Patient Immobilization @ UFPTI

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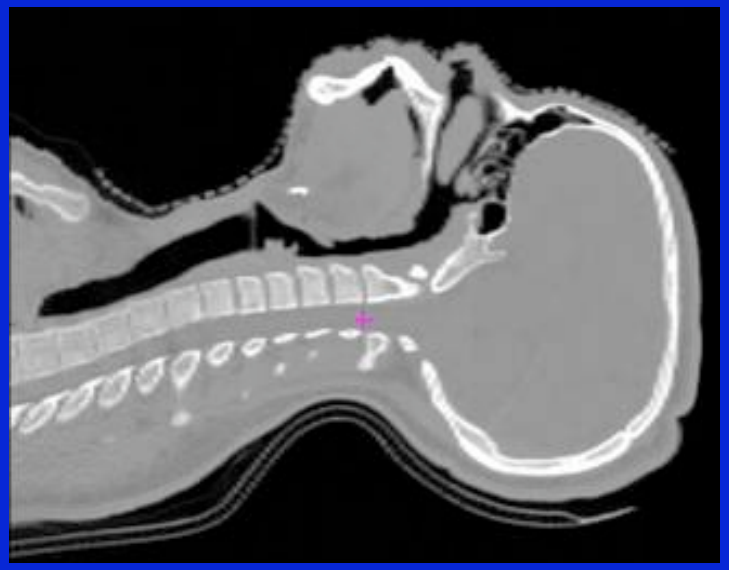
Immobilization for Proton Therapy

