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Recent conservative management protocol of hypomineralized first permanent molars in children: an overview

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ABSTRACT

Molar incisor hypomineralization (MIH) poses a significant clinical problem due to its diverse clinical scope. The severity of enamel defects can range from mild opacities with minimal functional impact to considerable post-eruptive disintegration and greater sensitivity, resulting in structural weakness and significant discomfort, as well as making affected teeth vulnerable to caries and pain. Consequently, these children develop a significant lack of cooperation and increased dental anxiety. Restoring first permanent molars affected with MIH is challenging. Focusing on improving the quality of life for children affected by MIH, at least until the complete eruption of first permanent molars to receive full coverage, to decrease the hypersensitivity and to be able to perform proper oral hygiene measures. The ability to treat a condition like MIH with a conservative technique could bring significant benefits in terms of patient comfort, enhanced caries resistance, and tooth structure preservation. Selective removal of carious tissue and SMART restoration, combined with dental home and professional preventive measures every 3 months maintained the integrity of restorations in MIH affected permanent molars up to 1 year and decreased the hypersensitivity in moderate and severe groups. Most of children tolerated the treatment well.

Keywords: *MIH, minimally invasive dentistry, SDF, children, glass ionomer*

1. Introduction

Clinical measurements for MIH have recently been defined using scientific criteria. These European Academy of Pediatric Dentistry (EAPD) rating criteria enabled and eased comparisons of study data (Weerheijm 2004). The estimated prevalence of MIH ranges between 2.8 and 40.2%, although accessible data are still limited, particularly in locations such as North America, Africa, and the Middle East, with the majority of studies concentrated in Europe (Elfrink 2012).

Despite the widespread adoption of the EAPD criteria, prevalence rates of MIH reported in epidemiological studies vary significantly. The varied criteria used to classify instances of MIH make it difficult to compare prevalence numbers published in different research, however this is likely to have resulted in an underestimation rather than an overestimation. A lot of scientists failed to include MIH teeth with extensive breakdown that required unconventional restorations or even extraction, implying that the prevalence of MIH was significantly underestimated (Jälevik 2012).

The ability to treat a condition like MIH with a conservative technique could bring significant benefits in terms of patient comfort, enhanced caries resistance, and tooth structure preservation. There are numerous treatment options for MIH, ranging from conservative resin-based sealants for moderate abnormalities to extraction in severe cases. Silver diamine fluoride (S D F) might be a ray of hope in such circumstances because it can significantly decrease MIH sensitivity and boost caries resistance while also adhering to the essential objectives of minimally invasive dentistry(Ghanim A 2017).These game changers include SDF and high-viscosity glass ionomer cement

(SMART). Because of its great prevalence, MIH should receive more attention, particularly in developing more appropriate dental healthcare procedures to manage the disease and improve the quality of life for these children.

2. Definition and prevalence of MIH

MIH was defined by ***Weerheijm et al 2001*** as a qualitative enamel defect of systemic origin. It affects from 1 to 4 of first permanent molars and can also be associated with permanent incisors(Weerheijm 2001). Dentists began to notice an odd and growing number of children in the late 1970s who had severe enamel hypomineralization in their first permanent molars and incisors that was vast and well defined, with no identifiable cause. Because of their great sensitivity, the enamel flaws were challenging to clean and repair. Silver amalgam was the restorative material available at the time for children's stress-bearing dental restorations. Naturally, massive atypical restorations with limited survival times were placed incorrectly, frequently as a result of recurrent fractures (Weerheijm 2001).

Bukhari et al. 2023 conducted a recent comprehensive assessment on the prevalence of MIH in the Middle East, specifically among children aged 5 to 18 years. Following screening, 29 relevant studies from 11 countries were added, totaling 32,636 children aged 7 to 12 years. The frequency of MIH recorded in the Middle East ranged from 2.3% to 40.7%, with a mean prevalence of 15.05%, equal to the global MIH prevalence rate (Bukhari 2023). According to Almenawi et al 2023, MIH affects 18.3% of the study group, with no significant gender differences (8.8% girls and 9.4% boys) and a mean age of 8.28.

3. Origin and causes of MIH

Molar incisor hypomineralization is most likely caused by disruptions in either the calcification or maturation processes. The ensuing structural and other alterations in the enamel will be discussed now. The majority of investigations found that MIH lesions penetrate the entire thickness of enamel, beginning at the dentino-enamel junction (DEJ) and finishing at the enamel surface. Several studies found that MIH-affected teeth had considerable porosity, ranging from 5% to 25%, as compared to normal enamel. It was established that teeth with white-MIH appears to have a complex pathophysiology, involving a genetic component as well as prenatal, perinatal, and postnatal stressors. Patients complain of hypersensitivity or pain, and dentists see posteruptive enamel disintegration with accompanying carious lesions (Americano 2017). The ensuing pulpitis interferes with successful local anesthetic (Lygidakis 2022).

