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A Study on Dental Radiographic Interpretation Skills and Knowledge among Undergraduate Students

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Abstract: Introduction: Dental radiographs play a pivotal role in oral health diagnostics and treatment planning. Competency in interpreting these images is vital for dental undergraduate students to provide effective patient care. The aim of this study is to evaluate the existing levels of perceived confidence and actual skills in radiographic interpretation among dental undergraduate students, with the ultimate goal of identifying areas for improvement in dental education.

Methods: A cross-sectional study was conducted at a private dental college in Chennai, involving 101 dental undergraduate students. A structured questionnaire comprising 20 questions, divided into confidence and knowledge assessment sections, was administered to the participants. The data collected were analysed using statistical software.

Results: The majority of participants were female (71.3%) and in their early twenties (mean age 22.5 years). While 37.6% felt moderately comfortable identifying anatomical structures on radiographs, 45.5% expressed moderate confidence in diagnosing dental pathologies.

Conclusion: This study highlights the need for continuous improvement in dental education, specifically in radiographic interpretation. Discrepancies between perceived confidence and actual skills suggest the necessity for enhanced curriculum and standardized evaluation methods.

Keywords: dental radiographs, radiographic interpretation, dental education, confidence, knowledge, dental students.

I. INTRODUCTION

Dental radiographs, including intraoral and extraoral X-ray images, are indispensable tools in the field of dentistry, serving as an essential component of diagnostic and treatment planning processes.[1]Radiographs constitute a critical diagnostic tool in the field of dentistry, playing an essential role in the identification and treatment of a wide range of oral conditions. These images are instrumental in diagnosing dental caries, periodontal conditions, bone texture evaluations, post-periodontal surgery changes in bone length, and a spectrum of benign and malignant craniofacial anomalies. Dental students must become proficient in recognizing various radiographic projections and principles to ensure accurate diagnoses. Proficiency in radiographic interpretation serves as the cornerstone for effective diagnosis and treatment planning, not only enhancing diagnostic capabilities but also fortifying patient safety by reducing the risk of missed diagnoses or erroneous treatment decisions. As students strive to evaluate various pathologies and distinguish normal from pathological conditions, they must not merely rely on classroom lectures and demonstrations but delve deep into the fundamental knowledge of human anatomy, physiology, and pathologies, complemented by a thorough grasp of radiology principles. The accurate interpretation of dental radiographs is a fundamental skill for dental undergraduate students, as it directly impacts their ability to provide comprehensive oral health care and make informed clinical decisions. As part of their education and training, dental students must develop competence in interpreting dental radiographs to diagnose a wide range of oral conditions, from caries and periodontal diseases to impacted teeth and oral pathologies.[2] Proficiency in this skill not only enhances their diagnostic abilities but also contributes to patient safety by reducing the chances of missed diagnoses or incorrect treatment plans.[3] However, the acquisition of radiographic interpretation skills in dental education is a multifaceted challenge. Furthermore, the self-perceived confidence of dental students in their radiographic interpretation skills may not always align with their actual competence, which could lead to discrepancies in clinical practice.[4]

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The development of radiological interpretation skills follows a specific schedule outlined by the Dental Council of India, with training in various radiographic projections and diagnosis for dental diseases occurring during the third professional year. However, before embarking on clinical training in the final year and during internship, it is essential to possess the knowledge to differentiate normal structures from pathological ones. Previous studies have shown that freshly taught curriculum content tends to be better retained by students, while others have indicated that interpretation skills improve as clinical exposure increases. Thus, this study aims to assess the interpretation skills related to radiographic projections, principles, and pathologies by means of a questionnaire, comparing final year students with interns. This study aims to assess the knowledge and confidence levels of dental undergraduate students in interpreting dental radiographs. By examining the extent of their expertise, the study seeks to identify areas where educational interventions may be needed to bridge the gap between perceived confidence and actual radiographic interpretation skills. This research is essential for enhancing the education and training of dental students, ultimately contributing to improved patient care and the overall quality of dental practice.

II. MATERIALS AND METHODS

This research employed a cross-sectional research design to evaluate the competence and self-assurance of dental undergraduate students in the interpretation of dental radiographs. The study was conducted at a private dental college in Chennai, with the participation of dental students from different academic years. A structured questionnaire was developed to gather information regarding the students' aptitude and confidence in interpreting dental radiographs, alongside recording their demographic details. For evaluating confidence, five questions were utilized, and for assessing knowledge, 15 image-based questions were included in the questionnaire. The questionnaire underwent scrutiny and approval by the department of oral medicine and radiology within the private dental college. Additionally, the research received ethical clearance from the Institutional Review Board (IRB), and all participants provided informed consent, signifying their willingness to partake in the study, emphasizing the voluntary nature of their involvement. Throughout the study, participant anonymity and data confidentiality were strictly maintained, with no personally identifiable information collected. To gather data, the questionnaire was distributed via Google Forms through various social media platforms. A total of 101 dental students actively participated in this study. The collected data were coded and analysed using IBM SPSS Version 26 software. Descriptive statistics were calculated for demographic variables and the responses provided by the participants, including frequency, percentage, mean, and standard deviation. Statistical significance was assessed using Pearson's chi-square test. The statistical significance in the present study was kept at $p<0.05$.

