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PATTERN OF FINDINGS IN DENTAL RADIOGRAPHS AT A TERTIARY HOSPITAL IN GHANA

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Abstract

Background: Dental radiographs are crucial for the diagnosis of oral diseases. This study investigates patterns in dental radiographs to enhance diagnostic precision.

Materials and methods: A cross-sectional study was carried out in a tertiary hospital in Ghana, examining 301 dental radiographs of patients between the ages of 5 and 60 years. Participants were selected purposively from individuals requiring dental treatment. The study predominantly used patients undertaking orthopantomograms (OPG) and periapical (PA) radiographs. SPSS version 25 was used to analyse data with descriptive and inferential statistical analysis (chi-square, Cramer's V).

Results: Caries and radiolucencies were the most common findings (47.2%, n=142), followed by miscellaneous anomalies (22.6%, n=68) and bone loss (11.0%, n=33). Most common radiographs taken was OPGs (78.7%, n=237). This was used in detecting a wide spectrum of conditions. Dental caries was the most common pathology: 18-41 year group being most affected (52.8%, n=75/142). There was a significant association between radiographic and clinical findings (chi-square=172.837, p<0.001; Cramer's V=0.309).

Conclusion: Dental radiographs, particularly OPGs, are essential for the diagnosis of prevalent conditions like caries and for facilitating comprehensive oral health assessments. Their diagnostic precision is underlined by the high radiographic-clinical correlation.

Implications for practice: Routine use of OPGs in dental practice can facilitate early detection and management of oral pathology, particularly caries, to achieve improved patient outcomes in radiography practice.

Keywords: Dental radiographs, findings, panoramic, bitewing, oral health

INTRODUCTION

Dental radiography is the use of radiation to provide images of the teeth and associated structures. It includes images of teeth, bones of the face and surrounding soft tissues.[1] Dental radiography is essential in modern dental practice, providing crucial information about oral structures and pathologies not visible during clinical examination. Dental radiographs can be intra-oral or extra-oral. Intra-oral radiographs are performed with the x-ray film placed within the mouth of a patient; the x-ray film is outside the mouth for extra-oral imaging. Common examples of intra-oral radiography include bitewing, periapical and occlusal; examples of extra-oral examinations include panoramic, oblique lateral and cephalometry.[2] Intra-oral and extra-oral radiographs are commonly used techniques, offering insights into tooth roots, nerves, and underlying bone structures.[2,3] These imaging modalities, which use electromagnetic radiation to penetrate soft tissues and form intricate representations of oral anatomy, are essential to the diagnosis of several pathologies, ranging from dental caries and periodontal disease to jaw abnormalities.[3,4] Dental radiograph interpretation is crucial for diagnosis, but it faces several challenges. These include variations in image quality, anatomical complexities, and inconsistent presentations of oral pathology.[5,6] Such difficulties would create inconsistency in radiographic pattern detection, potentially causing delays or diagnostic mistakes with adverse implications for patient care.[7]

Research highlights that discrepancies among dental professionals in radiographic interpretation often stem from subjective assessments, compounded by the lack of standardised protocols and comprehensive reference materials.[8,9] These gaps underscore the need for studies that systematically analyse radiographic findings to improve diagnostic accuracy and inform clinical practice. In Ghana, where oral health issues like dental caries remain prevalent due to limited access to preventive care and varying oral hygiene practices,[10] understanding radiographic patterns is particularly crucial for enhancing patient outcomes. There is paucity of literature on the prevalence of patterns of anomalies observed in dental radiography in Ghana.

This study investigated the prevalent patterns and anomalies observed in dental radiographs at a major tertiary centre in Accra, Ghana. By examining a cross-sectional sample of 301 radiographs from patients aged 5-60 years, it aimed to identify common findings, assess their distribution across age groups, and evaluate their correlation with clinical observations. The findings of this study should help in understanding the patterns of findings in dental radiographs which may improve the management of patients.

