World Journal of Pharmaceutical Sciences
ISSN (Print): 2321-3310; ISSN (Online): 2321-3086

Available online at: http://www.wjpsonline.org/
Original Article

Prevalence, severity and clinical characteristics of Molar- incisor hypomineralization in and around Tirupati, AP among 8 to 15 years old children

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Received: 10-01-2017 / Revised: 03-03-2017 / Accepted: 06-03-2017 / Published: 10-03-2017

ABSTRACT

Developmental disorders of teeth are the problems that are mostly seen in pediatric dentistry, especially on first permanent molars and incisors. Molar incisor hypomineralization (MIH) is the proposed term for this phenomenon. The last couple of decades has seen an increasing interest in MIH. Although the reported prevalence ranges from 2.4% to 40.2% worldwide, very little data is available from India **Objective**: To assess the MIH prevalence, severity and clinical characteristics in 8-15 years old children in Tirupati, Andhra Pradesh. **Study design**: This cross-sectional descriptive study consisted of 1268 children aged 8-15 years of Tirupati selected by random sampling procedure. The European academy of pediatric dentistry criteria were followed for MIH diagnosis. The presence of dental caries and treatment need for MIH-affected teeth were recorded as per the WHO criteria. **Results:** The results were obtained using chi-square test and prevalence of MIH in the children examined was 3.93%. Severity of the defects increased with the age of the children. Involvement of incisors increased when more First permanent molars (FPMs) were affected. Significantly larger numbers of maxillary FPMs and central incisors were diagnosed with MIH. The association of dental caries was significantly higher with MIH-affected FPMs. Primary molars and permanent canines and premolars were also showed MIH like lesions in some of the MIH-affected children. **Conclusion:** MIH was observed in about 4% of the children examined. MIH-affected FPMs appear to be more vulnerable to early caries and subsequent pulp involvement with need for extensive dental treatment.

Keywords: Molar, incisor, hypomineralization, Tirupati

INTRODUCTION

The decline of dental caries worldwide has encouraged researchers and clinicians to observe and recognize other problems that were often overlooked in the past. The last couple of decades has seen the recognition and acknowledgement of non-fluoride associated developmental dental defects as an increasing clinical problem.[1] Enamel defects are known to occur due to depressed activity of the enamel-forming ameloblasts which result in the formation of linearly distributed pits or grooves. These alterations can be found in two different stages: Enamel matrix formation (secretion phase) and enamel mineralization (maturation phase). If an unbalance occurs during the secretion phase, which results in formation of enamel defect called 'hypoplasia'? If it occurs during the maturation phase, it is called hypomineralization.[2]

Recently one enamel alteration of great clinical significance affecting the first permanent molars (FPM) was described in four presentations at the European Academy of Pediatric Dentistry Congress in 2000. These reports called the condition "Hypomineralised FPM", "idiopathic enamel hypomineralisation in FPM", "Non-fluoride hypomineralisation in FPM" and "Cheese molars" [Weerheijm et al., 2000].[3] During the last decade, the term "Molar-Incisor Hypomineralization (MIH)" has gained increasing popularity and is used to describe hypomineralization of systemic origin affecting one or more permanent first molars

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and frequently associated with hypomineralized permanent incisors. For a patient to be diagnosed as suffering from MIH, at least one permanent first molar must be affected with or without involvement of the incisors.[1] MIH does not appear to be a new phenomenon; it was first noted in Sweden in the late 1970s. Reports of the prevalence of MIH vary considerably throughout the world and rates range from 2.4% to 40.2%[1]. With the highest prevalence reported in children of Rio de Janeiro, Brazil.[1,4]

A majority of MIH prevalence studies have been conducted in Europe. Results of a questionnaire survey mapping the occurrence of MIH throughout Europe have suggested that MIH had been observed in all the responding European countries, apart from the Czech Republic. However, there exists a paucity of data pertaining to MIH in Indian populations.[1]

Hence, the present study attempted to determine the prevalence of MIH in a young, Indian population of Tirupati, Andhra Pradesh and to define the clinical features, severity and distribution of defects and their association with dental caries in affected individuals.

