MASSACHUSETTS GENERAL HOSPITAL
CANCER CENTER℠

Patient Immobilization & Position Verification Strategies

Marc R. Bussière, M.Sc.
Dept. of Radiation Oncology, FHB Proton Center
Massachusetts General Hospital
Harvard Medical School

mbussiere@partners.org

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Objectives:

Review the role of patient immobilization in proton therapy in contrast to photon therapy.

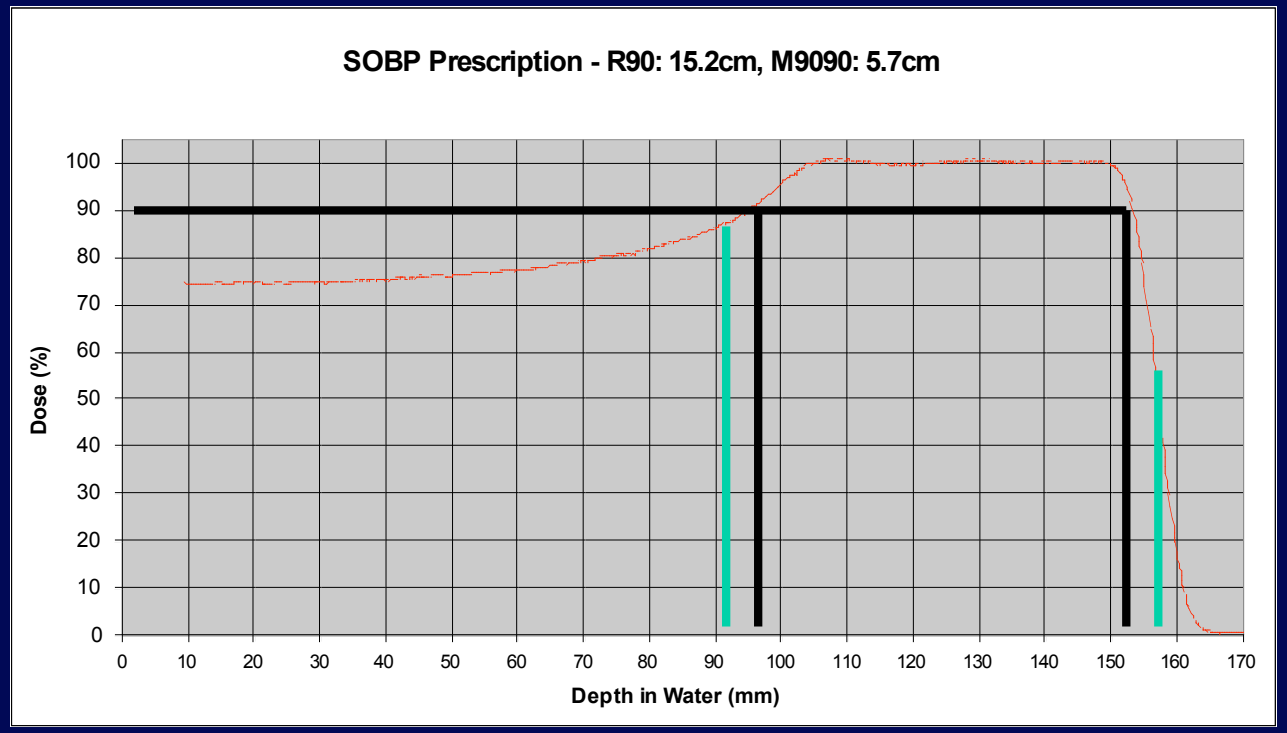
Discuss immobilization device selection with emphasis on the clinical requirements.

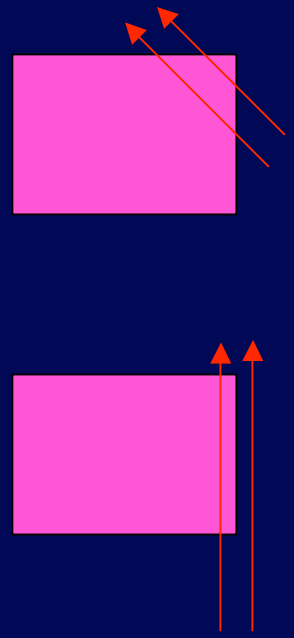
Discuss strategies for improving our understanding of device limitations in the clinic.

