Keywords
Pediatric dentistry, Panoramic radiography, Dental diseases, Early diagnosis, Preventive care

Authors
Hend Ahmed Alfadhli*

*BDS,MSD,CCPD,PhD Assistant Professor in Paediatric Dentistry, Basic and Preventive Sciences Department (DBSD), aediatric Dentistry, Batterjee Medical College, Jeddah
Orid ID: 0009-0006-4601-5365
hend.alfadhli@bmc.edu.sa

Received-16-05-2026
Revised-20-06-2026
Accepted-23-06-2026
Doi:10.1922/ejprd.v34i4s.1471

European Journal of Prosthodontics and Restorative Dentistry (2026) 34(4s), 400-408

Radiographic Assessment of Dental Diseases in Pediatric Dentistry: Applications for Early Diagnosis and Preventive Care

Abstract
Dental diseases are among the most common chronic conditions affecting children, making early diagnosis essential for preventing disease progression and preserving oral health. Panoramic radiography provides comprehensive visualization of the developing dentition and serves as an important diagnostic tool for identifying dental abnormalities that may not be evident during routine clinical examination. This study evaluated the radiographic characteristics and distribution of dental diseases in pediatric panoramic radiographs and examined the role of radiographic assessment in supporting early diagnosis and preventive care. A retrospective observational study was conducted using a publicly available dataset comprising 73 pediatric panoramic radiographs (49 training and 24 testing images) with corresponding YOLO annotation files. Radiographic lesions were analyzed according to lesion frequency, anatomical distribution, and lesion burden per radiograph using Python-based statistical analysis. A total of 314 annotated dental lesions were identified, with a mean lesion burden of 4.30 ± 3.34 lesions per radiograph. Lesion counts ranged from 1 to 16, and approximately 65% of all annotated lesions were in the mandibular regions. The findings demonstrate that panoramic radiography is an effective modality for detecting multiple dental abnormalities and facilitating comprehensive radiographic assessment in pediatric patients. Furthermore, standardized annotated radiographic datasets provide a valuable foundation for the development of artificial intelligence-assisted diagnostic systems, supporting earlier diagnosis, preventive interventions, and evidence-based clinical decision-making in pediatric dentistry.

1. Introduction

Oral health is an integral part of children's health, and oral diseases, including dental caries, developmental anomalies, eruption disturbances and periapical pathologies, are among the most prevalent chronic diseases in children globally. When undetected, these conditions can cause problems with chewing, speech development and the growth of the face, as well as risk of pain, infection, and early tooth loss, and affect quality of life. It is therefore important to identify such pathological changes early on so that interventions could be started at the right time and the disease could be prevented from progressing further. This has been a major shift in preventive dentistry in recent years, focusing on personalised diagnostic approaches to detect dental lesions at an early stage before irreversible structural changes occur, to promote long-term oral health outcomes (Abdelaziz, 2023; Cameron & Widmer, 2021).

The use of radiographic imaging has become an invaluable diagnostic resource in the practice of pediatric dentistry as many dental disease processes can only be properly diagnosed with the aid of such imaging. The panoramic view is great for examining both the maxillary and mandibular arches and can give the clinician a view of tooth development and eruption patterns, carious lesions, periapical pathology, impacted teeth, and developmental abnormalities in one view. Panoramic imaging provides a wider field of view than multiple intraoral radiographs and may be quite helpful in young children who are not cooperative for multiple intraoral imaging. The importance of panoramic radiography in diagnosing oral diseases is well established and has become an integral part of comprehensive dental assessment in children (Al Domyati et al., 2024; Aps, 2020; Alzaqy et al., 2024).

Although very useful, prescription and interpretation of pediatric dental radiographs must be done with prudence. Based on evidence, guidelines suggest radiographic exams be justified to consider the child's clinical condition, developmental stage, and potential diagnostic benefit while reducing unnecessary radiation exposure. The selection of the appropriate radiograph aids in an accurate diagnosis, effective treatment planning and optimal patient safety. In addition, systematic reviews have shown that radiographs significantly improve the diagnosis of proximal caries, developmental abnormalities, and occult lesions which can only be diagnosed with the aid of radiographs. For this reason, it is important to follow standardized radiographic procedures, which is considered as the necessary part of modern pedodontics (Benyekhlef, 2025; Kühnisch et al., 2020).

Dental caries, one of the different conditions examined radiographically, is the most common disease in children, and still constitutes a high public health burden. Radiographic assessment has been used to complement clinical examination which can help improve the detection of early enamel and dentinal lesions, assess the depth of the lesions, evaluate periapical involvement and help identify the progression of the disease (Dayo et al., 2021). Panoramic radiographs are also useful for the diagnosis and treatment planning of a complete evaluation of caries detection, supernumerary teeth, missing teeth, cystic lesions and eruption abnormalities in mixed dentition. Thus, the incorporation of radiographic findings in the routine checkup examinations of pediatric patients has gained increasing significance in the field of preventing the diseases and managing them over a long period of time (Jayaraman et al., 2021; Shukla et al., 2021).

