AdventHealth

DoseRT Implementation and Clinical Experience

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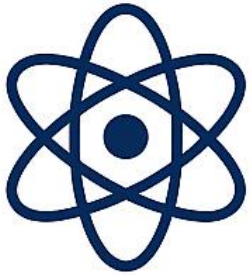
Disclosures

- AdventHealth Celebration maintains a Center of Excellence (COE) agreement with VisionRT.
- AdventHealth Parker maintains a Professional Services Agreement (PSA) with VisionRT
- The content presented reflects clinical experience and independent evaluation.
- This presentation was not influenced by financial incentives.

Objectives

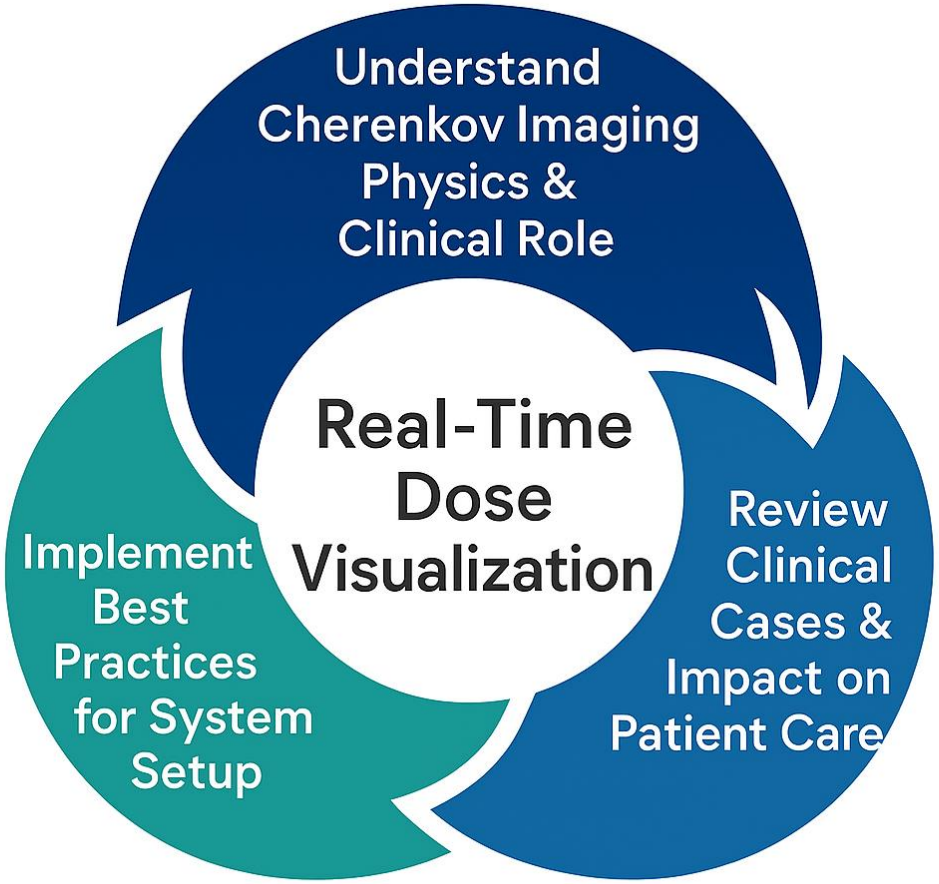


Understand the physics & clinical role of Cherenkov imaging

Describe acceptance testing and implementation best practices of a Cherenkov imaging system

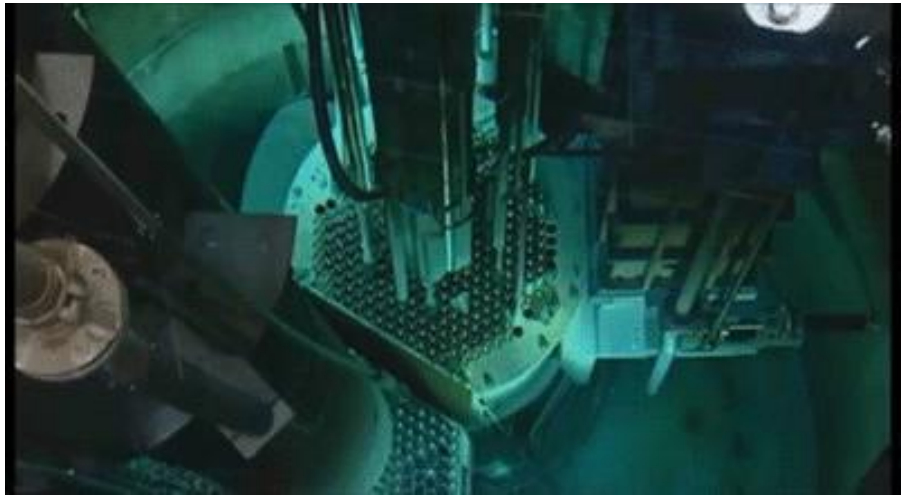
Review clinical cases where Cherenkov imaging impacted patient care

