Considerations for clinical management of molar-incisor hypomineralization: A literature review

Considerações para o manejo clínico da hipomineralização molar-incisivo: Revisão de literatura

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Abstract

Clinically seen as demarcated opacities in permanent first molars and incisors, Molar-Incisor Hypomineralization (MIH) is a clinical challenge to dental professionals. Histologically, these opacities are shown to be porous, making the affected tooth enamel less resistant to the mechanical forces of mastication. Consequently, children with this enamel defect may require more frequent and often more complex restorative treatments, which increases their anxiety before treatment begins. Furthermore, when present in incisors, these defects may damage children's psychological and social development. Based on a literature review, this article discusses the developmental defects of enamel (DDE), with emphasis on MIH. The purpose is to provide professionals with a theoretical and conceptual basis that will enable them to provide more appropriate care that takes into consideration not only the clinical needs of affected children, but their psychological and social needs as well. The management of teeth with MIH may involve stages ranging from early diagnosis through to tooth extraction and orthodontic follow-up in more severe cases. Children with this defect, and their families, should receive special care and guidance about the necessary oral care and prognosis of each case. Therefore, in addition to technical knowledge, it is necessary for the professional to be prepared to deal with the psychological and social needs of each child, to provide a more satisfactory quality of dental care.

Key words: Dental enamel; molar-incisor hypomineralization; dental care for children

Resumo

Clinicamente visualizada como opacidades demarcadas em primeiros molares e incisivos permanentes, a Hipomineralização Molar-Incisivo (HMI) representa um desafio clínico para profissionais da odontologia. Histologicamente, estas opacidades apresentam-se porosas, tornando o esmalte afetado menos resistente à cárie e às forças mecânicas da mastigação. Consequentemente, crianças com este defeito de esmalte podem apresentar necessidades de tratamentos restauradores mais frequentes e em geral, mais complexos, o que aumenta a ansiedade perante o atendimento. Além disso, quando presentes em incisivos, tais defeitos podem causar prejuízos psicológicos e sociais às crianças portadoras. A partir de uma revisão da literatura e apresentação de casos clínicos, este artigo discute sobre os defeitos de desenvolvimento do esmalte (DDE), com ênfase na HMI, a fim de proporcionar ao profissional, base teórico-conceitual para que este ofereça um cuidado mais adequado, que considere, além das necessidades clínicas das crianças afetadas, suas características psicológicas e sociais. Após considerar todas as características apresentadas da HMI, chega-se à conclusão que o manejo dos dentes com HMI pode envolver desde o diagnóstico precoce, à extração dentária e acompanhamento ortodôntico nos casos mais severos. As crianças portadoras deste defeito, bem como suas famílias, devem receber atenção especial por parte do profissional e serem orientadas quanto aos necessários cuidados bucais e prognósticos de cada caso. Por isso, é necessário que além do conhecimento técnico, o profissional esteja preparado para lidar com as necessidades sociais e psicológicas de cada criança, a fim de proporcionar uma qualidade de cuidado mais satisfatória.

Palavras-chave: Esmalte dentário; hipomineralização molar-incisivo; cuidados bucais para crianças

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Introduction

The clinical management of developmental defects of enamel (DDEs) is a challenge to dental professionals worldwide. For example, enamel hypoplasia may facilitate the caries process, as a result of greater plaque accumulation on their surfaces (1,2). In addition hypomineralization may cause rapid coronal destruction by mechanical forces, due to the structural weakness of the affected enamel (3-6).

Among the DDEs, the scientific literature has pointed out "Molar Incisor Hypomineralization" (MIH) (3), as a result of its high prevalence in the child population, severe clinical consequences for affected children, in addition to the difficulty professionals find with its treatment (1,3,6-8).

It is a fact that children with MIH present more frequent and more complex dental treatment needs when compared with those who have normal tooth enamel (9-11). As it is more porous and less resistant (4,12), the hypomineralized enamel facilitates the entry of bacteria into the subjacent dentin (13), resulting in a constant state of pulp inflammation (14) which causes discomfort on mechanical manipulation of the affected tooth (3,7). In some more severe cases, this hypersensitivity may also make it difficult to achieve efficient dental anesthesia, contributing to an increase in anxiety in children when they are faced with the prospect of dental treatment (11). Moreover, when present in incisors, these defects may cause the affected children psychological and social harm (16).

Therefore, the aim of this article is, by means of a review of the literature, to discuss DDEs, with emphasis on MIH, in order to provide professionals with theoretical-conceptual bases so that they are able to offer more adequate care, which considers not only the clinical needs of affected children, but their psychological and social characteristics.

A brief review about the process of dental enamel formation and the developmental defects of enamel

Tooth enamel is a tissue of epithelial origin, incapable of being regenerated after its formation. As a result of this characteristics, injuries that occur during this period are permanently recorded on its surface (17,18), characterizing the DDEs.

