

Assessment of the subjective image quality in the digital panoramic radiography at a reduced tube current level

Dr. Ahlam A. Fattah B.D.S M.Sc. (Ass. Prof.)

Abstract

To assess the subjective image quality in digital panoramic radiograph, when the tube current level (mA) is reduced.

By Dimax 3 digital planmeca x-ray machine two digital panoramic projections can be obtained for a dry skull, the first projection was performed at standard exposure setting, the tube current level (mA) was reduced in the second exposure by 25%, 50%, and 75% respectively. 10 observers evaluated both projections for the anatomical landmarks which are commonly appearing in the panoramic radiograph.

Radiographs taken at the reduced (mA) level of 75% had highly statistically significant inferior score $P < 0.0001$ for anatomical details.

At reduced tube current level (mA), radiographs had inferior subjective image quality, but a reduction in tube current level (mA) of approximately 50% is accepted.

Keyword:-Digital panoramic radiography, tube current (mA).

Introduction

A major goal of diagnostic radiology is maximal visualization of diagnostic information with minimal radiation dose to the patient¹.

The term digital radiography refers to a method of capturing a radiographic image using a sensor, breaking it into electronic pieces, and presenting and storing the image using a computer, one of the advantages of the digital radiography is the reduction in the radiation dosage for the patient compared with a complete intraoral survey².

Previous studies have demonstrated that it's possible to achieve a degree of dose reduction up to 40% in digital panoramic radiography without impairment of subjective image quality³.

Dula et al⁴ have reported in an experimental evaluation of digital panoramic radiography a decrease of

up to 43% in the radiation dose without loss of subjective image quality.

In the present study the aim is to evaluate the subjective image quality for digital radiograph. How much the tube current level (mA) can be reduced without adverse effect on the quality.

Materials and Method

X-ray machine:-

The panoramic x-ray machine that was used in this study was Dimax 3 digital planmeca x-ray machine fig.1 with focal spot size 0.5 x 0.5 mm. Target angle 5 degree, the total filtration is 2.5 mm Al. the magnification is 1.2.

Image acquisition:-

A digital panoramic image was performed for a dry skull at 66 KVP and 8 mA. The second image was performed at the same KVP which is kept constant, but at a reduced tube

current level (mA) in accordance with the study design, where the tube current level (mA) was reduced by 25% in the second exposure and by 50% in the third exposure and by 75% in the fourth one fig.2, 3, &4.

Observers:-

10 dentists with clinical experience scored the radiographic image for evaluation of the subjective image quality using the rating scale based on three numbers from 1 which means the worst image for diagnosis to 3 which means the best for diagnosis⁵.

Subjective image quality was evaluated by means of the visibility of 12 anatomical landmarks table1, which are commonly appear in panoramic radiograph⁶.

Statistical analysis:-

Analysis of variance (ANOVA) was used to test the significance of variance between the means of scores given by 10 observers for evaluating the subjective image quality of the digital panoramic radiographs at tube current level (mA) recommended by manufacturer and the reduced level by 25%, 50%, and 75%.

Results

The results for this study were summarized in table,2,3 ,4 so from these table we noticed that :

1. There was a tendency for the scores to decrease with decreasing the tube current level (mA).
2. The tube current level (mA) reduction of 25% - 50% is possible with the digital panoramic radiograph without adverse effect on the subjective image quality.
3. The tube current level (mA) reduction up to 75% was adversely affected the subjective image quality.

Discussion

Reduction of radiation dose to the patient can perform by reducing the tube current level (mA) which has a direct effect on the quantity of x-radiation.

While the KVP level unchanged, because holding the KVP level constant lead to a constant x-ray beam energy and acceptable contrast in both compared radiographs⁷.

Practically , in our clinic we follow the manufacturer recommendation about the tube current level (mA) and KVP used to obtain a radiographic image , but as a result of this study it's useful to reduce the tube current level (mA) down to 50% specially for the follow up examinations (e.g. orthodontics) which required radiographic evaluation over long period of time .

The results of this study are confining with the previous researchers⁸ that a tube current level (mA) reduction of 40%-50% is possible with panoramic radiography without affecting the subjective image quality.

In conclusion, this study has shown that in digital panoramic radiograph a tube current level (mA) reduction up to 50% can be achieved while maintaining a satisfactory image quality.

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Table 1: A list of anatomical landmarks which are commonly represented on panoramic radiograph:

Region	Anatomical landmarks
1. Mandible	1. Condylar process Coronoid process Mandibular canal Mental foramen
2. Maxilla	2. Anterior nasal spine Maxillary tuberosity Maxillary sinus Zygomatic arch
3. Dento alveolar	3.Periapical lamina dura Periodontal ligament space
4. Temporo Mandibular joint	4. Styloid process External auditory meatus

Table 2: The Mean scores by 10 examiners and standard deviation (St. Dev.) for the radiographic image quality at different Tube current level (mA).

