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Determination of Superficial Dose Profile in Z-Line for Each Slice in CT.Scan Machines

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Abstract
CT.Scan examinations cause high patient absorbed dose from x-ray ionizing radiation. Therefore it is necessary to obtain superficial dose profile in Z-line. In this research 11 thermoluminecent dosimeter (TLD), after calibration were located on Z line perpendicular to slice thickness. CT.Scan machines did X-ray exposures. The resultant dose profiles showed gussian shape apperience, which has severed dose reduction off the slice thickness. By attention to high patient absorbed dose in CT.Scan machines, it is better to referre that patients towards any other diagnostic methods with lower risk and reasonable quality.

Keywords: CT.Scan Dose Profile, Z-Line, Patients absorbed dose

Introduction

CT.scan machines can do sectional imaging. Also they can show different tissues with high contrast resolution. But unfortunately patients under CT.Scan examinations receive high x-ray radiation dose. Mckinlag by using thermoluminecent dosimeters found (1):

1) Dose distributions in patients between CT.Scans and conventional radiography examinations are completely different.
2) Patient absorbed dose in CT.Scans examinations is so higher than conventional radiography.

Shope computed, patient absorbed dose for each slice, between 2.5-3.5 rem in ten types of CT.Scan machines (2). Pentlow found large focal line in CT.Scan machines produces large penumbra, which causes increment of patient dose (3). Therefore it is necessary to determine dose distribution profile for each slice thickness.

In this research absorbed dose is measured by thermoluminecent dosimeters (TLD). After dose absobtion, electrons in these dosimeters are transferred from normal levels to excitation levels. Therefore we have free electrons and positive holes. When excitation electrons are going back to the normal levels, some of them are captured by trap energy levels. In the next step thermoluminecent dosimeters are placed into the TLD-reader and are exposed by high temperature heat. This exposure will cause to release the captured electrons. At last released electrons and positive holes will make recombination and will release visible light or ultraviolet energy.

Materials and Methods

In this research for measuring absorbed dose, 11 TLDs were used, with trade name, Li:Mg:Ti (TLD), which were constructed by Harshow Company. 11 TLDs were packed together in a line into a plastic bag. These TLDs were placed over, anterior part of a head equivalent phantom in Z-line. Center of exposures was middle TLDs.

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For calibration ^{60}Co was used. Calibrations were done four times, along the research. Before each time, dosimeters were heated by oven with 400°C for 1 h. Therefore high peaks in response curve were being omitted and dosimeters sensitivity to radiation was being reached before exposure. For omitting low peaks in response curve, oven was regulated on 100°C and dosimeters were held into it for 2 h.

After exposure by x-ray, dosimeters were held into oven with 100°C for 10 min. Then each dosimeter was put separately into a TLD reader and its response on a scale of nanocolumb was computed.

Results

For calibration 4 times TLDs were exposed by ^{60}Co Gamma rays and mean response of dosimeters on a scale of nanocolumb for each time was computed (Table 1).

Table 1: Thermoluminecent dosimeters responses for different doses

Delivered dose (mGy)	**1.44**	**4.9**	**9.6**	**16.74**
Mean response	3.726	16.491	27.598	52.402

11 TLDs were located on Z line perpendicular to slice thickness after calibration. X-ray exposures were done by CT.Scan machines (MAX and GE 9800). The resultant dose profiles showed gussian shape apperience, which had severed dose reduction off the slice thickness (Figs. 2&3). Peaks of curves showed maximum absorbed doses,which were very high(3-4 rem).

