STEREOTACTIC BODY RADIOTHERAPY OF A LUNG TUMOR WITH LARGE RESPIRATORY MOTION USING REAL-TIME ADAPTIVE MOTION MANAGEMENT: A CASE REPORT

CyberKnife® *Conventional Linac*

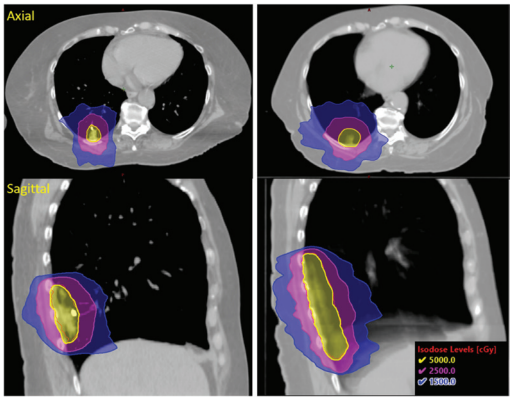

Fig. 3 from paper: Dose distribution of the treatment plan with (CyberKnife System) Synchrony real-time adaptive radiotherapy, and (Conventional Linac) ITV-method

Challenge:

Traditional internal target volume (ITV) methods for the treatment of a lung tumor on conventional linac would require a large planning target volume (PTV), risking high radiation exposure to the chest wall and lungs.

Solution:

Synchrony® on the CyberKnife® System was used to adapt the radiation beam in real time to the tumor's motion, eliminating the need for large motion margins.

Case:

Patient	72-year-old female
Diagnosis	Stage IA2 non-small cell lung cancer in the right lower lobe
Radiotherapy Challenge	Tumor exhibited large respiratory motion (~5 cm) and an elongated shape
Plan	Initially planned for conventional linac-based SBRT, the patient was switched to CyberKnife-based SBRT using real-time adaptive motion management (AMM) due to concerns about excessive radiation to healthy tissue

Treatment Planning:

Fiducials	A single gold fiducial marker was placed in the lesion approximately one week prior to simulation
PTV margin	3 mm margin added to the GTV
Dose	50 Gy in five fractions was prescribed to cover at least 95% of the PTV
Treatment beams	152 beams on 40 nodes
Estimated treatment delivery time	46 minutes
For comparison a VMAT Plan was created	PTV expanded 5 mm from the ITV. The same clinical goals and OAR dose constraints were applied

READ THE ARTICLE

CyberKnife®

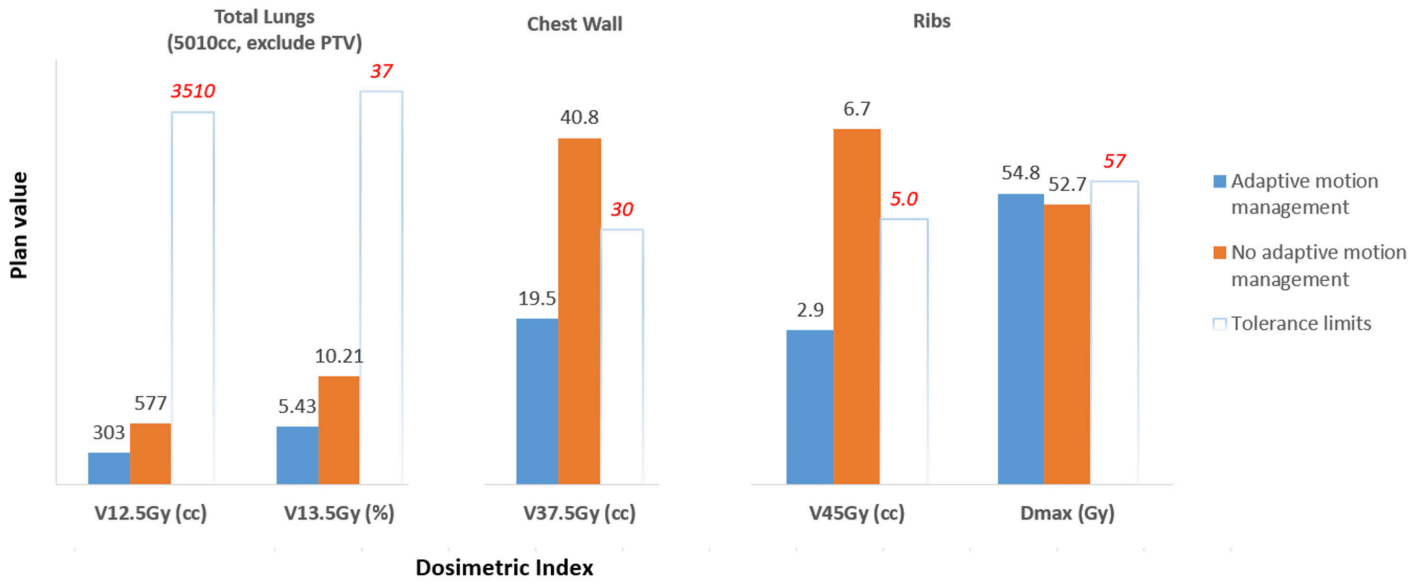

Figure 5 from paper: comparison of dosimetric parameters between the CyberKnife® System with real-time adaptive radiotherapy (blue), ITV approach with conventional linac (orange), and the tolerance limits (white).

Outcomes:

- The CyberKnife® plan with Synchrony® real-time adaptive radiotherapy significantly reduced radiation dose to the OARs as shown in figures 3 and 5.
- The patient received the five-fraction treatment with the CyberKnife System as scheduled with no acute treatment toxicity.

Advantages:

- The CyberKnife® System with Synchrony® real-time adaptive radiotherapy "allows the removal of the motion margin from the planning target and allows beams to only target the tumor itself, thus significantly avoiding unnecessary dose to healthy tissues".
- "Similar applications would also be beneficial to liver or abdominal cases where lesions are close to the diaphragm and have significant motion or are surrounded by low-dose-tolerance OARs such as the duodenum and small bowel."

Conclusion:

This case demonstrates that Synchrony real-time adaptive radiotherapy with the CyberKnife System is highly beneficial for tumors with large respiratory motion, offering minimized dose to healthy tissue and potentially improving patient outcomes.

Chen X, Hayes S, Cohen R, et al. (June 20, 2025) Stereotactic Body Radiotherapy of a Lung Tumor With Large Respiratory Motion Using RealTime Adaptive Motion Management: A Case Report. Cureus 17(6): e86436. DOI 10.7759/cureus.86436

CyberKnife®