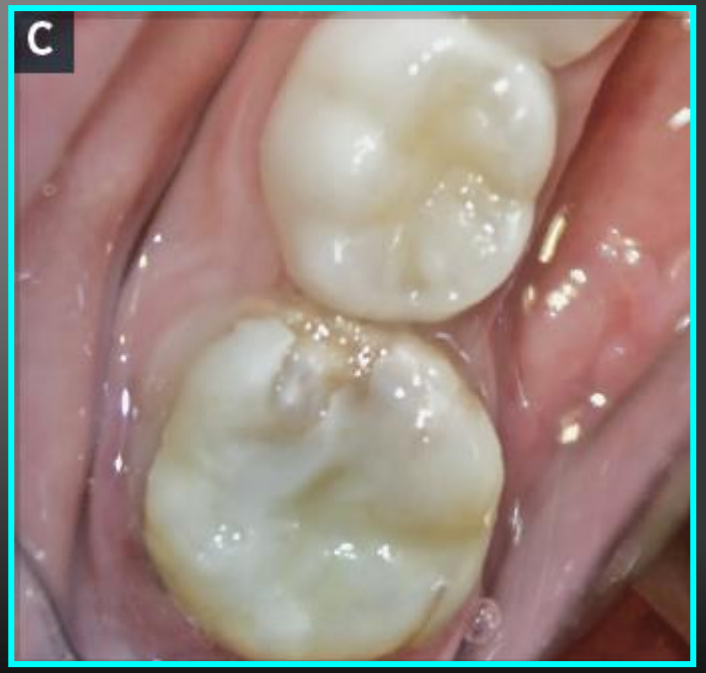
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Fig 4. Restored maxillary molars at the 7-year follow-up. Teeth 3 and 14 require replacement restorations. **3 = 16** **14 = 26**

12 mois

Fig. 2 12-month follow-up and restorative failure. **a**, **d**, **g** - initial aspect of MIH affected molars associated with carious lesions at baseline; **b**, **e**, **h** - clinical aspect of restorations immediately after being performed using the ART technique involving 1 surface (**b**), 2 surfaces (**e**) and all surfaces (**h**); **c**, **f**, **i** - clinical aspect of restorations after 12 months (**c** and **d**) and the only failure observed (**i**) which occurred after 6 months follow-up

Glass hybrid restorations as an alternative for restoring hypomineralized molars in the ART model.
Grossi JA, Cabral RN, Ribeiro APD, Leal SC.
BMC Oral Health. 2018 Apr 18;18(1):65. doi: 10.1186/s12903-018-0528-0.

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- Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

NaOCl
Hypochlorite de sodium 5 %

UMDNJ
NEW JERSEY DENTAL SCHOOL
University of Medicine & Dentistry of New Jersey

Management of the Molars in a Patient with Molar Incisor Hypomineralization

A Case Report.

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Introduction: *Molar Incisor Hypomineralization* (MIH) is defined as the hypomineralization of systemic origin of one to four permanent first molars, frequently associated with similarly affected permanent incisors (Weerheijm 2001).

Prevalence : varies worldwide 2.8% - 19.8%

Clinically the affected molars may present as demarcated opacities, disintegrated enamel, atypical restorations or history of extracted molars in a patient with similar lesions on the molars present intra-orally at the time of examination.

Various factors have been shown to be associated with MIH, such as genetics, perinatal complications, antibiotics used to treat childhood infections or the infections themselves, environmental factors such as pollutants, dioxins from breast milk. There is no concrete evidence of a single causative factor.

Case report: A 12 year old female with no significant medical history, no allergies, presented with pain and sensitivity of posterior teeth and a history of extraction of a permanent tooth due to similar symptoms. Diagnosis of Molar Incisor Hypomineralization (MIH) was made on the basis of demarcated opacities on permanent first molars, loss of enamel, sensitivity to air/water and the history of extraction of #14 due to similar symptoms.

