Molar Incisor Hypomineralisation in a group of children and adolescents living in Dresden (Germany)

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Abstract. Aim *This was to determine the prevalence of Molar Incisor Hypomineralisation (MIH) and to evaluate possible causes of these enamel defects.* ***Methods*** *The study group consisted of 2,408 10-17 year old children born during 1985-1992 and living in Dresden (Germany). Enamel defects were recorded using the modified DDE index. Children with enamel defects and their parents were invited for a re-examination to record the medical history of the children during the first 3 years of life; these children were matched by age with other children with apparently normal first molars (control group).* ***Results*** *135 (5.6%) of the children had demarcated opacities in at least one first molar, i.e. MIH. A significantly higher prevalence of MIH was seen in children born between 1989 and 1991 compared with those born before and after that period ($p<0.01$). The number of children returning for the medical history questionnaire was low, 31 out of 135 responded (test group). Although there were no significant differences between the test and control groups in terms of peri and neonatal complications or other health problems, the low return precluded any definitive interpretation.* ***Conclusion*** *The overall prevalence of MIH in this study was low by comparison with other previous epidemiological reports.*

Keywords*: Developmental defects of the enamel, Epidemiology, Hypomineralisation, Aetiology.*

Introduction

Against a background of a decreasing prevalence of caries in children and adolescents developmental enamel defects meet with increasing interest both in scientific aspects and in clinical practice. Over recent years, for instance, the international literature has included frequent reports describing hypomineralised first permanent molars and incisors in children of different age groups, for which Weerheijm et al. [2001a] suggested the term Molar Incisor Hypomineralisation (MIH). For these structural anomalies an incidence of 10% is given for The Netherlands [Weerheijm et al., 2001b], 18% for Sweden [Jälevik et al., 2001a], and 19% for Finland [Leppäniemi et al., 2001]. Evaluations carried out in 13-14 year olds from 8 German towns in 1995 showed that only 0.6% and 0.7% had demarcated opacities of the first mandibular molars [Künzel, 1997].

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There is often a considerable need for treatment of children affected by MIH [Leppäniemi et al., 2001]. This arises in that:

- hypoplastic enamel may be lost shortly after a permanent tooth has erupted;
- affected teeth are often quite temperature sensitive.

Affected children, therefore, experience problems when cleaning their teeth, with increased plaque accumulation and a rapid progression of carious lesions contributing to the destruction of the crown. In addition to the molars and incisors the cusps of the canines may be affected, as they are mineralised during the same developmental period [Weerheijm et al., 2001a].

The aetiology of MIH is not yet fully understood. The risk factors that are usually considered include systemic disturbances during the peri and postnatal phase or unspecific diseases during early childhood. These are especially those that are associated with alterations in the calcium-phosphate balance or with insufficient oxygen supply to the ameloblasts [Van Amerongen and Kreulen, 1995; Jälevik and Norén, 2000; Jälevik et al., 2001b; Beentjes et al., 2002]. In addition environmental toxins (dioxins) taken up

directly with food or via breast milk may induce defective enamel formation [Alaluusua et al., 1996; Jan and Vrbic, 2000]. Recently subacute vitamin D deficiency has been suggested as another potential cause of MIH [Künzel, 2003].

This study was designed to determine the prevalence of MIH in a group of German children and adolescents and to evaluate possible causes of such deficient enamel formation.

Materials and methods

The study made use of the annual dental screening of 2002, conducted by the public health services, and examined all pupils of classes 5 to 10 (born between 1985 and 1992), aged 10-17 years, from 11 Dresden schools. Of the overall number of 2,608 pupils attending these schools 2,408 (92%) could be included. The remaining pupils were not present on the day of the examination. The 11 participating schools out of a total of 181 schools in Dresden belong to the service area of a paediatric dentist. The schools were in urban districts with a mixed population and comprised 5 primary schools, 5 secondary schools, and 1 grammar school. The fluoride content of local drinking water was 0.25 ppm F.

Dental examinations were carried out by one investigator (SS) on the premises of the participating schools, with sufficient illumination (halogen light), using mirrors and probes (explorers). The probe only was applied for plaque removal. Apart from carious lesions (D3,4MFT) use of the modified DDE index [Clarkson and O'Mullane, 1989] permitted a registration of defective enamel formation in all erupted permanent teeth. By analogy with other studies [Wetzel and Reckel, 1991; Jälevik et al., 2001 a] all demarcated opacities were also classified for their degree of severity, that is mild (A), moderate (B), or serious defects (C). First molars with atypical localisation or outline of fillings and already extracted first molars were included as demarcated opacities if further first molars were affected in the same dentition. By contrast opacities occurring in incisors but not in at least one first molar were not grouped with the MIH category.

Prior to the onset of examinations the examining investigator was calibrated using a group of 20 patients, not in the main study. In order to evaluate the intra-examiner reproducibility of the investigator, 10 patients were re-evaluated a few weeks later and results were assessed using Cohen's kappa coefficient.