III. RESULTS

A total of 101 undergraduate dental students took part in this study. The majority, 71.3%, were female, while 28.7% were male. On average, the participants were 22.5 years old, with the youngest being 20 and the oldest 27. In terms of their academic standing, 46.5% were in their house-surgeon (CRRI) year, 34.7% were fourth-year dental students, and the remaining 18.8% were in their third year.

When it came to their comfort level in identifying anatomical structures on dental radiographs, 37.6% were moderately comfortable, and 28.7% were somewhat comfortable. About 45.5% expressed moderate confidence in diagnosing dental pathologies from radiographic images, while 5% had no confidence at all. In their study habits, 57.4% occasionally referred to textbooks or reference materials when interpreting dental radiographs, while 55.4% occasionally practiced this skill outside of scheduled coursework or clinical rotations. Interestingly, 10.9% never practiced outside of their coursework. When faced with difficulties in interpreting dental radiographs, 74.3% typically sought help or clarification from faculty, and 64.4% referred to textbooks or online resources. Regarding their performance on image-based questions, 51.5% correctly identified the lateral fossa [image 1] in a maxillary anterior periapical radiograph, 68.3% identified the nasal septum [image 2], and 65.3% correctly identified gutta-percha [image 3] as the radiopaque structure.

Furthermore, 72.3% correctly identified dilacerations [image 4], 65.3% identified Dens Invaginatus,[image 5] and 63.5% named a given radiograph as a peri-apical radiograph. [Image 6] When it came to identifying anatomical features, 72.3% correctly identified the mental ridge, [image 7] while 43.6% correctly identified the mental foramen [image 8] and 40.6% confused it with a periapical cyst. A majority of 58.6% correctly identified a well-defined oval radiolucent lesion as a lateral periodontal cyst.[image 9] Only 35.6% correctly identified the cause of radiolucency as one of the three options: root fracture, periodontal pocket, or chronic periodontitis.[image 10] Additionally, 57.4% correctly identified a given radiograph as panoramic,[image 11] and 38.6% correctly identified errors in the radiograph as film bending and a rectangular BID cone cut.[image 12] Most impressively, 76.2% correctly identified the artifact in the radiograph as a cone cut,[image 13] and 70.3% correctly identified a large multi-locular lesion with a

honeycomb or soap bubble appearance as an ameloblastoma.[image 14] In terms of improving their skills in interpreting dental radiographs, 39% of the participants expressed a desire for more webinars, and 57% were interested in additional clinical training.

