

MIH: EPIDEMIOLOGIC CLINIC STUDY IN PAEDIATRIC PATIENT

R. CONDÒ, C. PERUGIA*, P. MATURO*, R. DOCIMO*

Department of Clinical Science and Traslational Medicine University of Rome "Tor Vergata"

**Department of Experimental Medicine and Surgeon*

SUMMARY

The Molar Incisor Hypomineralization (MIH) is a qualitative and quantitative defect of the enamel structure of the first permanent molars, which may vary from 1 to 4 with involvement of maxillary and jaw permanent incisors.

Aim. Aim of this study is that to evaluate, among 1500 paediatric patients chosen at random aged between 0 and 14 years, afferent by the Paediatric Dentistry of the Azienda Ospedaliera Policlinico Tor Vergata of Rome from 1996 to 2011, the incidents and the prevalence of the MIH distribution, and furthermore to ascertain the possible relationship with the data described in the literature.

Results and discussion. From the sample of 1500 paediatric patients, the number of those affections from MIH has turned out to be pairs to 110 (7.3%) aged between 4 and 15 years, and an average age equal to 9.7. The incidence of the hypoplastic defects is greater in the elements of the permanents series in which the functional class mainly interested is that of the first molars, with a percentage of 39.8%. Regarding the elements of the deciduous series affections from hypoplasia, they turn out to be in all in number of 20 represented in 80% of the cases from the seconds molars while in the remaining 20% of the cases the items involved are the central incisors. About the percentage of elements involved in the MIH: the molars, involved with a frequency of 56%, turn out to be more hit regarding incisors (44%). As reported in the literature, it can be asserted that the MIH can hit in equal measure both the male sex that feminine one.

Conclusions. MIH represents a condition quite frequent in the paediatric population. In managing this anomaly takes an essential role in the early diagnosis and in the differential one. The study done underlined the importance of a correct application of the therapeutic protocol which, starting from a careful diagnosis and articulating themselves in the execution of preventive treatments and in severe cases restorative and prosthetic, has the aim to certify the functionality and the aesthetic of the dental elements affected by MIH.

Key words: MIH, paediatric patient, epidemiology.

Introduction

The Molar Incisor Hypomineralization (MIH) is a qualitative and quantitative defect of the dental enamel, to idiopathic aetiology characterized by the progressive and simultaneous hypomineralization and/or hypoplasia of the enamel structure of the first permanent molars, which may vary from 1 to 4 with involvement of maxillary and jaw permanent incisors.

In the past many Authors described clinically such a peculiar and specific pathological condition making reference to it, any time with different terms and even contradictory.

It was only in the 2000 that the European Academy

of Paediatric Dentistry recognizes the necessity to identify it in an univocal and unequivocal way with the terms of Molar Incisors Hypomineralization (MIH) not to confuse with the Molar Hypomineralization (MH) that does not affect at all the incisors.

Therefore, the lack of appropriate definition made it, for many years, that the related literature often confused and however insufficient to the extent that even today it is difficult to establishing if some of the studies made actually refer to said pathology. Aim of this study is that to evaluate, among 1500 paediatric patients chosen at random aged between 0 and 14 years, afferent by the Paediatric Dentistry of the Azienda Ospedaliera Policlinico Tor Vergata of Rome from 1996 to 2011, the incidents and the

prevalence of the MIH distribution, and furthermore to ascertain the possible relationship with the data described in the literature.

Aetiology

Although the international literature agrees in recognizing that, the aetiology of the MIH might be due to some idiopathic factors of systemic origin, in the 2008 the European Society of Paediatric Dentistry, assumed that it could be tied up also with some genetic component and, since the susceptibility to such a pathology may vary a lot from one individual to another, even if casual factors may be the same, it indicates that, in reality the MIH recognises an aetiology of a multifactor type.

Lygidakis, among 2000 individuals aged between 3 and 15 years, demonstrated that, in a percentage of 14.5%, the MIH is most correlated to any systematic pathology, in a percentage of 19.2% it is linked with prenatal problems and with a birth delay, in the 44.3% it is due to perinatal problems and in the 21.8% it is due to neonatal problems, coming to the conclusion, in a second time, that in the 12.2% it is not associated with any important medical history while, in the remaining 87.8% may be correlated with numerous systematic problems incurred in from the birth to the first childhood like: asthma, pneumonia, infection of the upper airway, otitis media, tonsillitis and tonsillectomies, taking up antibiotic molecules, some presence of dioxin in the mother's milk and some childhood spotted fever (1-7).

According to a systematic revision of 2007, William V. has declared that, even if a specific aetiological for the MIH is not yet known, it is sure instead that the children characterized by a bad general health status during the first three years of life, the ones born before the term or exposed to contaminated areas (phytoestrogens, mercury, phthalates, bipocidi, pesticides) are more subject to be affected by MIH (8). In general, in any case, the surveys made towards the analysis of all possible factors aetiological as of today resulted to be retrospective studies, that send back to an individual memory, often incomplete and inexact. This to support the fact that, in reality,

the perspective studies, conducted at the birth and up to the eruption of the first permanent molars are necessary and contribute to clarify the question. Therefore at today, the literature agrees and concludes that it is not yet possible to define a specific aetiology for the MIH (4).