- 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

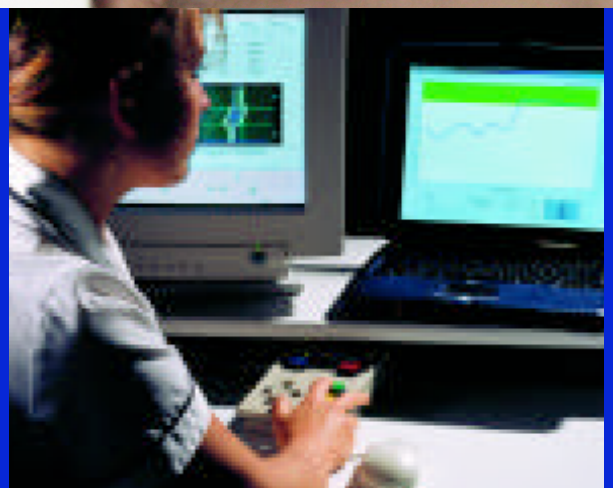
- Med-Tec VacLOC vacuum bags

Thorax and Abdomen Immobilization

- Medical Intelligence BodyFIX system

Breath Holding for Thorax/ Abdomen Treatments

- Elekta Assisted Breathing Coordinator (ABC) device



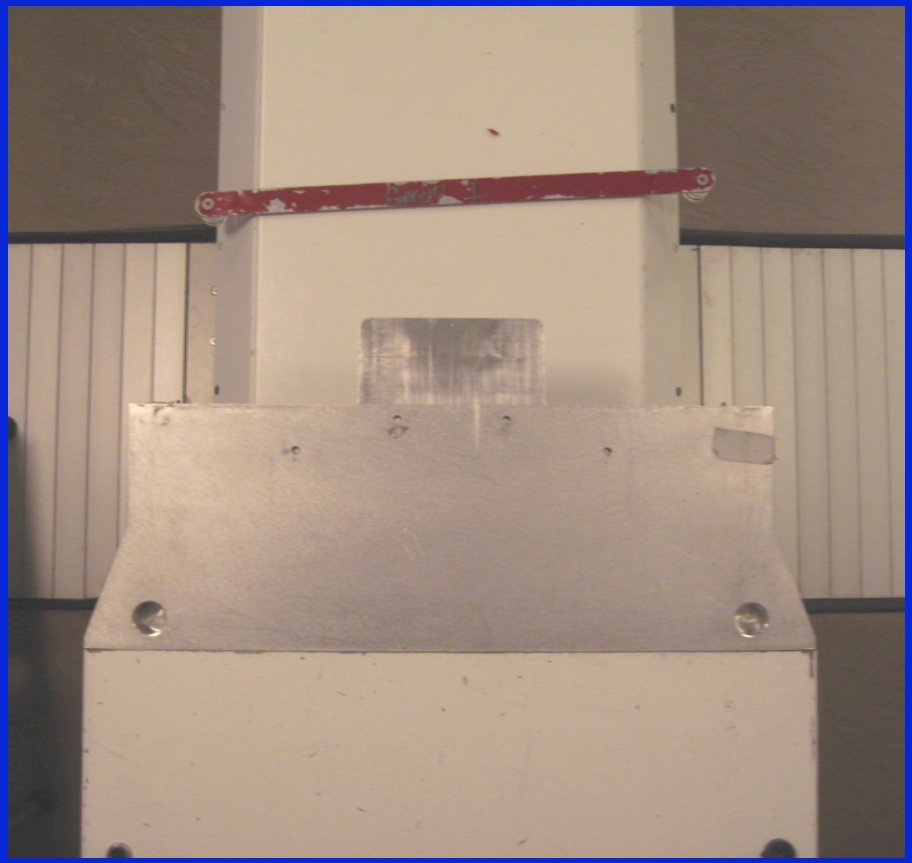
Cranial-Spinal Irradiation

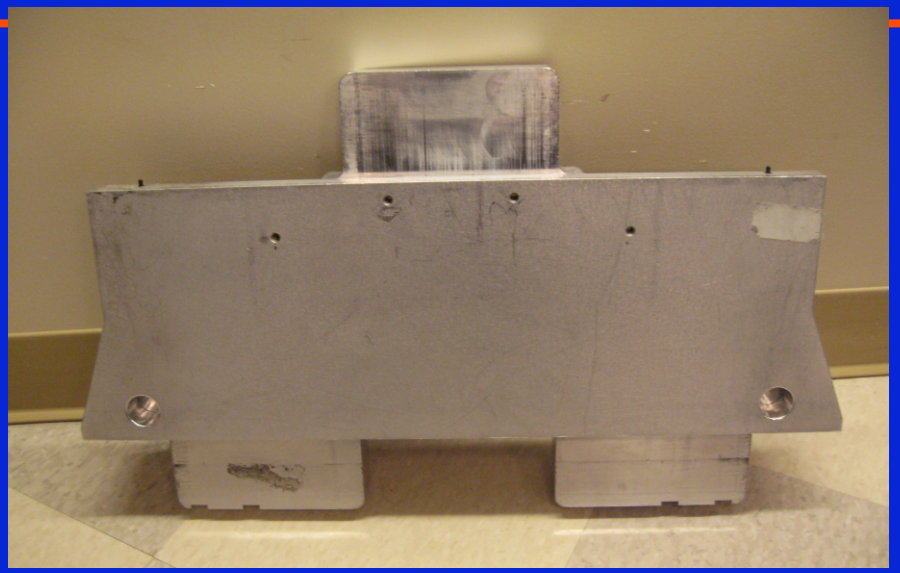
- Med-Tec Prone Head Holder in combination with VacLOC vacuum bag

