

Experience with Clinical Implementation of the Halcyon: Lessons Learned for the Practicing Physicist

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Topics Covered

- ▶ SBRT
 - ▶ Sites treated
 - ▶ Sites avoided
 - ▶ SBRT doses per site
- ▶ Difficult 3D cases
 - ▶ Breast Planning (discussed by Brian)
 - ▶ Large Fields
 - ▶ Femurs, etc.
 - ▶ HO Bones
- ▶ Work arounds
 - ▶ Two CBCT options
 - ▶ Flexibility with part replacement
 - ▶ Replans necessary

SBRT

- ▶ First Steps
 - ▶ Ensure machine is within guidelines
- ▶ Small field output factors, PDDs, absolute doses measured and verified
- ▶ End to End test completed and within 1mm (must be <1.5mm)
- ▶ WL performed and within 1mm

SBRT

- ▶ Most Sites
 - ▶ Lung
 - ▶ Bone
 - ▶ Abdomen
- ▶ Potentially Avoid
 - ▶ Vertebral bodies
 - ▶ When PTV surrounds cord
 - ▶ Lung volumes that could benefit from gating

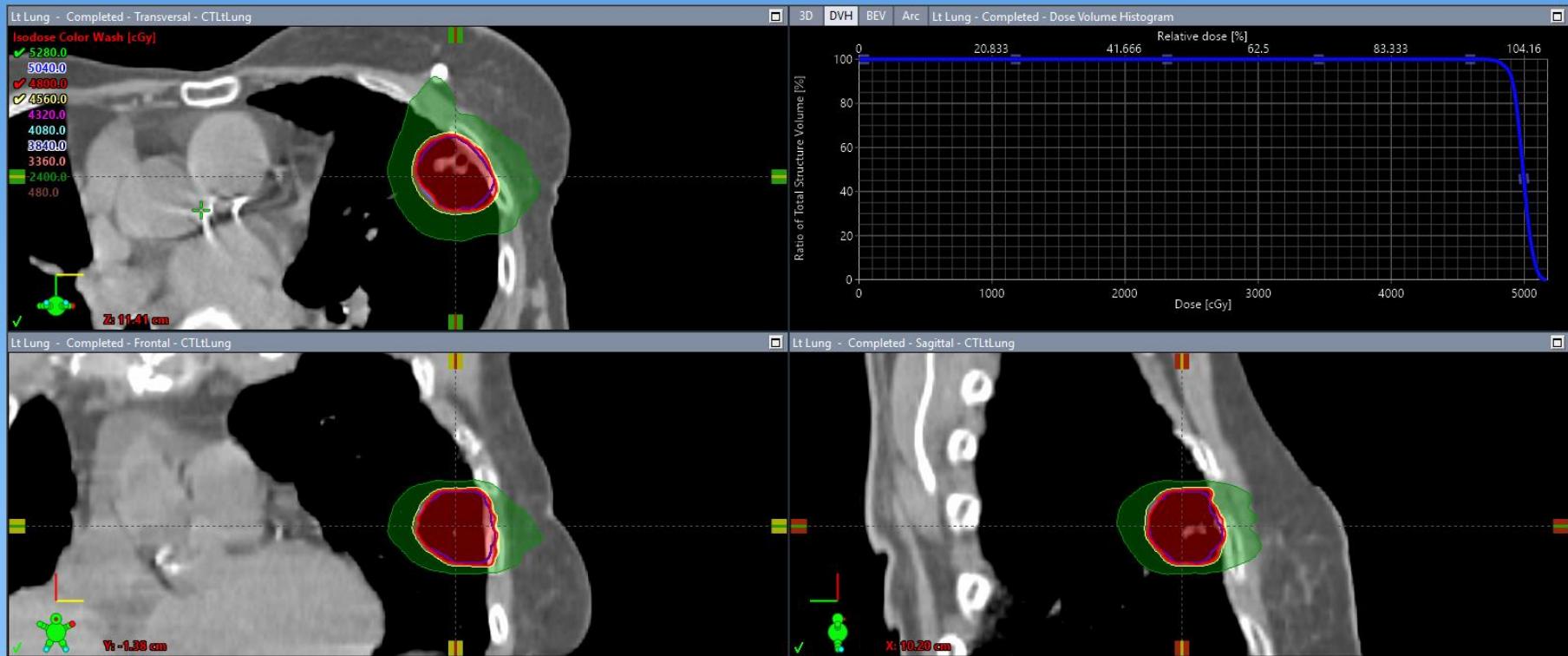
SBRT Dosing

- ▶ Same SBRT dosing as regular machine
 - ▶ Lungs
 - ▶ 1200cGyx4
 - ▶ 1000cGyx5
 - ▶ Adrenal
 - ▶ Fiducials Placed
 - ▶ 1500cGyx3
 - ▶ 800cGyx5
- ▶ Pancreas
 - ▶ Fiducials Placed
 - ▶ 660cGyx5
 - ▶ Can reduce to 500cGyx5 if OAR limits are not met
 - ▶ Consider SIB up to 800cGyx5
- ▶ Liver
 - ▶ Fiducials Placed
 - ▶ 1000cGyx5
 - ▶ 800cGyx5
 - ▶ 1500-1800cGyx3

