

Assessment of Radiographic Errors Made while Taking Intraoral Periapical Radiographs at Tertiary Care Centre

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ABSTRACT

Introduction: Errors may be present in intraoral periapical radiographs (IOPARs) which make the radiographs unacceptable for diagnosis and so repeat radiographs have to be taken. Repeat radiographs lead to increased radiation dose to the patient.

Objective: To assess radiographic errors made while taking intraoral periapical radiographs.

Materials and Method: This was a descriptive cross-sectional study in which the radiographs taken by the interns and technicians in the department of Oral Medicine and Radiology, People's Dental College and People's Dental College were assessed for any errors. Radiographs were assessed from 7th April 2021 to 16th August 2021 after obtaining ethical clearance from Institutional Review Committee. A convenience sampling method was used to assess 686 IOPARs of patients above 15 years. The radiographic errors made during the procedure were assessed. Data were collected, entered in Microsoft Excel and then transferred to SPSS v.16 for descriptive analysis.

Result: Out of total 686 radiographs assessed, there was a total of 221 (32.21%) projection errors and 241 (35.135%) processing errors. The most frequent error was cone cut 110 (16%), and 32 (4.7%) radiographs were repeated.

Conclusion: In the current study, the most common errors that occurred were cone cut, dark radiographs, and light radiographs. Training for all the technicians and interns taking radiograph focussing on correct positioning, correct projection, and correct processing should be advisable.

Keywords: Dental radiograph; dental student; dental technician; intraoral periapical radiograph; radiographic error.

INTRODUCTION

Radiographs are best aids for proper diagnosis and treatment of teeth and its supporting structures.^{1,2} An ideal radiograph is “one which has desired density and overall blackness and which shows the part completely, without distortion with maximum details, and has the right amount of contrast to make the details fully apparent.”³ However, not all radiographs taken have diagnostic quality. Radiographs with errors are not diagnostic.⁴

Repeating radiographs not only cause extra exposure to patients leading to increase radiation dose^{2,5} but also leads to extra cost for institute due to waste of time, film, and processing solution.^{4,6}

Citation

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In all educational institutes, students take radiographs as part of their curriculum. Students take radiographs in their clinical postings in third year and also in final year. After course completion, it is mandatory to complete their one-year rotatory internship. Interns, posted in Department of Oral Medicine and Radiology, also take routine radiographs. Knowing common errors made by interns will help in knowing areas of difficulty interns are facing while performing radiographic examination. Repeatedly training the interns and technicians focussing on the common errors would help minimise the errors. Hence, objective of study was to assess radiographic errors made while taking intraoral periapical radiographs (IOPARs).

MATERIALS AND METHOD

This descriptive cross-sectional study was carried out after receiving the approval from Institutional Review Committee People's Dental College and Hospital (IRC-PDCH, Ref. 1-CHNo33.2077/2078). The data collection was done from 7th April 2021 to 16th August 2021. The sample size was calculated by using the formula

$$n = z^2pq/d^2;$$

where, n = required sample size; z = 1.96 at 95% confidence interval level; p (proportion to be measured) = 0.3594 (35.94% of radiographs unacceptable according to study by Peker and Alkurt); ⁴ q = 1-p = 0.6406; and d (degree of accuracy) = 10% of p = 0.03594. Hence, n = 685.09 ≈ 686.

After taking written informed consent from patients, IOPARs were taken. While taking IOPAR, patients were asked to wear the lead aprons, the radiographic films were positioned properly for bisecting angle technique and projected at standard angulations for each area of interest. The patients were then asked not to move, then the operator exposed the film by pressing the switch which was present outside the room. The exposure time was kept standard for all the radiographs. The IOPARs were taken of patients more than 15 years of age in Carestream, E speed, double emulsion, size two film of dimension 30.5X40.5 mm with Carestream CS 2100 x-ray machine working on 60kVp, 7mA

as Department of Oral Medicine and Radiology in this college examines patients above 15 years of age. The IOPARs of patients with painful ulcers or swelling in the mouth, patients with restricted mouth opening, exaggerated gag reflex or patients with neuromuscular disorders or cerebral palsy, who cannot be stable while taking radiographs were not included in the study as there could be unavoidable errors that might occur due to patient's condition and not due to the operator's insufficiency.