Didactically, the process of enamel formation, or amelogenesis, is divided into two main phases, known as secretion and maturation. The first phase, denominated the secretion phase, is when the organic matrix deposition of enamel by the ameloblasts occurs, these being the cells responsible for its production. The matrix is deposited in layers throughout the entire thickness of the future enamel, and alterations that occur during this phase result in quantitative defects or hypoplasia (18), clinically visualized by the reduced thickness of the affected enamel.

The second and longer phase of amelogenesis is the maturation of the organic matrix. At this time, the ameloblasts modulate and transport ions necessary for the growing mineralization of the tissue. Alterations that occur during this phase result in a tissue with a large quantity of organic matter and lower mechanical resistance than normal enamel, configuring the qualitative defects or hypomineralization (18). These defects are clinically visualized by means of alterations in translucence of the affected enamel, or opacities, which may be diffused, characteristic of fluorosis, or demarcated (17,18). Figure 1 shows the clinical characteristics of the DDEs presented.

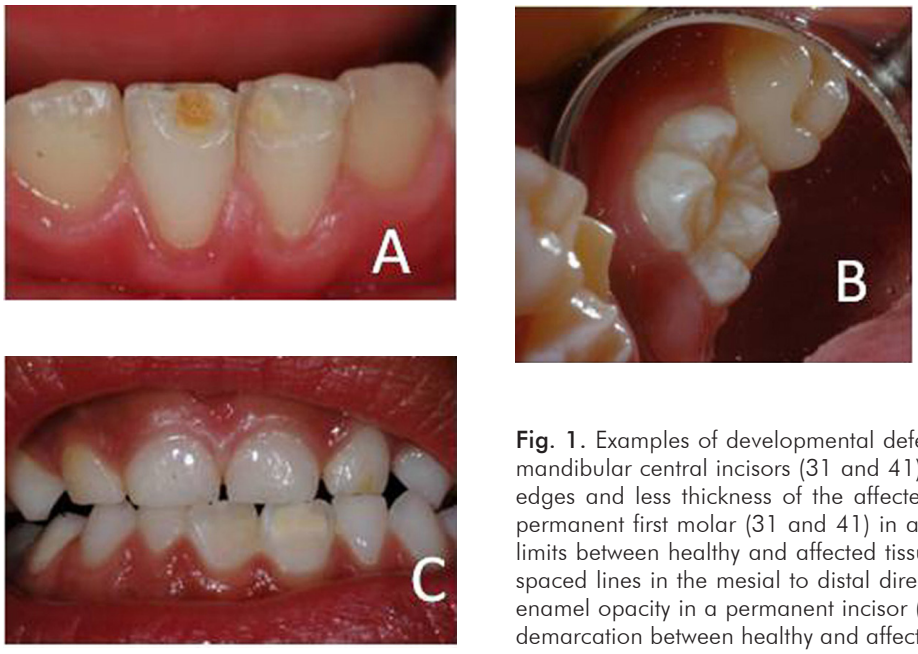

Fig. 1. Examples of developmental defects of enamel. **A.** Enamel Hypoplasia in mandibular central incisors (31 and 41) in a 7-year-old child. Note the rounded edges and less thickness of the affected tissue. **B.** Tooth enamel fluorosis in a permanent first molar (31 and 41) in a 7-year-old child. Note absence of clear limits between healthy and affected tissue, in which it is possible to observe fine spaced lines in the mesial to distal direction, with small groups. **C.** Demarcated enamel opacity in a permanent incisor (32) of a 6-year-old child. Note the clear demarcation between healthy and affected tissue. Source: Costa-Silva, 2012.

Molar Incisor Hypomineralization

Hypomineralization or demarcated opacities of enamel are common in the permanent teeth of children and adolescents all over the world (19-21). When these are present in permanent first molars, either associated with affected permanent incisors, or not, these defects are denominated Molar Incisor Hypomineralization (MIH) (3).

In 2003, the European Academy of Pediatric Dentistry published the diagnostic criteria of MIH, in which atypical restorations that involved the free surfaces generally not affected by caries, would also be comprised within this classification (22). Moreover, in spite of the low number studies, characteristic enamel defects may also be found in primary second molars (23-25).

It has been recognized that MIH is of systemic origin, resulting from problems such as prematurity, low birth weight and infections during early childhood (3, 26), the cause of the problem remains unknown (27). It is known, however, that injuries to the ameloblasts occur during the maturation phase of enamel (3).