Epidemiology

The epidemiologic data, present in the literature of the last fifteen years, are only limited and turned mostly to studies of prevalence. The epidemiological studies on the frequency of hypoplasia of the dental enamel in the contemporary populations demonstrate the liaison between the socio-economical conditions and the prevalence of this defect. In the developed countries the incidence of this condition for an average of 10%, while in the developing countries the same incidence is higher than the 50% (9).

In the 1987, Koch noted that, in the permanent elements the prevalence of hypomineralization and/or idiopathic hypoplasia of the dental enamel varied between the 3.6 and the 21.5 according to the year of birth (10-12).

The studies undertaken between the 1987 and the 2001 are of difficult interpretation because they do not have as objective the study of prevalence, recorded as secondary result only. They certify that it varies within an ample interval, included between the 2.8 and 2.5%, up to assume a more reliable and constant value, around the 15%, immediately after such time term (7, 12-24).

In reality, the more recent epidemiological studies seem to suggest on the contrary that the MIH prevalence is more and more increasing (15).

According to a study dated 2008 on 3518 Greek children, aged between 5.5 and 12 years, it results that: the 10.2% of them (58.6 female and 41.4 male) present MIH, while the total of the tooth affected resulted equal to 1286, of which 776 molars and 510 incisors with an average of involved elements, per child, equal to 5.7 (3.4 molars and 2.2 incisors). In the 28.4% of the children affected by MIH are interested only molars while in the 71.6% both the molars and the incisors. The association of the af-

affected tooth more frequently noticed has resulted to be: 4 molars/2 incisors (23.5%), 4 molars/4 incisors (16.8%), only 4 molars (15.1%), only 2 molars (9.7%) with a major involvement of the maxillary elements in respected to the lower jaw. Such study demonstrates finally the such pathologic condition in progressive because the interested dental elements are hit by a post-eruptive repartition of the enamel in relation to the age, and determine that the gravity of the MIH increases in a way proportional to the chronologic age while the more light defects appear prevalently charged to the permanent incisors (2, 14).

The major part of the studies undertaken between the 2001 and the 2007 demonstrate that it does not exist any difference of distribution among the two sexes (7, 14, 17-21).

In any case, recently some Authors report a major evidence charged to female sex, but with no demonstration if it is really a significant data (3, 23).

The numerous studies undertaken to establish the average value, per child, of tooth affected by MIH demonstrate that it varies from 5 to 5.7 elements per individual; they highlight furthermore that the damages involving the first permanent maxillary molars are the more serious as well as the more frequent (2, 7, 14, 16, 17, 19-23).

On the other hand, four clinic studies demonstrate, on the contrary, that the permanent molars affected by MIH belong prevalently to the jaw dental arch (7, 14, 20, 25).

Diagnosis: clinical signs and symptoms

In the 2003, Weerheijm has established that the MIH clinic evaluation must be executed only on dental elements well washed and wet, underlining that the age optimal for a diagnostic survey of such pathological condition corresponds to the 8 years old, time in which we may suppose that both the first molars and the permanent incisors are already there (15).

From the diagnostic point of view it is important also to consider that the MIH hits, in a prevailing manner but not exclusively, the permanent molars

and incisors, because as Weerheijm himself demonstrated that also the second deciduous molars, the second permanent molars and the cusps of the permanent canines may occasionally show some defects of the dental enamel (26).

Notwithstanding that, very different from the histological point of view, clinically the damages hypomineralization and that ones hypoplastic of the MIH are considered referred to the same pathologic environment (15). Even if, the literature defines as "hypomineralization" the qualitative defect of deposit of matrix and minerals and as "hypoplastic" the quantitative defect of formation of the matrix. From the clinical point of view, both of them are classified as defects inadequate of the dental amelogenesis and they are characterized by some areas of enamel opacity and of colour whitish, yellow, yellowish, dark, up to the black. The damages tend to further worse and often the molars may suffer of the so called post-eruptive break down, either to say a structural collapse, frequently diagnosed as a caries damage, due to the presence of a light and porous structure, that it is also responsible of forming of atypical cavities and particular distortion of the crown morphology (27). The incisors affected, rarely show the divisions post eruptive because, in reality, we think that said phenomenon is due to back of occlusive charge on the opacity, event that in the contrary involves prevalently the first permanent molars. It is important underline that the division of the enamel, being an event post-eruptive, may complete a clinic situation of hypomineralization or hypoplasia in these cases it is imposed a differential diagnosis with those enamel defects, appeared during the process of amelogenesis and therefore before the eruption of the element in the arch (19, 26, 28).

Some Authors agree in considering the dental elements affected by MIH hyper sensitive to the stimulus (26, 29). Both of the clinic level and radiographic they are characterized by the presence of an inflammation of the pulp due actually to the increased dental sensibility (29). The first permanent molars affected by MIH may turn into caries pathologies very quick and the presence of a caries damages may hide the true diagnosis of MIH (26, 30).

