2nd PANHELLENIC CONGRESS OF MEDICAL PHYSICS
4-6 OCTOBER 2024| EUGENIDES FOUNDATION

Intercomparison of MRI based polymer gel dosimetry readouts implemented by 1.5T and 3T clinical MRI systems

Angeliki Ntouli[1], Georgios Kalaitzakis[1], Evangelos Pappas[3], Vereniki Mari[1], Antonis Papadakis[4], Maria Tolia[2], Michalis Mazonakis[1],Thomas G.Maris [1]

[1]Department of Medical Physics, University of Crete, Heraklion, Greece, [2]Department of Radiotherapy, University of Crete, Heraklion, Greece, [3]Department of Biomedical Sciences, University of West Attica, Athens, Greece, [4]Department of Medical Physics, University General Hospital of Heraklion, Crete, Greece.

Background

• Polymer gel dosimeters (PGD) offer 3D dose distribution for radiotherapy QA.
• Accurate MRI readouts are essential for assessing dose spatial distribution.

Purpose

To compare dosimetric readouts of 1.5T and 3T clinical MRI systems for PGD.

Materials & Methods

• **Study Design**: MRI was conducted on the Prime head phantom (RTsafe, Athens, Greece), containing a PGD insert, after VMAT irradiation with 6-MV photons, targeting three tumor sites with a prescribed dose of 20 Gy to each tumor.
• **MRI scheme**: T2 measurements were conducted utilizing a Multi-echo HASTE sequence with 4 TEs. T1 measurements were obtained utilizing an IR HASTE sequence with 11 TIs. T2 and T1 measurement protocols were performed on both 1.5T and 3T clinical MRI systems, utilizing a 2 channel and a 20 channel head coil respectively.
• **Signal-to-Noise (SNR) measurements:** SNR was calculated for irradiated and non-irradiated areas.
• **1D, 2D, and 3D Gamma Index (GI) analyses** for both MRI scanners were performed based on T2-HASTE measurements.

Results

• 50% reduction in acquisition time when using the 3T MRI clinical system.
• Significant SNR increase (~30%) on the 3T MRI clinical system.

irradiated areas:

SNR 1.5T = 51.77 SNR 3T = 158.94

non-irradiated areas:

SNR 1.5T = 63.88 SNR 3T = 197.04

• High level of agreement between TPS and PGD dose response on both clinical MRI systems.
• Gamma Index Passing Rate > 92% with Dose Difference (DD)/Distance to Agreement (DTA): 5%/2mm criteria for both MRI scanners.

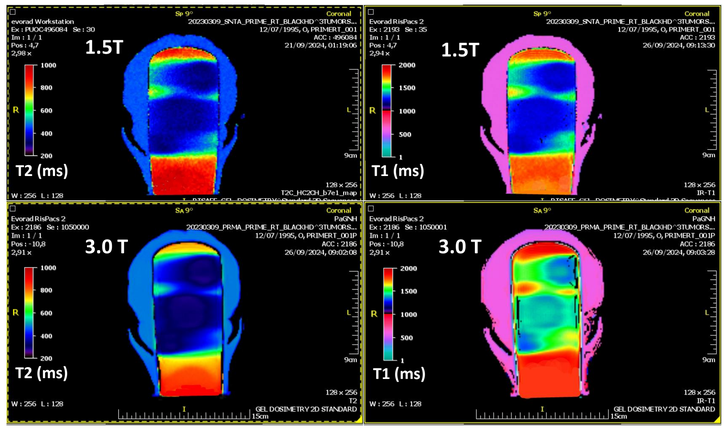

Fig.1: Color T2 and T1 parametric maps in 1.5T and 3.0T clinical MRI systems of 3 irradiated tumors each of which received a dose of 20 Gy. Noticeable T2 and T1 differences on the irradiated and non-irradiated areas between the two different static magnetic fields.

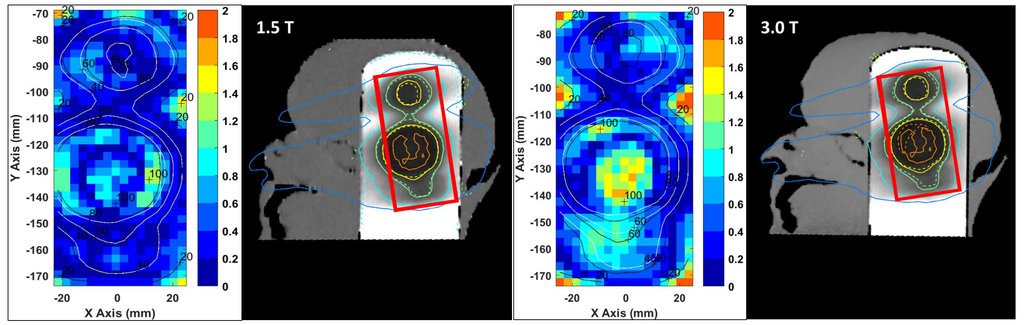

Fig.2: 2D Gamma Index analysis on 1.5T and 3.0T MRI scanners in sagittal plane at the location depicted by the red area.

1.5 T			
Structure	DTA (mm)	DD(%)	GIPR*(%)
Tumor 1	2	5	97.60
Tumor 2	2	5	98.39
Tumor 3	2	5	99.73
3.0 T			
Structure	DTA (mm)	DD (%)	GIPR*(%)
Tumor 1	2	5	92.76
Tumor 2	2	5	95.96
Tumor 3	2	5	94.14

*GIPR: Gamma Index Passing Rate

Table 1. Results from the 3D gamma index analyses, comparing gel-measured (reference) with the TPS-calculated dose distributions using 5%/2mm passing criteria for both MRI scanners.

Conclusions

• Using a 3T MRI clinical system with quantitative T2-HASTE sequences, significantly shortens acquisition time while preserving image quality.
• A threefold increase in SNR on the 3T MRI scanner enhances the reliability of dose readout.
• Both MRI clinical systems provide accurate and consistent dosimetric measurements.