Use of In-beams Structures in Shape Relationship-Driven Treatment Planning

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Purpose/Objectives

- The use of dose and shape information from prior patients allows for the predicting of achievable doses for critical structures in future patients.
- Large volumes which extend outside of the beams complicates comparison of similar structures with different beam arrangements
- The use of an "in-beams" structure allows for more consistent comparison of critical structures between patients with different beam arrangements and anatomical geography

Materials/Methods

- A database of 35 Pancreas patients treated with IMRT is used for contour generation
- An in-beams contour is first generated by shaping open beams to the target structures(s) and computing a contour from the 30% isodose line
- Each in-beams ROI is generated by excluding the portion of the ROI outside of the in-beams contour
- Dose Volume Histograms (DVHs) and Overlap Volume Histograms (OVHs) are generated for both the inbeams and standard version of each structure.

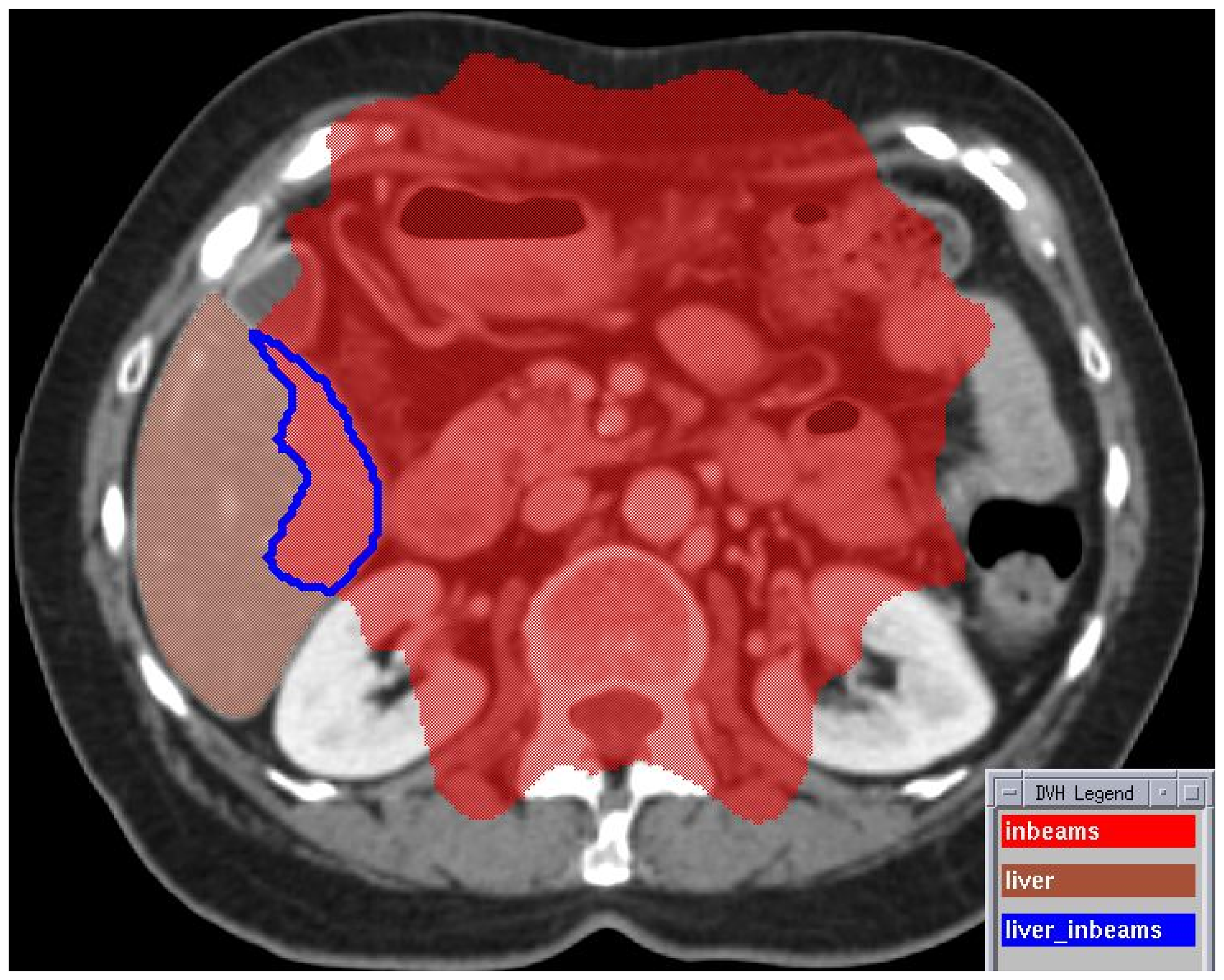

Figure 1: Example of the inbeams contours. The inbeams structure is in red and the liver is in brown. The blue outline is the liver-inbeams structure defined as the intersection between the liver and inbeams structures.

