

INTRODUCTION

- Conventional whole brain radiation therapy (WBRT) is commonly prescribed for patients with brain metastases who are not suitable candidates for stereotactic radiosurgery (SRS), have poor performance status, rapidly progressive disease, or leptomeningeal involvement.
- Standard WBRT workflows typically require several business days from simulation to delivery, even though this timeline may be compressed to a few hours in urgent settings.
- While expedited palliative workflows such as simulation-free or direct-to-unit approaches are beginning to emerge, these strategies have not yet been applied to WBRT.
- In this study, we propose a CT simulation-free WBRT workflow that enables the generation of a clinically acceptable treatment plan within minutes of acquiring cone-beam CT images. The goal of this approach is to substantially reduce time to treatment while maintaining plan quality.

RESULTS

- Figure 1 presents the simulation-free WBRT workflow.
- Without adaptation, none of the scheduled plans met clinical objectives. In contrast, adaptation resulted in clinically acceptable plans for all 12 patients.
- In a single fraction of 3 Gy, Table 1 summarizes the DVH metrics for the scheduled and adapted plans, while Figure 2 presents a representative comparison for patient 9.
- For a single fraction of 3Gy, the average CTV V100% was 98.2±0.1%,PTV D95% was 2.99±0.01Gy, PTV D0.03cc was 3.20±0.01Gy, and mean lens dose was 0.46±0.19Gy.
- The median plan turnaround time was 4.4±1.2 minutes (range, 4-7 minutes)
- Adapted plans required 935±38 MUs (range, 868-987).

CONCLUSIONS

- Validated HyperSight CBCT dose calculations now support simulation-free WBRT workflows that substantially reduce planning time and resource utilization
- This approach offers an especially practical solution for urgent palliative scenarios where conventional simulation may delay treatment.

REFERENCES

1. McGrath, K. M., MacDonald, R. L., Robar, J. L., & Cherpak, A. (2025). Direct-to-Treatment Adaptive Radiation Therapy: Live Planning of Spine Metastases... *International journal of radiation oncology, biology, physics*, 122(4), 1045–1053. <https://doi.org/10.1016/j.ijrobp.2025.02.045>

2. Nelissen, K. J., Verbakel, W. F. A. R., Slotman, B. J., Visser, J., & Versteijne, E. (2025). Routine Use of Single Visit Online Adaptive Cone Beam Computed Tomography Guided Sim-Free Palliative Radiation Therapy. *International journal of radiation oncology, biology, physics*, 122(4), 1035–1044. <https://doi.org/10.1016/j.ijrobp.2025.03.040>

3. MacDonald, R. L., Fallone, C., Chytyk-Praznik, K., Robar, J., & Cherpak, A. (2024). The feasibility of CT simulation-free adaptive radiation therapy. *Journal of applied clinical medical physics*, 25(9), e14438. <https://doi.org/10.1002/acm2.14438>

METHODS AND MATERIALS

- Feasibility was evaluated in silico using an Emulator (Varian Medical Systems) with CT images from 12 previous patients.
- A reference plan created on a CT image of a generic patient, defining the whole brain as the clinical target volume (CTV) and the planning target volume (PTV) as the CTV plus a 1cm margin excluding the orbits.
- A field arrangement analogous to conventional opposing lateral fields was used, and the plan was optimized in Ethos Treatment Management (V3.0) with a prescription of 30Gy in 10 fractions.
- Images were imported into the Emulator and designated as HyperSight CBCT images for direct plan adaptation at the first treatment fraction.
- Following acceptance of a CBCT image, the whole brain orbits, and lenses were automatically segmented, and patient-specific adaptive plans were generated with dose calculated directly on the HyperSight CBCT using the same field arrangement and optimization objectives as the reference plan.
- Turnaround time (TAT) from CBCT acceptance to adaptive plan approval, total monitor units (MUs), and dosimetric endpoints were recorded.