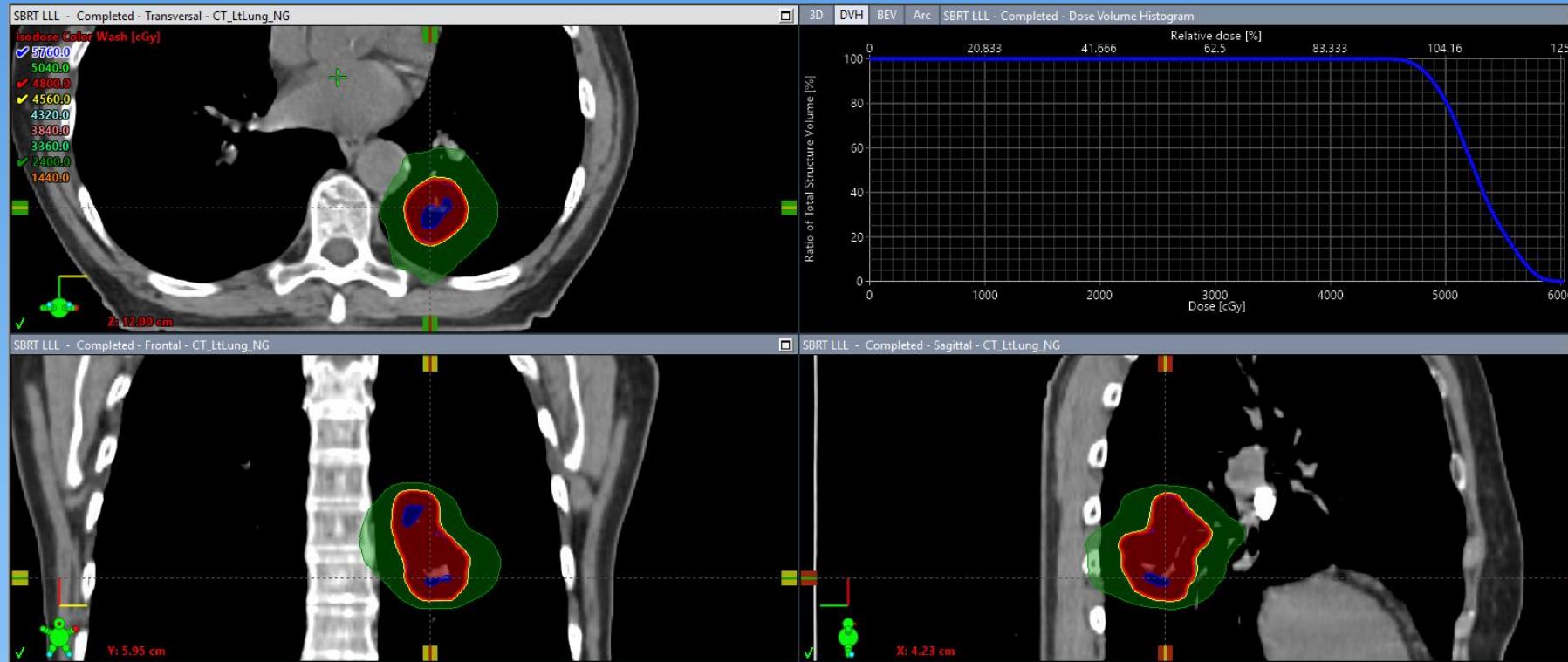
SBRT Limiting Factors

- ▶ Lack of Couch kicks
 - ▶ Dose spill stretches more in-plane
 - ▶ Skin maximum dose could be close if patient is skinny and lesion is close to the chest wall
 - ▶ 3-5 fraction maximum goal between 33-39.5Gy, V30-36.5<10cc
- ▶ Lack of 6 DOF couch
 - ▶ Unable to make small rotational adjustments to align spine