Table 1: Distribution of participants based on gender

Gender	%
Females	71.3%
Males	28.7%

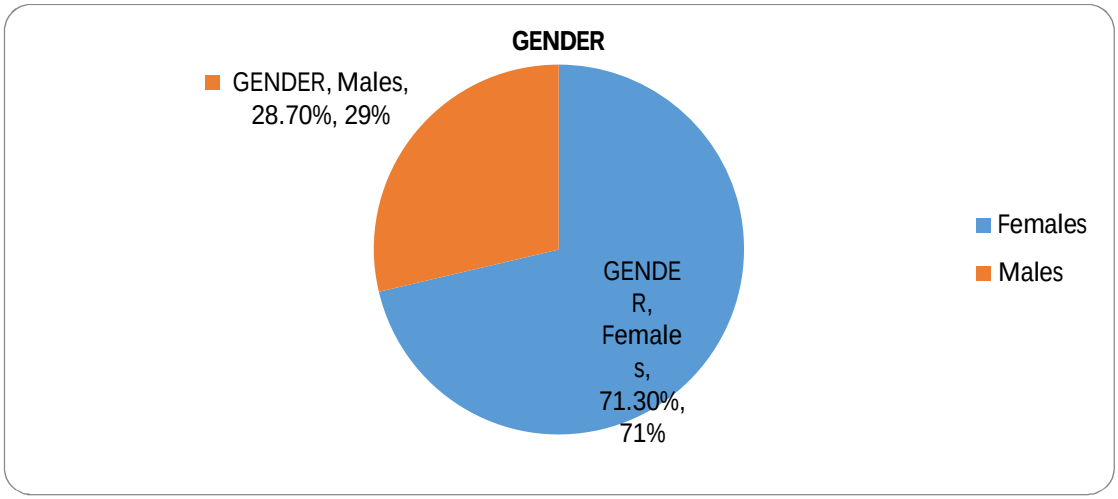


Figure 1

Table 2: Distribution of participants based on year of study

CRRI	46.50%
4TH YEAR	18.80%
3RD YEAR	34.70%

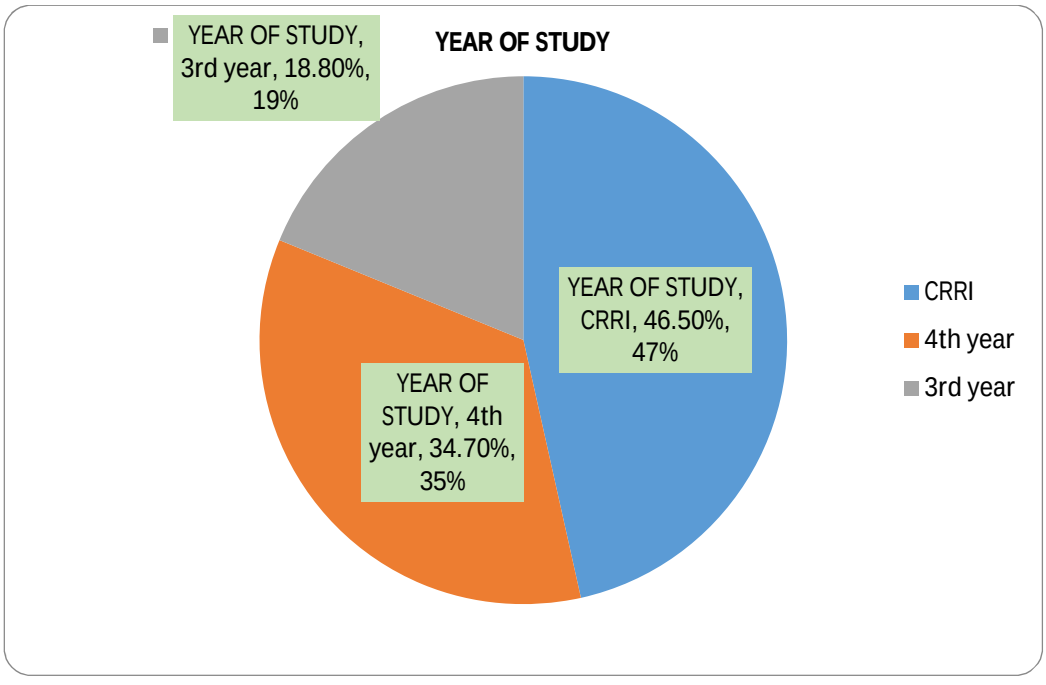


Figure 2

1) Q.1. How comfortable are you in identifying anatomical structures on dental radiographs (e.g., teeth, bone, roots)?

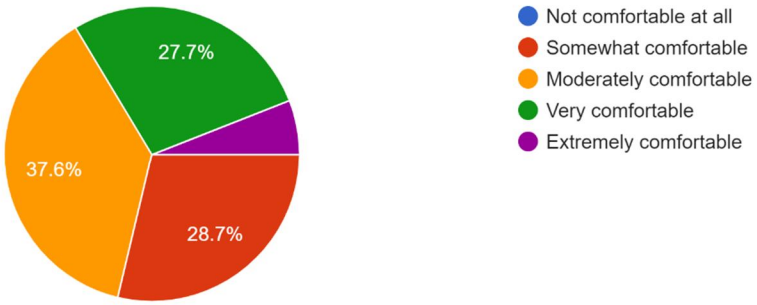


Figure 3.Pie chart representation of percentage distribution of response to question 1

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
How comfortable are you in identifying anatomical structures on dental radiographs (e.g., teeth, bone, roots)?	Not comfortable at all	0	0	62.24	<.0001	Statistically significant
	Somewhat comfortable	29	28.7			
	Moderately comfortable	38	37.6			
	Very comfortable	28	27.8			
	Extremely comfortable	6	5.9			

Table 3. Distribution of response to question 1

2) Q.2. Rate your confidence level in diagnosing dental pathologies (e.g., caries, periodontal disease) based on radiographic images.

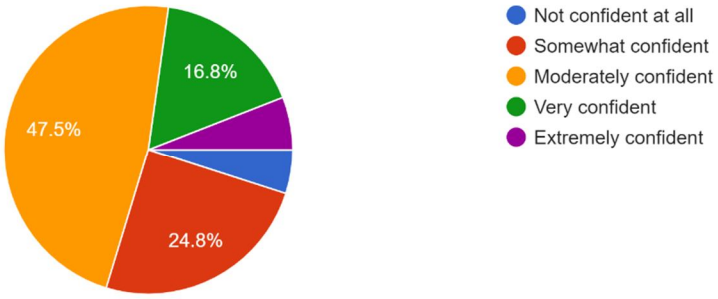


Figure 4. Pie chart representation of percentage distribution of response to question 2

Question	Options	[n] 101	[%]	Chi-square	p-value	Significance
Rate your confidence level in diagnosing dental pathologies (e.g., caries, periodontal disease) based on radiographic images	Not comfortable at all	5	5	62.24	<.0001	Statistically significant
	Somewhat comfortable	25	24.6			
	Moderately comfortable	48	47.5			
	Very comfortable	17	16.8			
	Extremely comfortable	6	5.9			

Table 4. Distribution of response to question 2

3) Q.3. How often do you refer to textbooks or reference materials when interpreting dental radiographs?

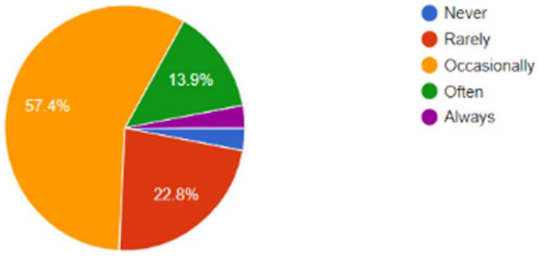


Figure 5. Pie chart representation of percentage distribution of response to question 3

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
How often do you refer to textbooks or reference materials when interpreting dental radiographs?	Never	3	3	62.24	<.0001	Statistically significant
	Rarely	23	22.8			
	Occasionally	58	57.4			
	Often	14	13.9			
	Always	3	2.9			

Table 5. Distribution of response to question 3

4) Q4. How frequently do you practice interpreting dental radiographs outside of scheduled coursework or clinical rotations?