Digital imaging technologies are increasingly being developed and are also improving the nature of radiographic interpretation in pedodontics in terms of accuracy and efficiency. Digital radiography enhances the quality of the image and allows for image enhancement and standardisation of archival of diagnostic records (Arizos et al., 2022; Vishwanathaiah et al., 2023). At the same time, the growing awareness of radiation protection has driven the adoption of optimized exposure techniques which aim to maximize diagnostic value while minimizing radiation exposure. Educational programs of parents/carers have also had a positive impact on the acceptance of clinically indicated x-ray and highlighted the role of radiography as a prevention tool in paediatric dentistry (Schüler et al., 2023; Sreenivasan et al., 2022).

Artificial intelligence (AI), in recent years, has garnered interest to help in the understanding of the radiograph, with automated detection of abnormalities and increased accuracy in diagnosis. While AI-driven diagnostic tools are still in their early stages of development, they hold promise in improving early detection of dental conditions, clinical decision-making, and preventive strategies in pediatric dental radiography. Thus, the current study is focused on the distribution of dental diseases in an annotated set of panoramic radiographs, and panoramic imaging in pediatric dental prevention and early diagnosis.

Research objectives:

1. To evaluate the radiographic characteristics and distribution of dental diseases using pediatric panoramic radiographs.
2. To assess the diagnostic value of panoramic radiography for the early detection of dental abnormalities in pediatric patients.
3. To examine the potential contribution of radiographic assessment to preventive care and clinical decision-making in pediatric dentistry.

2. Materials and Methods

2.1 Study Design

A retrospective observational design was used to assess dental disease radiographic features in paediatric population using a publicly available annotated panoramic radiographic database. The investigation aimed to determine the radiographic features of frequently occurring paediatric dental diseases and the significance of these features in the early detection and prevention of dental disease in children. The study did not involve recruitment of patients or treatment of any patients, but rather anonymous secondary data.

2.2 Dataset Description

The radiographic data set consisted of 73 paediatric panoramic dental radiographs that were downloaded from a publicly available repository (Makhdoom, 2024). The images were saved as Portable Network Graphics (PNG) images with a fixed resolution of 2000 × 942 pixels. The dataset consisted of 49 training images and 24 testing images along with the annotation files in the YOLO text format. Such annotations identified radiographically detectable dental lesions within the images to enable systematic assessment of the location and distribution of these lesions. Only paediatric panoramic radiographs were included in the dataset and hence the dataset was suitable for investigating the use of radiographs in paediatric dentistry.

2.3 Image Acquisition and Dataset Preparation

All panoramic radiographs were analysed at their original image resolution to avoid information loss and to maintain anatomic detail. The image quality was judged visually to make sure it was in focus and that there was contrast and good visibility of the dental structures. For each of the corresponding annotation files, the completeness and consistency of the annotation with the corresponding X-ray was verified. The predefined training and testing subsets were used to organize images and annotation files without any changes in the original data set. Images that were severely corrupted on the radiograph or not fully annotated were not analysed but all images in the final dataset adhered to the predetermined quality criteria.

2.4 Radiographic Assessment Procedure

The panoramic radiographs were individually reviewed using annotations for the presence of radiographic dental disease. The item assessed was the occurrence of radiographically observable lesions in the dentition and their anatomical location and distribution. Lesions detected on panoramic images were assessed based on appearance, localization and clinical relevance for paediatric oral health. Radiographic changes that might aid in the early detection of pathological changes prior to the onset of advanced clinical symptoms were discussed. Common patterns of disease seen in the data set were also illustrated by representative radiographs.

2.5 Variables Evaluated

The main variables examined were presence or absence of dental lesions visualized radiographically, total occurrence of lesions, distribution of lesions in the jaws and presence of lesions on separate radiographs. Information on the image characteristics was also recorded including resolution and whether the images were annotated. Descriptive evaluation was conducted to describe the disease patterns radiographically and to determine findings of interest for paediatric dental disease prevention. These variables presented a general scope of the diagnostic information that could be gathered from panoramic radiography to be used in everyday clinical evaluation.

2.6 Outcome Measures

The main outcome index was the number of dental lesions per panoramic radiograph detected by their paediatric dentist. Secondary outcomes were lesion distribution by anatomical site, rate of radiographs with detectable abnormalities and the role of panoramic imaging in identifying lesions. The results were read under the light of the prevention of dental interventions, early diagnosis and better treatment planning of children.

