Evaluation of Multiple Planning Strategies for Lung SBRT Using Version 18 of Eclipse

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1. INTRODUCTION

Transition from Eclipse Version 15 to Version 18. From Progressive Resolution Optimizer (PRO) to Photon Optimizer (PO).

Eclipse Version 15
PRO
Uses Point Cloud model to define structures.
Better peripheral resolution of targets
Limiting MUs ⇨ Open MLCs
NTO

TPS Upgrade

Eclipse Version 18
PO
Uses single matrix over image.
Poorer peripheral resolution of targets
Limiting MUs ⇨ Open MLCs?
SBRT NTO

To identify a preferred Institutional strategy for LUNG SBRT on Version 18, four planning strategies were compared:

- **Limiting MUs + SBRT NTO**
- **Conformal Arc + SBRT NTO**
- **ASC + SBRT NTO**
- **SBRT NTO**

Research Strategy

1. Selection of 13 Cases
2. Retrospective planning with all planning strategies
3. Plan Evaluation on TPS
4. End to End evaluation (Radiochromic film vs TPS)

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2. METHODS AND MATERIALS

2. a) Parameters used for Plan Evaluation on TPS

% Difference on V50%[cc] from clinical plan.	$\Delta V50\%$
Conformity Index at 100% Isodose	$CI = \frac{V100\%[cc]}{Vol_{PTV}[cc]}$ (Ideally 1)
% Difference on MUs from clinical plan.	MU[%]
Modulation Complexity Score (MCS) [1]	Index score from **0 to 1.0** where 1.0 corresponds to a plan with open rectangular fields.
OAR Improvement	The number of times that a given strategy improved a dose/ volume constrain

2. b) End to End Evaluation

Radiochromic film measurements were acquired using the Quasar Motion Phantom with sinusoidal and irregular breathing patterns (**Figure 1B**). Treatment plans were generated on the TPS from 4DCT Average Intensity Projection images using a motion-encompassing technique.

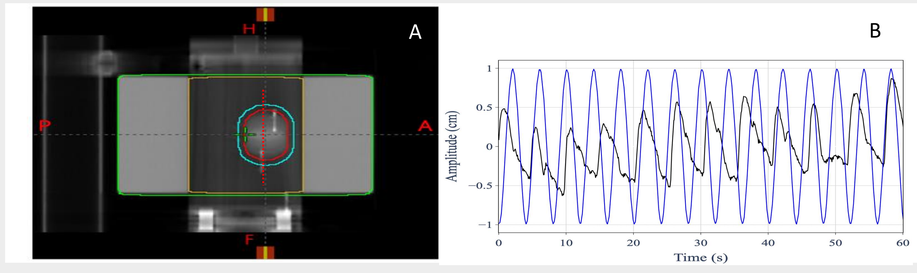

Figure 1: A) 4DCT MEAN scan of the QMP with the cedar insert showing the sphere target moving following a sinusoidal trace and the location of the line profile (dotted red line) used for Film vs TPS comparison. **B)** Breathing traces **Black** Irregular and **Blue** sinusoidal .

3. RESULTS & DISCUSSION

3. a) Evaluation on TPS

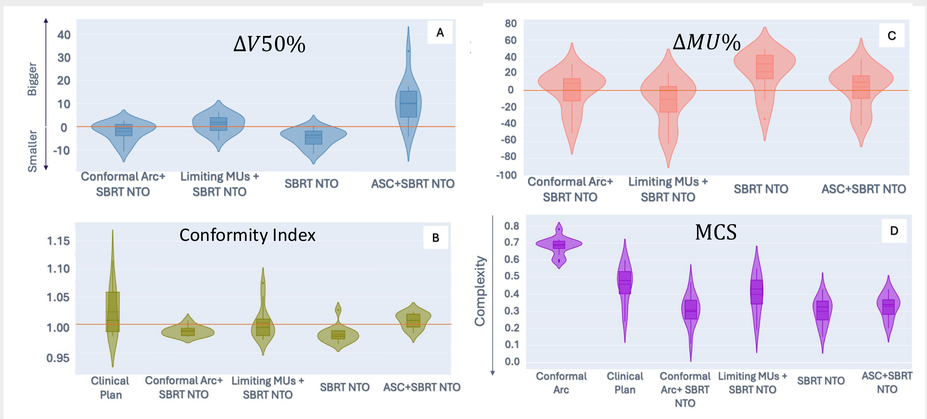

Figure 2: Dosimetric comparison of all strategies inside of the TPS of **A)** the relative change on the V50 isodose volume, **B)** the conformity index (CI), **C)** the number of Monitor Units (MUs) against the current institutional strategy. Additionally, **D)** provides the Modulation Complexity Score of all strategies and the treated plan.