All the radiographs were then viewed in the same view box. In this study, the radiographs in which information of region of interest were provided were considered acceptable, whereas if the radiographs were not diagnostic for area of interest, it was considered unacceptable. Thus, some radiographs with minor faults or faults not in the region of interest were not repeated. The findings were then recorded in a predesigned Proforma.

Data were entered in Microsoft Excel Sheet and analysed using SPSS Statistics for Windows, version 16.0 (SPSS Inc., Chicago, Ill., USA). Number and type of projection and processing errors were assessed.

RESULT

A total of 686 intraoral periapical radiographs were assessed, 408 were taken by technicians and 278 were taken by the interns. There were total of 221 (32.21%) projection errors and 241 (35.13%) processing errors (Table 1, 2). The most frequent error was cone cut in 110 (16%) followed by dark radiograph in 66 (9.6%), and light radiographs in 61 (8.9%). Of total radiographs, 654 (95.3%) were acceptable, 32 (4.7%) radiographs were unacceptable, thus repeated (Table 3).

Maximum number of radiographs taken were of mandibular molars in 183 (26.67%), followed by maxillary molars in 133 (19.38%) cases. In projection error, maximum errors were evident in mandibular molar projection in 61 (8.89%), followed by maxillary molar projection in 45 (6.55%). The least number of radiographs assessed were from mandibular canine in four (0.58%), followed by maxillary canine in 15 (2.18%) cases.

Total of 130 projection errors were made by the technicians out of which maximum (68, 52.3%) were cone cut and minimum (3, 2.3%) were blur image, apical cut off, and occlusal cut off (Table 1). Out of 91 projection errors made by the interns, maximum number of errors were cone cut in 42 (46.51%) and minimum number of errors was nail

mark artifact in one (0.35%). Number of processing errors caused by technicians and interns were 124 and 117 respectively (Table 2). The most frequent processing error caused by technician was dark radiograph in 36 (29.03%) in contrast to the interns wherein light radiographs were most frequent error in 37 (31.62%).

Table 1: Different types of projection errors taken by technicians and interns, n (%).

Projection errors	Radiograph taken by	
	Technicians	Interns
No error	278 (68.1)	187 (67.3)
Foreshortening	11 (2.7)	2 (0.7)
Elongation	12 (2.9)	18 (6.5)
Overlapping	13 (3.2)	4 (1.4)
Opposite teeth visible	12 (2.9)	8 (2.9)
Cone cut	68 (16.7)	42 (15.1)
Blurr image	3 (0.7)	4 (1.4)
Occlusal cutoff	3 (0.7)	3 (1.1)
Apical cutoff	3 (0.7)	6 (2.2)
Slanting of occlusal plane	5 (1.2)	3 (1.1)
Nail mark artifact	-	1 (0.4)
Total	408	278

Table 2: Different types of processing errors taken by technicians and interns, n (%).

Processing errors	Radiograph taken by	
	Technicians	Interns
No error	284 (69.6)	161 (57.9)
Dark radiograph	36 (8.8)	30 (10.8)
Black spot	15 (3.7)	12 (4.3)
Light radiograph	24 (5.9)	37 (13.3)
White spot	13 (3.2)	15 (5.4)
Emulsion peel	28 (6.9)	21 (7.6)
Finger print	8 (2.0)	2 (0.7)
Total	408	278

Table 3. Number of radiographs repeated by technicians and interns, n (%).

