

Multi-institutional/technique dose comparisons using Overlap Volume Histograms for difficulty normalization

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Purpose/Objectives

- The dosimetric difference between current and newer radiotherapy techniques have not been fully explored
- Techniques are compared for a population but do not account for patient variations and planning difficulty
- Overlap volume histograms (OVHs) can be used to normalize plan difficulty between sites and remove the influence of structure proximity

Materials/Methods

- Database of 53 previously treated pancreas SBRT patients
- Three institutions
 - 6 VMAT plans
 - 25 IMRT plans
- Dose and structure information for
- Dose volume histograms (DVHs) and OVHs are generated for each structure for each patient
- An OVH (Figure 1) describes the relationship between structures in the patient by plotting the Planning Target Volume (PTV) expansion distance required to overlap a percentage of the Organ at Risk (OAR) volume

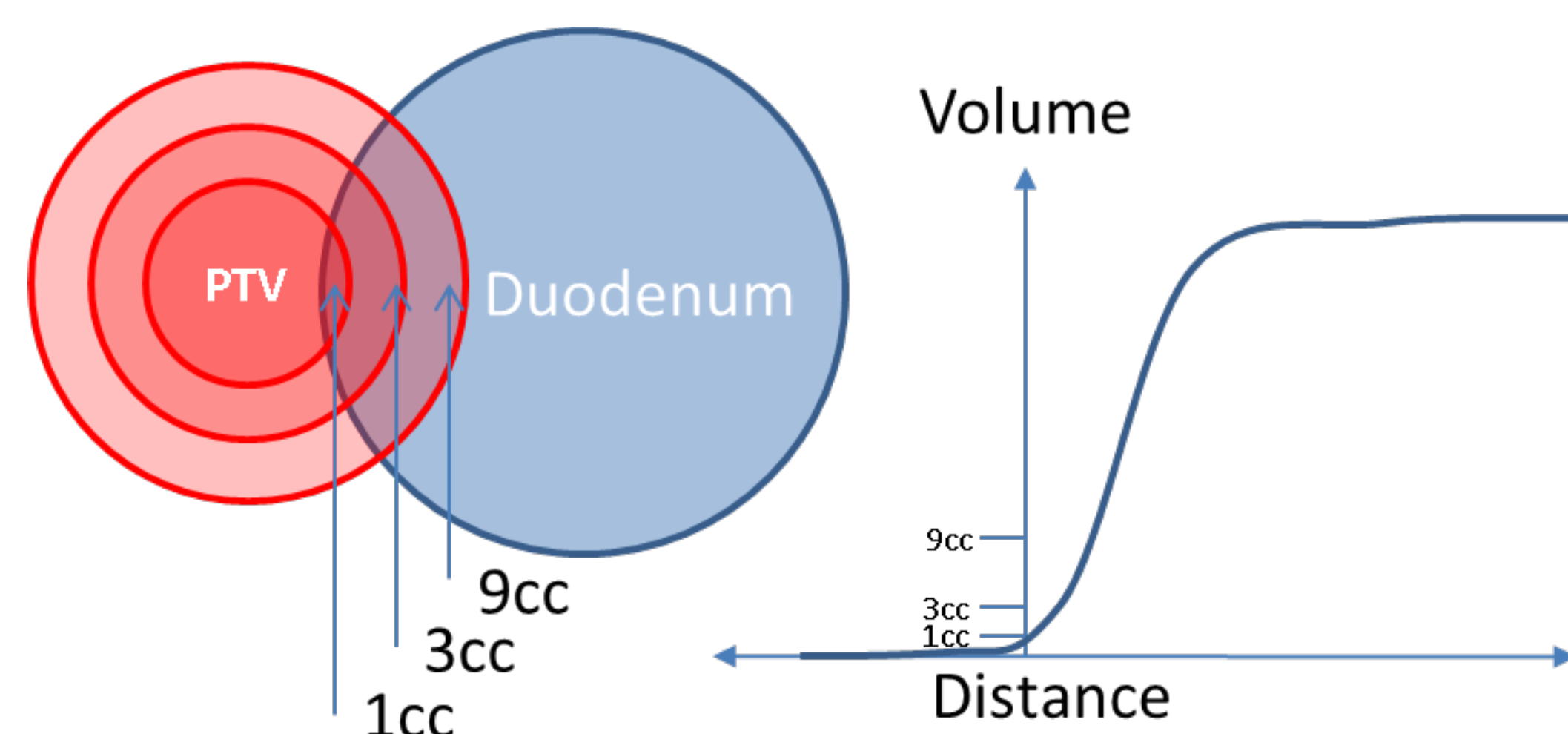


Figure 1: Visual description of OVH generation. Target expansion is plotted against volume of overlap with organ at risk with each expansion.