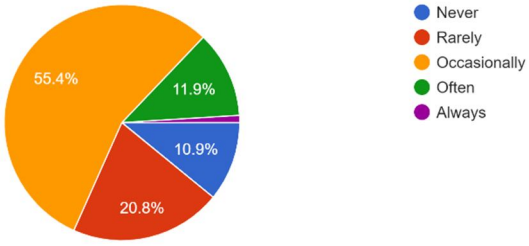


Figure 6. Pie chart representation of percentage distribution of response to question 4

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
How frequently do you practice interpreting dental radiographs outside of scheduled coursework or clinical rotations?	Never	11	10.9	62.24	<.0001	Statistically significant
	Rarely	21	20.8			
	Occasionally	56	55.4			
	Often	12	11.9			
	Always	1	1			

Table 6. Distribution of response to question 4

5) Q5. How do you typically seek help or clarification when racing difficulties in interpreting dental radiographs? (Select all that apply)

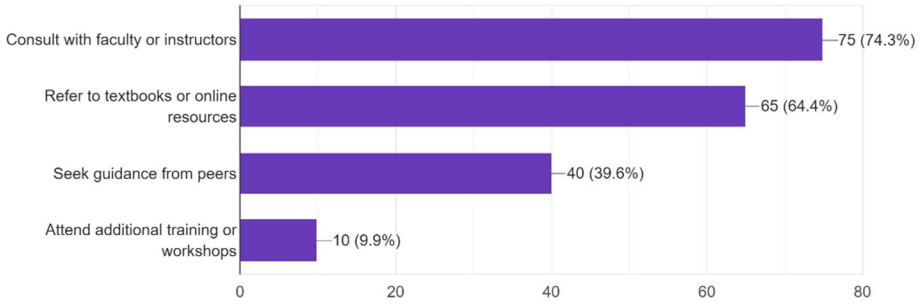


Figure 7: Pie chart representation of percentage distribution of response to question 5

Question	Options	[n] 101	Chi-square	p-value	Significance
How do you typically seek help or clarification when facing difficulties in interpreting dental radiographs?	Consult with faculty or instructors.	75	62.24	<.0001	Statistically significant
	Refer to textbooks or online resources	65			
	Seek guidance from peers	40			
	Attend additional training or workshops	10			

Table 7. Distribution of response to question 5

6) 6.Structure seen in maxillary anterior periapical radiograph.



Image1



Figure 8. Pie chart representation of percentage distribution of response to question 6

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
Structure seen in maxillary anterior periapical radiograph.	Lateral fossa	52	51.5	62.24	<.0001	Statistically significant
	Genial tubercles	15	14.9			
	Zygomatic arch/ zygomatic process of maxilla	7	6.9			
	Maxillary sinus	27	26.7			

Table 8. Distribution of response to question 6

7) 7. Which part is the arrow pointing to?

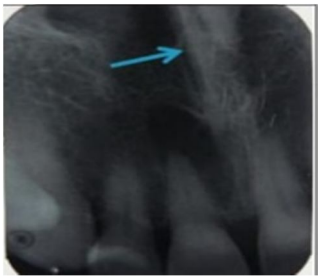


Image 2

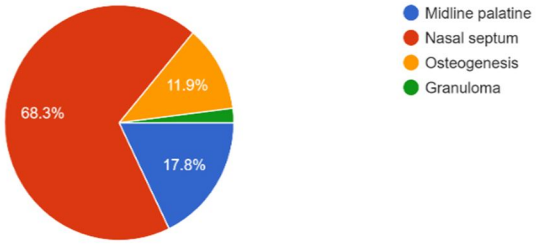


Figure 9. Pie chart representation of percentage distribution of response to question 7

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
Which part is the arrow pointing to?	Midline palatine	18	17.8	62.24	<.0001	Statistically significant
	Nasal septum	69	68.3			
	Osteogenesis	12	11.9			
	Granuloma	2	2			

Table 9. Distribution of response to question 7

8) 8. What is the radiopaque line, the arrow is pointing at?



Image3

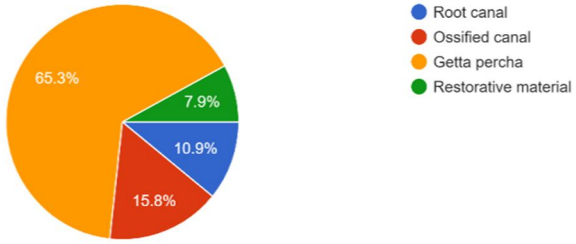


Figure 10. Pie chart representation of percentage distribution of response to question 8

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
What is the radiopaque line, the arrow is pointing at?	Root canal	11	10.9	62.24	<.0001	Statistically significant
	Ossified canal	16	15.8			
	Gettapercha	66	65.4			
	Restorative material	8	7.9			