Figure 1. Simulation-free whole brain treatment timeline

|                 | CTV V100% (%)           | PTV D95% (Gy)            | PTV D0.03cc (Gy)         | Lens Dmean (Gy)          |
|-----------------|-------------------------|--------------------------|--------------------------|--------------------------|
| Scheduled Plans | 67.3 ± 27.4 (3.7, 95.7) | 2.89 ± 0.05 (2.77, 2.95) | 3.32 ± 0.04 (3.27, 3.37) | 2.53 ± 1.00 (0.20, 3.25) |
| Adapted Plans   | 98.2 ± 0.1 (98.1, 98.4) | 2.99 ± 0.01 (2.98, 3.00) | 3.20 ± 0.01 (3.18, 3.23) | 0.46 ± 0.19 (0.20, 0.68) |

Table 1. Comparison of dose-volume metrics in the schedule vs. Adapted plans (N=12 in a single fraction of 3 Gy)

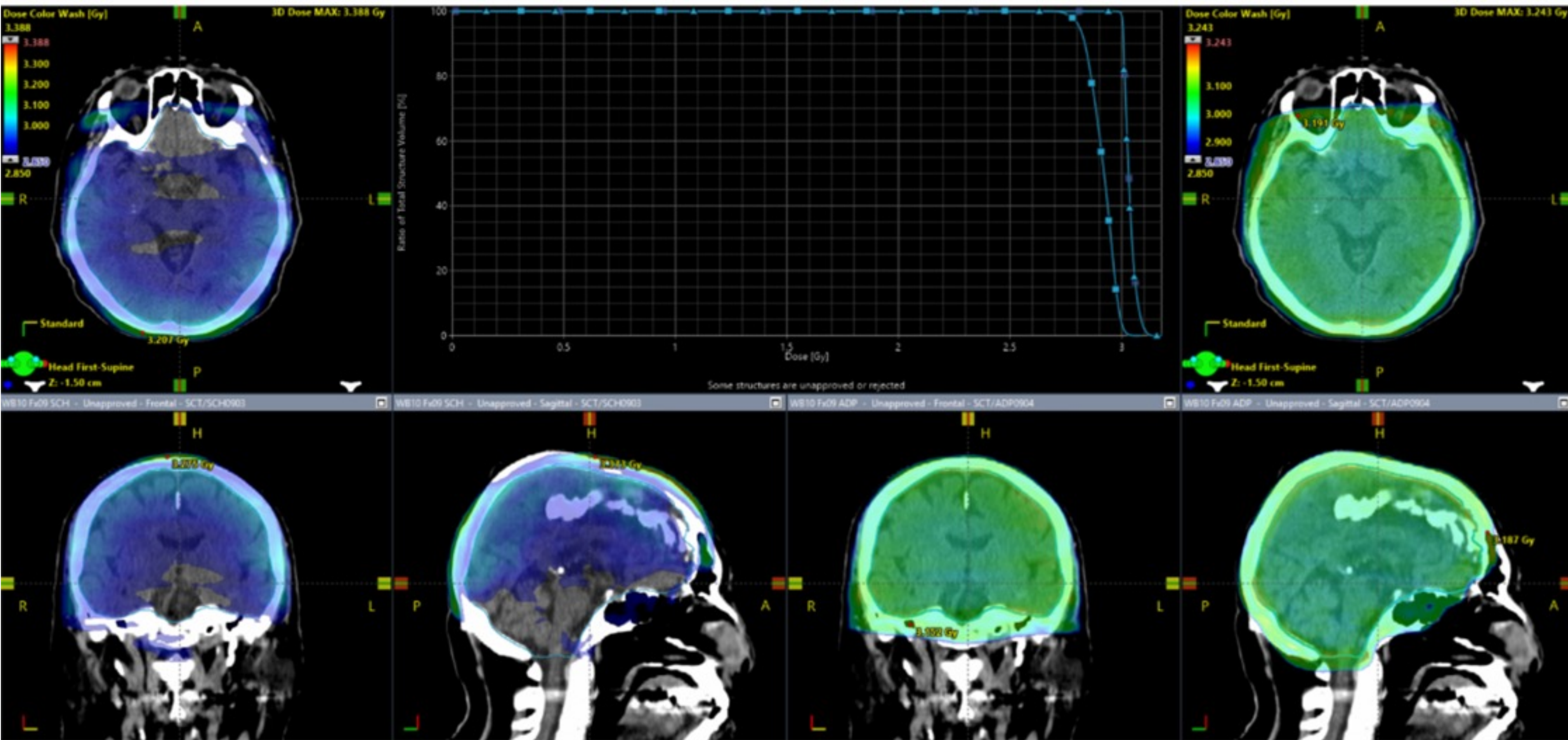


Figure 2. Simulation-free whole brain treatment timeline