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Case Report
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Diagnosis and Treatment of a Six-year-old Patient with Molar-incisor Hypomineralization a Case Report

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Abstract

Molar-incisor hypomineralization (MIH) is a qualitative and quantitative enamel dysplasia that affects one or more permanent molars and incisors.

Objectives: *This study was conducted at the University-Medicodental Center at the Faculty of Dental Medicine at the Medical University "Prof. Dr. P. Stoyanov" in Varna, Bulgaria. The patient, 6 years old, from Varna, complained of newly erupted, unaesthetic teeth with discoloration in the frontal area, deep carious lesions with periodic pain, and fractures on the lingual surfaces of the second lower primary molars. The diagnosis was MIH. The carious process was complicated by irreversible pulpitis, Pulpitis symptomatica aperta, diagnosed on teeth 74, 75, and 85, which determined treatment of the lower primary molars using the formalin-resorcinol method with 3 stages, for the remaining teeth. We also performed and application of sealants, fluoride varnishes, and remineralizing pastes. Teeth with white-yellow-brown lesions diagnosed with MIH are subject to prophylaxis, preventive and non-operative treatment, strict clinical control, and observation, due to the risk of rapid destruction and high sensitivity of enamel and dentin, almost immediately after eruption. Early diagnosis of hypomineralized molars and incisors and timely prophylaxis and treatment can prevent complications of MIH.*

Keywords: Molar-incisor Hypomineralization, MIH, Dysplasia, Pediatric Dentistry

Introduction

Molar incisor hypomineralization (MIH) is a qualitative and quantitative enamel dysplasia that affects and damages one or more permanent molars and permanent incisors. MIH is a disease first reported in the late 1980s, when several scientists described in a study the hypomineralization of permanent teeth, especially associated with the first permanent molars and incisors. Authors from Bulgaria also studied the prevalence of MIH in Northeastern Bulgaria and found that 6% of 1183 children in the sample were affected by MIH [1]. For the city of Plovdiv, Bulgaria, and the region, scientists found that the average incidence of MIH in the studied child populations was 3.58%. The prevalence of MIH for different age groups of children ranged from 2.43 to 7.84%. The highest prevalence of MIH was among children born in 1999 (7.84%). The average number of affected teeth per person with MIH was 3.99, of which 2.08 were first permanent molars, 1.86 were incisors and 0.5 were canines. First permanent molars and incisors were affected approximately equally [2].

Authors using the EAPD classification have found a higher prevalence of MIH - 14.5%, in contrast to studies using alternative diagnostic criteria - reporting a prevalence of MIH of 10.2% [3, 4]. MIH is estimated to affect 14.2% of the population [5, 6], with 17.5 million children and adolescents worldwide affected, with no significant difference in prevalence between males and females. Almuallem Z. et al. in 2018, describe that epidemiological studies from different parts of the world show a wide

variation in the prevalence of MIH, which can range between 2.8 to 40.2%, but this may be due to the lack of standardized tools for diagnosing and recording MIH, leading to inaccuracies in prevalence [7-9].

Several etiological hypotheses for MIH have been described in the available literature. During fetal development, spanning from the 28th week of intrauterine life to the first few days of life, amelogenesis begins for the first permanent molars, permanent incisors, and second primary molars. Prenatal exposure to harmful factors such as maternal smoking or illness, perinatal factors including premature or prolonged labor, low birth weight, cesarean section, and birth complications, as well as postnatal viral illness (roseola), drug use, or prolonged breastfeeding, are all factors described as potential causes or associated with the etiology of MIH. In addition, however, multifactorial pathogenesis with potential genetic involvement is highly likely to be the cause of MIH [10, 11]. Enamel affected by MIH is brittle with a high pore content and has poorer mechanical properties, as it contains increased levels of proteins (residual amelogenin) that inappropriately inhibit the formation of hydroxyapatite crystals [12]. Despite ongoing research, the complete etiology of MIH remains elusive [13, 14]. Early diagnosis and treatment of hypomineralized second primary molars and timely prophylaxis could reduce the complications of MIH [15-17].

