"STUDY OF A TREATMENT PLANNING SYSTEM EFFICIENCY TO ESTIMATE THE ABSORBED DOSE BY PACEMAKERS IN EXTERNAL RADIOTHERAPY"

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Introduction & Purpose

The number of patients with pacemakers receiving radiation therapy is increasing.

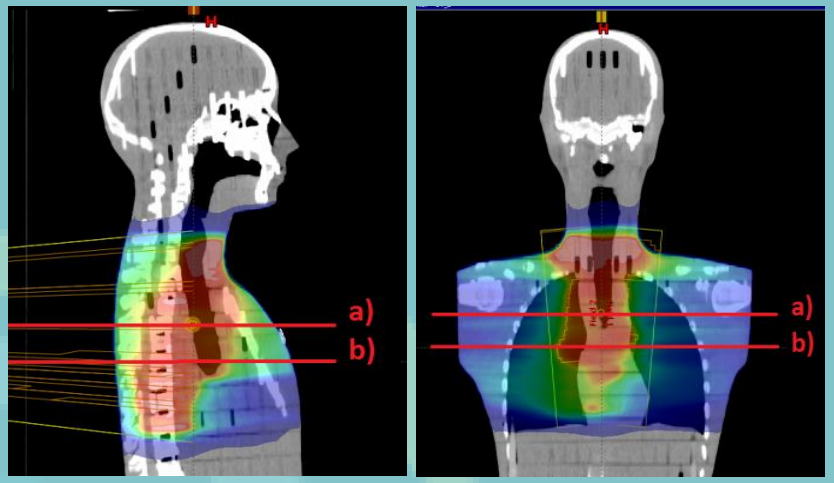
According with the AAPM TG-34 guidelines, pacemakers should not be irradiated with primary radiation fields; also, absorbed dose should be estimated before treatment and should not exceed 2 Gy.

The purpose of this work was to assess the accuracy of Varian Eclipse Treatment Planning System (TPS) used to estimate the absorbed dose by pacemakers.

Methods

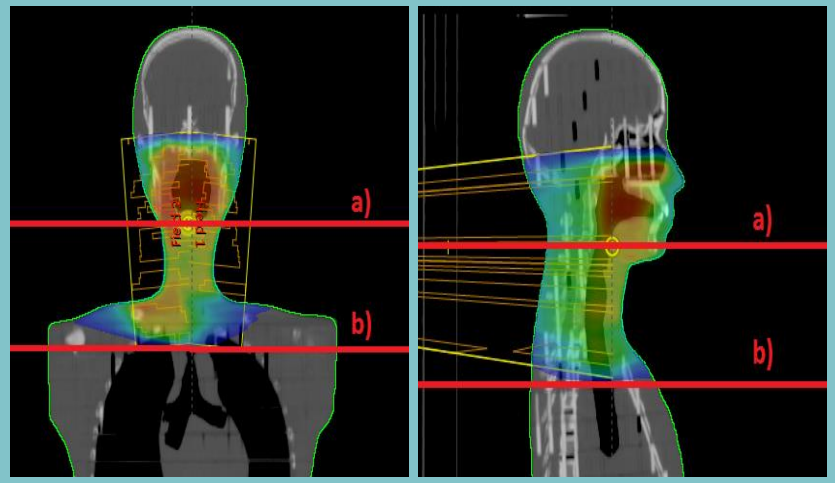
Two VMAT plans, previously used to treat patients with pacemaker, were simulated in a RANDO phantom:

Treatment 1: Oesophagus



Sagittal and coronal views of treatment plans, showing: (a) isocenter and (b) pacemaker levels.

Treatment 2: Faciocervical



Doses were computed on the Eclipse TPS v.13.5 using the analytic anisotropic algorithm (AAA).

