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Time Dependent Deterioration of the X-ray Dental Diagnostic Equipment

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Keywords **– dental x-ray equipment, time, degradation.**

I. Introduction

Statistics presented by NMS GRUPA Ltd. demonstrates that the Trophy ELITYS (25%) (*further in text – ELITYS*) is the most popular dental x-ray with high frequency and the Trophy IRIX 70 (13%) (*further in text – IRIX 70*) – with half-period generators in Latvia.

Time dependent degradation of x-ray machines gives a strong impact on quality of diagnostics. However, there are no data on time dependent degradation.

The goal of the study was to explore time dependent behavior of dental x-rays ELITYS and IRIX 70 dose providing parameters such as:

- X-ray tube voltage [kV]. Quality of this parameter has an influence on a spectrum, image quality, and an absorbed dose.
- X-ray exposure time [ms] - influences the absorbed dose.
- X-ray tube output [mGy/mAs] influences the absorbed dose.
- Air KERMA [mGy] – influences the absorbed dose [1].

II. Materials and Methods

Selection of the parameters has been done on the demands by the Republic of Latvia Cabinet of Ministers No. 97 of March 5, 2002 "Regulations on protection against ionizing radiation in medical exposure" [2].

Statistical processing of the collected data (arithmetic mean, experimental standard deviation) has been determined in accordance with EAL Publication EA-4/02 [3].

The correlation of the approximation of the x-ray machine parameters with respect to time has been verified by linear and polynomial (2nd and 3rd order) functions. The "least squares" method has been applied to confirm the best approximation.

III. Results

The results are presented in Figure 3.1.*High frequency generator type – ELITYS*

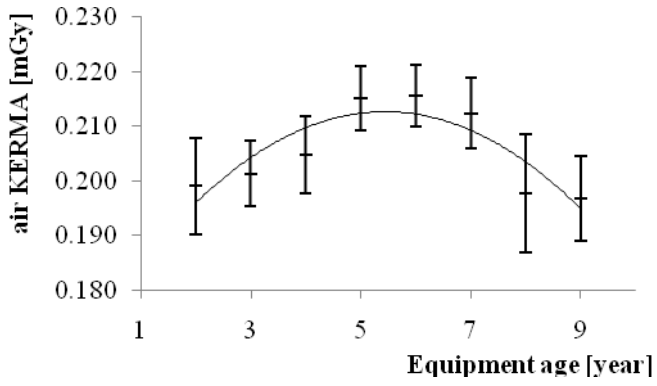

Fig. 1. The influence of the age of equipment on air KERMA

Air KERMA follows the polynomial 2nd order correlation with a parameter maximum on equipment`s 5-6 year age, during first 4 years increases by 7.4%. During next 4 years results decreases by 8.8%.

A. Half-period generator type – IRIX 70

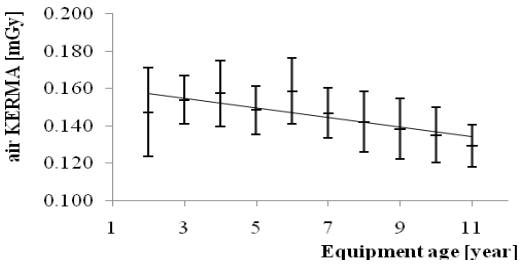

Fig. 2. The influence of the age of equipment on air KERMA

The linear approximation has been confirmed for air KERMA. Air KERMA follows the linear correlation and during 10 years decreases by 14.3%.

IV. Conclusions

1. Degradation of dose characterizing parameters were explored for dental x-ray ELITYS with high frequency generator type for over 8 year of the equipment age.
2. Deviation of the parameters comparing first and last year (the 8 year of equipment exploitation) of studied equipment is shown in Table 1.

Table 1. Deviation of the parameters

Dose characterizing parameters	Deviation, %
x-ray tube voltage [kV]	- 1.1
x-ray exposure time [ms]	+ 0.4
air KERMA [mGy]	- 1.0
x-ray tube output [mGy/mAs]	- 2.0

3. Degradation of dose characterizing parameters were explored for dental x-ray IRIX 70 with half-period generator type for 10 year of the equipment exploitation (Table 4.2).

Table 2 Deviation of the parameters

Dose characterizing parameters	Deviation, %
x-ray tube voltage [kV]	- 1.2
x-ray exposure time [ms]	+ 0.5
air KERMA [mGy]	- 12.3
x-ray tube output [mGy/mAs]	- 14.3

V. References

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[2] Demands by the Cabinet of Ministers No. 97 of March 5, 2002 "Regulations on protection against ionizing radiation in medical exposure" at http://www.likumi.lv/.
[3] EAL Publication EA-4/02 at http://www.european-accreditation.org/.