Therefore, the appropriate diagnosis of MIH needs a

selective registration of the clinic evidences related to the single dental elements (4 first permanent molars and 8 permanent incisors) in order to evaluate:

- the presence or absence of limited opacities;
- the presence of enamel division post eruptive;
- the presence of atypical repairs;
- verification of past extractions of first permanent molars;
- check the lack of a molar eruption or of a permanent incisor (Fig. 1) (26).

MIH methodology of clinic classification

The classifications to which the scientific literature send in order to evaluate the clinic entity of the damages caused by the MIH and therefore to establish the gravity of such pathological condition, are essentially two:

- Classification of dental amelogenesis (31);

- Classification of gravity of defects caused by the dental amelogenesis (5, 13).

The defects caused by deficits happened during the amelogenesis process have been classified in three types:

- 1) hypoplastic, it happens during the formative phase of the matrix deposition. The enamel, characterized by a thickness of the tissue very light, may have an aspect dot-shaped, smooth or rough;
- 2) hypocalcified, that it is produced at the time of the calcification, during which the matrix mineralizes. It is characterized by an enamel easily pierceable with probes;
- 3) hypomaturational, that happens during the maturity during which we have an increase of crystallites; the enamel may be pigmented or white and it is characterized by a thin stratum enamel soft and crumbly; such a defect, often is linked to taurodontism (31).

Last, in order to evaluate the defects of the amelo-



genesis taking into consideration their peculiarity, extension and position in the teeth crown, it is possible to correlate the gravity of the MIH to that of the areas hit by such damages and therefore identify it in:

- severe (loss of enamel correlated to a dental impairment);
- moderate (limited to the only loss of enamel);
- slight change of the colour (into white, yellow or brown).

The areas with a minor MIH appear only with a colour change, while the moderate with the loss of enamel. In the cases of serious MIH the loss of structure interests also the dentin (5, 13).

Materials and methods

The purpose of this study is that of evaluating a sample of 1500 paediatric patients taken at random, aged between 0 and 14 years, all of them affected by the Paediatric Dentistry of the Azienda Ospedaliera Policlinico Tor Vergata of Rome from 1996 to 2011, the incidence, prevalence and distribution of MIH, and also to establish the eventual relationship with the data referred in literature.

Of any patient have been recorded the data related to sex and age and it has been analyzed with attention the dental formula, in order to register the presence and the gravity of eventual defects of quality and/or quantity inherent to the dental enamel.

Of any patient affected by hypomineralization

and/or hypoplasia have been recorded number and functional class of any interested dental elements, specifying if they were deciduous or permanent. Subsequently, it has been evaluated the near or post medical history, in order to underline the presence of eventual pathologies linked or in any case correlated to MIH.

It has been made a statistical analysis, based on numerical values and percentages. Have been calculated the averages arithmetic of the various distribution, the averages of the various incidences, linking them to two sex and patient age, and it has been evaluated the correlation with eventual pathologies linked with the presence of MIH. The data so obtained have been included in tables and graphics, namely histograms and aerogrammes, later on described and commented in details.

Results

From the initial sample of 1500 paediatric patients, the number of those affections from MIH has turned out to be pairs to 110 (7.3%) aged between 4 and 15 years, and an average age equal to 9.7 (Diag. 1).

Taking in consideration the group of children who anticipate hypoplasia, a further distinction between the dentals elements based on the belongings series has been carried out, therefore if deciduous or permanent (Diag. 2).

The incidence of the hypoplastic defects is greater in the elements of the permanents series. The value percentage of 85% represents a total data, where

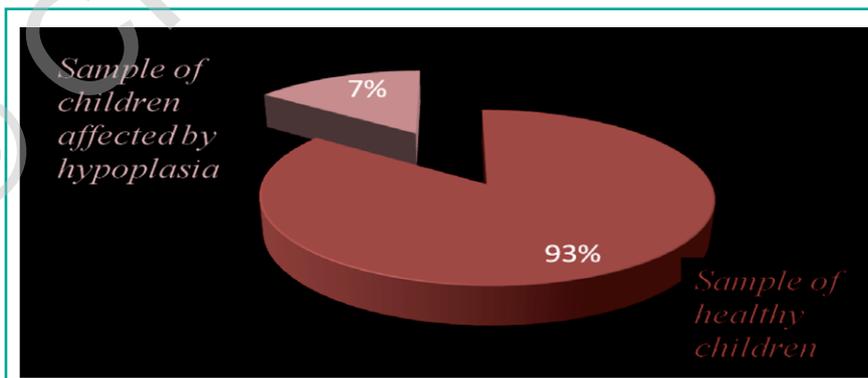
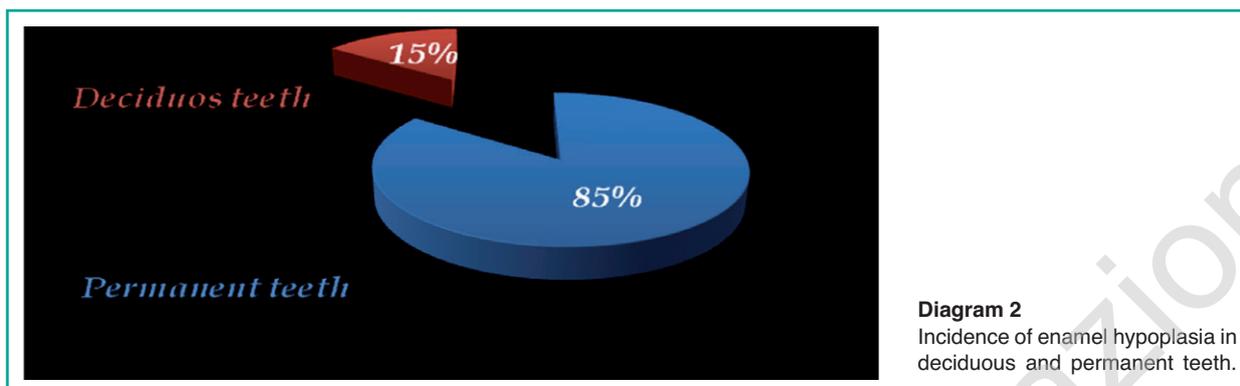


