Hypomineralisation of second primary molars and primary canines: Prevalence and description of lesions in a population of 153 patients visited at a hospital paediatric dentistry service



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Abstract

Aim The enamel defects of Molar-Incisor Hypomineralisation (MIH) share clinical characteristics with hypomineralised second primary molars (HSPM) and hypomineralised primary canines (HPC). The main objective of this study is to determine the prevalence of these entities in a population of patients in a hospital dentistry service. The secondary objectives are to know the number and distribution of lesions, classify them according to their degree of severity and to know which dental surfaces are most affected.

Methods A cross-sectional and observational prevalence study was carried out over a 32-day period, guided by the diagnostic criteria of the European Academy of Paediatric Dentistry (EAPD) together with the descriptive study of the lesions. Healthy patients between 30–42 months and who had all erupted teeth were included.

Results Out of a total of 153 patients, 29 presented HSPM (18.95%) and 17 HPC (11.11%). Check-ups were made on 116 second primary molars (SPM) and 116 primary canines (PC), obtaining 81 HSPM (69.82%) and 31 HPC (26.72%). The lesions observed were mild in 60 molars (74.07%) and in 27 canines (87.09%). As for the 405 surfaces checked, 168 showed HSPM (41.48%) and 43 HPC (10.61%).

Conclusions The prevalence of HSPM and HPC varies depending on the population studied. It was observed that SPM were affected more often than PC, with the occlusal and buccal surfaces being the most affected, and the majority of the lesions presenting a low degree of severity.

KEYWORDS Dental hypomineralisation, Second primary molars, Primary canines, Enamel alterations, Prevalence HSPM/HPC.

Introduction

During growth and development of the oral cavity, defects in enamel development can appear in both dentitions and can be either quantitative or qualitative defects [Weerheijm et al., 2003; Elfrink et al., 2008; Elfrink et al., 2012]. Hypomineralistion is a qualitative defect caused by an alteration during the initial process of calcification and/or the maturation of the enamel and from which results an enamel with a normal thickness but with a more porous and fragile consistency, due to a lower amount of protein and disorganisation of the enamel prisms [Americano et al., 2017]. This constitutes a high-risk factor for the development of fast-growing caries and in the most severe cases can lead to post-eruptive enamel breakdown accompanied by dental sensitivity [Weerheijm, Jälevikb and Alaluusua, 2001; Jälevik et al., 2001; Elfrink et al., 2010; Alaluusua, 2010; Elfrink et al., 2012; Temilola, Folayan, Oyedele, 2015; Bullio Fragelli et al., 2015; da Silva Figueiredo et al., 2017; Americano et al., 2017].

These enamel defects can be visibly identified as enamel areas with altered translucency (opaque) and generally well delimited, characterised by a colour that can vary from cream to brown through yellow [Weerheijm, Jälevikb and Alaluusua, 2001; Oyedele, Folayan, and Oziegbe, 2016; Negre-Barber et al., 2016; da Silva Figueiredo Sé, 2017]. They are opacities that can vary in size [Americano, 2017], which are more frequently limited in atypical areas, such as the incisal or cuspid third of the crown and that rarely involve the cervical area [William, Messer and Burrow, 2006]. These lesions can involve varying degrees of severity, even varying between the molars of the same patient [Weerheijm, 2003]. Biochemically, cream-yellow-brown lesions have been reported to have 20-22% lower mineral density than healthy areas of the same affected tooth as opposed to white areas, which have been shown to have equal mineral content than that of healthy enamel [Jälevik et al., 2001; Elfrink, 2013; da Silva Figueiredo Sé et al., 2017]. The presence of these demarcated areas, that affects at least one first permanent molar and can also be associated with permanent incisors, was called Molar-Incisor Hypomineralization [MIH] by Weerheijm in 2001 [Weerheijm, Jälevikb and Alaluusua, 2001; Weerheijm, 2003]. Lesions similar to those of MIH have been detected in second primary molars (HSPM) and primary canines (HPC) [Elfrink et al., 2008; Temilola,



FIG. 1 Photographs to evaluate the severity of HSPM/HPC (mild/severe).