SBRT Lung



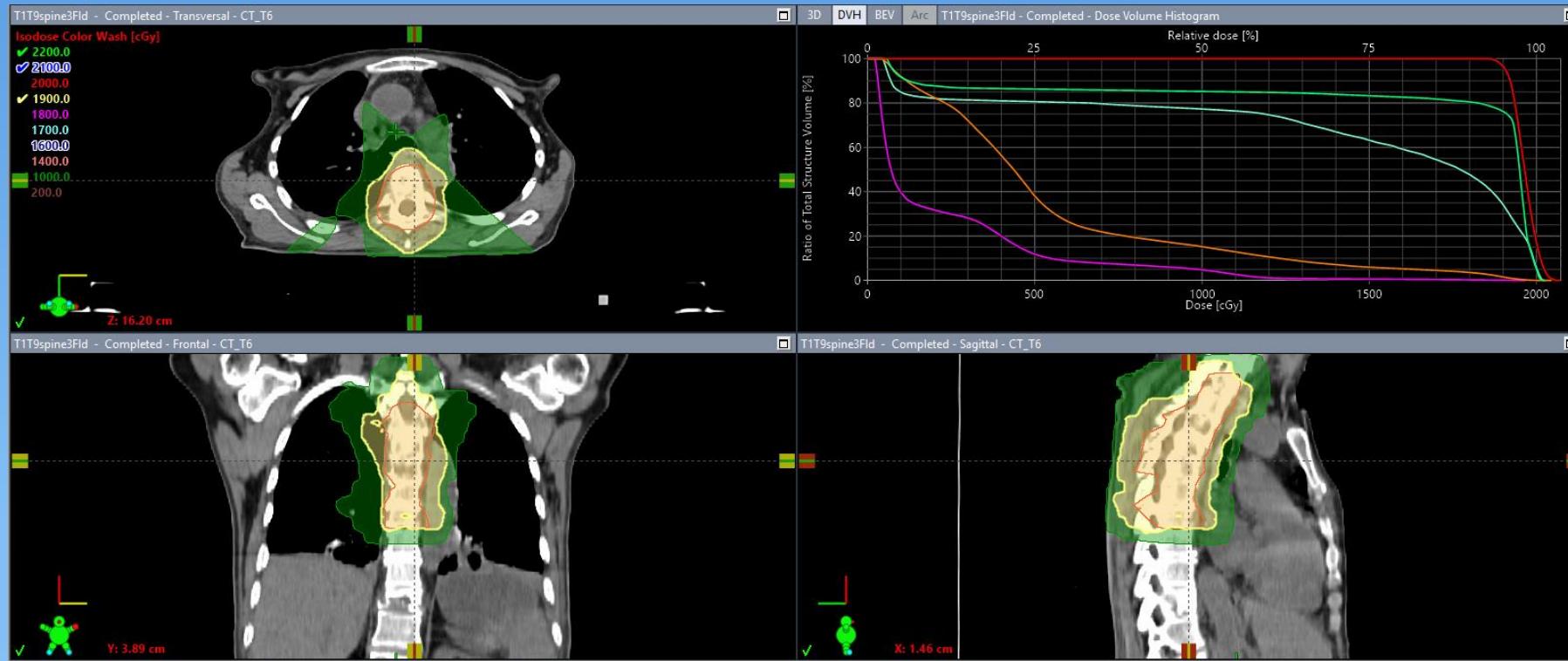
SBRT Lung



Palliative Cases

- ▶ Typically AP/PA or wedge pair and potentially higher energy
- ▶ Can use 3 field
 - ▶ RPO, PA, LPO
- ▶ 400cGy \times 5 or 300cGy \times 10
- ▶ Still get V95% $>$ 95% and low/no hotspots
- ▶ Easier with EZ Fluence
 - ▶ Essentially makes a 3D sliding window plan

