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A new multi-functional implant for 4DRT, including positioning, dose measurement and patient identification.

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Introduction

Organ positioning for radiotherapy using electromagnetic technology was first described by Lennernäs & Nilsson in 1995. The RayPilot™ system is a wire based organ positioning system with the possibility to add other functions to an implantable transmitter.

Purpose

To investigate accuracy in dose and position measurements in an implantable transmitter for 4DRT.

Materials & Methods

An implantable RayPilot™ electromagnetic transmitter (Micropos Medical, Sweden) for real-time organ positioning was modified to include a dosimeter that was mounted near the positioning sensor in the tip of the transmitter.

The modified RayPilot™ transmitter was radiated at the Sahlgrenska University Hospital (Gothenburg, Sweden) using a Varian linear accelerator (Field 10x10cm; 2Gy= 120 MU at 100 cm, 15MeV) in 5 steps of 100 MU from 100 MU. Dose measurement was performed with the transmitter connected to a Hermes 5 electrometer (Mimator, Sweden). To evaluate changes in dose sensitivity due to the direction of radiation the transmitter was radiated with 100 MU from different gantry angles (45, 90, 135 and 180 degrees).

The same transmitter was evaluated regarding the accuracy in position using an automatic 3D moving device that moved the transmitter in 2 000 random positions.

***Figure 1**. The RayPilot™ System. 1. RayPilot™ Transmitter 2. RayPilot™ System 3. RayPilot™ Software*

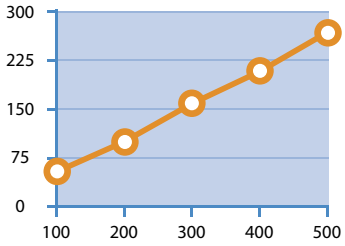
***Figure 2**. The RayPilot™ System.*

Results

The results of the dose measurements was nearly linear, as presented in the table and corresponding diagram, and independent of real-time positioning measurements (or vice versa). Measurement of dose using 100 MU at different gantry angles showed a mean of 53 nC (SD 1 nC).

The accuracy in positioning showed a mean error of 0.38mm (SD: 0.18 mm).

Dose rate [MU]	Electrometer value [nC]
100	53
200	106
300	158
400	210
500	262



Conclusions

This is the first report of a multifunctional transmitter measuring both dose and position in real-time. This study shows that neither the dose or the positioning components of the transmitter interfere with each other. The implantable transmitter seams to be well suited for real-time dosimetry and organ positioning measurements during radiotherapy.