Folayan and Oyedele, 2015; da Silva Figueiredo Sé et al., 2017].

This can be explained by the fact that the process of formation and mineralisation of the second primary molars occurs almost at the same time as that of the first permanent molars (around the 18th week of pregnancy) [Weerheijm et al., 2003], with the only difference that the maturation and calcification process is faster in the primary molars [Elfrink et al., 2008; Elfrink et al., 2012; Ghanim et al., 2013; Temilola, Folayan and Oyedele, 2015; Owen et al., 2018]. In this way, HSPM can be considered as a predictive factor for the onset of MIH in permanent dentition [Temilola, Folayan and Oyedele, 2015; da Silva Figueiredo Sé et al., 2017; Owen et al., 2018, Giuca et al.,2020].

The diagnosis of both entities is clinical, since the evaluation of the morphology of the affected teeth may be normal in radiographical terms, however, with a reduction in the opacity of the enamel that can resemble that of dentin [Temilola, Folayan, Oyedele, 2015].

According to the literature, the appearance of HSPM and/or MIH has been related to environmental changes, problems during pregnancy, low birth weight, breastfeeding, respiratory diseases, lack of oxygen of the ameloblasts, possible genetic variations and diseases related to high fever, among others, without having been able to obtain clear evidence to reach a consensus [Beentjes, Weerheijm and Groen, 2002; Weerheijm, 2003; Crombie, Manton, and Kilpatrick, 2009; Alaluusua, 2010; Costa-Silva et al., 2013; Elfrink et al., 2015; Negre-Barber et al., 2016; da Silva Figueiredo Sé et al., 2016]. The fact that these external factors can produce these alterations is due to the extreme sensitivity of ameloblasts to any stimulus during the process of calcification and the maturation of the enamel [Crombie, Manton, Kilpatrick, 2009; Alaluusua, 2010; Salanitri and Seow, 2013].

The prevalence of HSPM and HPC is very diverse (0–21.8%) and this fact is due to the different calibration methods, the disparity in terms of the number of samples and their age, and the number of examiners, but above all, due to the lack of standardised protocols for an optimal diagnosis [Ghanim et al., 2013; Elfrink et al., 2015; Temilola, Folayan and Oyedele, 2015; Negre-Barber et al, 2016; da Silva Figueiredo Sé et al., 2017; Owen et al., 2018].

The main objective of this study is to determine the prevalence of HSPM/HPC, as well as to know the number and distribution of HSPM and HPC lesions in paediatric patients who attend a paediatric dentistry service for a dental check-up. The secondary objectives are to classify these lesions according to their degree of severity and to know what dental surfaces are the most affected.

Methods

A cross-sectional and observational prevalence study of HSPM and HPC has been carried out together with a descriptive study of these lesions. During a 32-day period, distributed between the months of June 2017 to December 2017, children aged between 30 and 42 months were studied and who had attended a routine check-up at the paediatric dentistry service of a paediatric hospital. All those healthy or non-syndromic patients who had a complete temporary dentition were included. Those children who had a syndromic-based pathology and also those who did not have all erupted temporary dentition, though of the selected age range, were excluded.

Approval was obtained from the Scientific Council of the HM Nens paediatric hospital (HM Hospitales, Barcelona, Spain) as well as the authorised informed consents of the parents of the children who participated in the study.

The clinical examination was carried out by two researchers calibrated in the same way, using the diagnostic criteria proposed by the European Academy of Paediatric Dentistry (EAPD) [Lygidakis et al., 2010], in which the HSPM/HPC diagnostic criteria are considered to be the following.

