Molar Incisor Hypomineralization (MIH): Clinical Presentation, Aetiology and Management

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Abstract: **In this paper, the current knowledge about Molar Incisor Hypomineralization (MIH) is presented. MIH is defined as hypomineralization of systemic origin of one to four permanent first molars frequently associated with affected incisors and these molars are related to major clinical problems in severe cases. At the moment, only limited data are available to describe the magnitude of the phenomenon. The prevalence of MIH in the different studies ranges from 3.6–25% and seems to differ in certain regions and birth cohorts. Several aetiological factors (for example, frequent childhood diseases) are mentioned as the cause of the defect. Children at risk should be monitored very carefully during the period of eruption of their first permanent molars. Treatment planning should consider the long-term prognosis of these teeth.**

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Clinical Relevance: **This paper relates the current knowledge of MIH to the clinical appearance of the phenomenon. At the moment, children with a poor general health in the first four years after birth should be considered at risk for MIH.**

During the past decades, declining caries prevalence figures have been noticed in all age groups. In the past, dentists were used to rapid caries progression in the primary as well as the permanent dentition in high caries populations. In those days, first permanent molars became carious shortly after eruption in most cases. Although occlusal caries still accounts for the majority of caries experience in children, a rapid caries progression in first permanent molars is not common any more in contemporary populations. However, dentists (especially paediatric dentists) are still confronted with large defects in first permanent molars during, or soon after, eruption (Figure 1). In the literature, such molars are referred to as non-fluoride enamel opacities, internal enamel hypoplasia, non-endemic mottling of enamel, opaque spots, idiopathic enamel opacities, enamel opacities and cheese molars.[1,2] Since these molars can be extremely painful to the children, such molars have become a field of renewed interest to clinical practitioners. Recently, Weerheijm *et al*. suggested the term Molar Incisor Hypomineralization (MIH) and defined it as hypomineralization of systemic origin of one to four permanent first molars frequently associated with affected incisors.[3] MIH does not appear to be a new phenomenon, but when caries prevalence was high, the developmental defect responsible for initiation of the cavity was probably not diagnosed.

Clinically, MIH molars can create serious problems for the dentist as well as for the child affected. For dentists, the problems are related to unexpectedly rapid caries development in the erupting first permanent molar, inability to anaesthetize the MIH molar when treatment is indicated, and unpredictable behaviour of apparently intact opacities. The child, on the other hand, will experience pain and sensitivity (even when the enamel is intact) creating, for instance, toothache during brushing. They may also complain about the appearance of their incisor teeth.

CLINICAL FEATURES

MIH is a hypomineralized defect of the first permanent molars, frequently associated with affected incisors. The number of affected first permanent

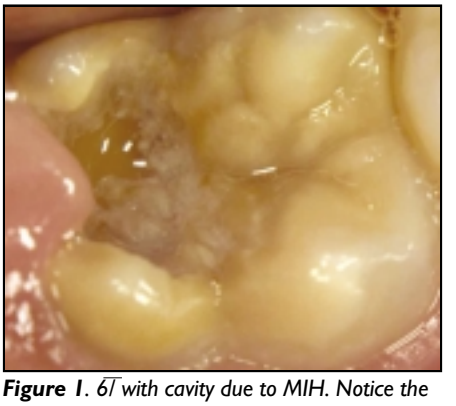

***Figure 1**. $\overline{6|}$ with cavity due to MIH. Notice the yellow opacities at the cavity border, buccal cusps and at the occlusal mesial part.*

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Figure 2. *White opacity buccal at /1 and white/yellow opacity buccal at $\overline{1}$ and $\overline{2}$/.*

molars per patient varies from one to four and expression of the defects may vary from molar to molar. Within one patient, intact opacities can be found on one molar, while in another molar large parts of the enamel break down soon after eruption. When a severe defect is found within a subject, it is likely that the contralateral tooth is also affected.[4]

In some cases, apart from defects in the first permanent molars, opacities may be found in the upper and sometimes the lower incisors (Figure 2). The risk of defects to the upper incisors appears to increase when more first permanent molars have been affected.[5] The defects of incisors are usually without loss of enamel substance.

