Pushing the Boundaries of SGRT

Exploring Current and Future Uses of SGRT Throughout the Radiation Oncology Workflow

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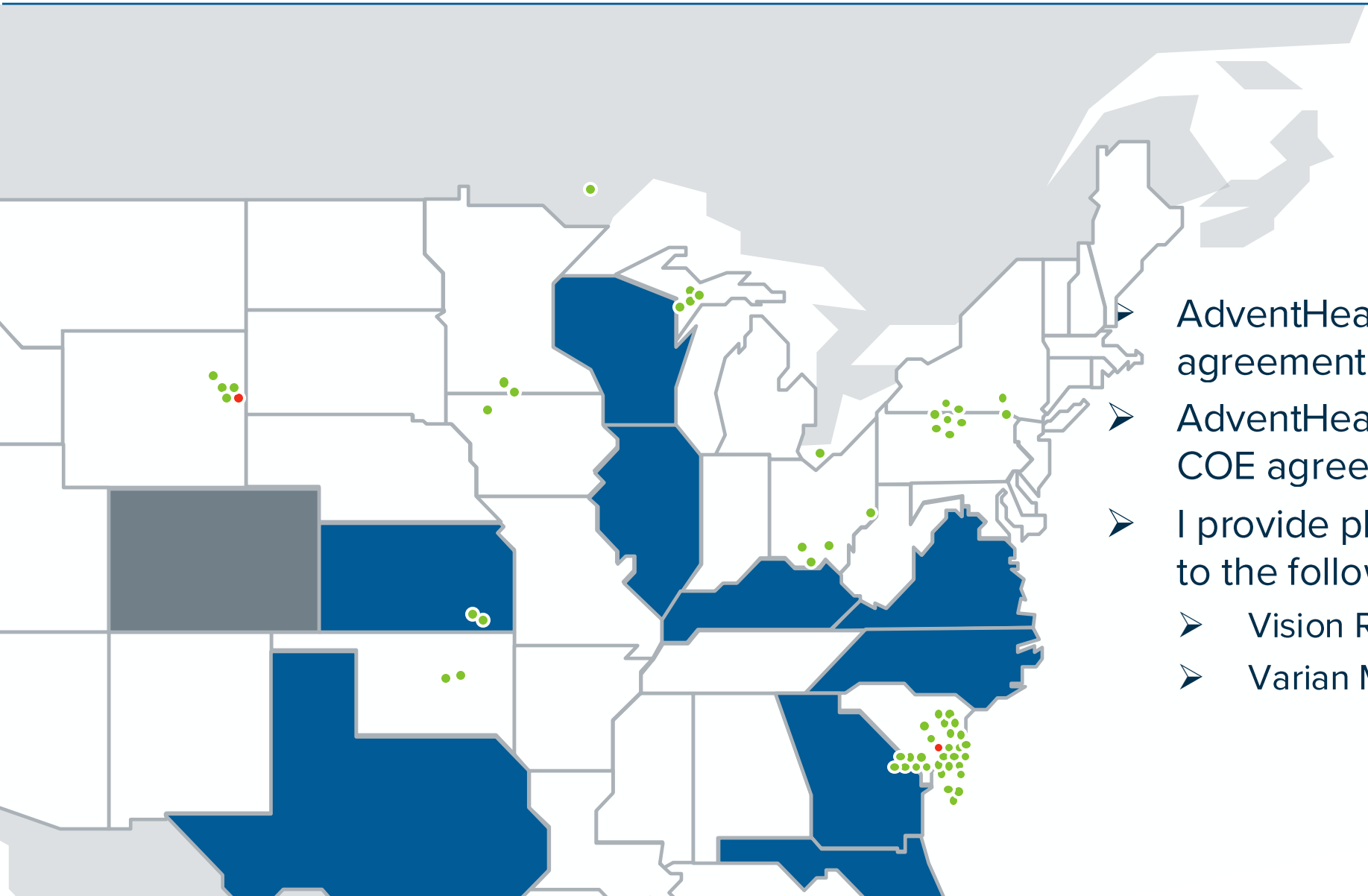
Disclosures



- AdventHealth – Parker has a PSA agreement with Vision RT.
- AdventHealth – Celebration has a COE agreement with Vision RT.
- I provide physics consultation services to the following vendors
  - Vision RT
  - Varian Medical Systems

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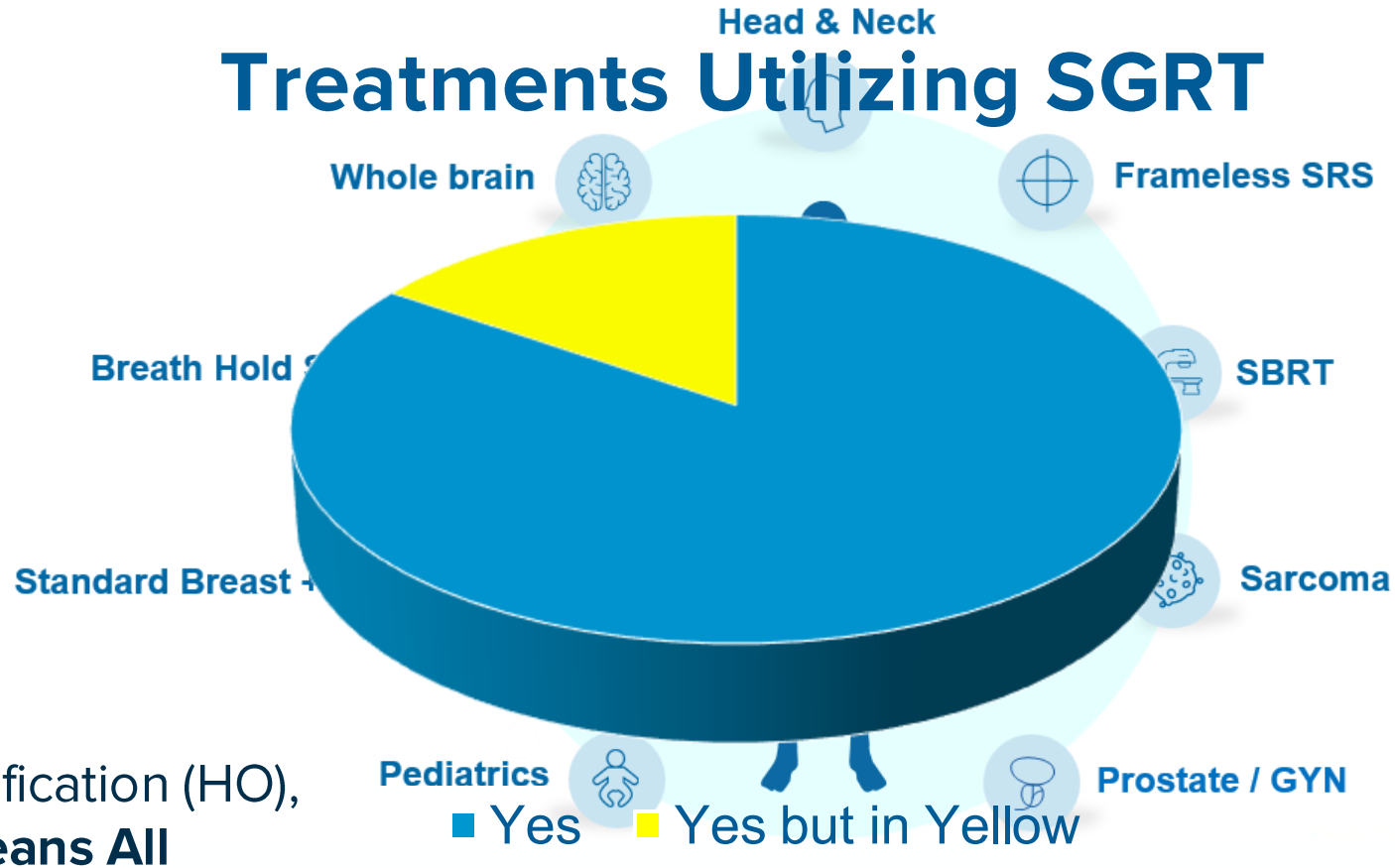
Rocky Mountain Region



- SGRT is standard of care
- 100% of patients treated with SGRT.
- All indications including Heterotopic Ossification (HO), Electrons, and Osteoarthritis (OA)…**All means All**
- SGRT used for Simulation, Planning, Patient Identification, Patient Setup, Motion Management (Respiratory), Treatment Delivery and Dose Visualization

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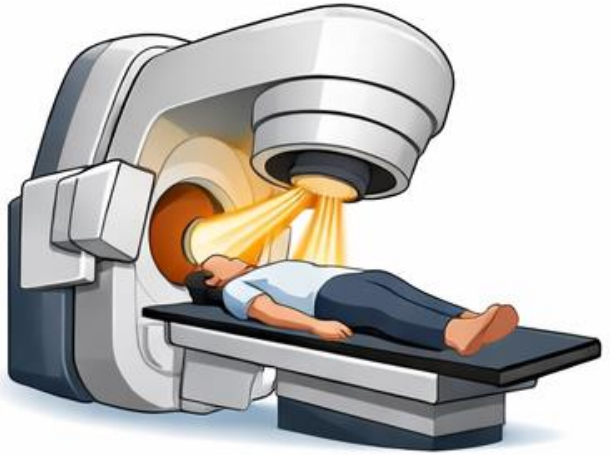
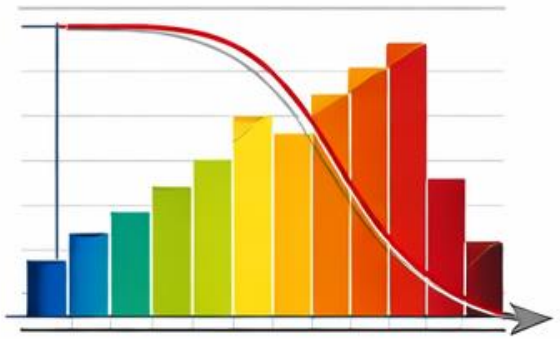
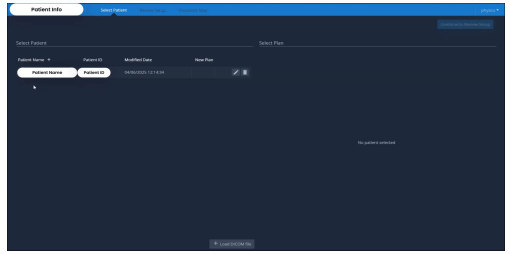
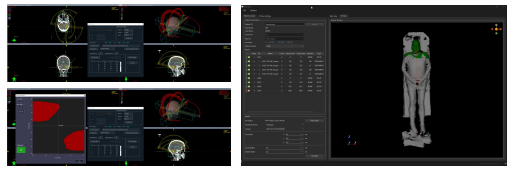
AdventHealth's SGRT Portfolio





Sim **Plan** **Treat** **Dose**





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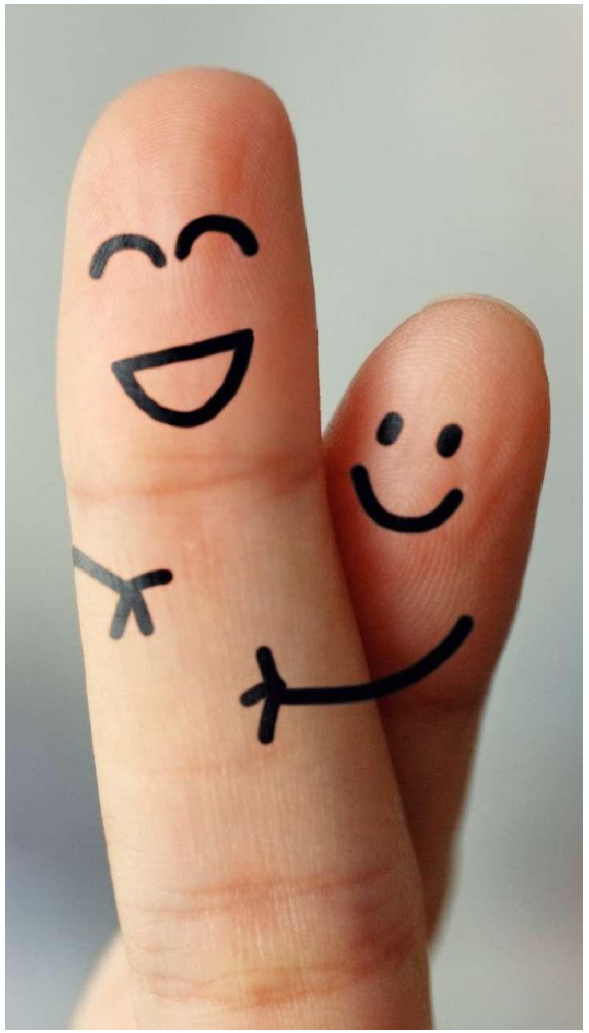
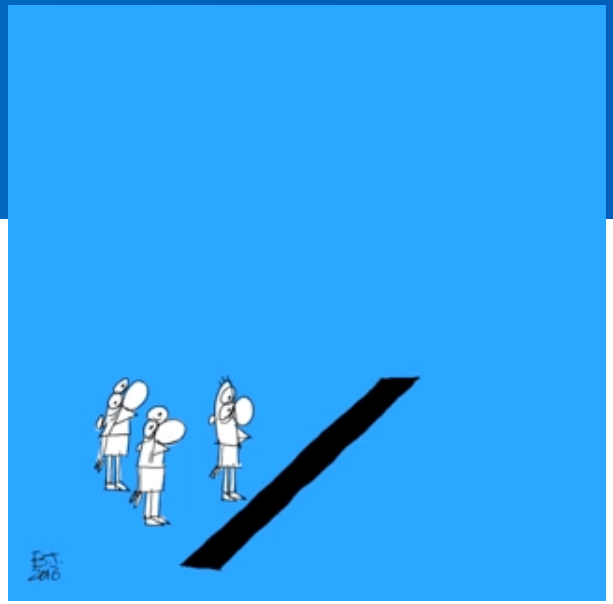
Pushing Boundaries Doesn't Mean Crossing "The Line"



This is a safe space



- SGRT as the standard of care was once thought of as one of those **"out-there"** ideas.
  - Generally refers to unconventional, extreme, or unusual ideas. It can be used to describe a person's thinking, their creative output, or even a situation that deviates significantly from the norm.
- Treating 100% of patients with SGRT is still, to some degree, seen as pushing some sort of boundary.
  - Tattooless treatments are still considered pushing the limits by some
  - "*Even Electrons*", "*Even Osteoarthritis*", "*Even Trigeminal Neuralgia*" …etc.
  - Treating SRS cases is still considered "risky" by some, even with the body of literature out there related to accuracy and clinical outcomes .
- Apply the principles of SGRT and SGRT technologies to
  - Simulation
  - Planning
  - Treatment
  - Exploring the utility of Direct Visualization of the Dose Delivery

  is often seen as "***ill advised***" or even "***unnecessary***".