Objectives

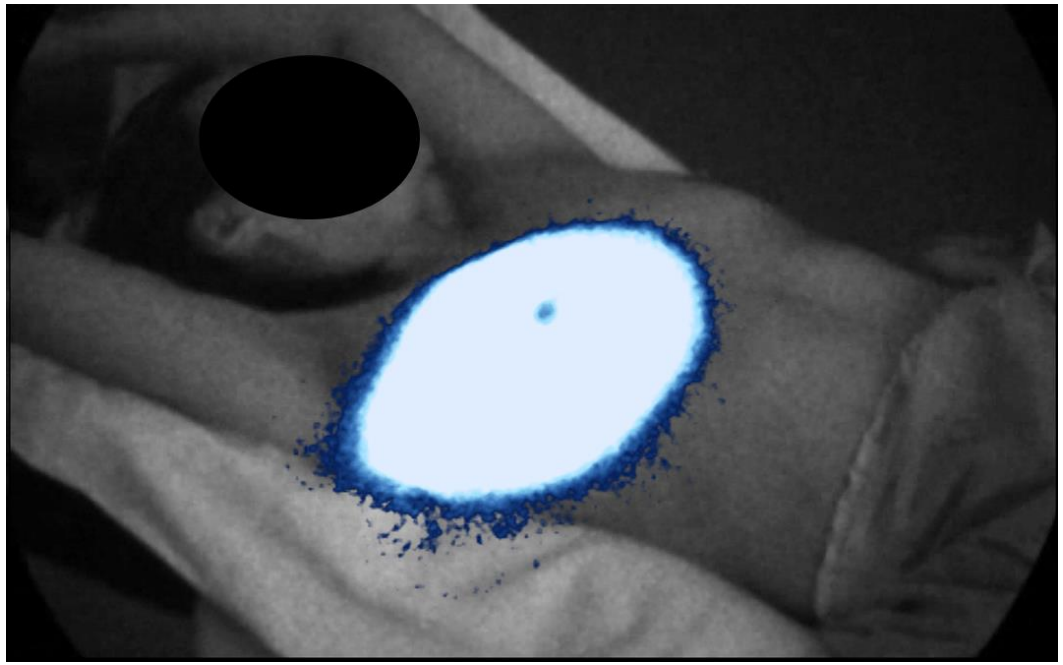

Understand Cherenkov Imaging Physics & Clinical Role
Review Clinical Cases & Impact on Patient Care
Implement Best Practices for System Setup
Real-Time Dose Visualization

Cherenkov Radiation

- Cherenkov radiation occurs when a charged particle travels through a medium faster than the speed of light in that medium, producing a faint bluish light.
  - Discovered in 1934 by Pavel Cherenkov
  - Theory developed in 1937 by Tamm & Frank
  - Nobel prize in physics awarded to Cherenkov, Tamm and Frank in 1985.



Cherenkov Imaging in Radiation Therapy



What is DoseRT?
Ultra sensitive cameras capture faint blue light from the patient's skin during treatment delivery

How does it work clinically?
The light patterns correspond to beam entrance/exit. It provides a direct visual map of delivered radiation

Why do we need it?
Enables real-time detection of unintended irradiation.

Traditional Verification Methods vs. Cherenkov Imaging

- Portal Imaging
  - ✓Good for: setup verification, field/MLC check, pre-treatment QA.
  - x Limitation: no real-time feedback, cannot capture dynamic changes during delivery
- Diodes/Film
  - ✓Good for: absolute dose points, small field verification
  - x Limitation: single point data, no patient anatomy, offline analysis

- Cherenkov Imaging
  - ✓Captures radiation induced light from tissue in real time
  - ✓Full 2D field coverage
  - ✓Direct anatomy referenced feedback
  - ✓Identifies motion, setup errors or drift, and beam interruptions instantly

Integrating Positioning and Real-Time Dose Visualization

AlignRT (SGRT)

- Provides tools for accurate patient positioning.
- Detects motion and setup errors before and during treatment.

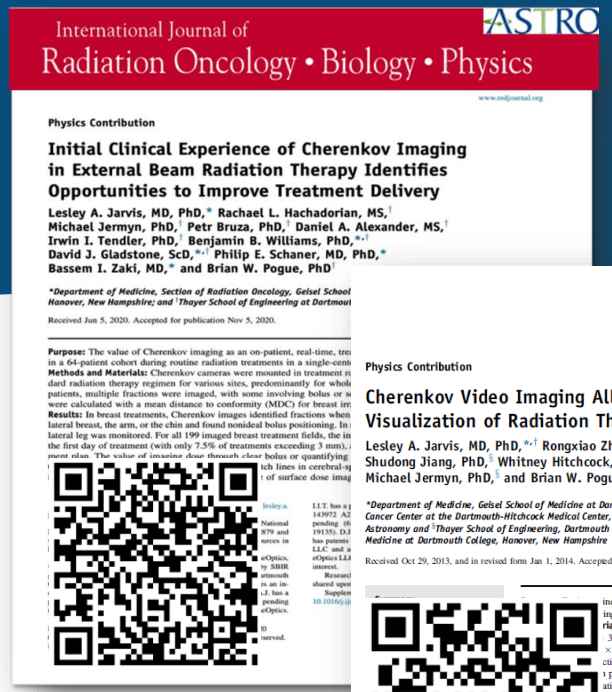
DoseRT (Cherenkov Imaging)

- Visualizes radiation dose delivery in real time.
- detects unintended irradiation and other planning or setup errors.

Why Combine them?

- AlignRT ensures precise positioning
- DoseRT confirms dose delivery
- Together, they create a system for maximum accuracy, safety and efficiency.

Benefits of Cherenkov Imaging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Physics Contribution

Initial Clinical Experience of Cherenkov Imaging in External Beam Radiation Therapy Identifies Opportunities to Improve Treatment Delivery

Lesley A. Jarvis, MD, PhD,* Rachael L. Hachadorian, MS,† Michael Jermyn, PhD,† Petr Bruza, PhD,† Daniel A. Alexander, MS,† Irwin I. Tendler, PhD,† Benjamin B. Williams, PhD,*,† David J. Gladstone, ScD,*,† Philip E. Schaner, MD, PhD,* Bassem I. Zaki, MD,* and Brian W. Pogue, PhD†


Physics Contribution

Cherenkov Video Imaging Allows for the First Visualization of Radiation Therapy in Real Time

