Evaluation of KV Reduction on image quality in OPG X-Ray

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Abstract

Panoramic radiographs are widely used to obtain an overall survey of the maxillofacial complex. One of the advantages is the reduction in radiation dosage compared with complete intraoral radiography. Digital imaging was first introduced in dentistry for intra-oral radiography. but is now widely available for panora micradiography. Many studies have demonstrated that it is possible to achieve a degree of dose reduction in digital panoramic radiography.

Keywordσ: *Kς , Reductiov ;imagε qualitψ ; ΟΠΓ Ξ-Raψ*

Introduction

In all aspect of radiography digital images has become the new way of view radiographic data to the monitor[1]. In the daily practice of dentistry panoramic radiography takes the second place in vital to intraoral radiography, however, panoramic imaging may be more useful to patients because it offers both excellent anatomical assessment and excellent evaluation of mandible fractures, tooth development and maxillary sinus disorders[2].

The ionizing radiation is an investigative method and the biological effects of radiation have established so much accuracy in the past that the radiation exposure has come to be a public attention fear. According to the ALARA principle (As Low As Reasonably Achievable) which holds that the amount of information must be acquired with the smallest possible amount of radiation[3]. The exposure reach of various digital systems has been described but we still lack information regarding benefit exposure which can produce diagnostically appropriate images[4].The decrease of radiation dose is considered as one of the most important benefits of digital radiography. It is however, debatable whether digital radiography really offers benefit to intraoral and extra-oral imaging. The conventional extra-oral radiography is depended on screen-film cassette, intensifying screen provides a major dose decrease in comparison to non-screen film-based imaging. Gaining the image digitally, hence, does not enhance much to the dose lessening in extraoral imaging [5].It is well-known that early detection and intervention of misdirected development can prevent substantial and difficult corrective treatments at later stages and that early detection and intervention most often depend uponradiographic examination. More generally for any group of dental patients , goodoral health is not possible without the use of x-ray; so then how to balance betweenthese good diagnostic goals and the hazards of achieving them[6].The patient dose has also been reported as the effective dose E, this method ofreporting resulted from the inability to make direct comparisons between radiographictechniques themselves and background radiation exposure in terms of dose becauseof the limited area of the body exposed during diagnostic radiology. It is onlythrough the E that possible adverse effects from irradiation to a limited portion ofthe body can be compared with possible adverse effects from irradiation of thewhole body[7].The special effects of low dose radiation are demonstrable only as astatistical increase in the frequency of normally occurring disease states among the general population[8] .The grade of danger that may be related to exposure to ionizing radiation and may be expressed in two ways; equivalent natural exposure and probability of stochastic effects[9].From dental radiography, the main hazard is radiation-induced cancer because of low doses exposure[10].The dentist must use professional judgment when prescribing diagnostic radiograph for dental patients. Diagnostic radiography must be only utilized after clinical examination taking into consideration

patients' history, dental and general health needs[11]. Every patient must be assessed for dental radiographs on an individual basis[12]. The clinician is advised to use the fastest film type available to minimize patients exposure..Two distances commonly used for intraoral radiography; these are 8 inches and 16 inches[13].The tissue area which are exposed to the primary beam must not exceed the minimum coverage and should be consistent with clinical feasibility[14].The collimation is utilized to confine the shape and size of the x-ray beam and to decrease the patient exposure. Patient exposure and dose are reduced when an x-ray beam is properly filtered. Filtration improves the quality of the beam by removing long-wavelength, low energy x-ray so that the mean energy of the beam is increased such that x-rays constituting the beam are nearly all in the use full diagnostic energy range [15]. Leaded thyroid collars are strongly suggested, though scatter radiation to the patient's abdomen is very low, leaded aprons must be utilized to diminish patient's exposure to radiation. The lead apron reduces exposure of the reproductive organs and the haematopoietic tissues and organs. The advent of digital imaging has developed radiology due to the improvement of computing systems for image retrieval and transmission and technologic innovation in image acquisition processes.[9]Panoramic radiography is a radiographic technique that creates a single image of the structures in the face, including both maxillary and mandibular arches and their supporting structure[16]. The panoramic radiograph is an excellent means of dental identification when utilized with the Polaroid photograph of the dentition[17].The Paatero in 1954, introduced the orthopantomograph , the apparatus of panoramic tomography of the maxilla and mandible. It has become widely used in otorhinolaryngology, for radiographic examination ofthe maxillofacial region. [18].The panoramic radiograph permits professionals to observe a large area of the maxilla and mandible on a single image. The aim of the study was to evaluate the effect of reduction of kilo voltage on interruption of certainanatomical landmark in O.P.G x-ray.

