Pre-eruptive intracoronal dentin defects of permanent teeth

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This study was conducted to determine the prevalence of pre-eruptive intracoronal dentin defects from panoramic radiographs from a group of children and young adults aged 20 years and below. The radiolucent lesions were noted with regard to which teeth were affected, the location of the defects and the size of the defects relative to the width of dentin. Out of 1007 radiographs examined, 275 (27.3%) have pre-eruptive dentin defects. The prevalence of anomaly among males was 28.4% as compared to 26.2% among females. However, the difference between genders was not significant, thus subsequent results have been combined. Of 275 subjects with dentin radiolucencies, 243 subjects (88.7%) had only one affected tooth, 30 subjects (10.9%) had two teeth affected and 2 subjects (0.7%) had three affected teeth. The tooth prevalence of the anomaly was 2.1% and most of the lesions occurred as a single occurrence on the affected tooth. Within each tooth type, the highest tooth prevalence of intracoronal dentin defect was found in the upper first premolar (5.1%). More than half of the lesions extended less than 1/3 of the width of the dentin thickness. The high prevalence of the condition indicates the need for increased awareness and recognition of this during radiographic examination of teeth in the pediatric age group in early pre-eruptive stages so that early detection and diagnosis can be made and treatment can be done at the most appropriate time.

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INTRODUCTION

Orthopantogram (OPG) radiographs are routinely taken for children and young adults for a variety of reasons. For the younger children, these radiographs are particularly useful for screening purposes. In the older children, OPG radiographs are taken mainly for orthodontic purposes, while in the young adults, OPO radiographs are commonly taken for problems relating to the third molars.

Besides providing the information for which they were taken, these radiographs also provide an opportunity for the clinician to diagnose the presence of other dental anomalies e.g. pre-eruptive coronal radiolucencies of unerupted teeth. These anomalies can be diagnosed in orthopantogram[1] as well as bitewing radiographs.[2] When teeth, with pre-eruptive coronal radiolucencies erupts into the oral cavity, the anomalies resemble dental caries, and they may be mistakenly diagnosed as such. Thus radiographic records of these anomalies are useful in order to provide the clinician with an accurate diagnosis.

Intracoronal pre-eruptive dentin radiolucencies are characteristically noted as incidental findings on radiographs of unerupted teeth, where they often appear as well- defined radiolucencies within the coronal dentin, immediate to the amelodentinal junction. These lesions often resemble dental decay, and the term 'pre-eruptive caries' had been occasionally applied.[1,8-13] Clinical and histological evidence from several case reports have suggested that these lesions are likely to be resorptive in nature.[3-5,14]

Although the etiology and factors associated with the initiation of resorption remain unknown, resorptive cells originating from the surrounding bone are thought to enter the dentin through the break in the dental follicle and enamel or cementum.[3,15] Although the clinical significance of pre-eruptive dentin defects is still unclear, they may constitute a proportion of radiolucent lesions often diagnosed as caries in radiographs of clinically sound, erupted permanent teeth.

The objectives of the study are as follows:

1. To determine the prevalence and distribution of pre-eruptive intracoronal dentin defects from OPG radiographs among children and young adults in Malaysia.
2. To determine the location of these defects.
3. To determine the size of the defects relative to dentin thickness.

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Table 1. Prevalence of pre-eruptive dentin defects by gender

	Defects Present		No Defects		
	Number	%	Number	%	p-value
Female	145	28.4	365	71.6	
Male	130	26.2	367	73.8	0.437
Total	275	27.3	732	72.7	