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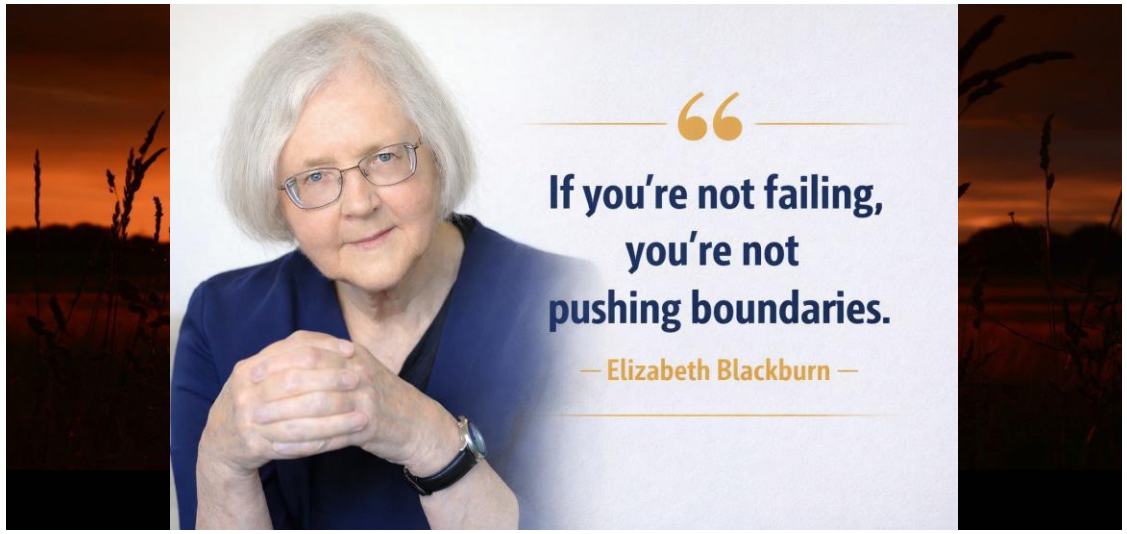
My philosophy tends to be “slightly” different

Goals

- Review a couple quick historical cases where boundaries may have been pushed and see where we are today.
- Look at some present “opportunities” to expand the utility of existing SGRT technologies by “nudging” a boundary or two.
- Peek over the fence and speculate on future opportunities.



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Back to the Future – SGRT Outback Edition

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Timeline for Pushing the Boundaries in SGRT

2019

Maskless H&N enters clinical discussion

Postural Correction and IGRT Augmentation Promoted

Importing of SGRT images and reports into OIS was first reported

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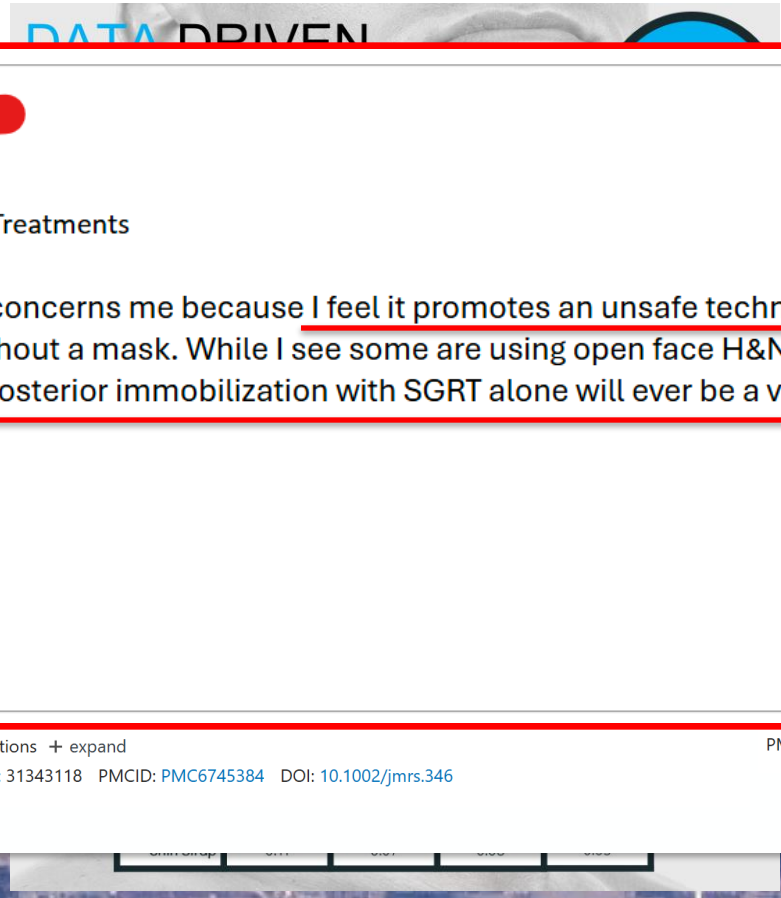
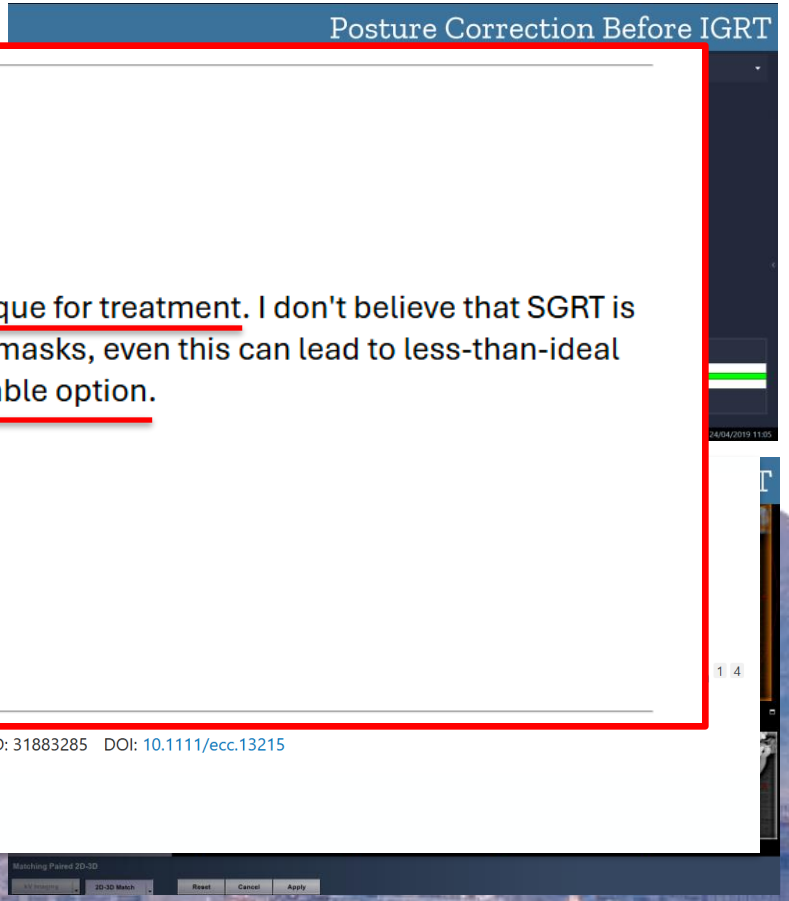
US SGRT Meeting 2019

- First 10 H&N patients presented
  - 7 Chinstrap mask only
  - [redacted]
- IGRT [redacted] Imm[redacted] Corr[redacted] pres[redacted]





From: [redacted]
Sent: Thursday, June 27, 2019 12:45 PM
To: Tallhamer, Michael <MichaelTallhamer@Centura.org>
Subject: [EXTERNAL] Re: Vision RT Maskless Head & Neck Treatments

Understood. Your presentation, while interesting, concerns me because I feel it promotes an unsafe technique for treatment. I don't believe that SGRT is capable of aligning a patient for H&N treatment without a mask. While I see some are using open face H&N masks, even this can lead to less-than-ideal setups and larger than normal shifts. I'm not sure posterior immobilization with SGRT alone will ever be a viable option.

I would encourage you to rethink this approach.

[redacted]

> J Med Rad

Explori[redacted] anxiet[redacted] underg[redacted]

Jodie L Nixo[redacted]
Laurelie R Wall [2 4], Elizabeth C Ward [2 4], Sandro V Porceddu [5 6]

Affiliations + expand
PMID: 30378282 PMCID: PMC6275267 DOI: 10.1002/jmrs.308

Affiliations + expand
PMID: 31343118 PMCID: PMC6745384 DOI: 10.1002/jmrs.346

PMID: 31883285 DOI: 10.1111/ecc.13215

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What has happened while we were gone?

Postural Video Released allowing for real-time video based postural correction prior to IGRT

2020

"The Futu ted at SGRT annual

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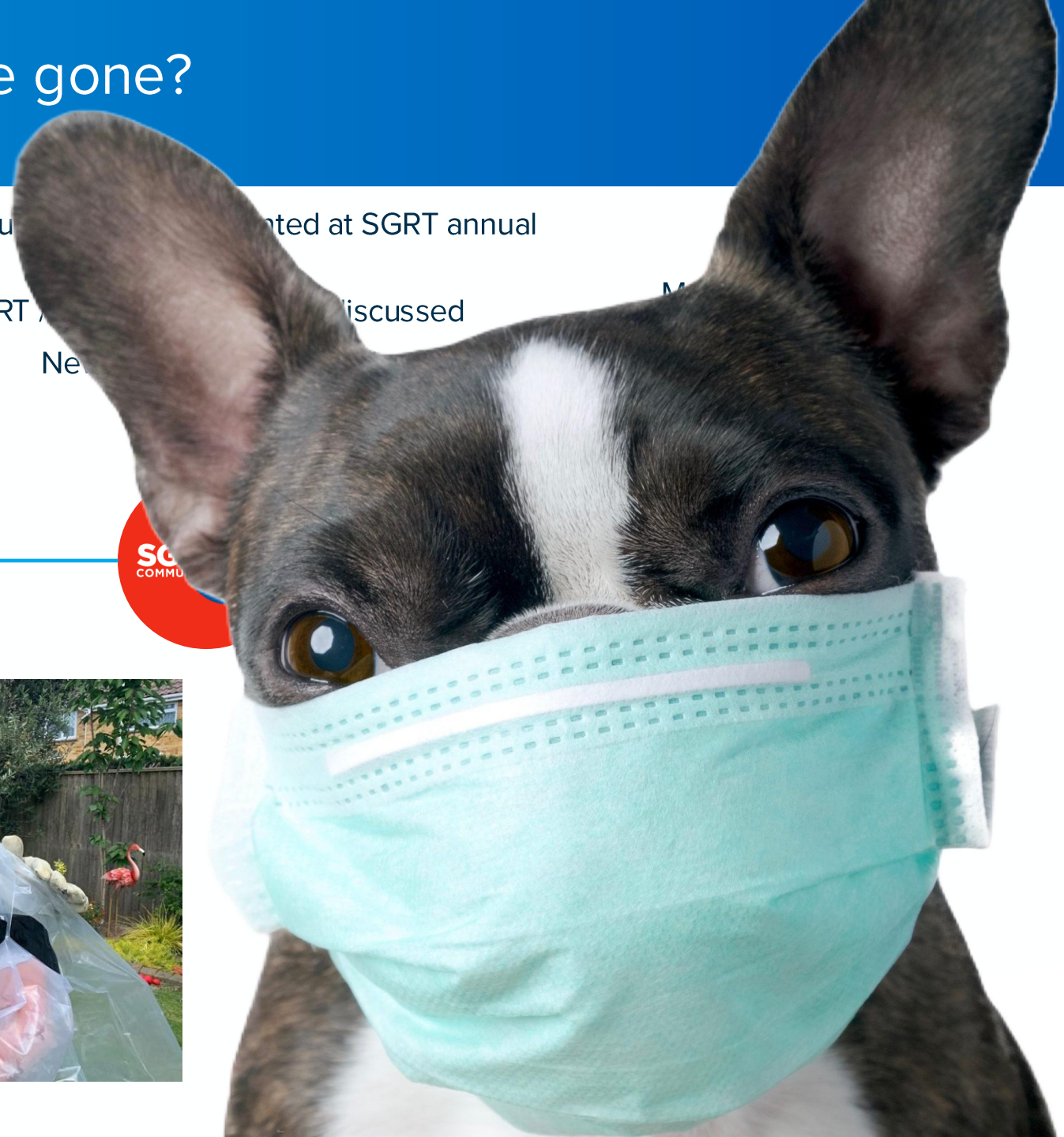
2019

Maskless H&N enters clinical discussion

Postural Correction and IGRT Augmentation Promoted

Importing of SGRT images and reports into OIS was first reported



where are we now

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Studies on “mask anxiety” in Head and Neck Cancer (HNC) Patients

Journal of Radiotherapy in Practice

cambridge.org/jrp

Original Article

Cite this article: Daniels J, Kyei KA, and Asomani BA. (2025) Thermoplastic mask-induced anxiety among head and neck cancer patients undergoing radiotherapy in a limited-resource setting: a cross-sectional study. *Journal of Radiotherapy in Practice*. **24**(e22), 1–6. doi: 10.1017/S1460396925000184

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Keywords:
Anxiety; coping mechanisms; head and neck cancers; patient immobilization; quality of life; radiotherapy; thermoplastic mask

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Thermoplastic mask-induced anxiety among head and neck cancer patients undergoing radiotherapy in a limited-resource setting: a cross-sectional study

Joseph Daniels[1], Kofi Adesi Kyei[1,2] and Baron Agyei Asomani[1,2]

[1]National Centre for Radiotherapy, Oncology and Nuclear Medicine, Korle-Bu Teaching Hospital, Accra, Ghana and [2]Department of Radiography, University of Ghana, Accra, Ghana

Abstract

Introduction: Radiotherapy is a critical component of head and neck cancer (HNC) management that requires reliable patient immobilization. Using thermoplastic masks helps to ensure reproducible patient positioning during radiotherapy, thus reducing the risk of a geographical miss. However, the use of these masks can also induce anxiety and distress, which can negatively impact treatment adherence and quality of life outcomes.

Methods: The research was a quantitative cross-sectional study that determined the prevalence and severity of thermoplastic mask-induced anxiety and assessed the scope of coping mechanisms used by HNC patients. Data were collected using a structured questionnaire from recruited participants and analysed with the Statistical Package for Social Sciences software, version 26·0. Relevant clinical and treatment-related data were retrieved from patients' hospital-based medical records. Descriptive and inferential statistical analyses such as chi-square tests and likelihood ratios were conducted, with p-values $< 0·05$ considered statistically significant.

Results: In all, there were 145 HNC patients with a male to female ratio of 1·9:1 and a median age of 52·8 years (IQR 20·7), ranging from 18 to 82 years. There was a high prevalence of thermoplastic mask-induced anxiety both during mask moulding (93·8%) and radiation therapy sessions (94·5%). Most participants (95·2%) adopted coping mechanisms including distraction (58%) and visualization techniques (46%).

Conclusions: Even though there was a high level of awareness and utilization of coping mechanisms, the high prevalence of thermoplastic mask-induced anxiety highlights a critical aspect of HNC patient care that may be overlooked in resource-limited settings.

Introduction

The curative management of head and neck cancer (HNC) requires a multidisciplinary approach that includes multimodality therapy with surgery and/or radiation therapy alone or in combination with chemotherapy, targeted or immunotherapy. Radiotherapy is a critical component of HNC management, requiring precise tumour-targeting to maximize radiation dose to the target volume. Immobilization devices, such as thermoplastic masks, help ensure that the patient's head and neck region remains in the same position throughout each treatment session, reducing the risk of a geographical miss caused by inadvertent patient motion during treatment. Thermoplastic masks are custom-moulded for each patient, ensuring a comfortably tight fit for reproducible treatment setup, thus minimizing both inter- and intrafraction variation in patient positioning.