Patients and Materials

The Planmeca Proline digital panoramic x-ray machine was used in this study with Dimax3 software, the machine is manufactured by planmeca and has the following specifications [19]: X-ray tubes / focal spot size : D-052SB/0.5* 0.5 mm ; Target angle: 5° ; Total filtration: 2.5 mm Al ; Anode voltage: 60-80 kv ±2.5kv ; Anode current: 4-12 mA ±1.0 mA ; Exposure time: 2.5-18 s as indicated ±10% ; SID : 480 mm ; Magnification: constant 1.2 ; Sensor height: 136 mm ; Line voltage:100,117, 220-230 , 240v ; Regulation: automatic ±10% ; Line current: max. 8A at 230v, 15 A at 100v ; Weight: 108 kg ; Cooling period: automatically controlled

Methods

After consultation with the engineer responsible about the standardization and maintenance of the x-ray machine, all the subjects were examined radiographically by using digital panoramic radiography machine. Two digital panoramic images were obtained for each subject at 5 minut esinterval , the first image was with standard exposure setting, which is recommended by the manufacturer. The second image was taken to the subject with reduced tube current by 50% and so each subject had two digital images. The kVp was kept constant throughout the study; all images were obtained by one radiographer. These tandardization of subject position after first image taking in order to take the secondimage was achieved by lines drawn on the face to coincide with the horizontal and vertical light beams on the machine. In addition a line was drawn on the floor for the feet position[19].

Panoramic procedure

1-The procedure about to be performed was explained for the patient.

2-All objects like eyeglasses, ear rings, necklaces hearing aids, and hair pins, complete or partial dentures should be removed.

3-The patient was advised to stand or sit with the back straight and erect.

4-The patient was instructed to use the plastic bite-block to be bitten on so that the lower andupperanterior teeth were located in an end to end position in the groove (notch), which ison the bite block. This groove is utilized to align the teeth in the focal trough, light was positioned between the canine and lateral incisor of the patient.

5-The middle sagittal plane was positioned vertical to the floor so that the patients head not be tipped or tilted to avoid image distortion.

6-The Frankfort plan was positioned parallel with the floor, so that the occlusal plane is locate dat the correct angle [19].

Finding

Two images for each subject were assessed by the two examiners for

evaluation of the fourteen anatomical landmarks. Each examiner gives the score of comparison of each landmark independently and separately.

1.The Sample

This study was based on the analysis of 20 subjects, 10 male and 10 female. Theage distribution was between 20-30 years old.For each subject we have two digital panoramic images. There were unacceptable images for viewing for seven of the subjects.

So those seven subjects with their images were excluded from the sample. The seven excluded subjects consisting 14% of the total sample. So the sample that has been examined is 20 samples.

2. Rating scores for male sample by the first examiner

The results show that scores were distributed between equal and worse score with the higher number and percentage for the equal score .For the equal score ,13landmark were above 90% .For the worse score ,3 landmarks recorded with zero worse score with higher number and percentage of worse score in one land mark. There was no reading for other scores, Table (1).

