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A survey on radiographic diagnosis and interpretation of proximal dental caries

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Abstract

Background: This survey addresses the awareness regarding the diagnosis and radiographic interpretation of proximal dental caries. Employing a Google Form questionnaire containing 15 inquiries, the study sought to capture varied opinions prevalent among practitioners. The survey was conducted over a period of two months, engaging 200 participants through social media platforms by sharing a generated link for the Google survey.

Aim: Aim of study is the assessment of radiographic diagnosis and interpretation of proximal dental caries by dental practitioners through a survey.

Materials and Methods: A survey of approximately 200 participants including dental students (UG, Interns, PG), general dentists (BDS), specialists in Conservative dentistry and Endodontics and specialists in other branches was under conduction using a questionnaire through electronic media concerning radiographic diagnosis of proximal dental caries and treatment planning.

Results: The study's focus encompassed understanding the comprehension of practitioners in acquainting various radiographic methods to diagnose proximal dental caries, emphasizing the significance of correct interpretation of the radiographs and ensuring efficient and standardized treatments.

Conclusion: Ultimately, the survey results are anticipated to provide valuable insights into the varied methodologies employed in detection of proximal dental caries, potentially paving the way for standardization or enhancement of diagnostic and treatment protocols.

Keywords: Proximal dental caries, bitewing radiography, cervical burnout

Introduction

One of the most prevalent chronic diseases worldwide is dental caries ^[1]. For each doctor, diagnosing an early case of incipient caries might be difficult because of the varying appearances. The decision might be compromised by the lesion's appearance. In ordinary clinical practice, the most popular adjunct approaches for identifying caries lesions are visual and radiographic evaluation ^[2]. Detection of caries lesions developed on proximal or occlusal surfaces may sometimes fail if it involves clinical examination only ^[1,3]. Among dental radiographic techniques, intraoral bitewings are more informative than Dental Panoramic Topography in revealing caries lesions located on proximal surfaces of premolars and molars ^[9, 10]. False-negative and false-positive errors during radiographic examinations due to variations in interpretation might complicate patient care and treatment decisions ^[5].

If it is assumed that, the presence of a cavity in the enamel surface necessitates the making of a restoration while the absence of a cavity makes it worthwhile to try preventive treatment, the diagnostic methods should be aimed at differentiating these two states ^[3].

The probability of presence of cavity at different depths of the radiographically observed lesions represent the positive predictive values when different radiographic criteria are used ^[3]. When it comes to dental caries detection and treatment, the interproximal tooth surface is regarded as a crucial and difficult location ^[4]. There is significant variance among practitioners regarding the criteria for when to intervene restoratively for interproximal caries, despite the fact that this topic has been extensively discussed. Since it might be challenging to visually inspect interproximal surfaces, radiography can help diagnose caries on these surfaces ^[5]. Accurate caries detection is crucial for treatment options, since inaccurate diagnosis can lead

to poor outcomes, especially for operational interventions [6]. The objectives of this study are (1) To evaluate the vigilance of dental practitioners for detection of early carious lesions in proximal areas. (2) to quantify the diagnostic techniques used by students and practitioner-investigators before they decide to treat primary caries lesions surgically. The survey aims to study the assessment of radiographic diagnosis and interpretation of proximal dental caries by dental practitioners.

Materials and Methods

A cross-sectional survey was involved in the study design which was conducted among practitioners to assess trends in evaluation of proximal caries via different radiographic techniques. The study was approved and ethical clearance was obtained from institutional ethical committee. The study population consists of general practitioners as well as specialists involved in endodontic practice and others. The sample size was derived based on convenience sampling, with a total of 200.

The study involved distributing a 16-question questionnaire to practitioners via Google Forms. Before use, the questionnaire was validated. Utilizing the Google survey, a link was shared with 200 participants through social media platforms over a span of two months. The responses gathered through this online survey method formed the basis for understanding the

various approaches and practices in recognizing proximal dental caries.

Informed consent was obtained from all participants before their involvement in the study. The inclusion criteria included practitioners actively involved in general dentistry and endodontic practice, while the exclusion criteria were not specified.