Clinically, the hypomineralized enamel can be soft, porous and look like discoloured chalk or old Dutch cheese. The enamel defects can vary from white to yellow or brownish but they always show a sharp demarcation between the affected and sound enamel (Figure 3). The porous, brittle enamel can easily chip off under the masticatory forces. Sometimes, the loss of enamel (post-eruptive enamel breakdown) can occur so rapidly after eruption that it seems as if the enamel was not formed initially. After occurrence of the post-eruptive enamel breakdown, the clinical pictures can resemble hypoplasia. In hypoplasia, however, the borders to the normal enamel are smooth, whilst in post-eruptive enamel breakdown the borders to the normal enamel are irregular.

MIH can sometimes be confused with fluorosis or amelogenesis imperfecta. It can be differentiated from fluorosis as its opacities are demarcated, unlike the diffuse opacities that are typical of fluorosis and by the structure of the enamel (fluorosis is caries resistant and MIH is caries prone). The cause of fluorosis can, mostly, directly be related to the period in which the fluoride intake was too high. Choosing between amelogenesis imperfecta (AI) and MIH as a diagnosis seems a matter of definition: it should be stressed that, only in very severe MIH cases, the molars are equally affected and mimic the appearance of AI. Mostly in MIH, the appearance of the defects will be more asymmetrical in the molars as well as in the incisors. In AI, the molars may also appear taurodont on radiograph and there is often a history of family onset.

PREVALENCE

In epidemiological studies, children are normally not screened for the existence of MIH molars. At the moment, only limited data of prevalence of MIH are available. The prevalence figures range from 3.6–25% and seem to differ between countries and birth cohorts.[1,4-8] In the study by Weerheijm *et al*.,[5] it was found that the frequency of MIH molars was not evenly divided among the children in the studied population. Of the children where MIH molars were found, about 80% had two or more affected molars indicating child-related factors.[5] A high impact on treatment need is reported in low caries prevalence areas resulting from MIH molars.[7,9]

AETIOLOGY

The asymmetrical occurrence of MIH molars within individuals suggests that the ameloblasts are affected by a systemic disorder at a very specific stage in their development. At the moment researchers speculate that, in the case of MIH, the ameloblasts are affected in the early maturation stage, or maybe even earlier at the late secretory phase.

In the literature, various causes for MIH molars, such as environmental conditions, respiratory tract problems, perinatal complications and dioxins have been suggested.[1,2,4,6] Other causative

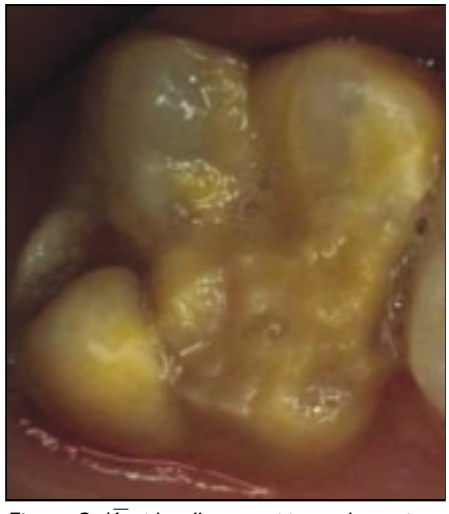

Figure 3. */$\overline{6}$ with yellow opacities and a cavity in the distal part of the occlusal surface.*

factors mentioned are oxygen starvation of the child combined with a low birth weight, calcium and phosphate metabolic disorders and frequent childhood diseases.[10-12] Vaccines given during early childhood have also been suggested as a possible cause but no data are available to substantiate this. The use of antibiotics has also been implicated, but antibiotic use is in most cases related to occurrence of diseases, so it is difficult to distinguish whether the association with MIH is caused by the antibiotic or by the illness itself.