Indexing of Immobilization Devices

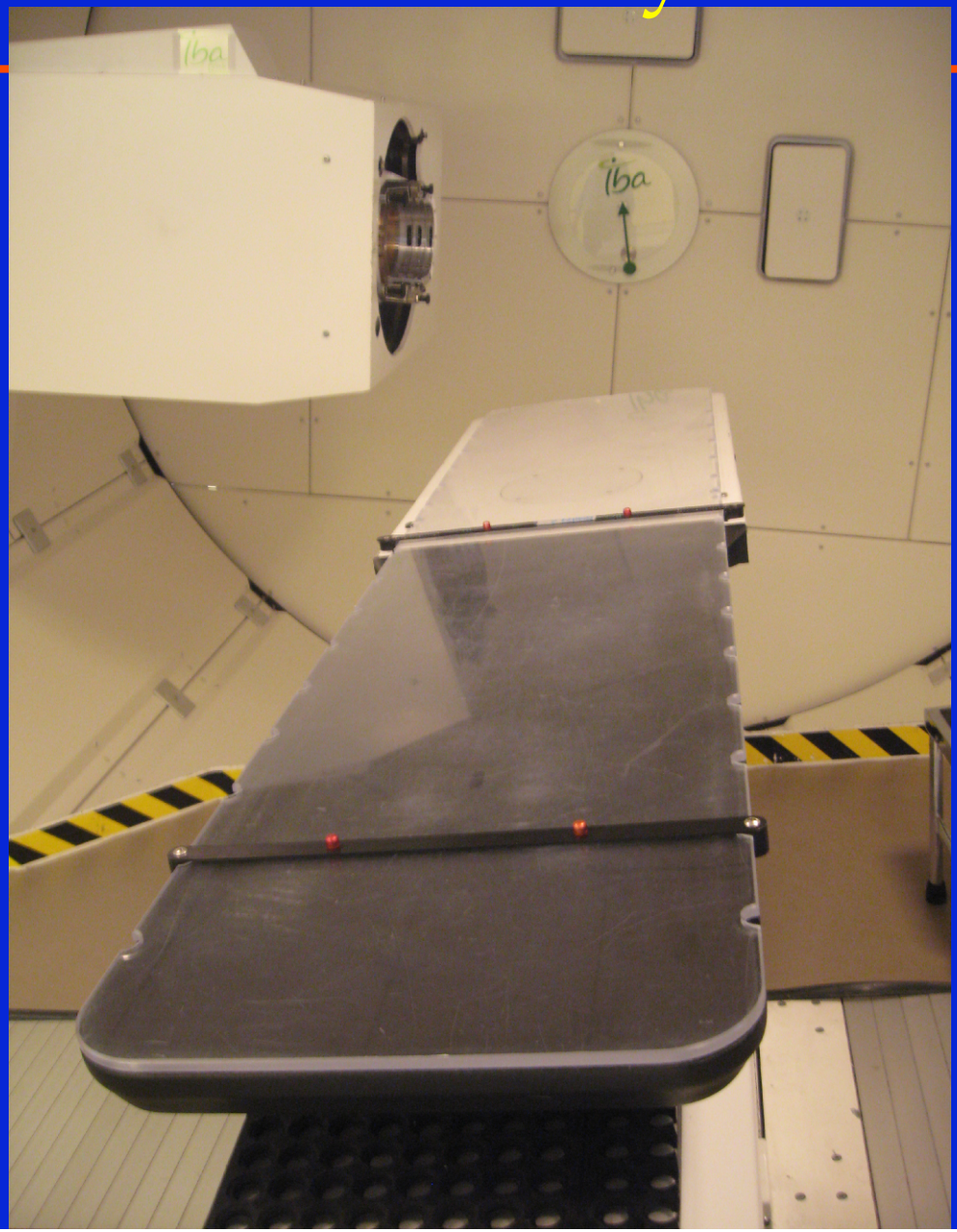
- Standard PPS tabletop has Varian-type indexing notches
  - No indexing at PPS base
  - Lucite overlay fabricated with indexing notches throughout its length for indexing long vacuum bags
  - Range pullback of Lucite overlay considered in treatment planning
- Custom-made short table extension to allow indexing of BOS frame and HeadFIX on PPS (*.decimal, Sanford, FL)*