Through online survey method, the collected data were analyzed statistically to identify trends and practices related to evaluation, diagnosis and treatment planning of proximal dental caries.

Statistical analyses, including descriptive statistics, Chi-square tests, and logistic regression, were conducted. Using pie charts and frequency tables the results were presented to illustrate the findings comprehensively.

Results

The present survey link was shared among 200 participants, out of which 152 completed the survey, thereby achieving the response rate of 76%. This questionnaire was collectively divided and presented into 3 tables. Table -1 include the general information of participants like their qualification and their working experience (Question1 and 2). Table 2-3 encompasses responses to various questions regarding variations in their clinical knowledge, interpretation of radiographic findings followed by their respective treatment.

Table 1: General Information Questionnaire.

Demographics data	Responses number	Responses percentage
1. What is your qualification?		
Student (intern/post-graduate)	59	38.80%
General dental practitioner	42	26.90%
Specialist in Endodontics	19	12.50%
Specialist in other branch	43	21.7%
2. Working experience?		
Less than 5 years	99	65%
5 to 10 years	22	14%
10-15 years	09	6%
More than 15 years	22	15%

The data presented in the table shows the distribution of 152 respondents based on their designations in the dental field. The majority of respondents, 38.80%, were dental students, indicating that a significant portion of the survey participants were in training phase. Following this, 26.90% of respondents are general dentists, who have completed their dental education and are practicing in a general capacity. There are also specialists among the respondents, with 12.50% identified as specialists in Conservative Dentistry and Endodontics, and 21.70% as specialists in other branches of dentistry. This distribution reflects a diverse group of participants with varying levels of experience and areas of specialization within the dental profession.

The largest group, comprising 65% of respondents, has less than 5 years of work experience. This indicates a significant portion of the participants are relatively new to the profession, which aligns with the high percentage of dental students in the survey. Those with 5-10 years of experience make up 14% of the respondents, showing a smaller but notable group of mid-career professionals. The smallest group, 6% of respondents have 10-15 years of experience, representing those who are well-established in their careers. Additionally, 15%, consists of respondents with more than 15 years of experience, indicative of highly experienced professionals.

Following set of questions in table 2 were asked based on the images given in fig.1 (a) and (b).



Fig 1 (a): Do you see any carious lesion in the following clinical picture?



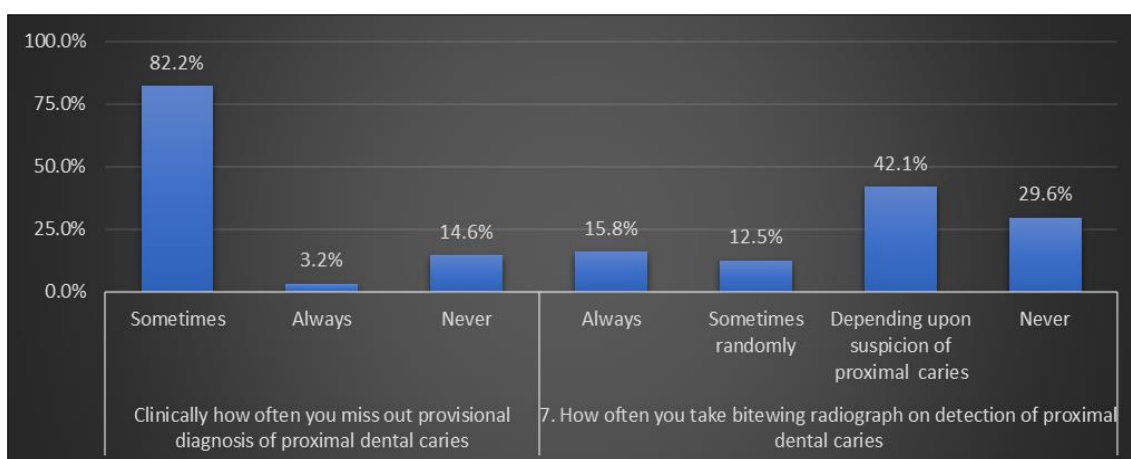
Fig 1(b): With respect to the clinical picture, which tooth do you think has a carious lesion?