Results

- The DVHs show noticeable differences due to reduction of low dose regions from each contour
- The inbeams structure has a higher relative volume receiving dose due to the exclusion of the low dose regions outside of the in-beams structure

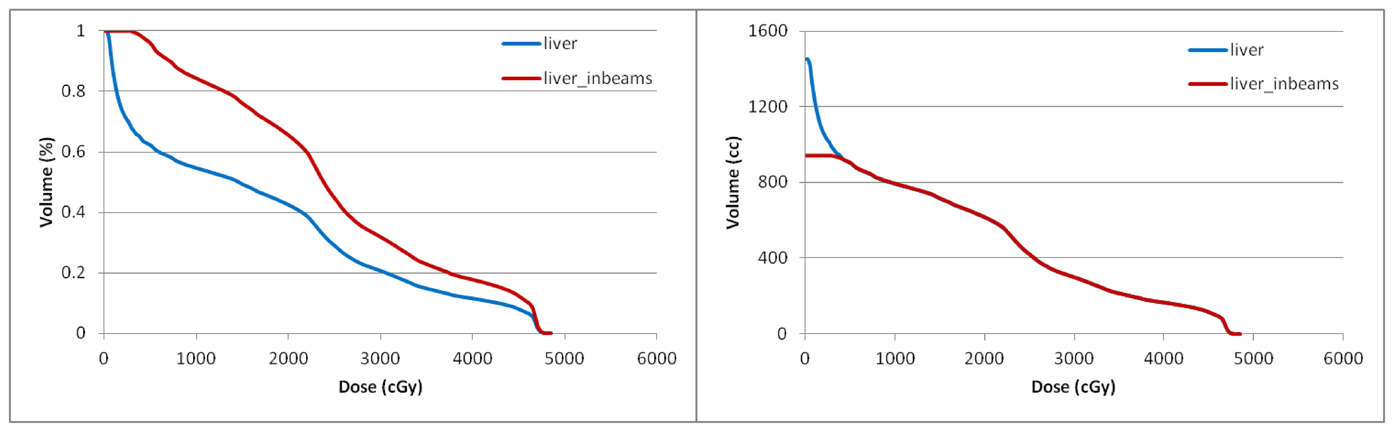

Figure 2: DVH differences between the liver and liver-inbeams structure with a) normalized and b) absolute volume axes.

- The OVHs show a decrease in volume distant from the target
- The inbeams structure shows a shift towards the target.
- The same absolute volume of the structure is within the target.

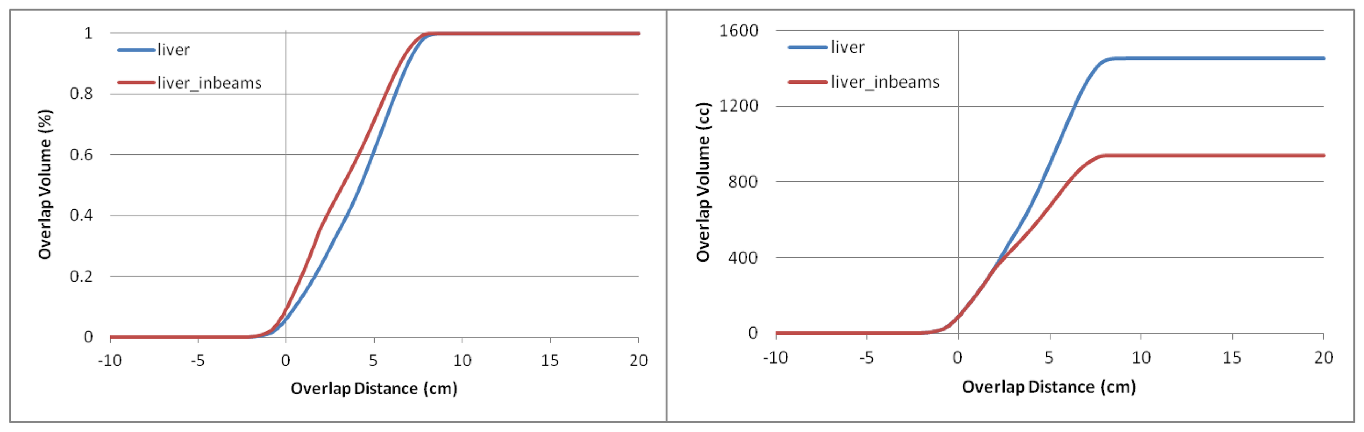

Figure 3: OVH differences between the liver and liver-inbeams structure with a) normalized and b) absolute volume axes

