Molar incisor hypomineralization in Hong Kong Chinese children

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Background. Most prevalence studies on molar incisor hypomineralization (MIH) were carried out in European countries, and data from the East-Asian populations were lacking.

Aim. This study aimed to investigate the prevalence of MIH in Hong Kong Chinese children.

Design. Since 2006, charting of teeth with MIH was included into the routine dental examination in a school dental clinic. The dental records of grade 6 primary school children who attended annual check-up in this clinic in 2006 were subsequently reviewed retrospectively. The records were selected for this study if the charting indicated that the children were affected by MIH.

Results. A total of 2635 records were reviewed and 73 cases of MIH were identified. The prevalence

Introduction

Permanent first molars and incisors with idiopathic enamel hypomineralization were first recognized in Sweden in the 1970s¹. The condition has been referred to as 'hypomineralized permanent first molars', 'idiopathic enamel hypomineralization', 'non-fluoride hypomineralization', and 'cheese molars' by different authors¹⁻⁵. In 2001, 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 incisors². This description emphasizes the fact that permanent first molars are always involved in those affected, and often there is a combination of molars with demarcated opacities

of MIH in this group of children was 2.8%. Their mean age was 12, and the male-to-female ratio was 1:1.2. The mean decayed, missing, or filled permanent teeth value of those affected was 1.5, which was higher than that of the general Hong Kong Chinese children aged 12 years old (0.8). A total of 192 teeth were affected. The most commonly affected teeth were permanent maxillary first molars, followed by mandibular first molars and maxillary central incisors. Dental fillings and fissure sealants were found in 52 (38%) and 65 (47%) permanent first molars with hypomineralization, respectively. Medical histories were unremarkable in 60 children, whereas early childhood diseases were reported in 13 cases. **Conclusions.** The prevalence of MIH in the permanent dentition of Hong Kong Chinese children was 2.8%. Children with MIH showed higher caries experience in the permanent dentition than the general population of similar age.

of the incisors^{2,3,6}. On the other hand, opacities only on the permanent incisors may indicate defects from other origin such as traumatic injuries or periapical infection of the primary incisors, and these lesions should not be referred to as MIH.

Clinically, the enamel defects can vary from white to vellow/brownish, but they always show a sharp demarcation between the affected and sound enamel³. The tooth surface enamel initially develops to a normal thickness. but can chip off under masticatory forces^{7,8}. After such post-eruption enamel breakdown, the clinical pictures can resemble enamel hypoplasia. However, the margins of the disintegrated areas are irregular, whereas those in hypoplasia are smooth and rounded⁹. The demarcated lesions in MIH should also be distinguished from the diffuse opacities typical of fluorosis³. Dentitions with generalized opacities present on all teeth such as in amelogenesis imperfecta, rather than limited to the permanent first molars and incisors, are not considered to have MIH^{6,8}.

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Most prevalence studies of MIH have been carried out in European countries, and rates between 3.6% and 19.3% were reported^{1,4,5,10-14}. According to Weerheijm and Mejàre¹⁵, the prevalence of MIH in Turkish children was reported to be 14.8%, whereas its prevalence in Libyan children was found to be 2.9% in a recent study¹⁶. At the time of this study, there has been no published prevalence study on MIH in East-Asia. The aim of this study was to investigate retrospectively the prevalence of MIH in a group of Hong Kong Chinese children.

Materials and methods

The study was carried out retrospectively in a school dental clinic in Hong Kong. In the clinic, basic dental treatments were carried out by 25 dental therapists (a group of trained ancillary dental personnel appointed by the Hong Kong Department of Health) under direct supervision of three specialist paediatric dentists. Since 2006, charting of teeth with MIH was included into the routine dental examination as it was felt that MIH was a clinically significant condition. Prior to this practice, a calibration exercise was conducted among the three specialist paediatric dentists in the clinic, using clinical photographs of 20 patients (eight cases of MIH and 12 cases with other enamel defects). The validity of using clinical photographs to study enamel defects has been confirmed by other authors previously^{17,18}. All cases of MIH and the teeth being affected were correctly diagnosed independently by all the three examiners, who were well familiar with diagnosis and management of children with MIH. The same exercise was conducted 1 month afterward and reproducibility was 100%. The diagnostic criteria for MIH in the authors' clinic were: (i) well-demarcated opacities when examined under wet condition; (ii) at least one of the permanent first molars was affected; (iii) the hypomineralization was limited to permanent first molars and incisors, but not generalized or diffused; (iv) the defects in the permanent incisors were not associated with history of trauma or infection in the primary dentition; and (v) permanent first molars with caries, fillings, or enamel breakdown would be diagnosed as MIH if demarcated

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opacities remained at the borders or on the other surfaces. After the diagnosis of MIH was made, the teeth being affected were recorded into the dental charting. The severity of hypomineralization, however, was not recorded. Neither were other types of enamel defects recorded.

