Using Initial Planning Assistant in the treatment of Head and Neck Cancers

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Introduction/Purpose

Evolving technologies in radiotherapy continue to enhance our abilities to deliver radiation to patients more precisely and effectively. One of these technologies, inverse planning, has produced a unique way of developing treatments that both contain a conformal dose of radiation to the planning target volume (PTV) while lowering dose to nearby organs a risk (OARs). However, inverse planning can utilize substantial amounts of time and often requires extensive experience. To help alleviate this burden an application called the Ideal Planning Assistant (IPA) was developed to support physicians and dosimetrists in predicting OAR sparing and target coverage. IPA is designed to reduce planning time by displaying potential problems between OAR sparing and target coverage using a theoretical dose model, while also generating expected dose-volume histograms.

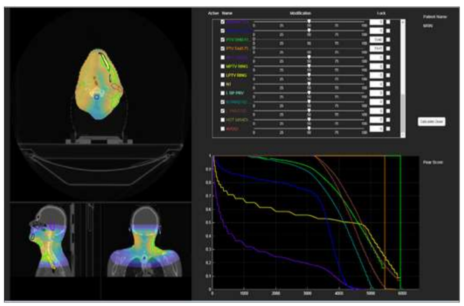

Figure 1. Screen shot of the IPA interface. Dose distribution along in transverse, axial and coronal views (left) OAR and structure adjustment window (top right) and the IPA theoretical DVH (bottom right)

Methods and Materials

In this study, the IPA application was evaluated with previously ten previously treated head and neck patients. First, plans were done without the use of IPA. They were planned with 6MV beams treated with the VMAT technique using full arcs. The collimator was adjusted at the discretion of the planner. Each plan went through multiple optimizations within a 90 minute period before stopping. The goal during the 90 minute optimization was to lower dose to the OARs as much as possible and meet a minimum of V95% >95% coverage for all PTVs. After ten plans were done "normally" without IPA, the same ten patients were re-planned using IPA. IPA assisted plans followed the same set up and beam parameters as the normal plans with the same 90 minute time frame for treatment planning. The plans were done with the use of the IPA created DVH. The DVH points for each structure created from the IPA software were put in the optimizer and OAR dose reduction was done using this method. Because IPA shows a theoretically attainable dose limit for OARs, this seemed to be the most efficient use of the software. Target coverage was done at the planners discretion.

	Homogeneity Index			Conformity Index		
	Historical	Normal	IPA	Historical	Normal	IPA
1	0.20346	0.166124	0.157715	0.992934	0.997209	0.991358
2	0.286577	0.288428	0.293633	0.989341	0.988913	0.977825
3	0.293014	0.413725	0.251776	0.982129	0.895271	0.992697
4	0.253709	0.251792	0.217065	0.964351	0.951729	0.95632
5	0.218675	0.189453	0.290359	0.989958	0.999279	0.952148
6	0.228695	0.211292	0.157162	0.958507	0.992819	0.997364
7	0.318631	0.35716	0.293561	0.986625	0.99077	0.985725
8	0.12765	0.149342	0.143967	0.987202	0.989576	0.992061
9	0.237141	0.037819	0.138329	0.987437	0.999819	0.999267
10	0.267161	0.225763	0.234092	0.996802	0.999565	0.999648

Table 1. The homogeneity index and conformity index for the historical plan, the plan non assisted plan, and the IPA plan. The table shows that there was no statistical significance between the three plans for these measurements.

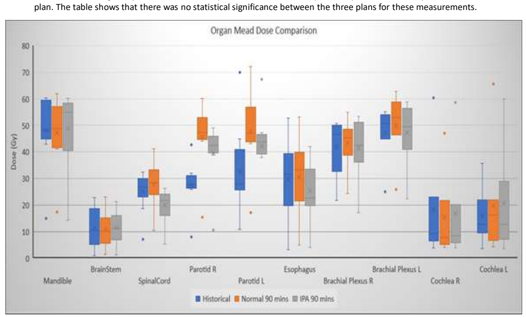

Figure 2. A box plot showing the dose of all of the Head and neck OARs that were included in the three different plans. The "X" represent mean dose value and "---" represents median dose value

Results

Evaluating the homogeneity index, conformity index, and the dose to OARs are the best ways to evaluate if IPA helped create a statistically significant better plan. Shown in Table 1 are the homogeneity index and the conformity index for al ten head and neck plans. As the table shows there was no statistical significance between the historical plan, the non assisted IPA plan, and the plan done with IPA assistance. The box plot in Figure 2 shows the mean dose of the OARs between the historical plan, the non assisted plan, and the IPA plan. Only two OARs, the spinal cord and the esophagus, illustrated a statistical significance from the use of IPA when evaluating all plans. The spinal cord had a mean dose of 24.9Gy, 27.7Gy and 19.9Gy for the historical, non assisted plan, and the IPA plan respectively. The esophagus mean dose values were 29.6Gy, 30.3Gy, and 25.3Gy respectively. Evaluating the mean dose for the OARs also showed that some of the OARs for the historical plans did much better that the organs for the IPA assisted plan. The left and right parotids were one of the organs. This is most likely due to the fact that when the historical plan was created, the planner had more that 90 minutes to get PT coverage and reduce dose the OARs, with the parotids being the main beneficiary of having more time.

Conclusion

On average the IPA plans were better in reducing the dose to the OARs but lacked the coverage for the target that the historical plan did. Organs like the Spinal Cord was able to receive less dose with the IPA plan when compared to the historical plans. Even though there was no statistical significance for IPA improving the overall quality of these treatment plans, with more honing it could be an effective tool for increasing efficiency in the treatment planning process.