- Circumscribed opacities: Abnormality in the translucency of the enamel identified as well-defined areas not less than 1 mm and cream-white/yellow-brown in colour.
- Post-eruptive breakdown of the enamel: Breakdown of the enamel when the affected tooth erupts as a result of some masticatory forces in the affected area.
- Atypical caries: Caries with a size, shape and location that do not correspond to the presence of habitual caries.
- Atypical restorations: Restoration with a size similar to the extension of the hypomineralised lesion and even with a halo around it.
- Hypersensitivity: Acute sensitivity to stimuli that in a healthy tooth do not generate an intense response.

- Atypical extraction: Absence of a second primary molar/primary canine that had either been previously referred to in the medical record as a tooth with hypomineralisation or is accompanied by the presence of other affected molars or with atypical restorations.

This examination was carried out in a dental chair with artificial light and with the help of the dental exploration kit (mirror, probe and tweezers) and cotton swabs to guarantee the drying of the dental surface and in this way, the entire surface of the examined teeth could be observed.

When at least one of the criteria was met, the second primary molar was diagnosed as a molar with HSPM. In those cases, in which some teeth could not be clearly diagnosed, intraoral photographs were taken with a camera having a macro lens and ring flash, to undergo posterior evaluation using a computer with a calibrated screen. Likewise, both HSPM and MIH can be classified according to their degree of severity, distinguishing the following types of lesions [Lygidakis et al., 2010] (Fig. 1):

- Mild:
  - Demarcated opacities in the enamel without fracture;
  - Occasional sensitivity to external stimuli such as air or water but not during brushing;
  - Mild aesthetic alteration in the opacities of the incisors.
- Severe:
  - Demarcated opacities in the enamel with fracture of same;
  - Caries;
  - Persistent or spontaneous hypersensitivity during an action, e-g. brushing;
  - Great aesthetic alteration that can produce a socio-psychological impact on the patient.

The collection of data was undertaken using a document designed to gather, on the one hand personal data (gender, age, underlying pathology) and on the other hand the presence of HSPM and HPC lesions (recording, in turn, the type of lesion, degree of severity and location). The data collected were entered in an Excel sheet, through which the results expressed in percentages could be obtained and a statistical analysis was conducted.

Results

Prevalence according to the diagnostic criteria of HSPM/HPC

From the prevalence study carried out, a total sample of 153 patients was obtained, of which 81 (52.94%) were boys and 72 (47.05%) were girls. A total of 29 patients (18.95%) presented HSPM and a total of 17 (11.11%) presented HPC. From the final sample of 29 patients with HSPM, 18 were female (62.06%) and 11 (37.93%) were male.

Of the total sample, 116 SPM and 116 PC have been reviewed, of which a total of 81 SPM (69.82%) and 31 PC (26.72%) affected have been obtained, producing an average of 2.79 of affected SPM per patient and of 1.06 affected PC per patient (Table 1).

The diagnosis of both entities (HSPM/HPC) has been undertaken following the diagnostic criteria cited by EAPD, obtaining a significant difference in the diagnosis of these lesions as a result of the presence of demarcated opacities rather than by any other diagnostic criteria (Table 2).

Distribution of lesions of HSPM/HPC

The prevalence of patients with HSPM and HPC has been studied according to whether they presented 1, 2, 3 or 4 SPM affected and whether they presented 0, 1, 2, 3 or 4 PC affected (Table 3). A higher prevalence of patients having 4 SPM affected (37.93%) and 0 PC affected (41.37%) has been observed. On the contrary, it was less frequent to have 2 SPM with HSPM (17.24%) and 3 PC with HPC (3.44%) (Table 4).

Distribution of lesions according to SPM/PC affected

Of the 81 molars affected, a higher prevalence of HSPM has been observed in the lower left second primary molar (29.62%) and a lower prevalence in the lower right second primary molar (22.22%), being greater to less prevalent in 7.5 (29.62%)>6.5 (24.69%)>5.5 (23.45%)>8.5 (22.22%).