All pupils with demarcated opacities received written invitations to attend a re-evaluation together with their parents. Health problems occurring in the peri and neonatal periods, diseases during the first three years of life, the length of time they were breastfed and the fluoride history were recorded using a standardised questionnaire. Pupils following the request constituted the test group. The control group consisted of peer-aged Dresden children who were patients of the department of paediatric dentistry of the university and had apparently normal first molars. The parents of these patients were requested to fill in the same questionnaire.

Statistical analysis of the data material was performed using the program package SPSS 10.0 and applying the t test and Chi squared test (c2). In all calculations a p value of <0.05 was considered significant.

Results

Agreement between the calibrator and the investigator proved to be very good as regards the diagnosis of disturbed enamel formation according to DDE index (kappa = 0.90) and good for the staging of opacities (kappa = 0.65). Evaluation of intra-examiner agreement showed that both the DDE index (kappa = 0.91) and the assessment of opacities (kappa = 0.89) were in close agreement.

On the basis of the DDE index an overall number of 152 pupils (6.3%) showed some kind of developmental enamel defects of their permanent teeth. No hereditary structural anomalies were identified. Demarcated opacities in at least one first permanent molar were found in 135 pupils (5.6%), who were thus deemed as affected by MIH. Prevalence of demarcated opacities proved significantly higher in pupils born in 1989, 1990 and 1991 as against pupils those born earlier or later ($p<0.01$) (Fig. 1). Out of the 135 pupils with demarcated opacities 78 (57.8%) had enamel lesions in first molars only, in 31 (23.0%) molars plus incisors would be affected and 26 (19.2%) showed additional opacities of the cusps of their canines (Fig. 2).

The average number of hypomineralised teeth was 4.8 (±5.0) per pupil, with 2.2 (±1.1) of these being first molars. Only one molar was affected in 34.1% of pupils; hypomineralisation of 2, 3 or all 4 molars was demonstrable in 28.1%, 9.7%, and 28.1%, respectively. In the 135 pupils an overall number of 658 teeth were diagnosed with demarcated opacities; 556 of these (84.5%) showed only mild lesions, in 40 teeth (6.1%) lesions were moderate and 62 teeth (9.4%) had severe defects (Fig. 3).

Out of a total of 540 first molars affected by MIH 212 had been restored; 115 of these showed atypical outlines. These restored teeth were included in the

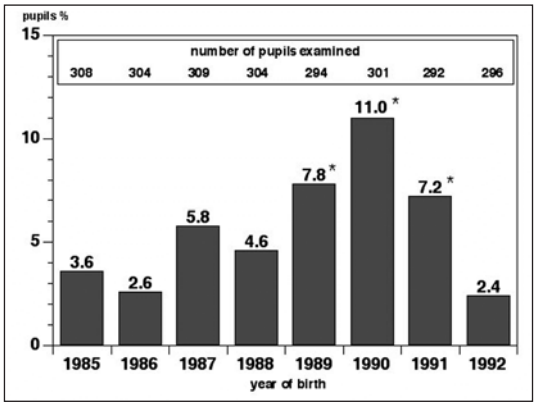

FIG. 1 - *Prevalence of demarcated opacities in different age groups (*p<0.01, t-test) for a group of German children living in Dresden.*

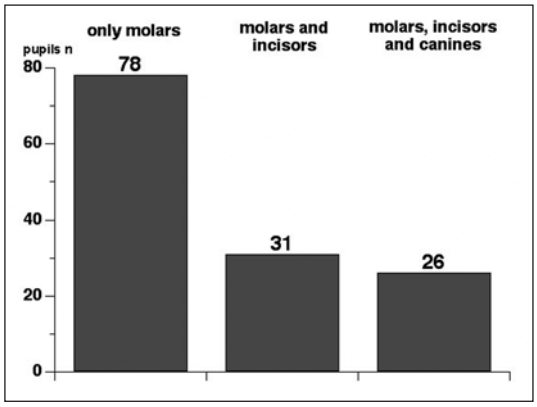

FIG. 2 - *Pupils (n=135) with demarcated opacities, distribution of opacities in different tooth groups in a group of German children living in Dresden.*

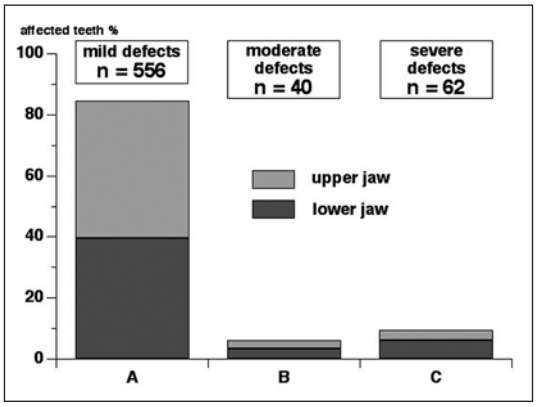

FIG. 3 - *Distribution of severity of the defects in 658 affected molar teeth.*

Diseases	Test group	Control group
	n=31	n=31
Premature birth	3	1
Birth complications	9	6
Jaundice of newborns	5	-
Airway infections	16	14
Asthma	2	1
Otitis media	2	-
Disorders of nutrition	-	5

TABLE 1 - *The most frequent diseases which occurred in a test and control group of German children living in Dresden.*

MIH category as were three first molars that had already been extracted. Carious lesions did not differ significantly between the group of pupils affected by MIH (D3,4MFT = 1.66) and non-affected pupils (D3,4MFT = 1.72).

