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RESEARCH ARTICLE

MOLAR INCISOR HYPOMINERALIZATION: A STUDY OF PREVALENCE AND ETIOLOGY IN A GROUP OF SOUTH BANGALORE CHILDREN

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ABSTRACT

Molar incisor hypomineralization (MIH) have significant impact on the quality of life of affected individuals. The purpose of this study was to describe the prevalence, gender influence, etiological factors, treatment need associated and the relation between MIH and dental caries. This cross sectional epidemiological study was conducted in a randomly selected 1004 children from the 8-9 years age group of south Bangalore. Hypomineralized molars and incisors were recorded based on the MIH diagnostic criteria of the European Academy of Pediatric dentistry (EAPD) and DMFT (Decayed, Filled Missing teeth) determined using World Health Organization (WHO) criteria. A detailed personal and family history in the questionnaire form included general information of the child and the mother with the prenatal, natal and post natal problems. Out of 1004 children, 115 (11.5%) had MIH with no difference between genders. Mother's and child's medical histories during prenatal, natal and postnatal periods showed increased incidence of MIH in children. The overall mean number of caries affected teeth was 0.4. The prevalence of MIH in a group of South Bangalore children was 11.5%. No gender differences seen. Prenatal, natal and postnatal medical conditions were more prevalent in children affected by MIH. The DMFT value was not statistically significant in MIH affected children.

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INTRODUCTION

Enamel hypomineralization in the permanent first molars (PFM) and incisors was first described in 1970 (Ahmadi *et al.,* 2012). Molar Incisor hypomineralization (MIH) is defined by European Academy of Pediatric Dentistry (EAPD) as enamel hypomineralization of unclear origin of one to four permanent first molar, frequently associated with affected incisors. In the literature MIH is also known as Hypomineralized Permanent first Molar's, Idiopathic enamel hypomineralization, Dysmineralized Permanent first molar, Nonfluoride hypomineralization, Cheese molars, Nonfluoride enamel opacities, Internal enamel hypoplasia, Non endemic mottling of enamel, Opaque spots, Idiopathic enamel opacities and enamel opacities (William *et al.,* 2006). An exact etiology of Molar incisor hypomineralization has not been established but it might be a combination of factors, which include prenatal, perinatal and postnatal problems.

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Formation of enamel on the permanent first molars and the incisors is initiated shortly before birth and occurs over the first 3-4 years of life (Beentjes *et al.,* 2002). Certain systemic conditions during these periods may disrupt the ameloblastic activity during secretion or maturation phase (Weerheijm (2004)). The defects range from simple whitish yellow to severe brownish opacities, which frequently breakdown rapidly following eruption (Alsakarna *et al.,* 2013). Affected enamel is soft and porous in nature, but they will show a clear demarcation between the affected and normal enamel (Pitiphat *et al.,* 2014). Patient with MIH often require multidisciplinary dental management. The management of these teeth are challenging for both patient and dentist because of the post eruptive breakdown of affected enamel, tooth becomes sensitive to temperature and tooth brushing, leading to poor oral hygiene and caries progression, difficulty in achieving anesthesia, predisposing to dental fears, defective fillings and ultimately leading to difficulty in behavior management without treating the pain (Oliver *et al.,* 2014). Early identification of the affected children, prompt, appropriate action can make the condition easier to treat and prevent possible negative consequences with a high health cost (Garcia-Margarit *et al.,* 2014). Hence the aim of this study was

to find the prevalence of MIH and to investigate gender influence, etiological factors, treatment needs associated and the relation between MIH and dental caries among children of south Bangalore zone.

MATERIALS AND METHODS

This cross sectional epidemiological study was conducted in randomly selected 1004 children of south Bangalore. Healthy children in the age group of 8-9 years with no significant medical condition were included in the study. Permission to carry out the study was obtained from the Head of the school. Clinical examination was performed in a school setting under natural light using a mouth mirror and probe. All the children were examined by a single dentist in an attempt to minimize the probable bias. Special emphasis were placed on MIH using the criteria suggested by the European Academy of Pediatric Dentistry (EAPD) on 8 index teeth, including four Permanent first Molar's and four incisors, under wet conditions. The recorded conditions included demarcated opacities (white or creamy or yellow or brown) with or without post eruptive breakdown, atypical restoration, missing tooth due to MIH, partially erupted or unerupted tooth with or without MIH, diffuse opacities or hypoplasia without MIH, combined lesion (diffuse opacities or hypoplasia with MIH), demarcated opacities in incisors only. A child was considered to be having MIH, when at least one Permanent first molar demarcated enamel lesion was present. The caries indices for the permanent teeth, DMFT (Decayed, Filled or Missing Teeth) score were determined using the World Health Organization (WHO) criteria. The evaluation of the medical history of the mother during the pregnancy, childbirth and on the child's medical condition within the first 3-4 yrs of his or her life was done using a detailed coded questionnaire, which was handed over to the child at school. A detailed personal and family history in the questionnaire form included general information of the child and the mother with the prenatal, natal and postnatal problems.