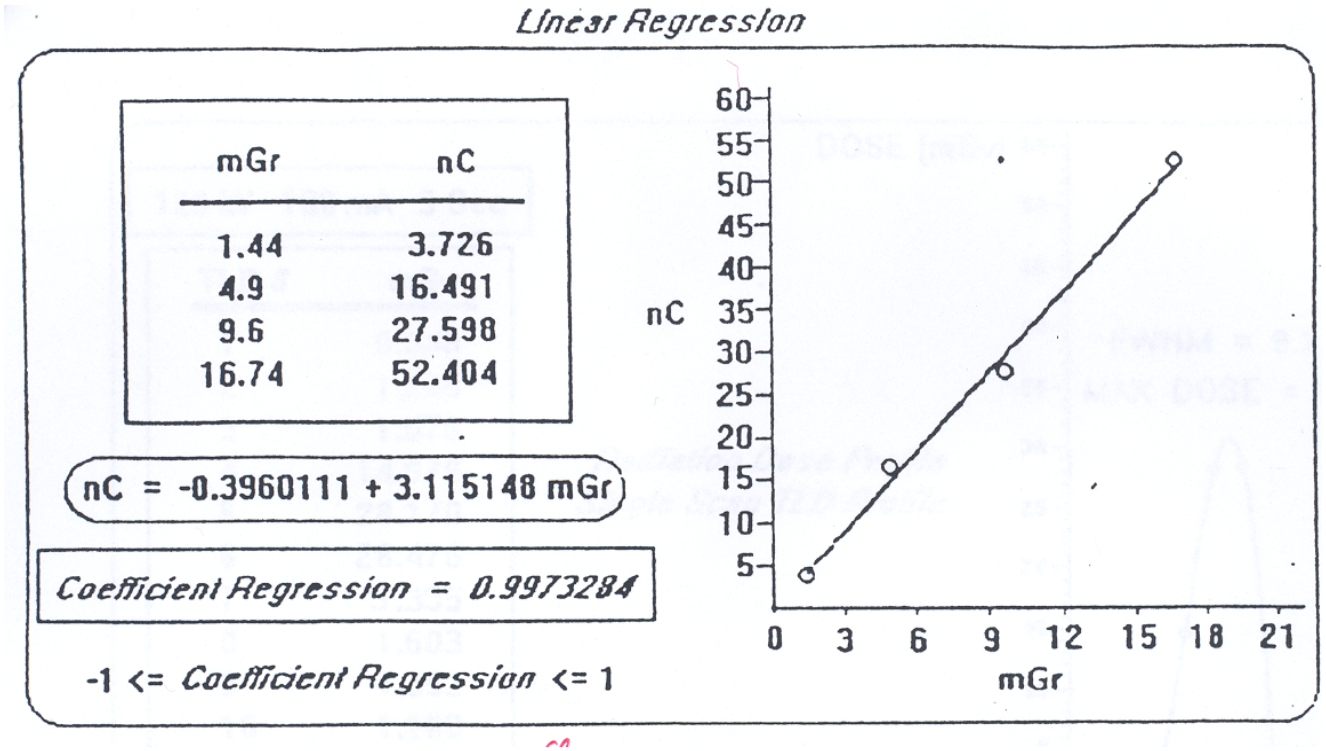

Fig. 1: Dosimeter response curve to different doses

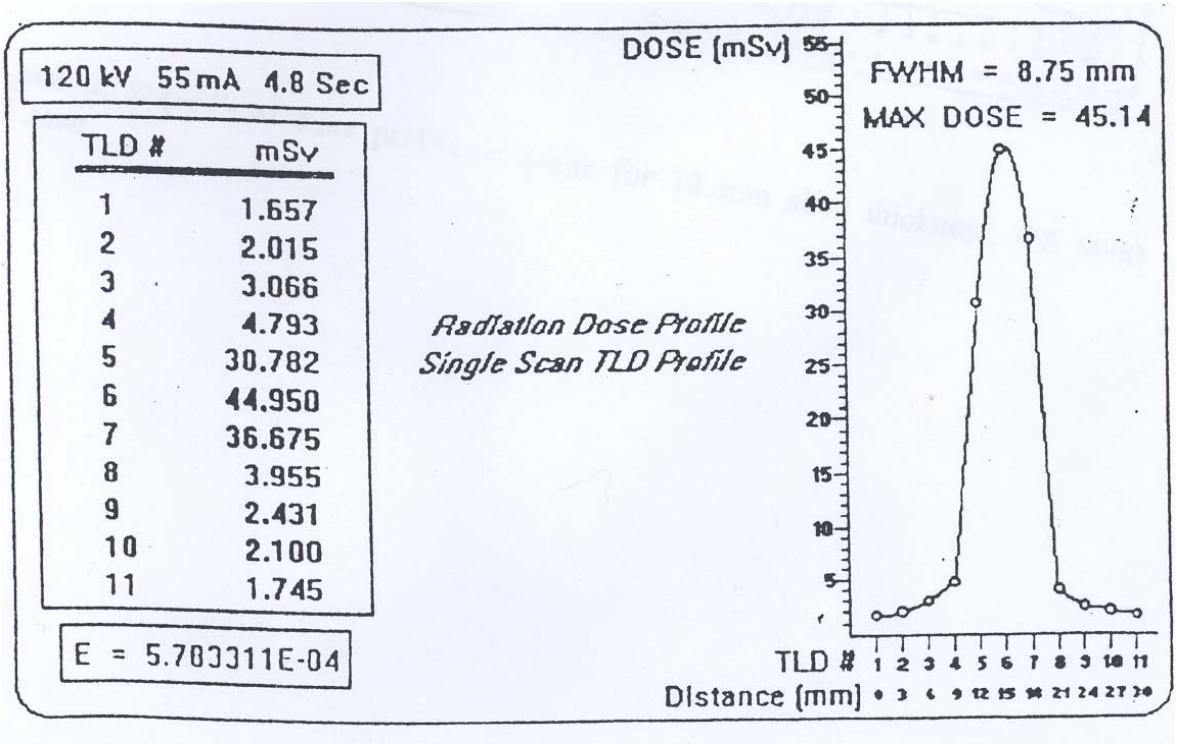

Fig. 2: Superficial dose profile in z-line for 10 mm slice thickness, GE MAX CT.scan

