BHPA 2020 abstract submission form

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II. Abstract information

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Film dosimetry, One-scan, Beldart, mailed audit, VMAT, dose verification,

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A method for performing film dosimetry as part of a mailed audit service using a recalibration process

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Introduction

We perform mailed dosimetry audits using alanine/EPR and film dosimetry. For mailed audits, it is very difficult to control the time window between scanning and irradiation. The films should also be possible to rescan if required even after very long times (order of years). This work evaluates our procedure wherein we compensate for the time delay and various scanner effects using the "one-scan" method (1). We investigated for post-exposure changes, lot-to-lot variability, different dose-response functions and the sensitivity of the delivered dose for rescaling.

Material and Methods

In the context of an audit, the centres irradiated an anthropomorphic phantom that contained EBT3 film and alanine detectors with an IMRT/VMAT plan. Besides, they irradiated a PMMA plate containing film and alanine detectors in contact with each other using a uniform field with a dose similar to the dose prescribed in the VMAT plan. This film was used to rescale the film calibration curve of the test film used in the audits. Films from previous audits were rescanned multiple times and compared to the patient plans and the dose maps of the original scans. Dose maps were generated from films of 4 different lots with one of the lots having a different marker dye. Two dose-response functions were used for the calibration of 3 of the 4 lots. The calibration curve of the last lot was only possible to fit with one of the functions. The sensitivity of the rescaling dose was investigated by recalculating the dose maps with artificially altered doses for the rescaling films.

Results

For the comparison to the patient plans, the passing rates are nearly unchanged (≥ 99%) using gamma analysis with 3%/3mm (Table 1) for the different scan times and using different lots. The only exception is lot C3 that could only be fitted with a cubic function. Some deviations are observed when the cubic function is used and when the marker dye of the calibration and test films is different. The passing rates were unchanged when the rescaling dose was altered by 1% but started to fluctuate when the dose was altered by 2%. The dose maps were compared with each other using gamma analysis with 2%/2mm (Table 2). The passing rates are ≥ 99% with the exception of lot C3 and using the cubic function with lots having a different marker dye for the calibration and test films.

Conclusion

We showed that it is possible to use film dosimetry for postal audit services using a rescaling method. These results show that it might be possible to use a generic calibration curve for EBT3 films in combination with the rescaling method. However users must be careful not to mix film lots that have a different marker dye while using a different dose-response function. The delivered dose to the recalibration films should be determined with an accuracy of ≤1%.

References

1. Lewis et al. An efficient protocol for radiochromic film dosimetry combining calibration and measurement in a single scan *Med Phys*. 2012;39(10):6339-6350

Table 1: gamma evaluation with 3%/3mm comparing the dose maps of the rescanned films generated with calibration curves from different lots and dose-response functions to the patient plans.

Plan (film lot)	Original curve		Curve of lot C1		Curve of lot C2*		Curve of lot C3	Curve of lot C4	
	Rational	Cubic	Rational	Cubic	Rational	Cubic	Cubic	Rational	Cubic
Plan 1 (C1)	99.32	99.21	99.52	99.19	99.42	99.06	62.06	99.09	99.14
Plan 2 (C1)	99.45	99.20	99.25	99.25	99.00	98.62	68.97	99.36	89.76
Plan 3 (C2*)	99.28	99.23	99.13	99.01	99.23	99.18	80.66	99.19	99.23
Plan 4 (C2*)	99.54	99.26	99.15	99.22	99.32	99.3	70.42	99.21	99.16
Plan 5 (C4)	99.33	99.19	99.56	99.28	99.56	99.32	83.21	99.54	99.36
Plan 6 (C4)	99.83	99.95	99.95	99.85	99.80	99.58	74.6	99.90	99.46
Plan 7 (C4)	99.84	99.88	99.81	99.87	99.70	99.73	72.22	99.83	99.63

*: Film lot **C2** had a different marker dye

Table 2: gamma evaluation with 2%/2mm comparing the dose maps of the rescanned films generated with calibration curves from different lots and dose-response functions to the dose maps of the original scans.

Plan (film lot)	Original curve		Curve of lot C1		Curve of lot C2		Curve of lot C3	Curve of lot C4	
	Rational	Cubic	Rational	Cubic	Rational	Cubic	Cubic	Rational	Cubic
Plan 1 (C1)	99.96	99.84	99.88	99.86	99.93	93.64	69.3	99.92	99.91
Plan 2 (C1)	99.94	99.96	99.95	99.9	99.7	91.39	76.04	99.86	99.51
Plan 3 (C2*)	99.58	99.45	99.63	99.34	99.24	96.25	78.46	98.33	99.12
Plan 4 (C2*)	99.37	99.77	99.85	99.29	98.91	97.18	76.27	99.36	99.29
Plan 5 (C4)	99.92	99.93	99.5	99.9	99.7	99.93	85.01	99.87	99.91
Plan 6 (C4)	99.6	99.68	99.65	99.81	99.9	99.87	73.14	99.93	99.49
Plan 7 (C4)	99.74	99.83	99.9	99.78	99.7	99.74	74.52	99.72	99.49

*: Film lot **C2** had a different marker dye