The records of grade 6 primary school children who attended annual check-up in 2006 were reviewed retrospectively by the same paediatric dentists 1 year afterward. Grade 6 school children were chosen as these children would have been examined by one of those three examiners in the clinic after the dental therapists finished scaling and polishing. The registration of MIH was therefore considered to be more accurate with this group of patients. The records of children diagnosed with MIH were selected and examined for completeness especially regarding the medical histories, dental charting, and treatment details. The demographic and dental data were pooled and studied by the first author. The prevalence of MIH and distribution of defective teeth were studied, and the latter was analysed using Fisher's exact test. The caries prevalence of the study population was compared with that of the general Hong Kong Chinese children of similar age, and the difference was analysed using chi-squared test. The difference would be considered statistically significant if P < 0.05. The reporting of this study was approved by the Department of Health, Hong Kong SAR Government, China.

Results

A total of 2635 records were reviewed and 73 cases of MIH were identified. All cases were ethnic Chinese, and the details of their dental records were adequate for this study. The prevalence of MIH in this group of children was 2.8%. Their mean age was 12.0 years (range 11.0-14.0, SD 0.6), and the male-tofemale ratio was 1:1.2. The mean decayed, missing, or filled permanent teeth (DMFT) value of those affected was 1.5, which was higher than the mean DMFT value (0.8) of the total study population (2635 children), as well as the mean DMFT (0.8) of the general Hong Kong Chinese children aged 12 years old¹⁹. Among the children with MIH, 81% of the filled/decayed permanent teeth were first

molars, and 12% were second molars. No permanent teeth have been extracted in these 73 children. Only 26 (36%) of the children with MIH were caries free, and this was significantly less than the 62% in the general Hong Kong Chinese children aged 12 years old¹⁹ (chi-squared test P < 0.0001). A total of 192 teeth were affected. The mean number of affected teeth in children with MIH was 2.6, of which 1.9 were the permanent first molars. The most commonly affected teeth were permanent maxillary first molars, followed by mandibular first molars, and maxillary central incisors (Table 1). The left-to-right ratio was 1:1. The difference in the number of maxillary or mandibular molars being affected was not statistically significant (Fisher's exact test P = 0.39), whereas central incisors were affected to a significantly greater extent in the maxillary arches (Fisher's exact test P < 0.05). The proportion of children with demarcated opacities on incisors increased with the number of defective molars (Table 2). Among the teeth with hypomineralization, dental fillings were found in 27 permanent maxillary first molars, 25 mandibular first molars, and one maxillary lateral incisor. Fissure sealants were placed in 29 permanent maxillary and 36 mandibular first molars with hypomineralization, respectively.

 Table 1. Distribution of permanent teeth affected by molar incisor hypomineralization.

	Maxillary arch	Mandibular arch	P-value
Central incisor	29	10	<i>P</i> < 0.05
Lateral incisor	7	9	Not significant
First molars	73	64	Not significant
Total	109	83	

*Fisher's exact test.

Table 2. Cases with incisors affected according to number of defective first permanent molars.

No. of first permanent molar affected	No. of cases	No. of cases with incisor also affected (%)
4	8	5 (63)
3	11	7 (64)
2	18	8 (44)
1	36	13 (36)
Total	73	33 (45)

Medical histories were unremarkable in 60 of the children with MIH, whereas early childhood diseases such as measles, chickenpox, and asthma were reported in 13 cases in the first few years of life.

Discussion

The prevalence of MIH in Hong Kong Chinese children was found to be 2.8%, which was lower than that observed in European countries^{10–14}. The differences in ethnic and age groups being studied and the retrospective nature of this study were probable reasons. In this study, only the dental records were reviewed and the prevalence rate was anticipated to be lower as compared with a prospective study. The diagnostic criteria used in this study, however, were basically the same as those adopted in epidemiologic studies^{6,10,11}, and the three examiners were calibrated and well familiar with diagnosis of MIH, which would help to reduce the magnitude of error caused by study design. Another drawback of this study was that the severity of the hypomineralization was not recorded in the clinical notes. Nevertheless, this study did provide baseline data in an East-Asian population, which at the time of writing was not available in the literatures. In a recent study of 12-year-old Hong Kong Chinese children, the prevalence of demarcated opacities on permanent maxillary incisors was found to be $4.5\%^{18}$. Cases with aetiologies other than MIH, however, were also included in that study, and so direct comparison could not be made with the present findings.