The left mandibular incisors also showed demarcated opacities, but the involvement of incisors is not a necessary criteria for the diagnosis of MIH.

Treatment options for Hypomineralized molars:
1) Sealants
2) Restorations
3) Stainless steel crowns
4) Extraction if not restorable

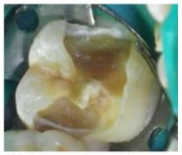
Treatment options for Hypomineralized incisors:
1) Aesthetic composite restorations or strip crowns
2) Bleaching to improve tooth color
3) Full coverage restoration: PFM or full ceramic crowns

(The treatment goal for the posterior teeth is restoring function as compared to aesthetic improvement in anterior teeth)

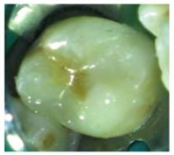
Clinical challenges in Management of MIH	Possible solutions
Sensitivity of affected teeth	Desensitization using: 1) high fluoride dentifrice (PreviDent) 2) CPP-ACP paste (MI Paste)
Rapid development of caries	Early diagnosis and preventive sealants (consider glass ionomer sealants in newly erupted hypomineralized molars due to isolation difficulty)
Limited cooperation in a young patient	Behavior management: Tell-Show-Do, Nitrous Oxide + Oxygen inhalation, consider pharmacological management
Difficulty in achieving adequate anesthesia	Desensitization, good local anesthesia technique, Nitrous oxide + Oxygen has analgesic effect
Repeated marginal breakdown of restorations and poor bond strength	Placing cavity margins on sound enamel, use of 5% sodium hypochlorite to remove surface enamel proteins (improve bond strength) and to reduce discoloration (bleaching in incisors), use of 5th generation bonding agents, micro-abrasion with 18% hydrochloric acid, reinforcing restorations with stainless steel orthodontic band or full coverage stainless steel crown.

Treatment plan:
-Prescribe PreviDent 5000 Plus for 3 months
-Restore #3, # 19 ; preventive sealant # 30.
-Use Nitrous oxide + Oxygen inhalation, 4% Septocaine with 1:100,000 Epinephrine for local infiltration
-Use rubber dam to optimize isolation
-Etch with 37% phosphoric acid, rinse, 5% sodium hypochlorite for 60 sec, rinse, re-etch
-Seal over composite resin restoration using Delton (clear) sealant.
-Tetric Flow (flowable) composite to cover defective enamel areas and fissures followed by the application of Delton sealant
-Patient did not desire treatment for mandibular incisors. The concern being only aesthetic, it was decided to monitor # 23 and # 24.

Treatment # 3

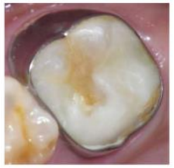

Caries excavation with margins on sound enamel


After 5% sodium hypochlorite


Restored with Heliomolar + Delton Sealant

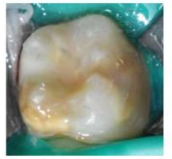

Reinforced with orthodontic band

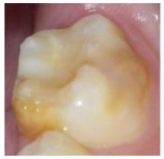

1 month follow up


4 month follow up

Treatment # 19

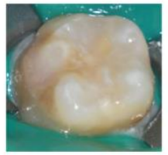

Caries excavation, all defective enamel was not removed.


Etch, sodium hypochlorite, re-etched followed by occlusal restoration with Heliomolar, defective enamel covered with Tetric Flow composite, Delton sealant over the entire tooth.


3 month follow up

Treatment # 30


Etch, sodium hypochlorite, re-etched


Tetric Flow composite to cover defective enamel and fissures followed by clear Delton sealant


3 month follow- up

Key Points for successful management of molars in a patient with Molar- Incisor Hypomineralization

- ✓ Desensitization using PreviDent
- ✓ Nitrous oxide + Oxygen inhalation.
- ✓ Use of sodium hypochlorite to improve bond strength of adhesive resin.
- ✓ Use of flowable composite to cover defective enamel thus conserving tooth structure.
- ✓ Sealing over composite resin restorations to prevent micro-leakage at the margins.