Table (1): Number and percentage of rating scores of Male

Anatomical landmarks		Rating score			total
		worse	Equal	better	
Nasal septum	No.	1	8	1	10
	Percentage	10.0%	80.0%	10.0%	100.0%
Floor of maxillary antrum	No.	4	5	1	10
	Percentage	40.0%	50.0%	10.0%	100.0%
Nasal cavity	No.	1	2	7	10
	Percentage	10.0%	20.0%	70.0%	100.0%
Zygomatic arch	No.	2	4	4	10
	Percentage	10.0%	40.0%	40.0%	100.0%
Mastoid process	No.	2	7	1	10
	Percentage	20.0%	70.0%	10.0%	100.0%
Styloid process	No.	5	4	1	10
	Percentage	50.0%	40.0%	10.0%	100.0%
Glenoid fossa	No.	1	9	0	10
	Percentage	10.0%	90.0%	0.0%	100.0%
Head of condyle	No.	1	5	4	10
	Percentage	10.0%	50.0%	40.0%	100.0%
Mental foramen	No.	1	6	3	10
	Percentage	10.0%	60.0%	30.0%	100.0%
Inferior border of mandible	No.	0	7	3	10
	Percentage	0.0%	70.0%	30.0%	100.0%
Hyoid bone	No.	1	7	2	10
	Percentage	10.0%	70.0%	20.0%	100.0%
Inferior dental canal	No.	1	7	2	10
	Percentage	10.0%	70.0%	20.0%	100.0%
molars	No.	1	7	2	10
	Percentage	10.0%	70.0%	20.0%	100.0%
Incisors	No.	-	-	10	10
	Percentage	-	-	10.0%	100.0%

3.Rating scores for female sample by the second examiner

The results show that scores were distributed between the equal and worse score with higher number and percentage for equal score .the equal scores were above 90% in 13 of the landmarks, also there was no reading for worse score is recorded for 12 landmarks and better score is 13. There was no reading for other scores recorded. (Table 2).

Table (2): Number and percentage of rating scores of female

Anatomical landmarks		Rating score			total
		worse	Equal	better	
Nasal septum	No.	2	8	0	10
	Percentage	20.0%	80.0%	0.0%	100.0%
Floor of maxillary antrum	No.	3	7	0	10
	Percentage	30.0%	70.0%	0.0%	100.0%
Nasal cavity	No.	0	1	9	10
	Percentage	0.0%	10.0%	90.0%	100.0%
Zygomatic arch	No.	1	9	0	10
	Percentage	10.0%	90.0%	0.0%	100.0%
Mastoid process	No.	0	9	1	10
	Percentage	0.0%	90.0%	10.0%	100.0%
Styloid process	No.	7	3	0	10
	Percentage	70.0%	30.0%	0.0%	100.0%
Glenoid fossa	No.	0	9	1	10
	Percentage	0.0%	90.0%	10.0%	100.0%
Head of condyle	No.	1	9	0	10
	Percentage	10.0%	90.0%	0.0%	100.0%
Mental foramen	No.	1	9	0	10
	Percentage	10.0%	90.0%	0.0%	100.0%
Inferior border of mandible	No.	0	3	7	10
	Percentage	0.0%	30.0%	70.0%	100.0%
Hyoid bone	No.	1	9	0	10
	Percentage	10.0%	90.0%	0.0%	100.0%
Inferior dental canal	No.	1	8	1	10
	Percentage	10.0%	80.0%	10.0%	100.0%
molars	No.	1	8	1	10
	Percentage	10.0%	80.0%	10.0%	100.0%
Incisors	No.	-	-	10	10
	Percentage	-	-	100.0%	100.0%

4. Rating scores for total sample by the first examiner

The result represent the total summation of both male and female sample by the first examiner .There was a distribution of the result between equal and worse score with higher number and percentage of equal score .For the equal score 13 of the landmarks were above 90%, for the worse score only 4 landmarks have the higher number. There were no reading for other scores (better, much better, much worse).Table (3):