Table 10. Distribution of response to question 8

9) 9. Select the most appropriate term for the anomaly associated with the 1st (most mesial) molar



Image4

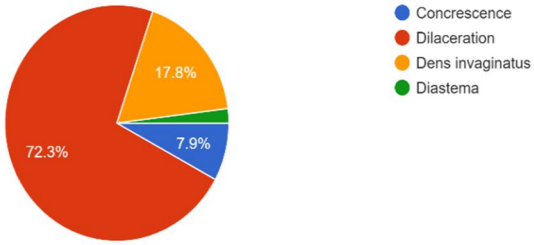


Figure 11. Pie chart representation of percentage distribution of response to question 9

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
Select the most appropriate term for the anomaly associated with the 1st (most mesial) molar	Concrescence	8	7.9	62.24	<.0001	Statistically significant
	Dilaceration	73	72.3			
	Dens invaginatus	18	17.8			
	Diastema	2	2			

Table 11. Distribution of response to question 9

10) 10. The rare development anomaly shown in radiograph is called:

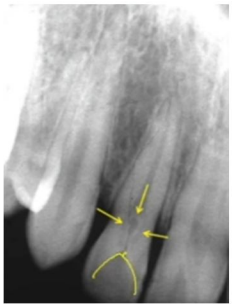


Image 5

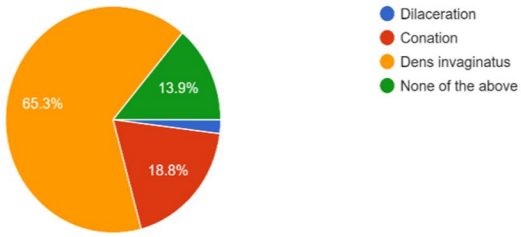


Figure 12. Pie chart representation of percentage distribution of response to question 10

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
The rare development anomaly shown in radiograph is called:	Dilaceration	2	2	62.24	<.0001	Statistically significant
	Conation	19	18.8			
	Dens invaginatus	66	65.3			
	None of the above	14	13.9			

Table 12. Distribution of response to question 10

11) 11. Name the following intraoral radiograph:



Image 6

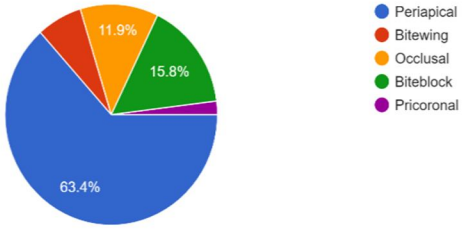


Figure 13. Pie chart representation of percentage distribution of response to question 11

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
Name the following intraoral radiograph:	Periapical Bitewing Occlusal Biteblock Pricoronal	64 16 12 7 2	63.4 6.9 11.9 15.8 2	65.98	<.0001	Statistically significant

Table 13. Distribution of response to question 11

12) 12. Identify the arrow pointed landmark in the above radiograph



Image 7

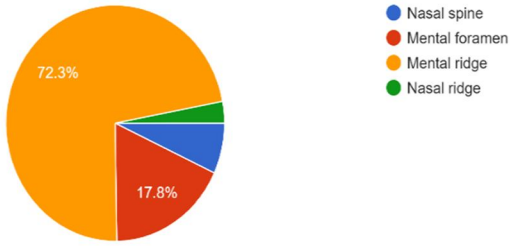


Figure 14. Pie chart representation of percentage distribution of response to question 12

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
Identify the arrow pointed landmark in the above radiograph	Nasal spine Mental foramen Mental ridge Nasal ridge	7 18 73 3	6.9 17.8 72.4 2.9	73.45	<.0001	Statistically significant

Table 14. Distribution of response to question 12

13) 13. The 2nd premolar is vital and asymptomatic, and the patient is a black female. Identify the radiolucency to which the arrow is pointing.



Image 8

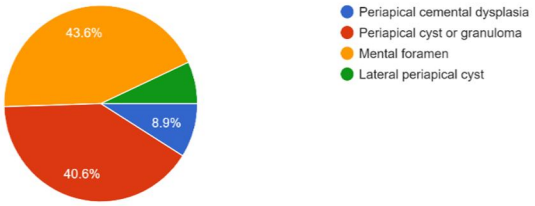


Figure 15. Pie chart representation of percentage distribution of response to question 13

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
The 2nd premolar is vital and asymptomatic, and the patient is a black female. Identify the radiolucency to which the arrow is pointing.	Periapical cemental dysplasia	9	8.9	52.35	<.0001	Statistically significant
	Periapical cyst or granuloma	41	40.6			
	Mental foramen	44	43.6			
	Lateral periapical cyst	7	6.9			

Table 15. Distribution of response to question 13.

14) 14. What is this well-defined oval radiolucent lesion likely to be?