Table 2: Responses of participants regarding identification of carious lesion in particular tooth (Questions 3 to 5).

	Responses number	Responses percentage
3. Do you see any carious lesion in the following clinical picture? [Fig.1(a)]		
Yes	76	50%
No	38	25%
Not sure	38	25%
4. With respect to the clinical picture, which tooth do you think has a carious lesion? [Fig.1(a)]		
Deciduous molar	69	45.3%
Permanent molar	29	19.1%
Both	54	35.6%
5. In relation to the previous clinical picture, do you find anything on below radiograph that shows a proximal dental caries? [Fig.1(b)]		
Yes	134	88.2%
No	7	4.6%
Not sure	11	7.2%

From the above table, for question 3 it is shown that a significant majority of 50% answered ‘Yes,’ indicating they did recognize the described carious lesion in the image provided. 25% of the respondents, answered ‘No’ and rest 25% were not sure indicating their confusion to recognize the lesion. For question 4 being in correlation to question 3, 45.3% of respondents found out deciduous molar as a carious

tooth. For 19.1% of respondents, it was permanent molar which was carious and 35.6% of respondents found caries in both the teeth. As per the survey question no.5, majority of respondents 88.2% found proximal dental caries in the provided radiographic image, 4.6% didn’t find and remaining 7.2% were not sure.



Graph 1: Clinically how often you miss out provisional diagnosis of proximal dental caries?

Table 3: (Questions 6 to 10)


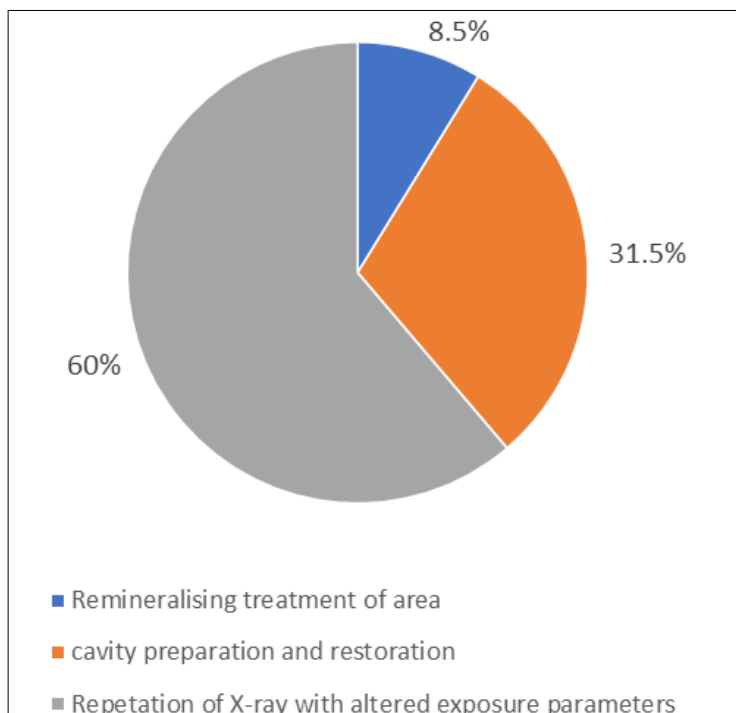
	Responses number	Responses percentage
6. Clinically how often you miss out provisional diagnosis of proximal dental caries? (Graph 1)		
Sometimes	125	82.2%
Always	5	3.2%
Never	22	7.2%
7. Which radiographic method you think is best for detecting the proximal dental caries?		
IOPA	36	23.7%
Bitewing	98	64.5%
OPG	0	0%
All	18	11.8%
8. Name the radiographic method given below.		
		