Lesley A. Jarvis, MD, PhD,*,† Rongxiao Zhang, BS,‡ David J. Gladstone, ScD,*,† Shudong Jiang, PhD,§ Whitney Hitchcock,† Oscar D. Friedman,§ Adam K. Glaser, BE,§ Michael Jermyn, PhD,§ and Brian W. Pogue, PhD‡§

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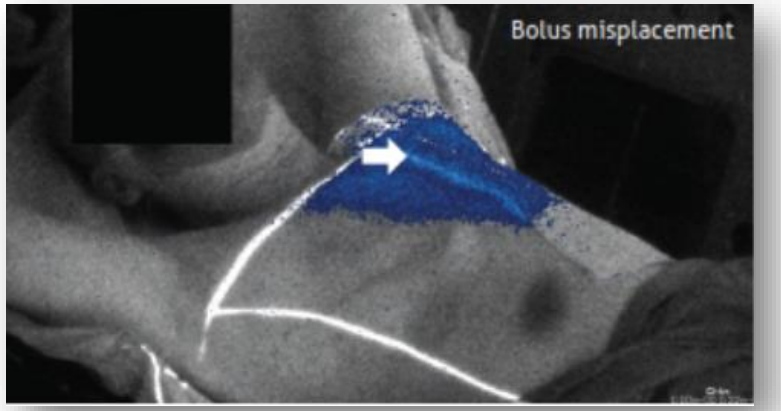
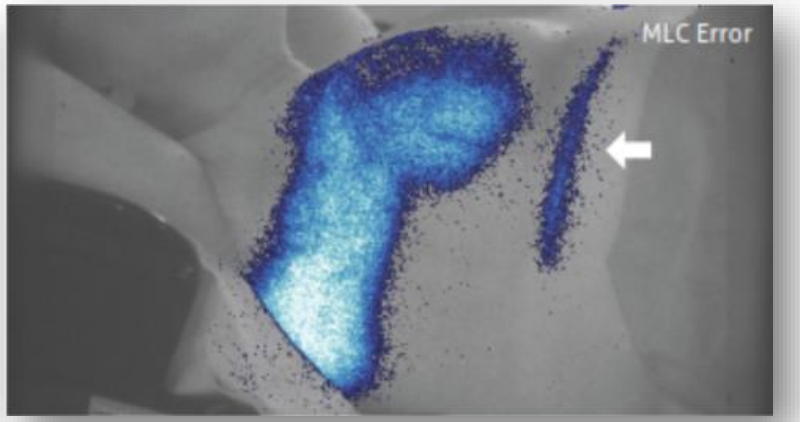
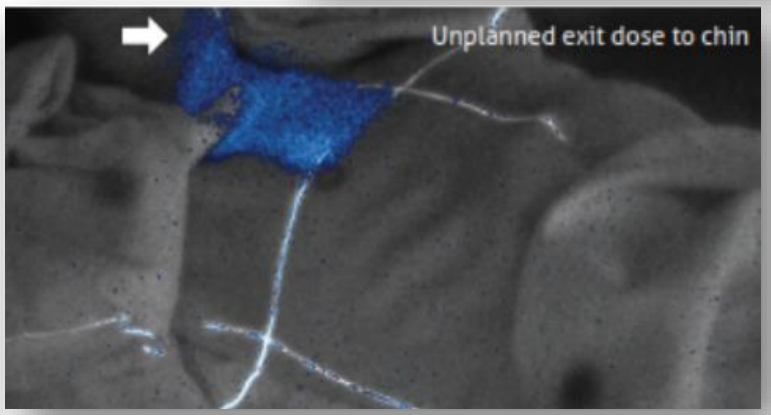
Initial experience* suggests **10% of patients** experience compliance, setup, plan or habitus issues;

- Chin irradiated during supraclavicular fields
- Arm irradiated during tangential breast fields
- Bolus misplacement
- Open MLC leaves

DoseRT™ can help detect, and prevent these cases







* Initial experience with 60 patients

DoseRT Technical Specifications

- Cherenkov signal can be visualized with most treatment plans, from the complex highly modulated VMAT to the simple 2D conformal.
- Compatible beam energies: 6 - 18 MV photons
- Compatible dose rates: 100 – 2400 MU/Min
- Minimum dose threshold to visualize signal: 10* MU
- Depth of Cherenkov imaging signal: up to 10mm

Pre-Installation Practical Considerations

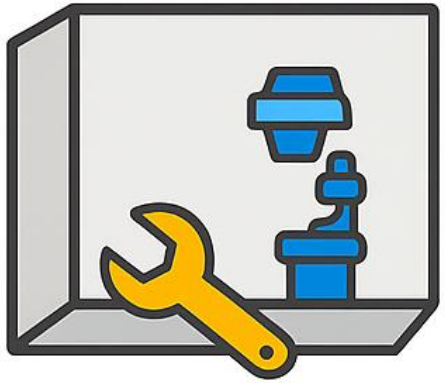
Light Sensitivity

BeamSite cameras detect faint Cherenkov Signal

- Ambient room illumination will require modification

Equipment Interference

Some in-room systems (monitors, overhead lights) will need to be powered down to reduce interference