METHODOLOGY

A cross-sectional study was conducted at a major referral centre in Accra, Ghana, with advanced dental imaging capabilities. Participants (n=301, aged 5-60 years) were purposively sampled from patients requiring dental radiographs between April - June, 2024. Inclusion criteria were patients undergoing routine or diagnostic radiography. Exclusions were those under 5 or over 60, pregnant individuals, or those who did not consent.

Data were collected using digital orthopantomograms (OPGs) and periapical (PA) X-ray machines. A senior oral pathologist recorded findings on a standardised checklist, categorizing them (e.g., caries, bone loss). Demographic details (age, gender) were obtained from the patients. Ethical approval was obtained from the hospital's Institutional Review Board (KBTH-ADM/00059/2024), with informed consent secured from participants or guardians for minors. Data were anonymised using serial numbers and stored securely.

The analysis utilised SPSS version 25, generating descriptive statistics (frequencies, percentages), and inferential tests (chi-square for distribution, Cramer's V for association). Findings were compared across age groups (5-17, 18-41, 42-60) and correlated with clinical observations.

RESULTS

• Demographic information

The study included 301 participants. The demographic specifics collected were primarily age, gender, level of education attained and occupation. Table 1 provides further demographic details. Most participants were in the 18-41 age group (51.8%, n=156), while those aged 5-17 years were the lowest (15.3%, n=46). Educationally, most participants had tertiary education (41.9%, n=126), followed by basic education (28.2%, n=85) and secondary education (25.6%, n=77).

• Patterns observed in dental radiographs

The analysis of 301 dental radiographs revealed different types and findings, as shown in Figures 1 and 2. Figure 1 shows the types of radiographs taken and their frequency. Figure 2 shows the radiographic findings made. The distribution of radiograph types showed OPGs as the most common, (78.74%/(237 OPGs), and bitewing radiographs, the least common (1.33%/4 bitewing radiographs). Caries and radiolucencies were the most common findings, 47.18% (observed 142 times) and retained roots were the least common finding, 2.99% (observed 9 times). Table 2. shows a cross-tabulation of radiography types and their corresponding findings. Bitewing radiographs exclusively showed caries and radiolucencies (n=4). Cone beam CT identified only masses and lesions (n=5). OPGs detected a wide range of conditions, including bone loss (n=33), caries and radiolucencies (n=109), fractures (n=18), impactions (n=16), masses and lesions (n=7), retained roots (n=9) and miscellaneous findings (n=45). The latter are abnormal or notable observations on the radiographs that do not fit into a specific, common category, or are considered less significant than other findings but still warrant mention.

Table 1. Demographic information

Age Groups	**Frequency**	**%**
5-17	46	15.3
18-41	156	51.8
42-60	99	32.9
Occupational Categories	**Frequency**	**%**
Students And Non-Working	86	28.6
Business And Trade	64	21.3
Administration And Management	25	8.3
Miscellaneous	25	8.3
Artisans And Technical Work	23	7.6
Other	22	7.3
Healthcare	22	7.3
Transportation And Mechanics	13	4.3
Religious Service	6	2
Education	6	2
Fashion And Beauty Industry	6	2
Law Enforcement	3	1
Education	**Frequency**	**%**
Tertiary	126	41.9
Secondary	77	25.6
Basic	85	28.2
No Education	12	4
Not Schooling	1	0.3

