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Radiation dose to the thyroid, eyes and parotid glands of patients undergoing intra-oral radiographic procedures in a teaching hospital in Ibadan, Oyo state Nigeria

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► ***Short Report***

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ABSTRACT

Background: Intraoral radiographs are believed to deliver low doses to patients, thus little work has been done in this regards. Considering the increment in the number of patients reporting for the examination and the probability of delayed somatic effects for accumulated low doses of X-irradiation, it is expedient to determine the doses to three critical organs eye, thyroid and parotid that are at risk during exposure. ***Materials and Methods***: Thermoluminescent dosimeters was used to measure Entrance Surfaces Doses (ESDs) to the thyroid, eye and parotids salivary gland of 40 adult patients undergoing intra-oral radiographic examination at University College Hospital, (UCH) Ibadan, Oyo state. ***Results:*** Results indicated entrance surface doses (ESD) ranged between 0.0447 mGy to 0.3898 mGy to the thyroid, 0.0742 mGy to 0.3989 mGy to eye and 0.0467 mGy to 0.4164 mGy to the parotids for the period of study. The mean ESD ± SD to the thyroid, parotids and eyes for male were 0.1798±0.081, 0.2155±0.109 and 0.2197±0.081 mGy with the female patients 0.1957±0.084, 0.2091±0.081 and 0.2280±0.113 mGy respectively. No statistically significant difference was found between these means. ***Conclusion:*** The doses obtained in this study were lower than the documented threshold that could cause significant damage in the various organs, not undermining stochastic effect of radiation. This study will assist in setting Diagnostic Reference Level (DRL) for intraoral radiographic imaging in Nigeria.

Keywords: *Intra-oral radiography; Thermoluminescence dosimeters (TLD), Entrance surface dose (ESD), Diagnostic Reference Level (DRL).*

INTRODUCTION

Since the discovery of X-rays in 1895, it has been widely used as the most important and reliable scientific tool for effective and proper diagnosis of diseases as well as assessing the results of a given treatment to patients. Its extensive use in dentistry is well documented [(1)]. Though these various uses come with significant benefits, there are also associated health detriments which can be significant for examinations not properly conducted [(2)]. Radiation exposure to the critical organs of patients in dental radiographic examination has often been investigated, predominantly for panoramic examination of phantoms patients but seldom for intraoral examination of real patients. Being able to accurately assess the radiation dose that patients receive during procedures is a crucial step in the management of dose [(3)]. If the dosage is higher than expected, this indicates serious health risk to the operator and recipient and this often evolve from problems in optimization of either equipment or

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procedures or both. The principal concern in radiological protection is to ensure that the examinations are conducted with radiation doses that are As Low As Reasonably Achievable to meet clinical practice.

Several dose measurements survey were previously carried out in respect to patients dosimetry in Nigeria. Most of these surveys were conducted on patients for conventional radiographic examination with very few survey on dental investigation [2].

Intraoral radiography is one of the diagnostic technique in dentistry which when properly conducted, the image quality is adequate for proper interpretations of various diseases such as dental caries and periodontal status within the oral cavity. Considering the increasing number of patients reporting for intra-oral radiograph in Nigeria, collective dose will also be on the increase. Although the radiation risk of intra-oral radiograph is generally low, there is delayed somatic effects of low doses of X-irradiation. Furthermore, dental radiography was associated with increased risk of parotid tumors and thyroid cancer [4].

The aim of this work was to measure ESDs to the eyes, thyroid and parotids glands on the patients undergoing intra- oral radiographic procedures at University College Hospital, University of Ibadan, Nigeria. The Entrance surface dose values will be compared with International recommended diagnostic reference values and previously published data. It is also our believe that this study will help to evaluate the radiation protection to these organs of patients undergoing intraoral radiography at UCH and its implication to standard safe practices and optimization of protections.

MATERIALS AND METHODS

Measurement of dose on the skin of the eyes, thyroid and parotid glands was made using thermoluminescent dosimeters (TLD-100, Harshaw, USA). The lithiumfluoride dosimeters (LiF:Mg, Ti) were mounted on adhesive tape and place on the skin of organ/tissues of interest before exposure. BlueX IntraOs-70 diagnostic X-ray machine, manufactured in June (2007) by Srl Assago Italy, and installed at UCH on May 2009 was used for this study. Its specifications are shown in table 1. Exposure time is varied depending on the area to be radiograph. Two TLDs were used to determine the background radiation for each experiment. All TLDs were read out with a Harshaw 4500 (Harshaw, Bicron USA) reader at the National Institute of Radiation Protection and Research, (NIRPR) University of Ibadan.

