

# อัตราความชุกของโรคฟันผุด้านประชิดที่พบจากภาพรังสีในผู้ป่วยกลุ่มหนึ่ง จากคณะทันตแพทยศาสตร์ มหาวิทยาลัยมหิดล

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## บทคัดย่อ

ฟันผุเป็นโรคฟันที่พบบ่อยที่สุด ผู้ป่วยอาจมีรอยผุด้านประชิดซึ่งตรวจไม่พบทางคลินิก รอยโรคเหล่านี้ควรได้รับการตรวจทางภาพรังสีก่อนจัดฟัน ในระหว่างจัดฟันควรถ่ายภาพรังสีเพื่อประเมินการดำเนินของโรคและตรวจหารอยโรคใหม่ ความถี่การถ่ายภาพรังสีซ้ำที่เหมาะสมกับผู้ป่วยแต่ละรายอาจประเมินได้แม่นยำจากอัตราความชุกของฟันผุในชุมชนนั้น การศึกษานี้มีวัตถุประสงค์เพื่อประเมินอัตราความชุกและการกระจายของฟันผุในผู้ป่วยกลุ่มหนึ่งโดยใช้ภาพถ่ายรังสีกัดปีก (bitewing radiograph) ทดสอบความถี่ของฟันผุด้านประชิดว่าขึ้นกับด้าน (ซ้ายหรือขวา) หรือ ขากรรไกร(บนหรือล่าง) ด้วยการทดสอบไคกำลังสอง จากผู้ป่วย 76 คน ผลพบว่าผู้ป่วยมีฟันผุด้านประชิดอย่างน้อยหนึ่งด้าน 36 คน (คิดเป็นร้อยละ47.37) พบฟันผุด้านประชิดเฉลี่ยต่อผู้ป่วยหนึ่งคนคือ 3.64 ด้าน (ค่าเบี่ยงเบนมาตรฐาน=2.76) จากรอยโรคทั้งหมด พบเป็นฟันผุเฉพาะชั้นเคลือบฟัน 91 ด้าน และฟันผุถึงเนื้อฟัน 40 ด้าน ไม่พบว่าความชุกของฟันผุด้านประชิดขึ้นกับด้านหรือขากรรไกร ( $p>0.05$ ) ร้อยละของฟันผุด้านประชิดมีค่าต่ำกว่าการศึกษาเดิม แต่จำนวนด้านฟันผุเฉลี่ยต่อคนมีค่าสูง อีกทั้งยังพบฟันผุในชั้นเคลือบฟันซึ่งตรวจไม่พบทางคลินิกถึง 91 ด้าน จึงอาจแนะนำว่าควรถ่ายภาพรังสีกัดปีกและให้ความรู้ทางด้านทันตกรรมป้องกันแก่ผู้ป่วยจัดฟันใหม่ทุกราย

**คำสำคัญ :** การรักษาทางทันตกรรมจัดฟัน • อัตราความชุกของโรค • ฟันผุด้านประชิด • ภาพรังสี

## Prevalence rate of radiographically diagnosed proximal caries in a group of patients at the Faculty of Dentistry, Mahidol University

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## Abstract

Dental caries is the most common dental disease. Some patients may have clinically undetectable proximal caries which requires bitewing radiographs prior to orthodontic treatment. During treatment, to reevaluate the existent proximal caries and assess new lesions, more radiographic examination will be required. If the prevalence rate of the caries is known, the frequency of repeat radiographic examination can be established precisely. It is the aim of this study to evaluate the prevalence rate and site-distribution of the proximal caries in a group of patients. The bitewing radiographs of seventy-six patients prior to treatment at Department of Hospital Dentistry, Mahidol University were examined. Chi-square test was utilized to test whether the presence of proximal caries was due to the dependence of two variables, sides (left or right) and dental arches (maxilla or mandible). The result showed that thirty-six patients (47.37 per cent) showed at least one surface of proximal caries. The mean of proximal carious surfaces was 3.64 surfaces per person. (S.D.=2.76) Among these lesions, 91 lesions were confined enamel caries and 40 lesions were dentinal caries. There is no significant dependence between the proximal caries prevalence neither on sides nor dental arches. ( $p>0.05$ ) To summarize, the percentage of individual with proximal caries of this group of patients is lower than previous studies. However, the average surfaces of proximal caries per person were not low. In addition, the distribution of caries showed 91 clinically undetected enamel caries. Therefore, it is recommended to have the bitewing radiograph and preventive dentistry for new orthodontic patients.