2.7 Statistical Analysis

The statistical analysis was done in Python (version 3.11). Pandas was used for data management and preprocessing, and NumPy for numerical computations. The characteristics of the radiographic data were summarized by descriptive statistics, categorical variables by frequencies and percentages, and continuous variables, if applicable, by mean ± standard deviation (SD). The Chi-square test was used to examine associations between categorical variables, and the independent-samples t-test was used to test between-group differences. Pearson's correlation coefficient was used to explore the association between lesion frequency and the radiographic findings, and simple linear regression analysis was used to evaluate the predictive association between lesion frequency and the radiographic disease burden. The SciPy and Statsmodels libraries were used for statistical analyses. All analyses were performed with a two-tailed p value set at < 0.05 for significance.

2.8 Ethical Considerations

A publicly available, anonymized dataset of panoramic radiographs of children was retrieved from an open access repository for this study. The dataset contained no personally identifiable information, patient demographics, or protected health information, thereby ensuring complete confidentiality and privacy. Given that the study involved secondary analysis of anonymized publicly available data, and that no patients were involved in the study, informed consent and institutional ethical approval were not required as per the normal requirements for research using publicly available anonymized data. The study was performed according to the principles of the Declaration of Helsinki, and all data were used only for academic and research purposes without altering the integrity of the original data set.

3. Results

3.1 Characteristics of the Pediatric Panoramic Radiographic Dataset

A total of 73 panoramic images of children were included in the present study, with 49 (67.1%) training images and 24 (32.9%) testing images. All of the radiographs had an associated annotation file, with a 100% image–label matching rate. Training subset included 206 annotated dental lesions, testing subset included 108 annotated lesions, resulting in a total of 314 potential radiographically identified lesions. The training and testing sets had similar proportions of lesions with mean lesion counts of 4.20 ± 3.56 and 4.50 ± 2.89 lesions per radiograph, respectively. The mean size of the image file was about 0.96–0.97 MB, which is a proof of the uniformity of the image quality throughout the data set. Examples of the panoramic images from the training set and test set are shown in Figure 1, and the general features of the data set are given in Table 1. Moreover, the percentage of radiographs in the training and test sets is shown in Figure 2.

ejprd.org- Published by Riset Publishing Services LLC.

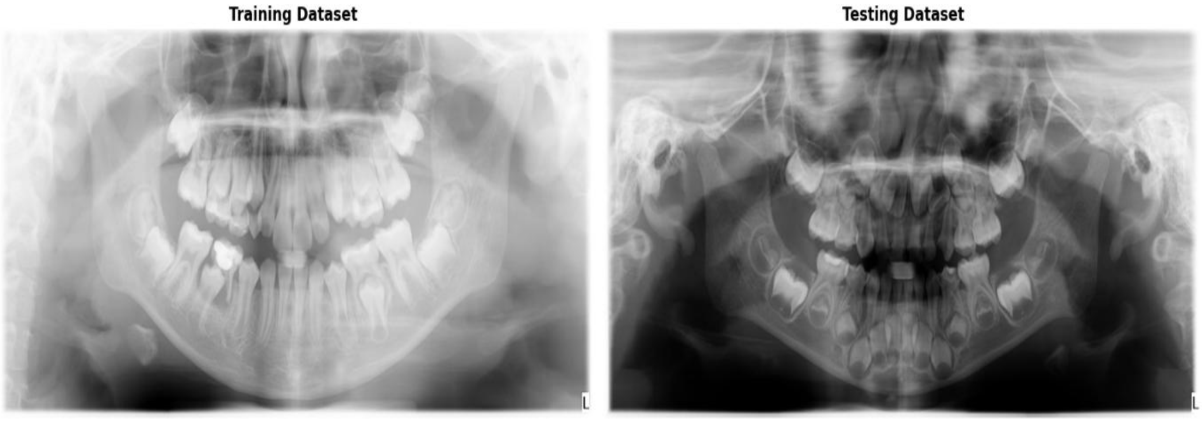

Figure 1. Representative Pediatric Panoramic Radiographs from the Training and Testing Datasets