The causes of MIH are currently unclear. Childhood diseases and genetic factors are likely to play a role, and there may be an individual threshold for vulnerability, as many children with no relevant medical histories are badly impacted by MIH and vice versa. The evidence base is constrained by concerns with existing study heterogeneity, particularly with relation to the European Academy of Pediatric Dentistry's indices and illness definitions. Recently, the number of articles employing the EAPD index has increased, allowing for more accurate comparisons (Lygidakis 2022).

A study by ***Hubbard et al. 2021*** was conducted to better understand the pathogenesis of MIH, as MIH is a global health problem which is worthy of prevention, they proposed a mechanism termed “mineralization poisoning”, that involves locally exposing immature enamel to serum albumin. Albumin binds to enamel-mineral crystals and blocks their growth, leading to chalky opacities with distinct borders. They believe that this breakthrough could eventually lead to prevention of MIH(Hubbard 2021).

4. Mineral density of enamel:

Molar incisor hypomineralization is most likely caused by disturbances in the calcification or maturation process. The subsequent structural and other changes in the enamel will now be discussed. The majority of studies indicated that MIH lesions permeate the full thickness of enamel, starting at the dentino-enamel junction (DEJ) and ending at the enamel surface.Several investigations discovered that MIH-affected teeth had significant porosity, ranging from 5% to 25%, as compared to healthy enamel. Teeth with white-creamy patches and no post-eruptive enamel disintegration were shown to have the lowest permeability flaws (Gambetta-Tessini 2017).

Mechanical parameters, often assessed as hardness and modulus of elasticity, of MIH-affected enamel were found to be considerably lower than those of sound enamel. MIH enamel is unlikely to hold restorations as well as

sound enamel, which has a high hardness, making it difficult to put restorations in such molars, resulting in the production of atypical restorations and post-eruptive degradation of enamel. (FRAGELLI, CMB 2015)

Mineral content in MIH-affected enamel was investigated utilizing a variety of techniques, including radiography micro-tomography, radiographic micro-computed tomography, and transverse microradiography. MIH-affected teeth had a considerable drop in mineral density (approximately -20%) compared to sound enamel, according to all methods tested. Mineral density dropped from the cemento-enamel junction (CEJ) to the occlusal surface before increasing again in the cusp tip area; the highest mineral density values were found near the DEJ (Farah R 2010).

5. Clinical presentation of MIH:

Clinically, afflicted teeth exhibit hypomineralization, as seen by an alteration in enamel translucency. Hypomineralized enamel can range in color from white to yellow or brown, but the borders are always well-defined and distinct from sound enamel. As previously stated, porous enamel is prone to chipping, particularly when subjected to masticatory forces.

Posteruptive enamel breakdown (PEB) occurs when enamel on afflicted molars breaks away easily following eruption, exposing dentin. On permanent incisors, impacted enamel seems less seriously fragmented, and because of the lack of chewing pressures, it is less prone to breakdown. Incisal enamel flaws are, however, frequently fairly significant and most common on the labial surfaces of the teeth, causing esthetic issues (Weerheijm KL 2003).

6.Treatment modalities:

The treatment options for MIH teeth include prevention, restoration, and extraction. The severity of the problem, existence of symptoms, patients' dental age, child/parent expectations, and social background all have a role in determining the best course of treatment (Lygidakis NA 2022). Nonetheless, early diagnosis and preventive intervention should always be the first treatment option, with severity serving as a guide for long-term treatment planning.

Williams et al. published the first clinical strategy to treating MIH, offering a 6-step management method (William V 2006), as follows:
• Identifying potential risks.
• Early diagnosis.
• desensitization and Remineralization
• Preventing dental cavities and posteruptive enamel deterioration.
• Restoration or extractions.
• Maintenance.

Mathu-Muju and Wright (2006) produced another treatment decision tree that took into account that the degree of the defect (mild, moderate, or severe) as well as the length of treatment planned (short and long term). For example, in severe cases with posteruptive disintegration and sensitivity, glass ionomers or stainless-steel crowns are used as short-term remedies, although full cast coverage is considered a long-term therapy option (Mathu-Muju 2006).

As a result, **Lygidakis et al. 2022** offered practical guidelines and proposed an approach that considers dental age and severity of the problem. Caries prevention is a crucial technique in the early stages of eruption, according to the authors, because MIH teeth are more prone to carious lesions and posteruptive disintegration due to greater porosity. In later developmental phases, when the enamel matures and prevention has been successful and the enamel surface has stayed intact, the relative relevance of prevention is viewed to be less than the necessity of restorative treatment (Lygidakis NA 2022).

