Prescription Level Distance-To-Agreement Criteria for IROC-Houston's SRS Head Phantom

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Purpose:

To evaluate the addition of a prescription level distance-to-agreement (DTA) acceptance criteria for IROC-Houston's SRS head phantom.

Methods:

The SRS head phantom contains one insert that includes a 1.9 cm spherical PTV where two TLDs and two planes of GAFchromic film are located. Institutions are instructed to deliver approximately 30 Gy to the center of the PTV. After delivery and with the return of the phantom, institutions are instructed to provide their DICOM data (plan, dose, structures and CT), in which, we compare to the dosimeters contained in the SRS phantom to generate results and create pass/fail criteria. The prescription dose covering the PTV varies depending on the delivery method: GammaKnife - 15 Gy, CyberKnife - 20 Gy, C-arm linac and TomoTherapy - 25 Gy.

Fig. 1: IROC Houston's solid SRS head phantom

Methods (cont.):

Current passing criteria are: TLD/TPS within 0.95 – 1.05 and ≥ 85% of pixels passing a 5%/3mm gamma analysis. Since gamma analyses are not sensitive in small area targets, we performed an additional DTA analysis on a subset of phantom results (n=66). DTAs were obtained at the prescription level from three profiles taken through the center of the PTV.

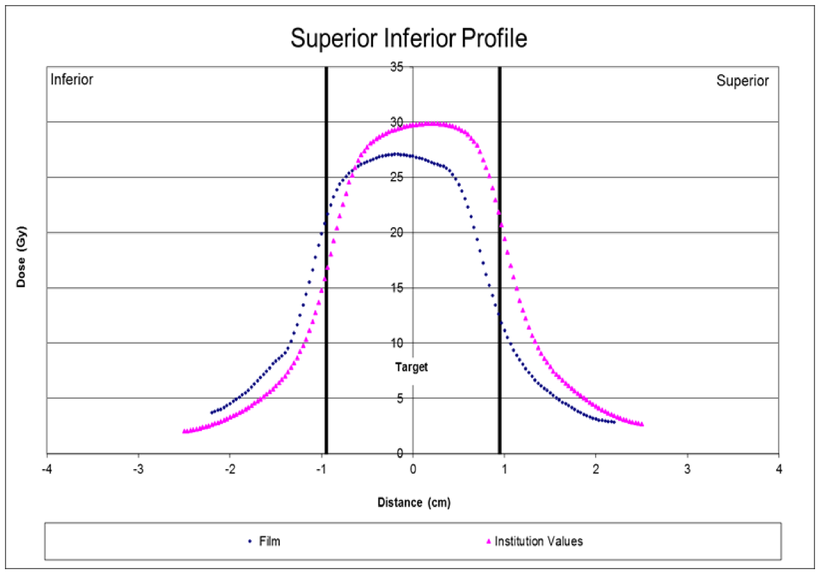

Fig. 2: Example of SRS Superior-Inferior dose profile with prescription dose at 25 Gy. The measured DTA for the superior side was approximately 4 mm and the inferior side was approximately 1 mm. This phantom received a pass with our current criteria but would have failed with the additional maximum DTA ≤ 2 mm.

Results:

The pass rate for the SRS phantom, since 2016, is 84% while our subset of data had a pass rate of 73% using current acceptance criteria. Our subset of data from 2018 included 66 phantoms: 59 TomoTherapy/C-arm linacs, 5 GammaKnifes and 2 CyberKnifes. The pass rate dropped from 73% to 50% or 71% with the additional maximum DTA ≤2 mm or ≤3 mm criteria, respectively. The average DTA values for all orientations were 0.94 ± 0.45 (range of 1 – 4mm) and 1.48 ± 0.56 (range of 1-6mm) for phantoms passing and failing our current passing criteria, respectively.

Conclusion:

The addition of a DTA acceptance criteria of 2 mm at the prescription dose level for SRS head phantoms significantly lowered the passing rates. This tighter criteria would ensure better target coverage and be more consistent with the goals of SRS treatment.

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	# of Phantoms	Average TLD (TLD/TPS)	Average Gamma Coronal (%)	Average Gamma Sagittal (%)	Pass Rate (%)	Average DTA (mm)	Maximum DTA Range (mm)
C-Arm/TomoTherapy	59	0.98	93.27	93.19	69.49	1.136	1 - 6
GammaKnife	5	0.98	98.50	99.25	100.00	0.625	0 - 3
CyberKnife	2	1.03	94.50	95.50	100.00	0.583	1 -2

Fig. 3: SRS Head phantom data showing average TLD, passing gamma pixels for coronal and sagittal planes, pass rate using current criteria (TLD/TPS within 0.95 – 1.05 and ≥ 85% of pixels passing a 5%/3mm gamma analysis), average DTA (over three profiles) and maximum DTA range. Statistics based on machines (separated by differing prescription doses) of the subset of phantom results.