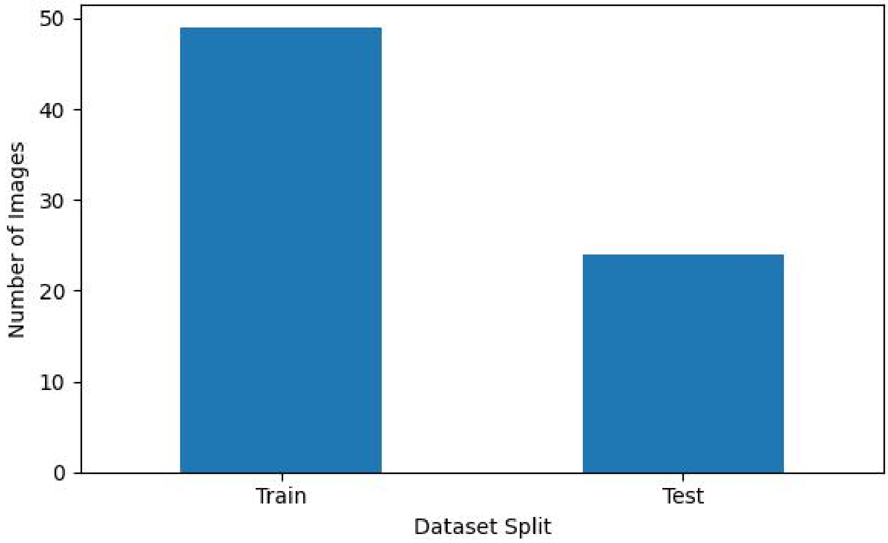

Figure 2. Distribution of Radiographs by Dataset Split

Table 1. Characteristics of the Pediatric Panoramic Radiographic Dataset

Split	Number of Images	Label Files	Total Lesions	Mean Lesions/Image	SD	Mean File Size (MB)
Test	24	24	108	4.50	2.89	0.97
Train	49	49	206	4.20	3.56	0.96

3.2 Distribution of Radiographically Detected Dental Lesions

Analysis of the annotation files showed differences in the frequency of lesions as per different image categories. Among the testing subset, cate1 had 55 lesions (5.00 lesions/image) followed closely by cate2 with 53 lesions (4.08 lesions/image). Cate4 had the largest number of lesions (55 lesions; 5.00 lesions/image) followed by cate2 (46 lesions; 4.60 lesions/image) and cate5 (38 lesions; 4.75 lesions/image) in the training subset. Lesion frequencies in the categories cate1 and cate3 were comparatively low. These results suggest that the radiographic dental lesions were heterogeneously distributed among the image categories. Details of the distribution of the lesions are presented in Table 2, and the graph of lesion frequency per image category is presented in Figure 3.

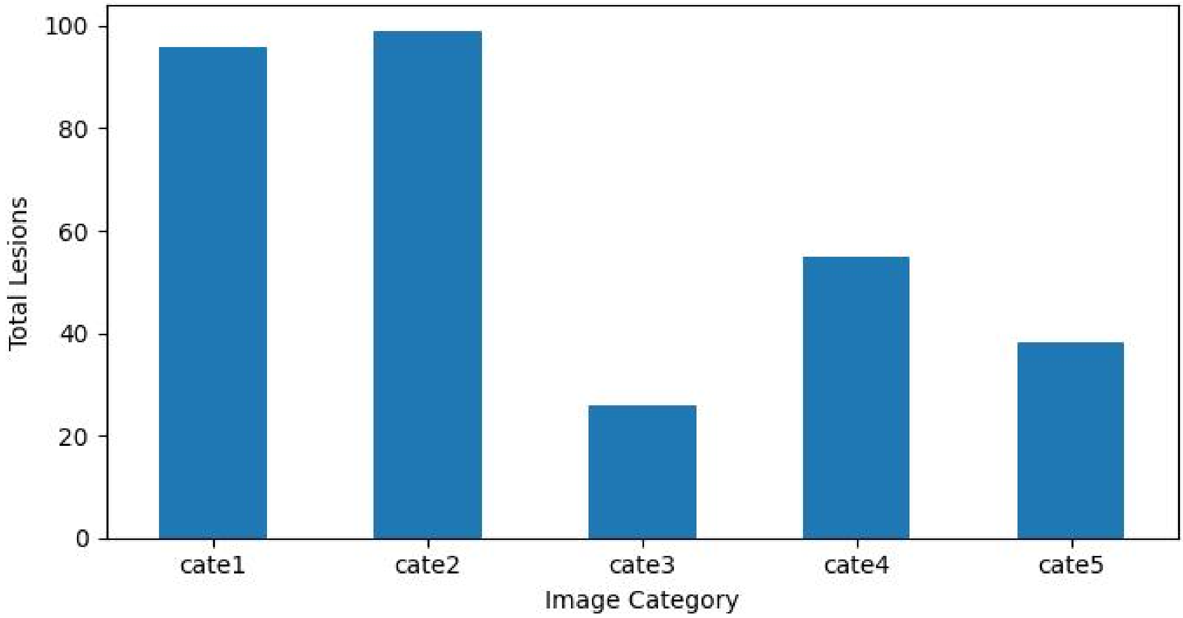

Figure 3. Distribution of Annotated Lesions by Image Category

Table 2. Distribution of Radiographic Lesions by Dataset Category

Split	Category	Number of Images	Total Lesions	Mean Lesions/Image
Test	cate1	11	55	5.00
Test	cate2	13	53	4.08
Train	cate1	12	41	3.42
Train	cate2	10	46	4.60
Train	cate3	8	26	3.25
Train	cate4	11	55	5.00
Train	cate5	8	38	4.75

3.3 Lesion Burden per Pediatric Panoramic Radiograph

Descriptive statistical analysis showed that there was considerable variation of lesion burden within individual paediatric panoramic radiographs. The mean number of lesions was 4.30 lesions/image, and the standard deviation of lesions per image was 3.34, which is a moderate amount of variation given the data set. The range of lesion counts per radiograph was 1 to 16 lesions and the median number of lesions was 4. Most radiographs did not have many detectable abnormalities, with the interquartile range (2-5 lesions) reflecting this fact, and a small number of images having a much higher lesion burden. The frequency distribution of the number of lesions per radiograph is shown in Figure 4 and a summary of the descriptive statistics in Table 3.