Prenatal Period: Gestational diabetes, infections or allergies, fever during mother's pregnancy, vitamin, calcium or iron supplements taken, antibiotics or drugs to control contractions or any other drugs taken during the pregnancy period.

Natal Period: Complications during birth of a child, type of delivery, premature birth, incubator if required, breast fed or bottle fed till what age.

Postnatal Period: Childhood illness and infections such as measles, mumps, whooping cough, ear infections, urinary tract infections, repeated high fever, respiratory problems (asthma, bronchitis, and allergy), diarrhea, pneumonia, injury to primary teeth, hospitalized as a result of accident or chronic disease.

Statistical Analysis

The responses given by the MIH affected and non affected children's mother was analyzed using Chi square test. Student unpaired't' test was used to compare mean dental caries among MIH and non-MIH children.

RESULTS

Children's out of 1004 examined, 115 (11.5%) exhibited MIH. The sample comprised of 491 (48.7%) boys and 513 (51.3%) girls. No statistically significant gender differences in MIH prevalence were found. Mother's and child's medical histories during the prenatal, perinatal and postnatal periods were significantly remarkable in MIH affected children when compared with Non MIH children. Prenatal factors such as infection, allergies and fever showed high incidence of MIH with P value of < 0.001. Natal history of longer breast feeding showed high incidence of MIH with P value of < 0.001. Post natal history of children who had repeated high fever, respiratory problems, ear and urinary tract infections and injury to primary teeth showed increased incidence of MIH compared to the non affected ones with a statistical significant values of $P < 0.001$. In the 115 children with MIH, 539 teeth were diagnosed as affected ones, of these 41.4% first molars (21.4% maxillary and 20.0% mandibular) and 58.6% of incisors were affected (32.6% maxillary and 26.0% mandibular).

Of these upper central incisors were the worst affected and the lower molars were least affected. The labial and occlusal surfaces of the incisors and molars were the most frequently affected by MIH. The labial surfaces were affected more in the maxillary incisors (18.9-18.3%) and the occlusal surface more in the upper molars (12.6 -12.3%). No statistical significant correlation between the numbers of molars and of incisors affected. The overall mean number of caries affected teeth was 0.4 (SD = 0.82). No statistical significant difference was seen between the nonaffected teeth with mean number of 0.3 (SD = 0.49).

Fig. 1. Demarcated opacities on permanent upper and lower incisors

Fig. 2. Demarcated opacities on permanent lower first molar

Table 1. The prevalence and gender wise distribution of MIH and non-MIH children

	MIH	Gender		NON MIH	Gender	
		Males	Females		Males	Females
N	115	59	56	889	503	386
%	11.50%	51.30%	48.70%	88.50%	56.60%	43.40%

Table 2. The presence of possible etiological factors in children diagnosed as with or without MIH

Personal & Family History	Non-MIH		MIH		χ^2 Value	P-Value
	N	%	N	%		
Pre-Natal History						
Gestational Diabetes	0	0.0%	0	0.0%	..	..
Infection, Allergies	89	66.9%	44	33.1%	70.461	<0.001*
Fever	122	57.0%	92	43.0%	265.99	<0.001*
Taken Vitamin Supplements	531	89.2%	64	10.8%	0.749	0.39
Taken Calcium and Iron Supplements	632	90.8%	64	9.2%	11.678	0.001*
Taken Antibiotics	74	79.6%	19	20.4%	8.088	0.004*
Natal History						
Complicated birth	191	82.7%	40	17.3%	10.074	0.002*
Caesarean	379	88.6%	49	11.4%	0.001	0.98
Preterm birth	36	78.3%	10	21.7%	4.998	0.03*
Incubator	37	88.1%	5	11.9%	0.008	0.92
Breast fed	297	76.9%	89	23.1%	82.871	<0.001*
Bottle fed	587	90.6%	61	9.4%	7.687	0.006*
Post Natal History						
Measles, Mumps, Rubella	5	71.4%	2	28.6%	2.023	0.16
Ear infection	9	45.0%	11	55.0%	37.996	<0.001*
Repeated high fever	74	62.7%	44	37.3%	87.705	<0.001*
Respiratory problem	47	49.5%	48	50.5%	157.516	<0.001*
Urinary tract infection	40	66.7%	20	33.3%	30.008	<0.001*
Diarrhea	115	93.5%	8	6.5%	3.413	0.07
Pneumonia	19	100.0%	0	0.0%	2.511	0.11
Injury to primary teeth	40	51.3%	38	48.7%	115.464	<0.001*
Hospitalized due to chronic illness	27	71.1%	11	28.9%	11.866	0.001*