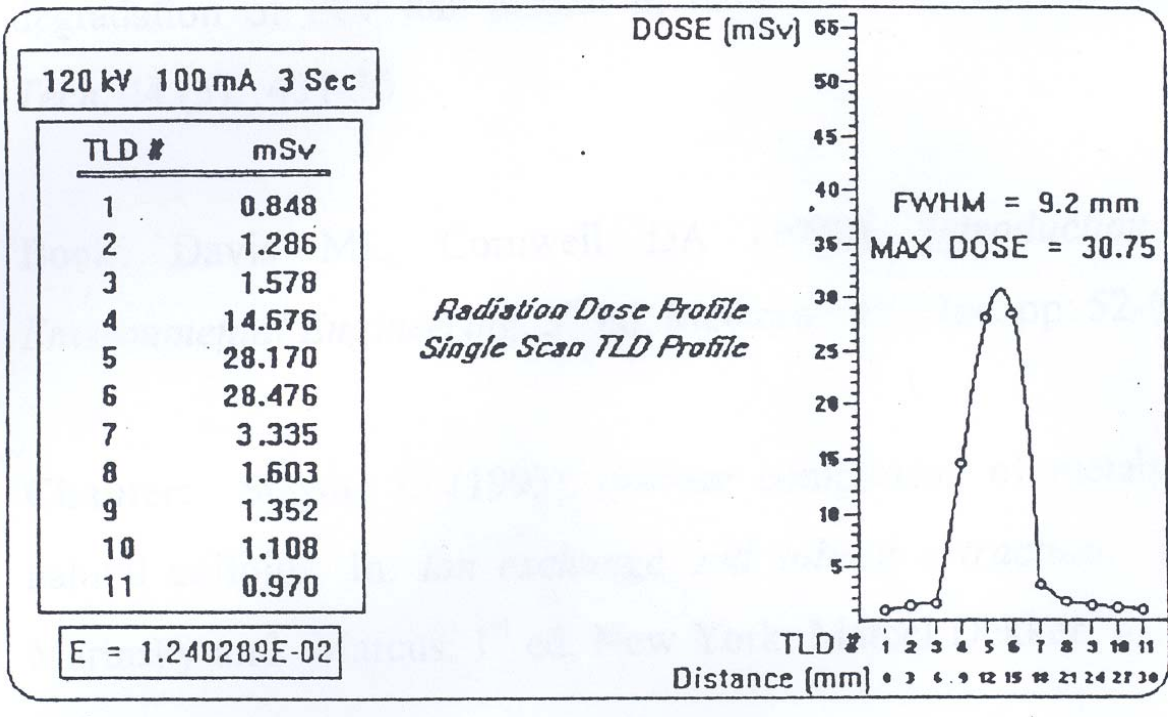

Fig. 3: Superficial dose profile in z-line for 10 mm slice thickness, GE 9800 CT.scan

Discussion

As Fig. 1 shows, all of the dosimeters have uniform response to energies, which are used in CT.Scan machines. These dosimeters have small sizes ($3 \times 3 \times 1$ mm), high stability, high accuracy and tissue equivalent atomic number. On the other hand, their absorbed dose is almost the same as tissue absorbed dose (4, 5). As a result of small sizes of TLDs, they can be placed into the slice thickness area.

In this research, absorbed dose was maximum in the center of slice thickness. Our measurments were close to Mckinlay and Shope measurements (1). Pentlow found large focal line produces large penumbra (3), however this research showed by slit field sizes there was sever fall in dose and penumbra, out of the slice thickness area. We have high patient dose in CT.Scan examinations because there are high exposure conditions (kV&mAs) and continuous radiation for each time of 360^{o} rotation of x-ray tube (5, 6). Energy sources are different between CT.Scan machine (x-ray) and ^{60}Co (Gamma ray), which was used for producing calibration curve. Therefore we used a correction factor (5), which was ½ in effective energy area of CT.Scan machines.

By attention to high patient absorbed dose in CT.Scan machines, it is better to reffer the patients towards any other diagnostic methods with lower risk and reasonable quality.

Acknowledgments

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