ASSESSMENT OF RADIOGRAPHIC ERRORS IN RADIOVISIOGRAPHY- A RETROSPECTIVE STUDY

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ABSTRACT

In dentistry, radiographs have an important role in diagnosis and treatment. It is important that students have to interpret and diagnose the radiographs. Radiovisiography (RVG) has replaced conventional radiography and the main reason for occurrence of faulty radiographs in them could be due to positioning errors. Hence this study aimed to determine the radiographic errors in radiovisiography. The study was done in Saveetha dental college and hospitals, Chennai, India. A convenient sampling was done. The study was conducted among third year and final year students. A total of 300 Intra Oral Periapical Radiographs were taken and were assessed for radiographic errors and statistical analysis was performed by Chi square analysis. From the study conducted, it was found that out of 300 IOPA, 170(57%) were without any radiographic errors whereas the remaining 130 (43%) had errors in it. The majority of radiographs were having cone cut (43.07%) followed by apex cut (17.6%) elongation (11.5%), overlapping (8.4%), artifacts (6.9%), crowncut (5.3%), foreshortening (3.8%) and blurring (3%). Final year students had less radiographic errors when compared to third year students. Students by mastering the techniques such as positioning of patient, X Ray tube head, RVG receptors can reduce faulty radiographs and thereby improving image quality.

Keywords: Faulty radiographs, IOPA, positioning errors, radiovisiography, conecut

INTRODUCTION

In dentistry, radiographs play a vital role in diagnosis and treatment. As a dental surgeon, it is important to know about the techniques for taking a radiograph. The institution trains their students to develop technical application skills as well (White and Pharoah, 2009). Radiovisiography (RVG) is a dental radiographic digital imaging system which is claimed to rival conventional techniques in terms of reduced radiation dose and the production of instantaneous images (Russell and Pitts, 1993) . Although standard for subjective quality rating of dental radiographs are well defined, there is clear evidence that very few students fail to achieve these (Karjodkar, 2008) . Radiographic errors decrease the rate of accurate diagnosis and treatment planning. Additionally, repetition of radiographs causes unnecessary radiation exposure to patients, clinicians, radiology staff and the environment, as well as the loss of time and money (Royal and Others, 1994) . Clinicians strive to reduce patients' exposure to radiation in an effort to decrease its damaging effects on the human body (Whaites and Drage, 2020) . The potential strategies for achieving this goal are the use of high-speed film and digital systems that require less exposure to radiation to form a

diagnostic image and decreasing the number of radiographic retakes (SMITH and N, 1993). Certain errors in the technique or in the radiographic processing, besides being difficult to interpret, lead to a repetition of the radiography. This not only exposes the patient to X-rays more times than necessary, but it also increases the clinical time and the treatment costs (Rushton and Horner, 1994). The learning of intraoral radiographic techniques is initiated during the undergraduate course in dentistry (Rushton, Horner and Worthington, 1999). During this period, it is important that the students have to make a critical analysis of the radiographs that they have performed. This learning can be improved when the students practise their practical activities, by improving the true radiographic technique and by identifying the types of errors and their causes (Mourshed and McKinney, 1972). The creation and the development of new teaching methods can help to correct these observed deficiencies, as well as to contribute to an improvement and a consolidation of the contents addressed (Peker and Alkurt, 2009). Previous studies have investigated the rate at which retakes are required when dental students take diagnostic radiographs (Elangovan *et al.*, 2016). They have determined that many

factors, such as radiographic technique, use of film holder and anatomical location of the teeth, affected radiographic errors. It was reported that there are common errors which occur during intraoral radiography (Kumar and Ganapathy, 2019) . They are: conecut, crown cut, apex cut, artifacts, elongation, foreshortening, blurring and overlapping of images. There is insufficient data about radiographic errors made by dental students in radiovisiography. Previously our team has a rich experience in working on various research projects across multiple disciplines. (Muthukrishnan and Warnakulasuriya, 2018), (Govindaraju, Neelakantan and Gutmann, 2017), (Chen *et al.*, 2019), (Priyanka *et al.*, 2017), (Sitharthan *et al.*, 2019), (Priyadharsini *et al.*, 2018), (Azeem and Sureshbabu, 2018), (Wu *et al.*, 2019), (Abitha and Santhanam, 2019), (Manohar and Abilasha, 2019), (Venu, Dhana Raju and Subramani, 2019), (Wang *et al.*, 2019), (Girija, Jayaseelan and Arumugam, 2018), (Sheriff, Ahmed Hilal Sheriff and Santhanam, 2018), (Dhinesh *et al.*, 2017) Now the growing trend in this area motivated us to pursue this project. Hence this study aimed to determine the various positioning errors made by undergraduate students while taking a radiovisiography.