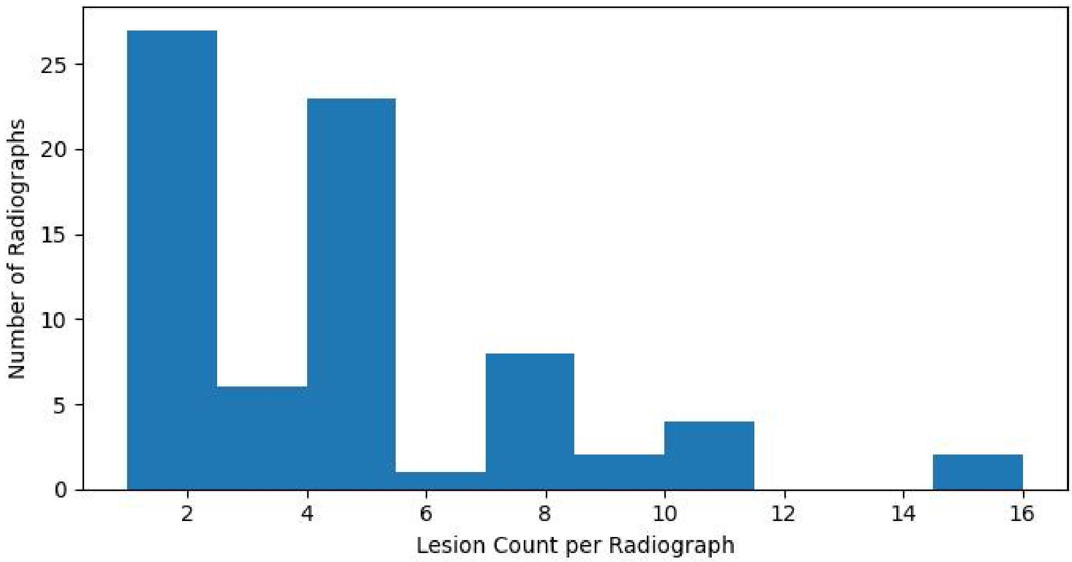

Figure 4. Frequency Distribution of Lesion Burden per Radiograph

Table 3. Descriptive Summary of Lesion Burden per Radiograph

Statistic	Lesion Count
Count	73.00
Mean	4.30
Standard Deviation	3.34
Minimum	1.00
25th Percentile	2.00
Median	4.00
75th Percentile	5.00
Maximum	16.00

3.4 Anatomical Distribution of Annotated Dental Lesions

Normalized annotation coordinates allowed the evaluation of lesion localization in the panoramic radiographs. Lesions were most frequent in the lower right region (104 lesions, 33.12%) followed by the lower left region (100 lesions, 31.85%). The upper left and upper right areas had 56 (17.83%) and 54 (17.20%) lesions respectively. Overall, the percentage of lesions in the mandibular (lower) regions was around 65%, indicating that there may have been a higher prevalence of radiographically identifiable abnormalities in the lower dentition. Anatomical distribution of lesions is summarized in Table 4 and depicted graphically in Figure 5.

