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

Vincent Ulizio
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
    - 1200cGy x 4
    - 1000cGy x 5
  - Adrenal
    - Fiducials Placed
    - 1500cGy x 3
    - 800cGy x 5

- Pancreas
  - Fiducials Placed
  - 660cGy x 5
    - Can reduce to 500cGy x 5 if OAR limits are not met
    - Consider SIB up to 800cGy x 5

- Liver
  - Fiducials Placed
  - 1000cGy x 5
  - 800cGy x 5
  - 1500-1800cGy x 3
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 \text{ 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 kV CBCT 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 kV CBCT, save image, and exit the plan
  - As long as shifts aren’t applied, machine will not allow treatment of the 1x1 field
- Use kV CBCT 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.