The opacities of MIH range from white to yellow-brown. This variation in color is related to the histological aspect of the lesion, as darker opacities present more intense porosity (12). Furthermore, there is also a correlation between the clinical appearance of the lesion and mineral density, as the darker opacities are less resistance and contain a lower mineral content in comparison with the lighter types (29). Dark demarcated opacities also have less mechanical resistance (29) resulting in more extensive structural losses after eruption of the affected tooth (19). Whereas, the lighter opacities generally have a covering of well mineralized enamel (12),and present a lower incidence of post-eruptive structural loss (29).

Frequently post-eruptive structural losses are progressive, and may result in extensive coronal destruction (29,30). Hypomineralized enamel presents a reduction in its modulus of elasticity, with regard to its resistance to abrasion (4). These structural losses may occur due to fracture of the hypomineralized enamel, as a result of its structural weakness or wear of the most affected tissue. Studies have demonstrated that hypomineralized enamel undergoes greater dental abrasion as a result of brushing (31) and that structural microlosses may be present, even when they are not clinically visible, leaving the tissue superficially rough (19).

As the MIH lesions are most concentrated on the middle and occlusal thirds of tooth crowns (12), the localization of this lesion may also be a fact that contributes to structural losses of enamel after tooth eruption (29), as the occlusal surface of molars present the highest incidence of masticatory forces when compared with the free surfaces of incisors, for example(7). Figure 2 shows and example of post-eruption structural loss progression in a hypomineralized tooth.

Clinical Management of MIH

As has been affirmed, laboratory studies have demonstrated that in addition to greater porosity, hypomineralized enamel has less mineral density, thinner and more irregular prisms, and lower mechanical resistance (4,12,29). All these characteristics added to masticatory force contribute to post-eruptive structural losses being common in teeth affected by MIH (19,29,30). This appears to be the main fact responsible for the difficulty in obtaining satisfactory results in the restoration of affected teeth (10,32).

Dealing with the structural losses of MIH is a clinical challenge, as these losses may contribute to plaque accumulation and consequent development of dental caries, a growing cause for concern. Nevertheless, in addition to structural losses that may create niches for bacterial retention, the affected teeth are hypersensitive to mechanical manipulation, probably as a result of the constant state of pulp inflammation found in the teeth (14), which makes it difficult to clean them (3,7,26). Another clinical concern is the esthetic problems generated when the permanent incisors present demarcated opacities, which may harm the self-esteem and social life of children with MIH (16).

All of these characteristics of MIH lesions have led to a great variety of treatments being proposed. Nevertheless, the choice of the best treatment for teeth affected by MIH includes, among other factors, the severity of the lesion.

Fig. 2. A. MIH defect in a permanent mandibular first molar (36) with the beginning of structural loss of the affected tissue, in a child initially 6 years old. At a smaller size, the permanent incisors of the same child, demonstrating the presence of demarcated opacities in these teeth (11 and 31). **B.** The same tooth (36), 18 months after the first exam, presenting more accentuated tissue loss. Source: Costa-Silva, 2012.

Although no single criterion has yet been arrived at for the classification of severity, some authors have suggested that MIH lesions must be divided into light or severe (6), according to their clinical characteristics such as structural loss, in conjunction with other subjective considerations, such as the patient's sensitivity to management of the affected tooth (33). According to the Guideline for the clinical treatment of MIC of the European Academy of Pediatric Dentistry (6), lesions that present demarcated opacities only, free of sensitivity, must be treated as slight lesions and receive only preventive treatment. Whereas lesions that present structural losses and/or sensitivity, deserve special treatment, which begins with prevention, restorative treatments and in more severe cases, going as far as extraction and orthodontic follow-up at an opportune time.

However, in severe cases, the affected teeth must be kept in the oral cavity with the minimum sensitivity and structural compromise possible, until they are definitively restored, or even until they can be extracted (34). But how can these teeth be maintained in the oral cavity in such a way that they do not interfere in the child's quality of life? This question emphasizes the need for a holistic approach to the patient, considering not only his/her clinical needs, but his/her psychological and social characteristics as well, which includes making the family aware of these needs and having their cooperation during treatment.

Early diagnosis of MIH, prevention of caries and post-eruptive structural losses

Early diagnosis is particularly important, because when there is presence of a demarcated opacity in a primary molar that is still erupting, the dentist must be alert to the possibility of the involvement of incisors and other first molars. In the same way, the presence of a demarcated opacity in a permanent incisor may be an indication of MIH and the professional must be alert to these characteristics. Thus, the child must be monitored constantly until the four permanent first molars have completely erupted.

Another important aspect for successful dental treatment is to make the parents aware of the problem. It has been well explained in the literature that children with MIH have a higher incidence of caries, greater and repeated dental treatment needs, hypersensitivity to manipulation, even when the enamel is visually intact (3,9). All these characteristics are important at the time of providing the parents/guardians with guidance. Counseling on diet and some attitudes, such as the parents' help during tooth brushing and the use of fluoridated toothpastes, may also help to prevent caries and reinforce the tooth structure. Simple measures, such as the use of warm water during brushing, are important for the reduction of sensitivity, and also help to promote better control of plaque and consequently, of dental caries(34).