Case Report

Anamnesis: The history was taken based on the patient, s and his parent's (mother's) testimony. The patient, 6 years old, from the city of Varna, presented with complaints of unaesthetic teeth with discoloration, newly erupted and deep lesions with periodic pain, and fractures of the lingual walls of the second primary molars of the lower jaw (dental arch). The reason for the visit was also a 6-month follow-up examination. The article aims to examine, diagnose, and treat a six-year-old patient with molar incisor hypomineralization.

Oral disease history: Dental examinations are regular, with the last visit in May 2023 - treatment of caries on tooth 85. No harmful habits are reported, and no orthodontic treatment has been performed. No previous traumas in the maxillofacial area have been identified. There are no missing teeth. Oral hygiene consists of cleaning teeth only in the morning with a manual brush, with a medium hardness of the fibers, and using toothpaste - Sensodyne. Mouthwash is not used. The patient has not taken fluoride endogenously, no exogenous fluoride prophylaxis has been performed to date. He uses only fluoride-containing toothpaste daily in the morning and evening. The child and mother report frequent consumption of carbohydrates during the day, as well as more than 3 snacks.

General medical history - The patient had a hospital stay at the age of 3 for treatment of a hernia and a tonsillectomy at the age of 4. The mother does not report any difficulties or illnesses during pregnancy and childbirth. There was no medication or harmful radiation during pregnancy. The child does not take any medication, and no allergies have been identified to date. The patient has no general medical illnesses and is eating a full diet, according to the diet for his age.

This study was conducted at the University-Medicodental Center at the Faculty of Dental Medicine at the Medical University, "Prof. Dr. P. Stoyanov" of Varna, Bulgaria. It was conducted after the child's parents provided prior written, free clarified, and declared consent and a completed questionnaire about the current and general medical condition of the child-patient.

Examination: Extraoral: no facial asymmetry, no scars, the skin of the face has preserved turgor, visible mucous membranes - without changes, no rash units and swellings are observed. Normal mouth opening volume, without trismus and scars.

Intraoral: Mucosa: no pathological changes; Gingiva: Color: red in places; Texture: smooth; Papillae: swollen; Gingival margin: swollen, red, thickened; Bite- normal with rotation of newly erupted 31 and 41 permanent central incisors, tooth 42 permanent lateral incisor is in lingual position. Tongue: uncoated, normal color, no eruption elements are observed.

The patient has erupted all permanent sixth teeth, except tooth 46 (and except for the third molars), newly erupted upper and lower central incisors, tooth, 22 and 42 teeth, from the group of lateral incisors, and they are expected to complete their root development in about 3 years. The patient is in the period of early mixed dentition.

An oral hygiene index of OHI-PLI by Silness-Loe was performed. His result is 1.9, which value defines oral hygiene as satisfactory to poor on the selected scale.

Dental Status: Multiple white, cream-colored dense lesions are observed on the vestibular surfaces of the teeth. We found that teeth 11, 31, and 41 have white (cream)-yellow-brown lesions with a change in the morphology of the enamel and are more atypical for the development of dental caries zones. We established the diagnosis of Pulpitis symptomatic aperta, diagnosis of teeth 74, 75, and 85 with the presence of a traumatic fracture of the entire lingual surface of the teeth and damage to their occlusal surface, carious lesions D4 (ICDAS II). The filling of temporary tooth 85 with a fracture of the lingual surface has fallen out. The patient is at high risk of developing caries – the presence of more than 3 intermediate meals; the presence of active white lesions and the diagnosis: Molar incisor hypomineralization-MIH. According to the classification of the disease, it concerns MIH TNI 1, and other factors, Table 1 and (Figure 1).