Methods

To measure the distance between the pacemaker and the edge of treatment fields, we used the 50% isodose line as the edge of fields, due to the complexity to determine these edges in VMAT treatments:

	Distance (cm)
Treatment 1	8.0
Treatment 2	10.2

Methods

Gafchromic EBT3 films were used to measure dose:

Films were placed between two slices in the RANDO phantom at the pacemaker level

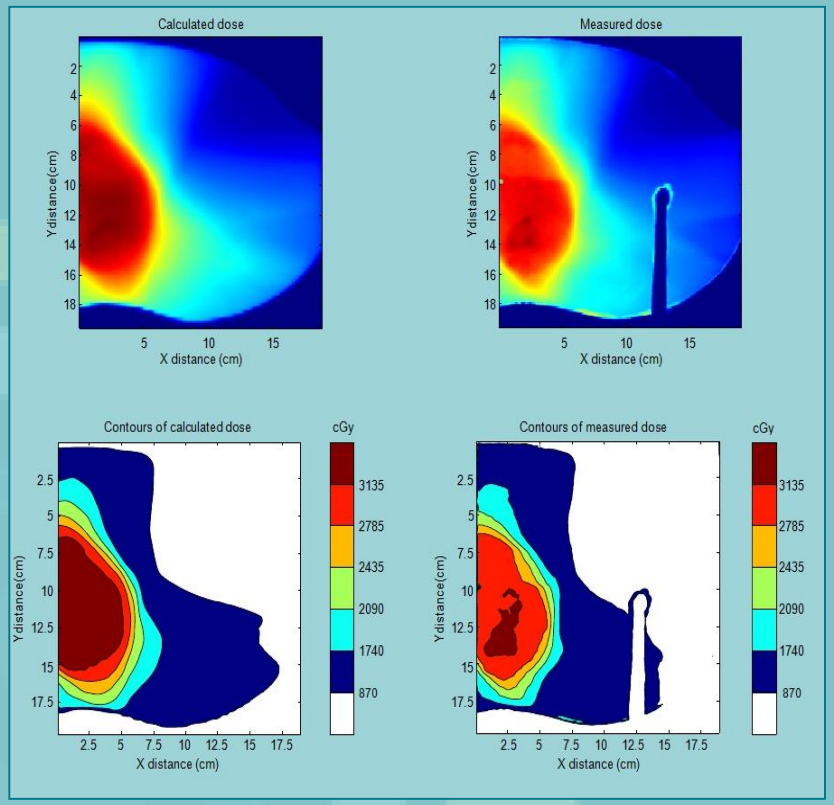
The plans were delivered in a Varian Trilogy linac

The dose planes were extracted from Eclipse and compared with the irradiated films using the software DoseLab.