However, the use of thermoplastic masks can induce anxiety, discomfort, claustrophobia and psychological distress. Several studies have identified strategies that may be effective for managing thermoplastic mask-induced anxiety such as mindfulness-based stress reduction techniques, cognitive-behavioural therapy and patient education.[1] The use of effective coping mechanisms can improve treatment compliance, alleviate psychological stress and mitigate the overall emotional impact of wearing thermoplastic masks for radiation treatment. In high-resource settings, various interventions, including pharmacological and non-pharmacological strategies, have been successfully employed to mitigate the impact of thermoplastic mask-induced anxiety.[2] However, in limited-resource settings, where healthcare infrastructure and support systems are often underdeveloped, effectively addressing anxiety in HNC patients poses a significant challenge.

Despite the significant impact of thermoplastic mask-induced anxiety, little is known about the extent and scope of this challenge among HNC patients managed with radiotherapy in limited-resource settings. Reliable data on effective coping mechanisms used by HNC patients in

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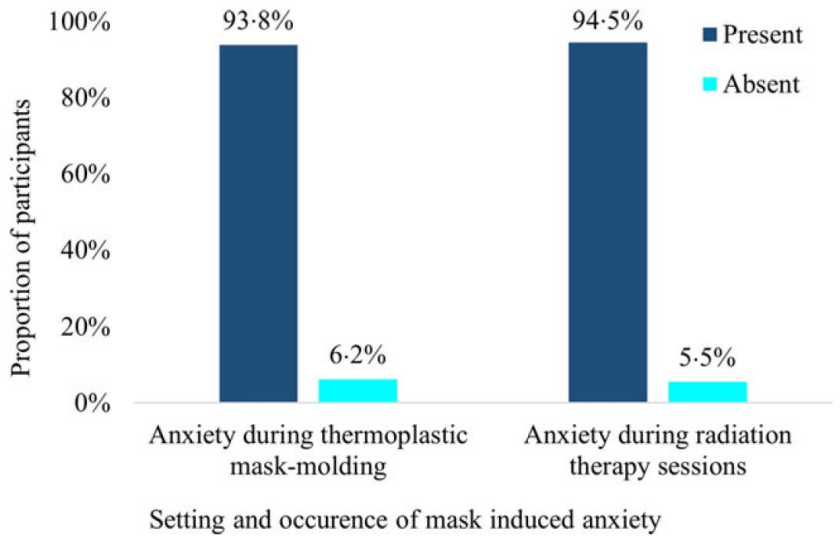
- Quantitative cross-sectional study of 145 patients that determined the prevalence and severity of thermoplastic mask-induced anxiety.
- There was a high prevalence of anxiety during the mask-making process as well as during radiation treatment, 93·8% (n = 136) and 94·5% (n = 137), respectively.
- The high prevalence of thermoplastic mask-induced anxiety highlights a critical aspect of HNC patient care



Meta Analysis of Comparisons Between Full, Open-Face, and No Mask

Journal of Radiotherapy in Practice

cambridge.org/jrp

A systematic review of open face versus mask less surface guided radiotherapy for patients undergoing radiotherapy for head, neck and brain tumours

Megan Sharkey and Pete Bridge

School of Allied Health Professions and Nursing, University of Liverpool, Liverpool, UK

Literature Review

Cite this article: Sharkey M and Bridge P. (2025) A systematic review of open face versus mask less surface guided radiotherapy for patients undergoing radiotherapy for head, neck and brain tumours. *Journal of Radiotherapy in Practice*. **24**(e15), 1–8. doi: 10.1017/S1460396925000111

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Keywords:
head and neck; maskless; open masks; radiotherapy; SGRT; systematic review

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Abstract

Introduction: Accurate delivery of radiotherapy to head, neck and brain cancer relies on the use of sophisticated immobilisation devices, usually using a restrictive thermoplastic mask. These masks can cause anxiety and can make treatment difficult for many patients. Open-face or maskless techniques are alternatives which can improve the patient experience. This systematic review aimed to compare the effectiveness of open-face (OF) masks and maskless surface guided radiotherapy (SGRT) with conventional masks.
Method: Primary research papers from the last 10 years were gathered from Scopus, PUBMED, Web of Science and OVID databases. Quantitative data reporting interfractional set-up errors and intrafractional patient motion were extracted from included studies and subjected to descriptive statistical analysis. Additional qualitative data relating to patient tolerance were also extracted to inform discussion.
Results: Ten studies were identified for inclusion. The data identified that OF masks can reproduce patient set-up with an accuracy of <2 mm and <1° and can restrict movement to <1 mm and 0·4°, while maskless SGRT can achieve accuracy to within 0·05 mm and 0·1°.
Conclusion: This review indicates comparable reduction of intrafractional motion between conventional masks, Open-Face masks and maskless SGRT techniques. More research is needed into the impact of maskless SGRT techniques on translational and rotational motions compared to traditional masks.

Introduction

The proximity of target volumes to critical structures is often a dose limiting factor for head, neck and brain cancer (HNBC) radiotherapy[1–7] with several severe toxicities including brainstem necrosis or loss of vision, reported.[6,8–12] The need to increase dose conformity to limit dose to surrounding non-target tissues for these patient groups is well recognised.[1–6,9] A key factor underpinning conformal radiotherapy is the need for reproducibility of internal structure positions.[13–17] Successful treatment delivery therefore relies on the use of sophisticated immobilisation devices with patient-specific thermoplastic masks covering the head, face and shoulders being the current standard of care (SoC) in most radiotherapy departments.[18]

While these devices do reproduce set-up position and reduce intrafractional motion, many patients suffer with anxiety and distress related to their use, particularly those with past trauma, mental health struggles, or claustrophobia.[19,20] Nixon et al. report that approximately one quarter of patients experience moderate to severe anxiety attributed to the use of thermoplastic masks.[19] Fu evidence suggests that while mask anxiety significantly reduces throughout the course of radiotherapy for the majority of patients, it remains consistent, or worsens, for 22% and 6% of patients, respectively, and is a significant cause of disruption to HN and brain radiotherapy treatments.[21,22] Patients report the fear of having the face covered and movement restricted as major factors contributing to anxiety.[23]

Recent developments in HNBC immobilisation have explored open-face (OF) masks and maskless surface guided radiotherapy (SGRT) techniques as ways to immobilise patients while reducing anxiety and feelings of claustrophobia.[24] A search of the literature has failed to identify any large scale randomised controlled trials (RCT)s that compared the effectiveness of these novel immobilisation techniques to that of the current SoC. The aim of this study, therefore, was to review the existing evidence within this field to compare the reported effectiveness of the immobilisation tools at reducing translational and rotational errors.

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- Meta analysis of primary research papers published in the last 10 years were gathered from Scopus, PUBMED, Web of Science and OVID databases.
- Ten studies were identified for inclusion
- The review indicated comparable reduction of intrafraction motion between conventional masks, Open-Face masks and maskless SGRT techniques.

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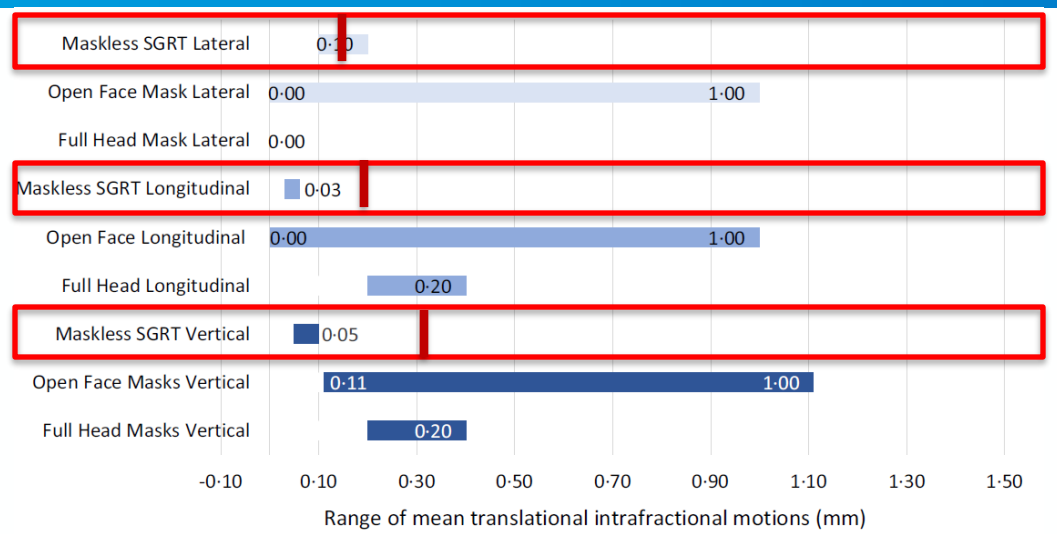
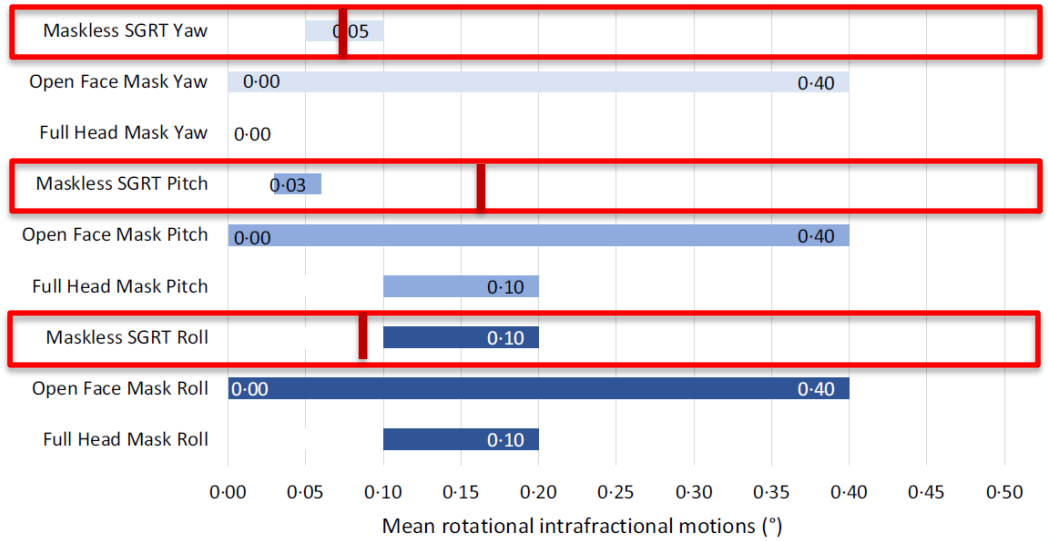
Meta Analysis of Comparisons Between Full, Open-Face, and No Mask



2019 AdventHealth – Parker (n=326)



- Comparing Full Mask (FM), Open-Face (OF) Masks, and Maskless setups.
- Findings suggested the current Standard of Care (SoC) Full Head (FH) masks, Open Face (OF) masks, and maskless SGRT can allow for comparable set-up accuracy and intrafraction motion restriction.
- Radiotherapy centers may consider transitioning towards the use of novel immobilization methods to improve patient comfort.
- Evidence is currently limited regarding maskless SGRT, but early reports show positive results and suggest it may be a safe and effective method of immobilization.
- **Additional studies are needed**

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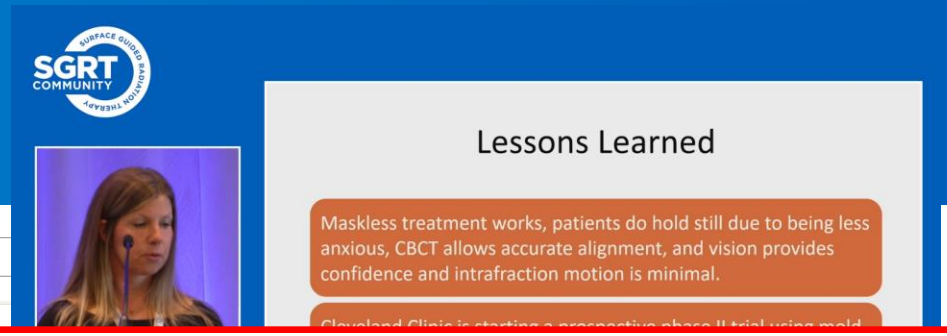
Additional Institutional Studies



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*Correspon

PMCID: PMC1091

From: [redacted]
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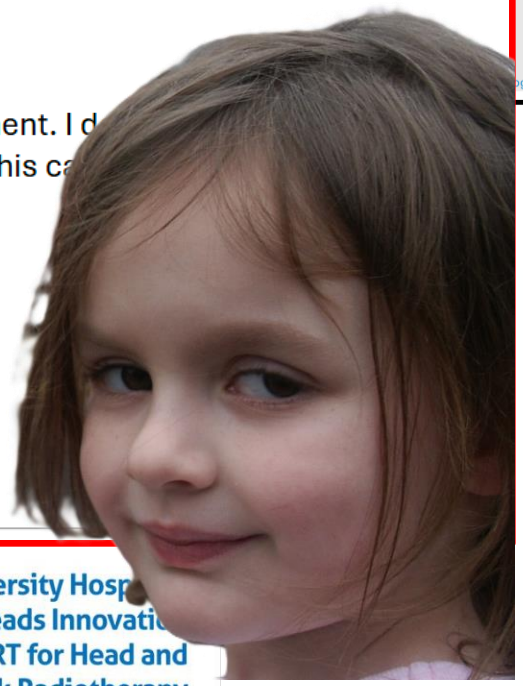
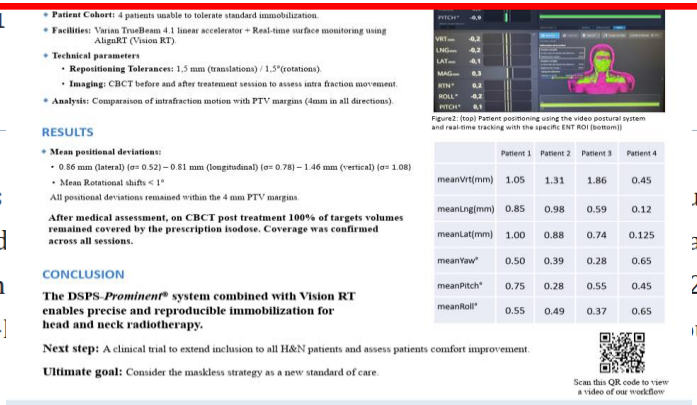


Highlights

- Maskless
- SGRT and
- SGRT can
- The CTV-


- **Patient Cohort:** 4 patients unable to tolerate standard immobilization.
- **Facilities:** Varian TrueBeam 4.1 linear accelerator + Real-time surface monitoring using AlignRT (Vision RT).
- **Technical parameters**
  - **Repositioning Tolerances:** 1,5 mm (translations) / 1,5°(rotations).
  - **Imaging:** CBCT before and after treatement session to assess intra fraction movement.
- **Analysis:** Comparaison of intrafraction motion with PTV margins (4mm in all directions).

RESULTS

- **Mean positional deviations:**
  - 0.86 mm (lateral) (σ= 0.52) – 0.81 mm (longitudinal) (σ= 0.78) – 1.46 mm (vertical) (σ= 1.08)
  - Mean Rotational shifts < 1°

All positional deviations remained within the 4 mm PTV margins.

After medical assessment, on CBCT post treatment 100% of targets volumes remained covered by the prescription isodose. Coverage was confirmed across all sessions.

CONCLUSION

The DSPS-*Prominent*® system combined with Vision RT enables precise and reproducible immobilization for head and neck radiotherapy.

