On the evaluation of patient specific IMRT QA using EPID, dynalog files and patient anatomy

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Abstract

Purpose: This research, investigates the viability of using the Electronic portal imaging device (EPID) coupled with the treatment planning system (TPS), to calculate the doses delivered and verify agreement with the treatment plan. The results of QA analysis using the EPID, Delta[4] and fluence calculations using the multi-leaf collimator (MLC) dynalog files on 10 IMRT patients are presented in this study.

Methods: EPID Fluence Images in integrated mode and Dynalog files for each field were acquired for 10 IMRT (6MV) patients and processed through an in house MatLab program to create an opening density matrix (ODM) which was used as the input fluence for dose calculation with the TPS (Pinnacle[3], Philips). The EPID used in this study was the aSi1000 Varian on a Novalis TX linac equipped with high definition MLC. The resulting dose distributions were then exported to VeriSoft (PTW) where a 3D gamma was calculated using 3 mm-3% criteria. The Scandidos Delta[4] phantom was also used to measure a 2D dose distribution for all 10 patients and a 2D gamma was calculated for each patient using the Delta[4] software.

Results: The average 3D gamma for all 10 patients using the EPID images was 98.2% ± 2.6%. The average 3D gamma using the dynalog files was 94.6% ± 4.9%. The average 2D gamma from the Delta[4] was 98.1% ± 2.5%. The minimum 3D gamma for the EPID and dynalog reconstructed dose distributions was found on the same patient which had a very large PTV, requiring the jaws to open to the maximum field size.

Conclusion: Use of the EPID, combined with a TPS is a viable method for QA of IMRT plans. A larger ODM size can be implemented to accommodate larger field sizes. An adaptation of this process to Volumetric Arc Therapy (VMAT) is currently under way.
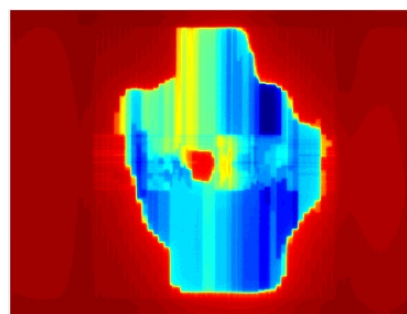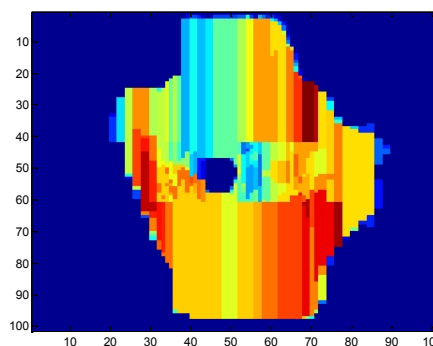
FIG 1: Fluence map measured by the EPID.

FIG 2: ODM created in Matlab from fluence map.

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TABLE 1: 3D Gammas at 3% 3mm for all 10 patients per QA method.

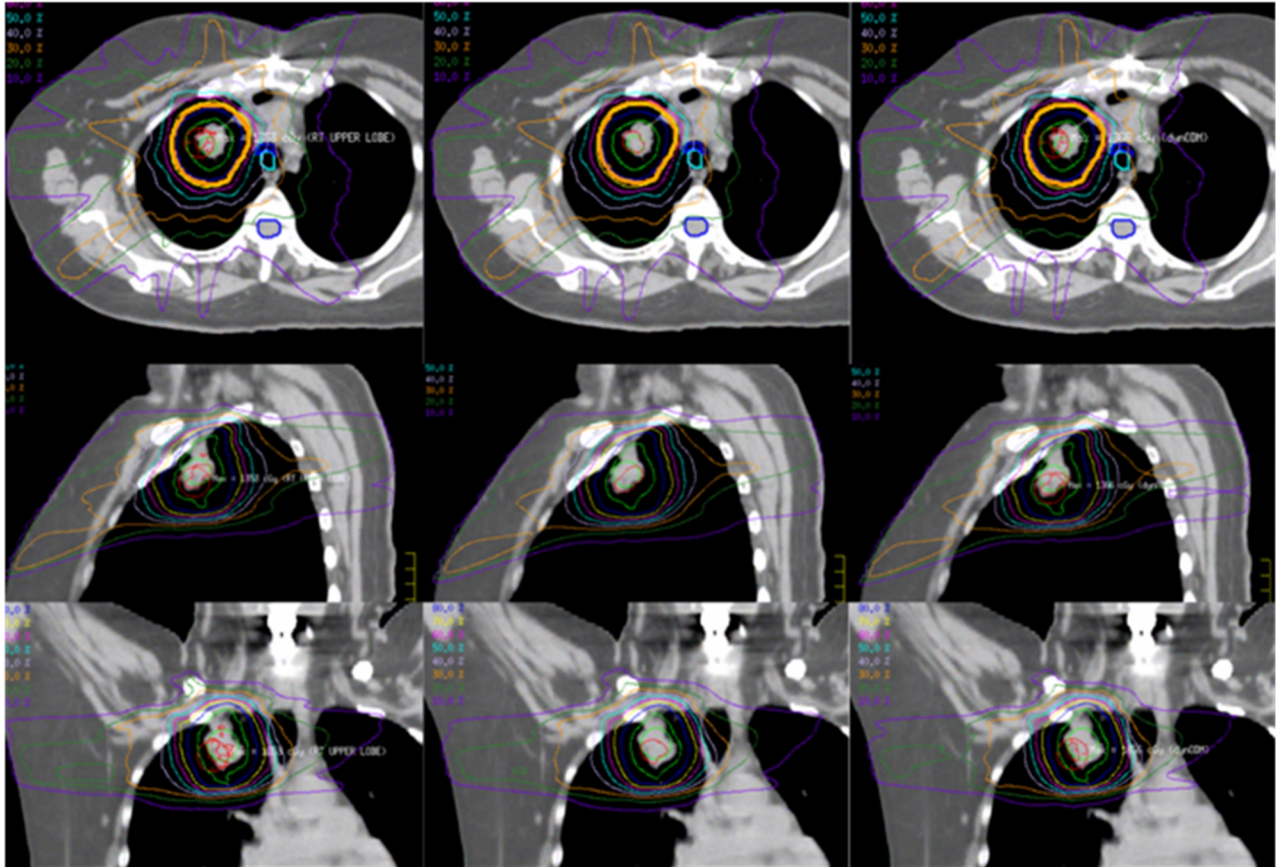|	1	2	3	4	5	6	7	8	9	10	
	Liver	Liver	Liver	Liver	Liver	Lung	Lung	Lung	Lung	Pelvis	Average
EPID	100%	98.1%	99.9%	97.6%	98.7%	100%	98.6%	99.1%	98.8%	91.4%	98% ±2.6%
Dynalog	98.2%	93.9%	98.7%	88.9%	95.2%	99.3%	99.3%	97.1%	94.4%	85.0%	94.6% ±4.9%
Delta⁴*	91.7%	96.9%	100%	100%	92.6%	99.8%	99.8%	98.3%	99.6%	96.3%	98.1% ±2.5%

* = 2D Gamma

FIG. 3: Dose distributions calculated in Pinnacle for the approved plan (left) EPID ODM (middle) and dynalog ODM (right).