IOPA	9	5.9%
Bitewing	141	92.8%
OPG	2	1.3%
All	0	0%
9. How often you take bitewing radiograph on detection of proximal dental caries? (Graph 1)		
Always	24	15.8%
Sometimes randomly	19	12.5%
Depending upon suspicion of proximal caries	64	42.1%
Never	45	29.6%
10. If bitewing radiograph is best to detect proximal dental caries, what is the reason for not using it frequently, rather in every case?		
Not routine practice	57	37.5%
More radiation exposure	36	21%
No. of retakes	42	30%
Patients discomfort	92	60.5%

Table 4: (Questions 11 to 15)

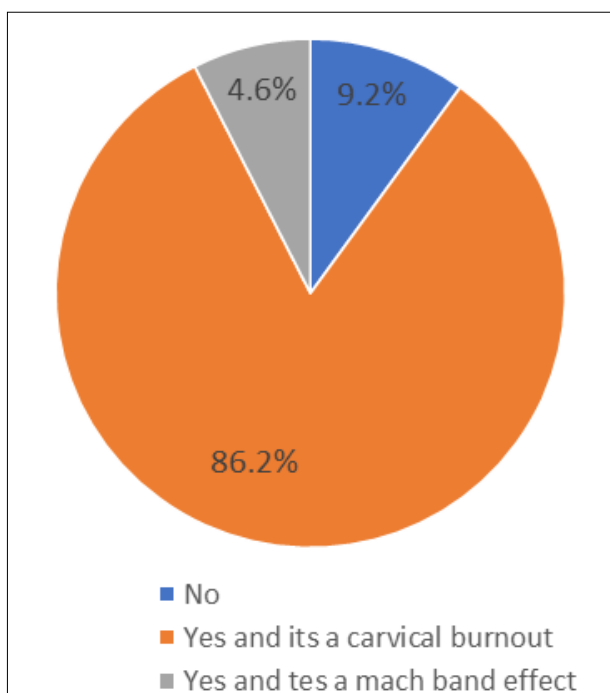
	Responses number	Responses percentage
11. With respect to tooth no. 35 in (Fig.1-c), what treatment would you like to perform? (Graph-2)		
Remineralising treatment on proximal area	13	8.5%
Cavity preparation and restoration	48	31.5%
Repetition of X-ray with altered exposure parameters	91	60%
12. By looking at the given X-ray (Fig.1-c), are you able to differentiate between a carious lesion and a radiographic error? If any, then what is it? (Graph-3)		
No	14	9.2%
Yes, it's a cervical burnout	131	86.2%
Yes, it's a Mach band effect	7	4.6%
13. How have you differentiated between proximal dental caries and a cervical burnout?		
Proximal caries found in area between contact point and free gingival margin	128	84.2%
Proximal caries close to contact point whereas cervical burnout close to crestal bone	48	31.5%
Proximal caries close to crestal bone whereas cervical burnout close to contact point	8	5.3%
14. Do you find the necessity to take bitewing radiograph more frequently to detect proximal dental caries in early stages? (Graph-4)		
Yes	118	77.6%
No	34	22.4%
15. From the above mentioned questions, do you feel the need to prefer bitewing radiographs for detection of early proximal caries that otherwise remains undetected? (Graph-5)		
Yes	134	88.2%
No	18	11.8%



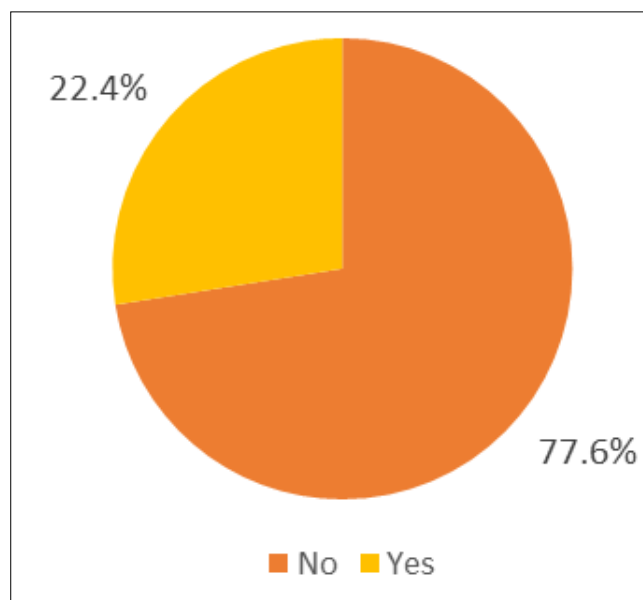
Graph 2: With respect to tooth no. 35, what treatment would you like to perform?