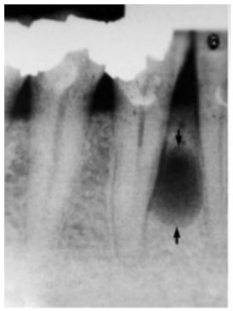


Image 9

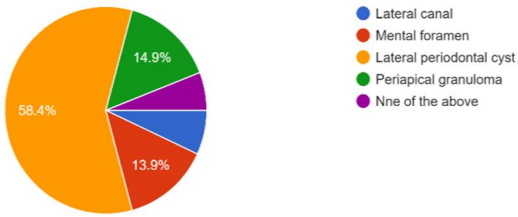


Figure 16. Pie chart representation of percentage distribution of response to question 14

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
What is this well-defined oval radiolucent lesion likely to be?	Lateral canal	7	6.9	56.76	<.0001	Statistically significant
	Mental foramen	14	13.9			
	Lateral periodontal cyst	59	58.4			
	Periapical granuloma	15	14.9			
	None of the above	6	5.9			

Table 16. Distribution of response to question 14

15) 15. What is the best answer to describe the cause of the appearance of the mesially to LL6?



Image 10

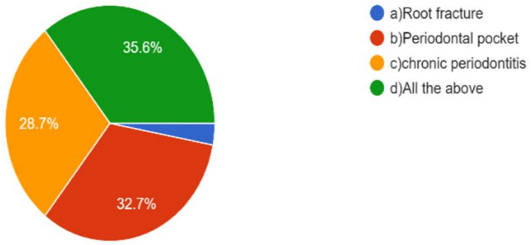


Figure 17. Pie chart representation of percentage distribution of response to question 15

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
What is the best answer to describe the cause of the appearance of the mesially to LL6?	Root fracture	3	3	60.54	<.0001	Statistically significant
	Periodontal pocket	33	32.7			
	chronic periodontitis	29	28.7			
	All the above	36	35.6			

Table 17. Distribution of response to question 1

16) 16. The radiograph shown is:

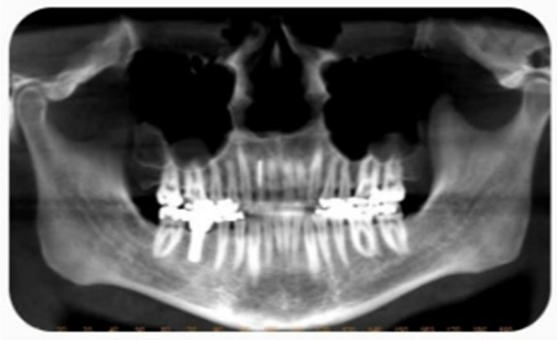


Image 11

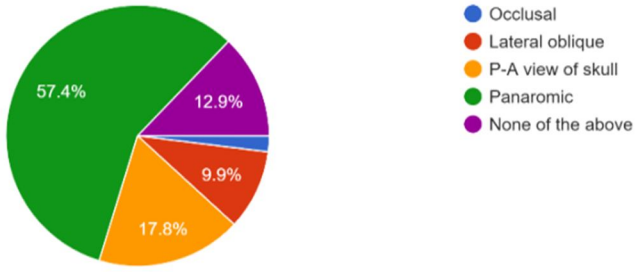


Figure 18. Pie chart representation of percentage distribution of response to question 16

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
The radiograph shown is:	Occlusal	2	2	58.75	<.0001	Statistically significant
	Lateral oblique	10	9.9			
	P-A view of skull	18	17.8			
	Panaromic	58	57.4			
	None of the above	13	12.9			

Table 18. Distribution of response to question 16

17) 17. Identify the errors in radiograph

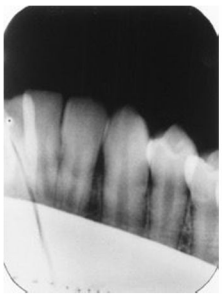


Image12

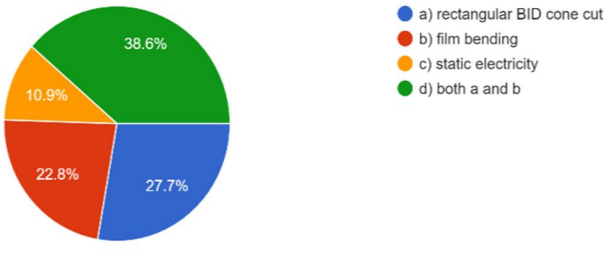


Figure 19. Pie chart representation of percentage distribution of response to question 17

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
Identify the errors in radiograph	rectangular BID cone cut film bending static electricity both a and b	28 23 11 39	27.7 22.8 10.9 38.6	46.73	<.0001	Statistically significant

Table 19. Distribution of response to question 17

18) 18. The given radiograph shows which of the following radiograph



Image13

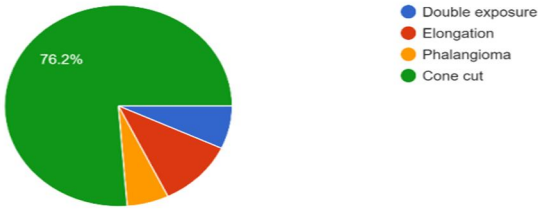


Figure 20. Pie chart representation of percentage distribution of response to question 18

Question	**Options**	**[n] 101**	**[%] 100**	**Chi-square**	**p-value**	**Significance**
The given radiograph shows which of the following radiograph	Double exposure Elongation Phalangioma Conecut	7 11 6 77	6.9 10.9 5.9 76.3	74.38	<.0001	Statistically significant

Table 20. Distribution of response to question 18

19. What is this large, multiloclular lesion that has a honeycomb/soap bubble appearance likely to be? It is a firm, painless lesion that can be very aggressive. It is more frequent in the mandible.