All the dosimeters used in this study were calibrated and annealed (in order to remove any residual signals in them)at the same research institute.

RESULTS

A total of 40 patients comprised of 22 males and 18 females were included in this study. Patients' information and exposure parameters are summarized in tables 1 and 2. The overall mean age of the patients was 34.1 ± 14.2 years with mean ages of (33.09 ± 15.98) years for males and 35.28 ± 12.04 years) for females. These patients suffers from various oral conditions such as dental caries, periodontal diseases, dental trauma and oral tumours which requirs intra-oral radiographic examination at the Dental centre of the University College Hospital (UCH) Ibadan, Oyo state.

As shown in tables 3 and 4, the overall mean (±SD) entrance surface doses to the thyroid, parotids and eyes of the patients were not statistically different between male and female patients ($p>0.05$).

Table 1. Specification of the BlueX machine.

Type	IntraOs-70
Tube voltage	70KVp
Tube Current	7mA
Exposure time	(0.50-1.00s)
Collimination	Round
Beam size and SSD	21cm and 8cm
Film type	E-speed

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Table 2. Data of patients exposed to intraoral radiograph at UCH, Ibadan.

Patients	Age	Sex	Diseases	Type of examination
1	40	Male	Caries	Periapical
2	58	Female	Periodontal	Occlusal
3	35	Female	Caries	Periapical
4	21	Female	Caries	Periapical
5	24	Male	Bony Swelling	Occlusal
6	64	Male	Malocclusion	Periapical
7	32	Female	Trauma	Periapical
8	16	Male	Periodontal	Occlusal
9	20	Male	Periodontal	Occlusal
10	19	Male	Caries	Periapical
11	33	Male	Caries	Periapical
12	22	Female	Bony Swelling	Occlusal
13	42	Female	Bony Swelling	Occlusal
14	28	Male	Caries	Periapical
15	20	Male	Caries	Peripical
16	52	Female	Caries	Periapical
17	75	Male	Trauma	Periapical
18	56	Female	Trauma	Periapical
19	27	Male	Periodontal	Occlusal
20	34	Male	Periodontal	Occlusal
21	58	Male	Periodontal	Occlusal
22	28	Male	Caries	Periapical
23	26	Male	Caries	Periapical
24	34	Female	Caries	Periapical
25	45	Female	Caries	Periapical
26	32	Female	Malocclusion	Periapical
27	42	Female	Malocclusion	Periapical
28	56	Male	Bony Swelling	Occlusal
29	38	Female	Periodontal	Occlusal
30	35	Male	Caries	Periapical
31	18	Male	Periodontal	Occlusal
32	27	Female	Periodontal	Occlusal
33	28	Male	Trauma	Periapical
34	25	Female	Trauma	Periapical
35	24	Male	Tooth Malformation	Periapical
36	26	Female	Periodontal	Occlusal
37	28	Male	Caries	Periapical
38	27	Male	Caries	Periapical
39	32	Female	Malocclusion	Periapical
40	16	Female	Periodontal	Occlusal

Result of the statistical analyses performed using IBM SPSS software (version 20) between the organs showed no significant difference between the entrance surface dose of males and females. Moreover, ANOVA test used to assess the variations among the organs, also showed no significant differences ($f \times 7.231$ *and* $p \times 6.758$).

DISCUSSION

X-rays are widely believed to cause malignancies, skin damage and other detrimental effects. Radiation induced cancer is widely believed to be a dose dependent phenomenon [5]. Justification of actions,

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optimization of protection and dose limits for individuals are the main principles of the general radiation protection system [6]. The results obtained in present investigation (tables 3 and 4) was very low in comparison to the proposed provisional reference level of 3.5 mGy entrance surface dose for intraoral radiology [7] in which data was collected from over 300 intraoral X-ray facilities using thermoluminescent dosimeters. Our overall range of doses was also far less than the 7mGy proposed reference level for diagnostic intraoral radiographies by International Atomic Energy Agency (IAEA) but falls within the range of 0.01 to 0.40 mGy for the distribution of ESDs (mGy) measured at the center of the beam on the patients' skin in intraoral radiography obtained by IAEA [7].

