

Theme: Physics Abstract No.: PTCOG-AO2025-ABS-0072

Integrating Dynamic MLC into IMPT Using a Novel Leaf Positioning Strategy for Head and Neck Cancer

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Background / Aims:

- Dynamic MLC (dMLC) is a technique that modifies the MLC shape for each energy layer.
- Since intensity modulated proton therapy (IMPT) doesn't require full-field coverage from a single beam, dMLC can be applied flexibly.
- Combining dMLC with IMPT can improve dose distributions in pencil beam scanning (PBS) proton scanning therapy for head and neck cancers.

Subjects and Methods:

- IMPT treatment plans accounting for ± 2 mm setup uncertainty and $\pm 2.5\%$ range uncertainty were generated using three techniques (Fig 1):
 1. **PBS**: no collimation.
 2. **dMLCcover**: the MLC encloses the target cross section for each energy layer.
 3. **dMLCblock**: the MLC additionally blocks the OAR and its distal region.

Result:

- Compared with uncollimated PBS, **dMLCcover** improved dose conformity (Fig 2).
- dMLCblock** further spared critical structures (eyeballs, optic nerves) adjacent to the tumor.
- The robustness of **dMLC** was maintained at a level comparable to uncollimated PBS (Fig 3).
- dMLCblock** achieved the largest reductions in:
 - Mean doses to eyeballs and optic nerves
 - D2% to the optic chiasm, brain, and brainstem

Conclusion:

- Combining dMLC with IMPT improved dose conformity while maintaining target coverage and minimizing OAR doses.

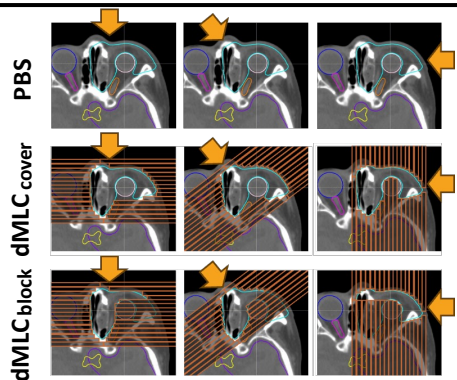


Fig 1. Schematic illustration of dMLC

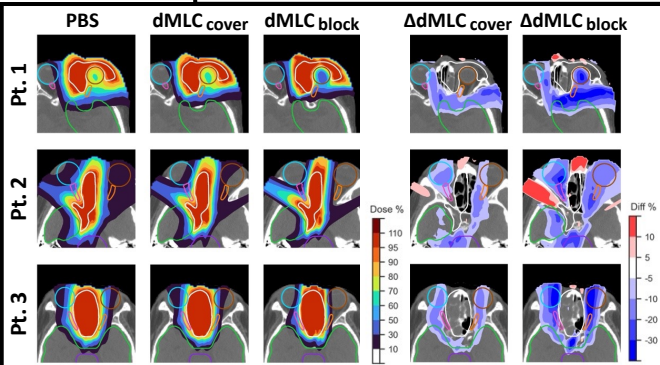


Fig 2. Dose distributions and differences from uncollimated PBS

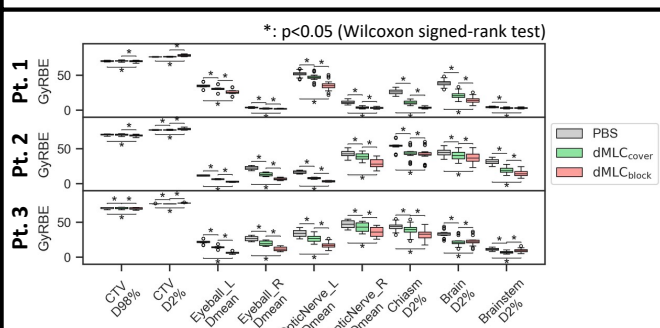


Fig 3. DVH indices accounting for ± 2 mm setup error and $\pm 2.5\%$ range error