Validation of SRS MapCheck for patient specific QA

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OBJECTIVES

The administration of high doses requires rigorous quality assurance (QA) procedures to verify the spatial and dosimetric accuracy of the delivery. SRS MapCheck diode array in the StereoPHAN phantom appears as a useful tool for patient specific pre-treatment measurements for plan verification. The objective of this work is the validation of this device for patient specific QA (PSQA).

METHODS

The diode array was firstly calibrated in a Truebeam STx for 6WFF, 6FFF and 10FFF beams and then StereoPHAN correction factors were determined.

A CT scan of SRS MapCheck inserted into the StereoPHAN was acquired with 1 mm slice thickness. In treatment planning system (TPS) a QA phantom template was created setting the origin in the intersection of fiducial markers and contouring a structure with the density overridden in four different configurations:

(i) forcing the Hounsfield Units (HU) to have mass density of 1.2g/cm3 (**$QA_{1.2}$**)
(ii) assigning PMMA material (**QA_{PMMA}**)
(iii) assigning water material (**$QA_{Water,1.2}$**) and mass density of 1.2 g/cm3,
(iv) assigning water material and mass density of 1.14g/cm3 (**$QA_{Water,1.14}$**)

AP fields of 5x5cm2 and 100 MU were used for the absolute dose calibration (**figure 1**).

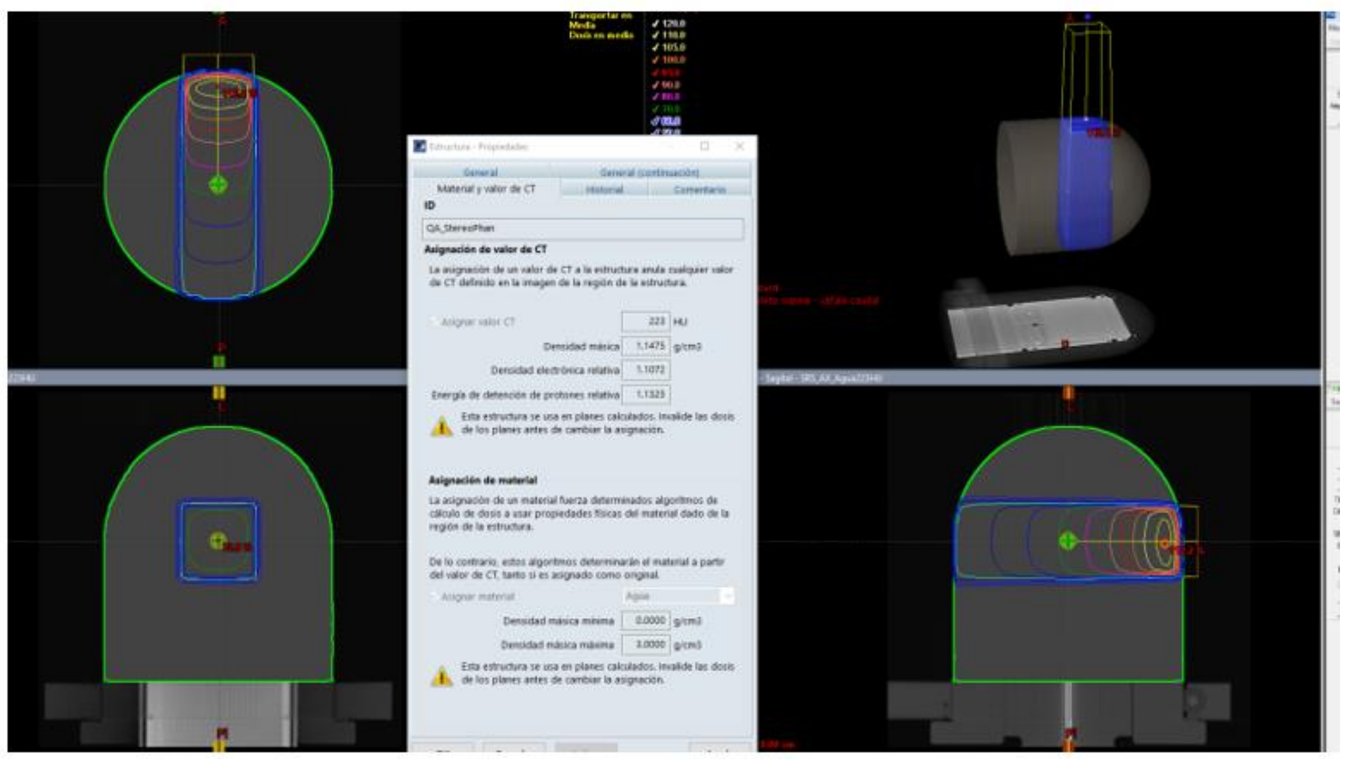

Figure 1. QA phantom on TPS

Finally, 7 patients treated previously with VMAT technique were evaluated using SRS MapCheck. In order to achieve higher precision on the comparison, the device was aligned using image guidance by acquiring CBCT and a performing a rigid registration, with 6 degrees of freedom, to the planning CT.

Treatment plans were calculated over the QA phantom with the Analitycal Anisotropic Algorithm (AAA) and Acuros XB (AXB) algorithm using 1 mm dose grid and the RT Dose DICOM files were then imported into the SNC Patient software and compared to the measured dose distribution (**figure 2**).

