Assessment and comparative study of Entrance Skin Dose for digital panoramic x-Ray equipments

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Background and objective: A panoramic radiograph is a panoramic scanning dental x-ray of the upper and lower jaw. It shows a two-dimensional view of a half-circle. The aim of this study was to estimate of entrance surface dose (ESD) to the patient, in diagnostic panoramic radiology, to compare ESD (Entrance skin dose) for panoramic radiographies, analyze the relative advantage and disadvantage of their modalities.

Methods: FONTA X Pan DG Plus devices (version 121001 code 6968271110) in dental clinical hospital and Planmeca pro max (ASENTAJANKATO 6 FI -00880 Hilsinki) in Xanzad centre were used in this study. panoramic imaging units offer an advanced and versatile 2D imaging experience. From flexible patient positioning to creative innovations and high image quality, these panoramic imaging units represent 2D dental imaging at its finest. ESD was estimated using ESD equation methods. A hundred patients were enrolled in this study for determination of the entrance surface dose that divided into five age groups theoretical.

Results: As a result showed that the mean of the entrance skin dose for patient up to 6 years, 7-12 year, female adult, male adult and large adult are (0.12mGy, 0.13mGy, o.14mGy,1.51mGy, 1.53mGy) for digital panoramic radiography in Dental x-ray respectively and (0.06mGy,0.07mGy, o.o7mGy, o.11mGy, o.13mGy) for digital radiography in Xanzad centre of dental treatment.

Conclusion: The study showed a significant association between entrance skin dose received by patient in dental clinical hospital and Xanzad centre and the study concludes that the received entrance skin dose by patients in clinical dental Erbil hospital higher than the other patient in Xanzad centre. It is recommended that the use of the newer equipment and the use of the proper radiological parameter can significantly reduce the Entrance skin dose.

Keywords: Digital panoramic X-Ray, KVp, mA, FSD (Focal skin distance), adult, weight

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Introduction

Panoramic imaging is one of the most commonly used imaging technique in dentistry. Being able to assess the radiation dose patients receive during procedures accurately is a crucial step in the management of dose.[5] The discoveries of X-rays and radioactivity had its own advantage and disadvantages. Scientists learnt that radiation is not only a source of energy in medicine, but it could also be a potential threat to human health if not handled properly.[10] Variation in patient dose emerges from the clinical condition, radiologist skill, the current tube, tube potential and focus skin distance.[2] The knowledge of the radiation dose received by the patient during the radiological examination is essential to prevent risks of exposure.[8] The entrance skin dose is the measure of the radiation dose that is absorbed (mGy) by the skin as it reaches the patient.

Dental panoramic radiography equipment consists of a horizontal rotating arm which holds an X-ray source and a moving film mechanism (carrying a film) arranged at opposed extremities. The patient's skull sits between the X-ray generator and the film.The X-ray source

is rectangular collimated beam.[12] The operating voltage of an X-ray machine is stated as the kVp.[13] Human organ imaging is performed by different systems and methods.[14] Knowlage of entrance skin dose is important to formulate national diagnostic reference.[15,16] Over the years, the dose of radiation per X-ray has decreased with the use of newer technology, such as digital radiography in diagnostic imaging exposure to radiation must be accompanied by related that outweigh the assossiation risk for the use of radiation.[17] Medical exposures are the most important source of public exposure to man-made radiation.[18] Entrance surface dose (ESD) is the most important parameters measured in diagnostic radiology.[20] ESD is a measure of the absorbed dose by the skin at the entrance point of the X-ray beam and can be performed directly or indirectly. ESD in diagnostic radiography is proportional to factors such as the tube current, expo- sure time and the square of tube voltage.[19]

Subjects and methods

The observation study was carried out in Dental college clinical hospital and Xanzad centre in Erbil city for four months which included the hundred most common performed diagnostic Panoramic X-ray examinations, that is; fifty for panoramic X-ray in Dental college clinical hospital and fifty for Xanzad centre .The total filtration ranged from 2.00 to 3.5 mm Al, 2.00-3.00 mm Al for Digital panoramic x-ray(OPG) types of digital imaging technologies use electronic sensors, in dental x-ray department and Xanzad centre respectively. FONA DG Plus is an extraoral panoramic and cephalometric X-ray system based on innovative technologies characterised by multiple software-controlled projections for better diagnostic rendering Radiographic factors included tube potential (kVp), exposure setting (mAs), and focus skin distance (FSD) that were normally used in each radiology room by radiographers for average size and age, child up to 6 years old, child from 7-12 years old, female adult, male adult and large adult patients. In the present work the Chuan and Tsai formula.[14] is applied to calculate the ESD for patients coming to the X-ray radiographic centre.[21] So Entrance skin dose is directly measurable by the following equation:

$$\text{ESD} = C\left(\frac{KVp}{FSD}\right)\left(\frac{\text{mAs}}{mmAl}\right.$$

Statistical analysis. Data were expressed as mean of ESD. Statistical analysis was done using the statistical package for social science-version 22. Different between two mean ESD of patient was done using t-test to look for the difference between two age group, ANOVA- test also was used for difference among more than two groups. High statistical significant considered (p-value < 0.05)

Statistical analysis also was done for each age group in dental x-ray and Xanzad centre.

Table 1: List of abbreviations.

Abbreviation	Technical parameters
ESD	Stand for entrance skin dose.
C	Is the constant which is equal to 0.2775.
Kvp	Is applied to the tube potential.
mAs	Is the tube current multiplied by exposure time.
FSD	Is the focus to skin distance.
mmAl	Is the thickness of aluminium filtration.