Vault Modification

BeamSite cameras mount separately from AlignRT

- Might require additional vault modifications

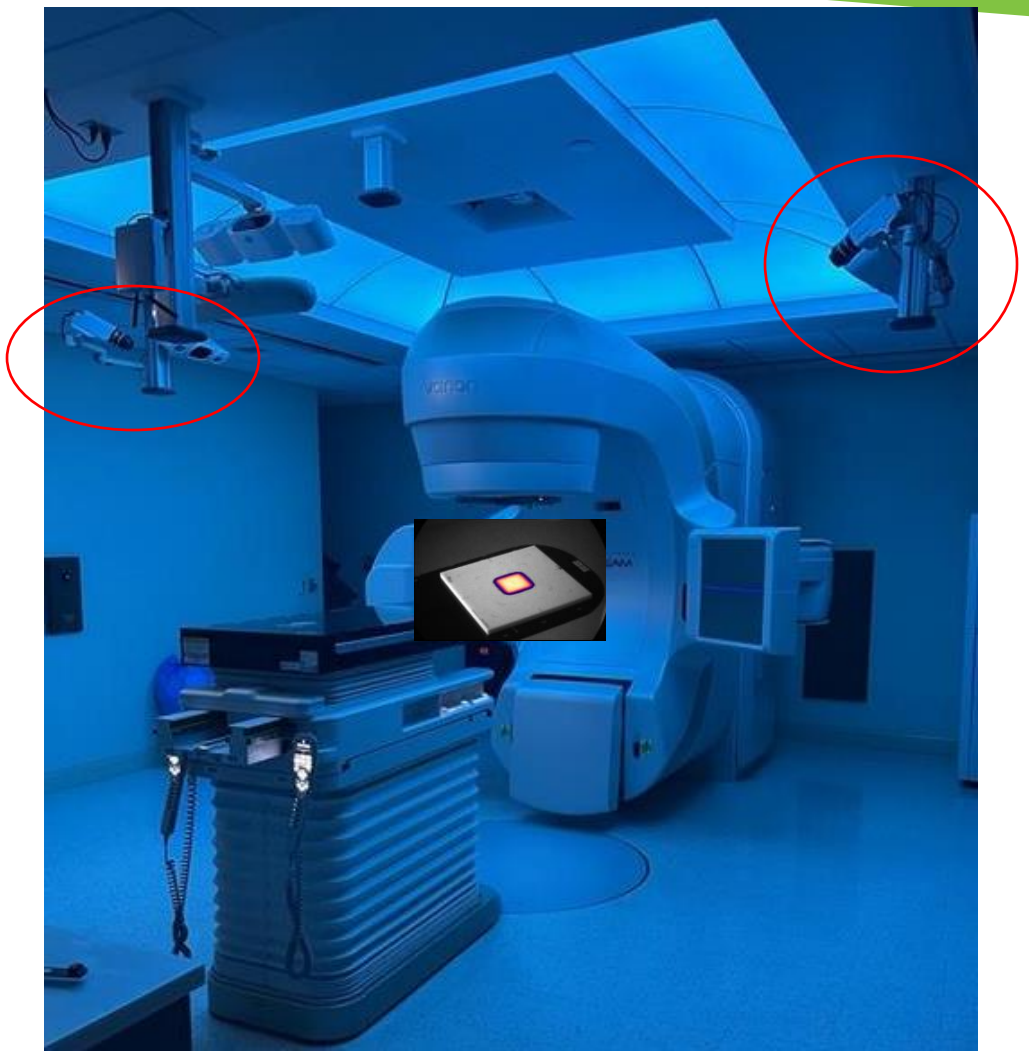
Installation and Acceptance

Key Installation Steps:

- Optimize ambient light
- Optimize cameras position
- System calibration

Acceptance Testing:

- Verify Cherenkov signal across all energies and dose rate

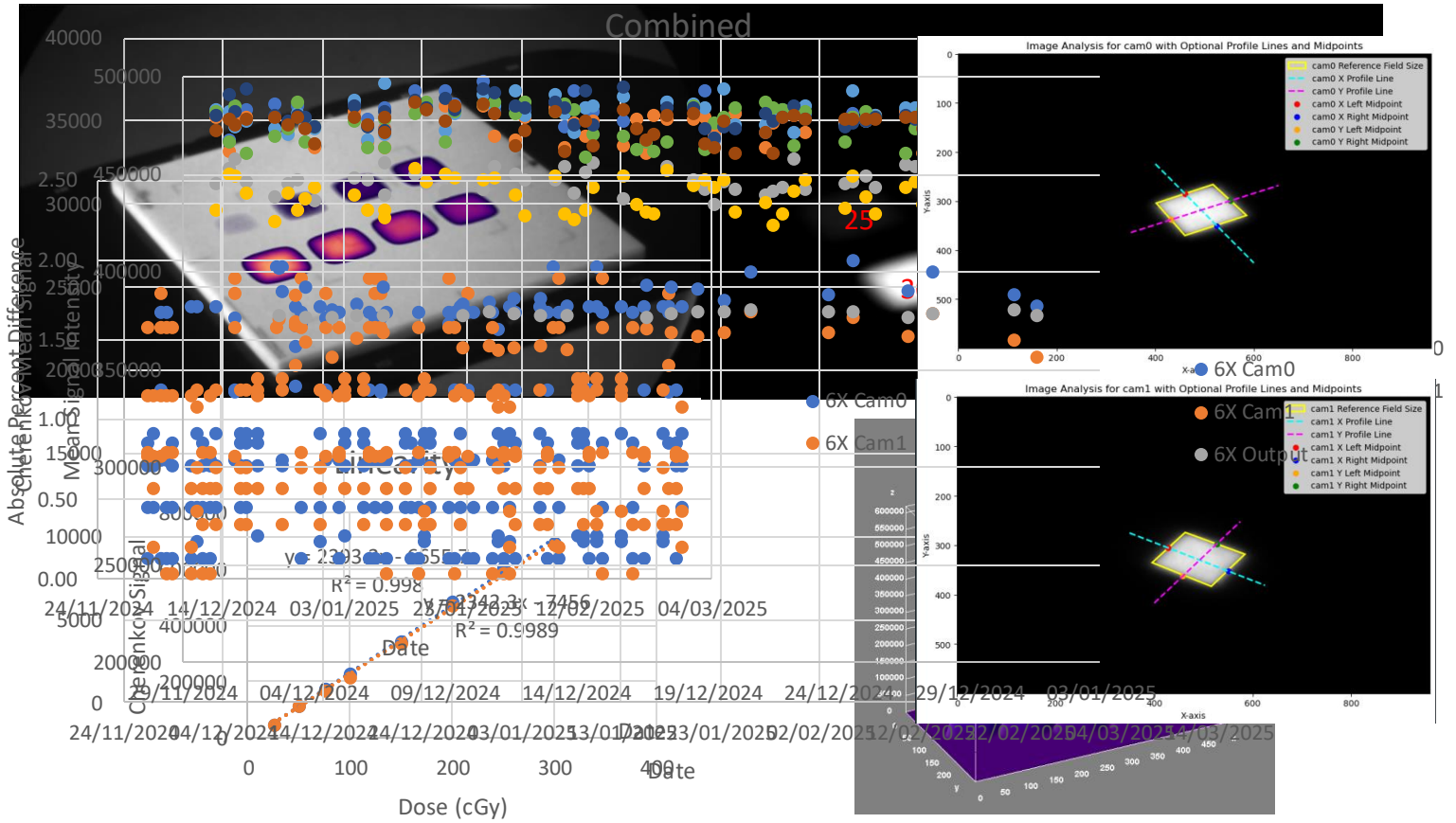


Additional Tests and Validation

Although DoseRT is currently a qualitative tool, routine QA will insure accurate and consistent signal.

Quality Assurance Tests:

- Linearity check - signal vs. delivered MU
- Constancy check - day to day reproducibility
- Field size constancy - signal "shape" reproducibility
- Signal vs. output – dose correlation tests.



How we use DoseRT in Daily Practice

- We monitor every patient using both AlignRT and DoseRT
- If the therapists visualize something out of the ordinary, they can do one of the following:
  - Pause treatment and call physics for review
  - Finish the fraction and notify physics for offline review
- Adjustments to the plan, patient positioning or treatment thresholds will be done accordingly after case review

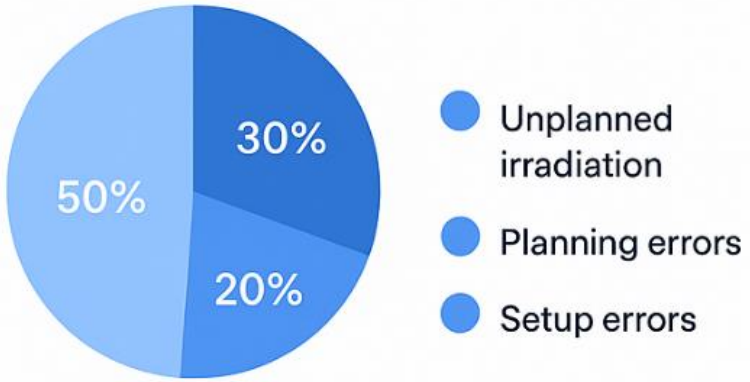
Clinical Impact - First 12 Months

Patients monitored:
659

Fractions with detected issues:
1650

Top errors:
- Unplanned irradiation: 50%
- Planning errors: 30%
- Setup errors: 20%

Top errors



Patient Safety Quality Improvement Workflow Efficiency

Case Study: Bolus Misplacement

Background

- Right Whole Breast Treatment
- 6MV Tangents, Free Breathing with Bolus.

Observation

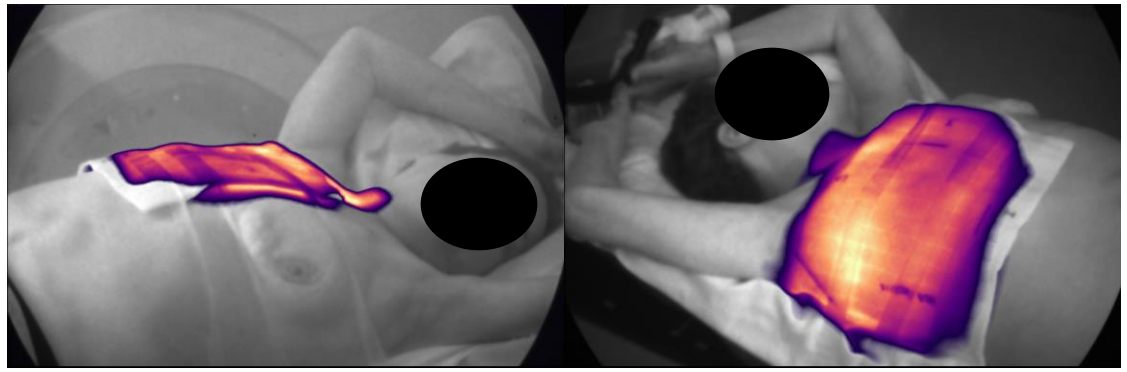
- On 8th fraction the bolus was misplaced.