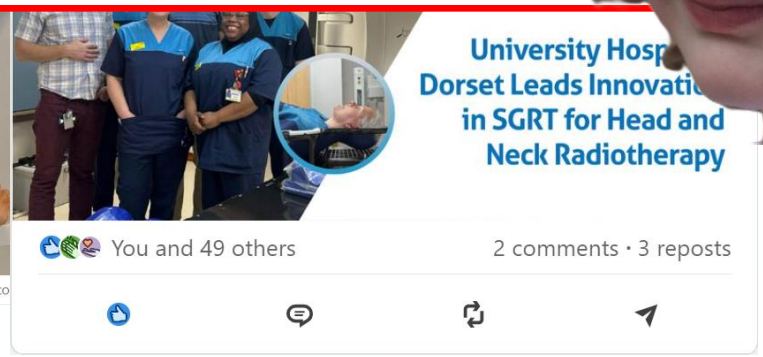
Next step: A clinical trial to extend inclusion to all H&N patients and assess patients comfort improvement.

Ultimate goal: Consider the maskless strategy as a new standard of care.

Figure2: (top) Patient positioning using the video postural system and real-time tracking with the specific ENT ROI (bottom))

	Patient 1	Patient 2	Patient 3	Patient 4
meanVrt(mm)	1.05	1.31	1.86	0.45
meanLng(mm)	0.85	0.98	0.59	0.12
meanLat(mm)	1.00	0.88	0.74	0.125
meanYaw°	0.50	0.39	0.28	0.65
meanPitch°	0.75	0.28	0.55	0.45
meanRoll°	0.55	0.49	0.37	0.65

Scan this QR code to view a video of our workflow



…urately
…ation.
…2 mm.
…ut mask is identical.

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Powerful Planning Insights – Noncoplanar Planning

RADIATION ONCOLOGY PHYSICS

WILEY

Dosimetric comparison of coplanar and noncoplanar beam arrangements for radiotherapy of patients with lung cancer: A meta-analysis

Min Ma | Wenting Ren | Minghui Li | Chuanmeng Niu | Jianrong Dai

National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

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Telephone: 86-10-8778-8893

Funding information
National Natural Science Foundation of China (NSFC), Grant/Award Number: 11875320

Abstract

Purpose: Radiotherapy plays an important role in the treatment of lung cancer, and both coplanar beam arrangements (CBA) and noncoplanar beam arrangements (NCB… the ques-
tion v…
Meth… ence, and
the C… ng: ((non-
copla… or ("lung
tumo… py")). The
inclu… nd funnel
plots … symmetry
tests …
Resul… nd treat-
ment … arget vol-
umes … x (GI) had
no st… he whole
lung … in NCBA
plans … lung, the
maxim… hibited no
signif… pared.
Concl… significant
advantages in reducing V20 of the whole lung and max dose of spinal cord.

KEY WORDS
coplanar beam arrangement, lung cancer, meta-analysis, noncoplanar

Dosimetric Comparision of Coplanar versus Noncoplanar Volumetric Modulated Arc Therapy for Treatment of Bilateral Breast Cancers

Avinav Bharati, Satyajeet Rath[1], Rohini Khurana[2], Madhup Rastogi[2], Susama R. Mandal[3], Ajeet Kumar Gandhi[2], Rahat Hadi[2], Anoop K. Srivastava[2], Surendra Prasad Mishra[2]

Department of Radiation Oncology, NCI-AIIMS, New Delhi, [1]Department of Radiation Oncology, Gujarat Cancer and Research Institute, Ahmedabad, [2]Department of Radiation Oncology, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, [3]Department of Radiation Oncology, AIIMS, New Delhi, India

Abstract

Introduction: The purpose of this stud… lated arc therapy (VMAT) treatment
plans using coplanar and noncoplanar be… rgan at risk sparing and target volume
coverage. The hypothesis was to test wh… livery to critical organs such as heart
and lung, which will result in lesser ove… reated at our hospital were retrieved.
Computed tomography simulation data … l the parameters were compared with
standard VMAT coplanar plans. Contou… s. Forty-five Gray in 25 fractions was
planned followed by 10 Gy in five fractio… ence in planning target volume (PTV)
coverage was found for the right breast/… total PTV ($P = 0.929$). Noncoplanar
beams resulted in better cardiac sparing … $3.80 \pm 0.28 - 7.28 \pm 0.33$, $P < 0.001$).
The D_{mean}, V_{20} and V_{30} values for total l… atistically significant difference. The
average monitor units (MUs) were sim… MU), but the overall treatment time
was higher in noncoplanar plans due t… VMAT plans, the mean conformity
index was slightly better although the … ith noncoplanar beam arrangements
had significant dosimetric advantages i… ith almost equivalent lung doses and
equally good target coverage. Larger st… this data.

Keywords: Bilateral breast cancer, non… re therapy

Received on: 14-03-2023 Review completed on: 19-08-2023 Accepted on: 28-08-2023 **Published on: 18-09-2023**

Noncoplanar VMAT for nasopharyngeal tumors: Plan quality versus treatment time

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(Received 29 August 2014; revised 26 January 2015; accepted for publication 17 February 2015; published 10 April 2015)

Purpose: The authors investigated the potential of optimized noncoplanar irradiation trajectories for volumetric modulated arc therapy (VMAT) treatments of nasopharyngeal patients and studied the trade-off between treatment plan quality and delivery time in radiation therapy.
Methods: For three nas… s for nine different
delivery scenarios using … enarios according
to dose characteristics, … . In particular, the
authors generated the f… equenced, fluence
optimized plan that uses … rections and marks
a theoretical upper limit … 72 coplanar beam
directions as pendant to … coplanar step and
shoot (SnS) plan, (5) a … (6) a noncoplanar
BAO SnS plan, (7) a V… VMAT plan with
an optimized great circl… n with an arbitrary
trajectory around the pa…
Results: VMAT using o… ean and maximum
doses in organs at risk … while the target
coverage remains const… r SnS or VMAT;
however, noncoplanar pl… AT yielded a better
plan quality than the be… plans depended on
the length of the trajecto… stimated to be 6.5
min in average; 1.6 min … han a noncoplanar
SnS plan with comparab…
Conclusions: The authors' study reconfirms the dosimetric benefits of noncoplanar irradiation of nasopharyngeal tumors. Both SnS using optimized noncoplanar beam ensembles and VMAT using an optimized, arbitrary, noncoplanar trajectory enabled dose reductions in organs at risk compared to coplanar SnS and VMAT. Using great circles or simple couch rotations to implement noncoplanar VMAT, however, was not sufficient to yield meaningful improvements in treatment plan quality. The authors estimate that noncoplanar VMAT using arbitrary optimized irradiation trajectories comes at an increased delivery time compared to coplanar VMAT yet at a decreased delivery time compared to noncoplanar SnS IMRT. © *2015 American Association of Physicists in Medicine.*

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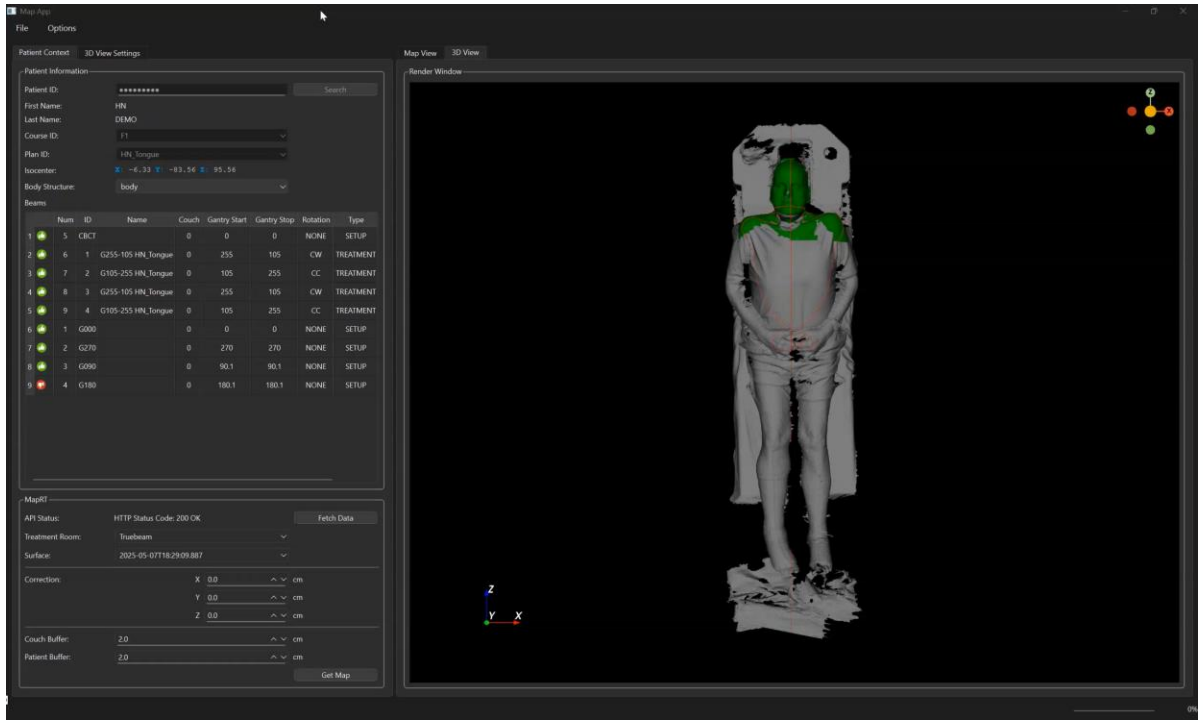
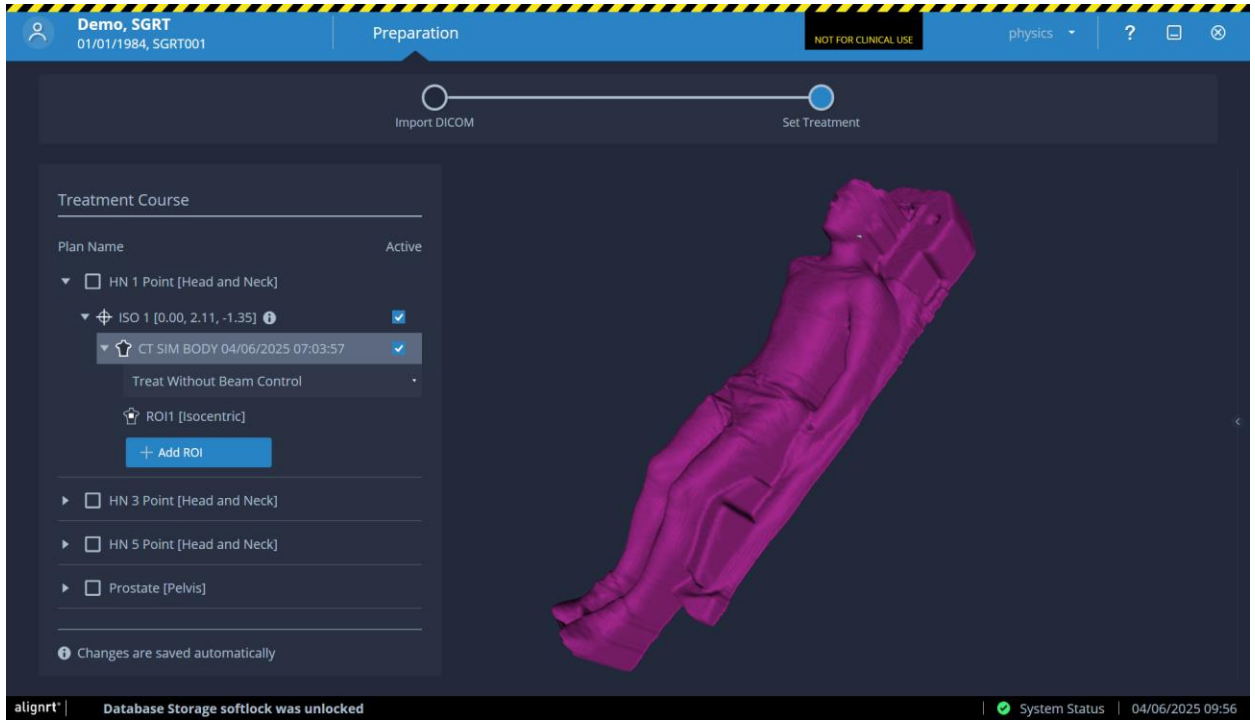
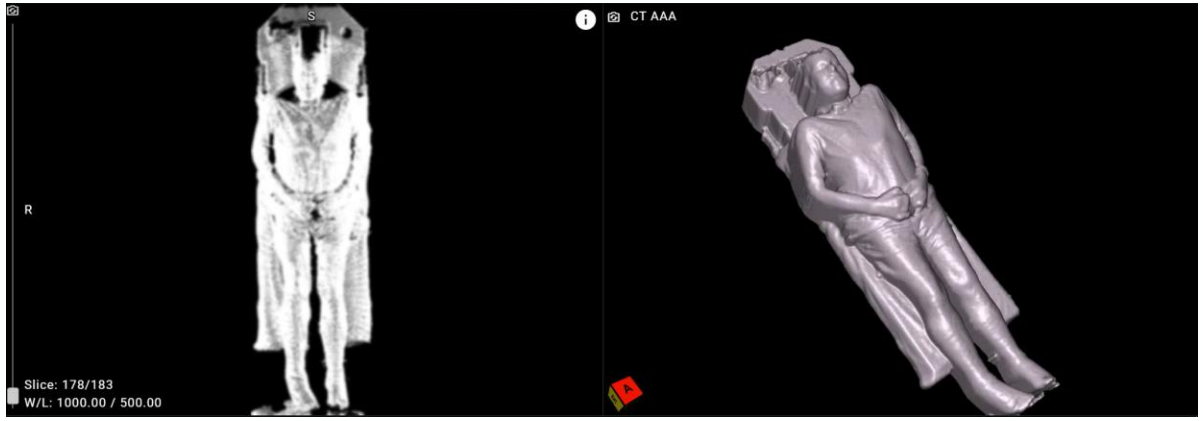
Powerful Pre-Planning Treatment Validation– Noncoplanar Planning