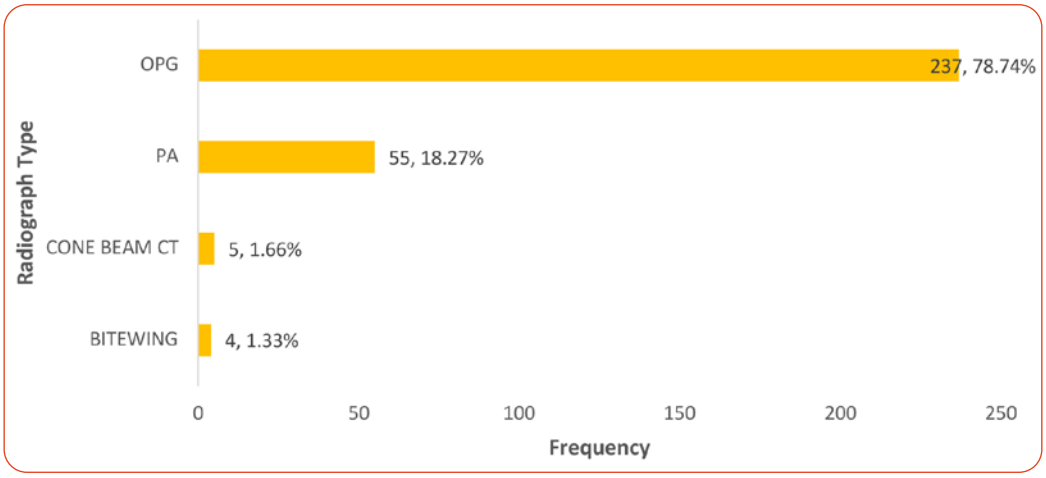

Figure 1. Distribution of the types of radiographs used.

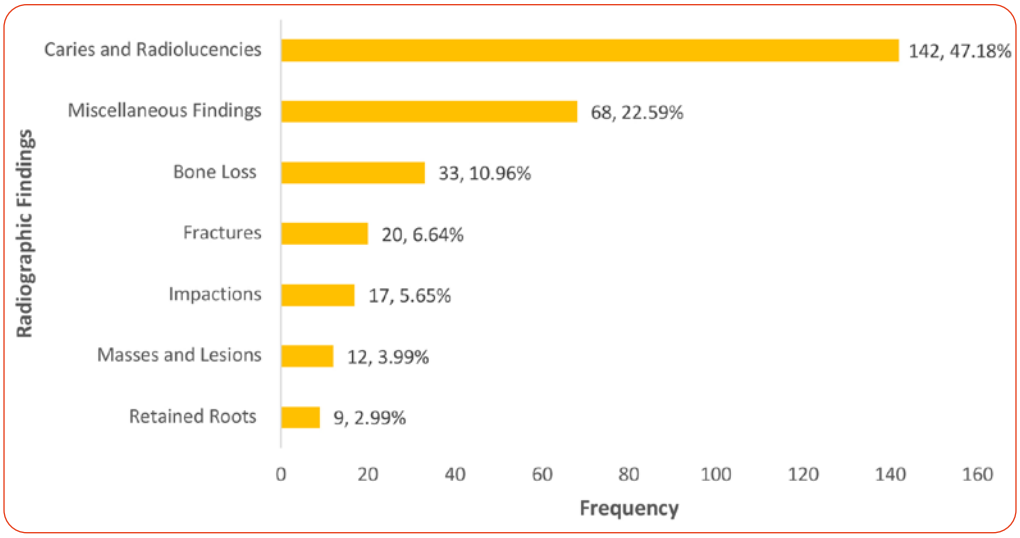

Figure 2. Distribution of radiographic findings.

• Common patterns of findings on dental radiographs across different age groups

The findings across age groups indicating caries and radiolucencies were observed 12 times for the 5-17 age group; miscellaneous findings were noted 13 times. In the 18-41 age group, caries and radiolucencies were most prevalent (n=75), followed by miscellaneous findings (n=34) and bone loss (n=18). Table 3 provides further details on age-group and radiographic findings. The chi-square test indicated no statistically significant differences in the distribution of findings across age groups: (χ^2 (12) = 14.34, p=0.28).

• Association between x-ray findings and provisional clinical observations

The distribution of radiographic findings by clinical observations is shown in Table 4. Caries and radiolucencies were predominantly associated with caries and dental decay (n=58) and miscellaneous findings (n=48). Bone loss was linked with miscellaneous findings (n=15) and gingival and periodontal issues (n=5). Fractures correlated with miscellaneous findings (n=12) and tooth mobility and fractures (n=8). Retained roots were exclusively associated with miscellaneous findings (n=9). The chi-square test showed a significant association between radiographic findings and provisional clinical observations (χ^2 (36) = 172.837, p<0.001), with Cramer's V indicating a moderate association strength (0.309).

