

Purpose

In Syed interstitial gynecologic (GYN) brachytherapy, preplanning is often used to guide applicator placement and anticipate target coverage. However, the accuracy of preplan-based contouring relative to treatment-day planning remains uncertain, particularly given anatomical changes after applicator insertion. This study evaluates the similarity between preplan and final plan contours for high-risk clinical target volume (HR-CTV) in patients undergoing Syed GYN brachytherapy.

Methods

A retrospective analysis was performed on 7 patients treated with Syed-Neblett template interstitial brachytherapy. For each fraction, HR-CTV was contoured on the preplan CT with MRI fusion and again on the treatment-day CT after applicator insertion with a new MRI. All sets of images were sent to MIM software for similarity study. Similarity metrics—including Dice Similarity Coefficient (DSC), Hausdorff distance (HD), and percent volume difference—were calculated to quantify agreement between preplan and plan contours.

Results

Preplan and live plan contours demonstrated moderate geometric agreement. HR-CTV showed the highest similarity, with DSC values indicating that preplan contours generally approximated final target shape but underestimated volume in cases with significant applicator-induced deformation or tumor response with external beam treatments. The dates between preplan and treatment range from 11 to 33 days. The DSC values 0.51 ± 0.38 (mean $\pm$ standard deviation) (range of 0.18–0.78), and HD of $14.84 \text{ mm} \pm 8.07$ (range of 4.21–31.02). The average HR-CTV volume for preplan is $12.31 \pm 15.15 \text{ c.c.}$, for treatment plan day is $15.72 \pm 18.60 \text{ c.c.}$

The preplan HR-CTV(High risk CTV red color line) was copied to the planning CT in Figure1, the deformation of HR-CTV(pink color line) was introduced by the needle insertion.

Figure2 shows the results for the similarity study with HD(maximum boundary discrepancy between two segmentations, units mm) and Dice(two segmentations overlap similarity coefficient), and the volume change between the preplan and treatment day live plan.

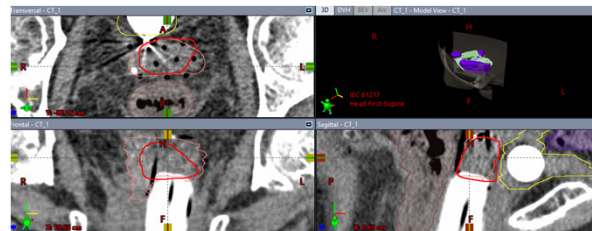


Figure1. An example of pre-plan and treatment day(plan) HR-CTV : Red color line is preplan HR-CTV, pink color line is plan HR-CTV

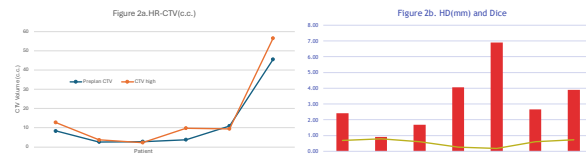


Figure2. a).The HR-CTV Volume for preplan and treatment day plan: Blue is Preplan day, Orange is Treatment day. b). Similarity study for the two sets HR-CTV using HD and Dice

The summary of HR-CTV volume studies are shown in the Table 1. The Jaccard measures the overlap between the two datasets to the union. A score 1 means identical sets, 0 means no overlapping items. The Hamming distance is used to approximate the Jaccard similarity of the original sets.

Table I, The Hausdorff distance , Hamming distance and Dice and Jaccard analysis between the two sets of HR-CTV

	HD(mm)	HD(mm)	DICE	Jaccard
Pt #1	13.26	2.41	0.69	0.53
Pt #2	5.61	0.92	0.79	0.65
Pt #3	4.21	1.69	0.61	0.44
Pt #4	14.03	4.07	0.25	0.14
Pt #6	19.53	6.91	0.18	0.10
Pt #7	11.31	2.66	0.61	0.44
Pt #5	19.75	5.54	0.23	0.13
Min	4.21	0.92	0.18	0.10
Max	31.02	6.91	0.79	0.65
Mean	14.14	3.22	0.55	0.41
Standard Deviation	8.40	1.83	0.22	0.20

The Hamming distance measures the number of positions at which two vectors of equal length differ while the Hausdorff distance measures the maximum distance of a set to the nearest point in the other set. It measures how far two subsets of a metric space are from each other.

The HR-CTV Volume change could be caused by deformation from needle insertion, or tumor response with other treatment, or contouring uncertainties, or limited number of cases. A further investigation will be carried on to specify.

Conclusion

Preplanning provides a useful structural reference for Syed GYN brachytherapy, but notable differences exist between preplan and treatment-day contours. Relying on preplan contours alone may lead to suboptimal dosimetry. These findings support the continued need for individualized, treatment-day imaging and contouring to ensure accurate target delineation and safe OAR sparing in interstitial GYN brachytherapy.