Diagram 1
Incidence of enamel hypoplasia on the sample examined.



still a distinction between the various dental functional classes is not carried out.

Regarding the elements of the deciduous series affections from hypoplasia, they turn out to be in all in number of 20 represented in 80% of the cases from the second molars (tot.16) while in the remaining 20% of the cases the items involved are the central incisors (tot. 4).

The obtained data concerning dental elements affected by MIH were divided in two tables, the first regarding the deciduous set of the teeth (Tab. 1) and the second one inheres that permanent one (Tab. 2); in both tables were distinct functional classes and sexes.

In a decreasing order of incidence, it has turned out that the dental elements that mainly anticipate defects of the dental enamel are represented by the second deciduous molars (tot. 11); successively

followed, therefore less frequently, from a condition of generalized hypoplasia of the incisors; at last from the involvement of first deciduous molars (Tab. 1)

Overall distribution of hypoplasia has turned out to have a slightly frequency greater in the male (Diag. 3).

Regarding the permanent dentition, Table 2 shows that there are not cases of second molars affected by hypoplastic defects. The hypoplastic instead envisages with a greater incidence of first molars followed, in a decreasing order, by conditions of generalized hypoplasia, hypoplasia of the elements incisors and at last by cases of MIH, condition generalized from the simultaneous presence of defects it is at the level of the molars that the incisors. The distribution of these data between males and females is evident in Diagram 4.

Table 1 - Deciduous teeth affected by MIH.

Generalized hypoplasia	Incisors	First Molars	Second molars
2 males	2 males	0 male	6 males
1 female	0 female	1 female	5 females
TOT 3	TOT 2	TOT 1	TOT 11

Table 2 - Permanent teeth affected by MIH.

Generalized hypoplasia	Incisors	First Molars	Second molars
13 males	7 males	21 male	5 males
11 female	15 female	16 female	5 females
TOT 24	TOT 22	TOT 37	TOT 10

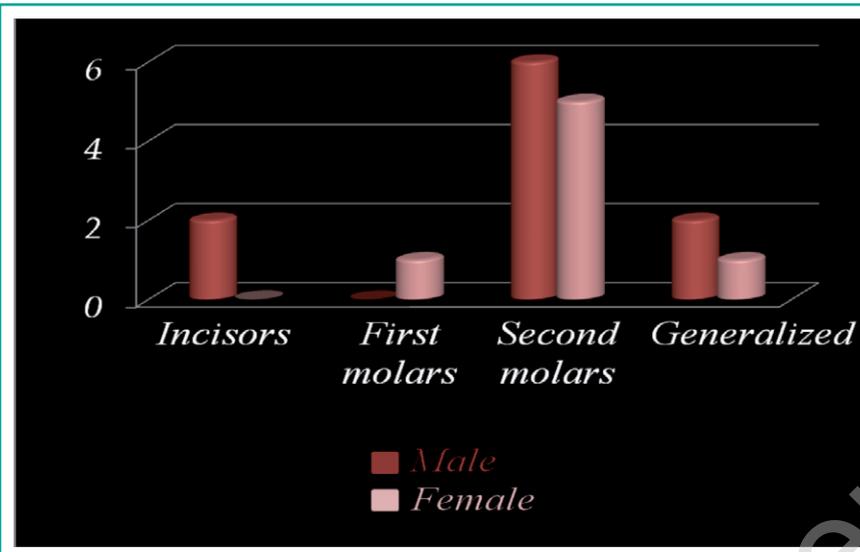


Diagram 3
Hypoplasia of deciduous teeth.



Diagram 4
Hypoplasia of permanent teeth.

Later, it was determined the distribution of dental elements permanent suffering from hypoplasia distinguishing them between maxillary and mandibular (Diag. 5). The study then has placed the attention on the MIH condition, considering the presence of hypoplasia not more isolated to single elements, but at the present level of molars and incisors. Out of 110 children with hypoplastic defects, those in which was detected MIH, were found to be 10, with an average age of 10.5. The distribution turns out to be absolutely fair between the two sexes, as 5 males and 5 females are interested. Entering more specifically, the distribution of such hypoplastic

condition anticipates the following distribution which showed in Diagram 6.