Another intriguing question is related to the use of resin-based fissure sealants, considering that hypomineralized enamel is resistant to acid etching as a result of its high protein content (28,34). However, resin sealants applied after the use of 5th generation adhesives appear to have better retention to hypomineralized enamel (36). There is also the possibility of the use of glass ionomer cement (GIC) to protect the fissures in affected teeth, thus allowing asymptomatic preservation (34). Small lesions, even with superficial structural losses limited to enamel may also be rehabilitated in this manner.

The use of other sources of fluoride, such as the application of concentrated fluoridated varnishes, may help with the mineralization process and reinforce the tooth structure, particularly in recently-erupted teeth, which are more susceptible to caries and structural losses (3). Another product that has been tested is calcium-phosphate casein, which has been shown to be effective, not only in the remineralization of the deeper layers of white spot caries, but also in increasing the phosphorous and calcium levels in MIH, which contributed to structural reinforcement and reduction in dentinal sensitivity (37). These treatment modalities must be preferred instead of the use of more invasive measures, such as crown restorations or extractions.

Restorative Treatment

Restorative treatment is recommended in the case of more severe structural loss, with dentinal exposure or the development of carious lesion in the affected tissue. Nevertheless, it is necessary to consider two main questions: the patient's sensitivity to manipulation, as well as under the effect of anesthesia, and the feasibility of maintaining the tooth in the oral cavity.

The dentist must be prepared for the difficulties encountered during the manipulation of affected teeth, such as hypersensitivity and the difficulty in providing the correct anesthesia. In addition, it may be necessary to perform extensive restorative interventions, constant re-treatments due to failures in the restorations, or even endodontic treatment, and placement of prosthetic crowns, overloading the child emotionally and leading to behavioral problems during dental treatment (9).

The interference of the opacities in permanent incisors in the social life of affected children must also be considered, because even if they do not present structural losses or sensitivity, these teeth may harm their quality of life. In these cases, interventions such as microabrasion and/or esthetic restoration with resin composite are recommended.

With regard to the restorative material, the professional should prefer adhesive materials to amalgam, because of its poor performance in the restoration of teeth with MIH (10). The use of GIC is recommended, particularly as an intermediate restoration in a tooth still at the stage of eruption, and which may remain as a future base for adhesive restorations.

The performance of adhesive restorations seems to be the best found up to now, compared with other restorative materials (10,38). Nevertheless, one must consider that when the restoration margins are in hypomineralized enamel, there is greater possibility of future structural losses and marginal leakage, due to the low mechanical resistance of the tissue, and the low bond strength to this tissue (35). Therefore, it is still necessary to conduct longitudinal studies with reference

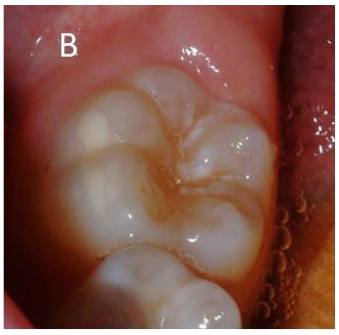

Fig. 3. Examples of MIH severity. **A.** One notes the opacity demarcated on the vestibular surface of tooth 46 in a 7-year-old child, without pain symptoms. **B.** A severe case of MIH in a 7-year-old child is presented, with structural loss and caries, in which there was sensitivity to manipulation. Not the plaque accumulation on the lesion, due to the child's difficulty in performing oral hygiene. Source: Costa-Silva, 2012

to the durability of these restorations with regard to cavity preparation (5,6), in order to opt between whether or not to remove all the hypomineralized enamel.

Whereas, metal crowns must be applied to teeth in which there is not sufficient dental structure to support a conventional restoration (6). Examples of light and severe MIH are shown in Figure 3.

Extraction and orthodontic treatment

The extraction of teeth with MIH and orthodontic follow-up may be a feasible alternative when the tooth is severely affected. Some authors have demonstrated that the extraction of affected molars in the correct period would not cause serious occlusal problems, and in some cases, would be the best alternative (39,40). This period varies according to the formation of the second permanent molars and good results have been found, also with the spontaneous closure of the space and establishment of acceptable occlusion (39,40).

Conclusions

After considering all the characteristics of MIH presented, the conclusion was reached that the management of teeth with MIH could involve procedures ranging from early diagnosis through to tooth extraction and orthodontic follow-up in more severe cases. Both children who have this defect and their families must receive special attention and be guided with regard to the oral care required and the prognosis of each case. Therefore, in addition to technical knowledge, it is necessary for the professional to be prepared to deal with the social and psychological needs of each patient, in order to provide a more satisfactory quality of care.

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