Reject Analysis of Intra-Oral Periapical (IOPA) Radiographs of Department of Radiology, Dental Teaching Hospital, Peradeniya, Sri Lanka

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Abstract —Intra-oral Periapical (IOPA) X-rays are the most common dental radiographs taken at the Department of Dental Radiology and which require considerable intervention of radiographer compared with the other modes of radiation diagnosis. It is shown that there are frequent repetitions of X-ray films that are reported in IOPA imaging due to the unacceptable image quality thereby subjecting the patients to excess radiation exposure and extra cost. This creates a situation which necessitates the need to explore causes of rejection and repetition of dental x-ray investigations. The objectives of this study were to identify the most susceptible region that is likely to be repeated in IOPA imaging and to find out the most common error associated on image repetition. Two hundred and fifty eight (258) rejected IOPA films taken by the radiographers, student radiographers and dental students during the period of February to December, 2014 were collected and analysed by a dental surgeon and three (03) qualified radiographers with a help of an illuminator which can provide standard viewing conditions. The observations on associated errors and the rejected region were recorded in a spreadsheet. The data was analysed by SPSS 17 software. The Results identified that the highest percentage of rejected region was molar (48%), followed by premolar (27.9%) and anterior teeth (24.1%). According to the study, film and/or radiation beam positioning was the major error highlighted and it was associated with the molar region in IOPA radiography. These results imply that the half of the rejected images of molar region is mainly due to the difficulties in positioning of radiographs in that particular region of oral cavity. It is also noted that the elongation was the mostly affected error to reject anterior teeth and there was a significant association between the elongation and anterior teeth region. Based on this study, it is strongly suggested to modify and improve the imaging techniques involved in IOPA molar imaging. Further, it is also essential to remedy the error of elongation by applying correct positioning of film and the tube at the region of anterior teeth. These suggestions would contribute to minimize the frequent repetitions of IOPA Radiographs.

Keywords- IOPA, Dental X-ray, Reject Analysis

I. INTRODUCTION

Dental radiography plays an enormous frontline role in the differential diagnosis of patients with many types of intra and extra oral illnesses or conditions. As with all radiation investigations, including dental imaging, ethical considerations need to be addressed before ionizing radiation is administered. A principle commonly used with radiography departments when administering ionizing radiation is the "ALARA Principle" (Milner, 1989). One way of helping to enforce the ALARA principle within radiography departments is through a properly conducted reject and repeat analysis (Clark *et al.* 2003).

The reject analysis is a part of overall Quality Assurance (QA) programmes in medical radiography and radiology services in the evaluation of image quality is a well established practice (Daniel *et al.* 2008). On the other hand, it is a quality indicator and is an important tool in localizing areas where optimization is required. Repeat examinations contribute to patient radiation dose and add to expense on films, X-ray personnel time, wear and tear on the equipment and accessories as well as inconvenience to patients. Therefore, minimizing the number of repeat films will not only reduce unnecessary exposure to patients, but can also have a significant effect on the reducing department's running cost and time (Ofori *et al.* 2013).

Unnecessary or repeated radiation carries a significant weight in light of unavoidable stochastic effects in which even very minimal radiation doses carry potential risk (Daniel *et al.*2008). This creates a situation which necessitates the need to explore possible causes of rejection and repetition of x-ray investigations. The reject analysis would provide relevant information that are help to achieve sound reduction in radiation exposure markedly and to enhance cost effectiveness as well as

develop acceptable image quality will be explored in this study.

Intra oral periapical (IOPA) X-rays are most common dental X-rays done in the dental radiology department and is extremely important in diagnosing pathologic conditions affecting the teeth and tooth supporting structures which needs considerable intervention of radiographers, compared with other modes of dental investigations such as Orthopantomography (OPG) and Cephalostat which are mainly technology based and less operator depended (Nixon *et al* 1995).

Generally,the dental X-rays are taken by qualified radiographers, student radiographers and the dental students at the Department of Radiology. The aim of this study was to identify the most susceptible region to be repeated in IOPA imaging and find out the mostly affected error on image repetition.