MATERIAL AND METHODS

The present cross-sectional descriptive study was carried out after obtaining ethical clearance from the institutional Ethical Committee.

Study population: The study population comprised of 8 to 15-year-old schoolchildren belonging to Tirupati city, who visited the pediatric dental service of CKS Theja Dental College, Tirupati and various schools as part of a school health programme

Children having fully erupted index teeth for MIH (all permanent first molars and incisors), were included in the study. Children with other defects of enamel such as amelogenesis imperfecta, dentinogenesis imperfecta, hypoplasia, diffuse opacities, white spot lesions, tetracycline staining, erosion, fluorosis, white cuspal and marginal ridges, or any disability or systemic disease that would compromise routine oral care were excluded.

Sample selection: The study sample was selected by random sampling procedure. Informed consent was obtained from the parents and head of institution of school

Method of data collection

Clinical examination and diagnosis of MIH: The children were seated on the dental chair and subjected to dental examination. Hypomineralized molars and incisors were diagnosed clinically based on the European Academy Pediatric Dentistry (EAPD) criteria recommended in 2003[5] and revised at an Interim Seminar and Workshop concerning MIH organized by the EAPD in 2009[6] [Table 1 and Figure 1-5].

Table 1: Diagnostic criteria and clinical appearance of MIH (EAPD 2003[5], 2009[10])

FPMs and incisors	One to all four permanent first molars shows hypomineralization of the enamel. Simultaneously, the permanent incisors can be affected. To diagnose MIH, at least one FPM has to be affected. The defects can also be seen in second primary molars, incisors and the tips of canines. More the molars and incisors affected, the more severe is the defect
Demarcated opacities	The affected teeth show clearly demarcated opacities at the occlusal and buccal parts of the crown. The defects vary in color and size. The color can be white, creamy or yellow to brownish. The defect can be negligible or comprise the major part of the crown. It is recommended that defects less than 1 mm not be reported [Figures 1 and 2]
Enamel disintegration (PEB)	The degree of porosity of the hypomineralized opaque areas varies. Severely affected enamel subjected to masticatory forces soon breaks down, leading to unprotected dentin and rapid caries development [Figure 3]
Atypical restorations	FPMs and incisors with restorations revealing similar extensions as MIH are recommended to be judged as affected [Figure 4]
Tooth sensitivity	The affected teeth may be reported frequently as sensitive, ranging from a mild response to external stimuli to spontaneous hypersensitivity; these teeth are usually difficult to anaesthetize
Extracted teeth	Extracted teeth can be defined as having MIH only in cases where there are notes in the records or demarcated opacities on the other FPM. Otherwise it is not possible to diagnose MIH [Figure 5]
Recording the severity of defects	Severity should be recorded as mild or severe in order to help the clinician. In mild cases, there are demarcated enamel opacities without enamel breakdown, occasional sensitivity to external stimuli e.g. air/water but not brushing and only mild aesthetic concerns on discoloration of the incisors [Figures 1 and 2]. In severe cases there are demarcated enamel opacities with breakdown, caries, persistent/spontaneous hypersensitivity affecting function e.g. during brushing and finally strong aesthetic concerns that may have socio-psychological impact [Figure 3]

Following thorough oral prophylaxis, the index teeth (four FPMs and eight permanent incisors) were kept wet for examination to distinguish opacities from incipient carious lesions. All clearly visible opacities measuring more than 1 mm were recorded. All examinations was carried out by one investigator.

Recording of hypomineralization in teeth other than index teeth: MIH-like defects on teeth other than index teeth (primary molars and permanent canines and premolars) in MIH-affected children were also recorded.

Assessment of dental caries in MIH-affected teeth: All permanent first molar teeth affected by MIH in the study population were assessed for the presence of dental caries as per the criteria established by the World Health Organization in 1997.[3,6]

Statistical analysis: The data was analyzed using the Statistical Package for Social Sciences software version 17.0 for Windows (SPSS Inc., Chicago, IL, USA). A descriptive analysis of the prevalence and distribution of the clinical recordings was performed. A comparison between groups was carried out using the chi-square test and Pearson correlations. For all tests a P-value of 0.05 or less was considered to be of statistical significance.