The data in the table outlines the preferred treatments for tooth number 35 among the 152 respondents in the survey. The majority, 60%, indicated a preference for repeating the X-ray with altered exposure parameters. This suggests that most respondents feel further diagnostic imaging is necessary to make an informed decision about the appropriate treatment. Another 31.5% of the respondents would opt for cavity preparation and restoration, indicating a significant portion believe that restorative intervention is required based on the current diagnostic information. Lastly, 8.50% of respondents prefer remineralising treatment for the area, suggesting a more conservative approach focused on enhancing the tooth's natural repair processes.

9.2% of the respondents answered "No," indicating they do not recognize the described phenomenon in the context provided. A significant majority, 86.2%, answered "Yes" and identified the issue as cervical burnout, which is a radiographic phenomenon where an area of decreased density appears near the neck of the tooth, often mistaken for decay. 4.6% of the respondents answered "Yes" and identified the issue as the 'Mach band effect,' an optical illusion that exaggerates the contrast between edges of slightly differing shades of grey, potentially leading to misinterpretation of radiographic images.



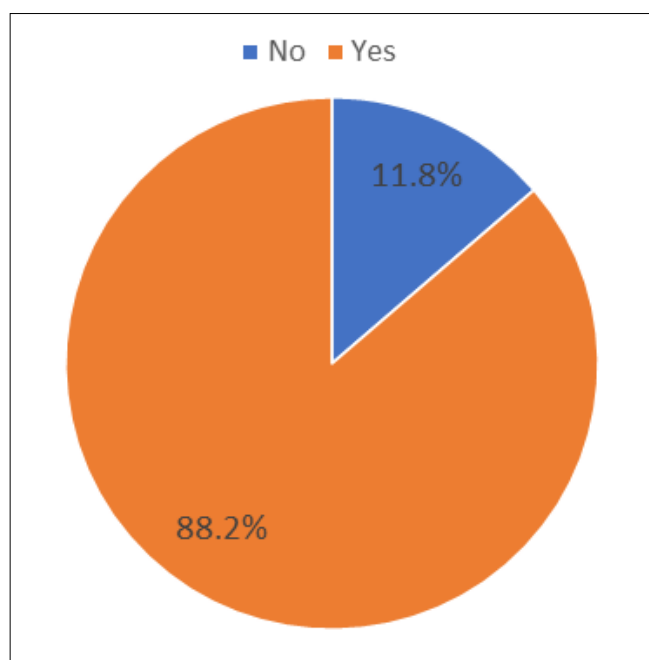
Graph 3: By looking at the given X-ray, are you able to differentiate between a carious lesion and a radiographic error? If any, then what is it?



Graph 4: Do you find the necessity to take bitewing radiograph more frequently to detect proximal dental caries in early stages?

The survey results indicate a predominant reluctance towards the frequent use of bitewing radiographs for detecting early-stage proximal dental caries, with 77.60% of respondents expressing a negative stance. This hesitance may stem from concerns over radiation exposure, cost-effectiveness, or the

perceived adequacy of alternative diagnostic methods. Conversely, 22.40% of respondents advocate for more frequent use, potentially driven by a desire for more accurate and timely detection of caries, which could lead to earlier intervention and reduced treatment complexity.



Graph 5: From the above mentioned questions, do you feel the need to prefer bitewing radiographs for detection of early proximal caries that otherwise remains undetected?

Significant majority, 88.20%, indicated "Yes," expressing a strong preference for using bitewing radiographs to identify early proximal caries. This suggests that most dental professionals and students recognize the importance of this diagnostic tool in providing a more thorough evaluation of dental health. In contrast, only 11.80% of respondents answered "No," indicating they do not see the necessity for preferring bitewing radiographs in detecting early proximal caries.