Table (3): Number and percentage of rating scores of total sample

Anatomical landmarks		Rating score			total
		worse	Equal	better	
Nasal septum	No.	3	16	1	20
	Percentage	15.0%	80.0%	5.0%	100.0%
Floor of maxillary antrum	No.	11	8	1	20
	Percentage	55.0%	40.0%	5.0%	100.0%
Nasal cavity	No.	1	3	16	20
	Percentage	5.0%	15.0%	80.0%	100.0%
Zygomatic arch	No.	3	13	4	20
	Percentage	15.0%	65.0%	20.0%	100.0%
Mastoid process	No.	2	16	2	20
	Percentage	10.0%	80.0%	10.0%	100.0%
Styloid process	No.	12	7	1	20
	Percentage	60.0%	35.0%	5.0%	100.0%
Glenoid fossa	No.	1	18	1	20
	Percentage	5.0%	90.0%	5.0%	100.0%
Head of condyle	No.	3	16	1	20
	Percentage	15.0%	80.0%	5.0%	100.0%
Mental foramen	No.	2	15	3	20
	Percentage	10.0%	75.0%	15.0%	100.0%
Inferior border of mandible	No.	0	10	10	20
	Percentage	0.0%	50.0%	50.0%	100.0%
Hyoid bone	No.	2	16	2	20
	Percentage	10.0%	80.0%	10.0%	100.0%
Inferior dental canal	No.	2	15	3	20
	Percentage	10.0%	75.0%	15.0%	100.0%
molars	No.	2	15	3	20
	Percentage	10.0%	75.0%	15.0%	100.0%
Incisors	No.	-	-	20	20
	Percentage	-	-	100.0%	100.0%

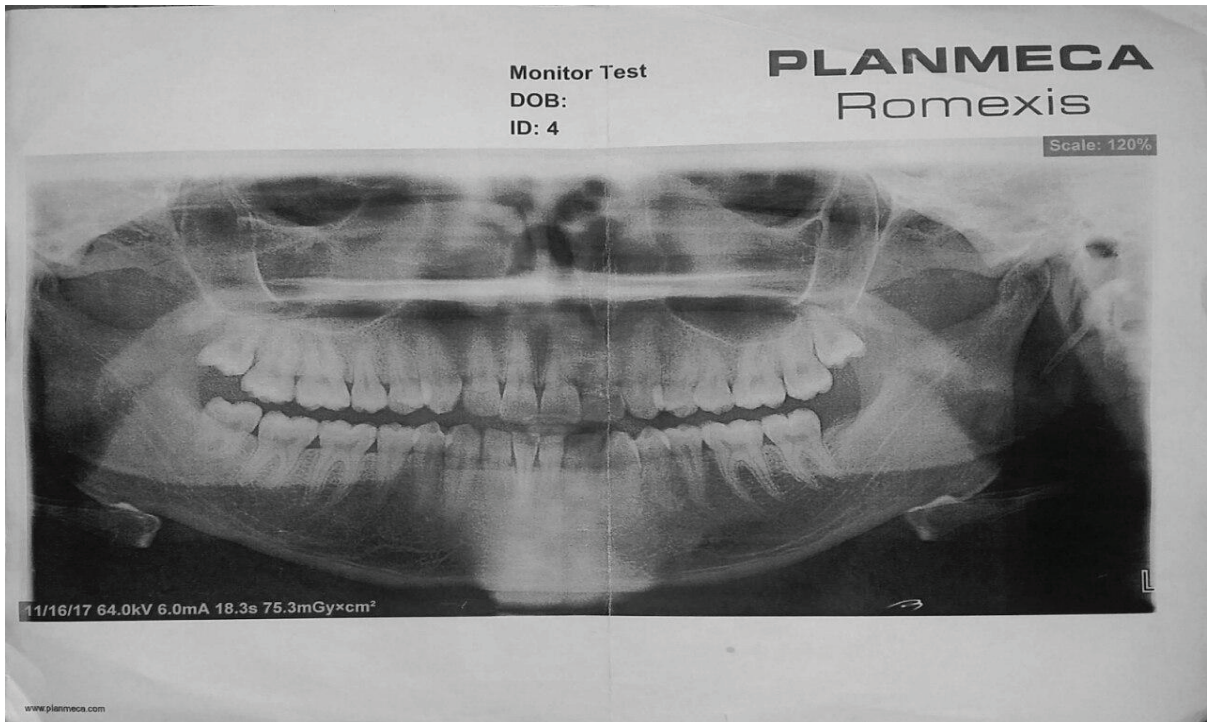

Figure (1): first image at standard exposure tube current as recommended by Manufacturer