**Key words:** orthodontic treatment • prevalence rate • proximal caries • radiography

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## Introduction

Dental caries is one of the most common dental diseases. The cost of treatment increases dramatically from an incipient lesion to an exposed pulp. Early detection of caries helps reduce this expense. It also eases the treatment procedure and the dental visits significantly. While occlusal and smooth surface caries are easily detected and treated, proximal caries detection is more complicated.

Lith and his colleagues suggested that clinical examination under-detected proximal caries.<sup>(1)</sup> Therefore, bitewing radiography seems to be the practical way for proximal lesions detection.<sup>(2)</sup> However, the accuracy of this radiograph is skeptical. A false positive is not uncommon especially when the prevalence rate of caries is low.<sup>(3)</sup> Treatment options according to this diagnostic method are also confusing. When the outer wall of the enamel is violated and the cavity is formed, the treatment of choice is restoration. However, when the cavity is still confined to the enamel, treatment options are intriguing. Although, overtreatment by filling is recommended by some operators<sup>(4)</sup>, the remineralization process also provides a cheaper non-aggressive option. To arrest the caries process, extensive oral hygiene instruction, information about dietary habits and fluoride application should be designated. In addition, repeat bitewing radiography should be cautiously done. This process is made so that the carious lesion would be detected before reaching the inner half of the dentin.<sup>(5)</sup> While the radiographic guideline is recommended, the bitewing radiograph to detect the caries in the individual patient should be exercised circumspectly. Moles and Downer found that this guideline for the frequency of bitewing radiography is too permissive for dentists.<sup>(6)</sup> Individual intervals between repeat bitewing radiographs also are determined by the caries risk, in other words, prevalence rate of caries in the community.

In orthodontic extraction cases where removal of some permanent teeth is necessary, orthodontists have always been requested that a tooth with caries be removed instead of a sound one. However, removal of a defective tooth causes treatment time to be longer or treatment procedure to be more complicated in some cases. Therefore, it is of value to know whether proximal caries detected in the radiograph are true positive caries. As shown previously, preventive dentistry might arrest the caries process. On the other hand, the unwanted effect that may happen will be undetected proximal caries. Because only caries extending into dentin shows cavity formation clinically<sup>(2)</sup>, enamel caries is not detectable. This enamel caries, if left untreated may extend into the inner half of the dentin or pulpal

cavity during orthodontic treatment. Even worse, it may not be detected during orthodontic treatment if the teeth were banded. This scenario can be avoided by preventive dentistry. Otherwise, it may cause patient's disapproval especially in extraction cases. Ultimately, it is also the individual caries risk or the prevalence rate of caries in the community which determines the progression of caries and finally affects the decision of an orthodontist.

Hugoson and his colleagues investigated proximal caries in 1973, 1983 and 1993. In the age group of 30-year-olds, they reported the carious proximal surface of 1.7, 3.3 and 3.6 surfaces per person respectively.<sup>(7)</sup> While the authors reported that overall oral health improved greatly in this 30-year period study, proximal caries did not. Studies by Fosling et al. and Bjarnason and Grondahl investigated proximal caries in teenagers only.<sup>(8,9)</sup> While Fosling et al. showed that 69.3 per cent of individuals had proximal caries,<sup>(8)</sup> Bjarnason and Grondahl reported the higher percentage of 94 per cent.<sup>(9)</sup>

Although, the information of DMFT and DMFS are available in Thailand, there is poor correlation between occlusal surface caries and proximal caries.<sup>(9)</sup> In addition, proximal caries that confines to enamel cannot be detected clinically. While proximal caries information in Thailand is available mainly for Thai children, the prevalence rate of the proximal caries from bitewing radiographs in adults is lacking. Further, little is known about the site-distribution of the proximal caries in Thai. Furthermore, at present, there is no report evaluating the dependence of proximal caries prevalence on the sides and dental arches. Therefore, it is the aim of this study to report the prevalence rate and site-distribution of the proximal caries from the bitewing radiographs. The test whether the presence of the proximal caries was due to the dependence of two variables, sides and dental arches, will also be carried out.