- Example OVHs and DVHs are shown in Figure 2
- Dose and distance to overlap is queried at the points specified in the trial protocol and plotted

Results

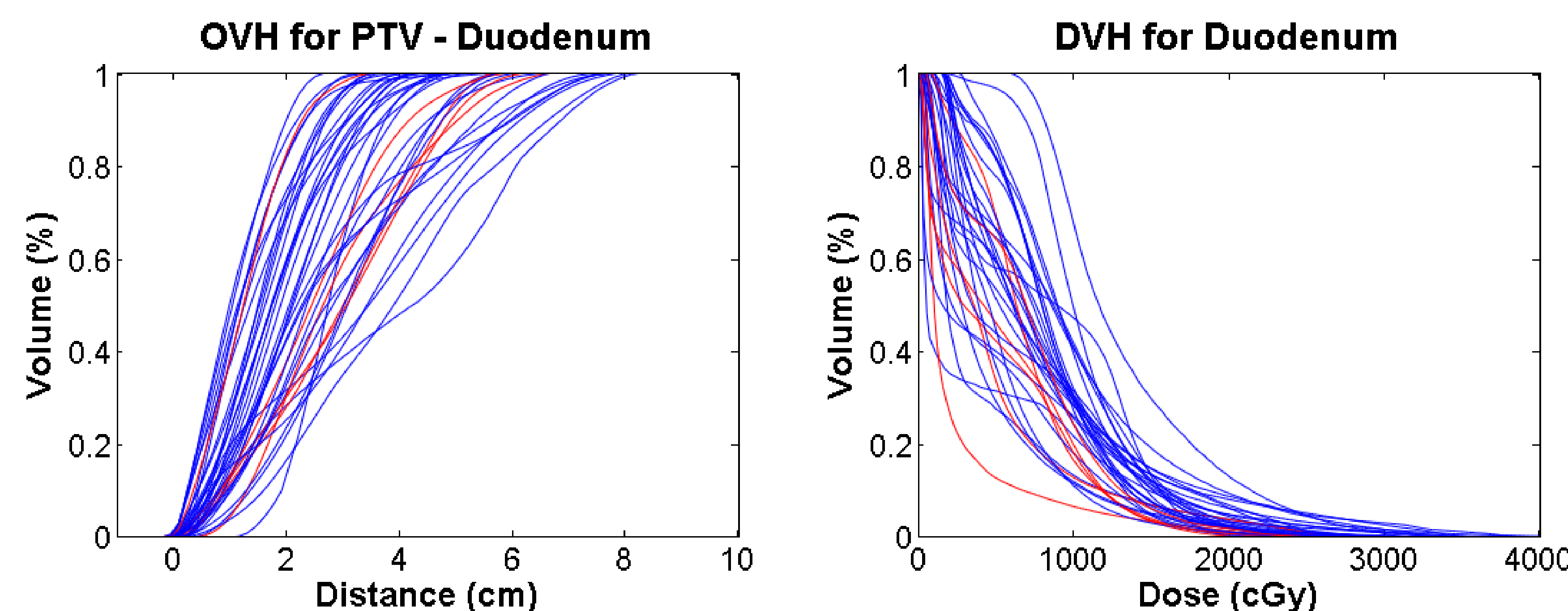


Figure 2: Overlap Volume Histograms represent relative volume of overlap of the OAR with the target as a function of expansion distance of the target. They can be read as Y% of the OAR is within X cm of the target. Also displayed are DVHs for the same structure. In both plots, VMAT plans are in red, while IMRT plans are in blue.

Objective	Average Dose (cGy)			Average Distance to Overlap (cm)		
	VMAT	IMRT	p	VMAT	IMRT	p
Duodenum-D1cc	1911	2538	0.01	0.35	0.25	0.22
Duodenum-D3cc	1470	2053	0.03	0.66	0.42	0.15
Duodenum-D9cc	1043	1480	0.04	1.29	0.76	0.14
Cord-D1cc	761	628	0.13	5.57	6.15	0.01
Kidneys-D25	512	747	0.01	6.30	5.98	0.21

Table 1: Average dose and overlap distance for a specified plan objective points for both VMAT and IMRT plans. P-value is a t-test between the VMAT plans and IMRT plans.