From this analysis it turns out that on 10 children affected from MIH, molars, interested in number of 21, are more involved than incisors, which are interested in number of 16.

The dental elements mainly hit from MIH are the mandibular molars, involved in number of 14 (Diag. 7). This value is performed by the maxillary incisors, in number of 8, and subsequently by mandibular incisors, in number of 6, and finally by maxillary molars, in number of 5. Overall, it is possible to say that for the functional class of molars is found an

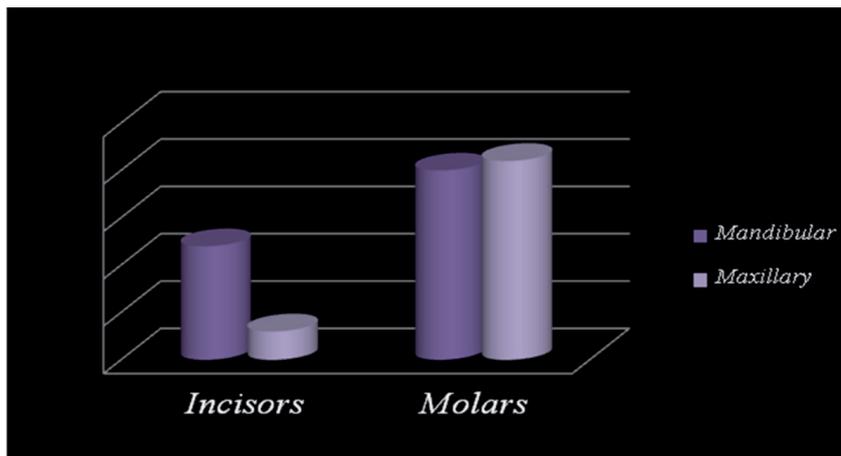


Diagram 5
MIH distribution in the permanent serie.

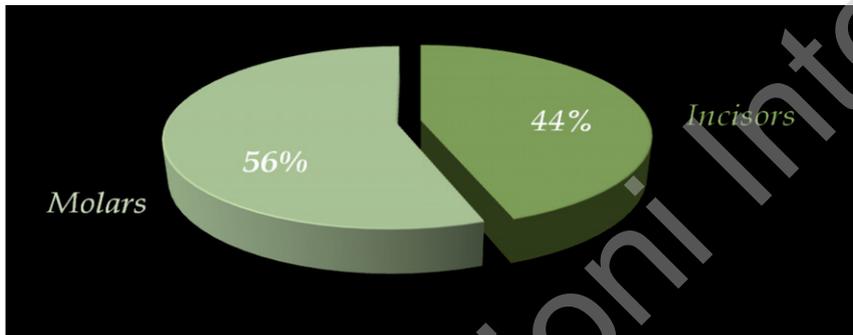


Diagram 6
Percentage of Dental elements affected by MIH.

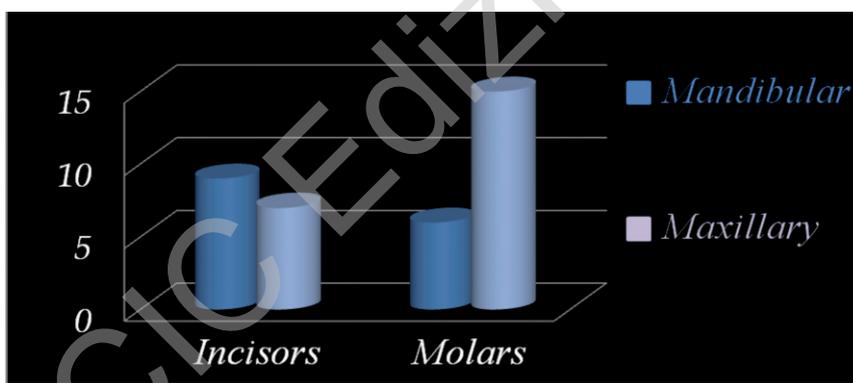


Diagram 7
MIH distribution.

higher incidence in the mandibular area, while for the incisors a light increase of the condition at the level of the maxillary one is present.

During the experimental study only a single clinical case of MIH (0.9 %) has been found with involvement of 4 first permanent molars and the 4 central incisors. This condition has been reported by a 11 years-old girl suffering from celiac disease. Analyzing folders anamnestic of the little ones pa-

tients, eventual associated pathologies to MIH have been estimated, and particular attention has been turn to the presence of Celiac disease, as it is recognized as a condition often aggravating these defects, such as dental hypoplasia. Talking about a positive sample of 110 patients affected by MIH, 22 children (20%) have been resulted affected by Celiac Disease, as represented by the Diagram 8.