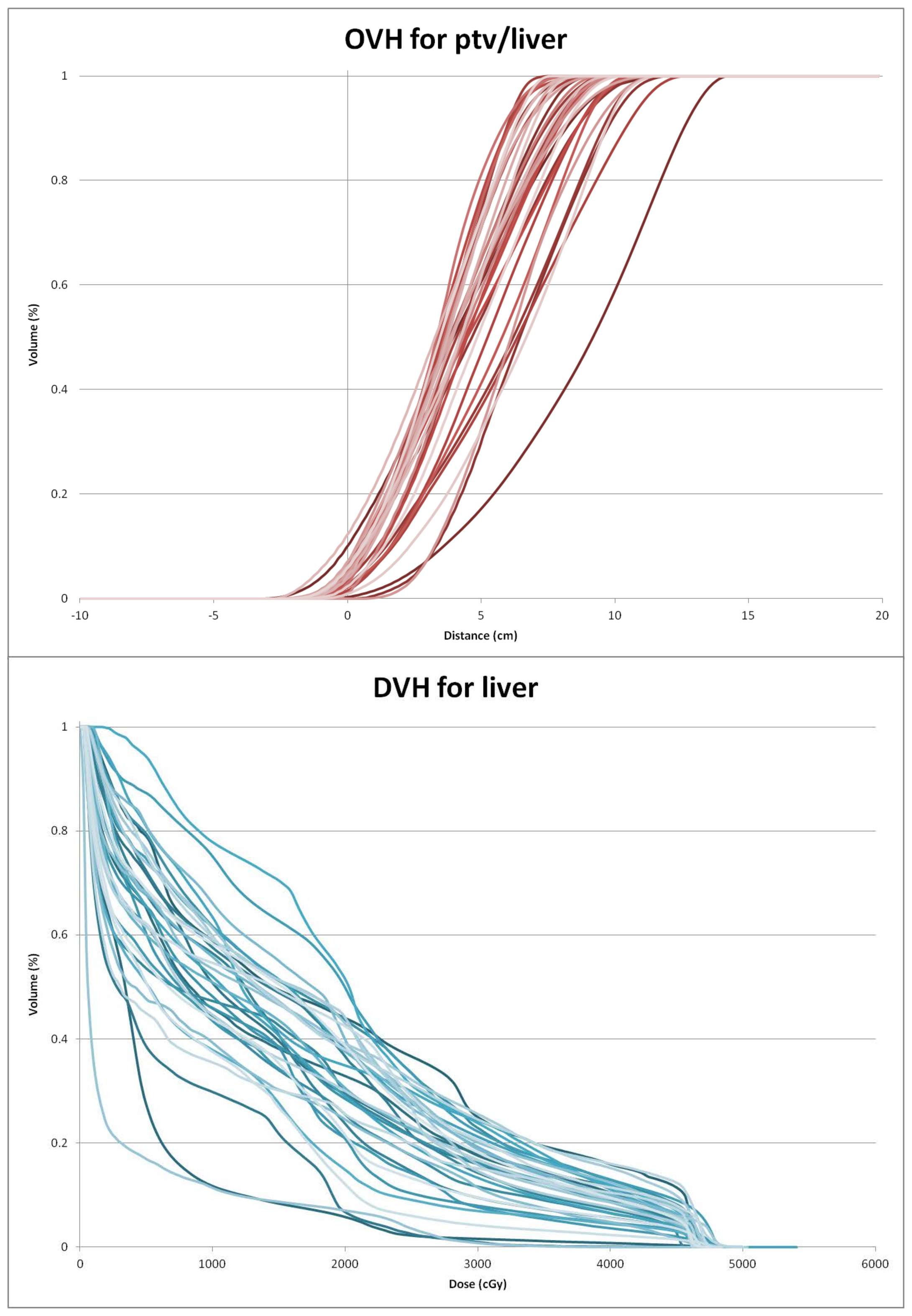

Figure 4: DVH and OVH plots for liver for the database population.