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http://www.meetingproceedings.com/2012/posters/aapd/SplitViewer.asp?PID=NjUwMTE5Njk#

Sönmez and Saat[48] suggested deproteinization using 5% sodium hypochlorite postacid conditioning (group III). The authors reported a statistically significant difference between group II (restoration without deproteinization) and group III, which suggests that in cavities without removal of all hypomineralized enamel sodium hypochlorite may help in achieving better bond strength although preventing major tissue loss. However, further research is required in order to evaluate the clinical efficacy of this technique because just a few studies on this topic have been conducted.[91–93]

J Esthet Restor Dent. 2019 Jan;31(1):26-39. doi: 10.1111/jerd.12420. Epub 2018 Oct 4.

Dental hypomineralization treatment: A systematic review.

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Dépistage à la maternelle 5 ans

- À risque élevé de carie dentaire ? — Ressources supplémentaires — Site Web
- Besoin évident de traitement — Taux de consultation — Plusieurs niveaux — Site Web
- Hypersensibilité … brossage des dents … douleur à la mastication — Protocole exact
- Évaluation du risque en lien avec l'hypominéralisation
  (triade : hypersensibilité, carie dentaire et destruction post-éruptive) — Valeur prédictive — Efficacité des interventions
- Fluorure Diamine d'argent — Programmation — « Timing »

SPI - Suivi préventif individualisé

- Intensité augmentée ou adaptée ?
  (exemples : > 2 applications de vernis fluoré, > 2 SPI par année) — Programmation — Évidence ?

2e année primaire, sélection des enfants / agents de scellement

- Scellant conventionnel avec ou sans adhésif hydrophile — Coût $$$ — Douleur mordançage
- Scellant conventionnel vs Scellant de verre ionomère — Longévité — Douleur Conditionneur
- Scellant conventionnel prétraitement à l'hypochlorite de sodium 5 %

Évidence scientifique ? — Temps d'intervention — Formation / Uniformisation

GESTION DES CAS DE MIH

MIH Opacité blanche	Non sensible	70 %	Avec occlusion - PEB	17 %
	Sensible	30 %	Sans occlusion - PEB	9 %
	Risque de PEB	14 %		
MIH Opacité jaune	Non sensible	45 %	Avec occlusion - PEB	28 %
	Sensible	55 %	Sans occlusion - PEB	27 %
	Risque de PEB	28 %		
MIH – PEB	Non sensible	48 %		
	Sensible	52 %		
	Aggravation de PEB	47 %		
	Dentine		Supra gingival	
	Pulpe		Sous-gingival	

Molar Incisor Hypomineralization: Review and Recommendations for Clinical Management

Vanessa William, BDSc, DClinDent[1] Louise B Messer, BDSc, LDS, MDSc, PhD[2]
Michael F Burrow, BDSc, MDS, PhD, MEd[3]

Abstract

Molar incisor hypomineralization (MIH) describes the clinical picture of hypomineralization of systemic origin affecting one or more first permanent molars (FPMs) that are associated frequently with affected incisors. Etiological associations with systemic conditions or environmental insults during the child's first 3 years have been implicated. The complex care involved in treating affected children must address their behavior and anxiety, aiming to provide a durable restoration under pain-free conditions. The challenges include adequate anaesthesia, suitable cavity design, and choice of restorative materials. Restorations in hypomineralized molars appear to fail frequently; there is little evidence-based literature to facilitate clinical decisions on cavity design and material choice. A 6-step approach to management is described: (1) risk identification; (2) early diagnosis; (3) remineralization and desensitization; (4) prevention of caries and posteruption breakdown; (5) restorations and extractions; and (6) maintenance. The high prevalence of MIH indicates the need for research to clarify etiological factors and improve the durability of restorations in affected teeth. The purpose of this paper was to describe the diagnosis, prevalence, putative etiological factors, and features of hypomineralized enamel in molar incisor hypomineralization and to present a sequential approach to management. (Pediatr Dent 2006;28:224-232)

KEYWORDS: ENAMEL HYPOMINERALIZATION, MOLAR , DENTAL HYPOMINERALIZATION, ENAMEL OPACITY

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Molar incisor hypomineralization: review and recommendations for clinical management.
William V, Messer LB, Burrow MF.
Pediatr Dent. **2006** May-Jun;28(3):224-32. Review.