Table 3. The distribution of MIH frequency by tooth type and surface

MIH	MIH by tooth %			MIH by surface (%)		
	Tooth	N	%	Occlusal/ Incisal	Labial/ Buccal	Lingual/ Palatal
Upper	11	88	16.3	5.4	18.9	0
	21	88	16.3	7.4	18.3	0
	16	57	10.6	12.4	3.3	4.3
	26	58	10.8	12.6	2.4	3.7
Lower	31	70	13.0	10.4	9.1	0
	41	70	13.0	11.1	11.7	0
	36	55	10.2	12.0	2.2	3.0
	46	53	9.8	11.5	3.0	3.3

Table 4. The comparison of mean dental caries among MIH and non-MIH children

MIH Status	N	Mean	SD	S.E.M	Mean Diff	95% CI of the Difference		T	Df	p-Value
						Lower	Upper			
Non-MIH	889	0.37	0.49	0.05	0.05	0.11	0.2	0.611	1002	0.54
MIH	115	0.42	0.82	0.03						

DISCUSSION

Developmental defects of tooth enamel are not uncommon, both in the primary and permanent dentitions which can be divided into hypomineralization and hypoplasia. Enamel hypomineralization can be observed visually because of a different translucence which is known as opaque enamel. The opacity may be diffuse or sharply defined, whereas in cases of hypoplasia parts of the enamel are absent or very thin with smooth borders adjacent to normal tissue (Beentjes *et al.,* 2002). The causes of developmental enamel defects may be congenital or acquired. Congenital defects such as amelogenesis imperfecta, has a genetic basis and the defects appear to be symmetrical. In case of acquired defects MIH can be differentiated from fluorosis as its opacities are diffused and by the structure of the enamel.

In case of fluorosis, the teeth are resistant to caries and teeth affected with MIH are caries prone (Weerheijm (2004)). In our study 491 (48.7%) boys and 513 (51.3%) girls were examined. Using MIH criteria as suggested by European Academy of Pediatric Dentisry it was found 115 (11.5%) of children exhibited MIH (Table 1). A systemic review showed wide variation in the prevalence of MIH (2.8% - 40.2%) and stated that the cross comparison of the various studies were difficult because of use of different indices and criteria, examination variability, methods of recording and different age groups (Dos Santos and Maia, 2012). Other studies using the same EAPD criteria found prevalence of MIH from 2.8 % in China (Cho *et al.,* 2008) and 40.2% in Brazil (Soviero *et al.,* 2009). The prevalence found in the present study was found to be greater than reported for study conducted in Argentina (Biondi *et al.,* 2011), Greece (Lygidakis *et al.,* 2008), Southeast Sweden

(Fagrell (2011)) and lower than that observed in Brazil (Da Costa-Silva and Malhe, 2012), Lithuania (Jasulaityte *et al.,* 2007) and Spain (Gomez *et al.,* 2012). In our study 56 (48.7%) girls and 59 (51.3%) boys were found to have MIH and no statistical significant gender difference was seen, which is comparable with the findings of some other study (Gomez *et al.,* 2012). However the study conducted in Greece (Lygidakis *et al.,* 2008) found an unequal distribution of MIH between different genders with higher in girls than in boys. In the present study children in the age group of 8-9 years were selected because at this age, the first molars and incisors have already appeared in the mouth but have only erupted recently, making it easier to detect the defect before it is masked by deterioration or other pathological conditions. Studies done in children between 6-14 yrs of age found more severe defects than in younger children because of enamel breakdown in hypomineralized teeth as a result of chewing forces and possible caries development (Gomez *et al.,* 2012).

