# Patient immobilization and position verification strategies:

## MDACC Experience

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The University of Texas
M.D. Anderson Cancer Center

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# Acknowledgements


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## Physicists

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- Al Smith, PhD
- Many Others

## Dosimetrists

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- Shiao Woo, MD
- James Cox, MD
- Many Others

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# Introduction

- Each beamline at MDACC/PTCH has three x-ray systems.
- Daily image guided treatment delivery using 2 of the 3 x-ray systems.

- Three Hitachi couch extensions: short, medium and long.
- One Head and neck extension.

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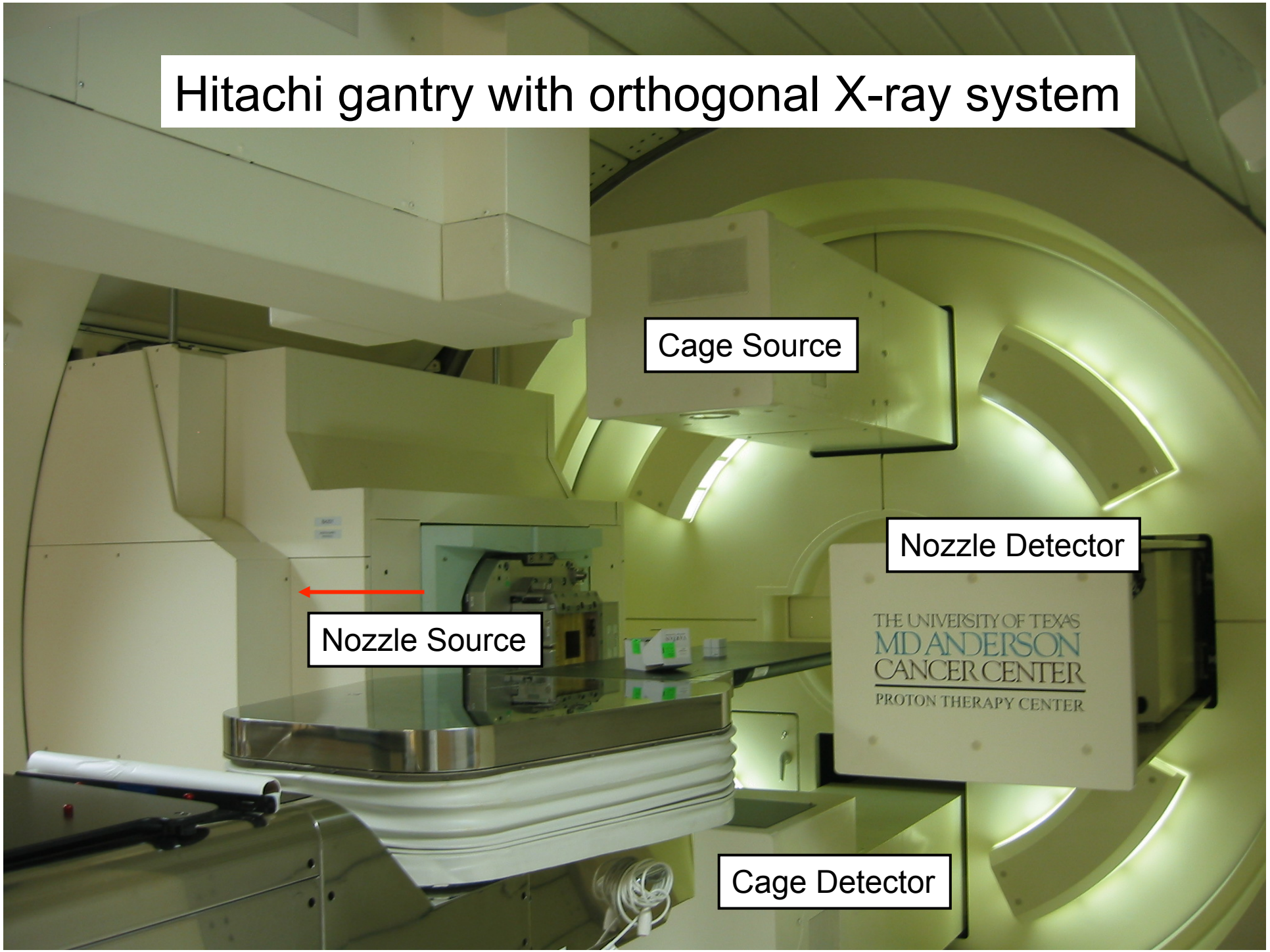
Hitachi gantry with orthogonal X-ray system
Cage Source
Nozzle Detector
Nozzle Source
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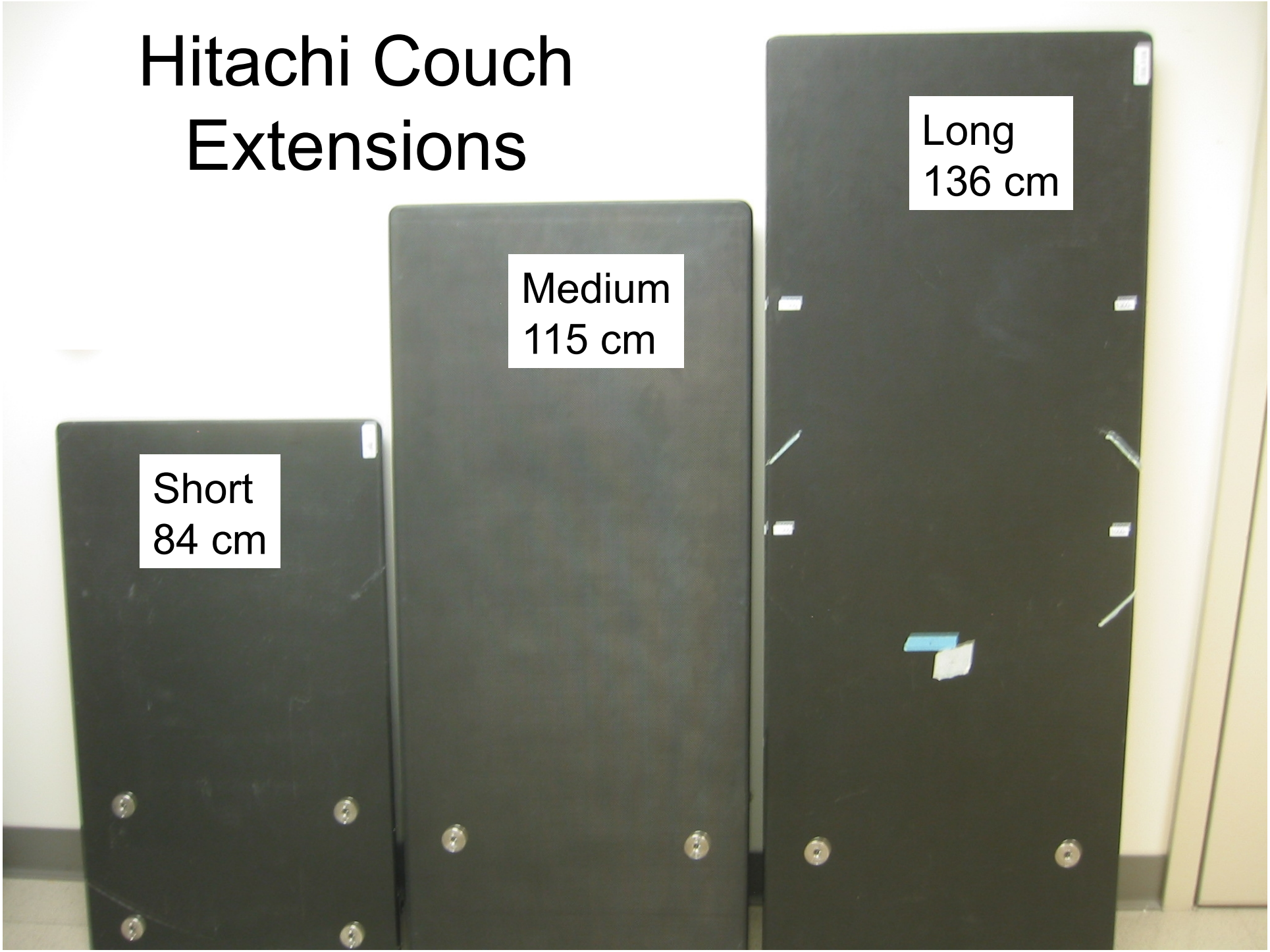
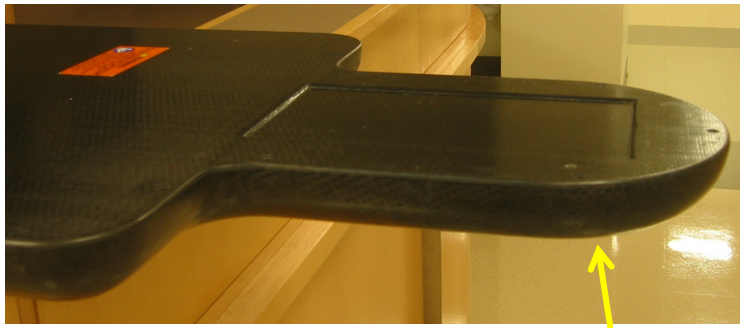
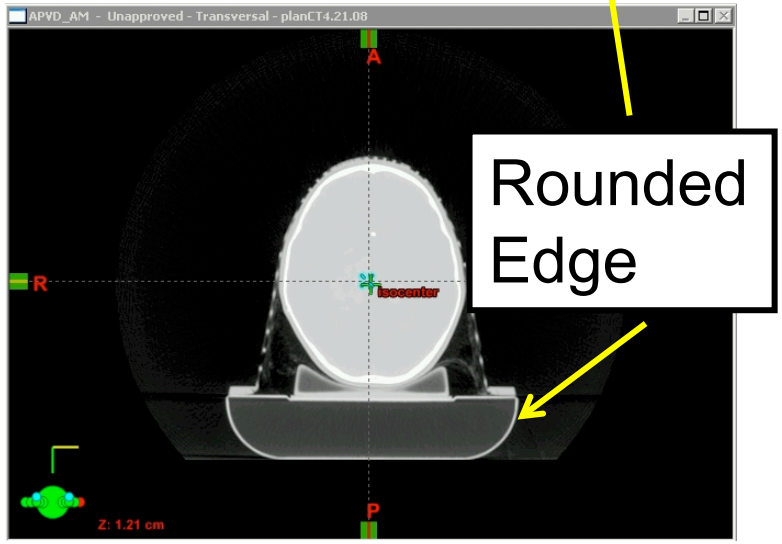
Cage Detector