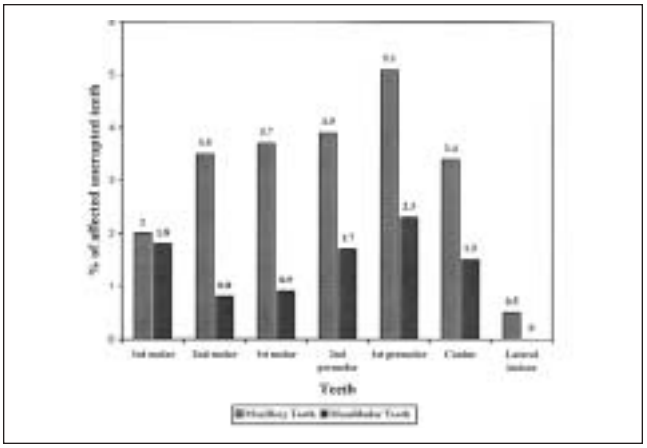

Figure 1. Prevalence of pre-eruptive dentin defects for various

MATERIALS AND METHODS

As it was important to distinguish the lesions of pre-eruptive dentin defects from caries lesions that occur post-eruptively, only unerupted teeth that have not emerged into oral cavity were assessed. In this study, the OPG was employed as it is commonly used in clinical practice, and shows the maximum number of unerupted teeth in a single radiograph. Subjects used for the study were selected using the following criteria:

1. Malaysian children and young adult aged 20 years and younger.
2. No medical and dental pathology such as amelogenesis imperfecta, dentinogenesis imperfecta or and hypophosphatemic rickets.
3. Availability of OPG radiograph.
4. Permanent teeth still unerupted. A tooth was considered unerupted if it was covered by bone and/or mucosa and is situated below the level of the occlusal plane.[2]
5. At least half of the crown of unerupted tooth/teeth has calcified.
6. Optimal positioning of the teeth; i.e. minimal overlap.
7. Optimal radiographic contrast.

The radiolucent lesions were noted with regard to which teeth were affected, and the locations of the defects were analyzed as to whether they were on the occlusal, mesial or distal aspects of the dentin in the crown. In addition, the size of the defect relative to the width of dentin was also noted. A standard radiograph viewer was used to examine the radiographs.

The data was manually inputed into a microcomputer. Statistical analysis was performed using the SPSS statistical software program. The chi-square test was used to determine statistical significance between groups. The level of significance chosen was set at a = 0.05.

RESULTS

A total of 1007 OPG radiographs were examined, of which they were from 497 males and 510 females.

Of the radiographs examined from 1007 subjects with suitable OPG, there were 275 subjects with at least one tooth showing pre-eruptive dentin radiolucency, i.e. a subject prevalence of 27.3% (Table 1). Although the prevalence of anomaly was slightly higher in males than females; 28.4% as compared to 26.2%, the difference was not statistically significant. Thus, analyses of data for subsequent results were combined.

A total of 14,554 unerupted teeth were examined, of which 309 teeth showed the presence of these defects i.e. tooth prevalence of 2.1%.

Of 275 subjects with pre-eruptive dentin radiolucencies, 243 had only one tooth affected, 30 had two affected teeth and 2 had three affected teeth.

When each tooth group was analyzed separately, the highest prevalence of pre eruptive dentin radiolucencies in the maxillary teeth was noted in the first permanent premolar, (44 out of 862 or 5.1%); followed by the second premolar (40 out of 1024 or 3.9%); first molar (8 out of 216 or 3.7%); second molar (40 out of 1136 or 3.5%); canine (39 out of 1136 or 3.4%); third molar (35 out of 1748); and lateral incisor (4 out of 734 or 0.5%). None of the central incisors was affected (Figure 1).

For the mandibular teeth, the highest prevalence was noted in the first premolar (24 out of 1024 or 2.3%); followed by third molar (32 out of 1748 or 1.8%); second premolar (17 out of 1024 or 1.7%); canine (15 out of 1024 or 1.5%); first molar (2 out of 216 or 0.9%); and second molar (9 out of 1136 or 0.8%). None of the lateral and central mandibular incisors was affected (Figure 1).

In all the subjects with pre-eruptive dentin radiolucencies, every one of the lesions was located in the dentin, just beneath the dentino-amelo junction. Table 2 shows the location of these lesions in to the crown of the unerupted tooth. About 55.3% of the defects were located on the mesial surface of the unerupted tooth, followed by occlusal (23.0%) and distal surface (21.7%).