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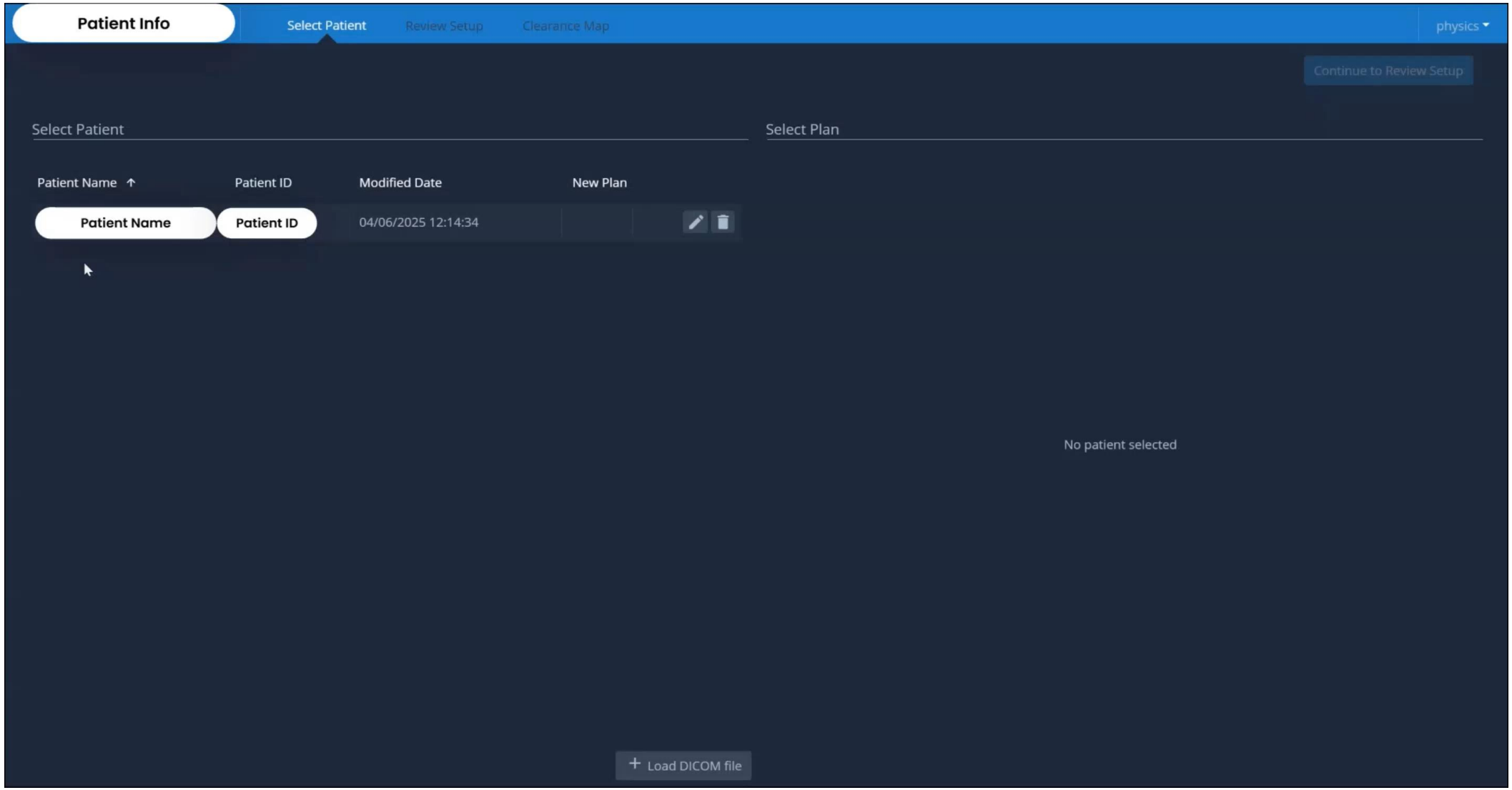
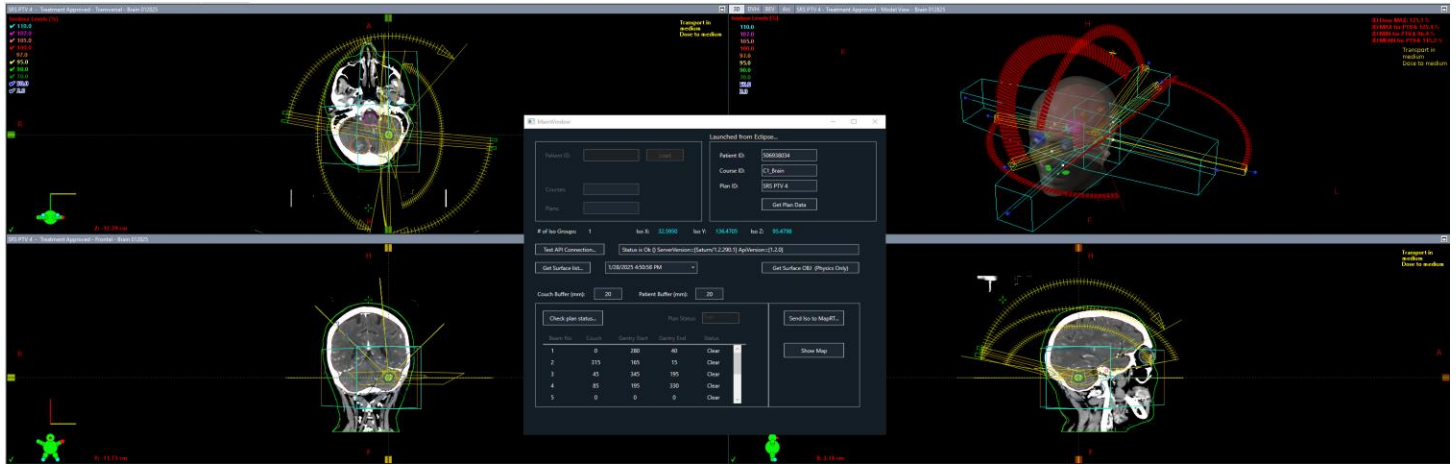
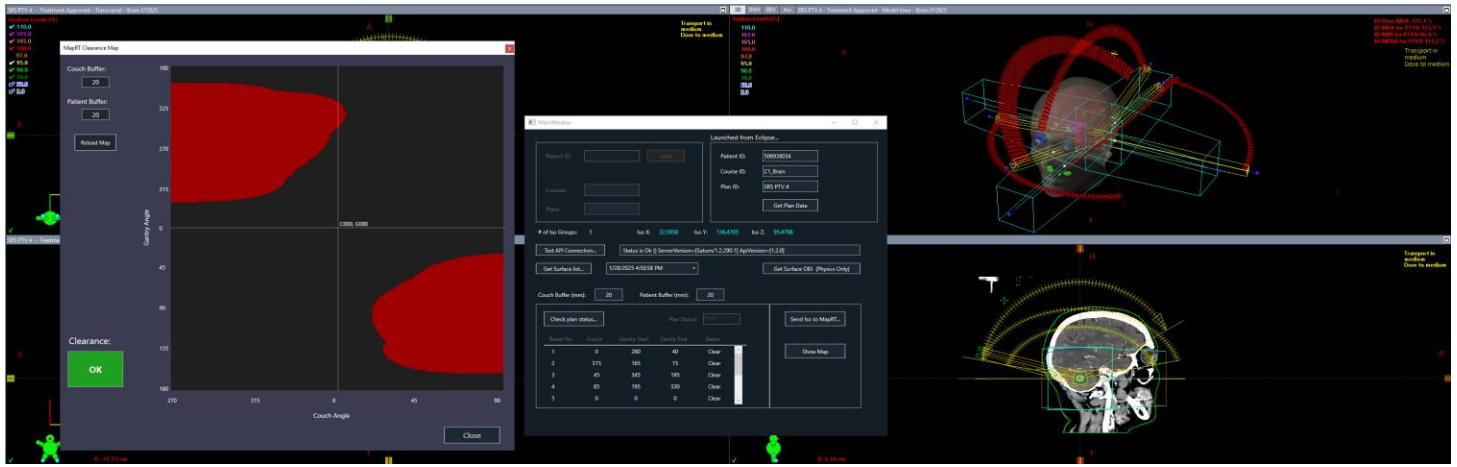
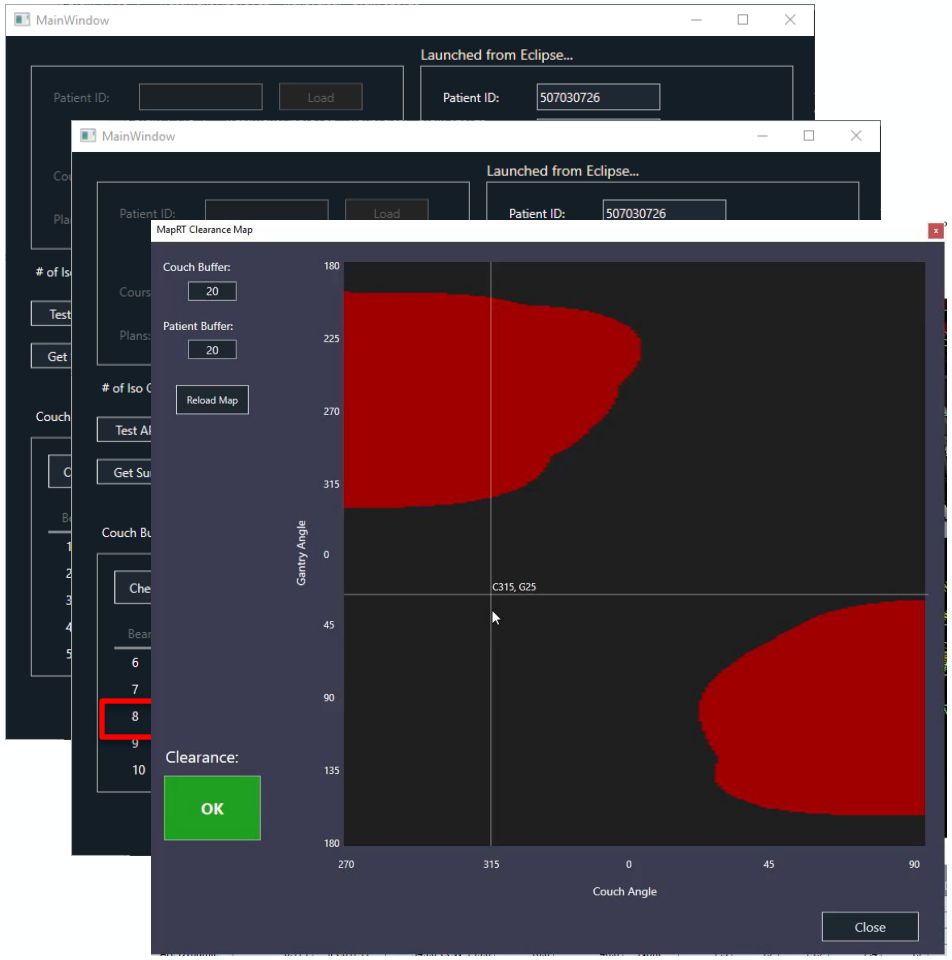
Powerful Post Planning Insights – Noncoplanar Planning



Rapid In-Plan Validation Through ESAPI Integration (C#)







- Leveraging the API allows the user to rapidly evaluate the plan context being worked on while planning.
- The API also allow the user to generate a collision map that can be dynamically explored for alternate solutions for failing fields reducing planning time by more than 30 minutes.

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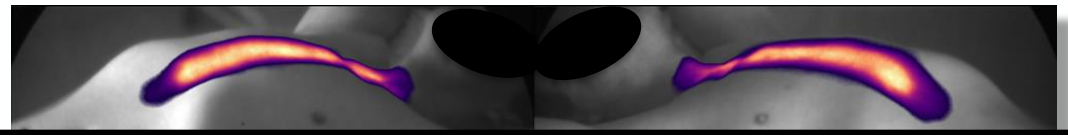
Visual Verification of Delivery



› Pract Radiat Oncol. 2025 Nov 4:S1879-8500(25)00259-0. doi: 10.1016/j.prro.2025.09.004.
Online ahead of print.

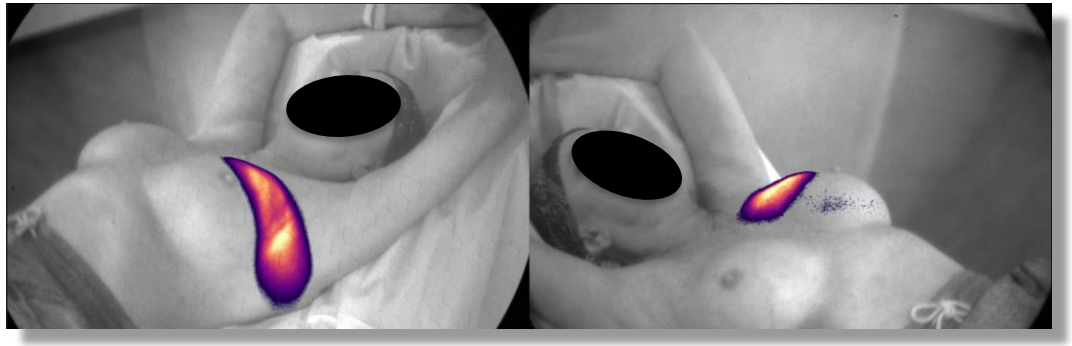
A Review of Cherenkov Imaging for Real-Time Verification in Radiation Therapy

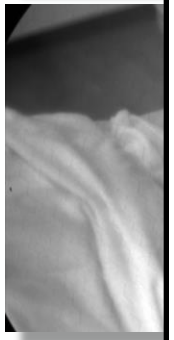
Adi Robinson [1], Michael Tallhamer [2], Florian Stieler [3]

Affiliations + expand

PMID: 41197798 DOI: 10.1016/j.prro.2025.09.004

Free article





Advances in Radiation Oncology (2025) 10, 101798

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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

Adi Robinson, PhD,[a,*] Michael Tallhamer, MS,[b] and Amber Orman, MD[a]

[a]Department of Radiation Oncology, AdventHealth Celebration, Celebration, Florida; and [b]Department of Radiation Oncology, AdventHealth Parker, Parker, Colorado

Received 10 February 2025; accepted 21 April 2025

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 the safety and precision of VMAT by increasing the distance between the heart and chest wall, significantly reducing cardiac dose. This approach is particularly beneficial for patients with left-sided breast cancer, because it mitigates long-term risks of radiation-induced heart and lung toxicity.[3,4] Surface-guided radiation therapy (SGRT) has been shown to accurately reproduce the DIBH position, providing a valuable technique for setup verification.[4,5]

Despite these advancements, VMAT can underdose the skin and superficial areas of the chest wall without specific modifications. This shortfall poses a risk to treatment efficacy, especially in cases where skin and surface structures are part of the clinical target volume. Although locoregional skin recurrence is rare, recurrence at the skin margin in these patients can be related to the under dosing of the skin and should be monitored and/or augmented when found to be inadequate.[6] The "skin flash" technique, which extends the dose distribution beyond the target's surface, addresses this challenge by ensuring better superficial coverage.[7-9]

Cherenkov imaging has emerged as a valuable tool for real-time dose visualization, enabling clinicians to assess dose coverage directly during treatment. By capturing Cherenkov light emitted during radiation delivery, this technology can identify underdosed areas with precision, facilitating timely adjustments.[10-12]

This case study demonstrates the integration of VMAT, D
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Method

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involving

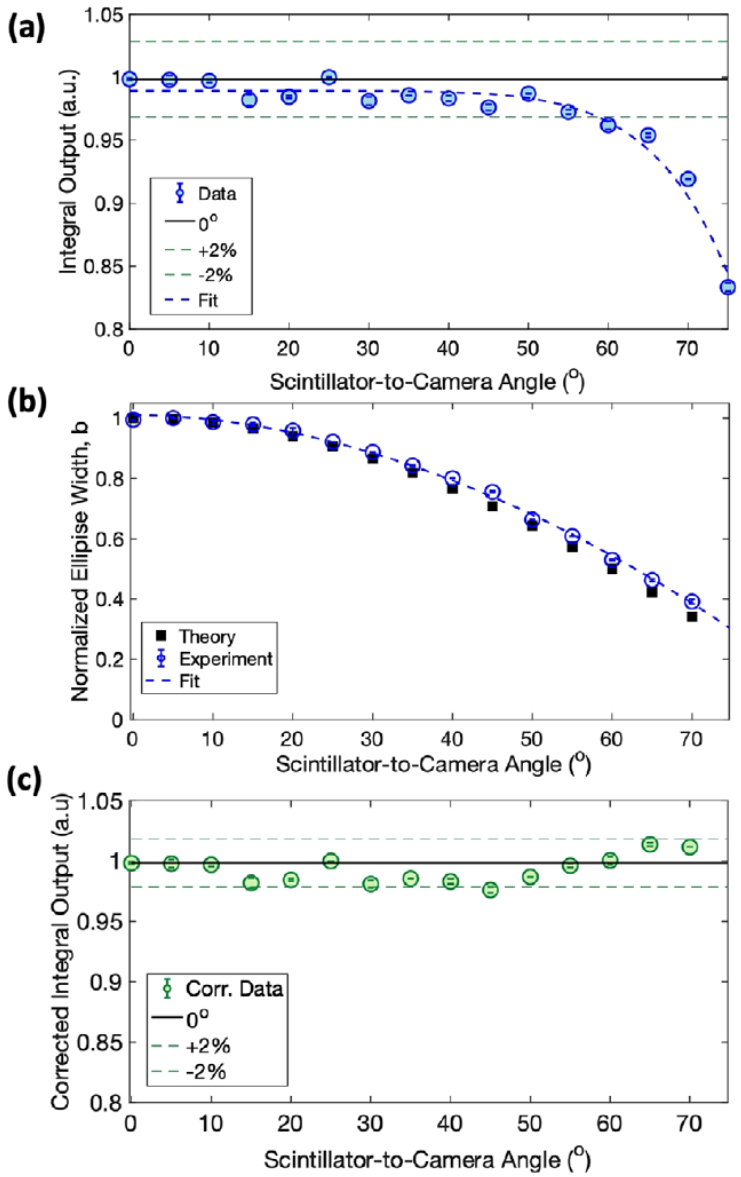
Sources of support: This work had no specific funding.

