HEALTH RISK ASSESSMENT OF DOSES TO PATIENTS' EYES FROM DENTAL X-RAY EXAMINATION

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Abstract

The skin entry dose to patients' eyes during dental x-ray examination was carried out on one hundred and ten patients comprising infants and adult of both sexes. The dose measurements was performed at Alpha dental centre, Ibadan, using Lithium fluoride thermoluminiscent dosimeters (TLD). The results of the study showed that the mean absorbed dose of the entire population is 0.438 mGy. The mean absorbed doses (mGy) for patients below 18yrs, between18-45 yrs and above 45yrs are 0.283, 0.461, and 0.391 respectively. A paired t-test was used to compare absorbed dose by the patients with the maximum permissible dose limit of 1mGy recommended by the International Commission on Radiological Protection (ICRP). The result of the t-test indicates the mean absorbed dose is significantly less than 1mGy. Also sex and age groupings show no significant effect on the absorbed dose. It is nevertheless, desirable to limit patients to the minimum exposure value consistent with the medical requirements.

Keywords: *X-radiation, thermoluminiscent dosimeters, absorbed dose.*

Introduction

Use of ionizing radiation in both diagnosis and therapy in human medicine has been widespread since the discovery of x-rays in 1895. Advances in the latter half of 20th century increased the use of medical radiation.

Exposure of human to ionizing radiation gives rise to absorption of its energy by the body organs according to the metabolism of the element involved and the organs. The response of an organ to radiation depends generally on its radio sensitivity, type of radiation, the energy deposited on the organ, as well as time and spatial distribution of the energy lost (Wood *et al*, 1989).

The manifestation of any form of biological consequences from an exposure to x-radiation is also dependent on such factors as sex, age, lifestyle and disease status. Exposure to x-radiation is most strongly associated with leukemia, and cancer of the thyroid, breast, and lung; association have been reported at absorbed dose of less than 0.2Gy (Bhatia et al, 2002). The risk of developing these cancers, however, depends to some extent on age at exposure. Childhood exposure is mainly responsible for increased leukemia and thyroid-cancer risks, and reproductive-age exposure for increased breast-cancer risks.

In addition, some evidence suggests that lung-cancer risk may be most strongly related to exposure at latter age in life. Associations between radiation exposure and cancer of the salivary glands, stomach, colon, bladder, ovary, central nervous system, and skin have been reported, usually at doses greater than 1 Gy (Kleinerman *et al,* 1995; Lichter *et al,* 2000; Bhatia *et al,* 2002).

X-radiation has also been shown to introduce genetic damage in somatic cells and transmissible mutations in mammalian germ cells. The DNA molecules may be damaged directly, by interaction with ionizing radiation, or indirectly, by interaction with reactive products of the degradation of water by ionizing radiation, that is, free electrons, hydrogen free radicals, or hydroxyl radicals (IARC 2000).

It has been recognized since early studies of x-ray radioactive minerals that exposure to high levels of radiation can cause clinical damage to tissues of the human body. The acceptance by society of the risks associated radiation is conditioned on the benefits to be gained from the use of radiation. Nonetheless, the risks must be restricted and protected against by the application of radiation safety standards

Radiography is also a common practice in dentistry. It can be used to yield views of both maxillary and mandible teeth and surrounding structure of a patient. In such examination, the lens of the eyes may receive as much as 5-25 rads (Benedittine, 1989). This quite high. It is therefore imperative that absorbed dose to the eyes resultant from oral radio graphical procedures be quantified as accurately as possible in order to avoid exceeding safety levels.

In this study, the skin entry dose to patients eye during dental x-ray examination were measured to ascertain whether the patients are exposed within the limit of established safety standards.

Theoretical Consideration

Radiation dose is a measure of the amount of energy deposited per unit mass of tissue and may be expressed as the absorbed dose, equivalent dose, or effective dose.

The absorbed dose, D, is the quotient of dε by dm, where dε is the mean energy imparted by ionizing radiation to matter of mass dm.

$$D = \frac{d\varepsilon}{dm} \qquad (1)$$

The standard unit for absorbed dose is the gray (Gy) or rad, which is equal to 1 J/kg of deposited energy.

1Gy = 100 rad = 1 J/kg.

The absorbed dose by patients was calculated as:

$$\text{Dose (iGy)} = \frac{100[0.14A + B(0.5)]}{4} \qquad (2)$$

where A and B represents the TLD measurements obtained from the reader

Materials and Method

The study of skin entry dose to patients eyes during dental x-ray examination was carried out on one hundred and ten patients comprising infants and adults of both sexes, at Alpha dental centre, Ibadan, Nigeria. Absorbed dose was measured with Lithium Fluoride thermoluminecent dosimeters (TLD).

The TLD discs were first annealed and enclosed in plastic covers. They were then placed on the patients eye just before the examination, and removed immediately after the procedures. The Pitman Toledo model 654 TLD reader was used to measure the thermoluminecense of the TLD.

The x-ray technique used is the bisecting angle technique, which utilizes specific recommended angles to position the x-ray beam and intra-oral films, such that the central ray of the beam is perpendicular to a plane bisecting angle formed by the plane of the film packet and the long axis of the tooth (Wood, 989). The data is given in Table1 in the appendix. The following statistical analyses were performed on the data:

(1) A regression analysis to show whether the absorbed dose depend on the age of patients.

(2) Analysis of variance test to see whether there are differences in mean of the absorbed dose for the various age groups and sex.

