

Safety Challenges in Motion Management

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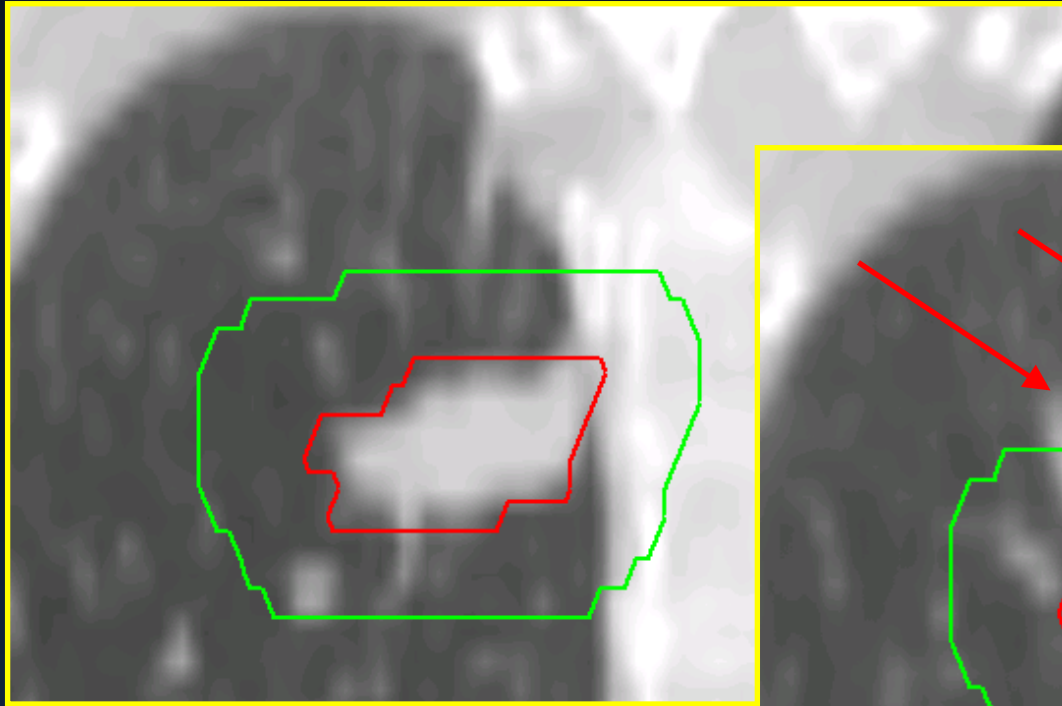
Disclosures

Learning objectives

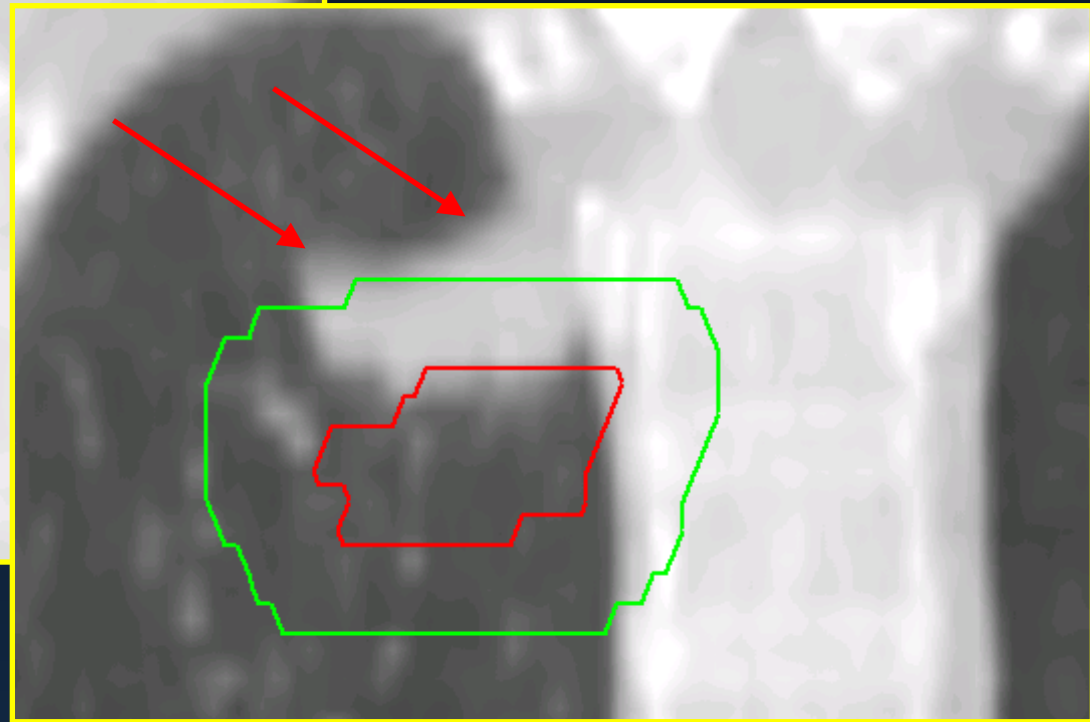
- Describe quality and safety challenges in motion management
- Raise awareness about safety issues in motion management at our home clinics

Goals of Motion Management (MM)