Children in grade 6 of primary schools were chosen as the study population, as this group of children had been seen by at least one of the three specialist paediatric dentists in the clinic before these children enter secondary schools. In addition, the records of these children allowed full analysis of all permanent first molars and incisors as these teeth were all fully erupted at the time of examinations. This is important as the eruption status of these permanent teeth has been suggested to be a significant factor when comparing the prevalence of MIH in different studies¹¹. The caries activity of permanent teeth in Hong Kong Chinese children was low¹⁹, which has also facilitated the diagnosis of hypomineralization⁵. Appointments for annual dental check-up were given to all children in grade 6 of the primary schools that were covered by the authors' clinic. Although attendance was not compulsory, the turn-up rate was over 80%. In addition, the caries experience of this group of children in terms of mean DMFT was similar to the general Hong Kong Chinese children of similar age, and so the study population could be considered fairly representative of the general Hong Kong Chinese children as a whole.

In this study, no significant difference was seen in the number of affected maxillary or mandibular first molars, which concurred with the findings of Weerheijm et al.⁴, Jälevik et al.¹⁰, Calderara et al.¹¹, and Kotsanos et al.²⁰; vet. Leppäniemi *et al.*⁵ reported significantly more maxillary molars were affected. The relationship between the number of affected molars and the presence of defects in incisors was also in agreement with other reports^{1,10,14}; but this trend was not observed in the study of Kotsanos et al.²⁰ Boys and girls were almost equally affected in this study, which was in agreement with other authors^{5,10,11,14,20}. In this study, the mean number of affected teeth among children with MIH was 2.6. Despite a low prevalence of MIH was seen in Hong Kong, the average number of defective teeth per child with MIH was similar to that seen in European countries^{10,11}.

A high impact on treatment need resulting from MIH molars has been reported in low caries prevalence areas^{5,10,21}. In this study, restorations and fissure sealants were placed in 52 (38%) and 65 (47%) of the hypomineralized permanent first molars, respectively. The mean DMFT value of children with MIH was almost twofold that of the general Hong Kong children of similar age¹⁹, which concurred with the findings of Kotsanos et al.²⁰ and Leppäniemi et al.⁵ In addition, significantly less children with MIH were caries free as compared with the general Hong Kong children. In this study, no permanent teeth have been extracted among the 73 children with MIH. Mejàre et al.²¹ suggested permanent first molars with severe MIH should preferably be extracted, followed by orthodontic treatment if needed. Kotsanos et al.20, on the other hand, were sceptical about this approach and in their study, all hypomineralized molars were treated conservatively. In a recent study, Jälevik and Möller²² followed up the occlusal development of 27 children whose one or more hypomineralized first molars were extracted prior to the eruption of the second molars. They found that about two-thirds of the children showed good spontaneous space closure after the extractions, with no or minor remaining gaps. Further studies would be desirable in order to determine the most optimal treatment for permanent first molars with severe MIH.

In this study, positive histories of significant early childhood illness were reported in only 13 of the children with MIH (18%), but these data could only be as accurate as the parents' ability to recall their children's medical histories. The aetiology of MIH is not clear. Neonatal complications, environmental toxins, childhood illness, or distress in the first few years of life have all been suggested as possible aetiological factors^{3,8,9,23,24}. It was confirmed in previous studies that optimal concentration of fluoride in drinking water was not implicated in the aetiology of MIH^{25,26}. The water supply in Hong Kong is artificially fluoridated at the level of 0.5 ppm, which is considered as optimum in view of the subtropical climate in Hong Kong and the availability of fluoride in Chinese-style diets such as seafood soups and congee¹⁸. Systemic fluoride supplement is contra-indicated and not recommended in Hong Kong. However, history about usage of other products such as fluoridated toothpaste was not recorded in the clinical notes and so such information was not available. The varying degrees of enamel defects in permanent molars in individual patients suggest that not all teeth are equally sensitive to the developmental disturbances. Genetic factors may therefore also play a part in aetiology⁷. It has been suggested that probably more than one interacting factors are required to produce the defects^{5,9,24}.

In conclusion, the prevalence of MIH in Hong Kong Chinese children was 2.8%. Caries experience in the permanent dentition was higher in children with MIH as compared with the general population of similar age. Relevant medical histories in early childhood were reported in less than one-fifth of the children with MIH. What this paper adds

- This study provides baseline data on prevalence of MIH in an East-Asian population.
- MIH is not a unique problem in European countries.
- Why this paper is important to paediatric dentists
- Paediatric dentists would have high chances to encounter children with MIH.
- Paediatric dentists who treat Chinese children should be aware that this population group can also be affected with MIH.

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