MATERIALS AND METHODS

This retrospective study was done in Saveetha dental college and hospitals, Chennai, India. A convenient sampling was done. All the radiographic procedures were performed with radiography equipment (Newlife radiology, Italy) operating at 70kvp 8mA following the manufacturers' instructions. The exposure time was 0.1 to 0.4 seconds. A total of 300 Intra Oral Periapical Radiographs which were taken by third years and final years for various treatments were assessed for radiographic errors. All the radiographs were assessed by 2 reviewers for radiographic errors. Data related to year of study and different radiographic errors such as elongation, cone cut, crown cut, foreshortening, blurring, apex cut, artifacts and overlapping were collected. The collected data were entered in an excel document and the results were obtained by using statistical analysis. Statistical analysis such as descriptive statistics of percentage distribution of various radiographic errors, Chi square analysis was done to find the association between different radiographic errors done by third year and final year students.

RESULTS AND DISCUSSION

From the study conducted, it was found that out of 300 IOPA, 170(57%) were without any radiographic errors whereas the

remaining 130(43%) had errors in it. The majority of radiographs were having cone cut (43%) followed by apex cut (17.6%), elongation (11.5%), overlapping (8.4%), artifacts (6.9%), crowncut (5.3%), foreshortening (3.8%) and blurring (3%). Final