## Material and method

The bitewing radiographs of 76 patients who were accepted in the Department of Hospital Dentistry, Mahidol University were analyzed. All patients were exposed to the bitewing radiography with Belmont Searcher model DX 068 dental X-ray machine, operating at 65 kV, 8 mA and 200 mm SSD (Takara Belmont, Japan). Kodak D-Speed films were used. (Carestream Health Inc., US) The films were developed manually as recommended by the company using Kodak developer and fixing solutions. (Carestream Health Malaysia Sdn. Bhd., Malaysia). The radiographs were read by six dental students who were trained

by one staff member of the Department of Hospital Dentistry (SM). All students had access to all films of a single patient at the time of the reading. Three light boxes with viewers providing a two-time magnification were used. All radiographic interpretations were reexamined by experienced staff members of the Department. At the time of radiography, all patients lived in Bangkok with a natural drinking water content of fluoride under 1 part per million.

The proximal surfaces were read from the mesial surface of the first permanent premolar to the distal surface of the second molar. There have been various categorizations reported in previous studies. This study

proposed a systematic and detailed categorization. The category for the reading was coded 0 when sound enamel is detected. It was coded E1 when the caries was confined to the outer third of the enamel. E2 stood for the enamel caries that extended more than one third but no more than two thirds of the enamel thickness. E stood for the enamel caries that extended more than two thirds of the enamel thickness. Likewise, dentin caries was coded in the same way except for the alphabet was changed to D. When the caries progressed into the pulpal cavity, it was designated as P. This categorization was summarized in Table 1.

**Table 1** The categorization of the severity of proximal caries and their code designation.

Code	Radiographic characteristics
0	Sound enamel
E1	Enamel caries confined to the outer third of the enamel thickness.
E2	Enamel caries extended more than one third but no more than two thirds of the enamel thickness.
E	Enamel caries extended more than two thirds of the enamel thickness.
D1	Dentin caries confined to the outer third of the dentin thickness.
D2	Dentin caries extended more than one third but no more than two thirds of the dentin thickness.
D	Dentin caries extended more than two thirds of the dentin thickness.
P	Dental caries exposed pulpal cavity.

## Results

Among seventy-six patients, twelve men and twenty-four women (36 patients) showed at least one surface of proximal caries. These consisted of 47.37 per cent of the overall patients. The average age of these patients was 29.19 years. (S.D. =10.14) The total number of teeth with proximal caries was 118. The total number of surfaces with caries was 131. The mean of carious surfaces was 3.64 surfaces per person. (S.D. =2.76) Three of these lesions exposed the pulpal cavity and required endodontic treatment. There were 49 and 42 surfaces of maxillary and mandibular enamel caries, respectively. There were 24 and 16 surfaces of maxillary and mandibular dentin caries, respectively. There was more proximal caries surfaces and teeth in the maxillary teeth than the mandibular teeth. The total number of enamel caries was 91 surfaces. The sum of the dentin caries of the maxillary and mandibular teeth was 40 surfaces. The site-distribution of the proximal

caries is shown in Tables 2 and 3, and Figure 1. For the maxillary arch, the most prevalent proximal caries were found on the first molar. By contrast, in the mandibular arch, proximal caries was most prevalent on the second premolar. The contingency table (Table 4) illustrates the sides (left or right) and dental arches (maxillary or mandibular arches) of the radiographic diagnosis of proximal caries by counting tooth surfaces. Table 5 is the similar contingency table, however, with the different unit count of number of tooth. To assess the dependence of the prevalence of the proximal caries on sides and dental arches, the Chi-square analysis was utilized. When the data from contingency table counted by surface of proximal caries (Table 4) were analyzed, no significant dependence was found on both factors, side and dental arch. ( $p > 0.05$ ). A similar Chi-square analysis was made on the contingency table counted by number of tooth (Table 5), and again no significant dependence was found ( $p > 0.05$ ).