Regarding the 31 affected canines, a higher prevalence was obtained in the left upper primary canine (32.35%) and a lower prevalence in the right lower primary canine (16.12%),

N° of SPM/PC affected		
	HSPM	HPC
With HSPM/HPC	69 .82% (81)	26.72% (31)
Without HSPM/HPC	30.18% (35)	73.28% (85)
	Total = 116	Total = 116

TABLE 1 Distribution of lesions HSPM of HPC in the 29 patients.

Diagnostic criteria HSPM/HPC		
	HSPM	HPC
Demarcated opacity	76.54% (62)	87.09% (27)
Posteruptive breakdown	18.51% (15)	12.90% (4)
Atypical restorations	4.93% (4)	0%(0)
Dental extraction	0%(0)	0%(0)
Dental sensibility	Unregistered	Unregistered

TABLE 2 Prevalence of the different diagnostic criteria according to EAPD.

Prevalence					
	1 SPM	2 SPM	3 SPM	4 SPM	Total
0 PC	10.34% (3)	3.44% (1)	13.79% (4)	13.79% (4)	41.37% (12)
1 PC	10.34% (3)	13.79% (4)	6.89%(2)	3.44% (1)	34.48% (10)
2 PC	0%(0)	0%(0)	3.44% (1)	6.89% (2)	10.34% (3)
3 PC	0%(0)	0%(0)	0%(0)	3.44%(1)	3.44% (1)
4 PC	0%(0)	0%(0)	0%(0)	10.34%(3)	10.34% (3)
Total	20.68% (6)	17.24% (5)	24.13% (7)	37.93% (11)	n 29

TABLE 3 Combination of HSP/WHPC lesions

N° of SP MI PC affected	
HSPM	HPC
	0 PC = 41.37%(12)
1 SPM = 20.68% (6)	1 PC = 34.48% (10)
2 SPM = l7.24% (5)	2 PC = 10.34% (3)
3 SPM = 24.13% (7)	3 PC = 3.44% (1)
4 SPM = 37.93% (11)	4 PC = 10.34% (3)
Total 29	Total 29

TABLE 4 Prevalence of patiens according the number of second primary molars and primary canines affected.

Prevalence per affected tooth	
HSPM	HPC
5.5 = 23.45% (19)	5.3 = 22.58% (7)
6.5 = 24.69% (20)	6.3 = 32.25% (10)
7.5 = 29.62% (24)	7.3 = 29.03% (9)
8.5 = 22.22% (18)	8.3 = 16.12% (5)
Total 81	Total 31

TABLE 5 Prevalence of thr hyponineralisation according the SPM/PC affected.

Degree of severity	HSPM	HPC
Mild	76.55% (62)	87.09% (27)
Severe	23.45% (19)	12.91% (4)
	Total 81	Total 31

TABLE 6 Distribution of HSPM and HPC lesions according to degree of severity.

Grade of severity HSPM			
	Mild	Severe	Total
55	78.94% (15)	21.06%(4)	19
65	80% (16)	20% (4)	20
75	79.17% (19)	20.83% (5)	24
85	66.67% (12)	33.33% (6)	18
	Total 60	Total 21	Total 81

TABLE 7 Grade of severity and SPM affected.

Degree of severity HPC			
	Mild	Severe	Tota!
53	85.71%(6)	14.28%(1)	7
63	80%(8)	20%(2)	10
73	100%(9)	0%(0)	9
83	80%(4)	20%(1)	5
	Total 27	Total 4	31

TABLE 8 Degree of severity and PC affected.

being greater to less prevalent in 6.3 (32.35%)>7.3(29.03%) >5.3 (22.58%)>8.3 (16.12%) (Table 5).

Analysing in greater detail the data in the previous table (Table 5), a similar effect of HSPM is also observed in the upper and lower quadrants, being slightly higher in the SPM of the lower quadrants (51.84% vs 48.16%). On the contrary, in HPC lesions, there is a similar incidence between upper and lower quadrants, observing a slightly greater appearance of PC lesions in the upper quadrants (55.83% vs 44.17%).