- Observation Signs: MIH TNI 1 at least one lesion/surface with a diagnosis of MIH, and/or hypersensitivity.
- Diagnosis and differential diagnosis of the disease- Diagnosis of MIH disease is carried out according to EAPD criteria / The European Academy of Paediatric Dentistry /

Table 1: Diagnostic criteria. Diagnosis of MIH disease is carried out according to EAPD criteria.

MIH TNI 1	MIH TNI 2	MIH TNI 3	MIH TNI 4
without hypersensitivity	without hypersensitivity	with hypersensitivity	with hypersensitivity
without loss of substance	with loss of substance	without loss of substance	with loss of substance
	2a- Extension of defect <1/3		4a- Extension of defect <1/3
	2b- Extension of defect >1/3 to < 2/3		4b- Extension of defect > 1/3 to < 2/3
	2c-Extension of defect >2/3 Or/ and defect close to pulp Or extraction Or atypical restoration		4c- Extension of defect >2/3 Or/ and defect close to pulp Or extraction Or atypical restoration

Figure 1: Clinical examination and diagnosis of MIH. Presence of opaque white (creamy, dense)-yellow-brown opalescence and opaque lesions on teeth 11, 31, and 41. Diagnosis of MIH severity – Diagnosis: MIH TNI. Clinical examination with measurement of oral hygiene index OHI-PLI by Silness-Loe. Its value is 1.9 and defines oral hygiene as satisfactory to the poor.

Treatment Plan. Motivation and training to improve oral hygiene are carried out. Treatment of plaque-induced gingival inflammation (Diagnosis: Gingivitis catarrhalis chronica) - conducting professional oral hygiene and prescribing means for individual hygiene, according to a prepared individual preventive program.

The opaque white (cream)-yellow-brown opaque lesions on teeth 11, 31, and 41 were applied with ApaCare fluoride varnish every 3 months according to the algorithm for 4 minutes on polished and dry enamel surfaces. Diagnosis of the severity of MIH – Diagnosis: MIH TNI 1. The patient had no destruction and sensitivity of the permanent teeth with MIH (only the primary lower molars - teeth 74, 75, and 85 were destroyed and complained of pain).

We continued the home individual treatment of the reversible lesions and incisors with MIH with Tooth Mosse cream for 7 months with application every evening on washed and dry enamel surfaces. We also established a carious process - active enamel white lesions, irreversible pulpitis, and treatment of the lower primary molars, 74, 74, and 85 using the formalin-resorcinol method in 3 stages. In the first stage, desensitization of the teeth with Devitec for 7 days, we filled with a temporary filling. In the second stage, an endodontic cavity is formed and the orifices are prepared 1-2 mm(millimeters) deep to the root canal, with a sterile bur and micromotor. A temporary insert is placed with a sterile swab soaked in an ex-tempore mixture of 40% formalin and resorcinol crystals and stirred until a saturated solution. We obturated with a temporary filling for 48 hours. In the third visit, the teeth are opened again, and the result of the treatment is also controlled. In the absence of pain and exudate, we proceed to filling. The same mixture of formalin-resorcinol is prepared again on a sterile plate, and zinc oxide powder is added to it until a paste is obtained. The resulting paste is placed to obturate the amputation depots of the orifices, at a depth of 1-2 mm and a glass-ionomer cement or glass liner is placed, the pad is polymerized for 40 seconds with an LED photopolymer lamp. The cavity is filled with a solid photopolymer, strictly following

the algorithm of obturation, enamel etching, and bonding of the tooth enamel. Adhesion is achieved according to the manufacturer's instructions.

The treatment begins with a diagnosis of the caries process and caries lesions - determination of active, stationary lesions, reversible, and irreversible lesions on the primary and permanent teeth. Active lesions are located under plaque, in places predisposed to the development of caries, the lesion is without clear boundaries, rough, without transparency, and without shine, color - white. Inactive carious lesion - in atypical places, lack of plaque, with clear boundaries of the lesion, there is shine, transparency, smooth, color - white to brown. Active lesions require non-operative preventive treatment. Inactive lesions do not require treatment. Reversible lesions are D1a, D1b and D2. They require non-operative preventive treatment. A differential diagnosis between deep fissure and occlusal caries is necessary to place sealants on newly erupted sixth teeth. All chewing teeth erupt with deep fissures. Fissures are formed last and their mineralization is the weakest (post-eruption maturation continues up to 10 years after eruption, but it has greater clinical significance in the first two years after eruption of molars).