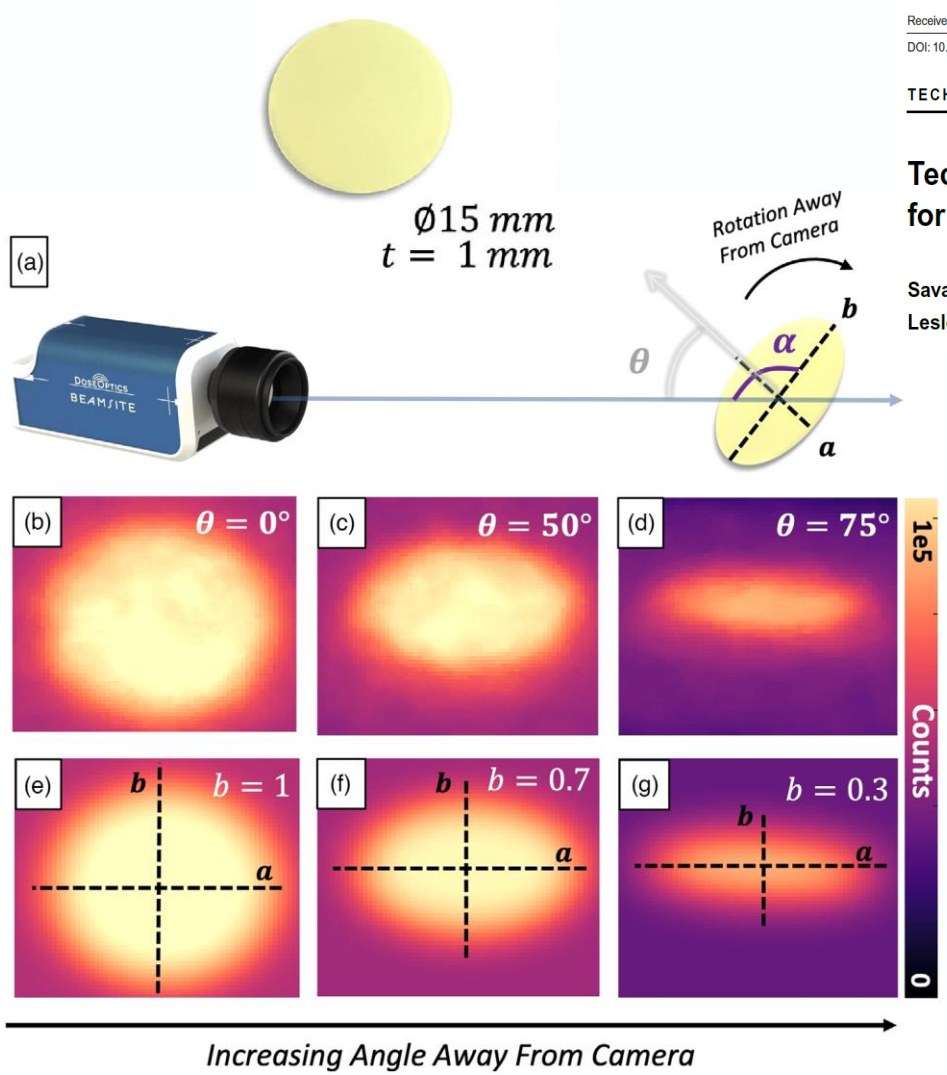
Research data are stored in an institutional repository and will be shared upon request to the corresponding author.

*Corresponding author: Adi Robinson, PhD; Email: adi.robinson@adventhealth.com

https://doi.org/10.1016/j.adro.2025.101798

Potential Quantitative Applications - In Vivo Dosimetry





Received: 26 October 2023 | Revised: 7 March 2024 | Accepted: 26 March 2024
DOI: 10.1002/mp.17071
TECHNICAL NOTE
MEDICAL PHYSICS

Technical note: Visual, rapid, scintillation point dosimetry for in vivo MV photon beam radiotherapy treatments

Savannah M. Decker[1] | Petr Bruza[1] | Rongxiao Zhang[2] | Benjamin B. Williams[3] | Lesley A. Jarvis[2,3] | Brian W. Pogue[1] | David J. Gladstone[1,2,3]

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CASE STUDY: Identifying the Impact of Daily Positional Variance

Identify interfraction changes in both patient position and immobilization…

- 67 Year Old Female undergoing 3DCRT for Prone Breast
- Visual verification of treatment dose initiated from fraction 1 of treatment
- Fraction 3 - Exit dose through arm noted by physics team during daily review
  - Investigation showed prone pad indexing places slightly inferior resulting in wrong elbow position
  - Decreased arm extension resulted in beam exiting through upper arm.

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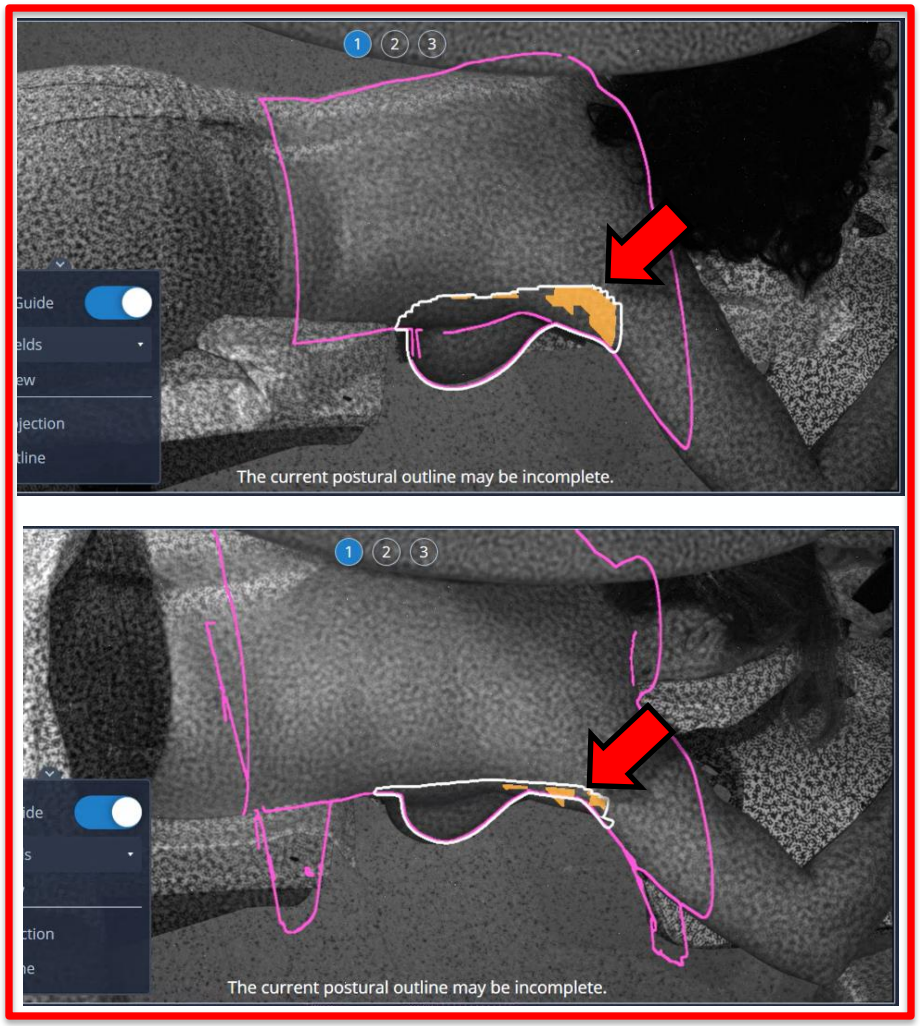
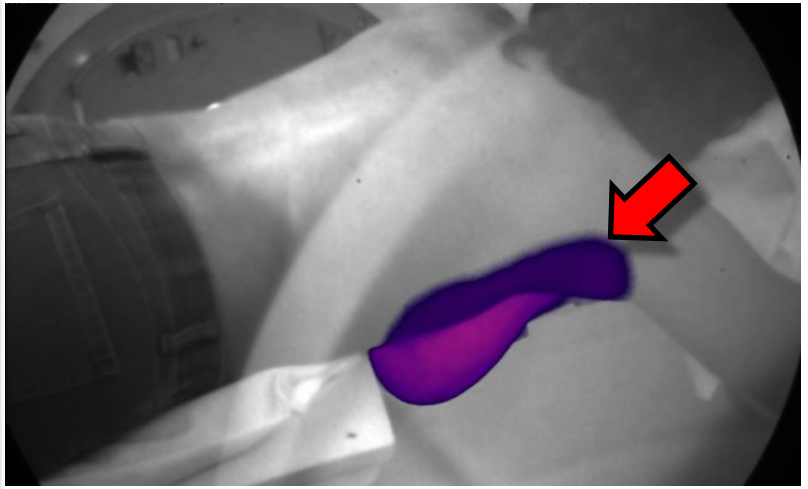
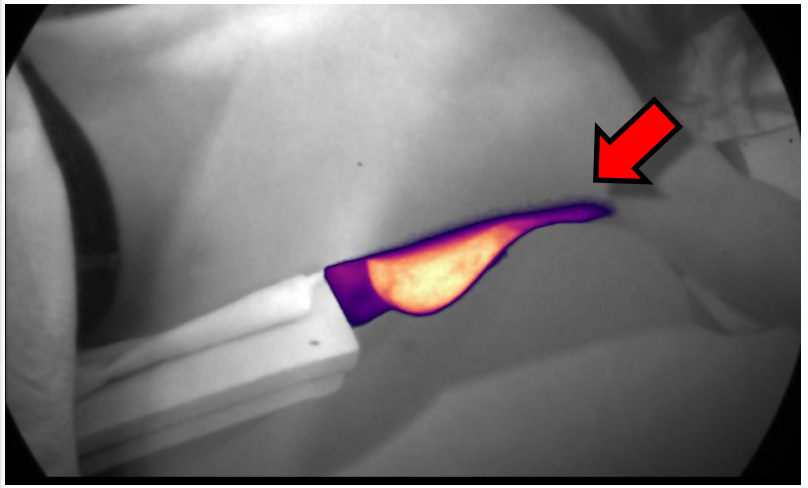
CASE STUDY: Beam Guide for Identifying the Impact of Positional Variance

Identify the impact of patient position on expected dose delivery…







- Planned Exposure?
  - Does the patient have entrance and exit dose exposure to posterior lateral chest wall and upper arm to address coverage concerns on breast and nodal regions or is this a setup error?
- Planned Exposure?
  - Are we limiting the entrance and exit dose exposure to posterior lateral chest wall and upper arm or is this a setup issue?

Beam Guide™

dosert™ Powered by BeamSite®

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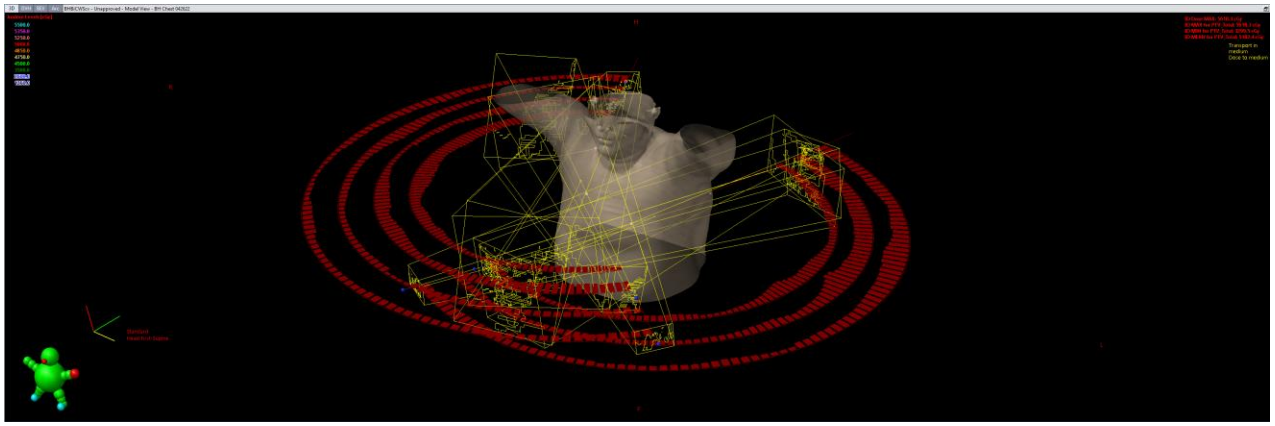
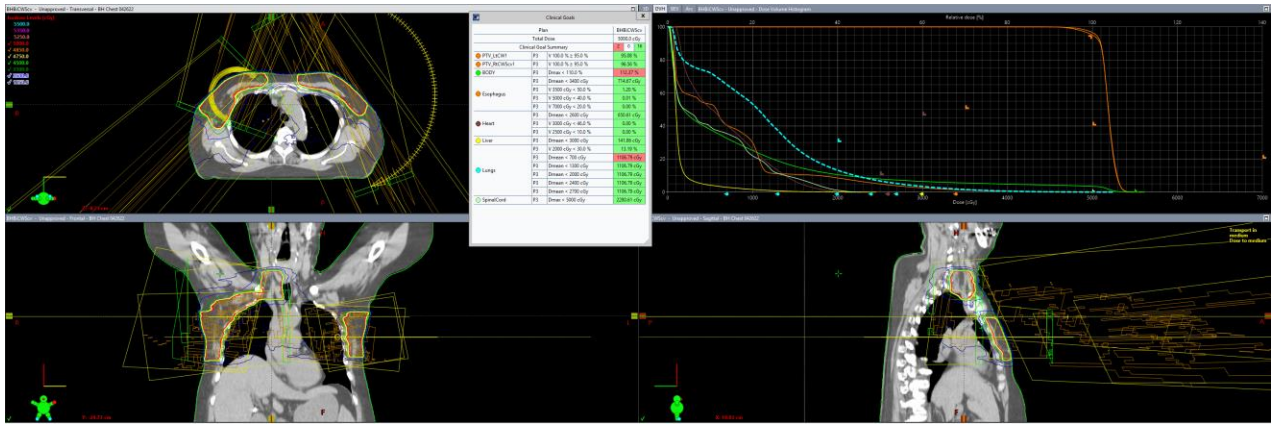
Beam Guide ™ is 510K Pending