- Keep the target in our sights
1 cm margin



Free-Breathing CT

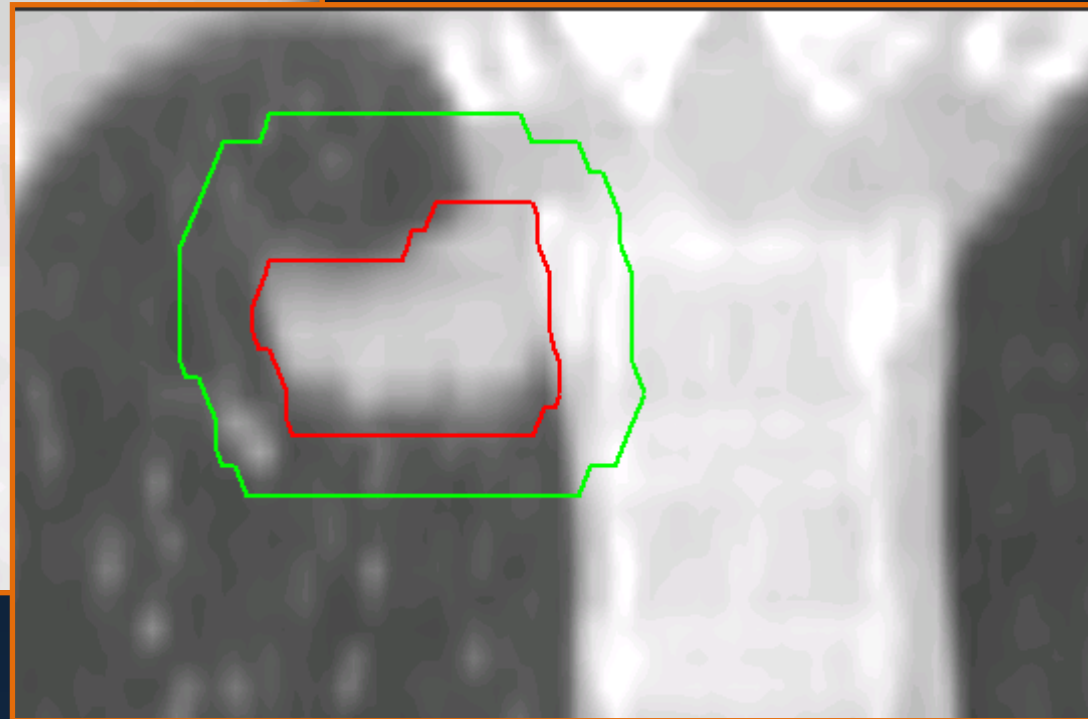
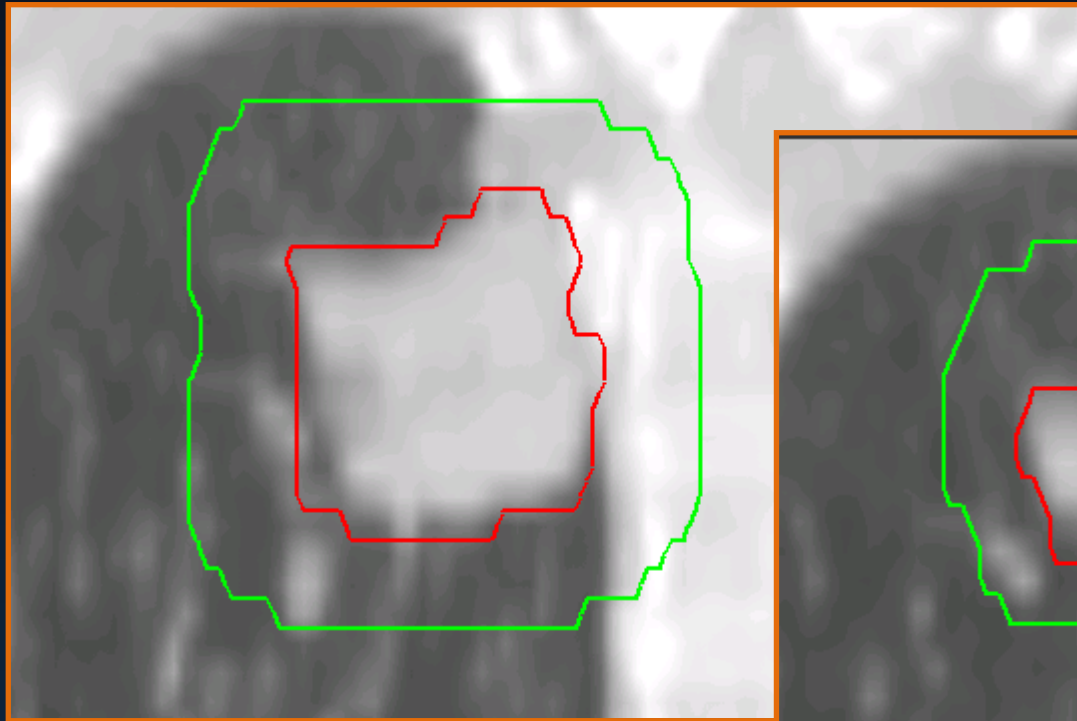


60% phase

Goals of Motion Management (MM)

- Spare normal tissue

0.7 cm setup margin



MIP

PTV: 107.6 cm³

40-60% phase

PTV: 53.4 cm³

Motion management techniques

- Motion–encompassing
- Respiratory gating
- Breath–hold
- Forced shallow breathing
- Real–time tracking

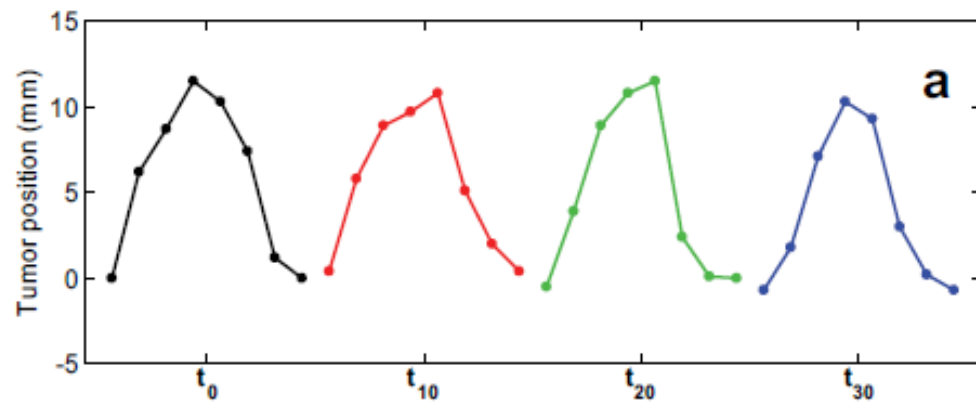
Know thy enemy

- Given that all other aspects of treatment are safe, what could possibly go wrong
 - Geometric miss
 - Marginal miss
 - Unnecessary normal tissue dose

