

“Evaluation of overlapping doses for gynaecologic cancer patients using semiconductor diodes”

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Introduction

There are cases where several fields are used in order to cover the whole PTV, during this procedure treatment fields are located next to each other which may lead to the probability for them to overlap. In order to evaluate this probability semiconductor diodes were used.

The advantage of these detectors are their high sensitivity to the treatment volume, quick response (1-10 μ s), small size, good mechanical stability.

The aim

To evaluate the doses which were received from individual patients dosimetry control and compare them with the planned ones in order to determine the influence of possible field overlapping.

Equipment

- a. The experiment was performed using 15 MeV photon beam generated by “Clinac 2100C/D“linear accelerator.
- b. p-type diodes (type T60010HP red, PTW) were used for dose measurement.
- c. All diodes were read out with a PTW VIVODOS electrometer.



Fig.1. “Clinac 2100C/D“.



Fig.1. Electrometer.

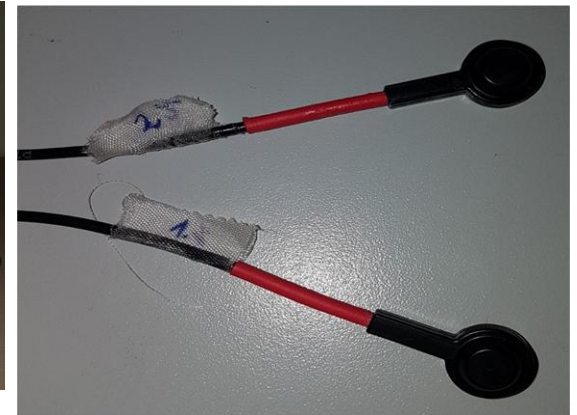


Fig.1. Semiconductor diodes used for patients.

Method

- Treatment scheme is provided in Fig. 2.