(3) A student t test to determine whether the average absorbed dose is significantly different from 1mGy.

Discussion of Results

The result of regression analysis is not significant(Table 2). That is, absorbed dose does not associate with the age of patients. Also sex and age groupings respectively show no significant effect (Table 5) on the absorbed dose in patients. Table 3 and 4 give the absorbed dose means for the various age groupings and sex. It is important to note that all values of means in the two tables are far less than 1 mGy, the critical dose level. The result of the t-test (Table 6) also indicate the average absorbed dose level by patients is significantly less than 1mGy.

Table 1: Absorbed dose to patients with their sex and age

S/N	Sex	Age (yrs)	Absorbed Dose (mgy)
1	F	24	0.082
2	M	19	0.035
3	M	28	0.048
4	F	27	0.081
5	F	57	0.052
6	F	21	0.042
7	M	22	0.014
8	F	24	0.059
9	M	38	0.032
10	F	35	0.045
11	F	29	0.079
12	M	58	0.041
13	F	28	0.035
14	M	32	0.056
15	M	14	0.045
16	M	52	0.038
17	F	12	0.052
18	F	28	0.042
19	M	36	0.063
20	F	30	0.018
21	M	22	0.048
22	M	23	0.045
23	F	28	0.014
24	F	28	0.045
25	M	30	0.018
26	M	38	0.011
27	M	30	0.035
28	M	21	0.052
29	F	24	0.017
30	M	22	0.035
31	M	24	0.014
32	F	26	0.018
33	M	18	0.070
34	F	30	0.014
35	M	30	0.079
36	M	58	0.035
37	F	30	0.042
38	M	32	0.049
39	F	14	0.007
40	M	18	0.011
41	F	28	0.007
42	M	65	0.038
43	M	48	0.045
44	F	27	0.077
45	M	21	0.007
46	F	23	0.012
47	F	28	0.075
48	F	32	0.035
49	M	37	0.052
50	F	22	0.045
51	M	32	0.032
52	M	14	0.014
53	M	23	0.039
54	F	34	0.080
55	F	29	0.041
56	F	24	0.012
57	M	62	0.032
58	F	53	0.053
59	M	37	0.017
60	F	28	0.013
61	F	16	0.016
62	F	18	0.020
63	M	41	0.032
64	M	21	0.041
65	F	36	0.030
66	M	47	0.037
67	F	32	0.028

68	F	50	0.013
69	M	35	0.014
70	M	53	0.058
71	M	48	0.038
72	F	38	0.062
73	F	30	0.018
74	M	20	0.011
75	M	32	0.048
76	F	28	0.013
77	M	26	0.052
78	M	32	0.032
79	F	30	0.014
80	M	44	0.046
81	F	31	0.070
82	F	28	0.035
83	M	32	0.063
84	F	18	0.042
85	F	34	0.056
86	M	68	0.041
87	M	14	0.018
88	M	47	0.028
89	M	35	0.014
90	F	17	0.030
91	M	29	0.034
92	M	41	0.037
93	F	24	0.018
94	F	41	0.045
95	M	24	0.032
96	F	23	0.032
97	M	38	0.049
98	F	24	0.017
99	F	25	0.011
100	M	36	0.019
101	M	21	0.041
102	F	26	0.030
103	F	16	0.018
104	M	37	0.028
105	F	32	0.014
106	M	27	0.037
107	F	47	0.028
108	F	25	0.012
109	F	50	0.038
110	F	17	0.011

Table 2: Regression analysis results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	.000	1	.000	.003	.954
Residual	.833	108	.008		
Total	.-833	109			

Table 3: Table of means for sex

Sex	Mean	Sdt Error	95% Confidence Interval	
			Lower Bound	Upper Bound
0	4.048E-02	.025	-8.580E-02	8.954E-02
1	3.515E-02	.019	-2.000E-02	7.230E-02

Table 4: Table of means for group-sex cross tabulation

Group	Sex	Mean	Std Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	0	2.950E-02	.063	-9.597E-02	.155
	1	2.775E-02	.045	-6.097E-02	.116
2	0	5.337E-02	.013	2.788E-02	7.965E-02
	1	3.630E-02	.015	7.120E-02	6.547E-02
3	0	3.817E-02	.037	-3.427E-02	111
	1	3.955E-02	.027	-1.395E-02	9.305E-02
4	0				
	1	3.700E-02	.052	-6.544E-02	139

Table 5: Results for test for sex and group effect

Source	Sum of squares	df	Mean Square	F	Sig.
Model	219	7	3.134E-02	3.917	.001
Group	1.707E-03	3	5.690E-04	.071	.975
Sex	3.014E-04	1	3.014E-04	.038	.847
Group.Sex	1.367E-03	2	6.833E-04	.085	.918
Error	824	103	8.005E-04		
Total	1.044	110			

Table 6: Result for t- test

	Test Value = 1					
	t	df	Sig (2-tailed)	Mean diff.	95% confidence Interval of the Difference	
					Lower	Upper
DOSE	-144.709	109	000	-9582	-0.9727	-0.9397

Conclusion

The contribution to radiation dose that can be derived from dental x-ray examination are seen to be low(<1mGy);almost insignificant to pose any serious detrimental health effects to the patients examined as recommended by the International Commission on Radiological Protection (ICRP). It suffices to say, therefore, that the patients are not exposed to any health risk. It is nevertheless desirable to limit the exposure of patients to the minimum value consistent with the medical requirements.

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