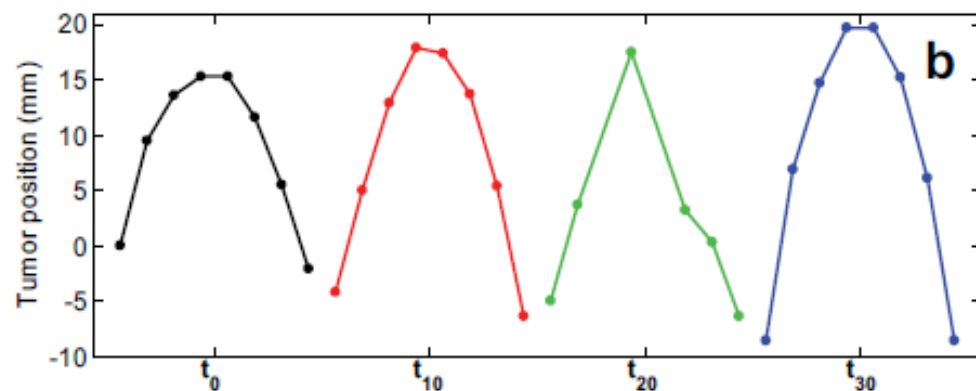
Safety Challenges

Simulation

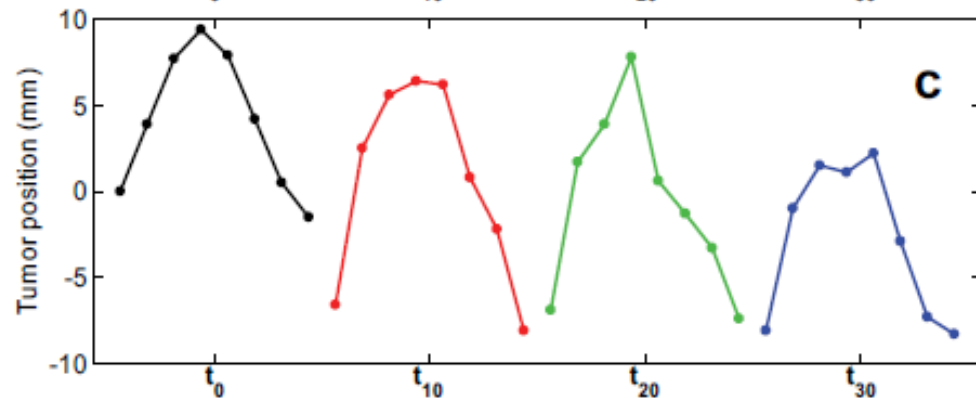
4DCT at simulation



← Stable



← Change in excursion



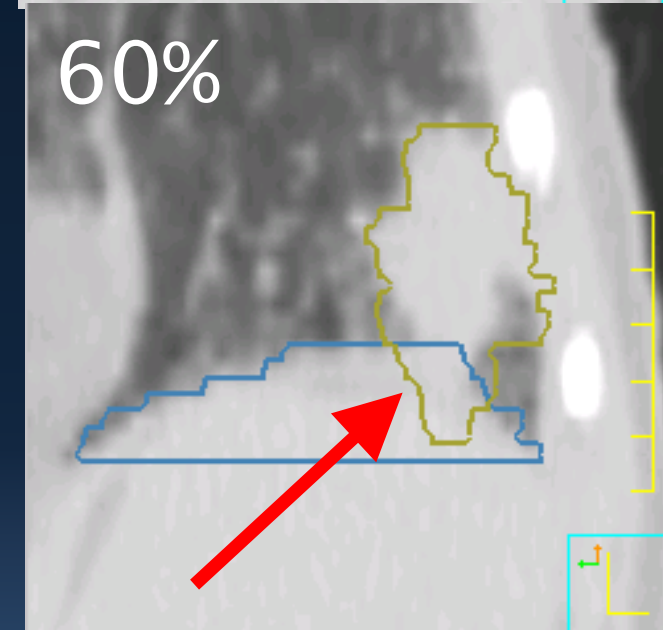
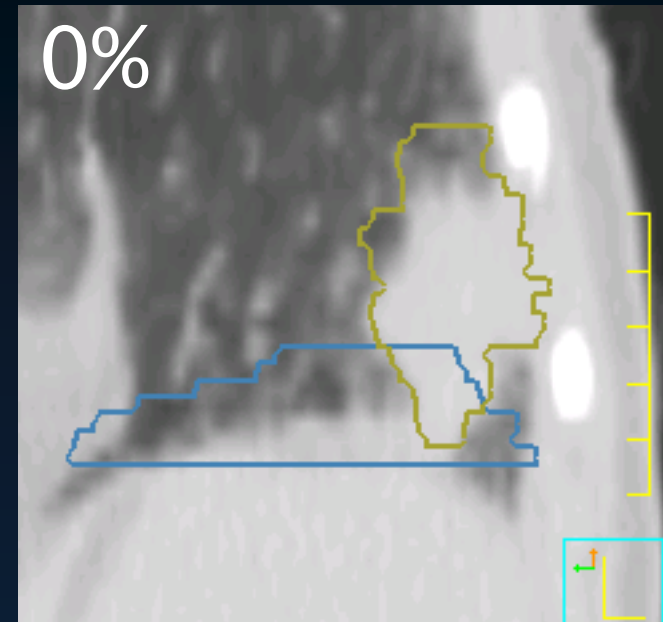
← Change in mean position