Table 3. Entrance surface dose (ESDs) mGy to the Thyroid, Parotids and Eyes of Males and Females Patients.

Male Patients	Age	Thyroid	Parotids	Eyes
1	16	0.0879	0.0518	0.0863
2	18	0.2482	0.2188	0.1402
3	24	0.2500	0.3060	0.3355
4	20	0.0633	0.0777	0.3019
5	19	0.2058	0.2363	0.1980
6	33	0.3353	0.4164	0.2367
7	28	0.2680	0.2664	0.2246
8	20	0.3159	0.3054	0.3814
9	27	0.1212	0.1233	0.1590
10	34	0.1810	0.1985	0.1749
11	28	0.0883	0.1394	0.3205
12	26	0.2453	0.3511	0.1757
13	35	0.1327	0.1133	0.1793
14	28	0.1346	0.4377	0.1776
15	24	0.1189	0.1693	0.1386
16	28	0.1726	0.2446	0.2236
17	27	0.1012	0.1223	0.1523
18	40	0.2356	0.2633	0.3674
19	64	0.0577	0.0574	0.1245
20	75	0.2529	0.3127	0.2817
21	58	0.1365	0.1316	0.2447
22	56	0.2023	0.1974	0.2101
Mean ±SD		**0.1798± 0.081***	**0.2155±0. 109***	**0.2197±0.0 81***

Female Patients	Age	Thyroid	Parotids	Eyes
1	16	0.1013	0.1292	0.1417
2	35	0.1911	0.2062	0.3826
3	21	0.2395	0.2676	0.3989
4	32	0.0447	0.0467	0.0742
5	22	0.3898	0.3055	0.3235
6	34	0.1097	0.1480	0.5011
7	32	0.1209	0.1326	0.1893
8	38	0.1724	0.2984	0.2496
9	27	0.2530	0.2282	0.1861
10	25	0.1672	0.2155	0.1292
11	26	0.1407	0.1893	0.1512
12	32	0.2106	0.1733	0.1326
13	58	0.2701	0.3727	0.2075
14	42	0.2025	0.2262	0.2474
15	52	0.3199	0.2876	0.2259
16	56	0.2426	0.2463	0.2837
17	45	0.1358	0.1016	0.1347
18	42	0.2116	0.1882	0.1458
Mean±SD		**0.1957± 0.084***	**0.2091± 0.081***	**0.2280±0. 113***

*Statistically no significant difference between organ doses measured for male and females. (p>0.05

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Table 4. Overall Mean entrance surface doses (ESDs) to the eyes, thyroid and parotid glands.

ORGANS	Range of (ESDs)	MeanSD ± (ESDs)mGy
Eye	0.3989-0.0742	0.2235 ± 0.095*
Thyroid	0.3898 -0.0447	0.1869 ± 0.082*
Parotids	0.4377-0.0467	0.2126 ± 0.097*

*Statistically no significant difference (p>0.05)

The overall mean ESD±SD in this study was lower compared with 1.173 mGy for females and 1.380 mGy for males, reported by Mortazavi *et.al* (2004) [8]. The absorbed doses obtained in this study, were also less in comparison to the Canadian reference ESDs values of 1.09-1.44 (mGy) for intraoral examinations at 70kvp, and also lower than other references doses such as in the UK, with 2.5 mGy reference dose for bitewing exposure at 70 kVp using E-speed film and 5.0 mGy at 50 kVp [9-12].

The slight disparities arising from our study and others might be explained to be due to the type of intraoral machine used, cone length and positioning, exposure conditions such as tube current, tube voltage and exposure time, the types, sensitivity and speed of films used and the accuracy of location/ measurements of TLD.

In the recent past, global attempts that were made at ensuring radiation safety of dental radiography include use of digital systems, thyroid shields and fastest possible films, preferably F films and careful patient selection for radigraphy.

CONCLUSION

The mean and range of entrance surface doses to the eyes, thyroid and parotids glands of patients who undergone intraoral radiograph at Dental centre, University College Hospital (UCH) Ibadan Nigeria were lower than proposed level set by IAEA. However it should be noted that experimental and epidemiological data do not support the proposition that there is a threshold dose of radiation below which there is no increased risk of cancer [12].

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***Conflict of interest*:** *Declared none.*

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