The size of the pre-eruptive radiolucencies relative to the width of dentin is as shown in Table 3. When the size of defects were classified relative to the depth of coronal dentin, it was noted that 170 (55.0%) extended less than one-third of the thickness of coronal dentin, 91(29.4%) were between one-third to two-third of

Table 2. Location of pre-eruptive dentin radiolucencies within the crown

	Mesial	Distal	Occlusal	Total
Third molar				
Maxilla	25	6	4	35
Mandible	16	2	14	32
Second molar				
Maxilla	27	8	5	40
Mandible	4	0	5	9
First molar				
Maxilla	7	1	0	8
Mandible	0	1	1	2
Second premolar				
Maxilla	20	11	9	40
Mandible	3	7	7	17
First premolar				
Maxilla	23	11	10	44
Mandible	11	7	6	24
Canine				
Maxilla	25	7	7	39
Mandible	9	3	3	15
Lateral Incisor				
Maxilla	1	3	0	4
Mandible	0	0	0	0
Central Incisor				
Maxilla	0	0	0	0
Mandible	0	0	0	0
TOTAL (%)	**171 (55.3%)**	**67 (21.7%)**	**71 (23.0%)**	**309**

Table 3. Size of pre-eruptive dentin radiolucencies within the crown

	<1/3	1/3-2/3	>2/3	Total
Third molar				
Maxilla	22	10	3	35
Mandible	19	12	1	32
Second molar				
Maxilla	24	6	10	40
Mandible	5	4	0	9
First molar				
Maxilla	4	1	3	8
Mandible	1	1	0	2
Second premolar				
Maxilla	14	18	8	40
Mandible	13	3	1	17
First premolar				
Maxilla	20	16	8	44
Mandible	12	6	6	24
Canine				
Maxilla	22	12	5	39
Mandible	11	2	2	15
Lateral Incisor				
Maxilla	3	0	1	4
Mandible	0	0	0	0
Central Incisor				
Maxilla	0	0	0	0
Mandible	0	0	0	0
TOTAL	**170**	**91**	**48**	**309**
TOTAL (%)	**55.0%**	**29.4%**	**15.6%**	**100%**

relative dentin thickness and 48 (15.5%) had extended to greater than two-third of the dentin thickness.

DISCUSSION

Although pre-eruptive coronal radiolucencies have been recognized as a clinical entity for more then 50 years, most of these reports in the dental literature were related to reports of cases in different teeth. [11,15,17,18] Currently, there are only two studies that reported on the prevalence of the condition. Seow *et al*.[16] used panoramic radiographs to diagnose these anomalies and reported that the subject and tooth prevalence of subjects in the Brisbane, Australia was 3% and 0.5% respectively. However, in another study, also on Brisbane school children that utilized bitewing radiographs, Seow *et al*.[5] reported a subject prevalence of 6% and a tooth prevalence of 2%. It is rather surprising that the subject prevalence was lower in the study that employed OPG radiographs rather than bitewing radiograph because, in the latter study, only posterior teeth (excluding third molars) were available for detection of these teeth. In contrast, with the OPG, all unerupted teeth, including third molars if present would be available, and earlier studies have shown that pre-eruptive radiolucencies may be seen in these teeth as well.

The subject prevalence of pre-eruptive radiolucencies in the dentin of permanent teeth in the present study is 27.3% and the tooth prevalence is 2.1%. It is much higher than the prevalence reported above. It is not possible to speculate the actual reason for the higher subject prevalence of defect in this study as compared to those on Brisbane schoolchildren. It is interesting to note through that although the subject prevalence observed in this study is much higher, the tooth prevalence of this study is similar to the study that employed bitewing radiographs.

As we are all aware, the radiographic contrast, which one gets from a bitewing radiograph is much better than that from OPG, thus this may be the reason for the higher subject and tooth prevalence in the studies on Brisbane school children. Thus, it is also most likely that the OPG available in this study is of better radiographic contrast than those available in Brisbane and this may explain the higher prevalence.

Earlier studies[3,4,10] have indicated that the most commonly affected teeth were mandibular first molar, followed by the mandibular first premolar, mandibular second molar and mandibular second premolar and that significantly smaller prevalence were found in the

maxillary molars and premolars. In contrast, it was found that the most commonly affected tooth in this study was the maxillary first premolar followed by maxillary second premolar.