Safety Challenges

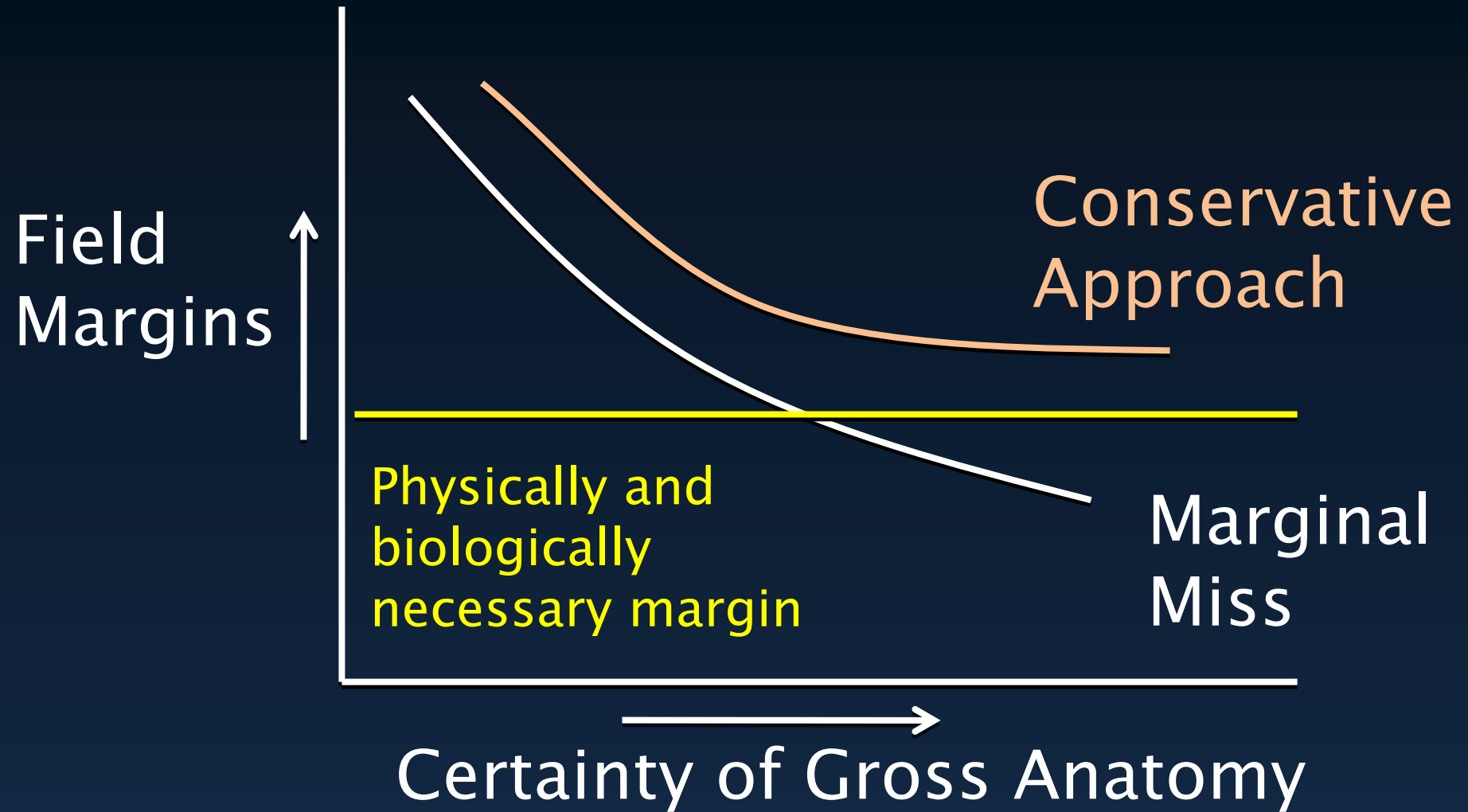
Planning

Contour QA

- Watch for overlapping anatomy in MIP
 - Chest wall, hilum, diaphragm
 - 4DCT
- Who checks the M.D.?
 - QA the ITV contours