Short Table Extension for BOS Frame



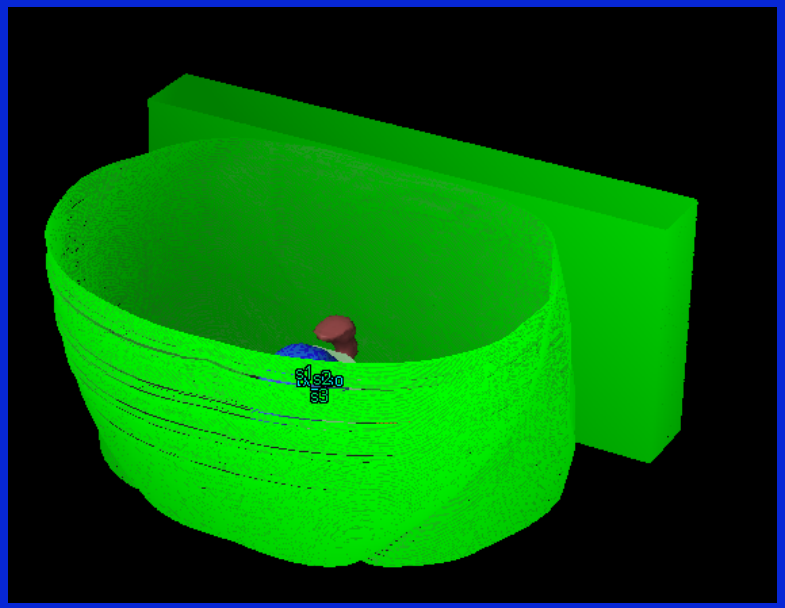


Lucite PPS Overlay for Indexing



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



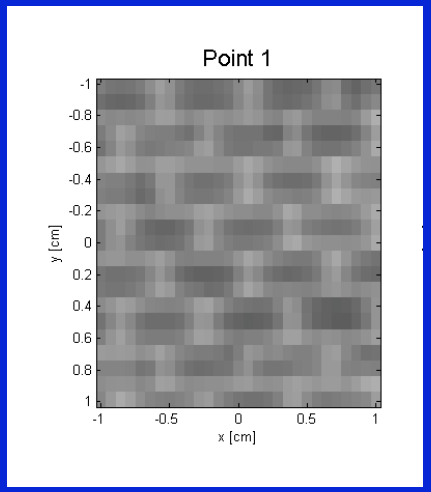
Commissioning of Immobilization Devices for Proton Therapy

- 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

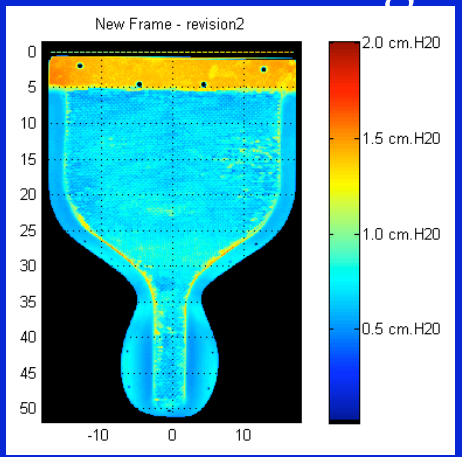
Evaluation of A New Immobilization Device for Proton Therapy