DISCUSSION

The predominance of participants in the 18-41 age group (51.8%) is consistent with literature showing this demographic is more likely to seek dental care due to heightened awareness and practices of self-care.[11] The significant proportion of non-working individuals and students (28.6%) suggests socioeconomic factors play a crucial role in access to dental care, aligning with studies indicating that unemployed individuals often have unmet dental needs.[12] The high level of participants with tertiary level education (41.9%) may correlate with better oral health knowledge

Table 2. Radiograph type vs radiographic findings cross-tabulation

Radiograph Type	Bitewing	Cone Beam CT	OPG	PA
Bone loss	0	0	33	0
Caries and radiolucencies	4	0	109	29
Fractures	0	0	18	2
Impactions	0	0	16	1
Masses and lesions	0	5	7	0
Miscellaneous findings	0	0	45	23
Retained roots	0	0	9	0

Table 3. Age group vs radiographic findings cross-tabulation

Age Group	5-17	18-41	42-60
Bone loss	2	18	13
Caries and radiolucencies	12	75	55
Fractures	5	9	6
Impactions	4	9	4
Masses and lesions	0	7	5
Miscellaneous findings	13	34	21
Retained roots	1	6	2

Table 4. Radiographic findings vs clinical findings cross-tabulation

Radiographic Findings Category	Bone Loss	Caries & Radiolucencies	Fractures	Impactions	Masses & Lesions	Miscellaneous Findings	Retained Roots
Caries and dental decay	0	58	0	1	0	4	0
Gingival and periodontal issues	5	10	0	0	0	5	0
Miscellaneous findings	15	48	12	16	6	39	9
Missing teeth	7	1	0	0	4	12	0
Oral hygiene and gingivitis	0	2	0	0	2	0	0
Root and pulp issues	2	13	0	0	0	2	0
Tooth mobility and fractures	4	10	8	0	0	6	0

and practices, as education level is a strong predictor of oral health literacy.[13,14] The higher the level of education the more likely it is to have better knowledge of oral health.

Our study established OPGs as the most frequently used imaging modality which aligns with literature where it is argued that OPGs utility in providing comprehensive views of the entire dental structure, is crucial for detecting a wide range of conditions.[1,15] It is therefore expected that its usage will be common given its ability to detect multiple dental pathologies. The most common pathologies were caries and radiolucencies. This finding is in keeping with research highlighting dental caries as a widespread issue, especially in populations with varying oral hygiene practices.[16,17] A high prevalence of dental caries was found in this study in individuals aged 40 years and older, in keeping with previous studies.[16,17] The study found bitewing radiographs were used in very few instances, which is due to its specificity in detecting caries. This aligns with Petty and Ellwood who argue that bitewing radiographs were mainly used to capture interproximal surfaces of teeth, commonly affected by caries.[8] Cone beam CT CBCT) was used for identifying masses and lesions which is reflective of its advanced imaging capabilities. This aligns with literature stating that CBCT possesses advanced imaging capabilities providing detailed three-dimensional views necessary for complex diagnostic cases, hence its usage in identifying masses and lesions.[9,18] The significant findings of miscellaneous anomalies (accidental findings) underscore the need for comprehensive diagnostic tools, as these often include a range of conditions from developmental anomalies to inflammatory diseases, necessitating varied imaging approaches as supported by literature.[7]

The high prevalence of caries and radiolucencies within age groups 18-41 aligns with global trends highlighting dental

caries as a significant health concern, especially in children and adults.[16,19] The combination of high caries and radiolucencies and substantial miscellaneous findings within this age group suggests a broader range of dental health issues, potentially impacted by lifestyle choices like food and dental hygiene. This is consistent with literature.[20] The occurrence of bone loss in this group also indicates early signs of periodontal disease, which can progress if not addressed promptly.[21] The presence of caries in the 5-17 age group emphasises the need for enhanced pediatric dental care and preventive measures, as untreated caries can lead to more severe dental and systemic health issues.[22]