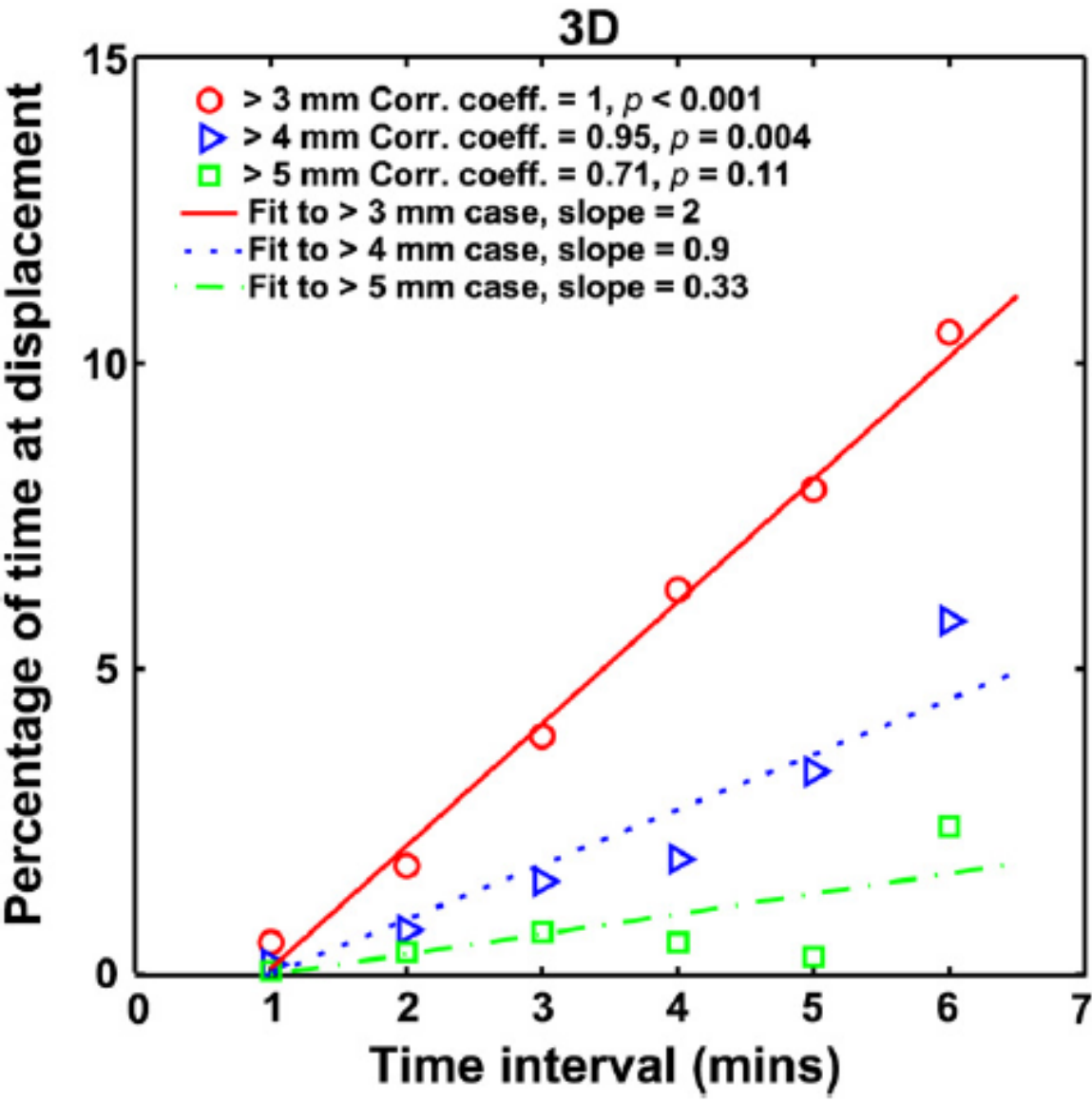


Physical and Biological limits



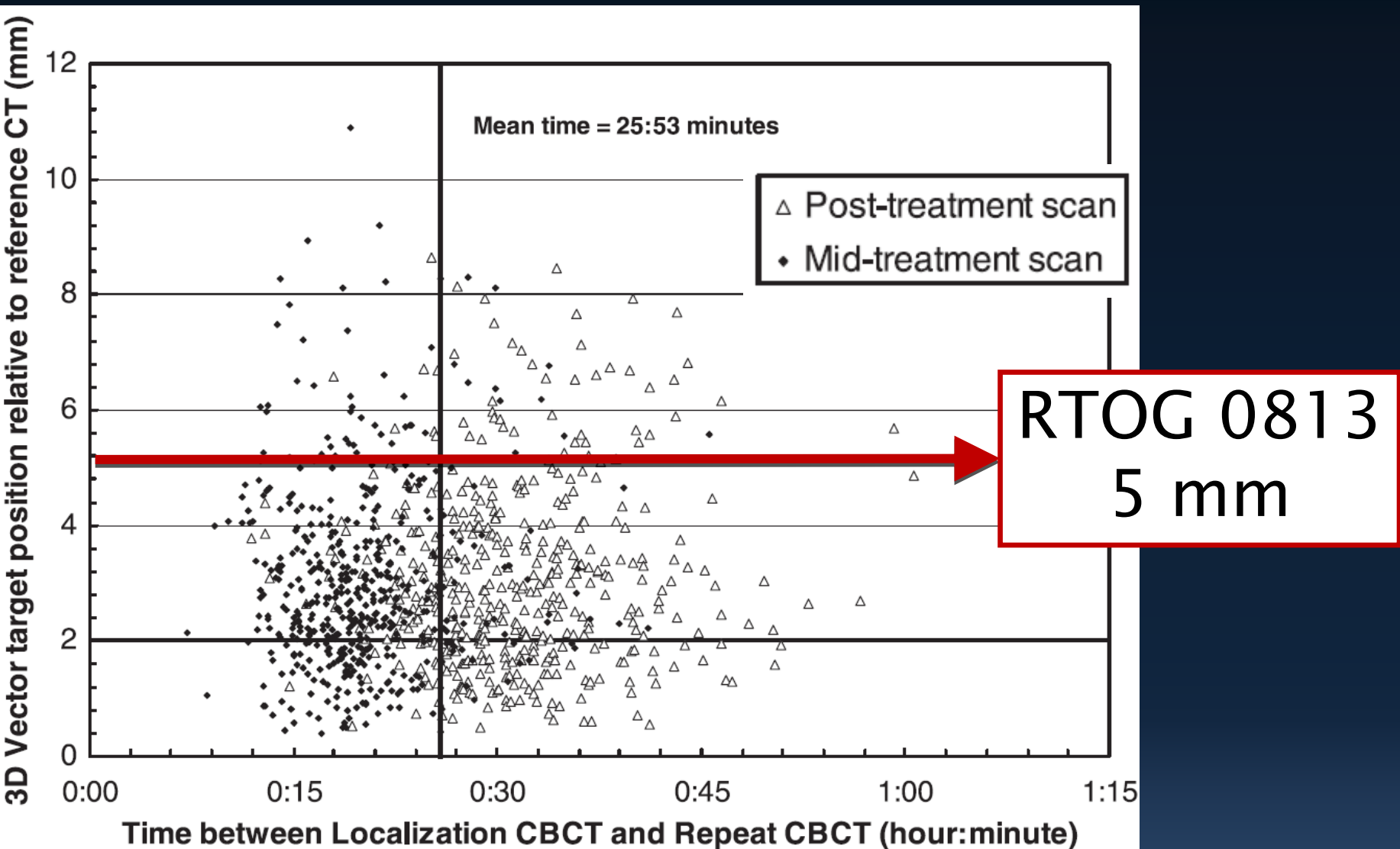
Safety Challenges

Patient setup/localization



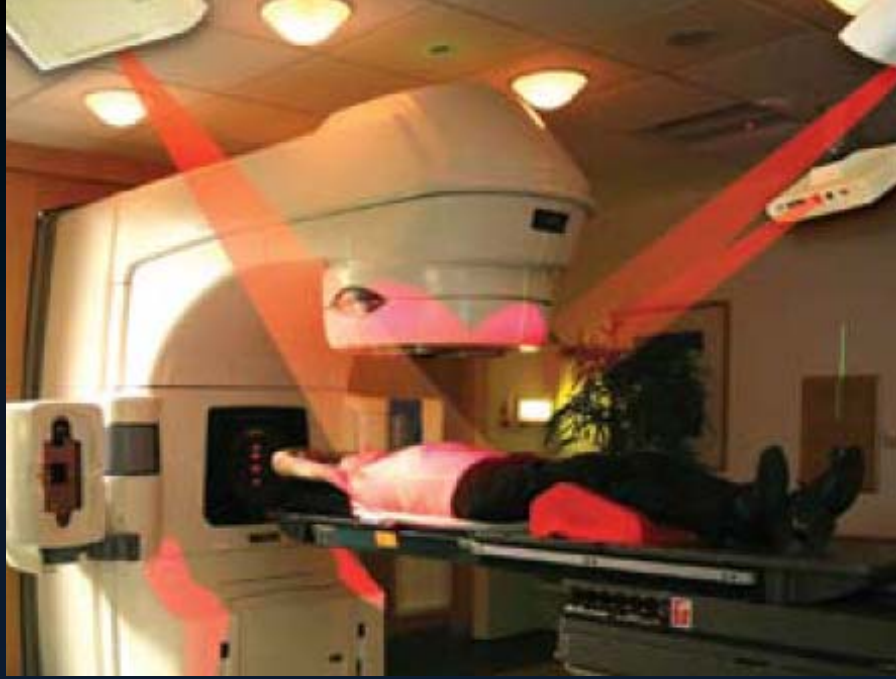
Intra-fractional prostate motion increases with time, even in the presence of an endorectal balloon