The results of the different studies are not always in agreement with each other. Problems during pregnancy and birth have been mentioned, while in other studies no differences were found concerning the health of mother and child during pregnancy and birth of the children with and without MIH.[2,12] The latter indicates a more child-related cause originating after birth. The suggested influence of prolonged breast-feeding could not be demonstrated in all studies.[6,7,12,13] At this moment, we have to conclude that the aetiology of MIH still remains unclear. It is likely that several unknown contributing factors are involved resulting in a number of possible causes.

TREATMENT

MIH may lead to extensive treatment need.[7,9] Although children with and

***Figure 4**. Lower arch with stainless steel crowns on first permanent molars in child with MIH.*

without MIH showed similar dental histories concerning their primary dentition, it was found that, after eruption of the first permanent molars by the age of nine, children with MIH were treated ten times as often as children without such molars.[9] The MIH children in this study displayed more dental fear and anxiety compared to the healthy control group. Adequate use of local anaesthesia is regarded as an important factor to prevent dental fear and the reduction of discomfort of the child during treatment.[9] The difference in treatment need was mainly related to the affected teeth.[7,9]

MIH molars are fragile, and caries may develop easily in these molars. This problem is aggravated because the children tend to avoid the sensitive molars when brushing their teeth. If an erupting first permanent molar shows signs of opacities and/or post-eruptive breakdown, the child should be monitored frequently until the moment that all four molars have completely erupted. In order to minimize the loss of enamel and any damage due to caries, both preventive and interceptive treatment is required. Besides normal brushing and education to child and parents, prevention also includes fluoride varnish application and application of glass ionomer sealants. Sometimes the sensitivity of the teeth is decreased by these applications. The first aim should be relief of pain followed by consideration of the long-term viability of the molars. If restorative treatment is indicated, proper local anaesthesia is mandatory. The dentist should keep in mind that, in some cases, it can be difficult to get the molar properly anaesthetized. Adhesive materials should be chosen for these restorations. The outline of the restoration should be made in non-hypomineralized enamel, but it can be very difficult to find out where sound enamel begins, resulting in repeated restorations due to disintegration of adjacent enamel or opacities on other spots. The disintegration of the hypomineralized enamel can be unpredictable in the first years after eruption. In hypersensitive cases, or very severely affected teeth, semi-permanent restorations with stainless steel crowns (Figure 4) or adhesive-retained metal castings can be an alternative restoration. Extraction of such molars, combined with orthodontic treatment, should be considered as an alternative treatment, especially if the molars have a poor long-term prospect. The optimal time for extraction is indicated by the beginning of calcification of the bifurcation of the roots of the lower second permanent molar (usually around the age of $8^1/_2$–$9^1/_2$ years). In practice, this will mean extraction of the lower molars followed, half a year later, by extraction of the upper molars. Orthodontic intervention is indicated in most cases to optimize the definitive treatment outcome.

Generally, the defects of the incisors are milder than those of the molars. Since masticatory forces on the opacities in incisors are absent, the enamel substance does not disintegrate after eruption. However, treatment is often required for aesthetic reasons. In such cases (and in the rare case of breakdown of the enamel), replacement with composite should be considered as first treatment option.

The presence of MIH molars not only requires the dentist to identify problems at the earliest opportunity, but also to explain the problem thoroughly and explain the treatment options to the parent and child. As only the first permanent molars (and sometimes the incisors) are affected by the developmental enamel defect, the parents can be reassured with respect to the quality of teeth that have not yet erupted.

SUMMARY

In summary, it seems advisable to consider children with a poor general health in the first four years after birth at risk for MIH.[12] These children should be monitored more frequently during eruption of the first permanent molars. The same applies to children at low risk of caries when an opacity is noticed at the eruption of one of the first permanent molars. Management of these teeth should consider their long-term prognosis, as well as management of the presenting features such as pain.

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