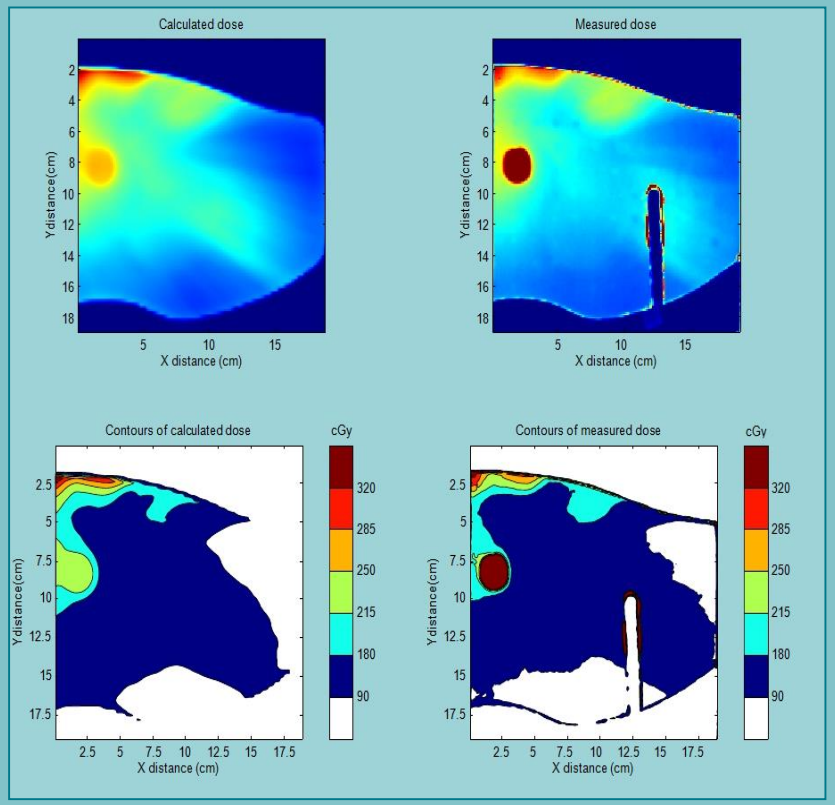
Results

Dose distribution at pacemaker level

Treatment 1



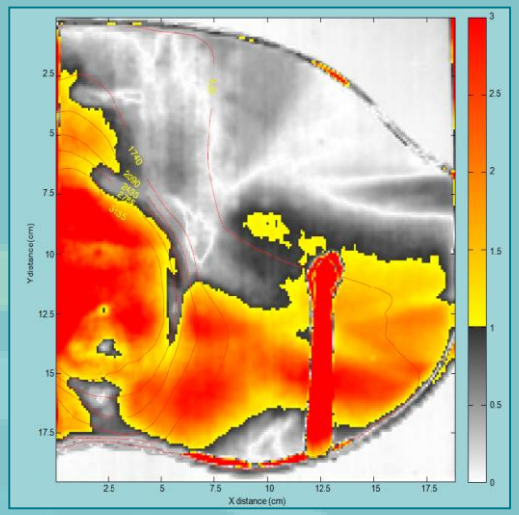
Treatment 2



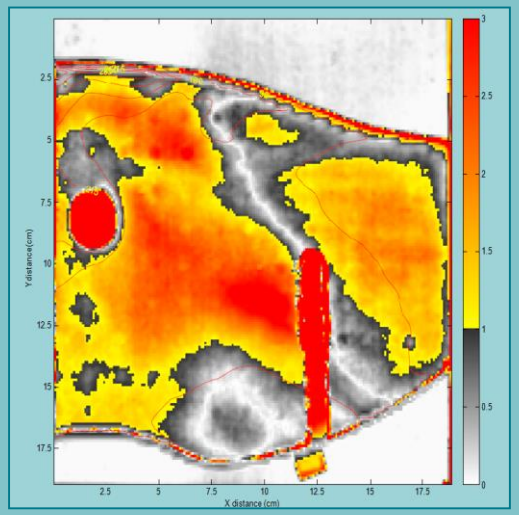
Results

Gamma analysis (3%/3mm)

Treatment 1	Treatment 2



- 61,6% of pixels pass γ criteria



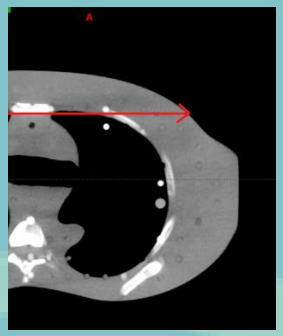
- 54.3% of pixels pass γ criteria

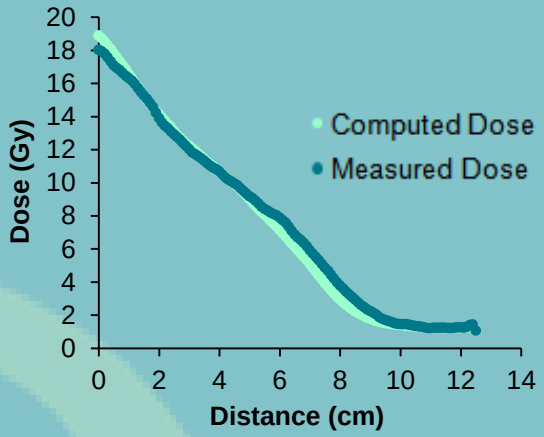
The gamma pass rates are low due to the existence of air cavities, lung areas and film cuts.