Figure 1: Demarcated opacities on PFMs (mild defects) hypomineralization)

Figure 2: Demarcated opacities on incisors (mild

Figure 3: (a, b,c) Post-eruptive enamel breakdown of PFMs

Figure 4: Atypical restorations of MIH-affected FPMs

Figure 5 (a,b,c,d): MIH-like defects on primary molars and premolars in an MIH-affected child

RESULTS

Prevalence of molar-incisor hypomineralization: Of the 1248 children examined ,49 were diagnosed as having teeth affected by MIH, giving a prevalence rate of 3.93%.MIH was more frequently effected in boys than in girls, but the difference was not statistically significant (p>0.05), Table 1]. Of the affected children, 3(6%) had hypomineralized molars (MH) only, while 46(93%) had both molars and incisors affected. The prevalence of MIH increases as age increases.(p<0.05)[table 2& 3].

Nearly 43% children had all four FPM's involved (0 with MH and 21 with MIH).Of the affected individuals, only 4 had all index teeth hypomineralized. The four FPM-two incisor combination (14%) of affected teeth was the most frequently observed association followed by the four FPM - three incisor combination and all index teeth involvement combination (8%)[table4]. A significant correlation (p<0.001) was observed between hypomineralization of molars and that of incisors with the involvement of incisors appearing to increase when more FPM's were affected (table 5)

Distribution of affected teeth in children with MIH: In the 49 MIH -affected children, 268 teeth (124 FPM's and 144 permanent incisors) were involved, with an average of 1 teeth per individual. Of 124 hypomineralized molars 106 were mildly and 18 were moderate - severely affected. Maxillary right FPM's (36) were most frequently affected, followed by maxillary left (35), mandibular right (28), and mandibular left (25).

A higher number of FPM's was affected in children aged below 10 years then above 10 years (p<0.005) with significantly higher number of severely affected FPM in younger children [table 6]. Significantly large numbers of maxillary FPM's were not only diagnosed with MIH (p >0.001), but showed hypomineralization of severe variety in maxillary arch (p<0.005) when compared to mandibular FPM's. A significantly higher number of mandibular FPM's were mildly hypo mineralized (p<0.001).No significant difference (p>0.005) was observed between the left and right sides of arches in the number and severity of FPM hypomineralization.(table 7)

Prevalence of caries in FPMs of MIH and non-MIH children: Dental caries was significantly more frequent in the hypomineralized FPM's of MIH affected children (p<0.005) when compared to FPMs of non-MIH children (table 8). The association of dental caries was significantly higher (p<0.005) with MIH-affected FPMs, especially maxillary (5.45%) when compared to mandibular (2.64%) FPMs (p<0.05).Nearly equal number of MIH-affected molars were involved by caries on the right and left sides of the arch.

Distribution of hypomineralized incisors in MIH- affected children: Of the incisors , the maxillary left central incisors (n=38) were the most commonly hypomineralized followed by maxillary right central incisors(n=32),maxillary right lateral incisors(n=19), maxillary left lateral incisors(n=18), mandibular right and left central incisors(n=12), mandibular left lateral incisors(n=7), mandibular right lateral incisor(n=6). All severely involved incisors belonged to maxillary arch. Hypomineralized maxillary permanent incisors were significantly more in number as well as mild and severely affected categories when compared to the mandibular incisors (p>0.005).Also significantly more maxillary than mandibular central incisors were involved (P>0.005).(table 9)

Hypomineralization of teeth other than index teeth: Another observation was the presence of hypomineralized primary molars in 2 out of 32(6.25%)MIH affected children in the mixed dentition group and 8 out of 17 (47.05%)in the permanent dentition group had hypomineralized canines , premolars and 2nd molars,6 out of 32(18.75%) MIH affected children in the mixed dentition group had hypomineralized canines and premolars.

