PHILIPS

Clinical Elements

MRCAT Pelvis provides dosimetric and positioning accuracy in an MR-only workflow

Purpose of this study

Scientists from Turku University Hospital (Finland) evaluated the dosimetric accuracy and verified CBCT- and DRR-based positioning accuracy of an MRI-only approach (MRCAT Pelvis) for radiotherapy planning of pelvic cancers. The following is a summary of the study published by R. Kemppainen et al. in Physics and Imaging in Radiation Oncology (2019).

Extending the MR-only planning workflow to the whole pelvis

Various studies have demonstrated the feasibility of using the first generation (bulk assignment of Hounsfield units) of Philips' MRCAT method for prostate cancer EBRT planning.[1-3] The second generation (MRCAT Pelvis) application can be used for a wider range of pelvic targets and uses assignment of continuous Hounsfield units. In this study the investigators assessed the dosimetric and positioning accuracy of MRCAT Pelvis against that of CT.

The prospective study included 75 patients. Forty-five patients had prostate cancer, of which 15 received definitive radiotherapy, 15 post-operative radiotherapy and 15 regional pelvic node EBRT. The other two groups were 15 patients with rectal cancer and 15 with gynecological cancer. All patients had MR scans including the source scans for MRCAT generation, as well as CT simulation scans.

Dosimetric agreement between the planning CT and MRCAT was assessed by recalculating the clinical plans in the planning system.
The evaluation metrics included dose-volume histogram (DVH) analysis for the PTV and OARs and 3D gamma analysis.

For a subset of the patients, the team evaluated several possible DRR- and CBCT-based positioning workflows using MRCAT imaging data.

Good dosimetric agreement between MRCAT and CT

The investigators found that the dosimetric differences between CT- and MRCAT-based plans were small among all pelvic cancer groups, with the average mean dose difference in the PTV of less than 0.2% with a standard deviation of 0.4%.

		Prostate cancer			Rectal cancer	Gynecological cancer
		Pelvic lymph nodes (n=15)	Post-operative (n=15)	Definitive (n=15)	(n=15)	(n=15)
Mean pass rate for a 2%/ 2 mm gamma criterion (%)		98	98	99	96	97
Mean relative dose difference between MRCAT and CT (%)	PTV	0.0	0.1	0.1	0.1	-0.2
		Less than 0.2%				
	OARs	Less than -0.3%				

MRCAT Pelvis images allows for accurate patient positioning

Next to dosimetric accuracy, an MR-only approach also needs to guarantee accuracy in patient position verification. This study has shown that with MRCAT Pelvis this is possible for both DRR-based and CBCT-based positioning:

- DRR-based positioning: Mean difference (standard deviation (SD)) between CT and MRCAT positioning is less than 0.3 (1.4) mm in all directions
- Bone-based positioning on CBCT: Mean difference (SD) between CT and MRCAT were less than 0.1 (1.1) mm in all directions.
- Soft-tissue matching on CBCT: Using MRCAT pelvis, soft-tissue match and fiducial marker-based positioning agree within 0.6 (1.8) mm in all directions.

www.philips.com/MRCATPelvis

References

1. Kemppainen R, Suilamo S, Tuokkola T, et al. Magnetic resonance-only simulation and dose calculation in external beam radiation therapy: a feasibility study for pelvic cancers. Acta Oncologica, 56(6), 1-7, (2017).
2. Christiansen RL, Jensen HR, Brink C. Magnetic resonance only workflow and validation of dose calculations for radiotherapy of prostate cancer. Acta Oncologica, 56(6), 787-791, (2017).
3. Tyagi N, Fontenla S, Zhang J, et al. Dosimetric and workflow evaluation of first commercial synthetic CT software for clinical use in pelvis. Phys Med Biol., 62(8), 2961-2975, (2017).

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

Kemppainen R, et al. Assessment of dosimetric and positioning accuracy of a magnetic resonance imaging-only solution for external beam radiotherapy of pelvic anatomy. Phys Imag Radiat Oncol 11, 1-8 (2019).

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