- 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*

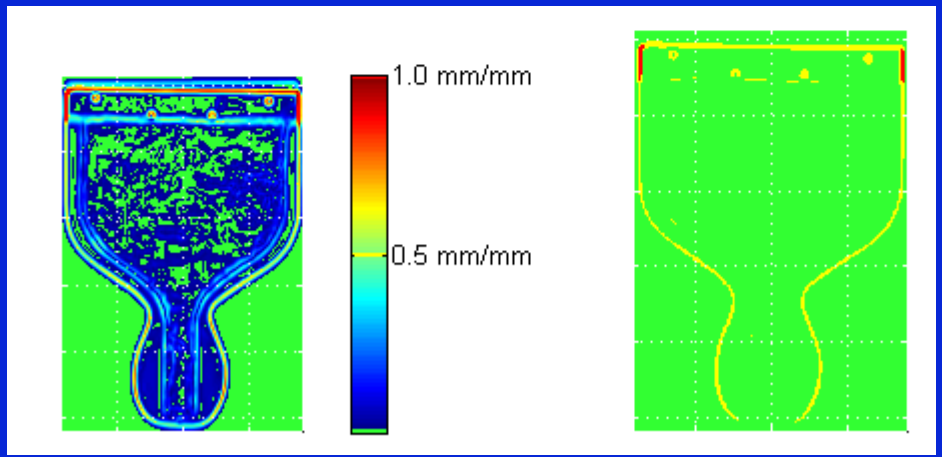
Evaluation of Radiological Uniformity



No smearing

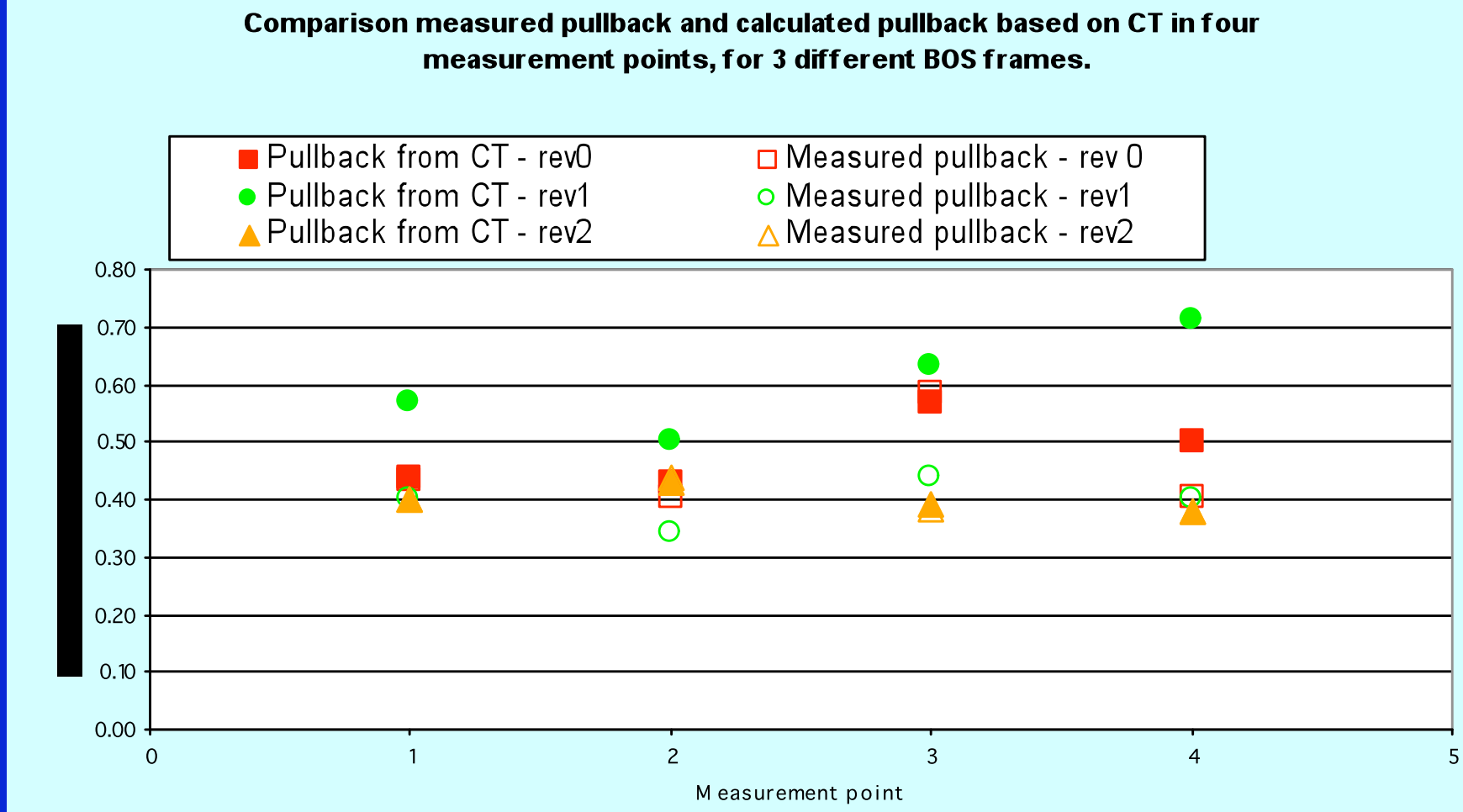


With 3 mm smearing