The 42-60 age group showed a notable amount of bone loss reflecting the increased risk of periodontal disease with age.[23] This group's dental radiographs also revealed retained roots and fractures which could be associated with ageing and the cumulative effects of long-term dental wear and tear. The chi-square test's lack of statistical significance ($p=0.279$) suggests that while age influences the type and frequency of dental issues, other factors such as socioeconomic status, access to dental care, and individual health behaviours might play more critical roles than age.[24]

The high correlation between radiographic caries and radiolucencies with clinical caries and dental decay is in keeping with literature emphasising the reliability of radiographs in detecting dental caries.[17,25,26] This underscores the importance of regular radiographic examinations for early caries detection and intervention. Bone loss association with gingival and periodontal issues highlights the critical role of radiographs in diagnosing periodontal diseases, with studies showing bone loss as a key indicator of periodontal involvement.[21,27] This suggests that integrating radiographic and clinical evaluations may improve periodontal disease management. Fracture correlation with tooth mobility and miscellaneous findings indicates the complexity of diagnosing dental fractures, where radiographs are vital for detecting issues not immediately apparent clinically, with respect to research advocating advanced imaging like CBCT.[9] The predominance of miscellaneous findings in both radiographic and clinical categories; for example, 39 cases with miscellaneous radiographic findings reflects the diverse nature of dental anomalies, including developmental and positional issues, emphasising the need for thorough radiographic evaluations in orthodontic planning.[7,28] The significant chi-square value (172.837, $p<0.001$) and moderate Cramer's V (0.309) imply a notable correlation, though other factors also influence clinical outcomes.

CONCLUSION

This study underscores the diagnostic value of dental radiographs, in the diagnosis of oral states of disease. Caries and radiolucencies were the most common pathologies identified and occurred among the 18-41 years age group. Since OPGs were the most frequently used imaging technique, adequately diagnosing diverse conditions, it is recommended that they are routinely used. High radiographic-clinical correlation testifies to their diagnostic consistency. Recommendations include incorporation of OPGs into regular practice with training, and acquisition of modern digital panoramic radiography equipment which provides image quality, reduced radiation dose and ensures alignment with current diagnostic workflow.

LIMITATIONS

Time constraints within this study prevented analysis of other types of radiographs and limited generalisability. Socioeconomic factors and long-term preventive outcomes must be examined in subsequent studies to enhance strategy refinement, a foundation for improved oral health care in Ghana. The study is a single centre study limiting generalisability.

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ETHICS AND DECLARATIONS

Ethical approval was obtained from the Institutional Review Board (IRB) at the Korle-Bu Teaching Hospital (reference number: KBTH-ADM/00059/2024),). The IRB thoroughly reviewed the study to ensure compliance with institutional policies and ethical standards, addressing and resolving any ethical concerns raised. The study was examined by the IRB to make sure it complied with institutional policies and procedures and was ethical. The IRBs resolved any ethical issues that were raised. Written informed consent was obtained for anonymised patient information to be published in this article.

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Conflict of interest statement

The authors declares that there are no conflicts of interest.

Availability of data

Data required for this study may be made available by the authors upon reasonable request.

Generative AI use

Not Used.

Author contributions

I.F.B, J. M, W. A.R: Conceptualisation, Methodology, Software
I.F.B, J. M, W. A.R: Data curation, Writing – Original Draft preparation
I.F.B, J. M, W. A.R: Visualisation, Investigation
I.F.B : Supervision
I.F.B, J. M, W. A.R: Software, Validation
I.F.B, J. M, W. A.R: Writing- Reviewing and Editing

DISCLAIMER

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the views of the publisher and editorial board.

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