Tube current level(mA)	Mean scores	St. Dev.
1.Standard Tube current level (8mA)	2.97	0.0483
2.Reduction of 25% (6mA)	2.73	0.0675
3. Reduction of 50% (4mA)	2.48	0.0789
4. Reduction of 75% (2mA)	1.22	0.0422

Table 3: Total mean of scores and ANOVA test revealed highly significant differences between different tube current levels (mA).

Total mean	Min.	Max.	F. test	P. Value
2.35	1.22	2.97	1632.18	0.000 p<0.0001 H.S

Table 4: T-test revealed the highly significant differences (HS) between different Tube current level(mA).

Tube current level(mA)	T-test	P-value	Sig.
1.Standarad VS reduction of 75%	86.31	0.000	HS
2.Reduction of 25% VS reduction of 75%	60.00	0.000	HS
3.Reduction of 50% VS reduction of 75%	44.55	0.000	HS



Figure 1 :- dimax 3 digital planmeca x-ray machine .

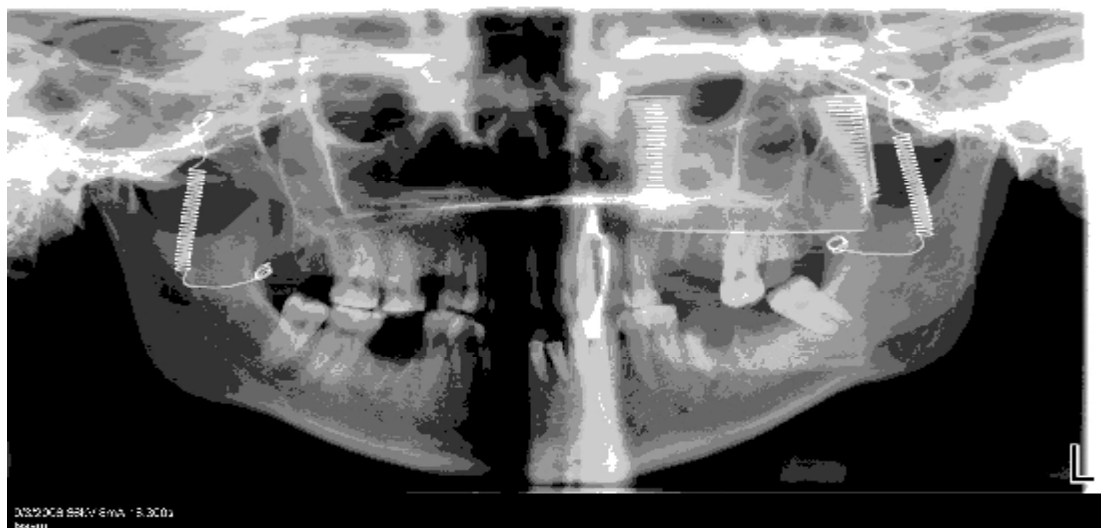


Figure 2:- digital panoramic radiograph at standard tube current level (mA) .

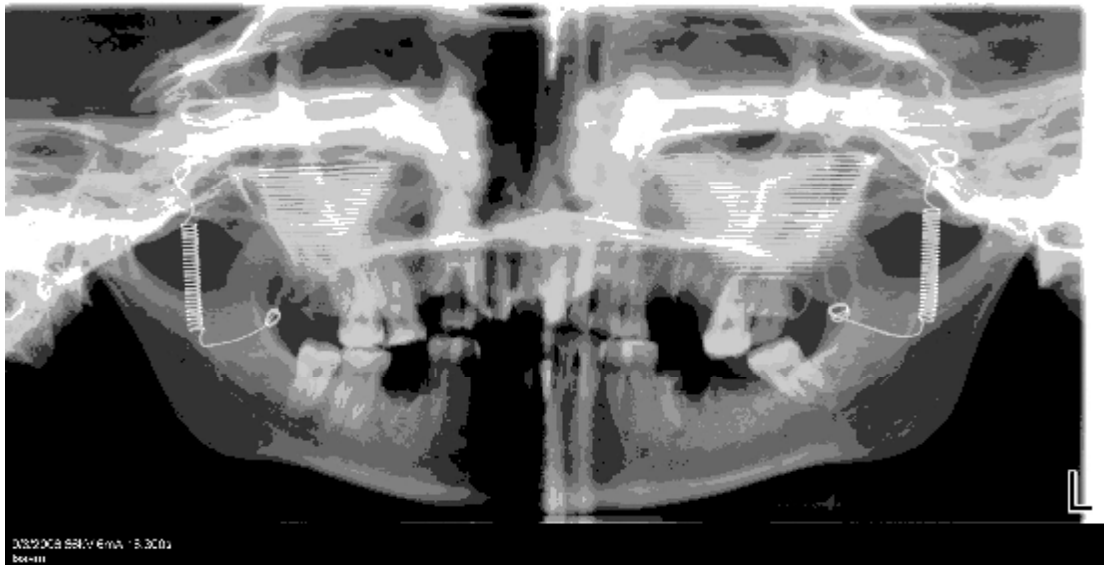


Figure 3 :- digital panoramic radiograph where the image obtained with a tube current level (mA) reduced by 25% .



Figure 4:- digital panoramic radiograph where the image obtained with the tube current level (mA) reduced by 50%.