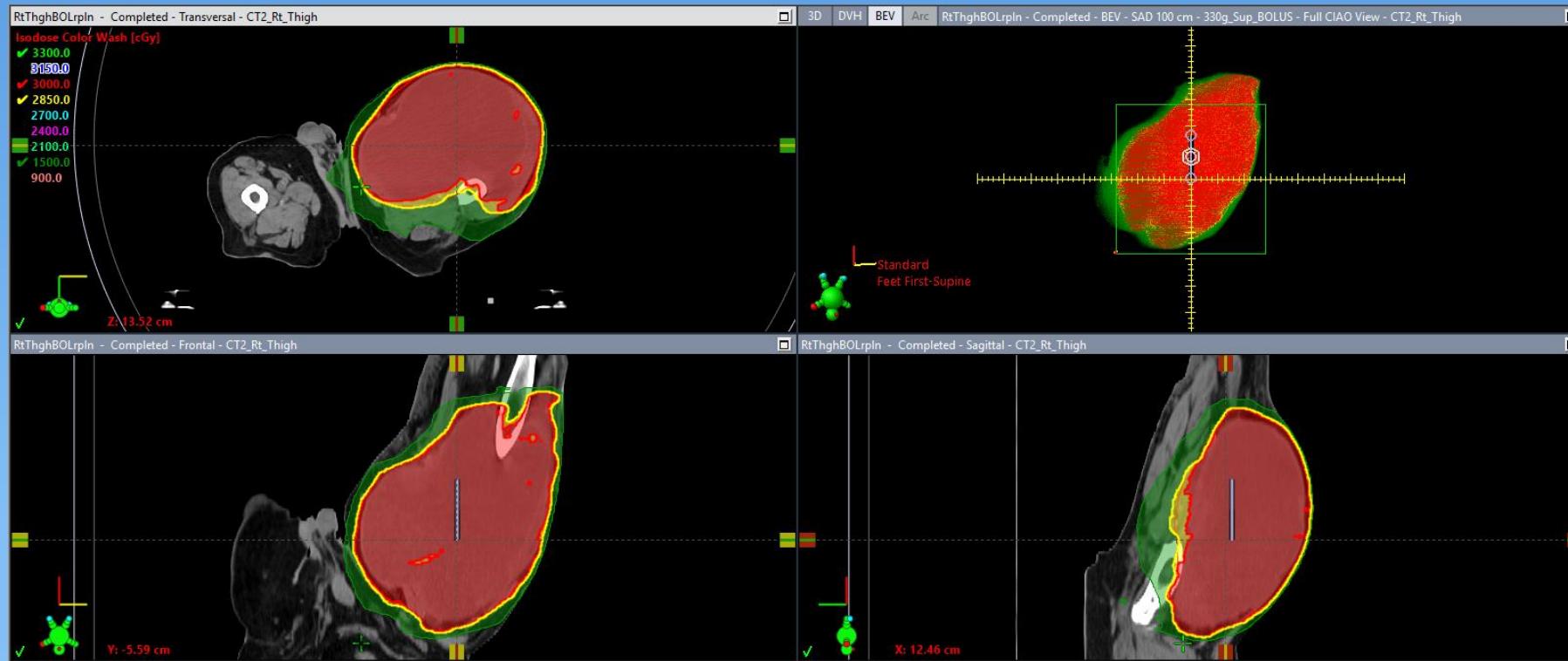
Palliative Cases



Palliative Cases

- ▶ Large Fields sometimes are out of MLC size
 - ▶ Need Two Isocenters
 - ▶ Makes 3D planning difficult
 - ▶ Use AutoFeathering technique similar to breast plans
 - ▶ Delivery is fast so it also helps to add more beams
 - ▶ Still billed as 3D since no OARs were avoided and uniformity of dose was only part manipulated
 - ▶ Even with lower energy, plan still uniform

Palliative Cases



HO Bones

- ▶ Typical Process
 - ▶ Get patient on table and set field sizes
 - ▶ MV Image to verify positioning and adjust field sizes
 - ▶ Verify with MV Imaging and calculate MUs based on field size, SSD, and depth
- ▶ Halcyon needs a plan in order to open
 - ▶ Must have imaging and treatment fields
 - ▶ Prior process needed adjustment
- ▶ Standard Prescription
 - ▶ 7-8Gy in 1 fraction
 - ▶ Within 24 hours pre-op or 72 hours post-op

HO Bones

- ▶ Needed to confirm setup and determine field size and MUs
- ▶ Quickest way determined was to do CBCT, then set field size on scan, then calculate MUs using that scan
- ▶ Had to create best way to get the process done quickly and correctly
- ▶ Current Process
 - ▶ Create Phantom structure in Eclipse and create a plan on that phantom with kVCBCT for imaging
 - ▶ Set field size to 1x1 and MUs to 1MU
 - ▶ Planning Approve this plan
 - ▶ Align patient on machine and put BBs at the laser marks
 - ▶ Align to the hip that will be treated
 - ▶ Acquire kVCBCT, save image, and exit the plan