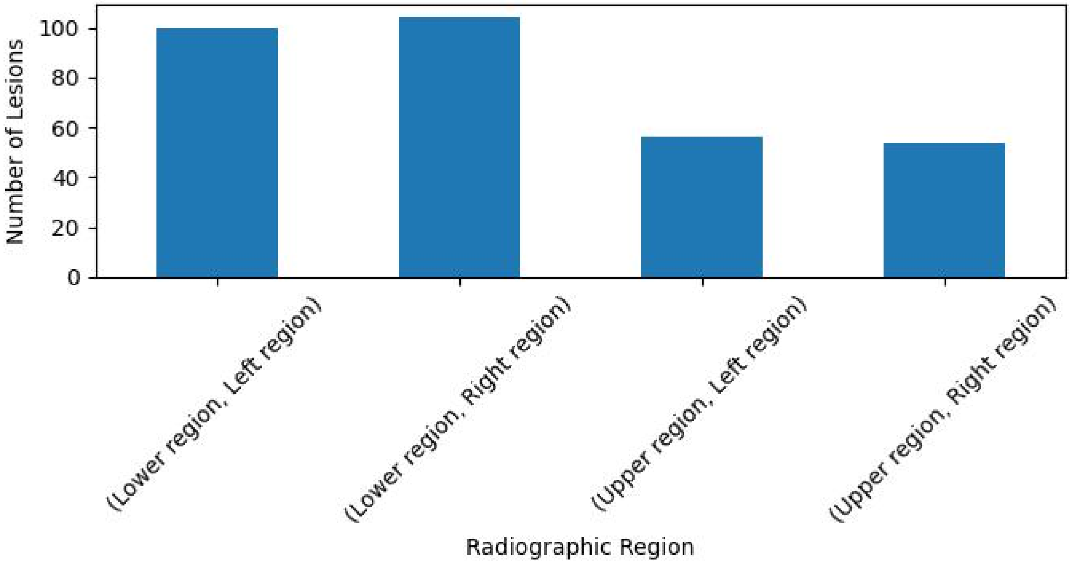

Figure 5. Anatomical Distribution of Annotated Lesions

Table 4. Anatomical Distribution of Annotated Dental Lesions

Vertical Region	Horizontal Region	Number of Lesions	Percentage (%)
Lower region	Left region	100	31.85
Lower region	Right region	104	33.12
Upper region	Left region	56	17.83
Upper region	Right region	54	17.20

3.5 Radiographs with the Highest Lesion Burden and Implications for Early Diagnosis

Assessment of single panoramic images revealed a high variability in disease loads within paediatric groups. The image with the largest number of lesions in the training subset was the radiograph cate5_010, which had 16 annotated lesions, followed by cate4_011 with 15 lesions. Cate2_003, cate1_012, cate2_011 and cate2_010 had 10-11 lesions with extensive radiographic involvement. In these high-burden radiographs, note that panoramic imaging can be used to simultaneously detect several dental abnormalities, which leads to a comprehensive early diagnosis and helps in planning to preventively treat those abnormalities. The highest lesion burden in the radiographs is shown in Table 5.

Table 5. Radiographs with the Highest Lesion Burden

Split	Image ID	Category	Lesion Count	Width (px)	Height (px)
Train	cate5_010	cate5	16	2000	942
Train	cate4_011	cate4	15	2000	942
Train	cate2_003	cate2	11	2000	942
Train	cate1_012	cate1	11	2000	942
Test	cate2_011	cate2	10	2000	942

Train	cate2_010	cate2	10	2000	942
Test	cate1_007	cate1	9	2000	942
Test	cate2_006	cate2	9	2000	942
Train	cate1_011	cate1	8	2000	942
Train	cate4_005	cate4	8	2000	942

4. Discussion

The present study assessed the pediatric panoramic radiographs to determine the distribution of dental lesions detected radiographically and to explore the usefulness of panoramic radiographs for early diagnosis and preventive measures. All radiographs had complete annotation files, and the total number of lesions was 314 annotated lesions spread over 73 pediatric radiographs. The fluctuation in occurrence of lesions per radiograph supports the fact that dental diseases in the paediatric population are not uniformly distributed and further emphasises the need for routine and thorough radiographic evaluation of a child to detect multiple pathological processes in one session. The results of this study agree with the increased use of digital radiography as a valuable diagnostic tool which can enhance clinical decision making and provide opportunities for preventive interventions in paediatric dentistry.

The spread of the lesions between training and testing sets also showed that the panoramic radiography can have equal visualization of the dental abnormalities irrespective of the splitting of data. Some categories like cate4 and cate2 in the training subset and cate1 in the testing subset had relatively high lesion burden, showing that the severity of the disease can vary significantly among pediatric patients. Similarly, the high proportion of lesions found in the mandibular areas in the present study indicated that the panoramic radiograph is an effective tool to detect anatomical patterns that could be useful to the clinician in the identification of at-risk areas that need closer attention. The same has been noted in studies that have examined AI-driven diagnostics platforms, demonstrating that automated image interpretation can assist in locating lesions, aid in achieving uniform diagnosis, and facilitate the practice of preventive dentistry (Alharbi & Alharbi, 2024; Chifor et al., 2022).

This study also highlights the growing role of AI and digital dentistry in the assessment of paediatric radiographs. With recent advancements in deep learning algorithms and computer-assisted diagnostic systems, the automated detection of dental caries, developmental abnormalities, and other radiographic abnormalities has significantly improved (Patil et al., 2022; Sivari et al., 2023). The standardized annotations that have been used in the present dataset are appropriate for these intelligent diagnostic models. Prior research has also shown that AI-driven systems can deliver high diagnostic accuracy, decrease the variability among observers, and aid clinicians in everyday pediatric practice (Khare et al., 2025; Lo, 2026; Naeimi et al., 2024).

The use of digital technology in pediatric dentistry extends beyond image interpretation, providing more opportunities to enhance access and continuity of care. Digital radiographs are useful in the context of tele dentistry, as they can be safely transmitted to specialists for advice, for diagnosis from afar, and for follow-up over time (Kanani et al., 2024). Thus, the use of standardized panoramic radiographs and annotation data could enable a collaborative diagnosis and remote clinical decision-making, especially in under-resourced areas where access to paediatric dental specialists is limited. Other research has also found that tele dentistry improves access to children's oral health care and that with good-quality radiographs, it can offer diagnostic results that are like in-person clinical assessments (Mola et al., 2025; Sharma et al., 2021).

