

A comparative study of two treatment planning systems for IMRT optimization



M. Mofya^{1,2,3,*}, M. D'Andrea^{4,3}, L. Strigari^{5,3}

¹Texila American University, Lusaka, Zambia - ²Cancer Diseases Hospital, Lusaka, Zambia - ³International Centre for Theoretical Physics, Trieste Italy - ⁴Istituto Nazionale Tumori Regina Elena, Rome, Italy - ⁵Policlinico S. Orsola-Malpighi, Bologna, Italy

* Corresponding author: mwapemofya@gmail.com

Background and Objective

Automatic planning algorithms have been introduced to alleviate the issues associated with manual planning. The plan quality of plans manually optimized both in Eclipse™ and Pinnacle³, and plans generated by the Pinnacle³ Auto-Planning® engine are compared.

Methods

- Nine cases including three breast, three head and neck, and three prostate were selected for this study.
- Forward planned IMRT plans were generated using the field in field (FiF) technique for the breast cases, fixed gantry inverse planning IMRT for the head and neck cases and VMAT for the prostate cases.
- Two plans were manually optimized for each case: the first plan was optimized using Eclipse™ and the second plan was optimized using Pinnacle³. A third plan was generated using Pinnacle³'s Auto-Planning® optimizer for the prostate and the head and neck cases.
- The target coverage, dose homogeneity, dose conformity, organ at risk sparing and delivery efficiency were evaluated.
- The PQM% and the APQM% scores calculated using the plan quality algorithm in the PlanIQ™ software provided a measure of the overall achieved plan quality of the plans.
- Statistical analyses were performed using paired t-tests with a level of significance at 5%.

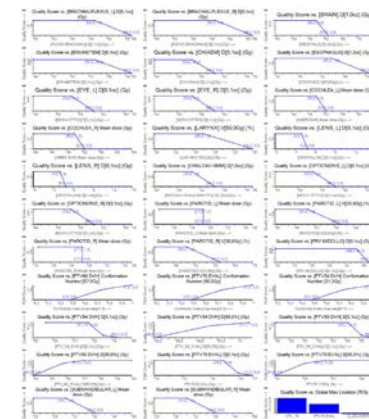


Figure 1: Scoring functions used to calculate the PQM% score for H&N IMRT plans.

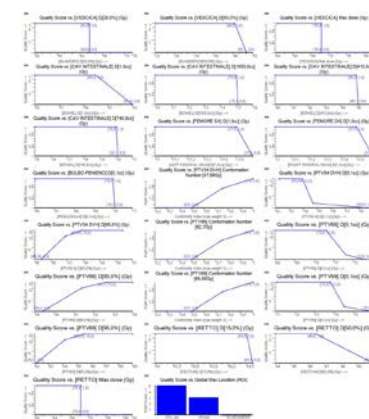


Figure 2: Scoring functions used to calculate the PQM% score for prostate VMAT plans.

Results and Discussion

- There were no significant differences between the FiF plans created in Eclipse™ and Pinnacle³ treatment planning systems.
- On average dose conformity was better in the Eclipse™ IMRT plans but with significantly increased monitor units. The Auto-Planning® IMRT plans provided better sparing of the OARs. The PQM% scores were slightly higher in the Eclipse™ IMRT plans but the differences with the manual Pinnacle³ and the Auto-Planning® IMRT plans were not significant.

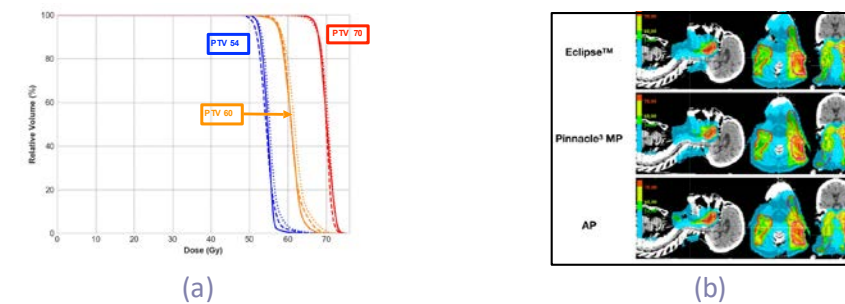


Figure 3: (a) DVHs of H&N inverse planning IMRT plans created in Eclipse™ (solid lines), Pinnacle³ MP (dashed lines) and AP (dotted lines). (b) Sagittal, axial and coronal slices showing the dose distribution in one of the patients for Eclipse™, Pinnacle³ MP and AP plans.

- VMAT plans optimized with Auto-Planning® had better target coverage, dose homogeneity, OAR sparing, and higher PQM% scores than the manually optimized Eclipse™ and Pinnacle³ VMAT plans. The monitor units obtained from Eclipse™, Pinnacle³ manual planning and Auto-Planning® VMAT optimization were comparable.

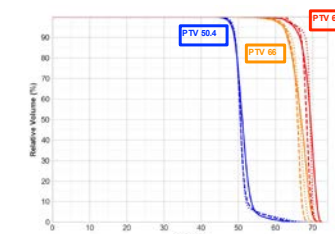
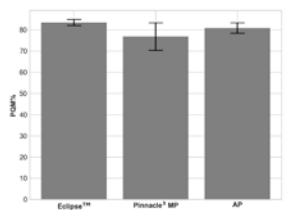


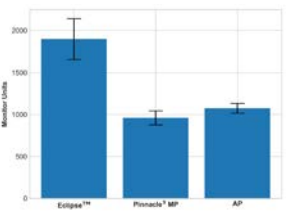
Figure 5: (a) Dose volume histograms of PTV 50.4, PTV 66 and PTV 69 of plans optimized in Eclipse™ (solid lines), Pinnacle³ MP (dashed lines) and AP (dotted lines).

Conclusions

- While the optimization algorithms, optimization tools, and dose computation algorithms differ in the Eclipse™ and Pinnacle³ treatment planning systems, IMRT plans of similar quality can be created.
- Auto-Planning®, with manual intervention, could increase the quality of IMRT and VMAT plans. Auto-Planning® could be used as a starting point. Manual improvements to the dose distribution could then be made starting from the Auto-Planning® solution.



(a)



(b)

Figure 4: (a) Average plan quality scores as defined by the PQM% scores. (b) Average monitor units of H&N IMRT plans.

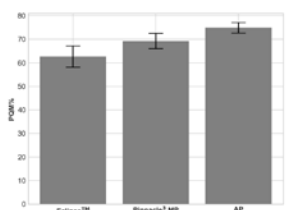


Figure 6: Average plan quality scores as defined by the PQM% for prostate VMAT plans.