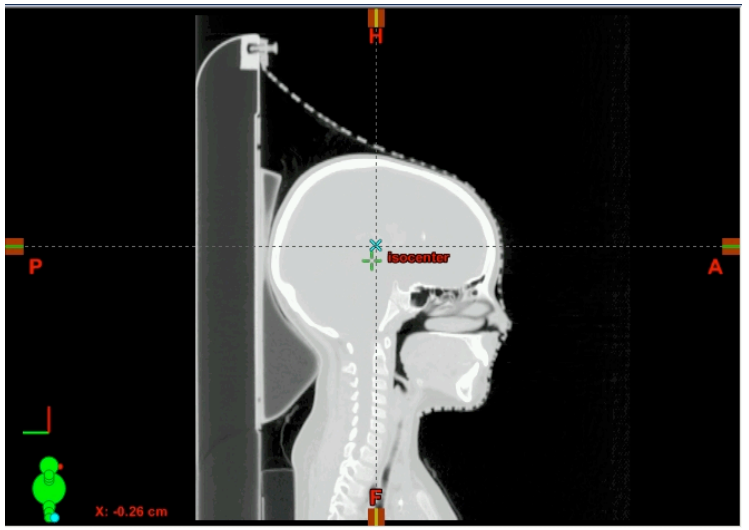
# Hitachi Couch Extensions



# Head & Neck Extension (HNE)






- No beam going through the edge of the couch extension

BOS headframe

# WET of Couch Extension

- Everything in the beam, we need to know what is the WET and If TPS can predict it.

- Water equivalent thickness (WET) can be determined through measurements of depth dose curves with and without the extension:
  - WET - Hitachi couch extensions = 1.1 cm
  - WET (HNE) = 0.7 cm

Narayan Sahoo, PhD

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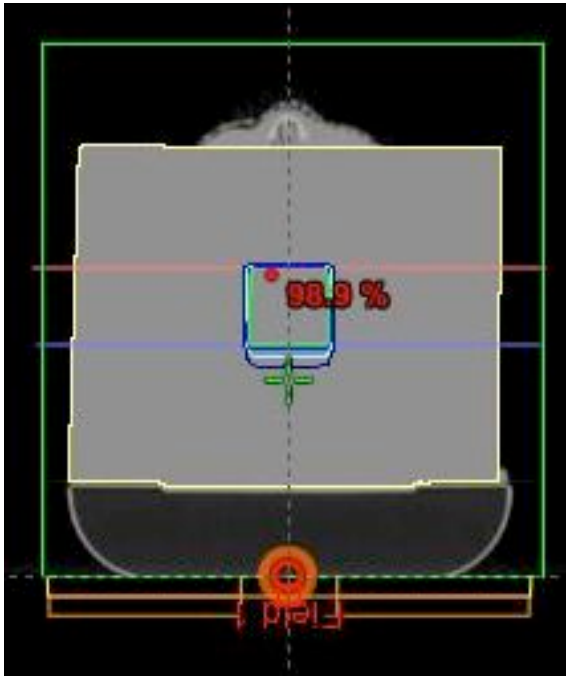
# WET by the Planning System

- Ranges calculated for a PA beam with and without the extension:




– With - Use CT values of the image
– Without - Over-writing the HNE as air (HU = -1000).