The present findings have clinical implication not only for disease detection. Imaging can help identify multiple dental abnormalities at an early stage, enabling timely intervention to prevent irreversible changes in the tooth structure, and to minimize the need for extensive restorative and/or surgical treatments (Orhan et al., 2024; Prasad, 2026). Digital dentistry is constantly maturing and will continue to be a combination of AI and radiographic imaging to enable automated risk assessment, treatment planning, and personalized preventive measures. AI applications for routine dental imaging (RDI) might extend diagnostic oral and systemic disorders identified on dental X-rays, as indicated by recent studies (Ramanathan & Chalakkal, 2025; Veseli et al., 2025).

These encouraging results are accompanied by a number of caveats, however. The number of images in the publicly available dataset used in the study was relatively small (73 images) and the distribution of types of lesions and images may not be widely generalizable. Further, there were no annotation files available with demographic, clinical or treatment outcome data to correlate with radiographic features. More in-depth data collection with clinical details and external validation would be desirable with larger and more global multicentre data collections, to increase the robustness of the models used for assessment of the radiography. Further studies and clinical use of this sophisticated deep learning algorithm can lead to better risk prediction, prevention and early diagnosis for pediatrics dentistry.

5. Conclusion

Evaluation of the radiographic examination is an important component to the diagnosis and treatment of dental disease in children, which can provide a complete analysis of the developing dentition and other oral structures. The current study revealed paediatric panoramic radiographs to be relevant for diagnostic use, 314 different lesions being marked on 73 panoramic radiographs, which means that several dental abnormalities could be identified in one panoramic image. The lesions observed and anatomical distributions indicate a need for systematic radiographic interpretation to allow identification of a disease pattern not discernible by clinical examination alone. The results also suggest that the standardized annotated radiographic data sets could be valuable data resources for objective image analysis as well as for the development of digital diagnostic tools. The incorporation of panoramic radiography with the development of new technologies like artificial intelligence and computer-assisted image interpretation will have the potential of enhancing diagnostic consistency, making early interventions easier, and improving preventive dental care. These enhancements could contribute to the personalization of treatment and slow the disease and the need for surgery. Although it has some disadvantages including the size of the data sets, and has no clinical information, this study indicates that pediatric panoramic radiography is a useful diagnostic tool for routine dental examination. Larger, multi-centre cohorts should be used in future studies; clinical follow-up should be incorporated; and advanced AI models should be used to further expand the use of radiographic assessment for evidence-based paediatric dentistry and improve diagnostic accuracy.