If HSPM lesions are analysed according to whether we make the difference between right or left quadrants, an incidence of 45.67%, in the right quadrants is observed, being slightly higher in the left quadrants (54.33%). Finally, a higher prevalence of HPC lesions has been observed in the left quadrants (61.30%) compared to the right quadrants (38.70%).

Prevalence of the severity of HSPM/HPC

Of the 81 SPM studied, a significant difference of SPM affected as a result of mild lesions (76.55%) was obtained compared with SPM with severe lesions (23.45%). A higher prevalence of PC affected with mild lesions (87.09%) was obtained compared with severe lesions (12.91%) (Table 6).

Likewise, it has been observed (Table 7) that there is a higher prevalence of severe lesions in the lower right second molar (38.88%) and a higher prevalence of mild lesions in the upper right second molar (80%).

Regarding the level of severity in the canines (Table 8), a higher prevalence of severe lesions has been observed in both the left upper primary canine and the right lower primary canine, and a higher prevalence of mild lesions in the lower/ inferior left primary canine.

Distribution of the lesions according to the dental surface affected

A study of the molar and canine surfaces affected by hypomineralisation lesions has also been carried out. A total of 168 affected surfaces (41.48%) of SPM were recorded of the 405 examined, with the occlusal surface being the most affected; and a total of 43 canine surfaces with the presence of lesions (10.61%) were obtained, with the buccal surface being the most affected (Table 9).

Discussion

Prevalence

This study reports a significant proportion of children (18.95%) with HSPM/HPC, a fact previously confirmed by other publications [Negre-Barber et al., 2016; Owen et al., 2018; da Silva et al., 2019] and highlights the fact that currently the prevalence of HSPM/HPC is highly variable [Temilola, Folayan and Oyedele, 2015; Negre-Barber et al., 2016; da Silva Figueiredo Sé et al., 2017; Ghanim et al., 2017]. The evidence associates this variability with the fact that there are not any standardised protocols in the interexaminer calibration methods, or in the size of the samples, or in the number of examiners, or in the records of the lesions [Ghanim et al., 2013; Elfrink et al., 2015; da Silva Figueiredo Sé et al., 2017].

It should be borne in mind that this study has been carried out at a paediatric dentistry service of a paediatric hospital where the individuals included in the study came for a check-up, therefore the prevalence cannot be extrapolated to the general population. Nevertheless, we wanted to make a comparison with other studies with the aim of analysing for

Molar surfaces HSPM 16S/405 (41.48%)	
Occlusa!	34.52% (58)
Buccal	26.19% (44)
Mesial	14.28% (24)
Distal	13.09% (20)
Palatal/lingual	11.90% (22)
Canine surfaces HPC 43/405 (10.61%)	
Buccal	53.48% (23)
Incisial	25.58 (11%)
Mesial	11.62% (5)
Distal	9.30% (4)
Palatal/lingual	0% (0)

TABLE 9 Hypomineralisation lesion distribution according to the dental surface.

standardising the criteria used for the diagnosis of HSPM/HPC and the carrying out of prevalence studies (Table 10).

All the studies consulted have still used the EAPD criteria initially proposed in 2003 and subsequently modified in 2010 [Lygidakis et al., 2010], even though there are other proposals for diagnostic criteria [Ghanim et al., 2015]. All the publications consulted have adapted the criteria to HSPM/HPC as proposed by Elfrink in his first study published in 2008, where the definitions of the criteria are adapted to second primary molars and primary canines [Elfrinket al., 2008].

In this study, 29 patients who presented HPSM lesions were included, obtaining HPSM/HPC lesions in approximately 70% of the SPM studied, and in around 30% of the PC analysed. Thus, an average of 2.79 affected SPM was obtained for each child, a figure that is slightly more than that analysed by Elfrink et al., 2012, obtaining 1.9 SPM affected per patient.