The enamel in the area of deep fissures is thin, the diagnosis of MIH will require prophylaxis, diagnosis, and treatment for a long time. Plaque formation is enhanced and unhindered - easy entry of food residues and microorganisms. Plaque biofilm in the fissure cannot be influenced by self-cleaning mechanisms in the oral cavity alone. A permanent caries situation is created that does not allow post-eruption remineralization. Fissure caries develop in many occlusal areas since the fissures, pits, and grooves on the occlusal surface of the newly erupted tooth are much more than those in adult individuals (strongly pronounced relief). The orifice to the deep fissure is narrowed, and there is an extension below it. The toothbrush is not able to enter the depth of these narrow spaces. Even the single fiber of the toothbrush is too large to enter and clean the fissure. Protection of these fissures is achieved by applying sealants. To make a successful differential diagnosis, the following are necessary: direct observation, additional examinations, indirect data, and identification of caries risk factors.

Direct observation includes: Visual observation – and requires good lighting, drying, and clean teeth. Any calculus deposits or plaque should be cleaned before the examination, as the fissure may be stained with food pigments. Tactile inspection using an atraumatic periodontal probe with number 621. Aggressive probing should not be used, as it may damage the surface enamel layer and initiate an incipient carious lesion. Keeping the probe in the fissure may lead to a false positive or negative result.

Additional examinations that may be performed: radiography (Figure 2), FOTI (fiberoptic transillumination), DIFOTI (digital fiberoptic transillumination), QLT (quantitative laser fluorescence), DIAGNODENT pen. Staining with dyes - fuchsin, methylene blue, and others.

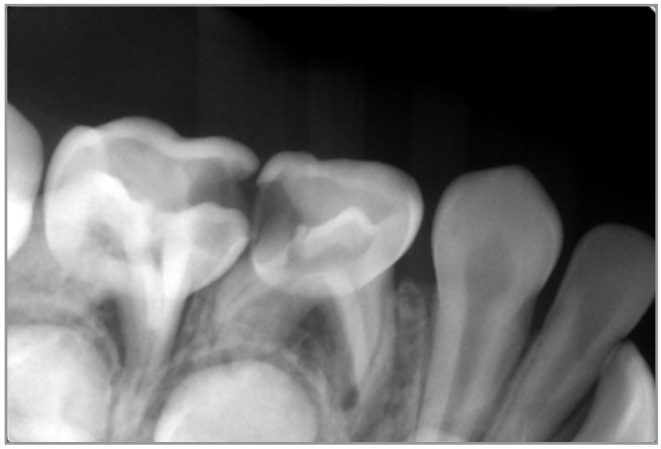

Figure 2: Intraoral, in the region of alveolar radiography of teeth 74 and 75. Preoperative imaging of the patient for the diagnosis and treatment of symptomatic open pulpitis of teeth 74 and 75.

Indirect data: Dental age - when the tooth erupted less than two years ago, the probability of a deep fissure is significant. After 2 years of tooth eruption, any staining or retention of the probe is more likely to be associated with caries or the development of molar-incisor hypomineralization affecting the permanent first molars. Caries of the teeth in the corresponding tooth group - if one or more of them have carious lesions or filling, the probability of the examined tooth having a healthy fissure is relatively small. General caries of the child - if there are more than two caries, pulpitis, or periodontitis of the primary teeth or dental caries of the permanent teeth, there is a greater probability that the occlusal surface has developed initial caries.