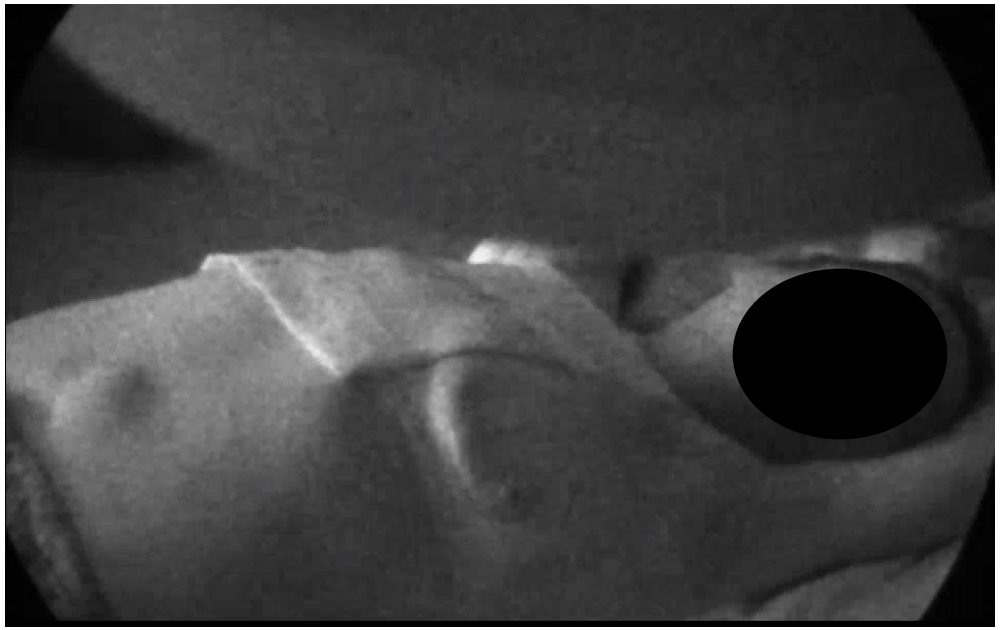
Action Taken

- Fraction was completed but corrections were made for future fractions

Outcome

- Underdose and overdose areas of the breast





Case Study: Dose to the Chin

Background

- Left whole breast and lymph nodes treatment
- 6MV tangents, DIBH

Observation

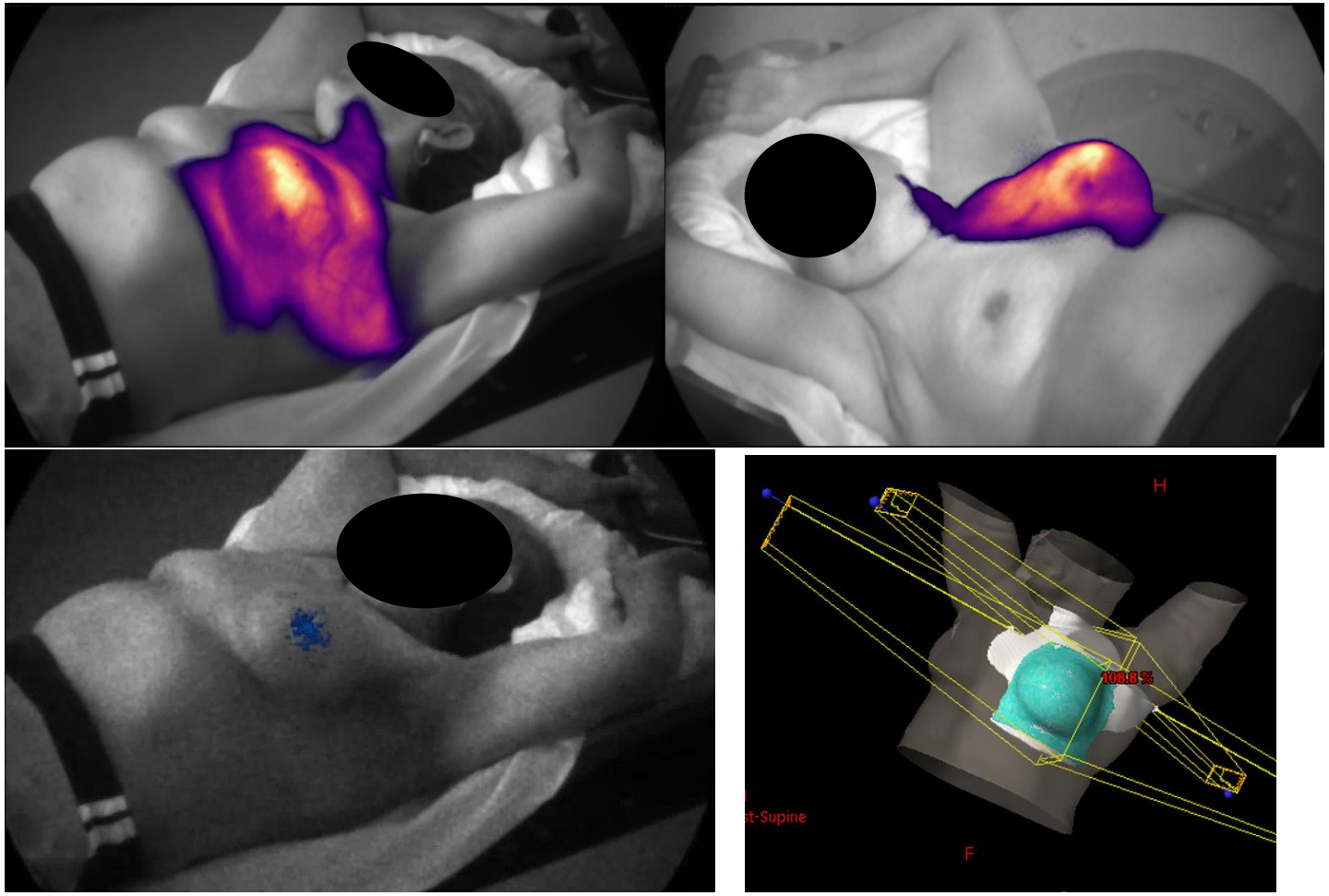
- On 2nd fraction dose to the chin was observed.

Action Taken

- Patient position was corrected

Outcome

- Additional unplanned dose to the chin.