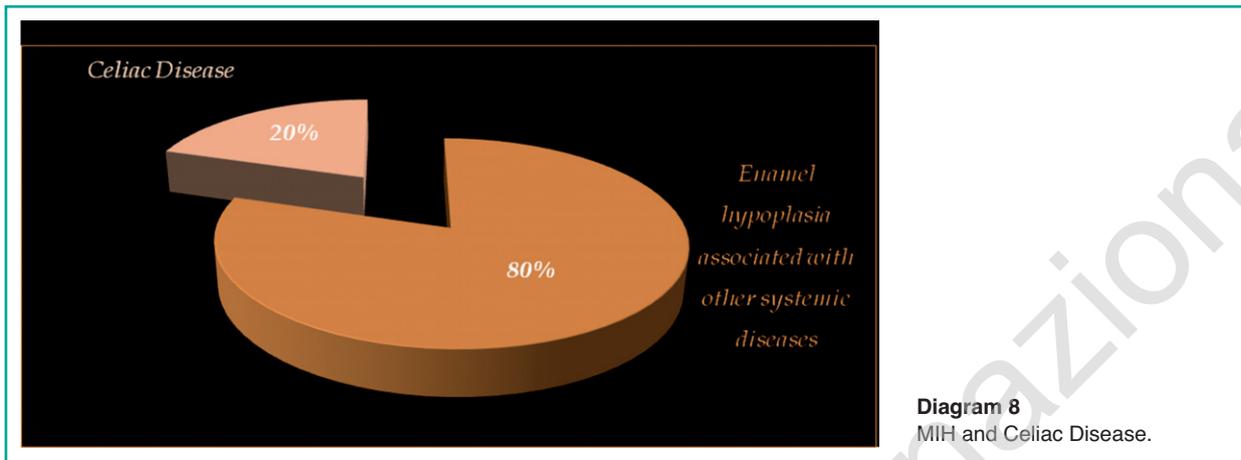


Diagram 8
MIH and Celiac Disease.

Discussion

Pointed out that, from the data collected during the study, the incidence of hypoplastic condition, in a sample of 1500 paediatric patients, it is equal to 7% (Diag. 1), it can be asserted that this value turns out to be slightly lower than the data in the literature, which provides a range of incidence between the 4 and the 20%, with an average of 12% (10, 11). Looking at Diagram 2 it is clear that the incidence of hypoplasia turns out to be significantly greater in the elements of the permanent series with a frequency of 85% with the average of the sample pairs to 9.7 years. This data is perfectly on line with studies in literature which reported a higher frequency of hypoplastic conditions in the permanent series compared to the deciduous one (11).

On the total sample of 110 children, those who have hypoplastic defects at the level of the deciduous teeth have turned out to be in number of 17, including 10 males and 7 females, with an average age of 5 years. Although a light prevalence of the hypoplasia is stressed in the males, this is not enough to assume a real correlation between hypoplasia and sex. The functional class of deciduous more interested, with a frequency of 64.7%, is that of the second molars. The central incisors instead are involved in the 11.8% of the cases (Tab. 1). As said by Weerheijm and other Authors, the MIH is a condition detail that regards, for definition, the elements of the permanent series (12). To support of

such consideration, in our study were not encountered cases of MIH in deciduous teeth (6, 32, 33). The permanent teeth, as pointed out, is by definition more affected by this anomaly dental development. As a matter of fact are involved 93 children on 110, of which 46 males and 47 females, with a medium age of 8 years. Even this value has been confirmed by the literature, since many Authors claim that there is a correlation between the incidence of disease and sex, as evidenced by this study (7,14, 17, 19, 20).

Some Authors however argue that the frequency of the MIH, in permanent teeth, is light greater in the female, aspect also found in this study (3, 23, 34). The functional class of the permanent series mainly interested is that of the first molars, with a percentage of 39.8%. This can be explained by the fact that, in the eruption sequence, the first molars are the first elements to erupt in arch, at the age of 6 approximately.

On line with what is reported in the literature, the study showed that in the permanent teeth, as well as deciduous, the incisors are elements that are involved to a lesser extent, with a frequency of 23.6%. Diagram 3 and 4 represent graphically what is reported in Table 1 and Table 2, therefore the distribution of different dental elements hypoplasia, respectively, in deciduous and permanent.

The Cartesian diagram shows on the x-axis dental functional classes, while on the y-axis numeric values representing the elements involved.

Permanent dental elements affected by hypoplasia were then divided according to functional class

(Diag. 4) and then, on the basis of the distinction between maxillary and mandibular, to assess the possible prevalence (Diag. 5). By processing the data, you can highlight that, as regards the maxillary incisors, those elements are involved in number of 20 (90.9%), while the maxillary involved in number of 2 (9.1%). The molars instead present a balanced distribution of hypoplastic overall between the two arches: these are indeed results involved 39 maxillary and 38 mandibular molars.

Diag. 5, 6 and 7 regard the MIH condition, in which it is possible to have a contemporary involvement of permanent elements, molars and incisors; such anomaly is found in 10 children (Tab. 2), therefore with a frequency of the 9.1% (Diag. 5). Making a first distinction on the sex, being interested 5 males and 5 females, it is not possible to indicate a prevalence or a greater predisposition of one of the two sexes regarding the other, so as already it is evidenced for the conditions of hypoplasia previously discussed. Also in this case the data turn out to be agree with the literature (14, 17-21, 35).