Impact of Effective Path Shifts

Example: 5 mm range shift

Impact on a 10MV x-ray beam is ~ 1.5%





86%

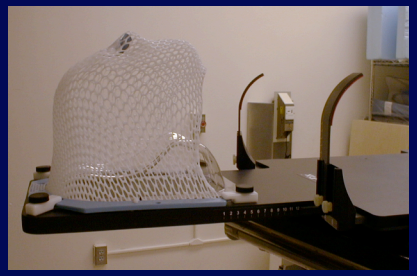
Δ = 4%

49%

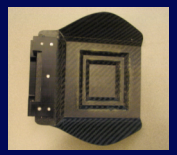
Δ = 41%

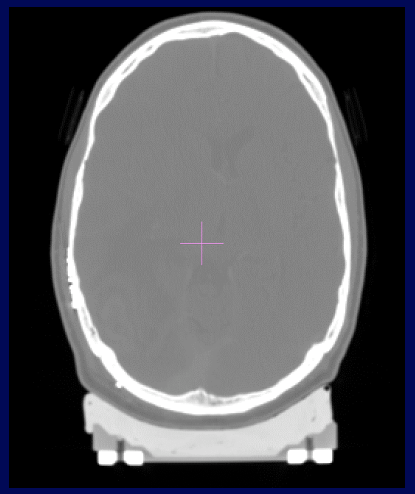
"ALARA"

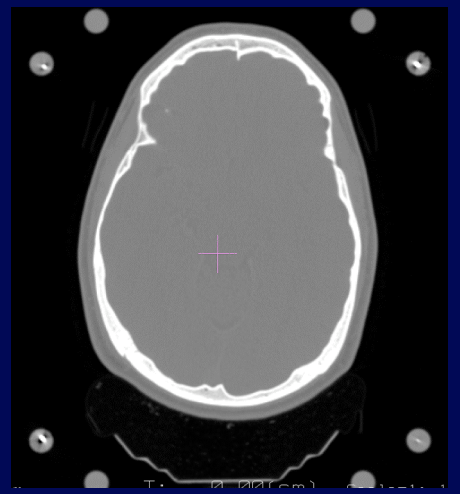
Typical X-Ray Device

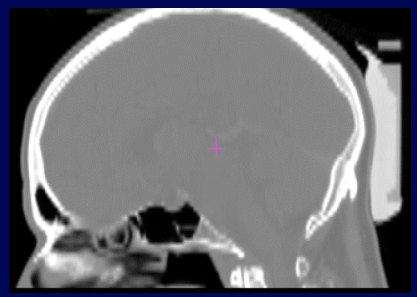


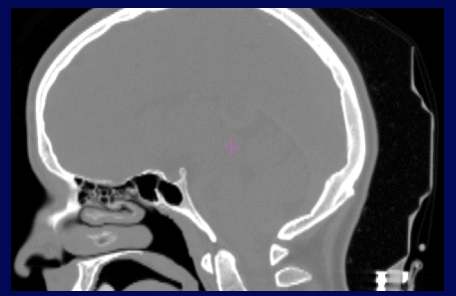
Proton Compatibility:



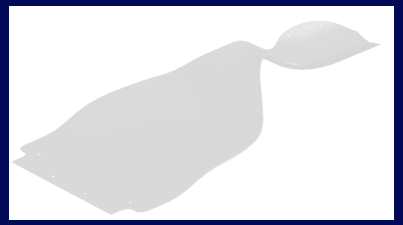


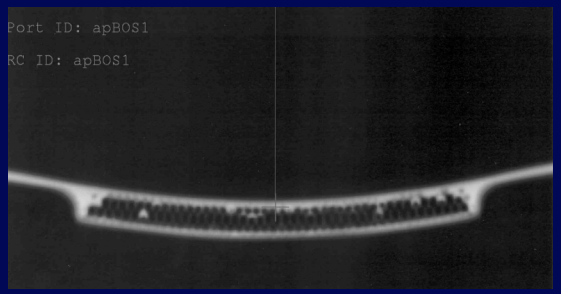


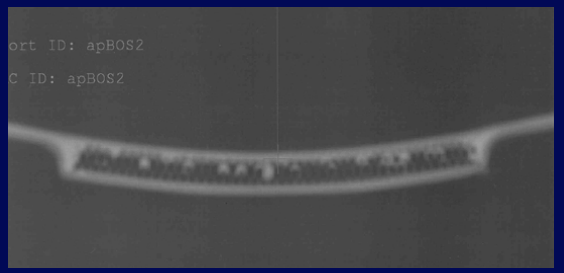


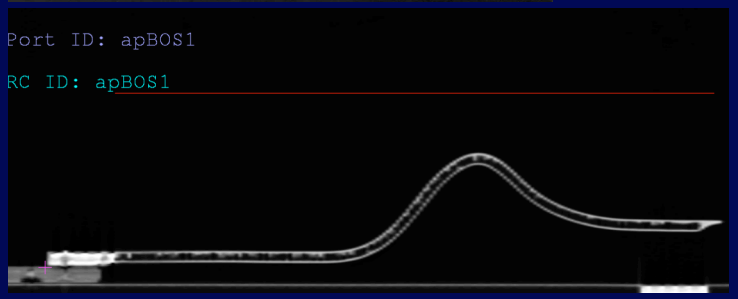


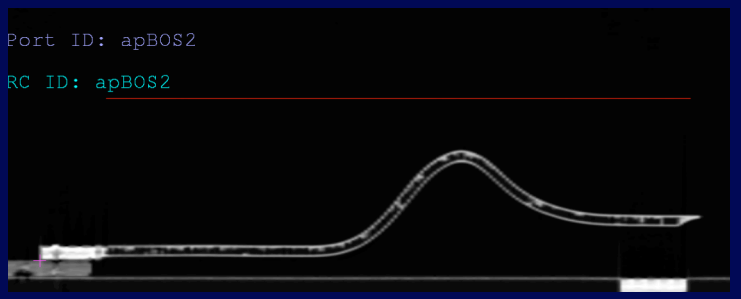
Device Uniformity:

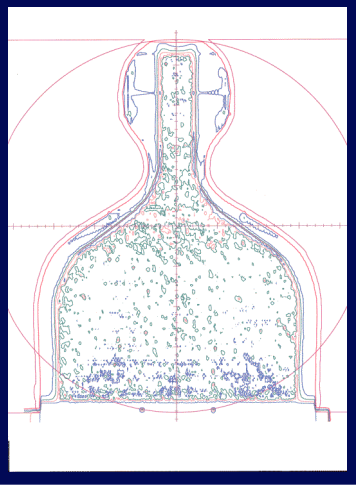


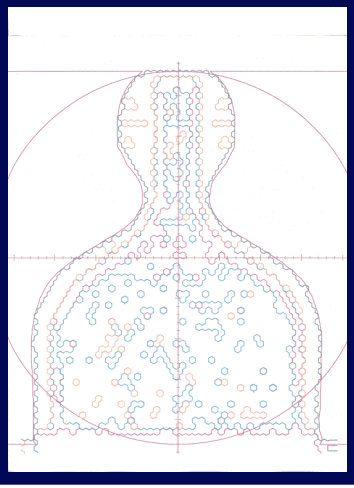


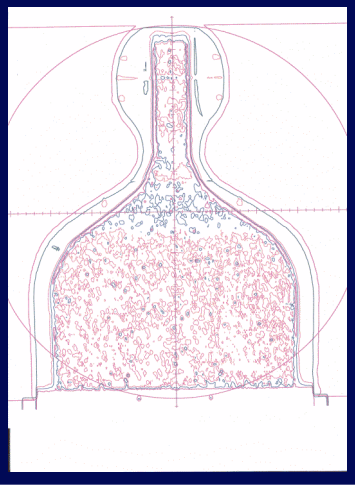


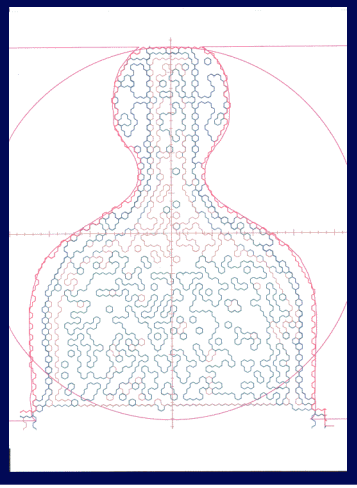












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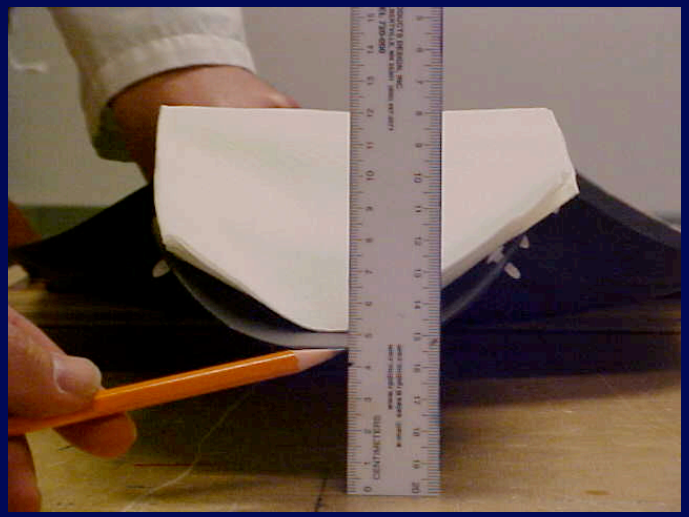
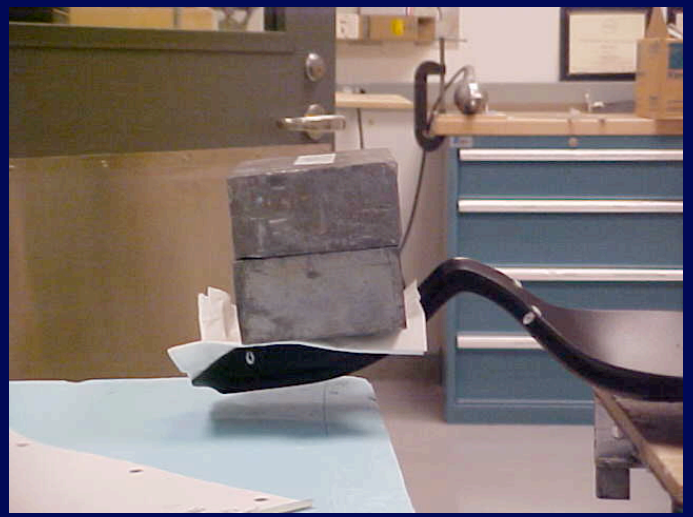
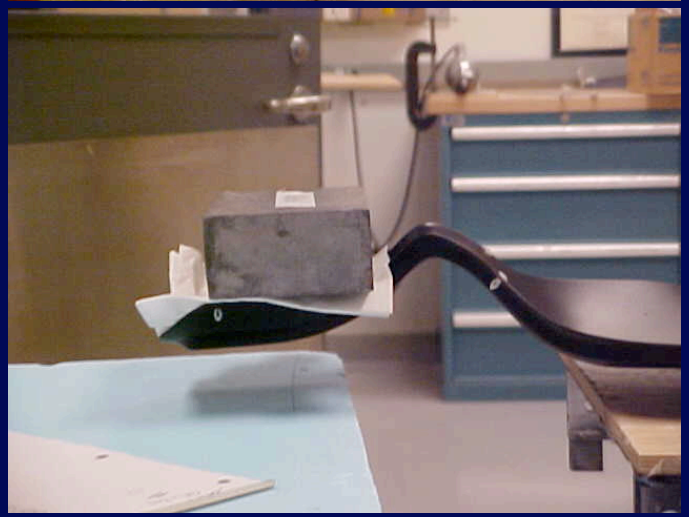
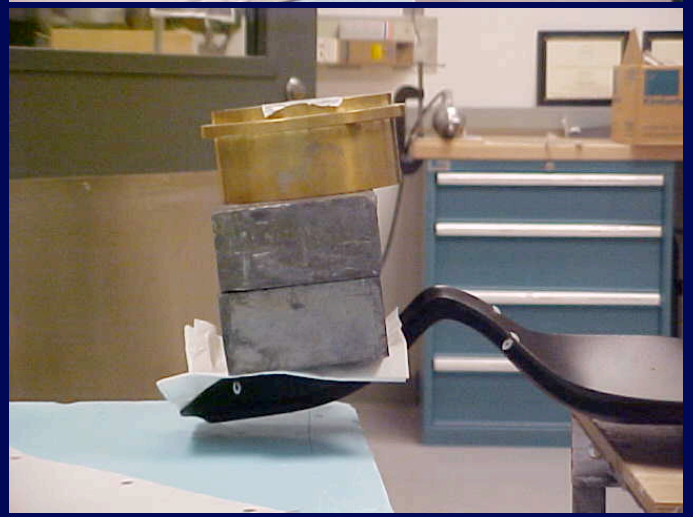
Device Specifications:

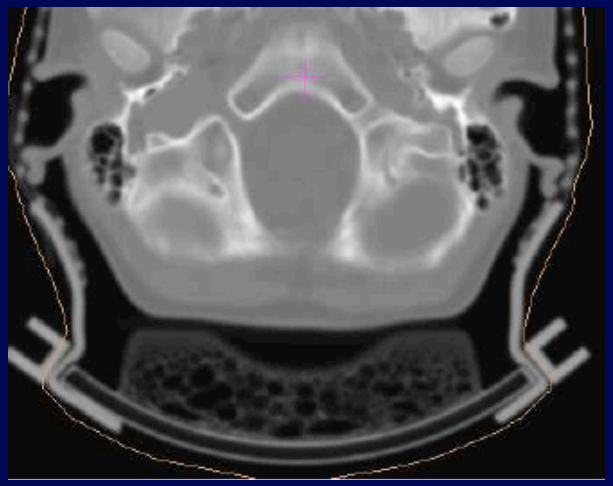


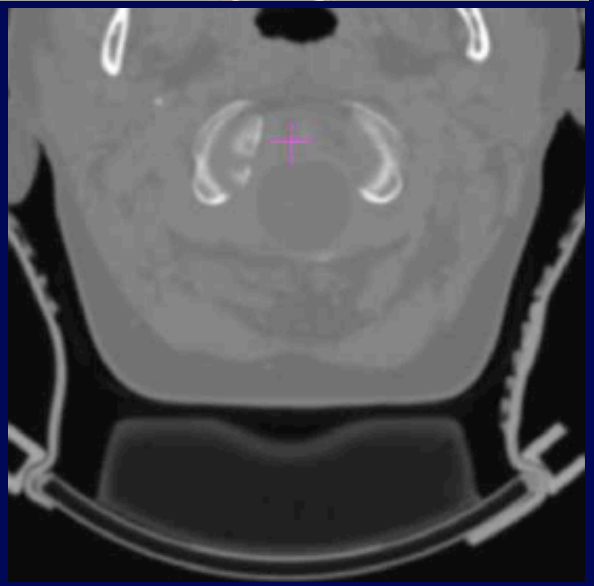


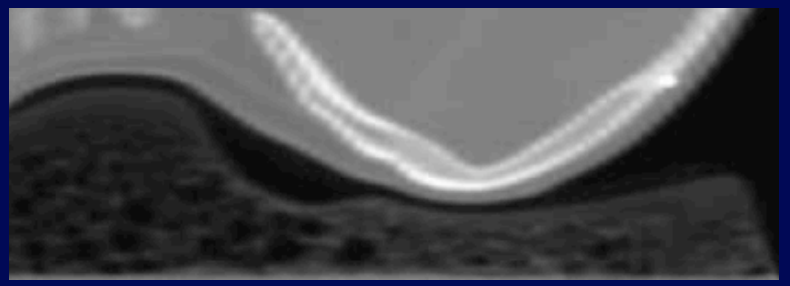


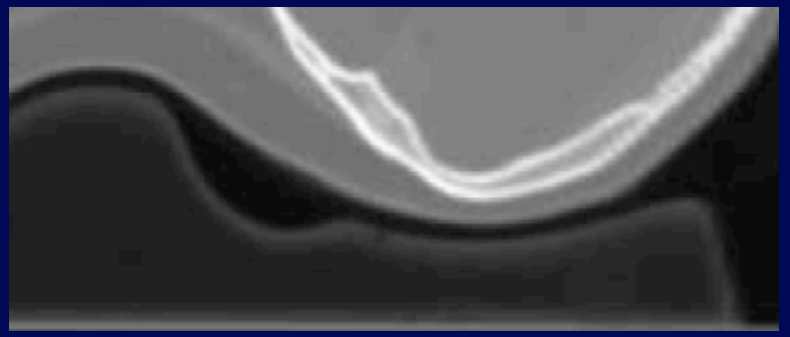


Accessory Uniformity:









FHBPTC Devices

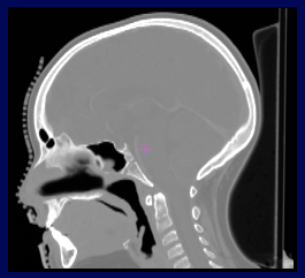
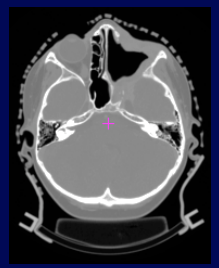
Prostate: Rigid Leg Immobilizer 920400
Alimed Inc, Dedham, MA 02026
800-225-2610
Simple device with reproducible neutral roll

Thorax/Abdomen: Tapered Wing Board MT WB10
Civco/MedTec, Kalona, IA 52247
800-842-8688
Often used with alpha cradle and/or other immobilization devices

FHBPTC Devices

Intra-Cranial (IC): Carbon Head Holder 237HH
TRU-SCAN IMAGING Inc., Annapolis, MD 21404
410-268-8305
Solid Core Styrofoam Filled Carbon Base
Foam Pad, Reinforced Mask (custom)



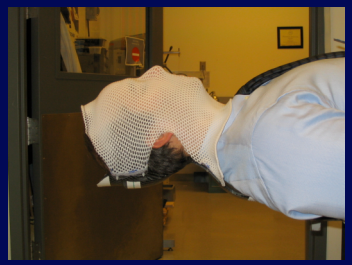
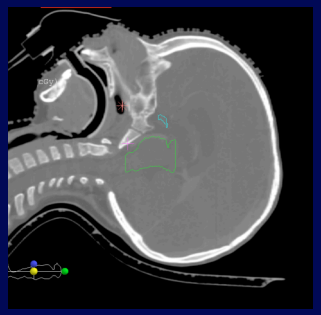
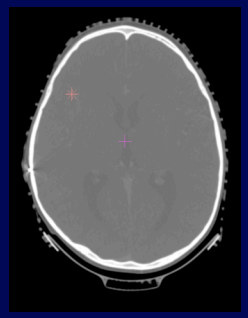



Stereotactic Intracranial PSRS/PSRT: GTC
Radionics, Burlington, MA 01803
800-466-6814
Modified from commercial product
GTC base frame, bite molds and straps
Modified head cup manufactured from carbon
Modified bite plate and "large" head adapter used
Occipital pad replaced with Civco MoldCare cushion


FHBPTC Devices

H&N Base of Skull (BOS): AccuFix BOS Frame RT-4535-M
Q-Fix WFR-Aquaplast, Wyckoff, NJ 07481
201-891-1042
Wafer Core Filled Carbon Base
Foam Pad, Aquaplast or Kevlar Mask (provided by WFR)