References

1. Abdelaziz, M. (2023). Detection, diagnosis, and monitoring of early caries: the future of individualized dental care. *Diagnostics*, *13*(24), 3649.
2. Al Domyati, R. M., Zagzoog, G. M., Obaid, A. K., Al Shehri, R. H., Al Blowi, R. H., Shibatalhamd, K. Y., ... & Alshehri, S. A. (2024). Pediatric dental radiography: safety, techniques and diagnostic applications. *Int J Commun Med Public Health*, *11*(1), 533.
3. Alharbi, N., & Alharbi, A. S. (2024). AI-driven innovations in pediatric dentistry: enhancing care and improving outcome. *Cureus*, *16*(9).
4. Alzaqy, H. N., Alyami, F. A. M., Alghamdi, T. A. A., Alotaibi, F. F., Altukhais, E. M., Alotaibi, M. E. A., & Alharbi, S. M. S. (2024). Dental Radiology In Clinical Practice: Principles, Techniques, And Diagnostic Value. *The Review of Diabetic Studies*, 238-244.
5. Aps, J. (2020). Radiography in pediatric dental practice. *Clinical Dentistry Reviewed*, *4*(1), 5.
6. Aps, J. K. M., Lim, L. Z., Tong, H. J., Kalia, B., & Chou, A. M. (2020). Diagnostic efficacy of and indications for intraoral radiographs in pediatric dentistry: a systematic review. *European Archives of Paediatric Dentistry*, *21*(4), 429-462.
7. Arizos, S., Aps, J. K., & Arapostathis, K. N. (2022). Examination, Diagnosis, and Treatment Plan Implementation. In *Pediatric Dentistry* (pp. 79-110). Cham: Springer International Publishing.
8. Benyekhlef, Y. (2025). Protocols for prescribing radiographies in pediatric dentistry.
9. Cameron, A. C., & Widmer, R. P. (Eds.). (2021). *Handbook of pediatric dentistry E-Book: handbook of pediatric dentistry E-Book*. Elsevier Health Sciences.
10. Chifor, R., Arsenescu, T., Dascalu, L. M., & Badea, A. F. (2022). Automated diagnosis using artificial intelligence a step forward for preventive dentistry: A systematic review. *Romanian Journal of Stomatology*, *68*(3), 106-115.
11. Dayo, A. F., Wolff, M. S., Syed, A. Z., & Mupparapu, M. (2021). Radiology of dental caries. *Dental Clinics*, *65*(3), 427-445.
12. Jayaraman, J., Hoikka, A., Mendez, M. J. C., & Hajishengallis, E. (2021). Radiographic diagnosis in the pediatric dental patient. *Dental Clinics*, *65*(3), 643-667.
13. Kanani, H., Khubchandani, M., Dangore-Khasbage, S., & Pandey, R. (2024). Teledentistry: A comprehensive review and its application in pediatric dental care. *Cureus*, *16*(1).
14. Khare, P., Maran, S., & Kale, A. K. (2025). *Artificial Intelligence in Pediatric Dentistry: AI-Driven Pediatric Dental Care| AGPH Books*. AGPH Books.
15. Kühnisch, J., Anttonen, V., Duggal, M. S., Spyridonos, M. L., Rajasekharan, S., Sobczak, M., ... & Tsiklakis, K. (2020). Best clinical practice guidance for prescribing dental radiographs in children and adolescents: an EAPD policy document. *European Archives of Paediatric Dentistry*, *21*(4), 375-386.
16. Lo, G. A. (2026). Current Evidence of Artificial Intelligence Tools Applied in Pediatric Dentistry: A Narrative Review. *Applied Sciences*, *16*(9), 4492.
17. Makhdoom, M. (2024). *Dental cavity detection dataset* [Data set]. Kaggle. https://www.kaggle.com/datasets/maazmakhdoom/dental-cavity-detection-dataset
18. Mola, M. E., Çoğulu, D., Eden, E., & Topaloğlu, A. (2025). Is teledentistry as effective as clinical dental diagnosis in pediatric patients?. *International Journal of Paediatric Dentistry*, *35*(4), 783-791.
19. Naeimi, S. M., Darvish, S., Salman, B. N., & Luchian, I. (2024). Artificial intelligence in adult and pediatric dentistry: a narrative review. *Bioengineering*, *11*(5), 431.
20. Orhan, A. I., Bezgin, T., & Orhan, K. (2024). Digital dentistry applications in pediatric dentistry. In *Digital Dentistry: An Overview and Future Prospects* (pp. 199-220). Cham: Springer Intern
21. Patil, S., Albogami, S., Hosmani, J., Mujoo, S., Kamil, M. A., Mansour, M. A., ... & Ahmed, S. S. (2022). Artificial intelligence in the diagnosis of oral diseases: applications and pitfalls. *Diagnostics*, *12*(5), 1029.
22. Prasad, P. (2026). The role of artificial intelligence in diagnosing pediatric dental disorders—a narrative review. *Frontiers in Dental Medicine*, *6*, 1685359.
23. Ramanathan, R., & Chalakkal, P. (2025). Artificial Intelligence in Revolutionizing Diagnosis, Treatment, and Preventive Care for Children's Oral Health: A comprehensive narrative review. *Journal of Chemical Health Risks*, *15*(5), 1859.
24. Schüler, I. M., Hennig, C. L., Buschek, R., Scherbaum, R., Jacobs, C., Scheithauer, M., & Mentzel, H. J. (2023). Radiation exposure and frequency of dental, bitewing and occlusal

radiographs in children and adolescents. *Journal of personalized medicine*, *13*(4), 692.

25. Sharma, H., Suprabha, B. S., & Rao, A. (2021). Teledentistry and its applications in paediatric dentistry: A literature review. *Pediatric Dental Journal*, *31*(3), 203-215.
26. Shukla, H., Sajjanar, A., Wasnik, M., Gahlod, N., Rojekar, N., & Bhattad, D. (2021). Caries Diagnostic Techniques in Pediatric Dentistry. *Annals of the Romanian Society for Cell Biology*, *25*(4), 6097-6107.
27. Sivari, E., Senirkentli, G. B., Bostanci, E., Guzel, M. S., Acici, K., & Asuroglu, T. (2023). Deep learning in diagnosis of dental anomalies and diseases: A systematic review. *Diagnostics*, *13*(15), 2512.
28. Sreenivasan, S. K., Lolayekar, N., Sheth, P., & Rao, D. (2022). Knowledge, attitude, and practices of parents toward pediatric dental radiography. *Journal of Health and Allied Sciences NU*, *12*(04), 448-453.
29. Veseli, E., Mehrabanian, M., & Ammar, N. (2025). The potential of artificial intelligence in the early detection of systemic diseases during routine dental care: The potential of artificial intelligence in the early detection of systemic diseases during routine dental care. *British Dental Journal*, *239*(3), 168-174.
30. Vishwanathaiah, S., Fageeh, H. N., Khanagar, S. B., & Maganur, P. C. (2023). Artificial intelligence its uses and application in pediatric dentistry: a review. *Biomedicines*, *11*(3), 788.