II. METHODOLOGY

All 258 rejected IOPA films taken by qualified radiographers, student radiographers as well as the dental students were collected from Department of Radiology, Dental Teaching Hospital, Peradeniya, Sri Lanka in the time period of February to December, 2014. The dental arch (maxilla vs mandible), side of the arch (right vs left), and the region (anterior, premolar, molar) were defined. All the rejected radiographs were taken with the same kind of film (Kodak), with similar X-ray units (70Kvp, J Morita Co, Japan) and processed using a non-dark room type automatic X-ray film processor (J Morita Co, Japan).

All the rejected radiographs were assessed by a dental surgeon and 03 qualified radiographers under standard viewing conditions and magnification. In order to minimize the inter examiner variability, the examiners were calibrated by examining 30 radiographs each separately to identify the differences and these were addressed.   The following criteria were used to identify the quality of the radiograph and reasons for rejection.

A. Vertical Angulation: Elongation or foreshortening of image.

B. Horizontal Angulation: Overlapping of images.

C. Image Contrast: Light or dark image due to overexposure, underexposure, overdevelopment or underdevelopment.

D. Film and/or radiation beam positioning: Incorrect image position, cone cut and back exposure.

E. X-ray processing errors: Improper use of fixative, existence of stains, streaks, and fingerprints.

E.   Image Artifacts

G. Patient's errors (movement blur) (Jayasinghe *et al* 2013).

The observations on associated errors and the rejected region were recorded in a spreadsheet. The data was analysed by SPSS 17 software.

III. RESULTS

Distribution of the 258 rejected films in relation to the regions defined is given in Figures 1.
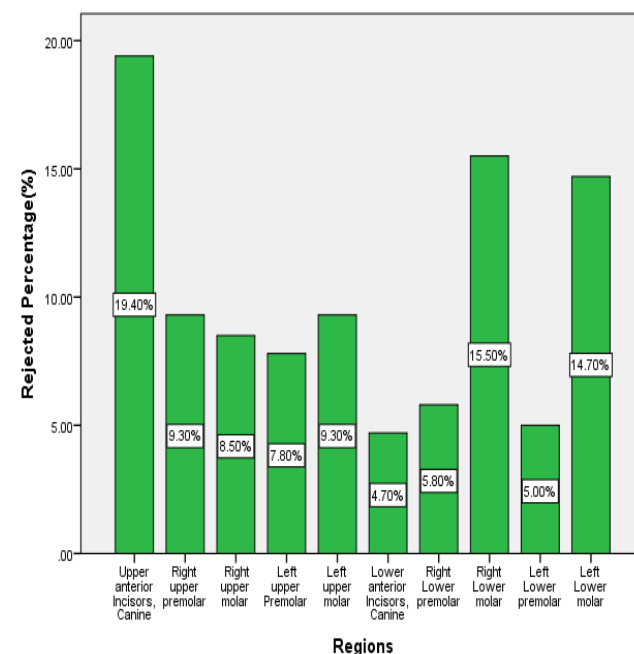

Figure 1. Distribution of rejected films in relation to regions defined.

As shown in Figure 1, the highest number of rejections was evident in the region of anterior teeth which include Incisors and canines occupying 19.4%, followed by right lower molar (15.5%) and left lower molar (14.7%).

The Upper molar and lower molar rejection percentages were 17.8% and 30.2% respectively. Total for molar rejections was 48% and it is almost half of the entire subjects. Rejected percentages of each region are shown in following figures. (Figures 2 and 3)
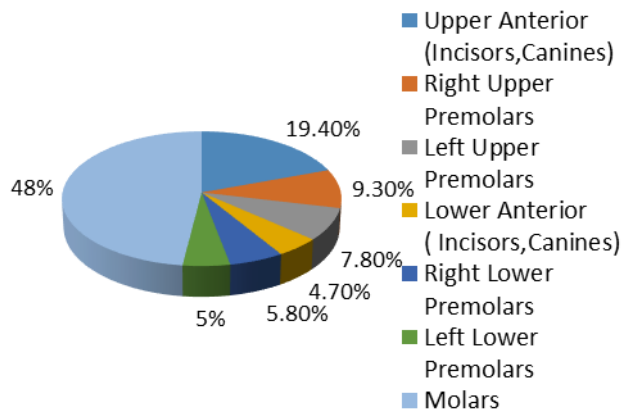
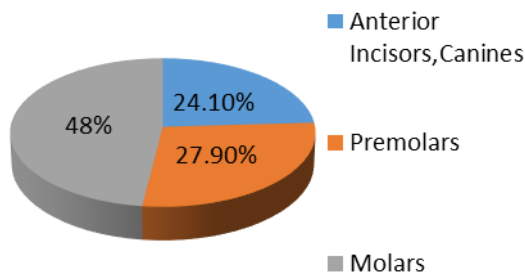Figure 2. Rejected percentages of different regions