Gamma tests applying a 10% threshold were used with evaluation criteria of 1 mm distance to agreement and 3% and 2% absolute dose difference (3% /1mm and 2%/1mm, respectively).

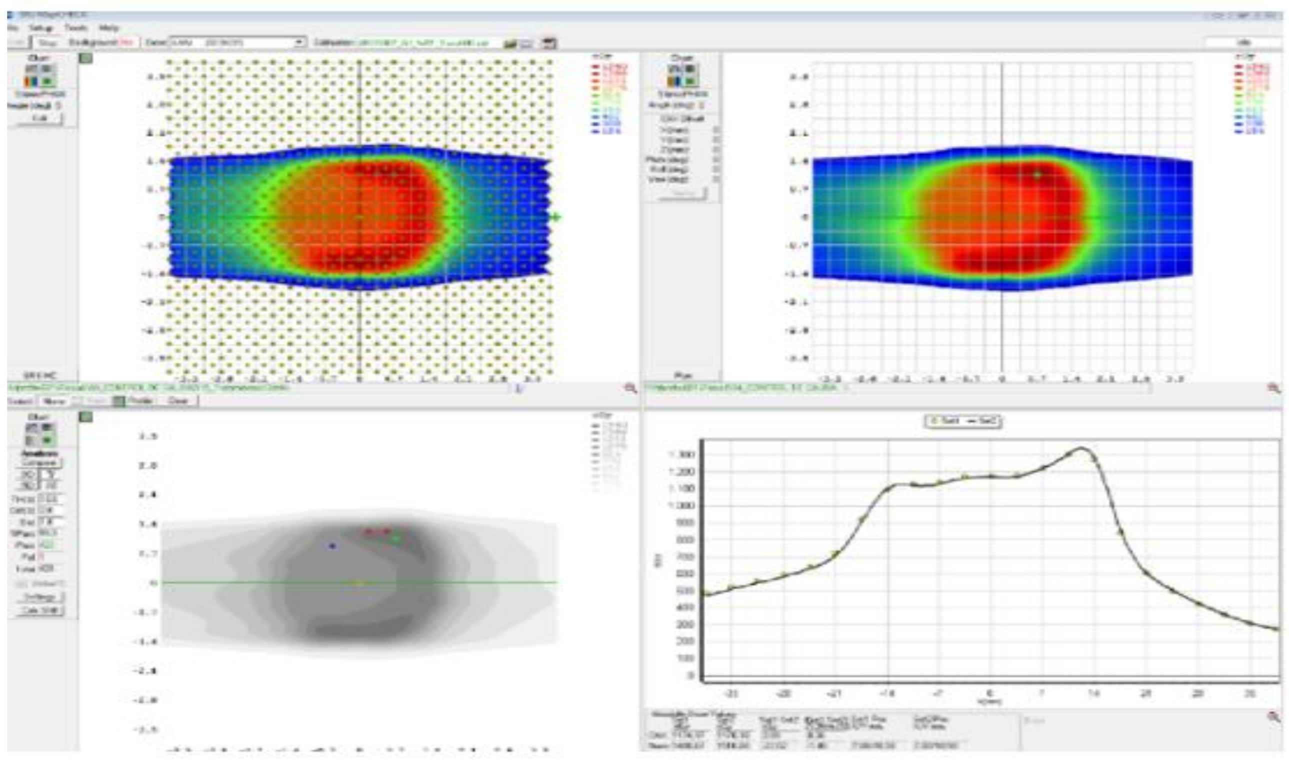

Figure 2 Gamma test analysis on SNC Patient

RESULTS

	$QA_{1.2}$		$QA_{Water,1.14}$		$QA_{Water,1.2}$		QA_{PMMA}	
	AAA		AXB		AXB		AXB	
	3%/1mm	*2%/1mm*	*3%/1mm*	*2%/1mm*	*3%/1mm*	*2%/1mm*	*3%/1mm*	*2%/1mm*
6WFF	99.9%	98.7%	99.6%	97.3%	98.0%	91.0%	69.3%	60.6%
6FFF	99.6%	98.5%	99.8%	99.3%				
10FFF	99.9%	99.7%	99.7%	99.0%				

Table 1. Average gamma passing rates for different phantom assign material

Gamma passing rates for each density overriding configuration are shown in **Table 1**. Plans calculated with AAA and the **$QA_{1.2}$** phantom showed high passing rates as it was expected from the vendor instructions. On the other hand, for AXB calculated plan average gamma passing rates assigning water material (**$QA_{Water,1.2}$** and **$QA_{Water,1.14}$**) were higher than for those calculated in PMMA material (**QA_{PMMA}**), which showed low agreement between the planned and delivered doses. Meanwhile AAA algorithm uses only HU for the calculation, AXB uses HU and the properties of the assigned material. The highest average gamma passing rate when using AXB is showed for the configuration **$QA_{Water,1.14}$**. Therefore, this configuration was validated for the PSQA workflow.

CONCLUSION

The validation of SRS MapCheck in the StereoPHAN phantom for patient specific QA requires TPS-to-phantom dosimetric equivalency to be verified within the accuracy of the dosimetric protocol and dose delivery.

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