Case Study: Mismatch between Plan and Treatment

Background

- Left chest wall treatment
- 6MV 2 VMAT arcs, DIBH

Observation

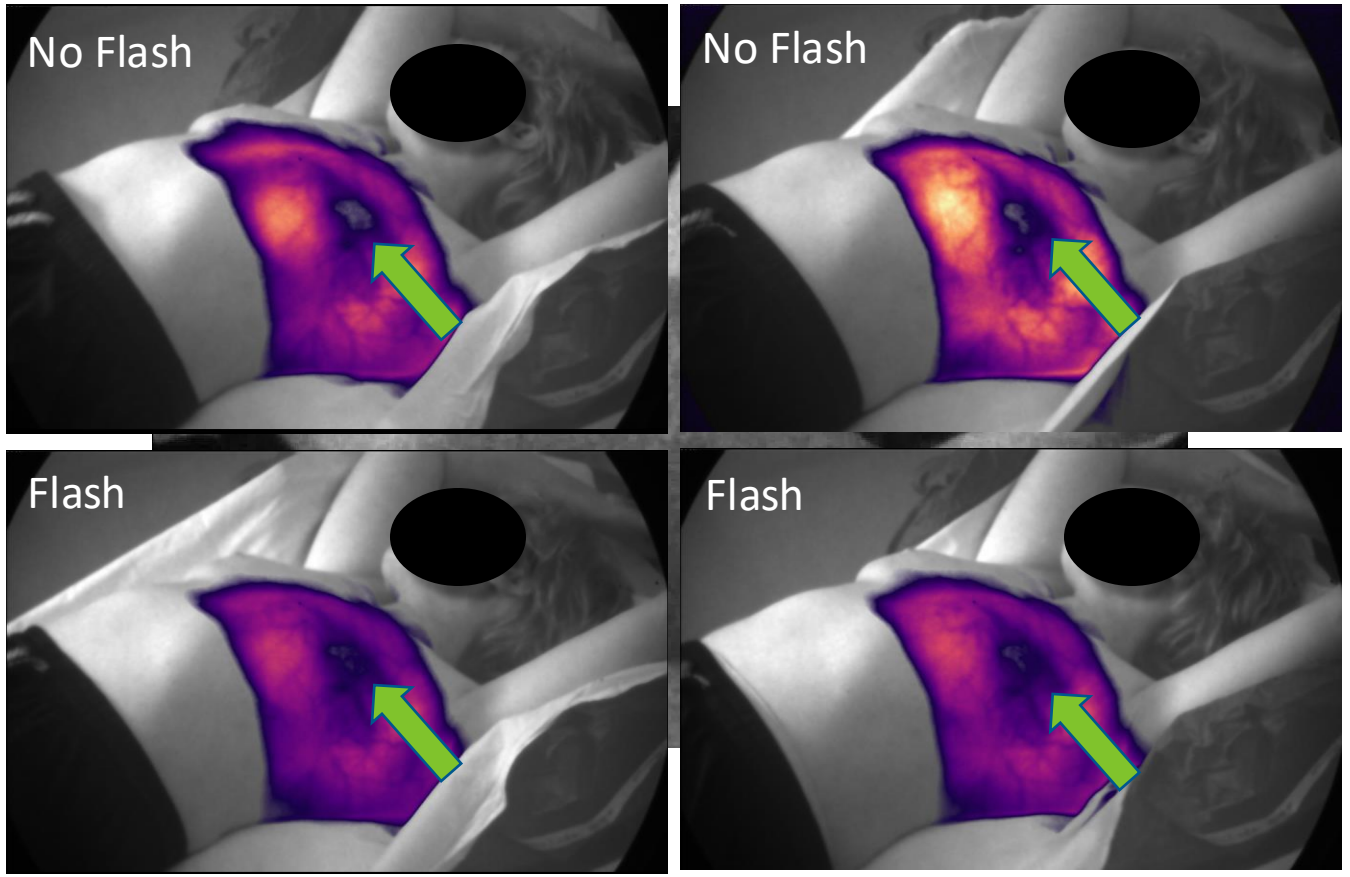
- Unexplained "no dose" area in treatment composite image

Action Taken

- Extensive plan review
- Replan initiated

Outcome

- A new plan was created with skin flash to cover under dosed region



Case Study: Mismatch between Plan and Treatment

Plan Review

- Original plan was reviewed by the physics team
- It was determined that the lack of skin flash caused the underdose

Verification

- TLDs were used for in-vivo dosimetry.
- TDLs suggest a discrepancy of 30-43cGy per fraction of 7.5-11Gy for the full course.

Correction

- A new plan was created with skin flash

Teaching Case

Optimizing Breast Cancer Radiation therapy With Volumetric Modulated Arc Therapy and Skin Flash: A Case Study Using Deep Inspiration Breath Hold and Cherenkov Imaging