The term molar incisor hypomineralization (MIH) was introduced in 2001 to describe the clinical appearance of enamel hypomineralization of systemic origin affecting one or more permanent first molars (PFMs) that are associated frequently with affected incisors.[1] Also referred to as "hypomineralized" PFMs,[2] "idiopathic enamel hypomineralization,"[3,4] "dysmineralized" PFMs,[5] "nonfluoride hypomineralization,"[6,7] and "cheese molars,"[8,9] the condition is attributed to disrupted ameloblastic function during the transitional and maturational stages of amelogenesis.[3,10]

MIH's clinical management is challenging due to:

1. the sensitivity and rapid development of dental caries in affected PFMs;
2. the limited cooperation of a young child;
3. difficulty in achieving anesthesia; and
4. the repeated marginal breakdown of restorations.

Research on adhesion of restorative materials to hypomineralized enamel is limited, and clinical decisions to date have not been evidence-based. This may reflect a paucity of extracted hypomineralized molars with suitable surfaces for in vitro studies. A recently developed microshear bond strength test has allowed initial studies of the bond strength of materials to small surface areas of hypomineralized enamel.[11]

The purpose of this paper was to describe the diagnosis, prevalence, putative etiological factors, and features of hypomineralized enamel in molar incisor hypomineralization and to present a sequential approach to management.

MIH diagnosis

Criteria for the diagnosis of demarcated opacities, posteruption breakdown (PEB), atypical restorations, and extracted PFMs due to MIH were developed by Weerheijm et al.[12] Dentitions with generalized opacities present on all teeth (such as in several forms of amelogenesis imperfecta), rather than limited to the PFMs and permanent incisors, are not considered to have MIH.[12] After thorough cleaning, the

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Correspond with Dr. Messer at ljbm@unimelb.edu.au

Table 2. A Clinical Management Approach for Permanent First Molars Affected by Molar Incisor Hypomineralization

Steps	Recommended procedures
Risk identification	Assess medical history for putative etiological factors
Early diagnosis	Examine at-risk molars on radiographs if available
	Monitor these teeth during eruption
Remineralization and desensitization	Apply localized topical fluoride
Prevention of dental caries and post-eruption breakdown (PEB)	Institute thorough oral hygiene home care program
	Reduce cariogenicity and erosivity of diet
	Place pit and fissure sealants
Restorations or extractions	Place intracoronal (resin composite) bonded with a self-etching primer adhesive or extracoronal restorations (stainless steel crowns)
	Consider orthodontic outcomes post-extraction
Maintenance	Monitor margins of restorations for PEB
	Consider full coronal coverage restorations in the long term

Identification du risque

Diagnostic précoce

Reminéraliser et désensibiliser

Prévention de la carie dentaire et de la destruction post-éruptive

Restauration ou extraction

Suivi régulier

Histoire médicale
Facteurs de risque

Dépistage via une radiographie dentaire

Suivi fréquent durant l'éruption

Fluorures topiques

Programme quotidien d'hygiène buccodentaire

Contrôler la cariogénicité et le pouvoir érosif de l'alimentation

Sceller les puits et fissures

Composite intra coronaire avec un adhésif auto-mordançant

Restaurations extra coronaire (CAI, incrustation)