As reported in the literature, it can be asserted that the MIH can hit in equal measure both the male sex that feminine one. Diagram 6 shows the percentage of elements involved in the MIH: the molars, involved with a frequency of 56%, turn out to be more hit regarding incisors (44%).

Conclusions

The clinical study has considered the condition made of MIH, which manifest with as a quality and quantity teeth enamel, to idiopathic aetiology characterized by progressive and simultaneous hypomineralization or hypoplasia of the structure of the enamel of the first permanent molars in variable number from 1 to 4 with frequent involvement of maxillary and mandibular permanent incisors (11, 12). Areas with light MIH are only manifested with dental discromation while, those moderated with a loss of enamel. In case of severe MIH, tissue loss can also affect the dentin (5, 13).

The exposure to certain environmental polluting agents, a general state of ill health in the first three

years of life, as well as a genetic predisposition, represent the main etiologic factors of MIH.

From the analysis of literature and from the results emerged from this clinical study, it has been highlighted that MIH represents a condition quite frequent in the paediatric population. Specifically, the literature reports a medium frequency equal to 12%. In the study being evaluated in a random sample of children aged between 3 and 14 years old, it has been turned out to be equal to 9%.

In managing this anomaly, take an essential role, the early diagnosis and the differential one. The first one is fundamental not only for the planning of the treatment of the lesions, but also to provide parents a correct information about the state of health of the dental elements concerned, in order to arise promptly to support a more favourable prognosis. The differential diagnosis is important to the aim not to confuse potential hypoplastic defects with other anomalies of enamel structure of the enamel, such as post-traumatic discolouration or tetracycline, fluorosis and processes of caries.

The therapeutic protocol articulates with prevention at different levels, including the sealing of the furrows of the permanent molars hypoplastic or hypomineralized and treatments of systematic and topical fluoride prophylaxis; it is important therefore, the clinical monitoring, with a continuous follow-up every 3 months.

The first permanent molars affected by MIH, in view of the mineralization's defects, can found very quickly a sharing post-eruptive of the enamel and a carious pathology, which can hide a hypoplastic lesions. The progress of the caries can also be aggravated by the fact that children suffering from this particular pathology neglect their oral hygiene, due to increased sensitivity, with further progression of the carious pathologies (30).

The study done underlined the importance of a correct application of the therapeutic protocol which, starting from a careful diagnosis and articulating themselves in the execution of preventive treatments and in severe cases restorative and prosthetic, has the aim to certify the functionality and the aesthetic of the dental elements affected by MIH.

This study represents a preliminary investigation on MIH: the values obtained are infact to be considered

baseline data, which can be expanded and supported by successive sample.