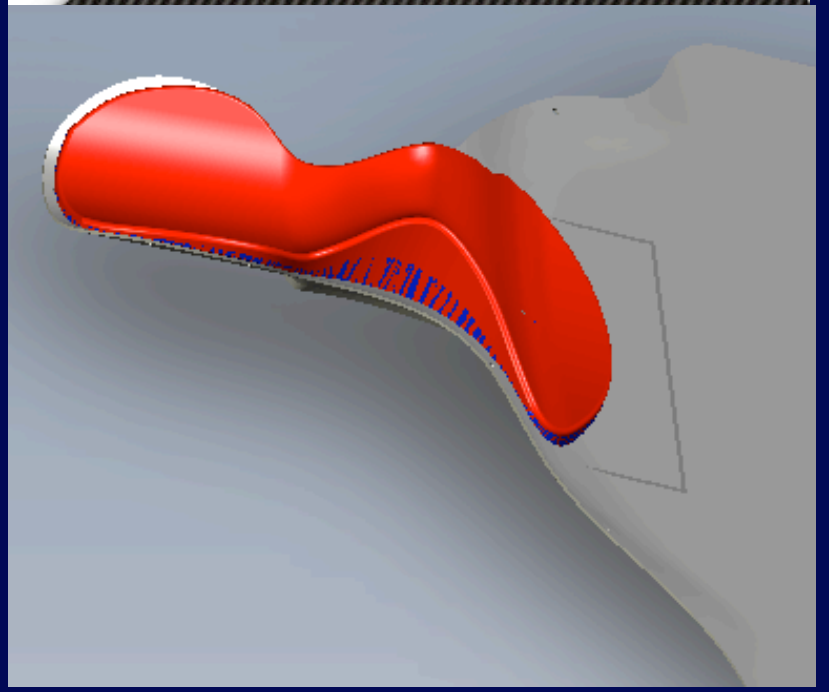


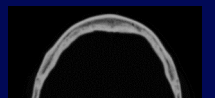
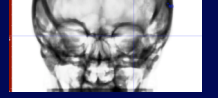
Cranio-Spinal: Prone Head Immobilizer MT-PB01/202
Civco/MedTec, Kalona, IA 52247
800-842-8688
Modified from commercial product
Styrofoam to elevate patient eliminate neck wrinkles
Synthetic Lambs wool for torso cushioning
No bean-bags/alpha cradle used
Anterior mask (not posterior) for better registration
Cushions for nose and forehead
Shoulder blades to provide better reproducibility


FHBPTC Devices

H&N / BOS / CSI:
Q-Fix WFR-Aquaplast, Wyckoff, NJ 07481
Solid Styro Core Filled Carbon Base
Sdd or Custom Foam Pad
Aquaplast or Kevlar Mask

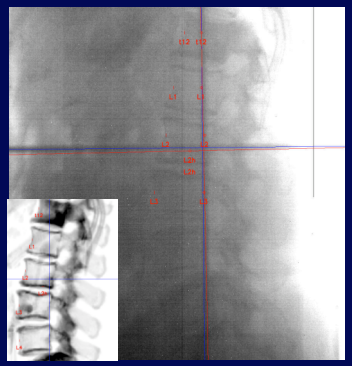


Accuracies and Limitations:

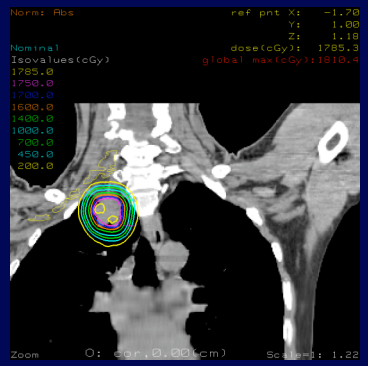
What affects reproducibility other than the immobilization itself?

- CT slice thickness
- Anatomical site
- Alignment verification method
  - 2D+ fusion surface mapping
  - Manual point mapping
  - 3D fiducial mapping



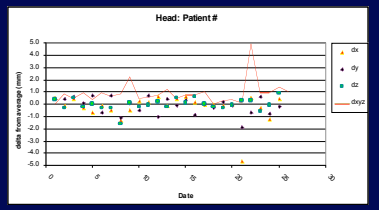
How do we describe our uncertainties?

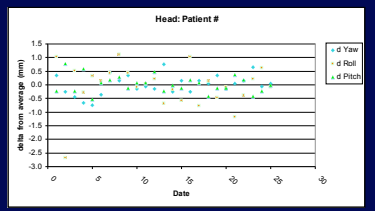
- Initial setup vs. CT image set
- Initial setup vs. subsequent setups
- RTT mapping variability (same RTT day after day)
- RTT mapping variability (different RTT)



Immobilization Device Uncertainties?

- With protons we must consider the impact on range as well as beam edges
- We must consider inherent device uncertainties as well as setup uncertainties
- Proper device use is essential (regular in-service sessions are necessary)
- Patient cooperation is critical





*QA/QC "**AMARA** - As Much As Reasonably Achievable"*

*Material "**ALARA** - As Little As Reasonably Achievable"*

Hsiao-Ming Lu