Results

Mean values of ESD, FSD, kVp, mAs, height and weight along with their range for each type of Digital radiological examination obtained in table (2) and table (3) or digital radiography(OPG), in X-Ray department in college of dentistry and Xanzad centre respectively.

The range and mean of the entrance surface dose values in digital panoramic radiography in dental X-Ray were (0.12mGy,

Table 2; Demographic data for digital panoramic for all age up to6 years old, 7-12 years adult female, adult male and large adult in dental X-Ray examination

Range											
Parameters		**SD**		**SD**		**SD**		**SD**		**SD**	**Pvalue**
Age/Year	Up to 6		7-12		Adult Female		Adult Male		Large Adult		
Weight/Kg	20		28		62		71		82		
Hight/m	70		79		168		179		178		
mA	6.3		6.3		6.3		6.3		6.3		
Time/sec	60		60		60		60		60		
KvP	70		73		75		77		79		
FSD	24		24		24		24		24		
mmAl	2.5		2.5		2.5		2.5		2.5		
ESD/mGy	0.12	0.1	0.13	0.13	0.14	0.15	1.53	0.7	1.53	0.76	0.07

Table 3; Demographic data for digital panoramic for all age up to 6 years old, 7-12 years old, adult female, adult male and large adult in Xanzad centre.

Range											
Parameters		**SD**		**SD**		**SD**		**SD**		**SD**	**Pvalue**
Age/Year	Up to 6		7-12		Adult Female		Adult Male		Large Adult		
Weight/Kg	23		26.5		67		73		79		
Hight/m	65		69		170		175		180		
mA	5		8		9		13		14		
Time/sec	15.81		15.81		15.81		15.81		15.81		
Kv P	62		64		66		68		70		
FSD	26		26		26		26		26		
mmAl	2.75		2.75		2.75		2.75		2.75		
ESD/mGy	0.06	0.01	0.07	0.03	0.071	0.03	0.11	0.012	0.13	0.03	0.15

Table 3: p- value for ESD of each age group, from up to 6 years, 7-12 years, female adult, male adult and large adult patient undergoing dental digital panoramic radiography in dental x-ray department and Xanzad centre.

Clinical variable		P value
Age(year)	Up to 6	1.20
	7-12	9.69
	Female adult	2.30
	Male adult	2.29
	Large adult	1.64

0.13mGy, 0.14mGy, 1.53mGy, 1.53mGy) for child up to 6 years old, child from 7-12, adult female, for adult male and large adult respectively. And in digital radiography in Xanzad centre were (0.06mGy, 0.07mGy, 0.07mGy, 0.11mGy, 0.13mGy).

In the present study showed that there are no significant differences at range (p value= 0.07) between the received dose by patients for digital panoramic radiographic in dental X-Ray examination and Xanzad centre. Also, in table (3) for all age group there were no significant differences (0.15) for digital radiographic in Xanzad centre.

In table (4) statistical analysis was done for each age group, for up to 6 years old,7-12, female adult, male adult and large adult we see very high significant difference in ESD for patient in college hospital dental centre and Xanzad centre (p-value= 1.20, 9.69,2.30,2.29, 1.64) respectively.

Discussion

As a results showed that mean entrance skin dose for digital panoramic x-ray in dental XRadiology department in college of dentistry of (0.12mGy,0.13mGy, 0.14mGy, 1.53mGy, 1.53mGy), and for digital radiography in Xanzad centre, (0.06mGy, 0.07mGy o.07mGy, 0.11mGy, o.13mGy) for child up to 6 years old , child from 7-12 years, adult female , adult male and for large adult are differs to those whom in , A chaparian Dr, F. Dehghanzade which is 7.32, 4.70,3.55, and 2.1 for patient in 5-10, 15 years old and adult age group.[6] So the result in the current study and the other study and this difference is more likely to be caused by systematic variation due to measurement method in using the different tube current and operating potential.[1]

Wide ESD differences in two devices may emerge from complex cause, but in general high kilovoltage and low milliamperes are associated with high dose.[9]

The stander deviation for ESDs was found to be (0.76) for digital panoramic x-ray in dental x-ray department and (0.03) in Xanzad centre. Assessment of entrance skin dose for patients in digital radiography examinations should be made as a means for optimization of the radiation protection of the patients.[7]

In the current study we show that there are no significant differences (p vlue=0.07) for all age group in received ESD by the patient in clinical dental hospital,also for whom in Xanzad centre there are no significant differences (p valu=0.15) for all age group.

Accurate dose measurement in diagnostic radiology procedure isis necessary.[4,11] In the diagnostic imaging, exposure to x-ray radiation must be accompanied by a related benefit that outweighs the associated risk for the use of that radiation.[3] A variety of imaging panoramic radiography was compared for their ESD.

The study found that the value of the extend ESD in panoramic radiography in dental X-Ray and Xanzad centre corresponded with and differ from one another and there was a clear discrepancy between the two device and highly significant differences between age group up to 6, from 7-12, adult female, adult male, large adult in dental clinical hospital and Xanzad centre.

Conclusion

The study showed a significant association between entrance skin dose received by pa-

tient in dental clinical hospital and Xanzad centre and the study concludes that the received entrance skin dose by patient in clinical dental Erbil hospital higher than the other patient in Xanzad centre. It is recommended that the use of the newer equipment and the use of the proper radiological

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