Patient Immobilization @ UFPTI

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Immobilization for Proton Therapy

- High accuracy and high reproducibility
- Patient comfort
- Minimization of inter-fraction setup errors
- Minimization of residual intra-fraction patient and/or organ motion
- Proton-friendly
  - Homogeneous radiological paths throughout regions of potential proton beam path
  - Minimal changes on patient anatomy that lead to radiological path length changes
- Compatibility with IBA PPS and Elekta Synergy LINACs (both allow Varian-style indexing)
Base-of-Skull Frame (NPTC design) with Med-Tec Bite Plate
Medical Intelligence HeadFIX
Med-Tec S-Frame (Pituitary Treatments)

- Patient set up on long table top
- Use 3-field:
  - Opposed laterals
  - Superior oblique vertex field with 90 deg table rotation and gantry angle > 290 deg (to avoid collision)
Prostate and Pelvic Immobilization

- Med-Tec VacLOC vacuum bags
Thorax and Abdomen Immobilization

- Medical Intelligence BodyFIX system
Breath Holding for Thorax/Abdomen Treatments

- Elekta Assisted Breathing Coordinator (ABC) device
Cranial-Spinal Irradiation

• Med-Tec Prone Head Holder in combination with VacLOC vacuum bag
Indexing of Immobilization Devices

• Standard PPS tabletop has Varian-type indexing notches
  – No indexing at PPS base
  – Lucite overlay fabricated with indexing notches throughout its length for indexing long vacuum bags
  – Range pullback of Lucite overlay considered in treatment planning

• Custom-made short table extension to allow indexing of BOS frame and HeadFIX on PPS (.decimal, Sanford, FL)
Short Table Extension for BOS Frame

May 23, 2008

PTCOG47, Jacksonville, FL
Lucite PPS Overlay for Indexing
Inclusion of PPS Table Range Pullback in Treatment Planning

- Total table thickness (carbon fiber tabletop + Lucite overlay) = 6.55 cm
- Total table WET = 2.40 cm
- Stopping power ratio = 0.366
- Manually draw total table into TPS
  - Use physical dimension for accurate air gap calculation
  - Assign HU to match stopping power
Commissioning of Immobilization Devices for Proton Therapy

- All proton therapy immobilization devices must undergo rigorous range pullback and radiological thickness/Water-Equivalent-Thickness (WET) uniformity evaluation
  - All additional materials in proton beam path must be measured and modeled in treatment planning
    - Determine whether TPS-calculated range pullback from CT scans of material correlates to measured value
    - If not, develop method to account for range pullback in TPS based on measured values
Evaluation of A New Immobilization Device for Proton Therapy

- Dosimetric Tests:
  - CT scan of device to evaluate WET uniformity
  - Compared TPS-calculated range pullback vs. measured range pullback at multiple locations on device
  - *These tests must be performed with consideration of TPS dose calculation grid sizes, compensator smearing used, and proton scattering at depths of target after passing through device*
Evaluation of Radiological Uniformity

No smearing

With 3 mm smearing

UFPTI Data: Slopsema, 2008
TPS-Calculated vs Measured Range Pullback

Comparison measured pullback and calculated pullback based on CT in four measurement points, for 3 different BOS frames.

UFPTI Data: Slopsema, 2008
Smearing of Radiological Length Variations vs Depth of Measurement

UFPTI Data: Slopsema, 2008
Mechanical Test
(Sagging vs Weight and Time)

Frame sagging as function of time

- Current frame (4.5kg head + 9.1kg shoulder)
- New revision 0 (5.1kg head + 13kg shoulder)
- New revision 1 (5.1kg head + 13kg shoulder) 11/13
- New revision 1 (5.1kg head + 13kg shoulder)

UFPTI Data: Slopsema, 2008