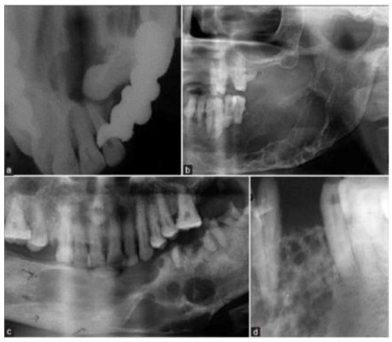


Image14

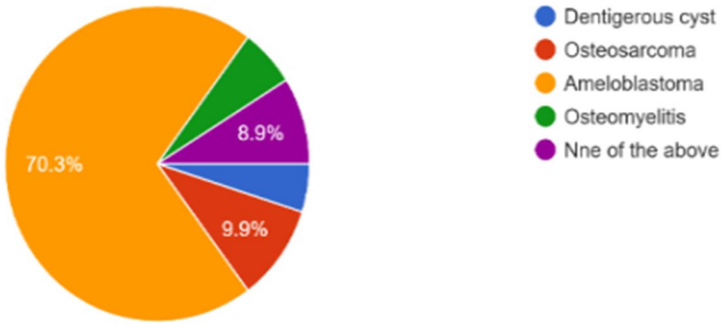


Figure 21. Pie chart representation of percentage distribution of response to question 19

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
What is this large, multiloclular lesion that has a honeycomb/soap bubble appearance likely to be? It is a firm, painless lesion that can be very aggressive. It is more frequent in the mandible.	Dentigerous cyst	5	5	68.72	<.0001	Statistically significant
	Osteosarcoma	10	9.9			
	Ameloblastoma	71	70.3			
	Osteomyelitis	6	6			
	None of the above	9	8.8			

Table 21. Distribution of response to question 19

19) 20 In your opinion, do you feel the need for more webinars or additional clinical training to enhance your skills in the interpretation of dental radiographs?



Figure 22. Pie chart representation of percentage distribution of response to question 20.

Question	Options	[n] 101	[%] 100	Chi-square	p-value	Significance
In your opinion, do you feel the need for more webinars or additional clinical training to enhance your skills in the interpretation of dental radiographs?	Yes, I would benefit from more webinars.	39	38.9	65.23	<.0001	Statistically significant
	Yes, I would benefit from additional clinical training.	57	56.2			
	No, I currently feel adequately trained in dental radiography interpretation.	5	4.9			

Table 22. Distribution of response to question 2

IV. DISCUSSION

The primary aim of this study is to comprehensively assess and understand the variations in comfort, confidence, study habits, and proficiency levels among dental undergraduate students in radiographic interpretation. With these insights, the study aims to inform the development and implementation of targeted educational interventions, encompassing enhanced curriculum design, additional clinical training, and the creation of online resources like webinars. By addressing these disparities, the overarching goal is to improve the radiographic interpretation skills of dental students, ensuring they are well-equipped to provide high-quality oral health care in their future professional practice. A notable proportion of students reported being moderately comfortable identifying anatomical structures and moderately confident in diagnosing dental pathologies from radiographs. However, a small percentage expressed a lack of confidence, emphasizing the need for targeted educational interventions. Study habits were also diverse, with a significant number of students occasionally referring to textbooks or reference materials when interpreting dental radiographs. Interestingly, a portion of students did not practice outside of scheduled coursework. This highlights the importance of encouraging regular practice and self-directed learning in radiographic interpretation. When faced with difficulties in interpreting dental radiographs, a substantial majority of students sought help from faculty or referred to textbooks and online resources. This proactive approach to addressing challenges is commendable and indicative of a desire to improve their skills.[5]The study assessed the students' ability to identify various radiographic features, and the results showed varying levels of success. While some students correctly identified certain structures, there were instances where confusion or incorrect identifications occurred. In SomayyehAzimi's research, it was found that the participants demonstrated a commendable level of knowledge, with 70% displaying acceptable understanding of the characteristics of radiographic images pertaining to bony lesions in the jaw.[6] In our own study, a similarly high percentage of 70.3% accurately identified the presence of ameloblastoma from a radiograph, indicating a substantial level of proficiency in recognizing specific pathological conditions in dental radiographs among our participants. In our study, 43.6% of participants accurately identified the mental foramen. In contrast, a study conducted by AsaadJavaidMirza et al found that a lower percentage, specifically 27%, correctly recognized the mental foramen.[7]Conversely, a comparable study conducted with dental undergraduate students in Saudi Arabia, specifically at Qassim University, indicated that the students who participated in that study exhibited stronger performance in identifying radiographic landmarks associated with the anatomy of the head and neck when compared to our study.[4] These findings underscore the need for targeted training in specific areas of radiographic interpretation. Notably, a significant proportion of students expressed interest in enhancing their radiographic interpretation skills. A substantial percentage indicated a desire for webinars, suggesting an appetite for online learning resources. The majority of students in our study expressed a strong interest in additional clinical training, which emphasizes the potential benefits of hands-on experience and mentorship in enhancing their radiographic interpretation skills. This aligns with the findings of Lanning et al., who demonstrated that the implementation of targeted training programs could significantly increase awareness of radiographic interpretation by up to 72%.[8] Furthermore, their research also highlighted that effective follow-up instructions and well-designed training initiatives had the capacity to substantially improve knowledge levels in radiographic interpretation, achieving an improvement of up to 85%.[9] This convergence of our study's findings with Lanning et al.'s research suggests that focused training and mentorship opportunities could be a promising approach to address the existing disparities in radiographic interpretation skills among dental students. The findings indicate variations in confidence, study habits, and performance on image-based questions. To address these disparities, it is imperative for dental education programs to consider targeted interventions, such as improved curriculum design, additional clinical training, and the development of online resources like webinars. By addressing these areas, dental colleges can better prepare their students for the challenges of radiographic interpretation and ultimately ensure that they are well-equipped to provide quality oral health care in their future professional endeavors.[10]