Considérations orthodontiques si extraction

Suivi régulier de l'intégrité des marges des restaurations

À long terme, considérer un recouvrement des cuspides avec une restauration

	DMD – Clinique privée	HD – Santé dentaire publique
Évaluation du risque	Histoire médicale MIH – Fratrie - famille MIH – dentition primaire	MIH – Fratrie - famille MIH – dentition primaire
Diagnostic précoce	Radiographie dentaire Monitorage – Examens de rappel aux 12 mois 12 mois Tous les enfants ≤ 9 ans	Dépistage, maternelle 5 ans + SPI Référence DMD Maternelle, 5 ans : 1 fois; SPI : 6 mois environ Environ 25 % des enfants Site Web
Reminéralisation désensibilisation	SDF > CPP-ACP > Vernis F	SDF > CPP-ACP > Vernis F Site Web
Carie dentaire Prévention	Hygiène + Alimentation Vernis F SDF	Hygiène + Alimentation Vernis F SDF site Web Référence DMD
Prévention de la Destruction post-éruptive	CAI > Restauration indirecte > Restauration directe > Scellant dentaire > Verre ionomère Hypochlorite de sodium 5 %	Vernis F SDF site Web Référence DMD Scellant résine ou verre ionomère

Dépistage à la maternelle 5 ans

Évaluation du risque

Dépistage – uniformisation ?

Abaisse-langue vs miroir ?

Dents antérieures et postérieures ?

MIH dentition primaire ou dentition permanente

Inclusion SPI ? Risque de carie dentaire ↑ 10 X

Classé à risque élevé de carie dentaire ?

Fratrie Informer les parents ?

Symptomatique ou asymptomatique

Hypersensibilité Traitement professionnel vs. personnel ?

Carie dentaire Traitement immédiat avec FDA ?

Destruction post-éruption Programmation

Site Web Document au parent

Référence chez le dentiste pour autre raison qu'un BÉT

Suivis préventifs individualisés

Professionnel

Reminéralisation désensibilisation	Fluorure Diamine d'Argent
	Vernis fluoré ↑ la fréquence ?
	Site Web
Carie dentaire Prévention	Fluorure Diamine d'Argent
	Vernis fluoré ↑ la fréquence ?
	Site Web
Prévention de la Destruction post-éruptive	Verre ionomère
	BÉT – référence chez le dentiste
	Scellant dentaire ?
	Référer vs. informer les parents ?

2ième année scellant dentaires

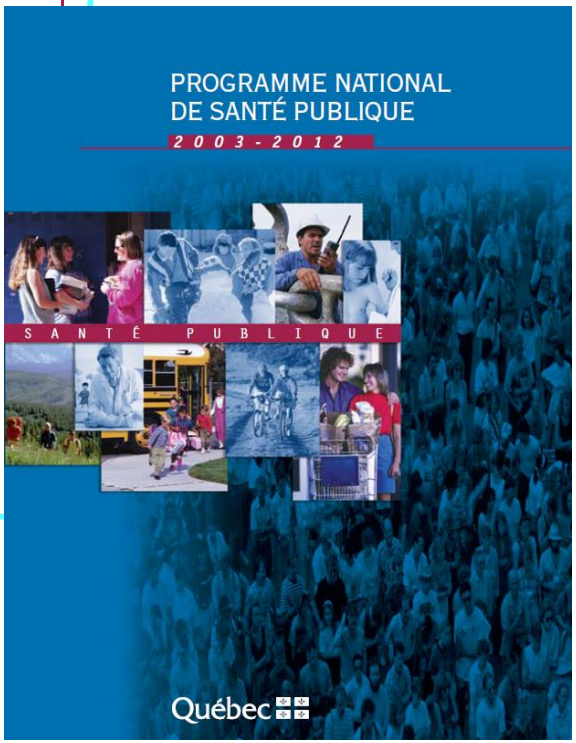
Les fonctions de santé publique

Fonctions essentielles

- Surveillance continue de l'état de santé de la population
- Promotion de la santé et du bien-être
- Prévention des maladies, des problèmes psychosociaux et des traumatismes
- Protection de la santé

Fonctions de soutien

- Réglementation, législation et politiques publiques ayant des effets sur la santé
- Recherche et innovation
- Développement et maintien des compétences



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