

# USE OF MOTION MANAGEMENT TO MODEL UNMANAGED MOTION: DOSIMETRIC CONSEQUENCES OF UNMANAGED PROSTATE MOTION ASSESSED USING REAL-TIME RADIOTHERAPY ADAPTATION DATA

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## Summary:

This case report explores the **dosimetric impact of unmanaged intrafraction prostate motion** during radiotherapy by retrospectively analyzing real-time motion data collected using the **Radixact® System with Synchrony®**. The study models what would have happened if a patient had been treated **without motion management**, using deformation vector fields to simulate dose shifts.

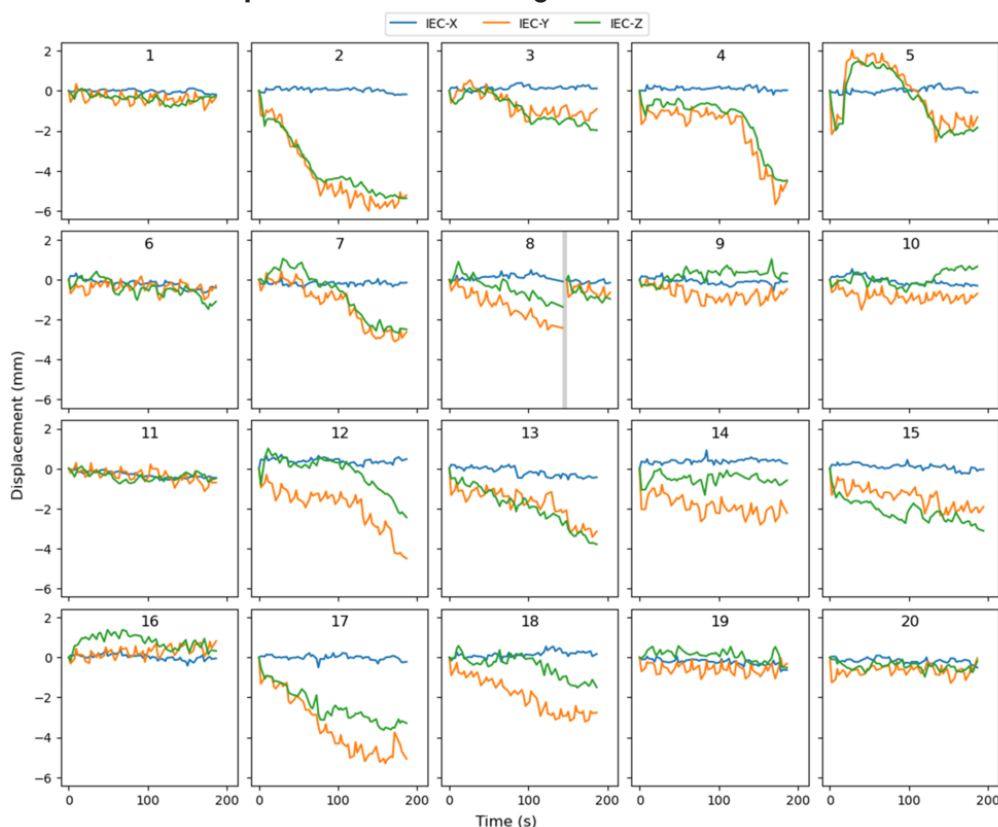


## Patient Profile:

Age	78-year-old male
Diagnosis	T2c N0 M0 prostate adenocarcinoma
Dose	60 Gy in 20 fractions
Case challenge	Frequent continuous drift of the prostate during treatment

Figure 1 demonstrates the IEC-X (left-right, blue), IEC-Y (superior-inferior, orange), and IEC-Z (anterior-posterior, green) motion for all 20 fractions. Graphs are labelled with fraction numbers from fraction 1 (top left) to fraction 20 (bottom right). There was a pause in treatment delivery in fraction 8, represented by a vertical grey bar.

Motion of prostate fiducials during fractional treatment deliveries



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Methodology:

- Real-time Synchrony® motion data extracted following treatment was used to simulate dose delivery **without real-time adaptation**.
- Dose distributions were deformed using a **voxel-wise deformation vector** field that accounted for couch motion interplay.
- Two scenarios were modelled:
  1. Standard hypofractionated regimen (60 Gy/20 fractions, 6 mm margin).
  2. Simulated ultra-hypofractionated SBRT regimen (40 Gy/5 fractions, 3 mm margin).

Key findings if the patient had not been treated with motion management:

Standard regimen	CTV coverage was maintained even in worst-case drift, but PTV coverage would be compromised without Synchrony
SBRT simulation	Significant underdosage occurred in worst-case scenarios, with CTV V95% dropping to 93.3%, below acceptable limits

Conclusion:

Real-time motion management is critical, especially for SBRT with tight margins, to avoid compromising tumor control.

Implications:

- The study highlights the importance of real-time tracking in maintaining dose accuracy.
- Suggests that narrow margins without motion management may lead to biochemical failure.
- The deformation modelling approach offers a valuable tool for evaluating margin adequacy and guiding treatment planning.

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