V. CONCLUSION

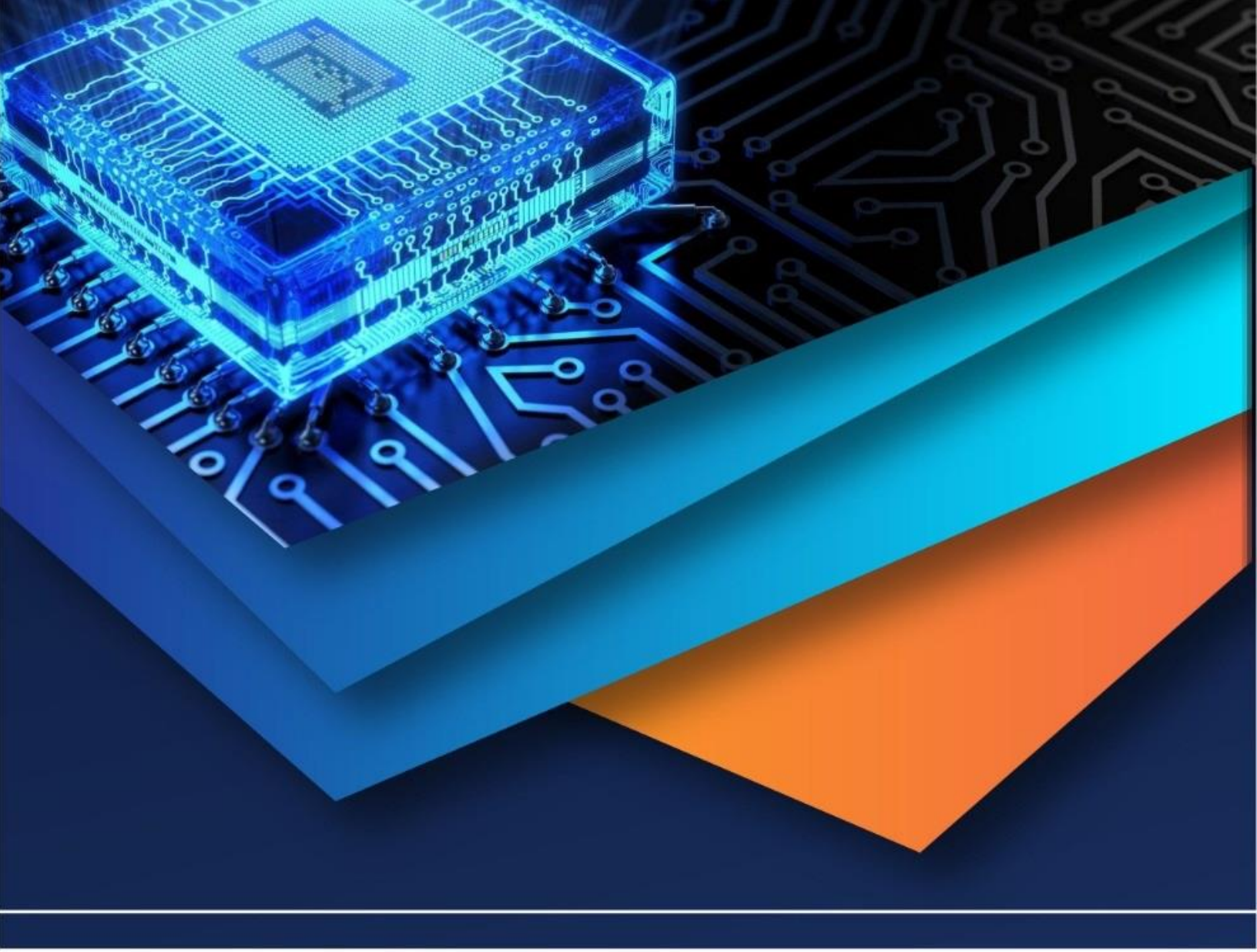
In summary, this research underscores the significance of ongoing enhancements in dental education, with a specific focus on the domain of radiographic interpretation. It highlights the need for rectifying these discrepancies to provide dental institutions with the means to better prepare their students, ensuring the delivery of top-tier patient care and enriching their impact on the field of dentistry. This study lays the groundwork for future progress in dental education, paving the way for the creation of more potent training initiatives aimed at strengthening the radiographic interpretation abilities of dental undergraduate students.

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