The Caries Risk is Assessed: Low risk - low probability of caries; Medium risk - suspected caries; High risk - high probability of development and presence of dental caries. The risk assessment is carried out with the tool of the American Academy of Pediatric Dentistry. Factors increasing the probability of caries - presence of new caries, presence of carious teeth from the molar group, high caries in the parents, poor oral hygiene of the patient, frequent carbohydrate intake, reduced salivation, irregular preventive examinations. All these factors and examination methods determine the development of caries complications and/or pulpitis of the second lower primary molars – 74, 75, and 85. The loosening and fracturing of the lingual walls of the teeth, without timely treatment, led to a complication of the diagnosis, (Figure 3 and 4).

Figure 3: Pulpitis symptomatic aperta, diagnosis of tooth 75, endodontic treatment performed. Filling in the endodontic cavity with glass ionomer cement for the base and hard photopolymer, strictly following the algorithm of obturation and etching and bonding of the enamel.

Figure 4: A layered filling technique is applied. Photopolymerization of each dose layer of composite for 20 seconds until the cavity is filled.

We have applied sealants in the healthy and intact dental fissures and grooves of teeth 16, 26, and 36 with a sealant of Glass-ionomer cement, monitoring will be conducted every 6 months, and after the second year, the sealant will be replaced with Clinpro™ sealant (3M ESPE). The Clinpro™ sealant, manufactured by 3M ESPE, is a photopolymerizable, fluorine-releasing material for filling deep fissures and pits, which has the unique quality of changing its color. It has the following composition: Resinous composition - BIS-GMA/TEGDMA and is not filled. When applied, the color of the sealant is pink, and when exposed to light from a photopolymer LED lamp, it changes from the source to a matte light yellow. The pink color helps dental professionals to precisely dose the material during the procedure. When photopolymerized under the influence of light, the material changes its color from pink to a matte light yellow.

Properties and advantages: Direct application from the syringe; Color-changing technology for easier application; Low viscosity for easier filling of pits and fissures; Contains and releases fluoride, bonds with enamel; Long-lasting protection against dental caries. Indications for application and algorithm of work: Teeth must be sufficiently drilled; Pits and fissures must be deep; Polishing, drying, and etching according to the algorithm (30 seconds) of the enamel; Rinsing with water for 60 seconds; Air

drying until the enamel surface becomes matte white; Place the sealant in the pits and fissures, application with a thin cannula at 1 mm covering the base of the tubercles and in all fissures, pits and grooves of the occlusal surfaces. Polymerization for 40 seconds. Testing occlusion and articulation with an articulation paper test and finishing with elliptical diamond finishing burs. Polishing with rubbers and pastes.

Differential diagnosis: We also made a differential diagnosis with the following diseases: single hypomineralized spots ((SHP); dental fluorosis (FL); Turner's dysplasia (T); Other dysplasias such as Amelogenesis imperfecta hereditary (AIH); enamel erosion (E) and others.

Discussion

In our study, we applied varnishes (ApaCare with fluoride) and pastes with casein phosphopeptide and amorphous calcium phosphate (CPP/ACP), which increase the bioavailability of calcium and phosphates in saliva and therefore stimulate remineralization and desensitization of teeth with MIH. CPP/ACP and fluoride can bind tightly to the plaque biofilm on tooth enamel and can stabilize calcium, phosphate, and fluoride ions in saliva from the presence of CPP, which prevents spontaneous precipitation and allows the penetration of these ions deep into the subsurface lesion for a minimum of 7 to 14 days. Other authors reporting on the subject have also identified these factors as effective in enhancing the remineralization process in the superficial and subsurface layers of enamel [18-20]. Researchers have shown that both composite sealants and glass ionomer cement reduce hypersensitivity immediately and after a 12-week follow-up. Furthermore, both types of sealants have similar retention [21-23].