Radiograph taken by	Repeat	Acceptable	Total
Technician	13 (3.2)	395 (96.8)	408
Interns	19 (6.8)	259 (93.2)	278
Total	32 (4.7)	654 (95.3)	686

DISCUSSION

The quality of image affect the diagnosis and treatment planning of the patient. The poor image quality can be due to lack of knowledge and skill of imaging technique which in turn can be due to lack of proper education regarding proper imaging techniques. To assure a good quality radiograph, many countries have their own criteria like Irish Dental Council of Ireland and National Radiation Protection Board for United Kingdom.⁷ International Organisation for Standardisation (ISO) have also specified speed, average gradient, base plus fog density, and latitude for standardisation of intraoral radiographic image.⁸ However, in Nepal we do not have specified quality assurance guideline, so radiograph is repeated when the image does not help in diagnosis and treatment plan. This repeat radiographs lead to unnecessary exposure to the patient and cause loss of time and money.

Most radiographic errors are made by students.^{9,10} The present study focusses primarily on the radiographic errors made while taking radiographs by technicians and interns. Cone cut occurs when the radiation does not cover the radiographic film. While taking IOPAR by bisecting angle technique, the exact placement of the radiographic film is not visible, especially in the posterior region, resulting in cone cut. In this study, cone cut was the most common error, which is similar to the study by Acharya et al.⁶ and Abdulla et al.¹¹ This cone cut could have been avoided by using parallel cone technique as parallel cone technique has a holder which aligns the tube over the radiographic film thus reducing cone cut. In the study of Presotto et al.,⁵ horizontal overlapping was the most common error when using phosphor plates, and in the study by Masserat et al.,¹ elongation was the most common error followed by cone cut. Use of parallel cone technique help minimise cone cut, also laser guided collimator produced lesser cone cut as laser light provided better visualisation.¹² The second common error was elongation which was seen more in maxillary molars followed by maxillary premolars and mandibular premolars. Elongation in maxillary and mandibular radiographs may be because of bending of film due to different anatomy

of palate in maxilla and shallow lingual vestibule in mandible.¹³⁻¹⁵ Other common error was horizontal overlapping which is commonly seen in maxillary and mandibular molars which may be due to limitation of vision.

In processing errors, dark radiograph was the most common error followed by light radiograph which was contradictory to the study done by Gopal et al.¹⁶ in which light radiographs were more than the dark radiograph. In this case, the dark and light radiograph can be due to the fact that visual method was used for developing radiographs rather than time and temperature method which would give a consistency while developing a film. This can be rectified by using a time and temperature method of processing or using an automatic processor. The National Radiological Protection Board (NRPB) guidelines of UK suggest “step-wedge” test to the processing solution.¹³

The distribution of projection errors, according to the region of which radiograph was taken revealed, maximum number of errors were made in mandibular molars followed by maxillary molars which may be due to gag reflex or misplacement of the radiographic films due to unintended resistance of the patients. In the study by Presotto et al.,⁵ most error occurred in mandibular premolars followed by mandibular molars, which is in contrast to the study by Haghnegahdar et al.² where most error occurred in maxillary molar projection.

Total of 32 (4.7%) radiographs were unacceptable, thus repeated. In this study the repeat of radiographs were mainly due to cone cut (16, 50% of total repeat). The reject rate is similar to study of Nixon et al.,¹⁴ where the reject rate was 3.06%. The reject rates were 2.96% in study by Mupparapu et al.,⁹ and 17.91% in study by Chau et al.¹² Common errors leading to rejects were positioning, horizontal angulation, and cone cut.^{6,15}

Taking a radiograph is a skill which requires knowledge and practice. As the operator takes multiple radiographs, chances of causing error also minimises. The rotatory internship in the Department of Oral Medicine is for one month. In this study which lasted for five months, there

were five batches of three interns who took the radiographs. In the beginning of posting the radiographs taken by the interns had more errors which gradually decreased with time. Taking a radiograph is a skill which requires knowledge and practice.

CONCLUSION

Based on this study most frequent errors were cone cut, dark radiographs, and light radiographs. Cone cut was the common error caused by both

technicians and interns. If record of every error of radiograph that has occurred is kept, it will be easier to educate the technician and students taking radiographs to rectify those errors. In addition, regular radiographic training focussing on correct positioning, correct focussing, and correct processing should be advisable for all the individuals taking radiographs.

Conflict of interest: None.



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