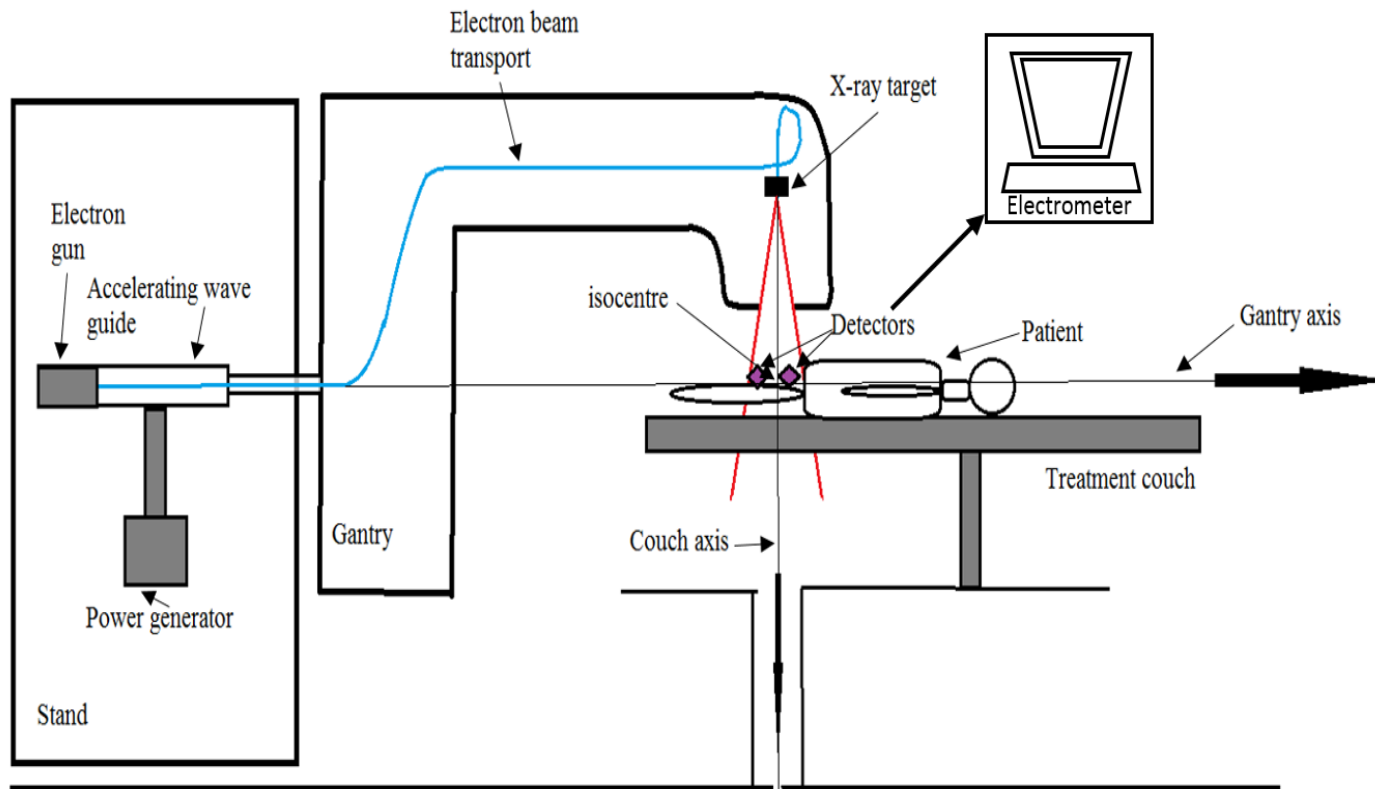


Fig.2. Schematic representation of the experiment.

