

Quality control measurements for head and neck cancer patients with SHANE phantom



B Melles-Bencsik¹, D Mihály¹, E Tolvaj¹, Z Takácsi-Nagy¹, T Major^{1,2}, Cs Polgár^{1,3}, Cs Pesznyák^{1,2}

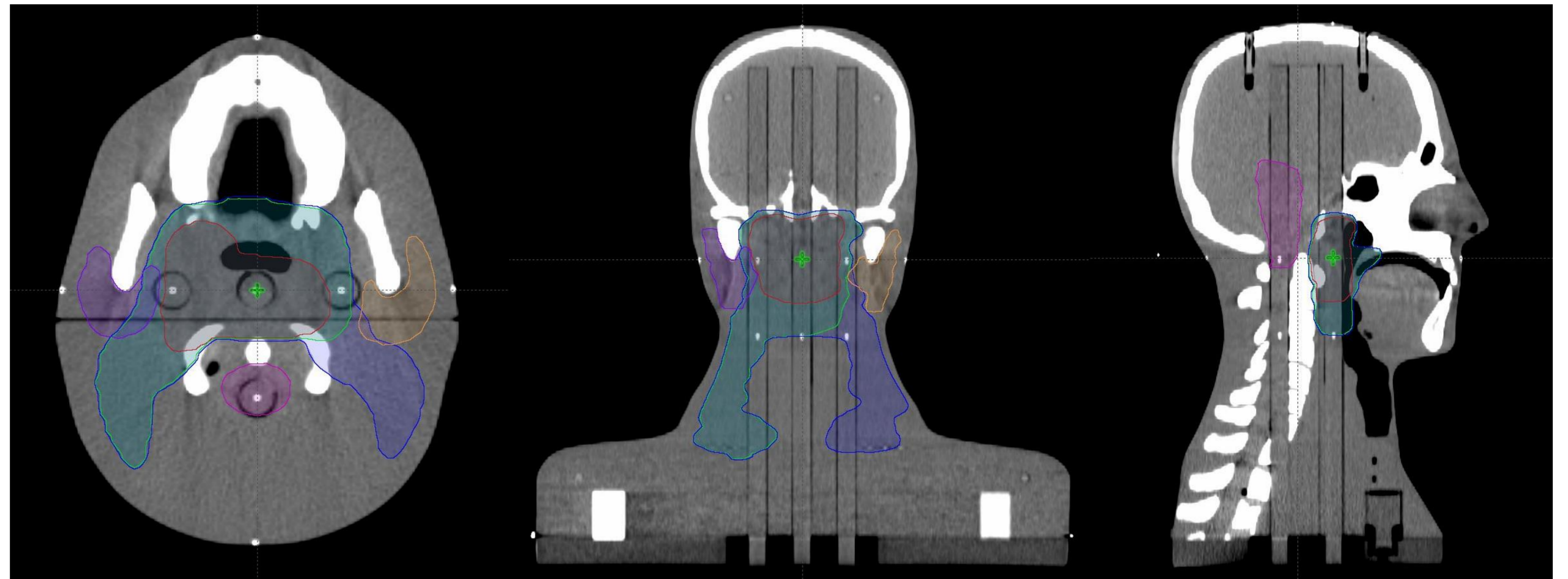
¹ National Institute of Oncology, Centre of Radiotherapy, Budapest, Hungary

² Budapest University of Technology, Department of Nuclear Techniques, Budapest, Hungary

³ Semmelweis University, Department of Oncology, Budapest, Hungary

PURPOSE

To investigate irradiation techniques for simultaneous integrated boost (SIB) treatment of nasopharyngeal cancer (NPC) in terms of organs at risk (OAR) toxicity and patient specific quality control (QC). This study was a part of an end-to-end audit programme for dose delivery using intensity modulated radiation therapy (IMRT).



Delineated structures at the isocenter plane on the planning CT of CIRS SHANE Phantom

METHODS

CIRS SHANE Phantom was used to create four different treatment plans for a NPC patient. SIB schedule prescribed 54 Gy, 60 Gy and 70 Gy in 30 fractions for elective nodes (both sides), involved nodes (right side) and primary nasopharynx tumour respectively, using 1, 2 or 3 arcs RapidArc (RA) or 7 field Sliding Window (SW) techniques. Patient specific quality control measurements were performed using EPID. As clinically acceptable, treatment plans with 2 and 3 arcs were delivered to the phantom. Point dose measurements with PTW Semiflex 0.125cc ionization chamber in the four longitudinal channels were repeated at least two times for all treatment fields. Measurement points were located in PTV70, PTV60, PTV54 and spinal cord. Dose distribution on coronal plane was checked by irradiating an EBT3 film and analysed using Ashland FilmQATM Pro. Local gamma analysis was applied using 2% / 2 mm and 3% / 3 mm criteria with 10% threshold.

RESULTS

All plans met the criteria of dose to OARs: D_{max} of the spinal cord and the brainstem on average were 35.4Gy and 39.8 Gy; mean dose of the left parotid on average was 22.9 Gy. Patient specific QC was performed without any interruption. MUs for 1, 2, 3 arcs and 7 field SW were 602, 706, 696 and 2447, respectively. Gamma analysis on EPID images gave 96.2%, 96.2%, 96.7%, 82.6% and 98.8%, 98.9%, 99.3%, 92.1% passing rate on average for 2% / 2 mm and 3% / 3 mm criteria, respectively. Results of the film analysis and point dose measurements can be seen in Table 1 and Table 2. Acceptance limit was 5% for all points.