Strategy	Conformity & Dose Spillage	Complexity	Overall Assessment
SBRT NTO & Conformal Arc + SBRT NTO	⇧ conformity and ⇩ median dose spillage	⇧	Better plan quality, but at the expense of deliverability
Limiting MU + SBRT NTO	Clinically acceptable conformity and dose spillage	⇩	Most favorable balance between plan quality and deliverability

3.b) OAR Evaluation

Chest wall was the only OAR that was occasionally accepted despite being slightly outside tolerance. As a result, the effectiveness of each strategy in improving chest wall metrics was evaluated (Table 1).

Strategy	Frequency of Chest Wall constrain improvement
Conformal Arc+ SBRT NTO	86%
Limiting MUs + SBRT NTO	64%
SBRT NTO	89%
ASC + SBRT NTO	82%

Table 1: OAR Sparing. Frequency of Chest Wall clinical constrain improvement per planning strategy.

- Plans exhibiting lower median dose spillage and conformity index values closer to 1.0 consistently achieved better chest wall sparing.

3.c) End to End Evaluation (Film vs TPS)

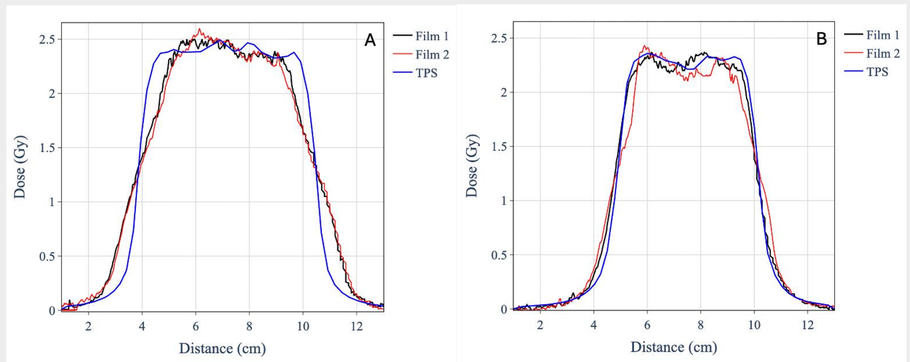

Figure 3: Dose profile comparison of Radiochromic film delivery (Black and Red) vs TPS (Blue) of the Limiting MUs + SBRT NTO strategy. A) under a Sinusoidal Breathing trace and **B)** under an irregular breathing trace. See **Figure 1A** showing location of profile measurements.

Finding	Outcome
Reproducibility between duplicate deliveries	Good agreement despite different starting respiratory phases
Motion-encompassing technique	Similar dose distributions independent of beam initiation phase
Planned vs. measured dose profiles	Differences observed near high-dose gradients
Effect of breathing pattern	Larger discrepancies for sinusoidal than irregular motion
Comparison with literature	Consistent with previous reports [2,3]

4. CONCLUSIONS

- SBRT NTO and Conformal Arc + SBRT NTO produce more conformal plans with smaller median dose spillage, but they do so by increasing the plan complexity.
- Limiting MU + SBRT NTO produces clinically acceptable plans in terms of conformality, median dose spillage and deliverability.
- We have then determined that Limiting MU + SBRT NTO is the plan strategy that better fits our centre needs

5. REFERENCES

1. Masi, L., Doro, R., Favuzza, V., Cipressi, S., & Livi, L. (2013). Impact of plan parameters on the dosimetric accuracy of volumetric modulated arc therapy. *Medical Physics*, *40*(7), 071718. https://doi.org/10.1118/1.4810969
2. Olding, T., Alexander, K. M., Jechel, C., Nasr, A. T., & Joshi, C. (2015). Delivery validation of VMAT stereotactic ablative body radiotherapy at commissioning. *Journal of Physics: Conference Series*, *573*, 012019. https://doi.org/10.1088/1742-6596/573/1/012019.
3. Olding, T., Garcia, L., Alexander, K., Schreiner, L. J., & Joshi, C. (n.d.). Stereotactic body radiation therapy delivery validation You may also like Stereotactic body radiation therapy delivery validation. *Journal of Physics: Conference Series OPEN ACCESS*. https://doi.org/10.1088/1742-6596/444/1/012073