References

1. Lygidakis NA, Chaliasou A, Siounas G. Evaluation of composite restorations in hypomineralised permanent molars: a four-year clinical trial. *Eur J Paediatr Dent* 2003; 3: 143-148.
2. Lygidakis NA, Dimou G, Marinou D. Molar-incisor-hypomineralisation (MIH). A retrospective clinical study in Greek children. II. Possible medical aetiological factors. *Eur Arch Paediatr Dent*. 2008a Dec;9(4):207-17.
3. Lygidakis NA, Dimou G, Briseniou E. Molar-incisor-hypomineralisation (MIH). Retrospective clinical study in Greek children. I. Prevalence and defect characteristics. *Eur Arch Paediatr Dent*. 2008b Dec;9(4):200-6.
4. Whatling R, Fearn JM. MIH: a study of aetiological factors in a group of UK children. *Int J Paediatr Dent* 2008; 18: 155-162.
5. Alaluusua S, Lukinmaa P-J, Vartiainen T et al. Polychlorinated dibenzo-p-dioxins and dibenzofurans via mother's milk may cause developmental defects in the child's teeth. *Environ toxicol pharmacol* 1996a; 1:193-197.
6. Alaluusua S, Lukinmaa P-L, Torppa J, Tuomisto J, Vartiainen T. Developing teeth as biomarker of diod exposure. *Lancet* 1999; 353:206.
7. Jalevik B, Norén JG, Klingberg G, Barregard I. Etiologic factors influencing the prevalence of demarcated opacities in permanent first molars in a group of Swedish children. *Eur J Oral Sci* 2001; 109: 230-234.
8. William V, Burrow MF, Messer LB. Microshear bond strength of resin composite to teeth affected by molar hypoplasia using two adhesive system. *Paediatr Dent* 2007; 28: 233-41.
9. Willmott NS, Bryan RA, Duggal MS. Molar-incisor-hypomineralisation: a literature review. *Eur Arch Paediatr Dent*. 2008 Dec; 9(4):172-9.
10. Koch G, Hallonsten AL, Ludvigsson N, Hansson BO, Holst A, Ullbro C. Epidemiologic study of idiopathic enamel hypomineralization in permanent teeth of Swedish children. *Community Dent Oral Epidemiol*. 1987 Oct;15(5):279-85.
11. Weerheijm KL, Jalevik B, Alaluusua S. Molar-Incisor-Hypomineralisation. *Caries Res* 2001a; 35: 390-391.
12. Weerheijm KL, Mejäre I. MIH A questionnaire inventory of its occurrence in member countries of the European Academy of Paediatric Dentistry (EAPD). *Int J Paediatr Dent* 2003; 13: 411-416.
13. Alaluusua S, Lukinmaa P-L, Koskimies M et al. Developmental dental defects associated with long breast feeding. *Eur J Oral Sci* 1996b; 104: 493-497.
14. Leppaniemi A, Lukinmaa P-L, Alaluusua S. Nonfluoride Hypomineralisation in the permanent first molars and their impact on treatment need. *Caries Res* 2001; 35: 36-40.
15. Weerheijm KL, Duggal M, Mejäre I et al. Judgement criteria for Molar-Incisor-Hypomineralisation (MIH) in epidemiologic studies: a summary of the European meeting on Mih held in Athens, 2003. *Eur Arch Paediatr Dent* 2003; 3: 110-113.
16. Dietrich G, Sperling S, Hetzer G. MIH in a group of children and adolescents living in Dresden (Germany). *Eur J Paediatr Dent* 2003; 3: 133-137.
17. Calderara PC, Gerthoux PM, Mocarelli P et al. The prevalence of MIH in a group of Italian school children. *Eur J Paediatr Dent* 2005; 2: 79-83.
18. Fteita D, Ali A, Alaluusua S. MIH in a group of school-aged children in Benghazi, Lybia. *Eur Arch Paediatr Dent* 2006; 7: 92-95.
19. Muratbegovic A, Markovic N, Selinovic MG. MIH in Bosnia and Herzegovina: Prevalence, aetiology and clinical consequences in medium caries activity population. *Eur Arch Paediatr Dent* 2007; 8: 189-194.
20. Preusser SE, Ferring V, Wleklinski C, Wetzel E-E. Prevalence and severity of MIH in a region of Germany – A brief communication. *J Public Health Dent* 2007; 67: 148-150.
21. Jasulaityte I, Veerkamp JS, Weerheijm KL. MIH review and prevalence data from a study of primary school children in Kaunas (Lithuania). *Eur Arch Paediatr Dent* 2007; 8: 87-94.
22. Arrow P. Prevalence of developmental enamel defects of the first permanent molars among school children in Western Australia. *Aust Dent J* 2008; 53: 250-259.
23. Cho S-Y, Ki Y, Chu V. MIH in Hong Kong Chinese children. *Int J Paediatr Dent* 2008; 18: 348-352.
24. Crombie FA, Manton DJ, Weerheijm KL, Kilpatrick NM. MIH: a survey of members of the Australian and New Zealand Society of Paediatric Dentistry. *Aust Dent J* 2008; 53: 160-166.
25. Chawla N, Messer LB, Silva M. Clinical studies in molar hypoplasia. Part I: Distribution and putative associations. *Eur Arch Paediatr Dent* 2008; 9: 180-190.
26. Weerheijm KL. MIH *Eur J Paediatr Dent* 2003; 4: 114-120.
27. Marthu-Muju K, Wright TJ. Diagnosis and treatment of Molar-Incisor-Hypomineralisation. *Compendium* 2006; 27(11): 604-611.
28. Fayle SA. MIH Restorative management. *Eur J Paediatr Dent* 2003; 4: 121-126.
29. Jalevik B, Klingberg G. Dental treatment, dental fear and behaviour management problems in children with severe enamel hypoplasia in their permanent first molars. *Int J Paediatr Dent* 2002; 12: 24-32.

30. Beentjes VE, Weerheijm KL, Groen HJ. Factors involved in the aetiology of MIH. *Eur J Paediatr Dent* 2002; 3: 9-13.
31. Witkop CJ Jr. Amelogenesis imperfecta, dentinogenesis imperfecta and dentin dysplasia revisited: problems in classification. *J Oral Pathol.* 1988 Nov; 17(9-10):547-53.
32. Jalevik B, Klingberg G, Norén JG, Barregard L. Epidemiological study of idiopathic enamel hypomineralisation in permanent first molars. *European Academy of Pediatric Dentistry Congress Abstract number 99.* *Eur J Paediatr Dent* 2000; 1:128.
15. Jalevik B, Moller M. Evaluation of spontaneous space closure and development of permanent dentition after extraction of hypoplastic permanent first molars. *Int J Paediatr Dent* 2007; 17: 328-335.
34. Lygidakis NA, Dimou G, Marinou D, Gouva G. Aetiology of MIH. A retrospective study. *European Academy of Paediatric Dentistry Congress Abstract number 069.* *Eur J Paediatr Dent* 2004; 5: 19.
35. Willmott NS, Bryan RA, Duggal MS. Molar-incisor-hypomineralisation: a literature review. *Eur Arch Paediatr Dent* 2008 Dec; 9(4):172-9.

Correspondence to:

Roberta Condò
Department of Clinical Science
and Translational Medicine
University of Rome "Tor Vergata"
Via Montpellier, 1
00166 Rome, Italy
E-mail: roberta.condo@uniroma2.it



© CIC Edizioni Internazionali