**Table 2** The distribution of the proximal caries of the maxillary teeth. (Di:Distal, Me:Mesial)

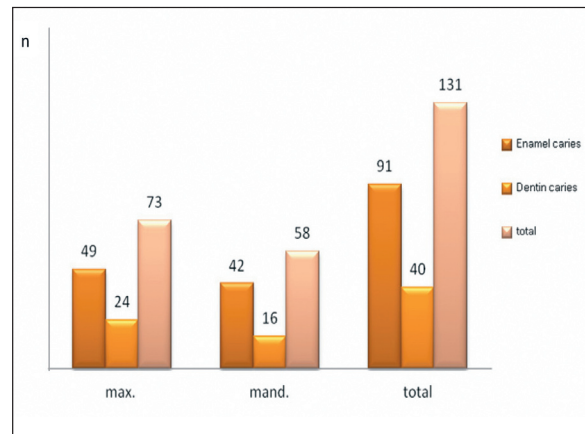
Tooth	17		16		15		14		24		25		26		27		Total
Surface	Di	Me	Di	Me	Di	Me	Di	Me	Di	Me	Di	Me	Di	Me	Di	Me	
Enamel caries	E2	E2	E1	E1	E2	E1	E1		E2	E1	E1	E1	E2	E1		E2	
		E2	E1	E2		E2	E2		E2			E2	E2	E1		E2	
			E2	E2		E2	E2		E2			E2	E2	E2		E2	
			E2	E2		E2	E2		E2			E2	E2	E2			
			E	E			E2					E2		E2			
							E2					E2		E2			
Dentin caries		D1	D1	D1	D	D2	D2		D1			D1	D1	D2		D2	
				D1		D			D1			D2	D1				
									D1			D2					
									D2			D2					
									D								
Exposed pulp					P						P						
					P												
Total (surfaces)	1	3	6	7	4	6	7	0	9	1	2	10	6	7	0	4	73
<b>Total (tooth)</b>	<b>3</b>		<b>11</b>		<b>9</b>		<b>7</b>		<b>10</b>		<b>11</b>		<b>12</b>		<b>4</b>		<b>67</b>

**Table 3** The distribution of the proximal caries of the mandibular teeth. (Di:Distal, Me:Mesial)

Tooth	37		36		35		34		44		45		46		47		Total
Surface	Di	Me	Di	Me	Di	Me	Di	Me	Di	Me	Di	Me	Di	Me	Di	Me	
Enamel caries		E2	E2	E2	E1	E1	E1		E1		E1	E1	E2	E2		E1	
		E2	E2		E1	E2			E2		E2	E2	E2	E2		E1	
		E2	E2		E2	E2			E2		E2	E2	E2			E2	
		E2	E2						E2		E2	E2				E2	
		E2									E2	E				E2	
																E2	
Dentin caries	D1		D1	D2	D	D1	D1		D1		D2		D		D2	D1	
			D	D	D						D						
					D												
Total (surfaces)	1	5	6	3	6	4	2	0	5	0	7	5	4	2	1	7	58
<b>Total (tooth)</b>	<b>6</b>		<b>8</b>		<b>9</b>		<b>2</b>		<b>5</b>		<b>8</b>		<b>5</b>		<b>8</b>		<b>51</b>

E1, Enamel caries confined to the outer third of the enamel thickness; E2, Enamel caries extended more than one third but no more than two thirds of the enamel thickness; E, Enamel caries extended more than two thirds of the enamel thickness; D1, Dentin caries confined to the outer third of the dentin thickness; D2, Dentin caries extended more than one third but no more than two thirds of the dentin thickness; D, Dentin caries extended more than two thirds of the dentin thickness; P, Dental caries exposed pulpal cavity.

