Original Research Article

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Radiographic Errors in Intraoral Periapical Radiographs: An Observational Study

Abstract:

Background: Radiographs are considered as pivotal aid in the diagnosis and treatment planning of various Oro-dental pathologies. Changes in the quality of radiographs may lead to misinterpretation, which results in incorrect diagnosis and treatment planning. The technical and processing errors can largely influence the radiographic interpretation. Both paralleling and bisecting angle techniques can have both technical and manual errors.

Aims: To estimate the frequency of radiographical errors in conventional radiograph taken by undergraduate dental students.

Materials And Method: Thousand (1000) dental radiographs taken by undergraduate students were examined. Patient's age ranged between 5 -75 years. X- ray films were examined on X-ray film viewer and were classified according to type of errors and anatomical distribution.

Results: The study aimed to identify common faults encountered during routine radiography. The most frequently observed error was Improper Vertical Angulation. Interns performed better in obtaining radiographs compared to Final year students.

Key-words: Radiographic errors, Dental students, Bisecting angle technique.

Introduction:

Periapical radiographs ("peri" meaning "around" and apical meaning "apex" or end of tooth root) record images of the outlines, position and mesiodistal extent of the teeth and surrounding tissues. The purpose of the intraoral periapical radiograph examination is to obtain a 2-D view of the entire tooth and its surrounding structures. Dental radiographs are considered a crucial aid for the diagnosis as well as intra and post-operative evaluation of conditions and different dental procedures.[1] In dentistry, radiographs are an important part of diagnosis and treatment. They help in clinical and anthropological diagnosis. Intraoral periapical radiograph (IOPAR) can be used to assess the bone resorption levels to check periodontal health. Improvement in their performance helps reduce exposure to radiation due to faulty radiographs.[2] Availability of basic knowledge, quality images, and absence of technical and processing errors are necessary factors for correct radiographic interpretation, documentation of different types and frequency of errors occurring when radiography performed by professionals and technicians is necessary to identify and correct the existing deficiencies.[1] The periapical radiograph, using paralleling technique, is considered as the gold standard. Several advanced techniques in radiographs include Digital radiography, CBCT etc.[2] Radiographic techniques and processing errors can highly impact the radiographic interpretation. It is necessary to gather proper radiological information, hence good quality radiographs are important to be taken by avoiding errors. Both paralleling and bisecting angle techniques can have both technical and manual errors. Besides the common errors, processing them incorrectly like image contrast can affect the interpretation.[3] The aim of study is to evaluate the prevalence of radiographical errors in intraoral periapical films taken by undergraduate dental students in our department.

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Materials and Methods:

This is an observational study that took in place in a period of one month. The study involved a total of 1000 dental radiographs of Himachal population, taken by undergraduate students in Department of Oral Medicine and Radiology (OMR), HPGDC Shimla using Bisecting angle technique without holders were examined. Ethical approval was obtained from institutional committee. Patient's age ranged between 5 -75 years. X- ray radiograph was examined on X-ray radiograph viewer and were classified according to type of errors and anatomical distribution.[4] Patients included in study were dentulous patients or patients advised with IOPAR (Bisecting angle technique) and this study excluded Edentulous patients and Other Radiographic method except IOPAR using Bisecting angle technique. The armamentarium used were Carestream 2200 at 70kv & 7mA and Carestream E- Speed Dental X- Ray films (size 2- 30.5x40.5mm). X-ray films were exposed by 2 groups i.e. final year & interns and examination on x-ray film viewer in a quiet, ambient lighting room and classified according to type of error and type of the group. All the radiographs were examined by two expert radiologists of OMR department separately and errors were noted. On statistical analysis, SPSS version 22 & Minitab statistical software version 21.1 was used. Z test for two groups was used with $p<0.05$. Inter Examiner Reliability was calculated with kappa statistics & Percentages were calculated for presence and types of errors.