Figure 3. Rejected percentages of different regions

Inferential statistics were performed to estimate the association between region & particular error factor. Chi-Square test statistics evident that there were significant association (P<0.05) in several error factors, such as positioning errors, periapical root cut, tooth centring and elongation with a particular region defined. In the study sample lower left molar, 31.91% were rejected due to positioning error, 26.50% were rejected due to periapical cut, 30% due to tooth center and upper anterior region were rejected in 50% due to elongation.
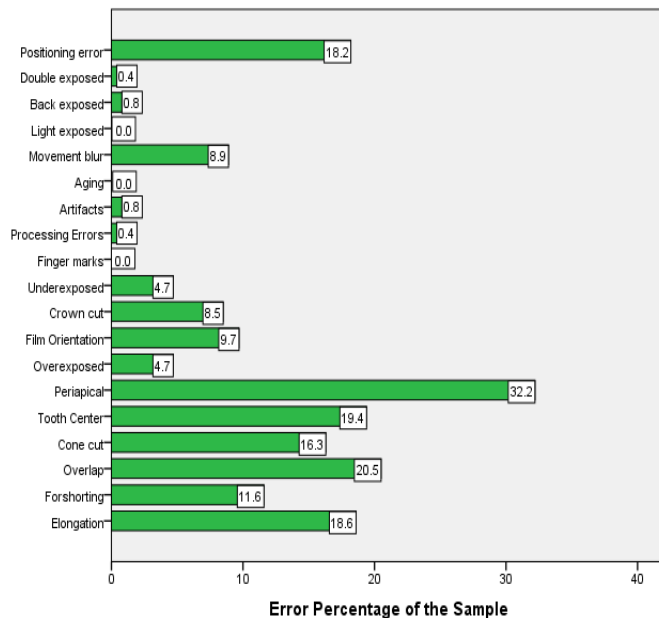

Figure 4. Rejected percentages for different rejection factors

The above graphical interpretation implies that the majority of rejected images is shown from molar region and its association to the errors are considered to be more important.

Distribution of the 258 rejected films in relation to the rejection factor or error is given in Figure 4.

In the present study, most highlighted errors were periapical cut, positioning errors, overlapping, tooth centring and elongation while the finger marks, film aging and light exposures are reported under the category of minute errors. So, the periapical cut of 32.2% are followed by overlapping (20.5%) and tooth centring (19.4%) respectively.

IV DISCUSSION AND CONCLUSION

The highest percentage of rejected region was molar 48% following premolar 27.9% and anterior teeth 24.1%. According to the study positioning error was the most highlighted error for the rejection of molar teeth in IOPA imaging. Elongation was the mostly affected error for the rejection of anterior teeth due to incorrect vertical angulation during the patient positioning. Further, a significant association between the elongation & anterior teeth region was evident. Results of the present study are similar to the results published in literatures by many authors (Patel *et al* . 1986; Peker *et al* . 2009) . A study done by Peker and Alkurt (2009) also reported statistically significant deference between errors and anatomical location. They found that the most common area to get errors were the maxillary molar area followed by maxillary premolar area and mandibular molar area. Finally the study suggested that modifications and

improvements of techniques involved in IOPA molar imaging are required to minimize the frequent repetitions of them. Further, it is also required to remedy the error of elongation by applying correct positioning of film and tube at the region of anterior teeth and these measures would contribute to minimize the frequent repetitions of IOPA Radiographs.

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