UFPTI Data: Slopsema, 2008

TPS-Calculated vs Measured Range Pullback



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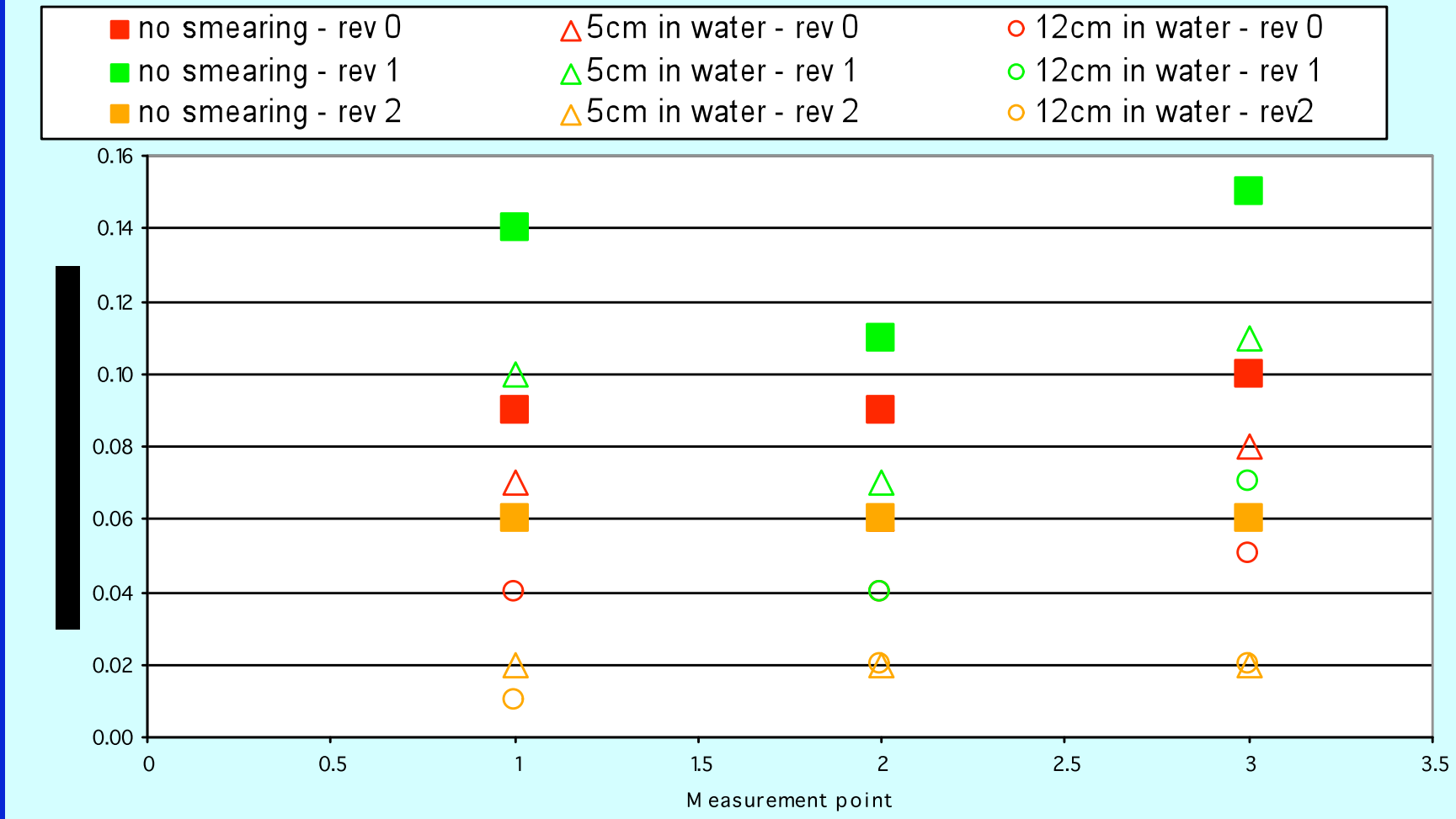
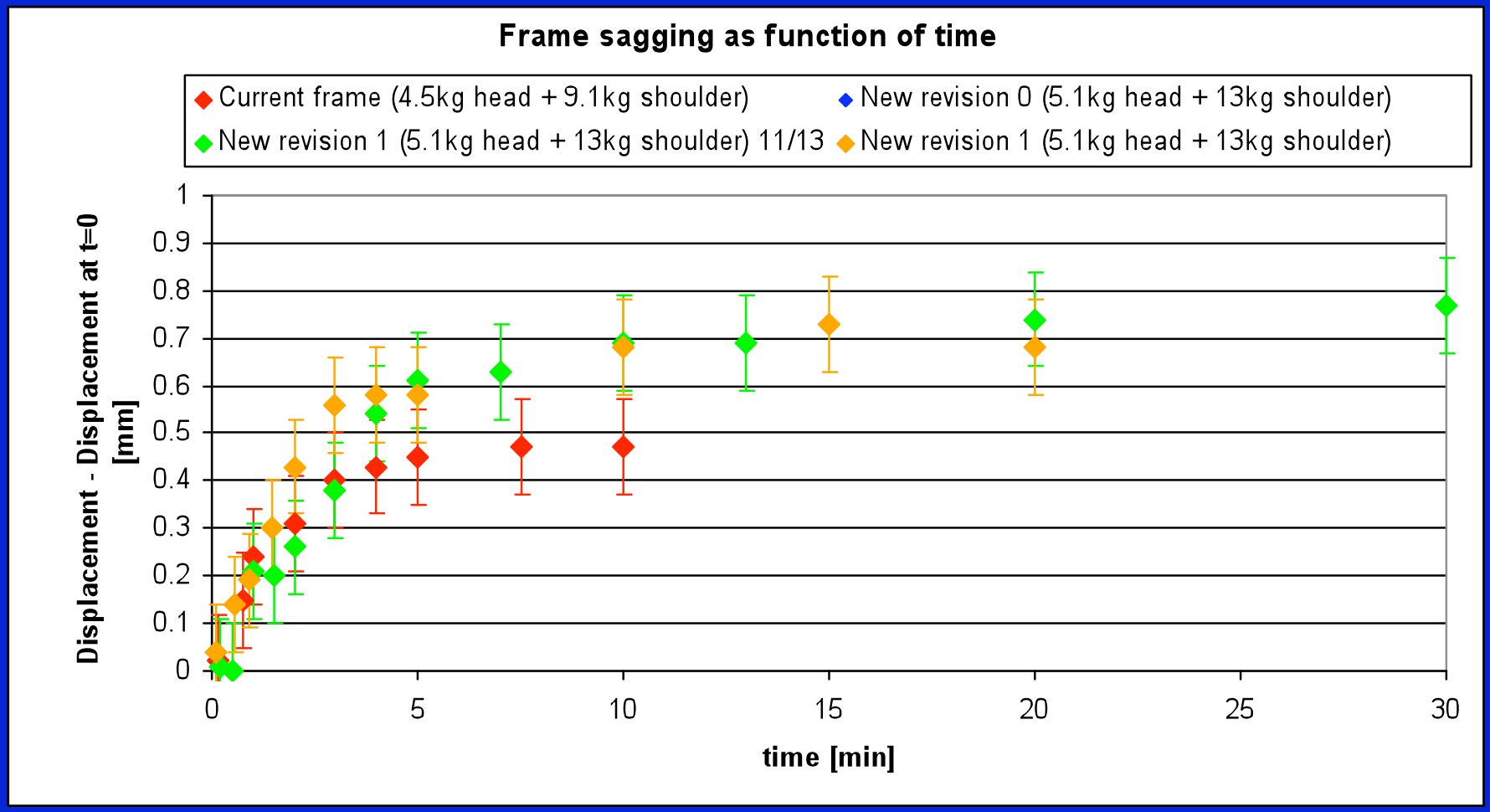
Smearing of Radiological Length Variations vs Depth of Measurement



UFPTI Data: Slopsema, 2008

Mechanical Test (Sagging vs Weight and Time)



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