year students had less radiographic errors when compared to third year students. Chi square test was done and the p value was 0.151(p<0.05) which was found to be statistically not significant **(Graph1)**. Association between year of study and the radiographic errors made by the students are shown in **(Graph 2), (Table 2)**. Cone cut was the most common radiographic error among third years when compared to other errors. Association was done by Chi Square test, *p* value=0.151, (p value >0.005) which was found to be statistically not significant.
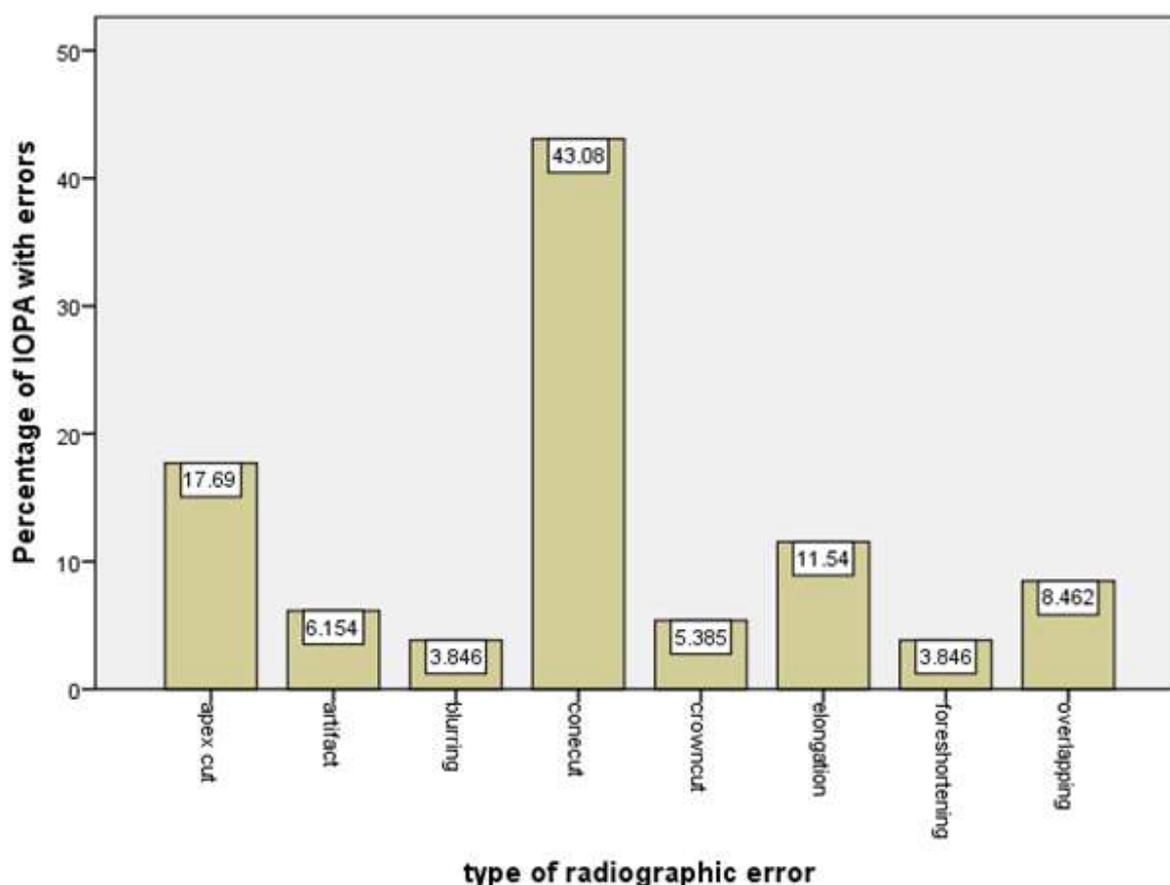
Graph 1: showing the percentage distribution of different radiographic errors made by third year and final year undergraduate students. X axis represents the different radiographic errors and Y axis represents the percentage of IOPA with errors. Majority errors encountered is cone cut 56(43%).
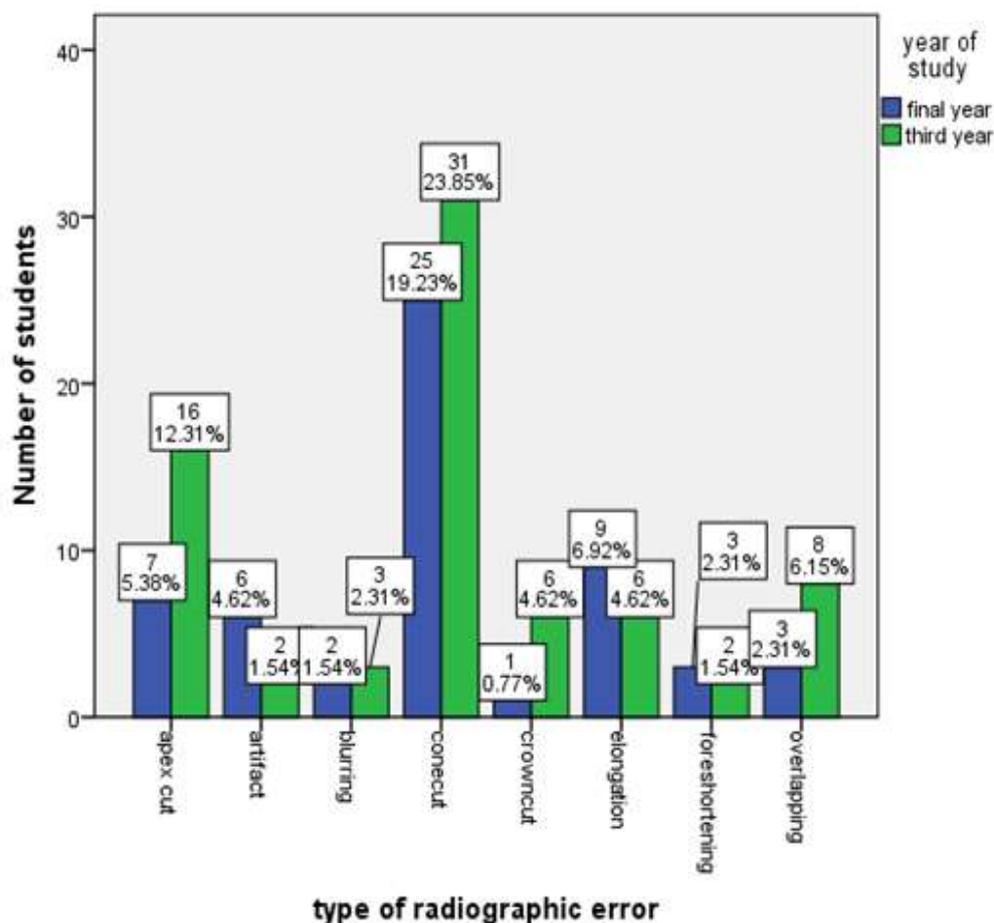
Graph 2: Showing the association between year of study and the radiographic errors made by the students. X axis represents the different radiographic errors and Y axis represents the year of study. Cone cut was the most common radiographic error among third years when compared to other errors. Association was done by Chi Square test, *p* value=0.151, (p value >0.005) which was found to be statistically not significant.

Table 1: Showing the association between year of study and different radiographic errors. Chi square test done (*p* value =0.151) - statistically not significant.