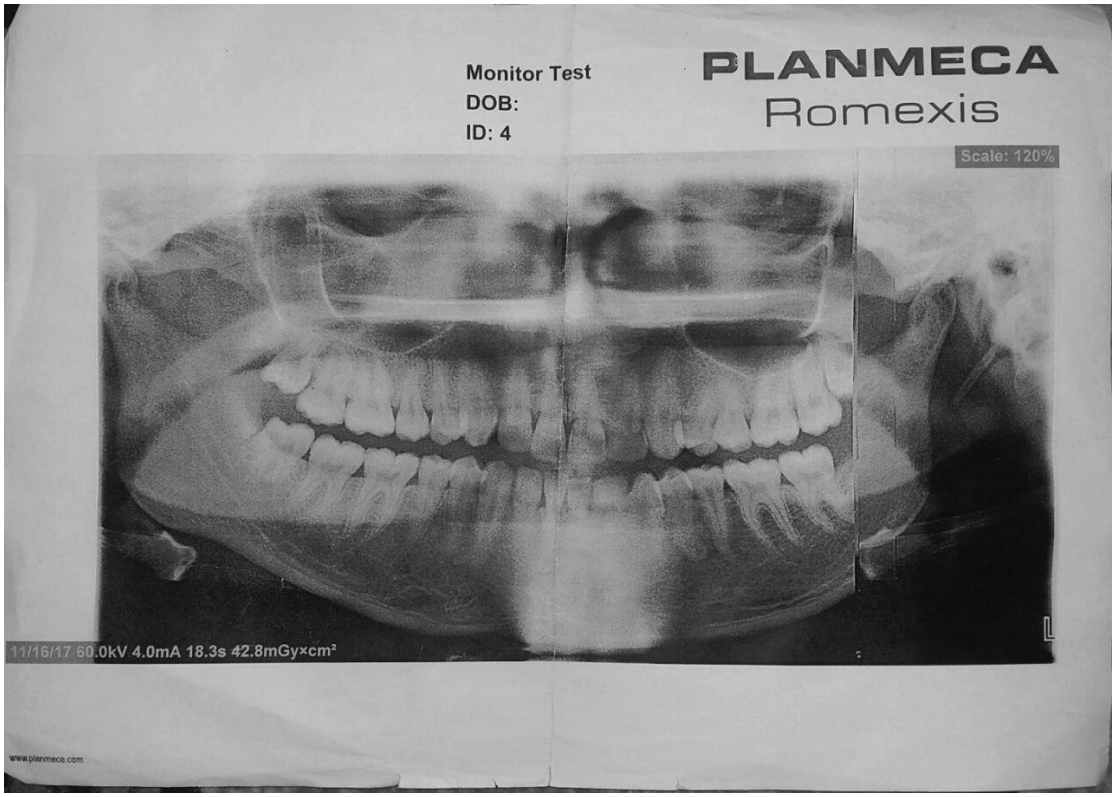

Figure (2): second image at 15% reduction of tube current (mA)

Table 4 : number and percentage of each individual score of total sample

Rating score	No.	%
Better	1	5.0
Equal	16	80.0
Worse	3	15.0
total	20	100.0

Discussion

Past studies have demonstrated that it is possible to achieve a degree of dose reduction in digital panoramic radiography without impairment of image quality. The aims of the present clinical study were to evaluate the effect of 15% dose reduction with the digital panoramic radiography unit on subjective image quality and interpretation performance hoping to achieve the desirable amount of information with the smallest amount of radiation.

Conclusions

This study has shown that in digital panoramic radiography, a dose reduction of 15% can be achieved while maintaining satisfactory image quality and interpretation performance.

Recommendations:

1-Design to assess the perfection of interpretation of certain anatomical landmarks at reduced dose digital panoramic radiography.

2-The capability of minimizing hazardous effects of radiation through studying the effect of dose reduction on human living tissue in digital panoramic radiography.

Conflict of Interest: non

Source of Findings: self

Ethical Clearance: This research was carried out with the patients .

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