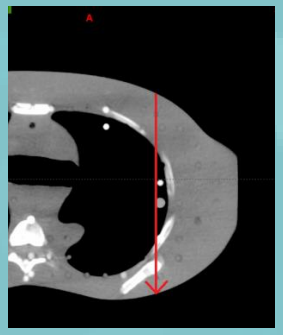
Results

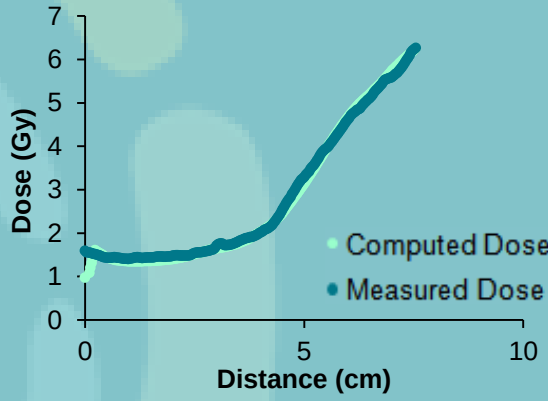
Beam profiles across the pacemaker

Treatment 1

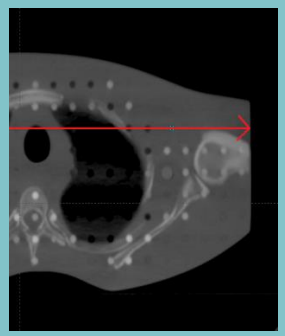


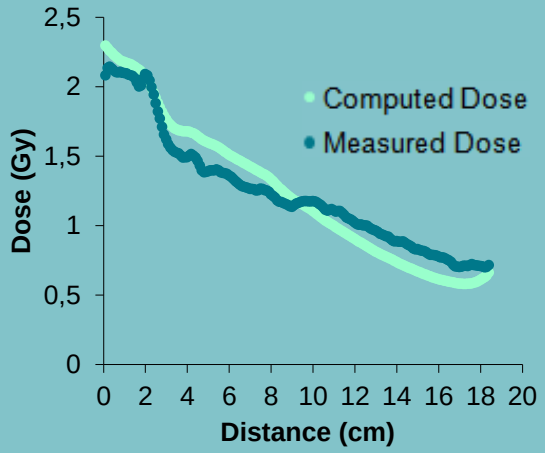


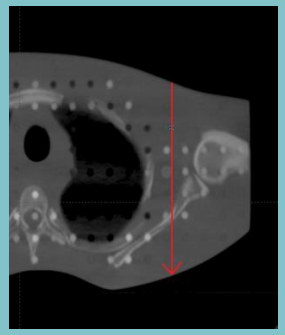


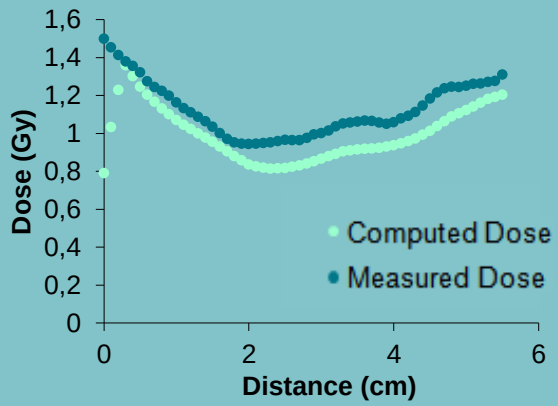


Treatment 2









Results

Mean dose

A 2x2 cm^2 ROI was used to determine the mean dose in the pacemaker:

	Calculated (cGy)	σ (cGy)	Measured (cGy)	σ (cGy)	Difference (%)
Treatment 1	140.57	12.25	148.58	18.12	5.30
Treatment 2	88.22	6.68	101.07	9.83	12.71

Discussion & Conclusions

Irradiated films showed higher doses in the pacemaker than the TPS prediction: 5% in Treatment 1 and 13% in Treatment 2.
In the former case, the pacemaker is closer to the field border

TPS underestimates dose in the region where pacemakers are placed; usually out of field. The underestimation of dose increases with increasing distance from the field border.

Other methodologies should be implemented in the future to improve dose estimation.