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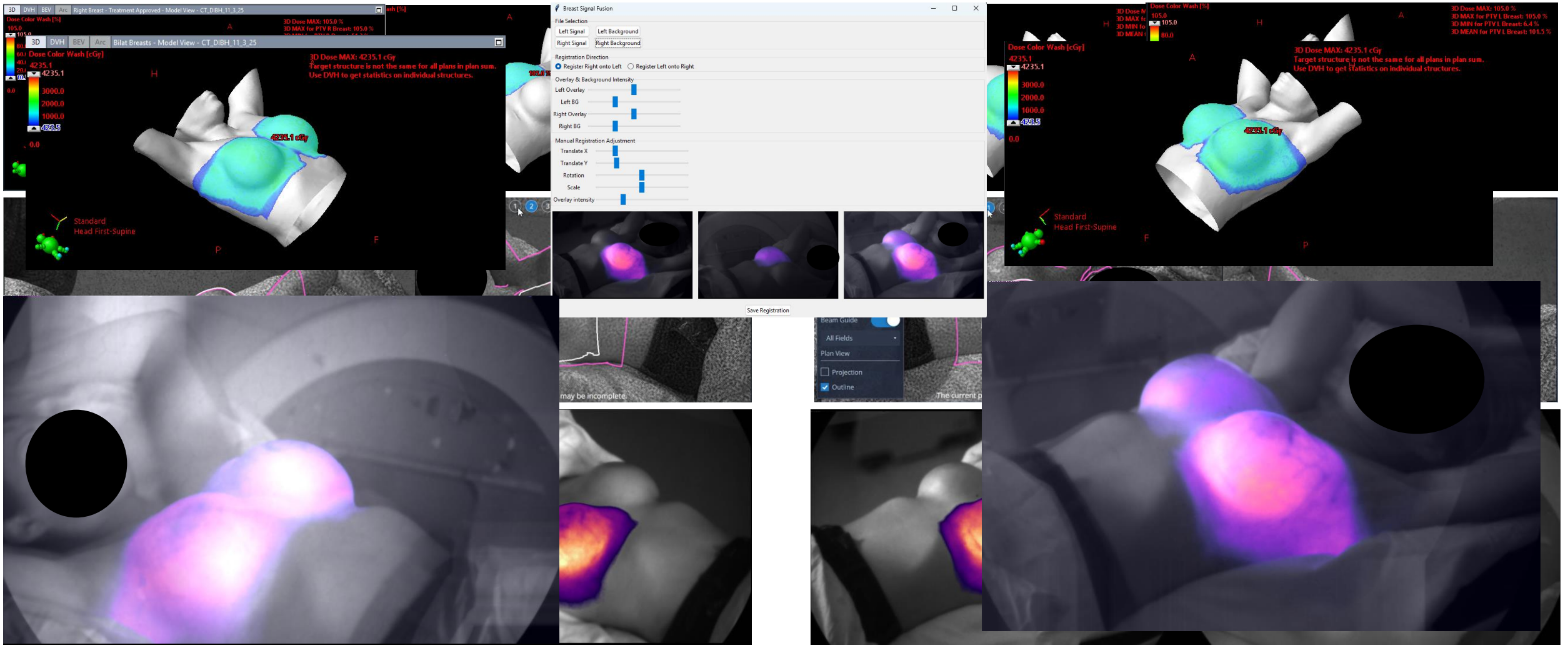
Introduction

Radiation therapy is integral to the management of breast cancer, particularly in cases involving the chest wall and regional lymph nodes. Modern techniques, such as volumetric modulated arc therapy (VMAT), have revolutionized treatment by delivering highly conformal dose distributions while minimizing exposure to critical organs such as the heart and lungs. Studies have shown that VMAT provides superior dose homogeneity and target coverage, especially in complex scenarios requiring chest wall and nodal irradiation.[1,2]

Deep inspiration breath hold (DIBH) further enhances

Case Study: Bilateral DIBH Breast



More About DoseRT!

BASIC ORIGINAL REPORT · Articles in Press, November 04, 2025 · *Open Access*

A Review of Cherenkov Imaging for Real-Time Verification in Radiation Therapy

Adi Robinson, PhD [1] · Michael Tallhamer, MS [2] · Florian Stieler [3,4]

Affiliations & Notes · Article Info

Show Outline

Abstract

Purpose

This paper aims to evaluate the integration of Cherenkov imaging into radiation therapy practices, focusing on its utility in enhancing treatment precision, patient safety, and clinical decision-making. The research highlights its application in quality and safety verification, breast treatment, dose visualization, confirming no radiation to unintended areas, and its broader clinical impact.

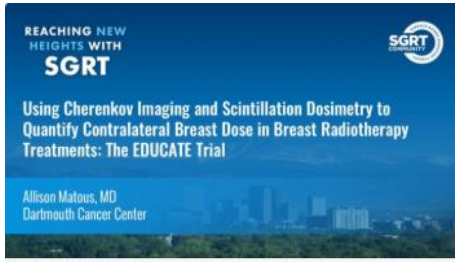
Methods

We employed two commercially available Cherenkov imaging systems, BeamSite and DoseRT, integrated with Varian and Elekta linear accelerators. The methodology involved real-time imaging during radiation therapy sessions for various treatments, capturing Cherenkov light with time-gated cameras synchronized with radiation pulses. Post-treatment, images were analyzed to assess treatment accuracy, dose distribution, and any deviations from the intended plan.

Results

Cherenkov imaging consistently provided high-quality imaging that allowed for immediate visualization of radiation dose distribution, detecting deviations in real-time, and ensuring no radiation was delivered to unintended areas. The results will be presented focusing on five main topics: quality and patient safety verification, breast treatment applications, treatment verification dose visualization, verification of negative dose in areas of concern, and observations with clinical impact. It was particularly beneficial in complex scenarios like breast cancer treatments and in cases where patient positioning was challenging.

SGRT COMMUNITY



Using Cherenkov Imaging and Scintillation Dosimetry to Quantify Contralateral Breast Dose in Breast Radiotherapy Treatments

Allison Matous, MD
Dartmouth Cancer Center

Cherenkov Imaging: Clinical Experience with DoseRT

Daniel Alexander, PhD
Assistant Professor of Radiation Oncology & Applied Sciences
Dartmouth College, Dartmouth Health

Latest Clinical Experience with DoseRT and Beam Guide

Dr. Florian Stieler, PhD
Medical Physicist, University Medical Center Mannheim, Germany

Summary

Safe Delivery

- By combining SGRT with real-time dose visualization, clinicians can ensure that treatments are delivered as intended.

Real-time Detection

- Cherenkov imaging provides immediate feedback during treatment, allowing for rapid identification of unintended irradiation

Enhanced Evaluation of Plan Robustness

- DoseRT helps assess how well treatment plans perform under real-world conditions, particularly for patients with challenging body habitus or compliance issues.

Supports Re-Planning and Adjustments

- Visualization data enables informed decisions for plan modifications, improving overall treatment accuracy.

Provides a Unique Perspective on Delivery

- DoseRT bridges the gap between planning execution, offering clinicians a direct view of what is happening during treatment.


Thank you!
Questions?
Email: Adi.Robinson@adventhealth.com