There were 31 pupils (23%) and their parents who came to the re-examination appointments. This was a low return out of the original 135 children initially examined. While the assessment of medical histories revealed a trend for higher rates of perinatal complications, problems in the neonatal period or diseases during their first three years of life among the pupils of the test group as against their controls (Table 1), these differences were not significant (p=0.08). No significant divergence was found in terms of the average length of breastfeeding among the children of the test group (5.2±2.9 months) versus the control group (5.9±4.4 months). No correlation between prolonged breastfeeding (more than 1 year) and the number of hypomineralised teeth or the severity of enamel defects was established in the test group. The low return, however, precluded any definitive interpretation of these results. Both the children and adolescents of the test group as well as those in the control group had been administered vitamin D/fluoride tablets for at least the first year of their lives.

Discussion

With an incidence of 5.6%, this study indicated the prevalence of MIH seems to be lower in children and adolescents of Dresden than in other European countries. As the recruiting of the pupils was not based on randomisation but depended on the schools they attended, it is conceivable that the study sample

does not fully represent all children and adolescents in the city of Dresden. However, the data obtained fits in well with the results of earlier investigations made in Germany by Künzel [1997]. Another previous study, conducted in the extended environs of Dresden in 1997, also established a prevalence of demarcated opacities of only 1.7% and 2.9% in children between the ages of 6 and 10 years [Nicko, 2002]. It should be noted that fewer permanent teeth had erupted in these children than in the Dresden group evaluated in the present study.

As far as the examination of 10-17 year olds is concerned, it should be kept in mind that due to the existence of restorations in first molars some opacities would be "masked" and thus no longer demonstrable. On the other hand the fact that restorations often bordered on enamel that showed opaque or yellow discolourations or atypical localisations and outlines of the caries pattern involved, allowed the structural anomalies of these teeth to be designated as MIH. Three participants already had had at least one first molar extracted. Clinical findings obtained on the other molars of these participants again pointed to MIH as the underlying cause for extraction in each case. It is therefore safe to assume that the share of unidentified opacities is very small. The evaluation of 10-17 year olds offers the added advantage that the proportion of all permanent teeth that can be assessed is higher than in younger children.

Because of the low response to the recall for the questionnaire the data in this part of the study preclude a reliable assessment of a possible aetiology for the increased incidence of MIH in pupils born between 1989 and 1991. In addition there were no indications of an increased exposure to harmful environmental substances within that time period. In considering some previous studies Koch et al. [1987] also described an increased incidence of enamel opacities in children related to a certain year of birth, but without being able to find a plausible explanation for this occurrence. It was unfortunate that there was such a low response rate in our study making any inference into aetiology impossible.

However, for some years now there have been reports from Scandinavian countries and from North America describing the re-emerging of rickets, a disease that was all but eradicated for many years [Welch et al., 2000]. These reports cover mild cases of the disease resulting from maternal vitamin D deficiency or prolonged breastfeeding without sufficient vitamin D supplementation. Deficiency symptoms of this kind might facilitate the development of MIH [Künzel, 2003], without presenting the classical signs of rickets. For that reason discontinuous vitamin D supplementation had been assumed to be at the root of MIH in pupils born between 1989 and 1991. Following the reunification of Germany antirachitic prophylaxis, that had been in the hands of public health services with complete inclusion of all children, changed to the care of the paediatric office, thus turning it into an individual measure. Gaps in the prophylactic care for all children are therefore conceivable. Despite the low response rate in the present study it should be noted, however, that there was no corroboration of any vitamin relationship by the patient histories of either the children in the test or in the control groups.

An analysis of the data obtained did not reveal any significant differences between the test and control children in terms of any health problems or diseases experienced by them. It is not known if the 104 children who did not return for questioning had any related aetiology for their enamel defects. For that reason it is possible only to support the conclusions from other investigations stating that a variety of risk factors may contribute to the development of MIH [Van Amerongen, 1995; Jälevik and Norén, 2000; Beentjes, 2002]. The exact causal connections can only be clarified by prospective studies.

Conclusion

The overall prevalence of MIH in this study was low by comparison with other previous epidemiological reports. Further research is needed to try to determine the aetiology of these defects in permanent molars.

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