Conflicts of interest / Disclosures

• No conflicts of interest related to this talk

• Some commercially available products are discussed. I am not endorsing these products nor am I suggesting these are the only or best products available.
Learning objectives

• Learn about the process of implementing a single-room proton therapy system
• Share our experience at the University of Utah
• …from a physicist without previous proton therapy experience
Overview

• Introduction to the Huntsman Cancer Institute at the University of Utah
• Proton system description
  • Mevion S250i
• Location / Construction
• Staff education
• Proton-specific QA equipment
• Treatment workflow consideration
Huntsman Cancer Institute
System description

• Mevion S250i
  • Gantry-mounted synchro-cyclotron
  • Pencil beam scanning (HYPERSCAN)
  • Adaptive aperture

• RayStation for treatment planning
  • Monte Carlo dose calculation algorithm

• Mosaiq for Oncology Information System

• QA equipment
Gantry-mounted cyclotron
Mevion anatomy

- Scanning magnet
- Dosimetry monitoring
- Energy selection
- Adaptive aperture
Energy selection

- 18 polycarbonate plates
- 2mm water equivalent thickness resolution

(Kang et al., Med Phys, 2020)
Adaptive aperture

• Used to sharpen the lateral penumbra
• Nickel 200
• 10 cm thickness along beam line
• Five 0.5 cm inner and 2 cm outer leaf pairs

(Kang et al., Med Phys, 2020)
Inner and outer gantry

- Inner and outer gantries move independently
- Align when beam is requested

(Vilches-Freixas, BJR, 2019)
Location

• Where to put a single room proton center?
• Considerations:
  • Land acquisition
  • Construction costs
  • Staffing

• Ideally – integrated into an existing site... but
Huntsman Cancer Institute
Construction area
Mevion – cyclotron delivery
Our treatment room
Staff training

- Start early

- Particle Therapy Co-Operative Group (PTCOG)
  - https://www.ptcog.ch/

- Proton courses (e.g. UPenn, Mayo, etc.)

- Site visits
  - Ideally at sites with your same proton system

- Invited speakers

- Internal talks for staff
Commissioning / QA

- Safety and mechanical tests
- Data for RayStation commissioning
- Treatment planning validation
  - IMPT QA
  - Heterogeneity corrections
- Imaging systems
- Water equivalent thicknesses (WETs)
- Establishing ongoing QA baselines
- End to end testing
- AAPM task group reports available
Output

- IAEA TRS-398 protocol
- PPC05 parallel plate chamber
- Reference field:
  - 10 x 10 cm² field size with 41x41 1 MU spots (1681 MU total) at 230 MeV with 2.5 mm spacing
- Measurement at:
  - 5 cm depth with chamber at isocenter
- 100 cGy
QA equipment

• Proton-specific equipment examples:
  • Bragg peak chambers
  • Scintillation-based detectors
  • 2D ion chamber arrays
  • Multi-layer ion chambers (MLICs)
Treatment workflow considerations

- Field size
  - 20x20 cm²

- Nozzle extension
  - Collision prevention
Smaller field size

- 20 x 20 cm² field size requires matching fields for large targets
- Gentle gradients to be robust against setup uncertainties
Collision avoidance

- Nozzle extends to limit air gap
  - Reduced lateral penumbra
- Clearance checks
- Nozzle modeling in RayStation
- Slightly increased scan length for CT simulations
Summary

• There many considerations on where to locate a single vault proton therapy system
  • Integration into an existing site may be the most cost effective
• Begin staff education early
  • Try to visit sites who have your system
• Proton-specific QA equipment
  • Talk to other sites, QA vendors, and your proton system vendor
  • Place timely orders→ there can be long lead times
• Develop a deep understanding of your system’s characteristics and operation to develop safe and efficient treatment workflows
Thank you for your attention!

Questions?
Mevion S250i gantry angles

- Half gantry
  - 190° of rotation
Mevion S250i couch angles

• Lateral treatments at 180° and 0°.

• kV/kV planar imaging at 270° couch angle