Complete documentation of complex cases within the OIS

Planning Challenges

- Overlapping dose volumes resulting in 110Gy regions of dose
    - Required optimization of plan around previous dose and strategy to account for dose from both sides (1 iso vs 2 iso)
- Limited ability to travel requiring treatment locally on Varian Edge linac (SGRT, HDMLC, PerfectPitch couch…etc.)
    - Limited MLC field sizes





Treatment Challenges

- Varian Edge won't treat 2 isocenters in the same plan **(2 isocenter synchronously optimized plan gives best result)**
    - **Uniformity of dose is dependent on both isocenter deliveries**
- Uncertainty needed for dose uniformity and overlap avoidance is approx. **3mm and 1.5 degrees** in all directions **(need DIBH CBCT)**
- 6DoF setups are non-transferable between isocenters with Varian PerfectPitch couch.
- Reference surfaces are non-transferable between treatment plans
- Bolus required over bilateral chest walls obstructs the surface of the patient

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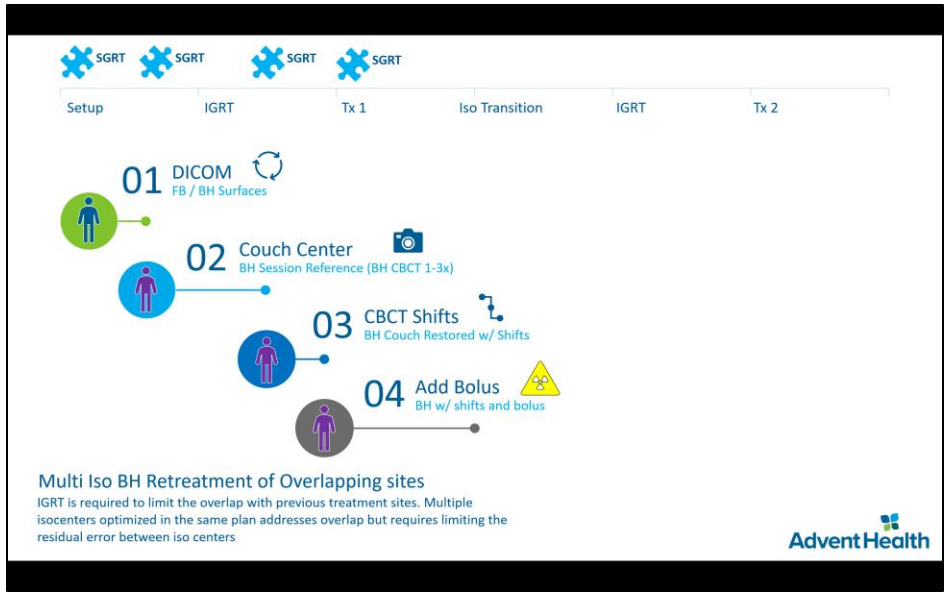
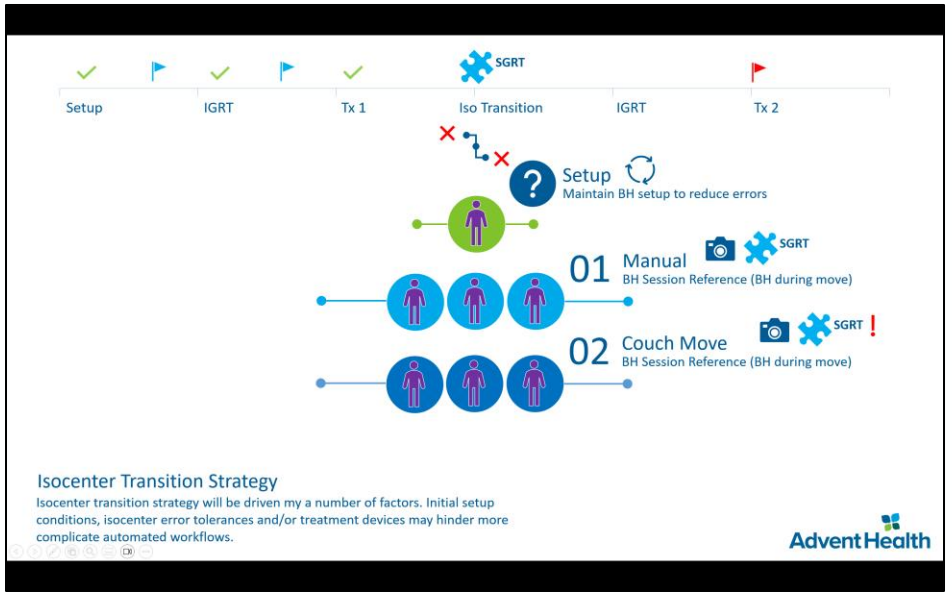
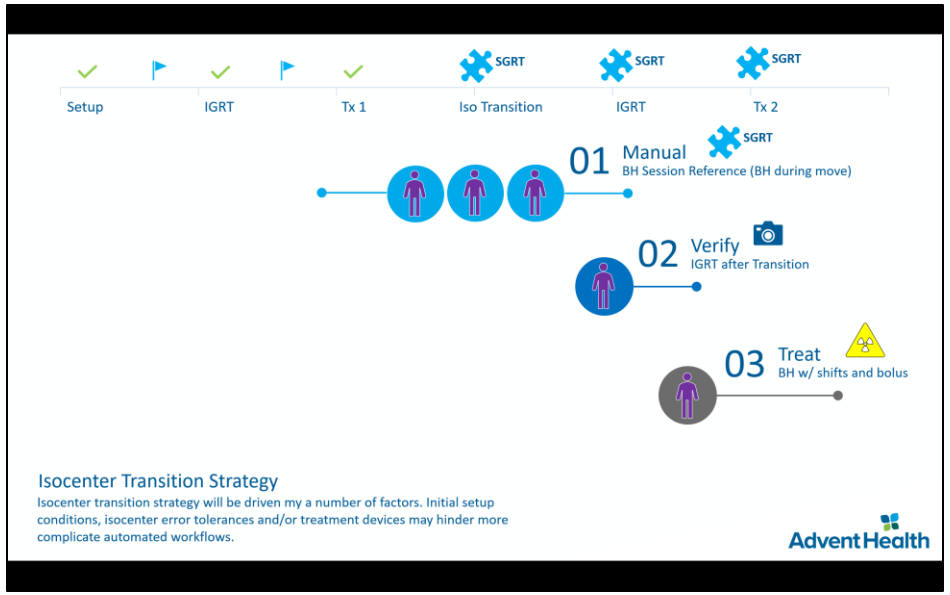
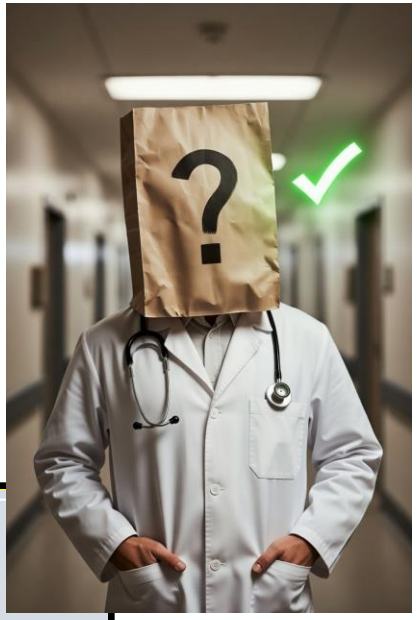
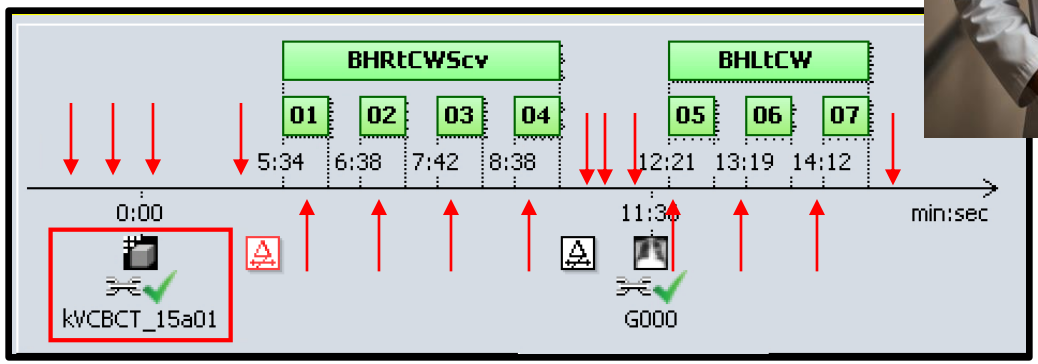
Complete documentation of complex cases within the OIS











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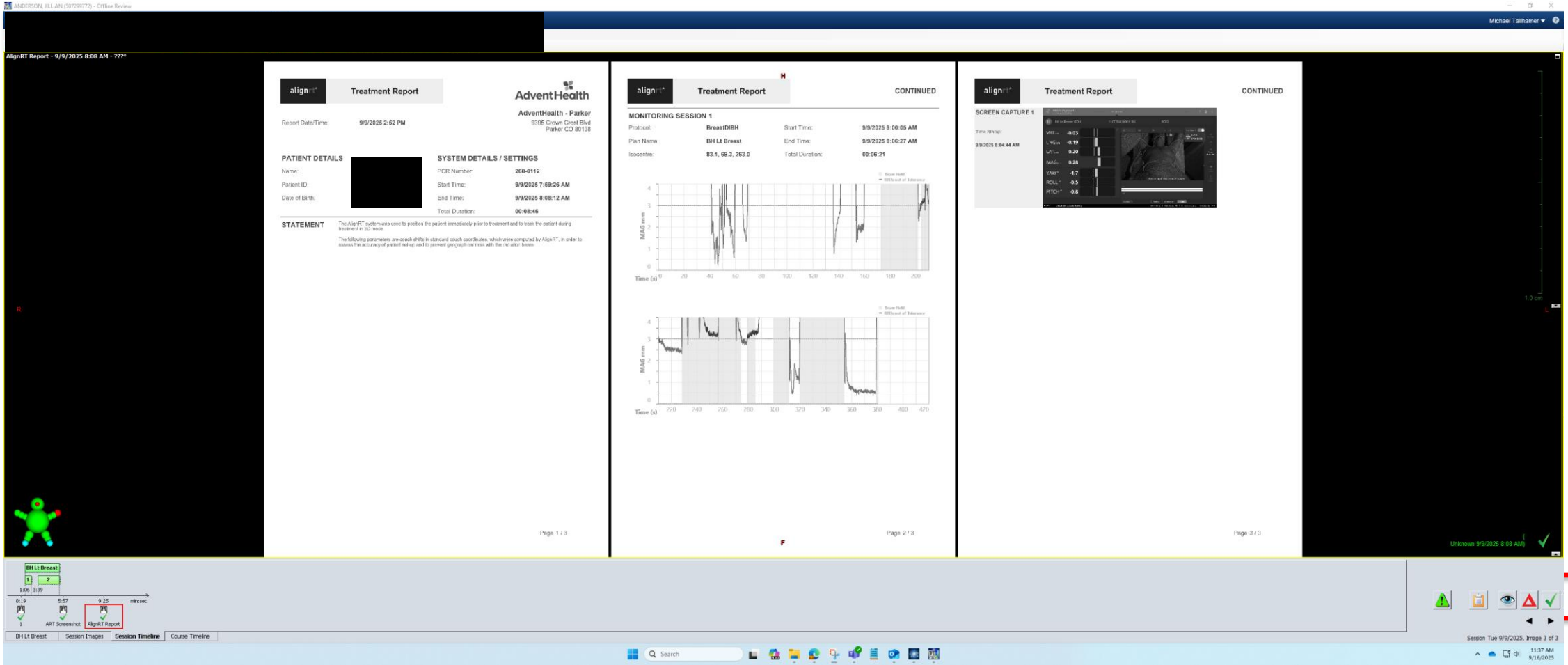
OIS Module: Standardize Your Documentation and Approach

The OIS Module allows clinicians to keep their standard, well established, IGRT process and promotes SGRT documentation so that the supervision requirements for SGRT fall within those same standard workflows.



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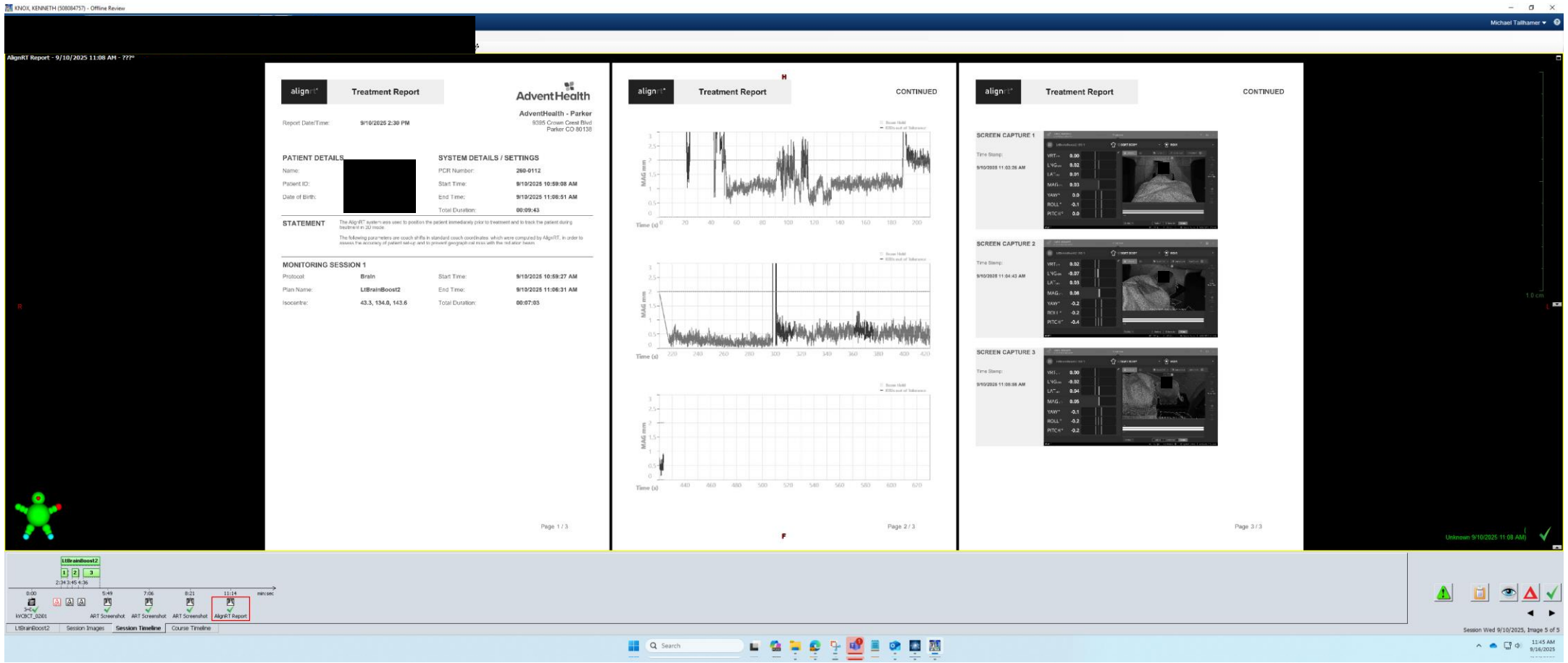


GREAT SCOTT!
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Osteoarthritis Workflows Reimagined

ALAR for non-malignant disease sites

We can replace a standard CT sim with a completely optical sim for some indications.