- Table 1 shows the average dose and distance for the protocol objectives
- Figure 3 shows the trending of VMAT and IMRT doses for the duodenum and kidney objectives
- VMAT plans show a trend toward lower duodenal doses with increasing distance to overlap
- VMAT plans show significantly reduced dose to duodenum and kidney with no significant difference in overlap distance
- No significant difference in cord dose, though the cord was significantly closer in VMAT plans

Conclusions

- VMAT planning may reduce critical structure doses for SBRT patients
- OAR doses trended lower with increased distance
- The use of OVHs allows for trends in plan quality to be assessed independently of plan difficulty

Acknowledgements

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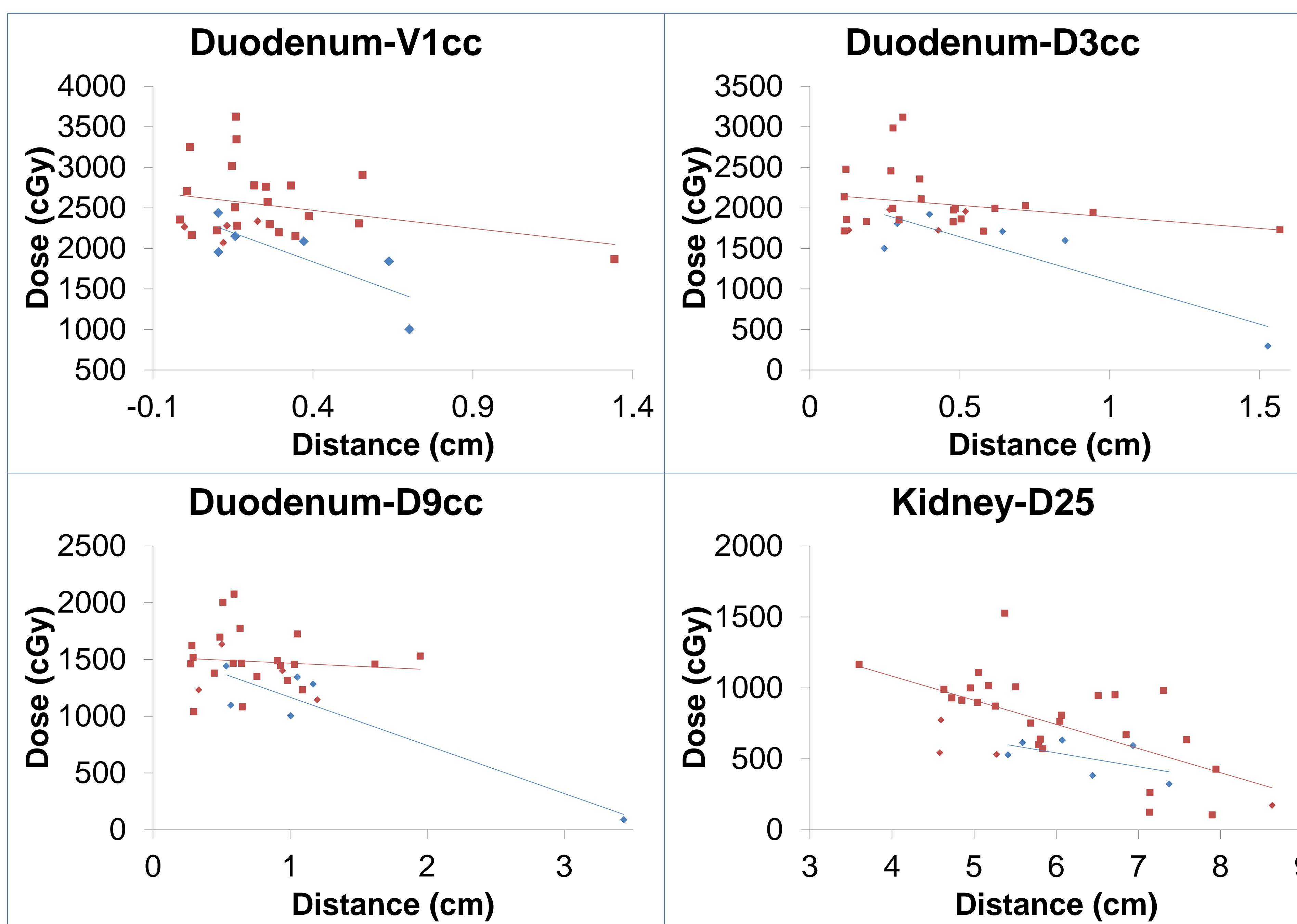


Figure 3: Plot of the dose to 1cc of the duodenum vs. distance from the PTV. Blue dots are VMAT plans and red dots are IMRT plans. Squares are from Institution 1, diamonds are from Institution 2. The plotted trend line shows that VMAT plans have a lower dose over the range of overlap distances.