Table 1: **Prevalence of molar-incisor hypomineralization based on gender**

Gender	**Children Examined**	**MIH - Children Affected - n(%)**	Chisquare	p value
Female	648	19 (2.93)	3.263	0.071
Male	600	30 (5.00)		
Total	1248	49 (3.93)		

Table 2: **Prevalence of molar-incisor hypomineralization based on age**

Age	**Children Examined**	**MIH - Children Affected - n(%)**	Chi square	p value
10 and Below	282	21 (7.44)	10.81	0.001
Above 10 years	966	28 (2.89)		
Total	1248	49 (3.92)		

Table 3: **Prevalence of molar-incisor hypomineralization**

Age	**Examined**	Children with MH		p value
		n	**%**	
8	83	5	6.02	r = 0.971** p<0.05
9	80	6	7.50	
10	119	10	8.40	
11	146	4	2.74	
12	143	7	4.90	
13	203	5	2.46	
14	230	9	3.91	
15	244	3	1.23	
Total	1248	49	3.93	

Table 4: **Prevalence of molar-incisor hypomineralization based on affected molars**

affected Molars	**Alone (%)**	**1 M (%)**	**2 M (%)**	**3 M (%)**	**4 M (%)**	**TOTAL (%)**
Alone	1	1	1	0	0	3
1 I	3	4	0	0	0	7
2 I	1	2	3	3	7	16
3 I	0	0	1	1	4	6
4 I	0	3	2	1	3	9
5 I	0	1	0	0	2	3
6 I	0	0	0	0	1	1
8 I	0	0	0	0	4	4
Total	5 (10.2)	11 (22.4)	7 (14.3)	5 (10.2)	21 (42.9)	49 (100.0)

Table 5: **Prevalence of molar-incisor hypomineralization based on No of Molars Affected**

No of Molars Affected	No of individuals affected by MIH + MH	No of individuals affected by incisors (46)
0	5	4 (80.0)
1	11	10 (90.91)
2	7	6 (85.71)
3	5	5 (100.0)
4	21	21 (100.0)
R VALUE	0.449	
P VALUE	P<0.01	

Table 6: **Distribution of affected teeth in children with MIH**

Age	Total No of teeth	< 10 years	> 10 years	Chisquare	p value
FPM Examined	191	79	112	2.709	0.100
FPM Affected	124	63	61		
Mild MIH	106	62	64	3.415	0.065
Severe MIH	18	11	7	0.131	0.780

Table 7: **Distribution of affected teeth in children with MIH**

		molars		Total	p value
		Maxilla	Mandible		
molar	1st Quardant	36	25	61	0.697
	2nd Quardant	35	28	63	
Total		71	53	124	

Table 8: **Prevalence of caries in FPMs of MIH and non-MIH children**

	STATUS				
	MIH	NON MIH	Total	Chisquare	p value
Caries	4	360	364		
Others	45	839	884		
Total	49	1199	1248	10.89	0.001

Table 9: **Distribution of hypomineralized incisors in MIH- affected children**

		Incisors		Total	p value
		Maxilla	Mandible		
Insisors	1st Q Insisors	50	19	69	0.561
	2ns Q Insisors	56	17	73	
Total		106	36	142	

DISSCUSSION

The present study assessed the clinical features, severity and distribution of MIH defects and their association with dental caries in a group of 8- to 15-year- old children. Eight years and above is considered the best time for examination for MIH because, at this age, most children will have erupted all four permanent first molars as also the most of the incisor teeth.[5,6]

Diagnostic criteria: Dental examination was carried out of cleaned and wet teeth to detect the presence of enamel defects and to allow distinction between diffuse opacities, demarcated opacities and white spot carious lesions. [5-7] Various researchers have used different criteria for recording the presence of MIH such as the DDE index or the modified DDE index. [6,8,9] the diagnostic criteria of Alalausua [10] and the criteria recommended by European Academy of Pediatric Dentistry in 2003.[11-16].