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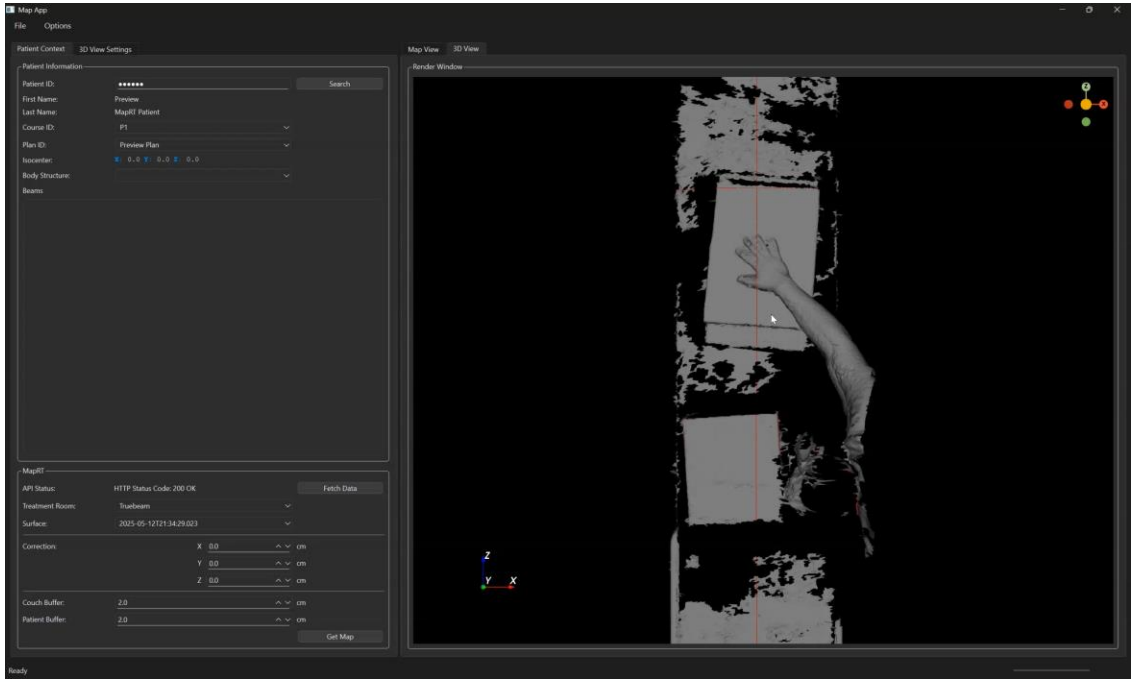
Osteoarthritis Workflows Reimagined



https://github.com/tallhamer/MapApp

We can replace a standard CT sim with a completely optical sim for some indications.

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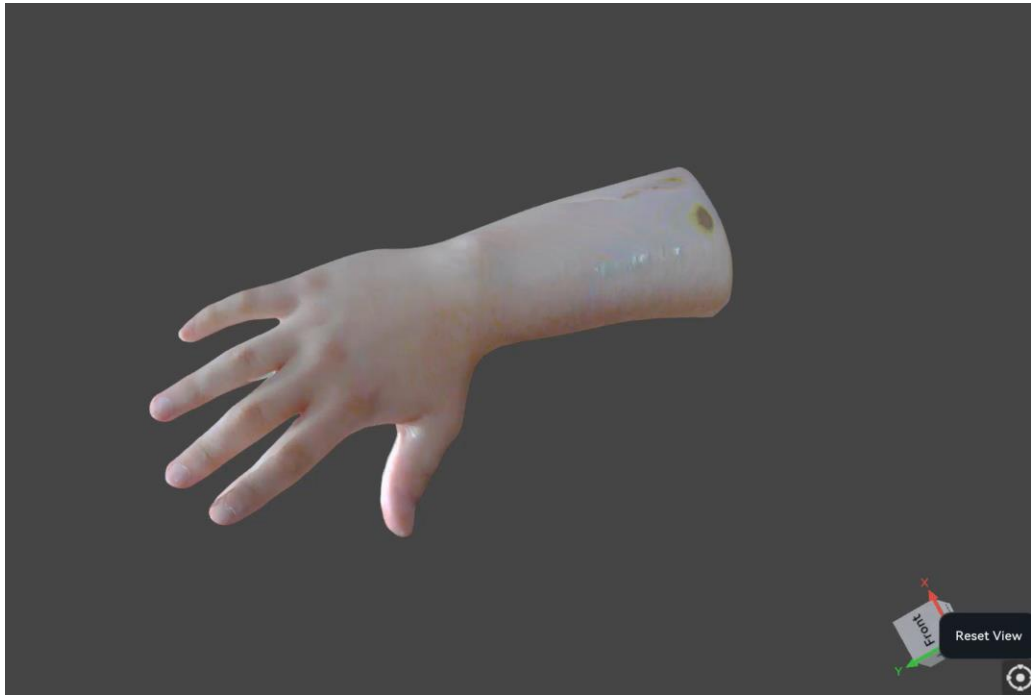
Osteoarthritis Workflows Reimagined



We can then convert an optical sim surface to a synthetic planning CT.

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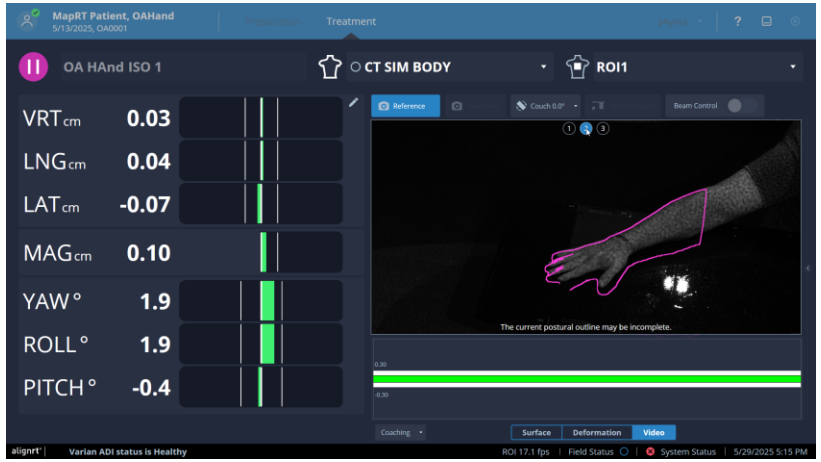
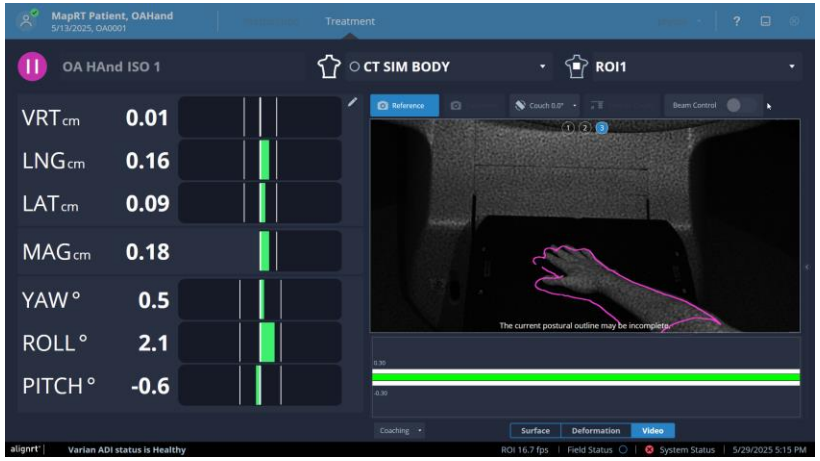
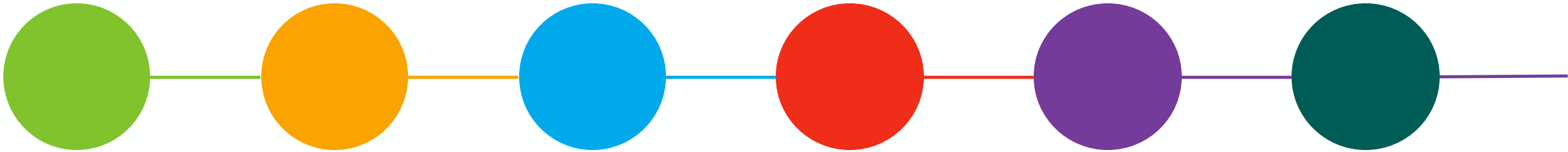
Osteoarthritis Workflows Reimagined







The sim surface then becomes the treatment setup surface.

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Osteoarthritis Workflows Reimagined

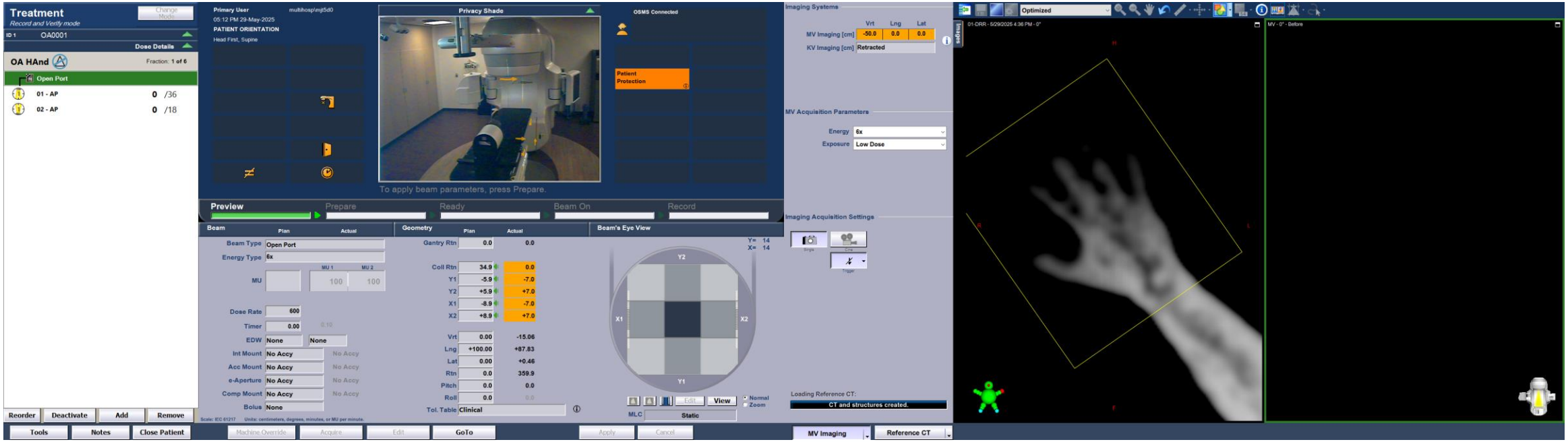

Image and deliver the treatment as planned using the synthetic CT.

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Osteoarthritis Workflows Reimagined

Visualize the dose delivery using Cherenkov imaging.

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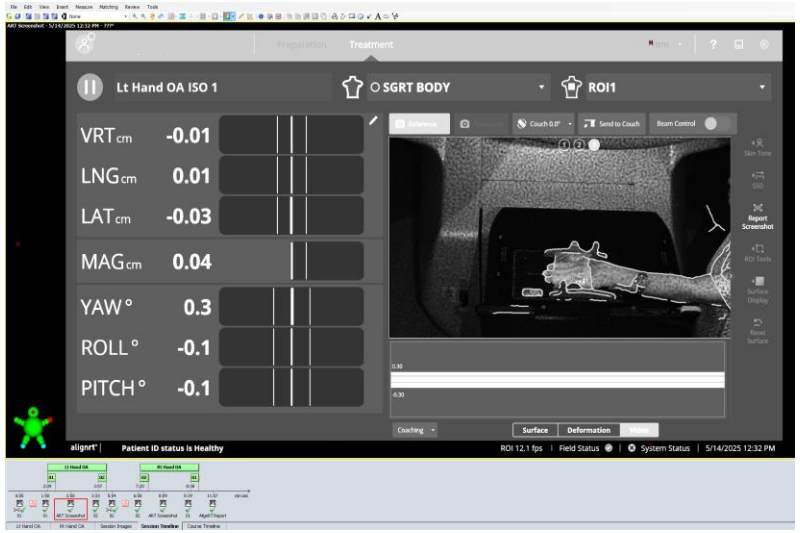
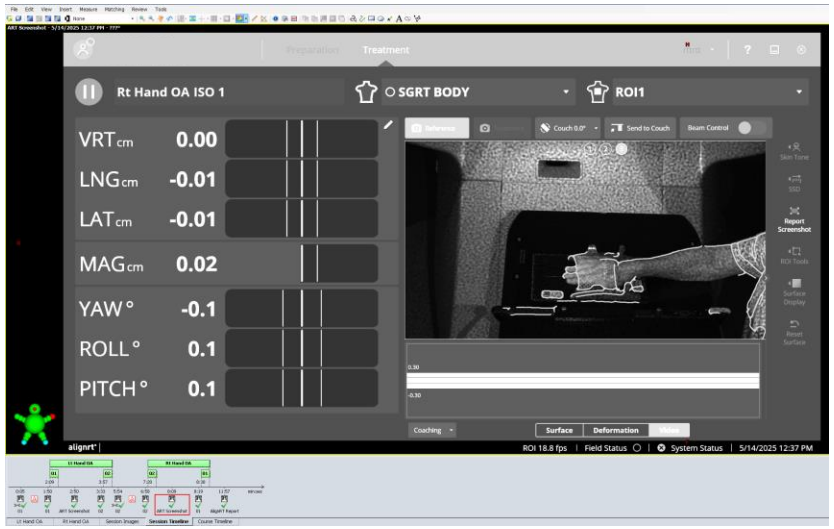
Osteoarthritis Workflows Reimagined





Document and review the treatment in the OIS (Offline Review) just like any other treatment.

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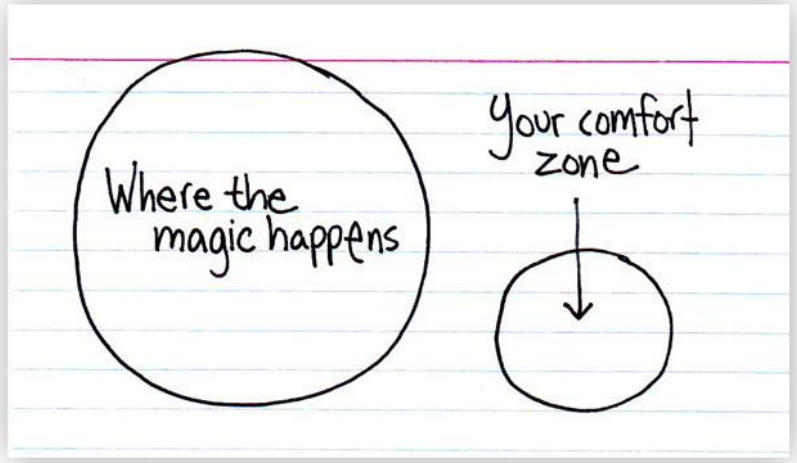
Summary

- We have reviewed historical cases where boundaries may have been pushed with maskless H&N cases and where we are now.

"*Good company in a journey makes the way seem shorter.*" – **Izaak Walton**

- We looked at some present "opportunities" to expand the utility of existing SGRT technologies by "nudging" a boundary or two.



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Thank You!

- Special Thanks to the AdventHealth Physics team.

- Special Thanks to to all of you who push the boundaries and bring hope to so many patients.

Extending the Healing Ministry of Christ