The etiology of MIH is unclear probably because the abnormality is not caused by one specific factor. Many environmental conditions may have a harmful effect, leading to an increase in defect or they can act together additively or synergistically. It also has a genetic predisposition in some cases. Altogether the etiology of MIH is complex with undetermined systemic and genetic factor disrupting normal amelogenesis in the affected teeth (Kaczmarck and Jawarski, 2014). MIH was significantly more observed among children who had prenatal, natal and postnatal medical problems compared to unaffected children ($P<0.001$) as shown in Table 3. Prenatally the critical period for crown formation of FPM is around 32 weeks in utero and incisors are around 3 months in utero (Kaczmarck and Jawarski, 2014). Prenatal factors such as infection, allergies and fever showed high prevalence of MIH with a P value of < 0.001. This was similar to those studies which reported a higher prevalence of MIH in children whose mothers suffered from different ailments during their prenatal period (Jalevik (2010)). In the present study children who were breastfed for long duration showed significantly higher MIH than the children who were breast fed for short duration. The result suggests that long breast feeding may increase the risk of mineralization defects in healthy children, possibly because of environmental contaminants where exposure to digoxin interfere with tooth development (Alaluusua *et al.,* 1996). On the contrary (Allazam *et al.,* 2014), found no association between longer duration of breast feeding and MIH (Laisi *et al.,* 2008). Children who had repeated high fever, respiratory problems, ear and urinary tract infections and injury to primary teeth during the first 3-4 yrs had increased incidence of MIH compared to the non affected ones. Studies done by Weerheijm found frequent childhood diseases like otitis media or high fever, respiratory diseases occurring within the first years of life leading to oxygen deficiency which could possibly lead to this condition (Weerheijm *et al.,* 2006).

The term MIH mainly affects the permanent first molars and incisors. The permanent first molars and incisors begins to mineralize within a very short time of each other, so empirically they could be expected to be similarly affected, as in chronological hypoplasia. This study confirms that upper incisors are more frequently affected than the molars with its asymmetrical appearance. It has been suggested that a tendency for more incisors to be affected as the severity of MIH in the permanent first molars increases. This study is in agreement with the study (Gomez *et al.,* 2011) which showed that the maxillary central incisors and less frequently the maxillary and mandibular lateral incisors were most affected despite of the affected permanent first molars. Contrary to this (Garcia *et al.,* 2013) confirms that the permanent first molars are more frequently affected. In terms of surfaces, the labial surfaces of the upper incisors and the occlusal surfaces of the upper molars was the most frequently affected ones. The mean number of affected incisors increases as there are more affected molars, which is similar to the study conducted in the past (Garcia-Margarit *et al.,* 2014). The hypomineralized part of the tooth is weak, and the enamel may chip off easily, resulting in post eruptive loss of enamel. The color of opacity may be suggestive of weaker tooth structure and subsequently higher risk for post eruptive enamel breakdown progressing in to rapid caries which in turn can cause severe pain. The DMFT value in affected children compared to non affected children did not show any statistical significance (Table 4).

In contrast certain studies showed a major statistical significance in the DMFT value between MIH affected and non affected children (Lygidakis *et al.,* 2008), (Soviero *et al.,* 2009). Patients with MIH affected teeth suffer from dentin sensitivity due to the presence of porous enamel and sometimes, the exposed dentin. The morphological aspects of MIH may favor ingress of bacterial contaminants thereby resulting in chronic inflammation of the pulp (Rodd and Boissonade, 2007). From a clinical perspective these findings would support early interventions in order to avoid the development of pulpal inflammation and associated hypersensitivity. Thus toothpastes and chewing gums with mineralizing products, such as Casein Phosphopetide Amorphous calcium phosphate or the application of desensitizers or sealers have been indicated (Lygidakis (2010). As such it is very important for the clinicians to understand the condition, severity and treatment implications associated with MIH children. The most conservative treatment consists of bonding a tooth colored material to the tooth to protect it from further wear or sensitivity although the nature of the enamel prevents formation of an acceptable bond. Less conservative treatment options, but frequently necessary include use of stainless steel crowns, permanent cast crowns or extraction of affected teeth in association with the orthodontic appliance or teeth replacement with a bridge or implant (Kabaktchieva and Bogdanov, 2012), (Nagaveni *et al.,* 2014). Some limitations were noted in this study: The information on the etiological factors was based on the memories of mothers interviewed, which may be affected by recall bias, instead of cross sectional longitudinal study, prospective study conducted on a larger scale would have given better results.

Conclusion

Based on this study results, the following conclusions can be made:

- The prevalence of MIH in a group of south Bangalore children was 11.5%.
- The DMFT value was not statistically significant in MIH affected children and non MIH affected children.
- Prenatal, natal and postnatal medical conditions were more prevalent in children affected by MIH in current study. Thus pediatricians play an important role in initial diagnosis of MIH and informing the parents about this type of enamel defects.

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