Results and Discussion :

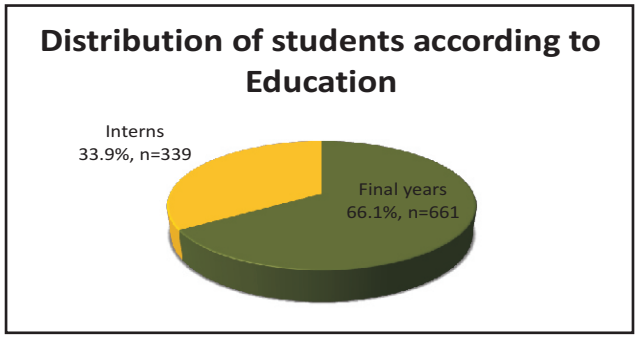
All the radiographs were examined by two radiographers of OMR department separately and errors were noted. To rule out difference, the results were subjected to KAPPA analysis and we found excellent inter-examiner reliability (=0.81). Table 1 depicts total no. Of 1000 X-rays with 312 as total no. Of errors, out of which 38.7% errors by final yr & rest 16.5% by Interns. Table 2 depicts image contrast to be the error with maximum percentage for final year students with 28.9%. Table 3 depicts improper vertical angulation to be the error with maximum percentage for intern students with 42.9%. Table 4 depicts the overall max percentage of error i.e. 28.8 % for Improper Vertical Angulation followed by Image contrast with 28.5%. The comparison between two groups i.e. Final year & Interns shows two significant values & three non-significant values.

In study by Antony M. et al (2020),[2] overlap of image was the most common radiographic fault with error percentage of 41% and by Greer et al (2018) [3], Gopal KS.et al (2018) [5] and Elangovan S. et al (2016) [6] cone cut was one of the most commonly encountered radiographic faults up to 35.4%,46%,25.5% respectively. In study conducted by Hasan A. et al (2019) [7] positioning error with 27.3% was encountered to be most common fault. Patel JR.et al (1986) [8] and Mourshed F.et al (1972) [9] placement of film as common radiographic fault with error percentage of 64.9% and 26.1% respectively. Compared to the above studies, in our study, we can see improper vertical angulation with max. Error percentage of 28.8%.

Possible reasons for Improper vertical angulation errors could be less practical experience, no use of film holders & increased patient load. Moreover, CARESTREAM 2200 do not have vertical angulation scale which also contribute to the errors. All the radiographs were examined by two radiographers of OMR department separately and errors were noted. To rule out difference, the results were subjected to KAPPA analysis and we found excellent inter-examiner reliability (=0.81). A comparison between Final year & Intern students with $p<0.05$ was done, were Improper vertical angulation and presence of artifacts were significant and improper horizontal angulation, processing errors & incorrect film placement were non-significant. Overall, Intern students showed better results compared with Final year with Improper vertical angulation as maximum error committed.

Table 1: Radiographic data

Course	Number of intraoral periapical radiographs taken	Number of faults committed	Percentage
Final years	661	256	38.7
Interns	339	56	16.5
Total	1000	312	31.2



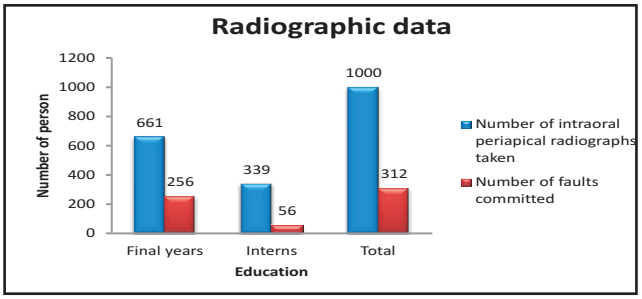


Table 2: Radiographic faults made by final year students.

Type of fault	Numbers	Percentage
Cone cut	74	28.9
Improper vertical angulation	66	25.8
Improper horizontal angulation	38	14.8
Processing error	25	9.8
Incorrect film placement	39	15.2
Miscellaneous	14	5.5
Total	256	100.0

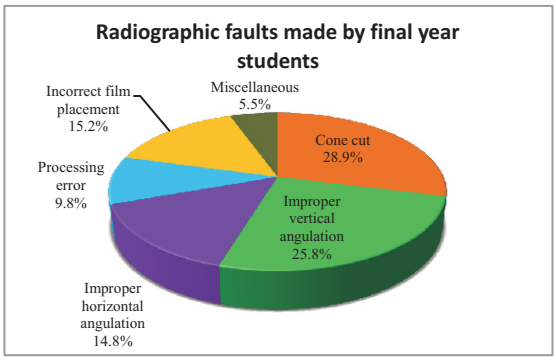


Table 3: Radiographic faults made by interns

Type of fault	Numbers	Percentage
Cone cut	15	26.8
Improper vertical angulation	24	42.9
Improper horizontal angulation	5	8.9
Processing error	4	7.1
Incorrect film placement	8	14.3
Miscellaneous	0	0.0
Total	56	100.0