Intra-fractional motion in lung not correlated to treatment time

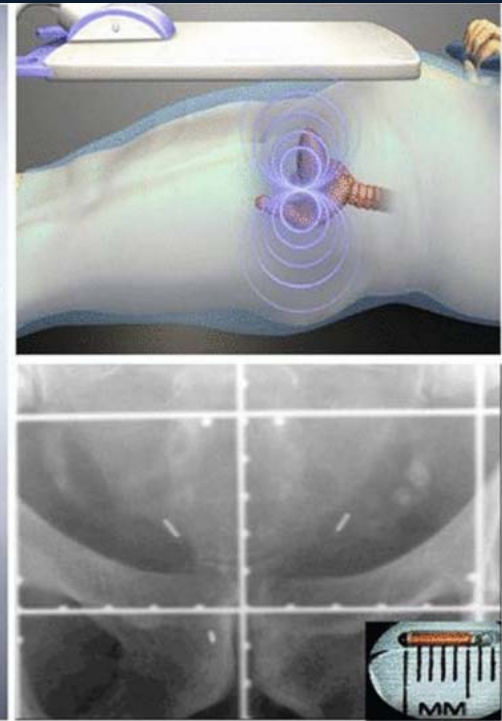


Safety Challenges

Treatment



Real-time tracking

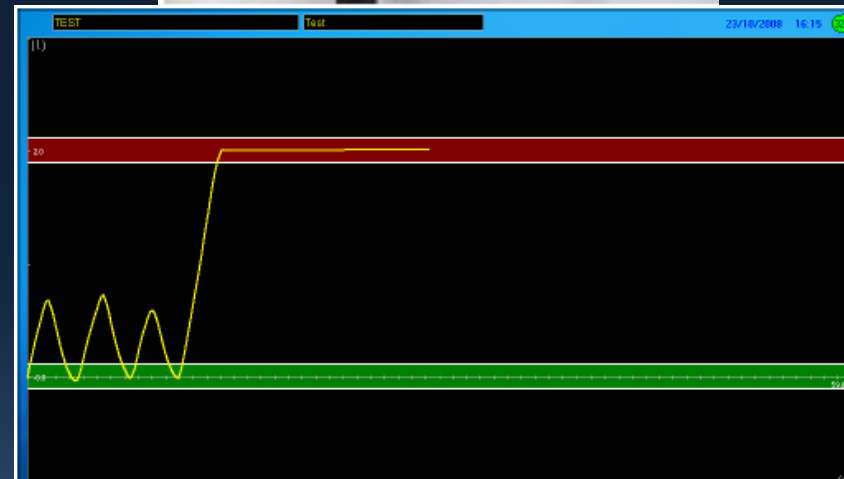
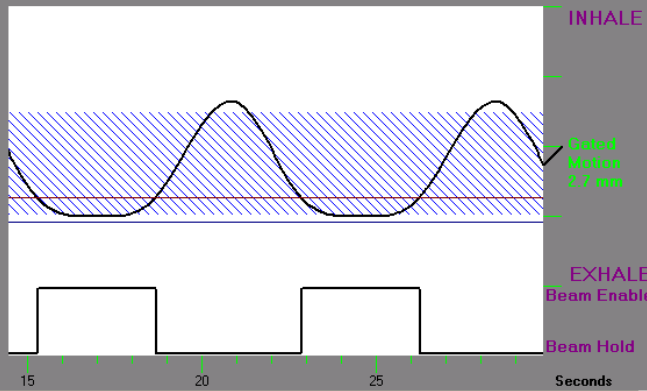
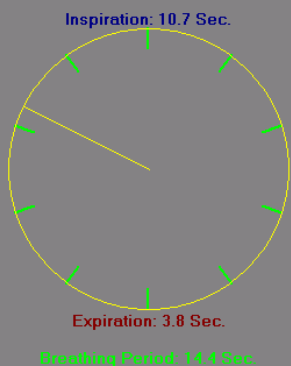