		Value	Approx. Sig.
Nominal by Nominal	**Phi**	.287	.151
	Cramer's V	.287	.151
N of Valid Cases		130	

Radiography serves as a key diagnostic tool in dentistry which renders good and quality radiographs a prime requisite to attain an appropriate diagnosis (Paavai, 2017). Radiographs with poor diagnostic value not only hinder the process of diagnosis and disease management but also create hazardous scenarios where the patient/subject and the operator are exposed to unwanted radiation and many other such discomfort

(Patel, 1979). A total no of 2013 faulty periapical radiographs were evaluated out of which 1008 were maxillary periapical radiographs and 1005 were mandibular radiographs. In our study, it was found that cone cut was the most common error made by the students (43%), followed by apex cut (17.69%), overlapping (8.4%), foreshortening (3.8%), crown cut (5.3%), artefact (6.1%), blurring (3%). Cone cut occurs as a result of improper positioning of the X ray tube with the receptor. Apex cut occurs as a result of the film not positioned apically enough to cover the entire tooth. Overlapping occurs as a result of improper horizontal angulation. Excessive vertical elongation leads to foreshortening. Crown cut occurs when there is no film extending occlusally. Artifacts in IOPA is due to nose rings. Blurring can occur due to movement of film, patient or X ray tube head during exposure. In our study , only digital radiographs were used. In the previous study done by Saraswathy *et al*, the radiographic faults were categorized into cone cut, elongation, overlap, brown stains, light, dark, light exposed, foreshortening, reverse film, artifacts, dark spots and light spots. It was found that the maxillary radiographs had cone cut in 35.4%, elongation 32.5%, foreshortening 1.7%, overlap 5.7%, reverse

film 0.4%, incorrect film placement 21%, light 6.9%, dark 3.7%, fingerprint 0.1%, light exposed 1.8%, light spots 0.2%, dark spots 0.3%, brown stains 3.2%, artifacts 0.9%.(Gopal, Krishnaraj and Priya, 2018). In our study, elongation errors were about 11.54% and it was found to be less when compared to the studies conducted by Masserat *et al* whose elongation errors were about 19.6 % (Masserat *et al.*, 2017).The reason for occurrence of elongation was due to lesser vertical angulation. Patankar *et al*, conducted a study to assess the quality of intra oral periapical radiograph. In their study, there were 2 audit cycles. In audit cycle 1, 400 recently taken intraoral periapical (IOPA) radiographs was assessed for the quality and was recorded according to subjective quality rating of radiograph given by the national board of radiation protection guidance and put them into Grades 1, 2, or 3. Audit Cycle 2 radiographs from Grades 2 and 3 were further randomly reevaluated to determine the causes of error and these are classified into faults due to positioning, exposure, and chemical processing. In Audit Cycle I – 180 (45%) IOPA radiographs were excellent , 165 (41.6%) were diagnostically acceptable 57 (13.8%) are unacceptable . The IOPA radiographs of Grade 2 and Grade 3 (Audit

Cycle II) were randomly assessed to determine the cause of error. In Grade 2, 165 (40.7%) . IOPA radiographs showed positioning error, 45 (11.2%) showed exposure error, and 9 (5.5%) showed chemical processing error (Patankar *et al.*, 2019). Manu Dhillon *et al* conducted a study in panoramic radiographs in which of the 1,782 panoramic radiographs viewed, 196 (11.0%) radiographs had no errors while 1,586 (89.0%) radiographs showed one or more positioning errors. The most common positioning error observed in the radiographs was failure to position the tongue against the palate (993, 55.7%) whereas the least common error recorded was patient movement during exposure (28, 1.6%) (Dhillon *et al.*, 2012). Perks *et al*, in his study determined various techniques for achieving rectangular collimation generate different numbers and types of errors and remakes and to determine whether operator skill level influences errors and remakes. Eighteen students exposed a full-mouth series of radiographs on manikins with the use of six techniques. The students were grouped according to skill level. The radiographs were evaluated for errors and remakes resulting from errors in the following categories: cone cutting, vertical angulation, and film placement. Significant differences were found among the techniques in cone cut, vertical angulation, total errors errors and remakes. Operator skill did not appear to influence the number or types of errors or remakes generated (Parks, 1991) . Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Vijayashree Priyadharsini, Smiline Girija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020; R *et al.*, 2020; Samuel, 2021). We hope this study adds to this rich legacy.

Among 300 radiographs, more than half of the radiographs were without errors. Final years in our study when compared to third years had lesser radiographic errors because of better experience in positioning of RVG receptor, X ray tube head and patient . The new teaching methodology followed in our college had led to better understanding about the technical aspects of the radiovisiography that made the students to produce better quality images with less repetition and reduced radiation exposure.

CONCLUSION

Among the study population, 57% of radiographs had no errors whereas the 43% had radiographic errors and the majority was found to be cone cut, apex cut, elongation, overlapping. Final year students had less radiographic errors when compared to third year students. Faulty radiographs can be controlled by implementing the theoretical knowledge in day to day clinical practice.

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CONFLICTS OF INTEREST

Authors have no conflicts of interest.

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