Research Article

Common Radiographic Errors in Dentistry

Umair Dastgir Bhatti*, Areeba Raisat Nehra, Arooj Tariq, Imrah Rafique and Gul muhammad shaikh

Foundation University College of Dentistry, Islamabad, Pakistan

*Corresponding Author: Umair Dastgir Bhatti, Professor and Head of Community Dentistry, Foundation University College of Dentistry, Islamabad, Pakistan.

Abstract

Intraoral radiographs are the backbone of dentistry and periapical radiographs are most commonly used intra oral radiographs. It was aimed to assess the error seen in periapical radiographs and to evaluate the types of error in association with anatomical structures. A retrospective study design was followed. The data of 3544 repeated periapical x-ray was retrieved from department of oral maxillofacial Radiology University of Lahore from year 2012 - 2016. A total 3544 repeated periapical radiographs were evaluated. According to anatomical region the percentage error in maxillary region was found as 81.9% while in mandibular region it was 19.1%. In accordance to types of error highest percentage error was found as overlapping 16.9%, crown cut 13.4%, absence of required tooth in the center of the film 11.7%, over exposed 10.2%. Other errors that were reported are cone cutting 8.3%, elongation 7.0%, under exposure 6.8%, improper film orientation 6.4%, processing errors 5.6%, absence of periapical region 3.1%, shortening 2.6%, artifacts 2.6%, finger marks 1.9%, light exposure 1.8%, movement blur 1.2% and back exposed 0.5%. This study has classified the types of radiographic errors with respect to their anatomical regions. Acknowledging the percentage of these errors will help dentist to reduce the incidence of repetition of dental radiographs, so that dentist can make better diagnosis and provide high quality treatment planning to the patient.

Keywords: Radiographic; Dentistry

Introduction

Radiographs are considered an indispensable adjunct in detecting, evaluating and even treating various lesions of teeth and oral cavity [1]. There are two types of dental radiographs that are intra oral and extra oral respectively [2]. Extra oral radiograph includes Oblique lateral radiograph, Skull and maxillofacial radiograph, Cephalometric radiograph, Tomographic radiograph and Dental panoramic radiographs [3]. Intra oral radiograph includes Periapical, Bitewing and Occlusal [4].

Intraoral radiograph is the back bone of dentistry [5]. Periapical is the most commonly used intraoral radiograph. Periapical radiographs are used for the pre-operative planning and evaluation because of its simplicity, significantly lower cost, less radiation exposure and easy availability in a dental clinical setup [6]. This type of radiograph provides vital information to aid in diagnosis of condition of tooth restorations, the presence of calculus or tartar, variations in tooth and bone anatomy, most common dental diseases [7-9].

In clinical dentistry periapical x-rays are almost involved in every clinical procedure starting from basic fillings to complex treatment like implant placement [10,11].

Errors that could be found in periapical radiograph manipulate the result accordingly. Technique and processing errors can affect accurate radiographic interpretation [12].

So it is of paramount importance that radiographic assistants and image support workers should be well informed and educated about positioning errors, processing errors, image contrast errors and angulations errors.

Processing errors does not only depend on radiographic assistants and image support workers but is also controlled by the degree of developing solution that includes developer activator restrainer, preservative and solvent. All of these constituents tend to undergo various chemical changes over the passage of time and become less potent. However the modern technique has reduced the processing errors but still in many parts of the world old technique is used to develop the x-ray.

The aim of the study was to evaluate errors in periapical x-rays with respect to anatomical regions. As these errors have a negative impact on the clinical work done in the respective area. For example artifact found on the periapical radiograph may interfere with the interpretation of the apical areas of the teeth.

Methodology

The study follows a retrospective observational study design. The data of all the repeated periapical x-ray of past 4 years was retrieved from department of oral maxillofacial radiology from year 2012 - 2016. A total of 3544 consecutive periapical radiographs which were taken by dental radiologist at the department using the receptor of size 2 (31x41mm) and speed (film ceadant agfa health care belgium) exposed by one intra oral machine vili systemi medicle1 (explor_x70,mains 220V, duty cycle 1/60, 4A,5 maximum exposure time 3.2s were included in the study. This machine was manufactured in 2001 in Italy serial number: 23010905.

The radiographs were processed in developing solution taken from 2 companies AGFA and Fuji, in powder form which is later mixed in liquid from a developing solution and were evaluated with respect to positioning, technical, and processing errors which were analyzed by the head of department of oral and maxillofacial radiology and errors were tabulated.

The ethical clearance was sort from the ethical review board of University College of Dentistry (annex A) attached herewith. The radiographs were evaluated with respect to technical and processing errors and then were analyzed. Teeth were classified as maxillary and mandibular anterior (incisors and canines) maxillary and mandibular posteriors (premolars and molars). X-rays that were, readable, included and those that were unable to interpret were excluded.

A convenience sampling technique was used in the study and all the periapical x-rays films available in the department (since these x-rays were repeated because of some error) were included in the study. Since the study followed a retrospective design and all repeated x-rays had to be included in the study, the total repeated x-ray films in past 5 years turned out to be 3544 which was a substantial number. Therefore a formal sample size calculation was not performed.

The data was entered in SPSS version 20 and analyzed using descriptive statistics. The results have were tabulated as percentages and graphs.

Results

A total of 3544 radiographs were evaluated. Errors with respect to anatomical regions and types of errors are discussed separately. According to anatomical region in maxilla highest percentage error was found in maxillary incisors as 38.5% and maxillary premolars as 33.5% respectively. While in mandible highest percentage error was reported in mandibular premolar area as 10.1%. hence, percentage error in maxilla with 81.9% is far high than in mandible with 29.1%.the anatomical distribution is presented in table.