Respiratory surrogates

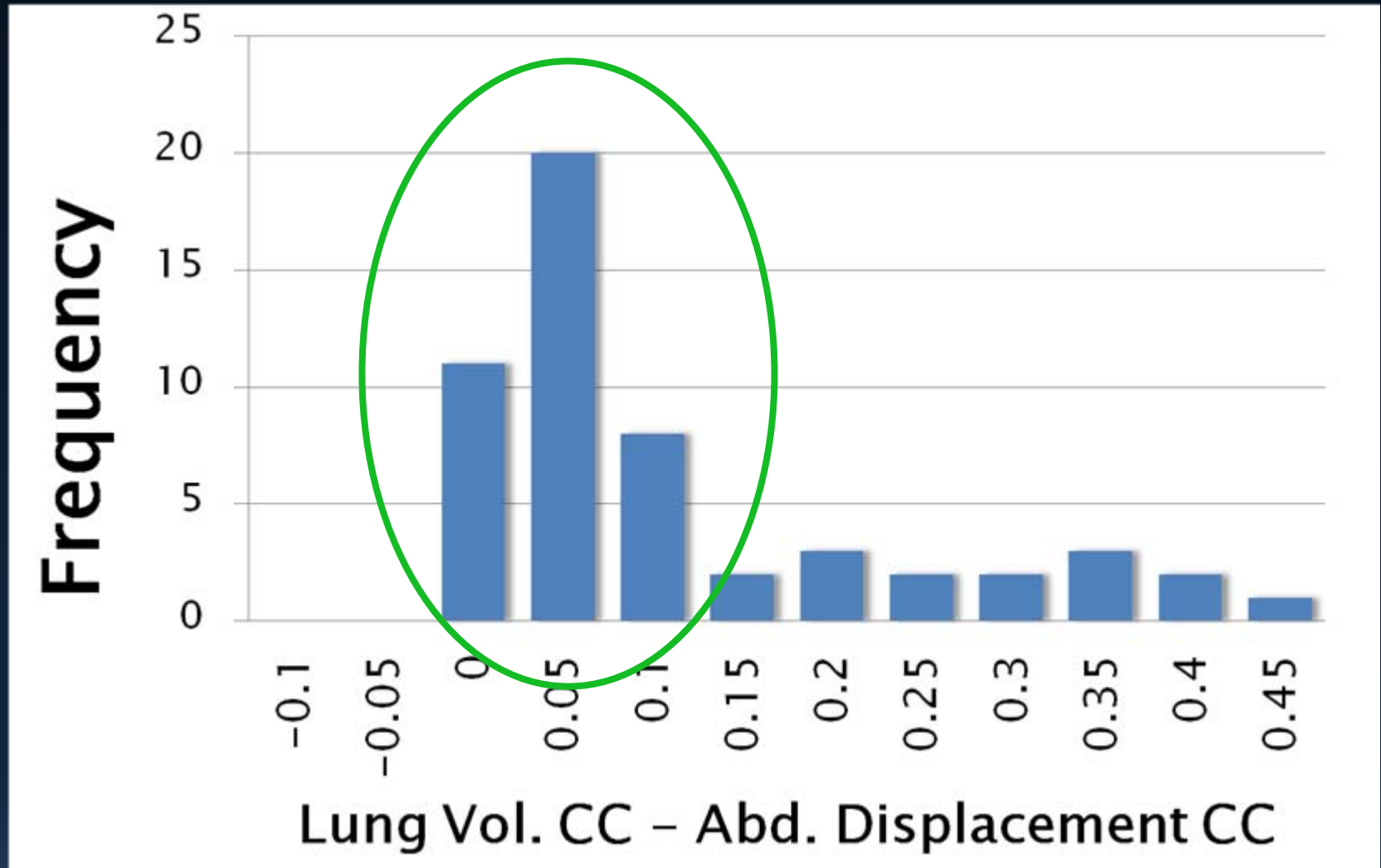
Abdominal displacement



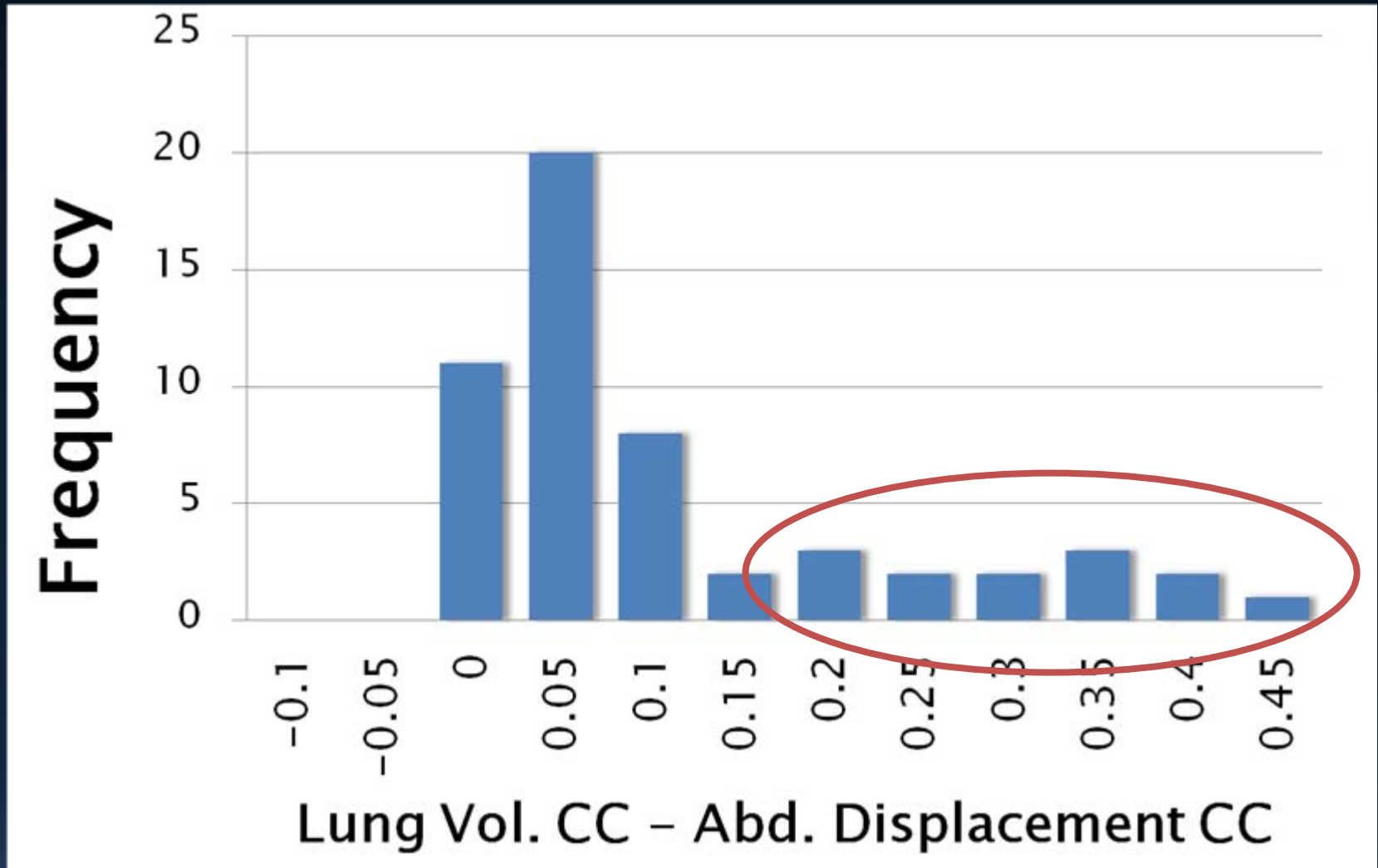
Differential lung volume



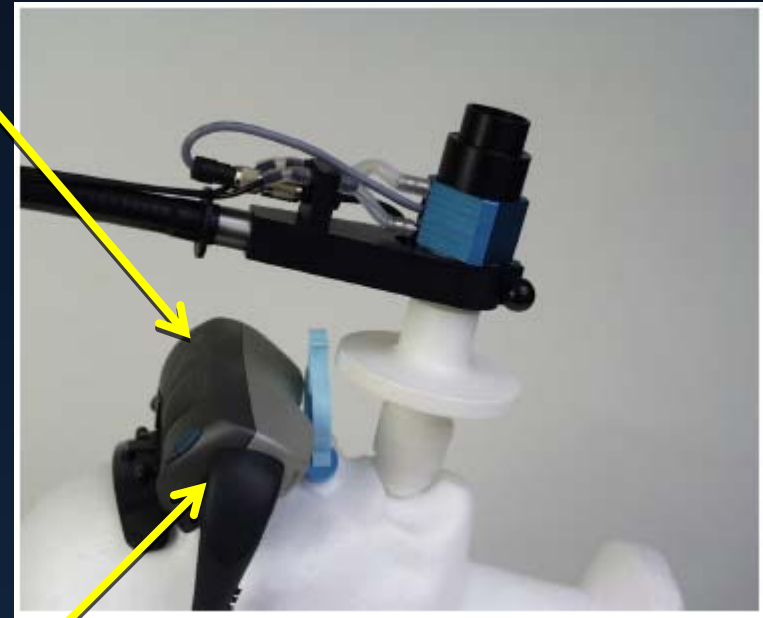
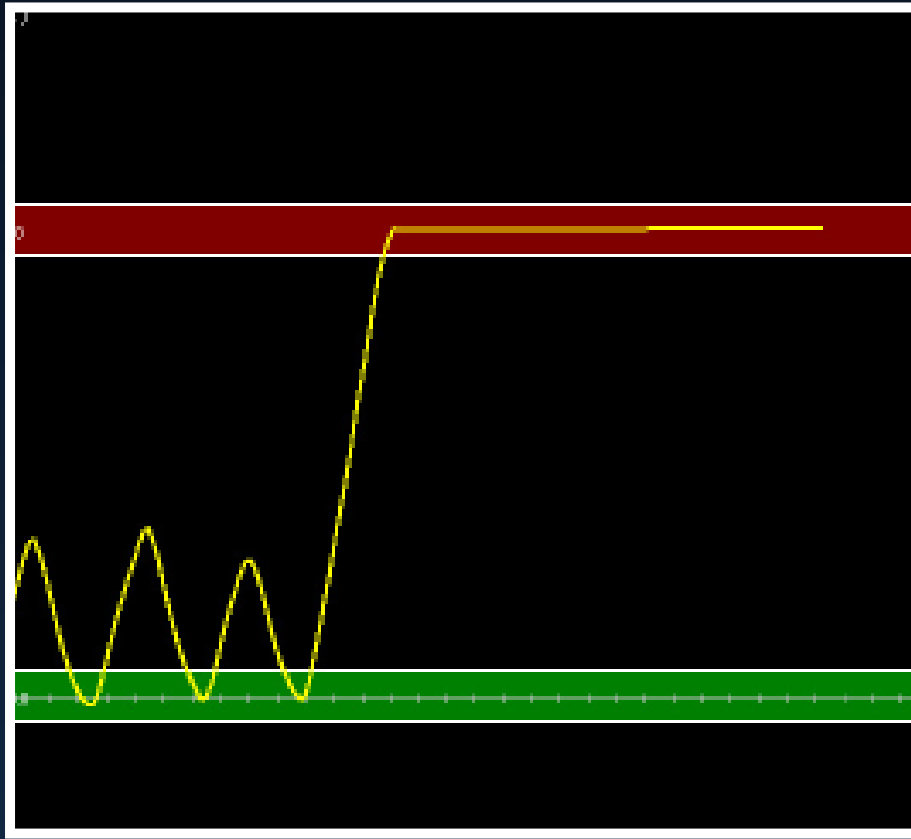
Lung volume vs abdominal displacement often have similar CC



When abdominal displacement correlates poorly, Lung volume CC remains high



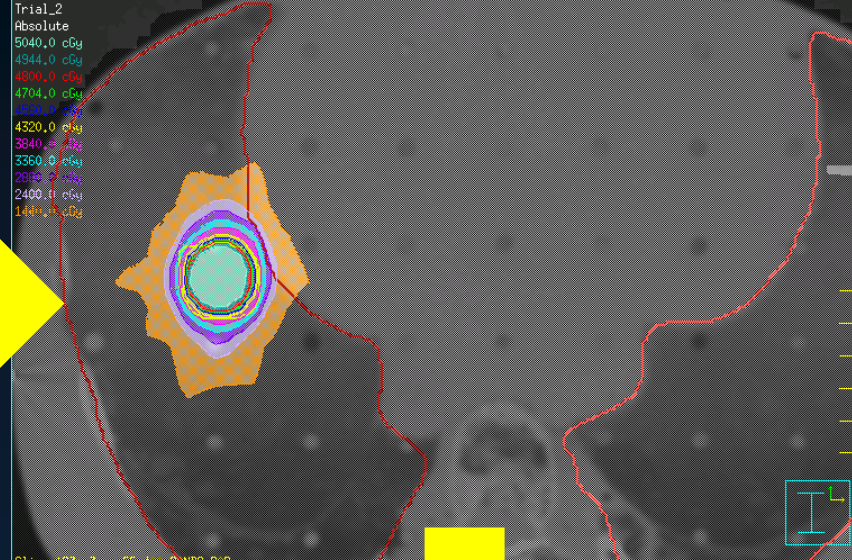
Can patient-feedback improve correlation among surrogates and internal motion?



Safety Challenges

Quality Assurance

Paradigm of the end-to-end test



Summary of Key Challenges

- Understanding biological and physical requirements of margins
- Identification of misalignment in real-time
- Developing tools and techniques least susceptible to patient-related variability
- Expanding the QA paradigm to include the patient and physician