Method

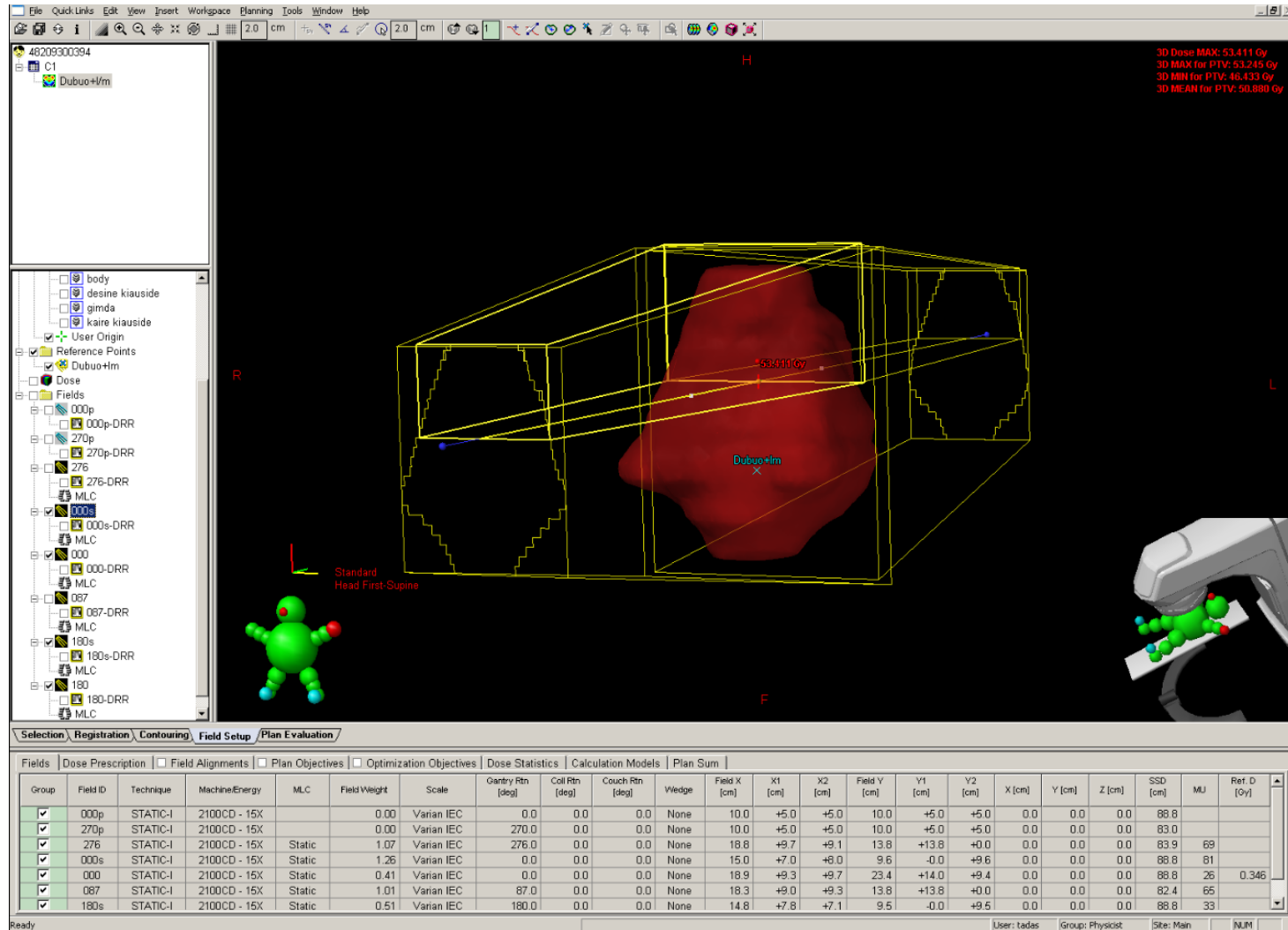


Fig.3. Actual treatment plan.

Workflow

Diode based dose evaluation was performed *in vitro* - using PMMA phantom and *in vivo*, when doses to three different gynecologic cancer patients were measured. In both cases doses were assessed at the point located on the junction of two (possibly overlapping) irradiation fields.

1. The reproducibility and stability of PTW detectors was checked before calibrating them.
2. In our *in vivo* experiments semiconductor probes were placed above or below the isocenter which was located on the junction area of two irradiation fields.

Workflow

Table 1. Size and beam weightings for segment (SF) and main (MF) irradiation field.

Patient's Nr.	SF size, cm	MF size, cm	Beam weight of SF	Beam weight MF
1	8.0 x 8.9	11.0 x 24.7	0.90	0.98
2	7.0 x 6.0	11.1 x 16.2	0.98	0.87
3	8.0 x 9.6	9.7 x 14.0	1.26	0.41

Workflow

3. The results of experimental dose measurements were compared with theoretically calculated doses obtained by using of treatment planning system Eclipse and with different reference doses (Ref. D) which were extra calculated before this individual dosimetry procedure in order to estimate an accuracy of the treatment procedure.

Calculated Ref. D values were:

1 patient: 0.705 Gy

2 patient: 0.688 Gy

3 patient: 0.346 Gy.

Results and Discussion

Table 2. Results from the experimental and theoretically calculated absorbed doses.

Patient Nr.	Dose above isocenter, Gy		Dose below isocenter, Gy	
	D_{calc}	D_{meas}	D_{calc}	D_{meas}
1	1.380	1.323	-	-
2	1.204	1.250	0.530	0.550
3	1.420	1.372	0.360	0.343

Results and Discussion

Table 3. Absolute and relative error calculations results.

Patient Nr.	Dose uncertainty above isocenter		Dose uncertainty below isocenter	
	Absolute	Relative	Absolute	Relative
1	0.057 Gy	4.1%	-	-
2	0.046 Gy	3.8%	0.02 Gy	3.7%
3	0.048 Gy	3.4%	0.02 Gy	4.7%

Results and Discussion

- Uncertainties may be related to the detector's calibration procedure, which was performed using PMMA phantom.
- Random errors.
- Systematic errors.
- Obtained uncertainties may indicate that the irradiation fields were overlapping.

Conclusions

- It was found, that the relative uncertainties varied between 3.4 % and 4.7 % for different patients and were not exceeding 5% limit.
- Obtained results led to suggestion that the probability of the two field overlapping effect (if?) in the described specific gynecologic cancer treatment procedure was very low and had no significant influence on the measured dose values.

THANK YOU