**Fig. 1** The site-distribution of enamel and dentin caries surfaces (n) of maxillary (max.), mandibular (mand.) and both maxillary and mandibular teeth. (total)



**Table 4** The summary of the number of tooth surfaces with carious lesions, distributed by side and dental arch

Tooth Surface	Right side	Left side	Total
Maxillary tooth	34	39	73
Mandibular tooth	27	31	58
<b>Total</b>	<b>61</b>	<b>70</b>	<b>131</b>

**Table 5** The summary of the number of tooth with carious lesions, distributed by side and dental arch

Tooth	Right side	Left side	Total
Maxillary tooth	30	37	67
Mandibular tooth	25	26	51
<b>Total</b>	<b>55</b>	<b>63</b>	<b>118</b>

## Discussion

Site-distribution and prevalence rate of proximal caries help determine options of treatment for proximal carious lesions. Firstly, the result of this study could not detect the site-distribution dependence on sides or arches. Secondly, the prevalence rate may indicate the progression of dental caries. Therefore, it determines the interval between repeat bitewing radiography. Knowing the prevalence rate of the proximal caries may enhance clinicians' ability to accurately interpret and treat proximal caries. The result may be the reduction of the cost of the dental treatment. Orthodontic treatment that requires extraction of some teeth leaves no choices for other teeth to be extracted. Early accurate diagnosis of both incipient and advanced dental caries aids an orthodontist's decision concerning extraction or conservation of particular teeth.

The number of carious surfaces per person of this study is similar to a previous study of the same age range.<sup>(7)</sup>(3.60 surfaces/person compared with 3.64 surfaces/person in the present study) The percentage of the individuals with proximal caries in this study, however,

is much lower than previous studies. The percentage of the individuals with proximal caries in this study was only 47.37 per cent for patient with mean age of 29.19. Others reported the percentage of 69.3 and 94 per cent in teenager groups.<sup>(8,9)</sup> This may be due to the sample of this study. They are in different age group. This study also was carried out in the Faculty of Dentistry. All patients seek dental treatment which may indicate their attitude towards dental health and their dental health status. It may be because the patients of the Faculty of Dentistry clinic can be divided into two groups, one with rampant caries and another with good oral health. This may explain why the percentage of the individual with proximal caries is low; however, the mean number of carious surfaces per person is not low. They also have to pay the cost of dental treatment. Although, it is partly supported by the government, the patients still consider this relatively expensive. Their positive attitude of seeking dental treatment may explain the low prevalence rate group.

As mentioned before, only caries extending into dentin shows cavity formation clinically.<sup>(2)</sup> Due to the result of this study, it is quite clear that proximal bitew-

ing radiographs are required before orthodontic treatment commencement. Although the prevalence of the proximal caries is lower than that of other studies<sup>(8,9)</sup>, the enamel caries of 91 surfaces may be missed out if there are no bitewing radiographs.

The accuracy of proximal radiograph gives more of the false positive when the prevalence rate of caries is low.<sup>(3)</sup> Hence, it should be noted here that proximal bitewing radiographs should be interpreted cautiously. In case non-aggressive preventive dentistry is possible, repeat bitewing radiography should be done so that the carious lesion would be detected before reaching the inner half of the dentin. We still recommend that the interval between taking bitewing radiographs should be determined by the caries risk, individually.

To arrest the caries process, preventive dentistry is the best solution. Extensive oral hygiene instruction, information about dietary habits and fluoride application should be given to every patient. Moreover, it should be done especially for the patient with high caries risk.

## Conclusion

The percentage of individuals with proximal caries of this group of 30 years old patients from the Faculty of Dentistry, Mahidol University is lower than in previous studies. However, the average surfaces of proximal caries per person were not low. The distribution of the proximal caries from the bitewing radiographs showed that the clinically undetected proximal caries of 91 surfaces. Hence, bitewing radiography is still recommended as per caries risk. As mentioned before, these patients were clearly separated into two groups. Due to this dichotomy of two groups of patients, interpretation of the bite-wing radiograph is not difficult; however, it should be done with caution to prevent false negative results. This study consisted of a select sample and the sample size is quite small. This was a study of an older age group than the typical orthodontic patient, so the findings may not be directly applicable to younger age

groups. Future study will be required and expansion of the sample to increase both the sample size and age groups is certainly needed. Finally, it is still always recommended that preventive dentistry is the main key to good oral health of every patient.

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