Recording of severity: The severity of defects was determined using the criteria recommended by the EAPD in 2009.[6] Earlier studies have classified MIH into mild, moderate and severe defects.[10]. Recently, the moderate and severe groups have been combined into one group i.e. disintegrated or severe in order to improve reproducibility.[6,7]

Prevalence of MIH: The prevalence of MIH in the present study group was observed to be 3.93%. This finding was comparable to that of a previous Indian study of 8- to 12-year-old schoolchildren from Gujarat.[12] A majority of the children diagnosed as having MIH in the present study had hypomineralized molars (MH) only, a finding similar to those of studies on Lithuanian,[13] Greece[15] and Jordanian[16] populations. Other studies, however, have reported MIH to be more

frequent than MH in their populations.[12] These variations may be due to differences in recording methods including the setting for clinical examination (e.g., in schools where examination may be carried out under poor light or without thorough oral prophylaxis), indices and diagnostic criteria used.

Distribution/clinical characteristics: In the present study an average 1 tooth were hypomineralized per individual affected by MIH. Other reported average hypomineralized teeth per individual affected were of 3.2 teeth and 2.4 FPMs in Swedish,[18] 3.4 FPMs and 2.2 incisors in Greek, 5.59 teeth and 3.16 FPMs in Bosnian,[17]

Distribution of MIH-affected FPMs: In the present study group, a wide spectrum of clinical characteristics of MIH was observed which ranged from a single hypomineralized molar to four hypomineralized molars to all eight index teeth hypomineralized. The older children had significantly more number of severely affected FPMs than the younger children. These findings are comparable with those of studies on Lithuanian, [13] Greek, [15] Brazilian,[11] Jordanian[16] and Gujarati Indian[12] populations. Some authors have suggested that differences in examination conditions may make it difficult to view maxillary molars as clearly as mandibular molars.[8] Also, the early eruption of mandibular molars with resultant early post-eruptive enamel breakdown or caries makes them more obviously affected than maxillary molars. In the present study maxillary FPMs were affected more.

Distribution of MIH-affected incisors: A larger number of maxillary incisors was affected than mandibular, a finding in accordance with those of most studies on different populations.[12-15] Most defects on incisors were of the mild variety, probably owing to no or minimal masticatory forces on the affected surfaces. All severely affected incisors belonged to the maxillary arch. The loss of tooth structure in these teeth may be a consequence of the abrasive force of tooth brushing.[11]

Prevalence of caries in FPMs of MIH and non-MIH children: MIH has long been associated with an increased incidence of dental caries, which has been attributed to the characteristics of hypomineralized enamel, such as higher porosity and lower mechanical resistance.[11] In the present study, dental caries was a more frequent finding in FPMs in children with MIH than in those without. MIH-affected mandibular FPMs were more frequently decayed than maxillary FPMs. Most studies have reported higher prevalence of caries in MIH- affected than in unaffected individual.[11,14]

Hypomineralization of teeth other than index teeth: To broaden the knowledge of the nature of MIH, it is of great importance to know the extent to which teeth other than FPMs and incisors are affected.[7] Weerheijm et al.[5] reported that MIH-like defects are also seen on second primary molars and permanent cuspids. In the present study, 47.05% of MIH- affected children who were in the permanent dentition stage had hypomineralized canines and premolars. It has been suggested that systemic etiological factors acting for longer periods during enamel mineralization and maturation tend to produce more affected teeth with more severe defects.[7,15]

CONCLUSION

Recent research supports the assumption that MIH is a widespread problem all over the world. In the present study MIH was found to affect one out of every 4 children examined as was observed in another study on Indian children. Hence, it appears that this condition is more prevalent than was recognized until recently. MIH threatens to become a concerning developmental enamel defect. Considering the low awareness of this condition among the dentists and general population of India, the demanding nature and the costs involved, the urgent need for further investigations into this problem becomes clearly evident.

ACKNOWLEDGEMENT

I am very much thankful to all the faculty members of Department of Dentistry, CKs Dental College, for their help during the study. I am very thankful to The Principal, CKs Dental College, for permitting me to do the study.

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