 - ▶ As long as shifts aren't applied, machine will not allow treatment of the 1x1 field
 - ▶ Use kVCBCT to create the plan
 - ▶ Double check MUs by overriding patient to water and recomputing the dose, if this appears more correct based on secondary MU check and experience then use this plan.
 - ▶ Then proceed as normal for any other Halcyon plan

Flexibility

- ▶ Has both kVCBCT and MVCBCT
- ▶ Larger advantage than expected
- ▶ Prior Possibilities
 - ▶ If kV panel was down then either had to MV port patients or put them on hold until repair could take place
- ▶ Solutions
 - ▶ With Halcyon, the kV panel can be down and treatments can continue essentially uninterrupted

Flexibility

- ▶ When kV panel breaks
 - ▶ Patients get replanned using MVCBCT
 - ▶ Replans are quick and mostly only require a recomputation and potentially a renormalization
 - ▶ Allows for machine to continue treating patients throughout the day and allows time for the kV panel to be fixed without it being an emergency

Caveats with MVCBCT

- ▶ Overall the images are of lower quality
 - ▶ But potentially better for some patients with implants
- ▶ Low dose objectives will be closer to limits
 - ▶ Lung V5 went up on all plans due to MVCBCT dose

Summary

- ▶ The Halcyon can handle complicated cases and can safely deliver SBRT treatments
- ▶ The Halcyon struggles more with large 3D plans but there are usable workarounds
- ▶ Although the process is different, the Halcyon is able to treat HO Bones
- ▶ With multiple imaging options, the Halcyon offers a little more flexibility than a standard linac