	3%/3mm	2%/2mm
2 arcs	99.04%	94.44%
3 arcs	96.37%	84.71%

Table 1 Film analysis results for 2 and 3 arcs treatment plans

	PTV70	PTV60	PTV54	SpinalCord
2 arcs	-1.20%	-1.80%	-1%	0.90%
3 arcs	-1.60%	-0.90%	0.50%	0.40%

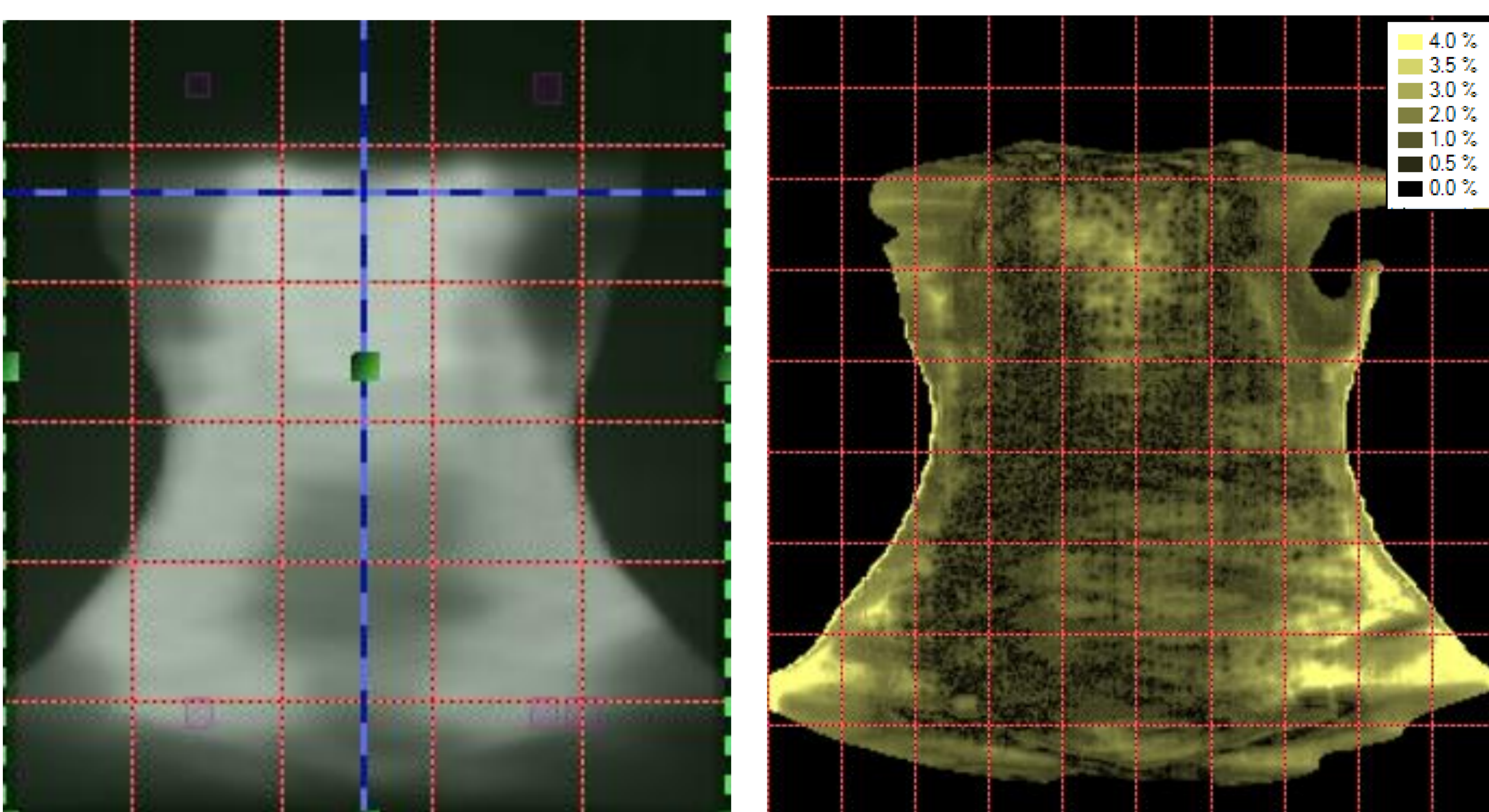
Table 2 Average of relative dose differences between planned and delivered point doses in the four measured points

CONCLUSION

CIRS SHANE Phantom is a recommended tool for IMRT quality control, which is applicable for both point and plane dose measurements. All treatment techniques were appropriate for NPC irradiation with SIB in terms of OAR toxicity although RA with 2 or 3 arcs were more preferable in terms of number of MUs. Patient specific QC with EPID alone did not provide sufficient information.



Disassembled CIRS SHANE with interchangeable sleeves for ionization chamber measurements in four longitudinal channels



Dose map (left) and gamma map (right) from FilmQA ProTM