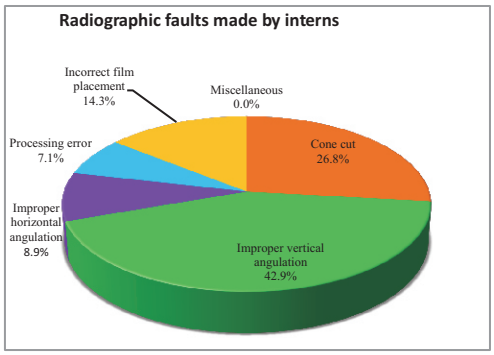
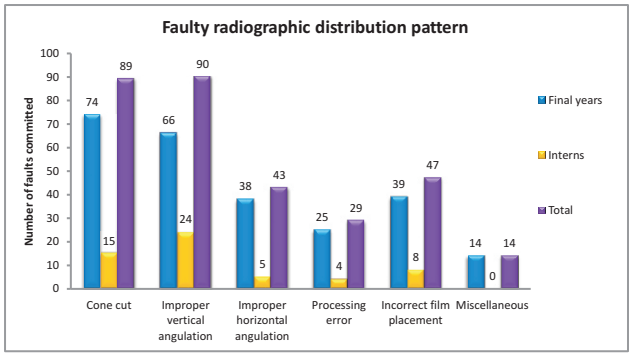
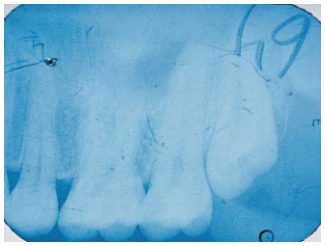


Table 4: Faulty radiographic distribution pattern

Type of fault	Final years	Interns	Total	Percentage
Cone cut	74	15	89	28.5
Improper vertical angulation	66	24	90	28.8
Improper horizontal angulation	38	5	43	13.8
Processing error	25	4	29	9.3
Incorrect film placement	39	8	47	15.1
Miscellaneous	14	0	14	4.5
Total	256	56	312	100.0



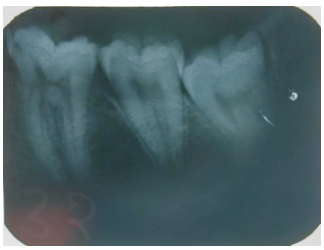
FIGURES:



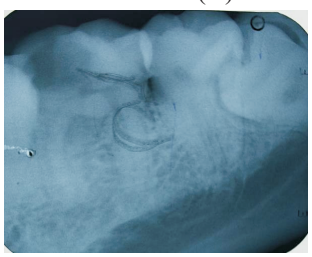
(A) Light Radiograph

(C) Cone Cut

(B) Fixer Spots



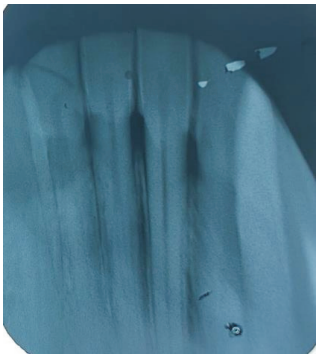
(D) Dark Radiograph



(E) Blurred Radiograph

(F) Improper Vertical Angulation

Foreshortening



Elongation

Conclusion:

The overall quality of radiographs was not found to be satisfactory. Improper Vertical Angulation was the commonest radiographic error observed in this study. The performance of interns in obtaining radiographs was better in comparison to Final year students as they have better experience due to their two times posting in final year as well as internship of 15 days each. Thus, we can reduce these errors by increasing the training course for students and by using film holder. Other recommendations included are use of paralleling technique with holders and use of vertical scale to measure vertical angulations. This study clearly states that experience reduces the chance of faulty radiographs.

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