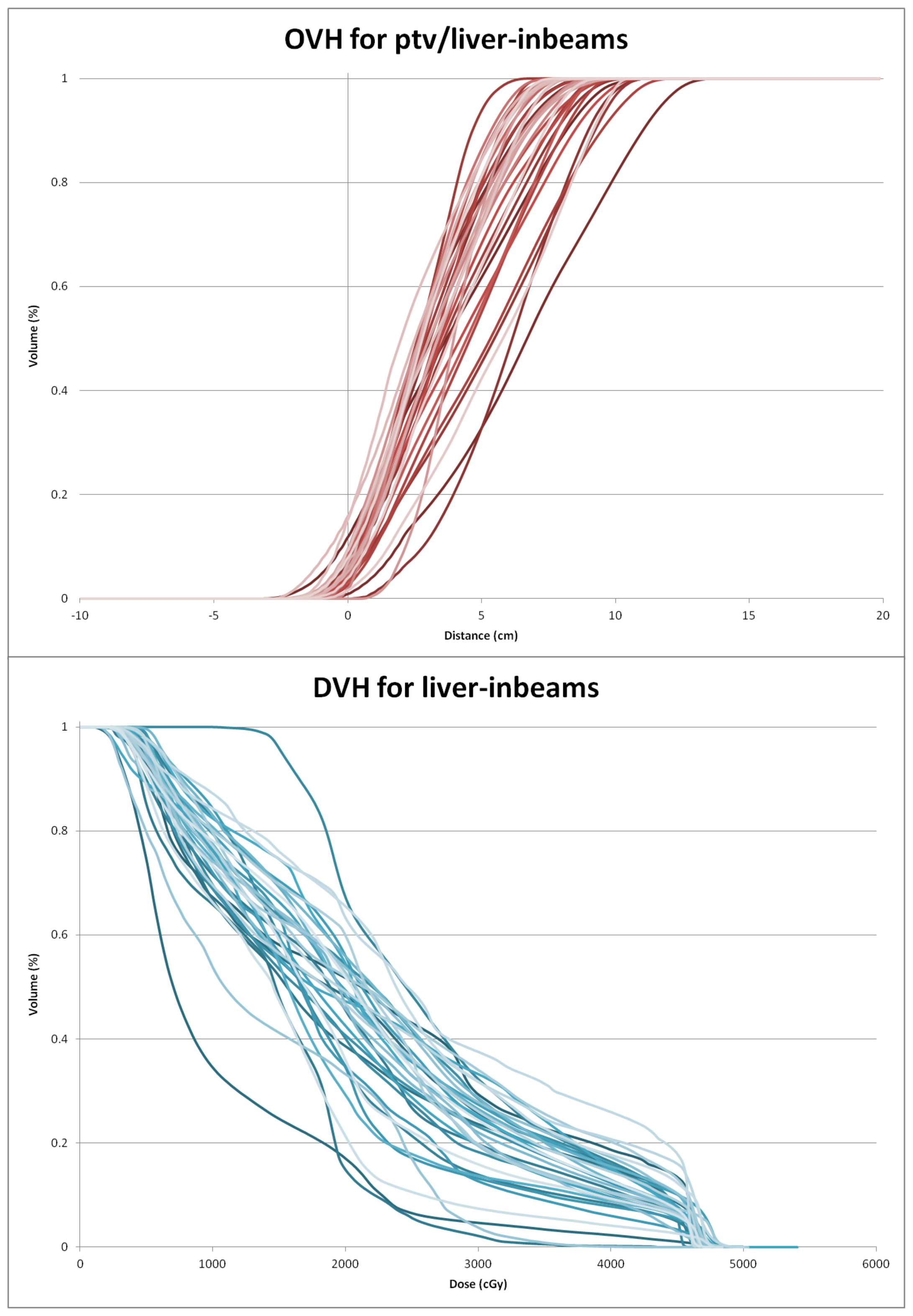

Figure 5: DVH and OVH plots for liver-inbeams for the database population.

	Avg Diff (cc)	Avg Diff (%)	Std Dev (cc)
Liver	512.70	33.2%	270.24
Bowel	123.51	19.4%	235.02
Cord	11.51	51.4%	5.76
Stomach	129.66	28.2%	167.70
Kidneys	26.96	7.8%	48.99

Table 1: Reduction of volume for inbeams structures compared to original structures.

Conclusions

- The use of inbeams structures in automatic planning reduces the influence of beam arrangement on the achievable dose values.
- Automatic planning with inbeams structures excludes from selection achievable doses that are not possible due to beam geometry