Seow *et al*.[5] found 163 teeth with pre-eruptive dentin radiolucencies in the study and noted that every one of the lesions was located in dentin, just beneath the dentino-enamel junction. They also reported that in the majority of cases that affected the mandibular first permanent molar, the defects were commonly located in the occlusal (40%) and mesial (39%) aspects of the crown and less commonly in the distal (17%). In contrast, for the maxillary first permanent molar, the majority of defects were found on the mesial aspects (77%) and very few lesions were noted in the occlusal (15%) and distal aspects (8%).[5] However, in the case of mandibular second permanent molar, they reported that the defects were most often seen in the mesial and central aspects of the occlusal (41% each), whereas in the mandibular first premolar, comparable percentages occurred in both mesial and distal aspects. By contrast, in the case of the mandibular second premolar, a large percentage of the defects were located in the distal aspects of the occlusal (60%).[5]

In this study it was similarly observed that all the defects were noted in the dentin just below the dentino-enamel junction. However, the defects were more frequently observed in the mesial aspect of the crown and over 55% of the defects were observed in this location. In addition it was also noted that except for defects that occurred in the occlusal surface of molar teeth, the maxillary teeth were generally more affected than the mandibular teeth, irrespective of whether the defects were on the mesial, distal or occlusal surface.

The size of the defect is of clinical importance as it has been shown that an untreated lesion is usually progressive in nature. In this study, it was noted that about 55% of the lesions were only less than one-third of the dentin thickness and only 15.5% of the anomaly presented with the defects that were greater than two-third of the dentin thickness. This finding is more favorable than the finding reported by Seow *et al*.[16] who observed that 23 (40%) had extended to the greater than two-third of the thickness of coronal dentin, 16 (28%) were between one-third and two-thirds relative dentin thickness, and 18 (32%) were less than one-third relative dentin thickness.

The majority of previous studies[2-5,14,15] have supported the hypothesis that pre eruptive lesions are resorptive in nature. In these lesions, there is usually evidence of resorption such as the presence of multinucleate cells, oseteoclasts, and other chronic inflammatory cells in the lesions as well as scalloping of the periphery of the lesion on histological examination.[3,15,19,20] The resorptive cells most probably originate from the surrounding bone, and are likely to have entered the developing tooth through break through the dental follicle and enamel.[3]

Although other trigger factors for the initiation of resorption are still unclear, it has been speculated that local inflammation, such as that associated with pulpal infection of the primary teeth, may serve as initiating factors for the resorption. However, the fact that many pre-eruptive dentin defects are founds in permanent molars which do not have primary predecessors obviates this hypothesis.

Other authors have speculated that pre-eruptive dentin defects may originate as developmental anomalies in which parts of the tooth crown are not mineralized properly.[7,13] That this is an unlikely possibility has been shown by previous studies that demonstrated that the crown of an affected tooth appeared well mineralized prior to the later appearance of the pre-eruptive dentin lesion.[1] Furthermore, the fact that many of these lesions enlarge with time, while unerupted points more to a resorptive nature rather than a mineralization. Seow *et al*.[5] thought that the condition is more likely to be due to local rather than systemic factors and they felt the ectopic positioning of the unerupted tooth may play an important role.[5] Other studies[17,18,21,22] have also indicated that pre-eruptive dentin defects are occur more frequently in teeth that are ectopically positioned and impacted as compared to teeth that are in a normal position.

The management of pre-eruptive dentin radiolucencies depends largely on the extent of radiolucency at the time of initial diagnosis.[4] Several researchers though that a rapidly progressive and large lesion in a tooth that is still unerupted should indicate immediate surgical exposure and curettage of defects followed by lining with calcium hydroxide and restoration with dental cements or amalgam.[3,6] However, if the lesion is small, and the affected tooth close to eruption, it may be possible to wait for the tooth to erupt to achieve occlusal access[12] for restoration of the defects.

CONCLUSIONS

The presence of pre-eruptive dentin defects may be detected from OPG radiographs. The prevalence of the condition by subject was 27.3% and the tooth prevalence was 2.1%. The high prevalence of condition indicates the need for increased awareness and recognition of this condition during radiographic examination of children's teeth in the early pre-eruptive stages so that early detection and diagnosis can be made and treatment can be done at the most appropriate time.

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