Discussion

The qualification of respondents was noted while carrying out the survey. The number of students (interns/post graduates) were 38.8%, general dental practitioner 26.9%, specialist in endodontics 12.5% and specialist in other branches 21.7% respectively. Further, working experiences were also noted. Respondents having working experience less than 5 years were 65%, 14% respondents having 5 to 10 years of experience, 6% respondents having 10-15 years of experience and 15% respondents having experience of more than 15 years. This data suggests that, most of the participants of this survey were young dental practitioners with a less amount of knowledge and experience about the simple looking but very important aspect of clinical diagnosis and radiographic interpretation of caries. It is substantial to know the essentials around the initial phase of learning dentistry.

As per the study there was substantial underestimation of the prevalence of proximal caries lesions, by clinical examination alone. In case of clinical examination, 50% of respondents detected proximal caries on deciduous molar. However, half of the respondents were unable to detect proximal dental caries lesions by clinical examination alone. Obviously, this has important implications for the measurement of dental disease.

Nearly, 42% of practitioners considers taking bitewing radiograph on detection of proximal dental caries depending upon suspicion of proximal caries and 30% never considered taking bitewing radiographs. The reason for not taking bitewing radiographs despite of knowing the fact that it's the best radiographic method for detection of proximal dental caries is the patient's discomfort as per 60.5% of respondents. On the other hand, majority (88.2%) finds the need to prefer bitewing radiographs for detection of early proximal caries that otherwise remains undetected. Adding bitewing radiography as an adjuvant to visual examination allows for more sensitive detection of proximal and occlusal caries lesions, providing a better estimation of lesion depth than visual inspection alone [7]. Moreover, it permits monitoring of the lesion's progress over time [7]. It has been demonstrated that radiographic caries detection exhibits lower sensitivity but higher specificity when identifying initial proximal caries lesions [8].

There are many different factors that can influence the ability to accurately detect these lesions and most crucial among all is the training and experience of the clinician [7].

Additionally, various morphologic phenomena, such as pits and fissures, cervical burnout, mach band effect, and dental anomalies, such as hypoplastic pits and concavities can mimic the appearance of a carious lesion [10].

Cervical burnout appears as a radiolucent band around the necks of teeth and is more pronounced at the proximal edges. The X-ray photons over penetrate or burn out the thinner tooth edge and create the radiolucent area that mimics cervical caries [9]. However, carious lesions involving proximal surfaces are most commonly found in the area between the contact point and the free gingival margin. Therefore, this type of lesion does not start below the gingival margin helps distinguish a carious lesion from cervical burnout [1, 10].

Mach band is visual phenomenon that occurs along the borders of structures with different radiographic densities. The common explanation of this phenomenon as lateral inhibition of neural receptors by adjacent receptors of retina [1, 11, 12]. In dentistry, mach band effects may present diagnostic dilemmas when they show fictitious radiolucent areas inside the proximal dentin enamel junction in incisors and canines, less frequently in premolars and to the least extent in molars [11, 12]. The mach band effect can be misinterpreted as caries and possibly lead to mistreatment. The perception of this effect is influenced by observers' experience [1].

Firstly, this study powered the importance of bitewing radiographs for the detection of proximal caries in clinical practice. Secondly, this study puts an emphasis on the clinical knowledge and diagnosis of proximal dental caries and radiographic knowledge about different techniques and errors.

Conclusion

In conclusion, several factors affect the ability to accurately diagnose the proximal carious lesions, especially when the lesions are limited to enamel. Even though bitewing projection is most useful radiographic technique to detect interproximal caries, it has some limitations such as radiographic visual illusions and in cases where the demineralized area is not yet visible in the image. Because, a proximal carious lesion can be incorrectly detected or failure to detect the lesion. Therefore, visual inspection should be combined with radiographic examination and clinician must be aware of the instances mimicking a proximal carious lesions to avoid unnecessary invasive treatment.

Conflict of Interest

Not available

Financial Support

Not available

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