

Assessment of Periapical Radiographic Errors Frequency in Dental Radiology Department in Al-Maghrib Specialized Dental Health Center

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Abstract: *This retrospective, cross-sectional study assesses the frequency and distribution of periapical radiographic errors in dental radiology, identifying common artifacts and their associations with dental regions. Conducted at the Radiology Unit of Al-Maghreb Specialized Dental Center, the study analyzed 312 periapical X-rays collected over six months (August 2023–January 2024). Error types, their frequency, and associated dental regions were recorded and statistically analyzed. The most frequent errors were "apex not shown in X-ray" (78%), followed by "cone cut" (10%). Errors were most common in posterior regions such as mandibular molars (28% on the right, 25% on the left) and maxillary premolars (27% on the right, 26% on the left). Chi-square analysis revealed significant associations between error type and region ($p < 0.05$). These findings highlight the need for improved radiographic protocols and operator training to minimize diagnostic inaccuracies in dental imaging.*

Keywords: dental X-ray errors, periapical radiographs, radiographic artifacts, dental imaging accuracy, operator training

1. Introduction

Periapical radiographs are integral to dental practice, providing detailed visualization of teeth and surrounding bone structures to aid in the diagnosis and treatment of dental diseases. Despite their clinical importance, radiographic procedures are prone to artifacts and errors that compromise diagnostic reliability. Technical errors, including poor positioning, beam alignment issues, and processing artifacts, remain prevalent, as reported in several studies (Aps et al., 2020; Petersson et al., 2022). In digital systems, the most frequently detected factors are related to the deficiency of operator skills, particularly with regard to patient positioning and proper device operation (MohdYusmiailid et al., 2017). Such errors have implications not only for patient care but also for operator efficiency and resource utilization. Errors like "apex not shown" and "cone cuts" can obscure critical diagnostic features, potentially leading to misdiagnosis or repeated imaging (Kumar et al., 2021). This problem not only expose the patient to X-rays more time than necessary, but it also rises the clinical time and the treatment costs (FabianaViero et al., 2017). This study aims to investigate the prevalence of common periapical radiographic errors and explore their distribution across dental regions to identify areas for procedural improvement and to avoid misinterpretation, the dentist must provide a suitable radiograph and thereby provide appropriate dental services to the patients. Therefore, the dentist should improve his/ her proficiency regard to this technique (Vida Masserat et al., 2017).

The specific objectives of this study are:

- 1) To identify the types and frequencies of periapical radiographic errors.
- 2) To evaluate the distribution of errors across dental regions (maxillary and mandibular).
- 3) To analyze associations between error types and regions using statistical tests.

2. Methodology

Study Design and Setting

This retrospective, cross-sectional study was carried out at the Radiology Unit of Al-Maghreb Specialized Dental Center in Iraq. Ethical approval was granted by the Iraqi Ministry of Health Research Ethics Committee (proposal/2023, registration number 127641, dated 31/8/2023).

Study Population

The study included 312 periapical radiographs taken by radiographic device (X-MIND SYSTEM, manufacturer: SATELEC-origin: Italy; S/No.33471; Voltage 220/230 V-50/60 Hz, 1 max 12 A) and MYRAY sensor (ZEN-X- Italy 5 V DC USB 500 mA, SN ZB 01407) during routine clinical procedures over six months (August 2023 to January 2024). All radiographs were assessed for errors by experienced radiologists.

Inclusion Criteria

- Radiographs containing artifacts or errors of any type.
- Radiographs captured during routine diagnostic procedures within the study period.

Exclusion Criteria

- Radiographs with errors due to equipment malfunction.
- Radiographs of patients with uncooperative behavior leading to unrepeatable positioning.

Data Collection

The data collected included:

- 1) Sociodemographic details of patients (age and gender).
- 2) Types of radiographic errors identified:
 - Apex not shown.
 - Cone cut.
 - Contact area overlapping.
 - Elongation.
 - Poor resolution.
- 3) Dental regions (mandibular and maxillary regions subdivided into molar, premolar, canine, and incisor areas).
- 4) Number and percentage of errors in each region.

Statistical Analysis

Data were analyzed using SPSS (version 26). Descriptive statistics were utilized to summarize frequencies and percentages. Chi-square tests were conducted to evaluate associations between error types and dental regions. A P -value < 0.05 was regarded statistically significant.

3. Results**1) Overall Error Distribution**

The study identified 10 categories of errors across 312 radiographs. Table 1 summarizes the frequencies and percentages of each error type.

Table 1: Error Type Distribution

Error Type	Frequency	Percentage (%)
Blank	1	0%
Poor resolution	2	1%
Shortage	2	1%
Contact area overlapping	3	1%
Root not shown	4	1%
Elongation	5	2%
Highly radiopaque	6	2%
Crown not shown in X-ray	12	4%
Cone cut	32	10%
Apex not shown in X-ray	241	78%

2) Error Distribution by Region

Errors were unevenly distributed across dental regions. Posterior regions, particularly the mandibular molars, exhibited the highest error percentage. Table 2 and Figure 1 illustrate the regional distribution of errors.

Table 2: Number and Percentage of Errors by Region

Region	Left Errors (%)	Right Errors (%)
Mandibular canine area	0%	0%
Mandibular incisor area	1%	1%
Maxillary canine area	2%	0%
Maxillary incisor area	6%	5%
Mandibular premolar area	17%	13%
Mandibular molar area	25%	28%
Maxillary molar area	25%	24%
Maxillary premolar area	26%	27%

3) Statistical Associations

Chi-square analysis revealed a significant association between error type and dental region ($P < 0.05$). Errors such as "apex not shown" were predominantly observed in posterior regions, while "cone cut" errors were distributed across both anterior and posterior regions.

4. Discussion**Error Patterns**

Literature showed that amongst the common errors which led to retakes are improper poisoning of the sensor or tube, improper angulations, and missing apical areas of teeth (Maysoon Haji et al., 2022). The findings in our study indicate that errors in periapical radiographs are highly concentrated in posterior regions. This aligns with previous studies, which attribute such errors to challenges in patient positioning and angulation in posterior areas (Aps et al., 2020). Specifically, the "apex not shown" error with frequency of 241 cases (78%) reflects inadequate film positioning, which could be mitigated through enhanced operator training and the use of positioning aids. Errors such as "cone cut," which result from improper beam alignment, were distributed more evenly across regions with frequency 35 cases (10%). This suggests systemic issues with radiographic technique that are not confined to specific regions. While in different study the cone cut was the most common error documented followed by overlapping (Umair Dastgir et al., 2020). Also in separated study the results were different, the most repeated error in this work were Elongation with frequency of 55 (19.6%), whereas the missing apex appears in 39 cases (9/13%), this study is based on training involvement, Depending on the results it was shown that training considerably decreases errors (Vida Masserat et al., 2017).

Clinical Implications

Radiographic errors compromise diagnostic accuracy and increase radiation exposure when repeated imaging is required. The high prevalence of errors in mandibular molars and maxillary premolars underscores the need for targeted interventions to address operator challenges in these areas. Digital radiography systems with real-time error detection may reduce the rate of such artifacts (Petersson et al., 2022).

5. Conclusion

The current study shows a high prevalence of periapical radiographic errors, particularly in posterior regions. "Apex not shown" and "cone cut" errors were the most frequent, indicating issues with positioning and beam alignment. Tailored training programs and advanced radiographic equipment are recommended to minimize errors and enhance diagnostic outcomes.

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