The perception of 64.7% that MIH is a public problem after dental caries was found, and for the diagnosis of MIH, it was found that 58.3% showed some confidence in diagnosing the same. The confidence of dentists regarding the treatment of MIH showed that 49.5% were confident in their results [24, 25]. Once scientists implement MIH TNI it may be possible to create a standardized approach to the dental treatment of MIH [26, 27]. Moderate defects are more common in molars, while mild lesions are more common in incisors. Antibiotics used during pregnancy and treatment may have a direct role in the etiology of MIH in children [28, 29]. However, there is no complete agreement regarding the correct diagnosis and etiology of the disease [30-32]. Within minimally invasive dentistry, the use of various biocompatible remineralizing agents on incisors and molars affected by MIH is of great importance [33-35]. The authors describe that laser therapy has a weak clinical effect and advantage over topical therapies in the treatment of dentin hypersensitivity [36, 37]. In addition, the use of ozone also to prevent the deterioration of dental caries or to treat teeth affected by MIH can be considered effective for the current “aerosol-free concept” [38].

According to scientists, toothpaste containing Zn-Mg-hydroxyapatite provides a significant reduction in sensitivity to airflow after two weeks of daily use, in adult patients [39]. Clinicians very rarely notice that in children with MIH, two diseases are usually diagnosed - hypomineralization and malocclusion, and they discuss a plan for a complex treatment. Children with MIH should be examined and treated comprehensively in cooperation with an orthodontist and, if necessary, by other specialists [40, 41]. According to other researchers, teeth affected by MIH are also more susceptible to dental caries, since the enamel is porous and fragile, which also "makes" it sensitive to thermal and mechanical external factors, which is why oral hygiene is difficult to perform [42-44]. The destruction of teeth after their eruption is also rapid since they are exposed to chewing forces, especially the sixth fused teeth [45]. In support of this thesis, scientists with in vitro studies bring the idea that there is a significant difference between the structure of MIH-affected teeth and MIH-unaffected enamel structures of healthy teeth in the dentition of children. Clinical results of diagnostics and examination of the enamel of teeth affected by MIH correlate with the severity of enamel changes from the norm [Svetla Petrova, Georgi Tomov, et al., [46].

In the future, the patient has the option of treating the frontal incisors affected by MIH with ICON, if necessary. The Icon system consists of: Icon-Etch (15% hydrochloric acid), Icon-Dry (99% ethanol), and Icon-Infiltrant (methacrylate-based resin). From the age of 6 to the age of 12: Permanent teeth are in pre-eruptive, eruptive, pre-functional and functional stage; Primary teeth are in different stages of root resorption; Into growing jaws there are about 50 teeth, in different stages of development; To be aware of the terms of dynamics of teeth development is important for the correct diagnostic and treatment procedures in childhood.

Scientists also suggest that it may protect enamel from acid attack, improve the micromechanical properties of enamel, reduce post-eruptive destruction and non-carious enamel defects, and/or possibly improve adhesion and restorative outcomes of teeth with MIH [47]. If there is hypersensitivity and the patient reports pain from the MIH teeth, desensitization therapy and longer studies and treatment of patients diagnosed with MIH are necessary [48].

Conclusions

The diagnosis and differential diagnosis present the relationship between dysplasia and MIH disease and the clinical manifestation in the color, shape, type, and severity of the lesions - observed on the tooth surface, with clearly demarcated opaque lesions, more atypical for dental caries lesions. Teeth with white(cream)-yellow-brown enamel lesions diagnosed with MIH should be subject to prophylaxis and non-surgical treatment, strict clinical control, and monitoring, due to the risk of rapid post-perforation destruction of their enamel and dentin. Early diagnosis of hypomineralized molars and incisors and timely prophylaxis and treatment can prevent complications of MIH.

Conflict of Interest

The authors declare no conflict of interest

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Author Contributions

Conceptualization, D. Damyanova; methodology, D. Damyanova, S. Angelova; validation, D. D., S. A., M. D.; writing—original draft preparation, D. D., S. A.; writing—reviewing and editing, D. Damyanova, M. Dimova. All authors have read and agreed to the published version of the manuscript.

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