Based on the MIH-TNI, a treatment plan for each index is devised, ranging from prevention to sealing, restoration (temporary or permanent), and extraction (Steffen R 2017). However, the suitability of these treatment options varies according to the index and the related M I H symptoms.

On the other hand, dentists have to be aware of their part in the whole process. They have an important role in preventing anxiety, improving their quality of life, enhancing the coping ability in children with MIH and improving the dentist/child relationships by the following points (Steffen R 2017).

Identifying MIH as soon as possible (possibly the most significant element) and explaining to the youngster that the molars are the source of discomfort. Also, consider the severity for a short- and long-term treatment plan, and keep in mind that treating a MIH molar differs from today's tooth-saving dentistry. Finally, keeping the child pain-free while also recognizing that some youngsters require remedial support during treatment.

7. Minimally invasive dentistry:

Minimally Invasive Dentistry (M I D) refers to the maximum preservation of healthy dental structures. This idea encompasses the utilization of all available knowledge and techniques, ranging from accurate caries diagnosis, risk assessment, and prevention, to technical processes for repairing restorations.

Minimally invasive dentistry (M I D), particularly alternative restorative techniques (A R T), is based on four key concepts: early diagnosis, caries risk assessment of oral and extraoral factors such as the family's socioeconomic status, the concept of a dental home and diet, minimal cavity preparation, and the use of biologically active materials and recent bonding systems. Silver diamine fluoride is the most recent addition to caries prevention tools (Mashhour A, 2023). It can thus help with patient behavior control, which is widely recognized as an important aspect in providing dental care to pediatric patients.

Elhennawy et al. (2016) reported in their systematic study that GI was associated with relatively significant failure rates. By far, only two studies using GI for M I H are available. One of them utilized the GI in a hand-mixed application without uniformity, resulting in decreased survival rates, whereas the other included it in the A R T. Success rates were not comparable, with 78% at 12 months in one study and 98% at 24 months in the other, indicating that limited research are available. (Grossi, J de A 2018)

It is unclear whether a high-viscosity GI (H-V-G-I) is acceptable to restore M I H cavities, especially if SCR is performed prior to the restoration; additional research is needed in this area. Minimally invasive dentistry is a patient-centered, evidence-based approach that encourages the development of novel treatment alternatives. SDF is an emerging star in minimally invasive dentistry as a cariostatic agent (Crystal YO 2019).

8.Silver Diamine Fluoride:

The Food and Drug Administration (FDA) approved SDF to treat dentine hypersensitivity in 2014. Other commercial products available include Advantage Arrest (US), Saforide (Japan), FAgamin (Argentina), Cariestop (Brazil), ammonia-free CSDS (Australia), E-SDF (India), and ToothMate SDF (Egypt). Riva Star SDF is available in the UK and Australia.

When SDF is administered to affected teeth, it causes a chemical interaction with hydroxyapatite, a key component of tooth structure. This reaction results in the formation of silver phosphate and calcium fluoride. The silver ions produced during this process effectively inhibit mineral demineralization, establishing a barrier to the acid-producing bacteria that cause caries. Fluoride ions also help to remineralize hydroxyapatite, which increases the mineral density and hardness of the affected tooth structure (Oliveira BH 2019).

SDF can also aid to manage dentine hypersensitivity and symptomatic MIH-affected teeth. Silver ions' capacity to obstruct dentinal tubules via protein precipitation is widely recognized. Furthermore, SDF implantation will stimulate the synthesis of calcium fluoride and silver iodide, both of which are necessary to occlude dentinal tubules and reduce their patency (Ballikaya E 2022).

9.Glass ionomer restorations on MIH affected molars:

Glass ionomer cement is the sole material that chemically bonds enamel and dentin; it also has similar thermal expansion to the tooth structure, stimulates absorption, and releases fluoride. They are also biocompatible and have established themselves as the preferred material for single surface restorations and deterioration limited to the dentin (Elhennawy K 2016).

Provisional restorations for MIH-affected molars are typically done with glass ionomer cements or resin-modified G I C. G I Cs are simple and quick to use, and they can effectively seal sensitive hypomineralized molars while releasing significant amounts of fluoride.

Conclusion

Restorations using a hybrid glass restorative system as highly viscous glass ionomer with SDF (SMART) performed by the ART technique demonstrated to be a successful way to preserve first permanent molars afflicted by MIH up to two years till complete eruption to be covered later on by stainless steel crowns after gaining more child cooperation and enhanced oral hygiene.

Disclosure

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