Description of the lesions

In the patients diagnosed with HSPM in our study, it is more frequent for them to present lesions in more than one SPM, with a higher prevalence of patients that present 4 affected SPM (37.93%), coinciding with the results of Elfrink et al. 2008. Other authors, however, have found a higher prevalence of patients with just one affected SPM [Ghanim et al., 2013] or two [Negre-Barber et al., 2016].

The results of this study show a slightly greater effect of HSPM in the left and lower quadrants (54.33% left, 51.84% lower), data that do not coincide with the rest of the authors studied [Elfrink et al., 2008; Temilola, Folayan and Oyedele, 2015; Oyedele, Folayan and Oziegbe, 2016]. In addition, a greater incidence of the lower left SPM (29.62%) has been obtained, data that do not coincide with Negre-Barber et al. [2016], an author who found a lower prevalence of SPM in that molar.

Regarding the most affected surfaces, our data is in line with the results of Ghanim et al. [2013], the occlusal (34.52%) and buccal (53.48%) surfaces being the most affected by hypomineralisation lesions.

HSPM/HPC severity

It was observed in our study, as well as that of other authors [Negre-Barber et al., 2016], that it is more frequent to find lesions of a mild character than those of a severe character (HSPM: 76.55%/ HPC: 87.09%). In our study, one out of four SPM studied presented severe lesions, while approximately, only one out of five affected canines presented severe lesions.

Conclusions

The prevalence of HSPM and HPC varies according to the population studied even if the diagnostic criteria are standardised, so it would be convenient to determine the characteristics of the samples for future research.

A greater incidence of HSPM than of HPC has been observed in the patients studied, as well as a greater presence of lesions on occlusal surfaces in SPM and on buccal surfaces in PC. In addition, a great number of mild lesions with respect to severe lesions have been found in both HSPM and HPC.

Limitations

The present study has a number of limitations since in order to obtain significant results, a much larger cohort is required.

Author	Year publication	Sample size	Sample age (years)	Diagnostic criteria	Prevalence (%)
Elfrink et al.	2008	386	5	EAPD 2003	4.90%
Elfrink et al.	2012	6161	6	EAPD 2010	9.00%
Ghanim et al.	2012	823	7-9	EAPD 2010	6.60%
Elfrink et al.	2013	6690	5-6	EAPD 2010	9.00%
Ghanim et al.	2013	809	7-9	EAPD 2010	6.60%
Elfrink et al.	2015	5697	6	EAPD 2010	9.00%
Temilola et al.	2015	327	3-5	EAPD 2010	4.60%
Negre-Barber et al.	2016	414	8-9	EAPD 2010	14.50%
Oyedele et al.	2016	469	8-9	EAPD 2010	5.80%
da Silva Fig et al.	2017	1963	5	EAPD 2010	6.48%
Owen et al.	2017	623	3-5	EAPD 2010	14.10%
Silva et al.	2019	344	6	EAPD 2010	19.80%
Present study	2021	153	2.5-3.5	EAPD 2010	18.95%

TABLE 10 Comparative prevalence.

Those included in this study are patients who attended a dental check-up, so the data obtained cannot be extrapolated to the general population.

In some patients, due to their early age and poor collaboration, it was difficult to take intra-oral photographs and as such the diagnosis of some lesions is questionable.

Finally, the presence or not of dental sensitivity of the affected teeth, as well as the presence of atypical extractions or atypical restorations and the diagnostic criteria of HSPM/HPC proposed by the EAPD could not be recorded. This is due, on the one hand, to the lack of communication with the patients because of their young age and, on the other hand, to the short time that had elapsed since the end of the eruption of these teeth.

Conflicts of interest

The authors declare that they do not have any conflict of interest. This study has been performed by the Research Group of the Paediatric Hospital.

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