In accordance to the types of error overlapping and crown cut were found as the most prevalent types of error as 16.9% and 13.4% respectively. Other types of error include elongation 7%, shortening 2.60%, cone cutting 8.30%, absence of periapical region 3.10%, over exposure 10.30%, improper film orientation 6.40%, under exposure 6.80%, finger marks 1.90%, processing errors 5.60%, absence of required tooth in the center of the film 11.70%, artifacts 2.60%, movement blur 1.20%, light exposure 1.80% and back exposed 0.50%. The types of error in percentage are shown in the (Table 1 and Figure 1).

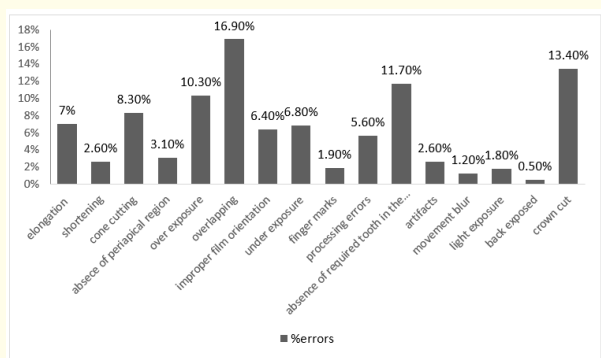| Anatomical Area	No of Errors	N%
Mandibular incisor area	219	6.2
Mandibular canine area	72	2.0
Mandibular premolar area	358	10.1
Maxillary incisor area	1366	38.5
Maxillary canine area	298	8.4
Maxillary premolar area	1197	33.8
Molars	34	0.9
Total	3544	100

Table 1: According to anatomical areas.

Figure 1: Types of error.

Discussion

Radiographs are valuable diagnostic tools as visual examination does not tell them everything that a doctor needs to know [13].

As a dental surgeon working in an overcrowded teaching hospital where patients of different socio economic status comes for the treatment of various dental diseases [14]. It is of paramount importance that a dental surgeon and associated dental staff should establish knowledge about potential faults in technique and processing of dental radiographs [15]. Radiographic errors lead to repetition of x-ray as a result of which patient experiences stress and unwanted radiation exposure. The wastage of radiographic films due to these error pose unnecessary financial burden on the institute. The money wasted on these films can be utilized to improve medical facilities in the hospital.

In our present study data of repeated 3544 periapical radiographs are reported which are categorized according to these type and percentage. The aim of the study was to examine the prevalence of and reasons of these errors in association with anatomical region.

Majority of the radiographs in our study possesses overlapping 16.9%, crown cut 13.4%, required tooth in the corner of the film 11.7% as a major error. This prevalence was different in accordance with previous studies conducted in India by Gopal., *et al* (2018) [8] and in U.S by Mauriello., *et al.* (2015) [16] respectively.

Cone cut was the most prevalent error recorded in these studies as 40.6% and 40% respectively. Cone cut was observed due to

the minimal expertise of the operating personal, displacement of the film when film holder is used or patient movement. While overlapping 16.9% as highest percentage error in our study was reported due to improper horizontal angulations of the x-ray that is the error which cause the image to shift too forward or backward, resulting in the overlapping of the interproximal surfaces. This problem can be solved if the radiologist use buccal object rule [17].

Other major errors in this study are crown cut and absence of required tooth in the center of the film. Crown cut 13.4% reported due to not enough film extending occlussal or more often x-ray beam perpendicular to the long axis of the teeth, rather than bisecting the angle between teeth and the receptor [18]. Absence of required tooth in the center of the film 11.7% is seen as not covering all teeth in the area of interest and not centralizing the film over the area of interest [19].

Faults like overexposure and under exposure accounted to be 10.2% and 6.8% respectively. The probable cause of these errors is negligence in exposure parameters during processing of the radiographs.

Technical errors like elongation 7.0% and shortening 2. 6% are mainly reported due to improper vertical angulation. However, error as improper film orientation 6.4%, expertise of the dental radiologist has an important role in reporting of this error.

Other radiographic faults like artifacts, light exposed, back exposed and finger marks which were found to be of minimal incidence computed to be 2.6%, 1.8%, 0.5%, 1.9% correspondingly.

Bearing in mind anatomical region a vast discrimination is seen while comparing maxilla and mandible. Most of the errors were seen in maxillary incisors as proper paralleling technique is not followed. A comparison was seen in comparison with the study conducted in turkey by peker and alkurt (2016). In which maxillary molar showed maximum errors 34.1% in their study [20].

Assembling this type of data will give analysis of the frequency with which radiographs are repeated, gives a measure of radiation exposure to patient in radiology department by possibly minimizing these errors we can reduce radiation over dose. Moreover, proper paralleling technique using film holder must be used as they align film precisely with collimated beam [21]. The criteria associated with repeating a film is subjective. There is no better way to

determine what the repeat rate should be. Each facility should decide on its own, but should strive for a repeat rate of no > 5 - 7% [22].

Conclusion

The present study focuses to identify prevalence of faults which are encountered during routine radiography and to develop an understanding about technical and processing errors which causes faulty radiographs.

Radiographs are essential part of any dental care treatment plan they are two sided coin that play a key role in diagnosis and prevention of dental diseases. That is otherwise impossible to detect routine clinical examination. This analysis will help in reducing repetition of radiographs, dental surgeons and radiologist to improve their professional skills, making patient safe from radiation overdose and to provide comprehensive dental care.

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