Calculated WET = 0.7 cm.

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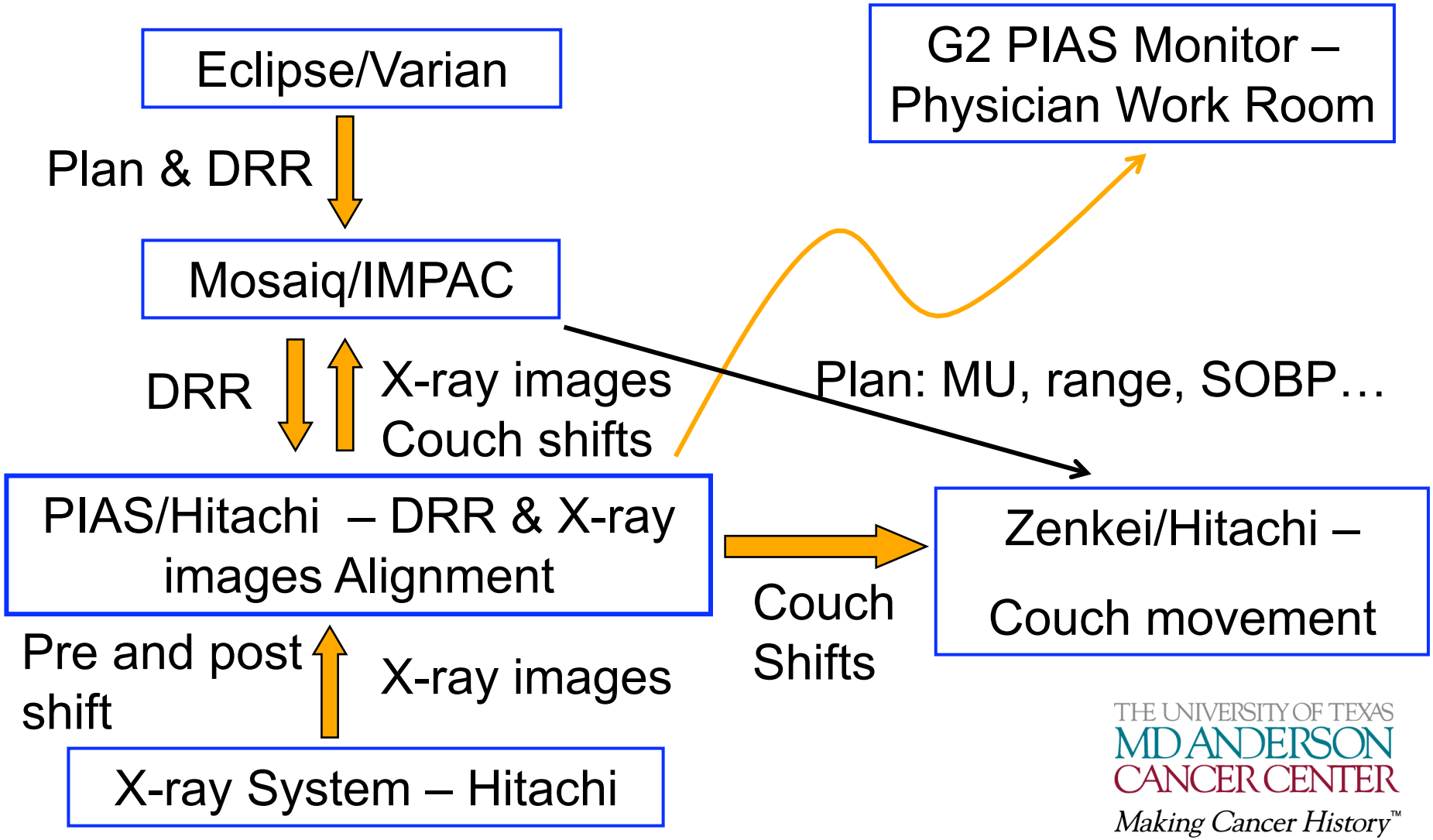
# IGRT Work Flow

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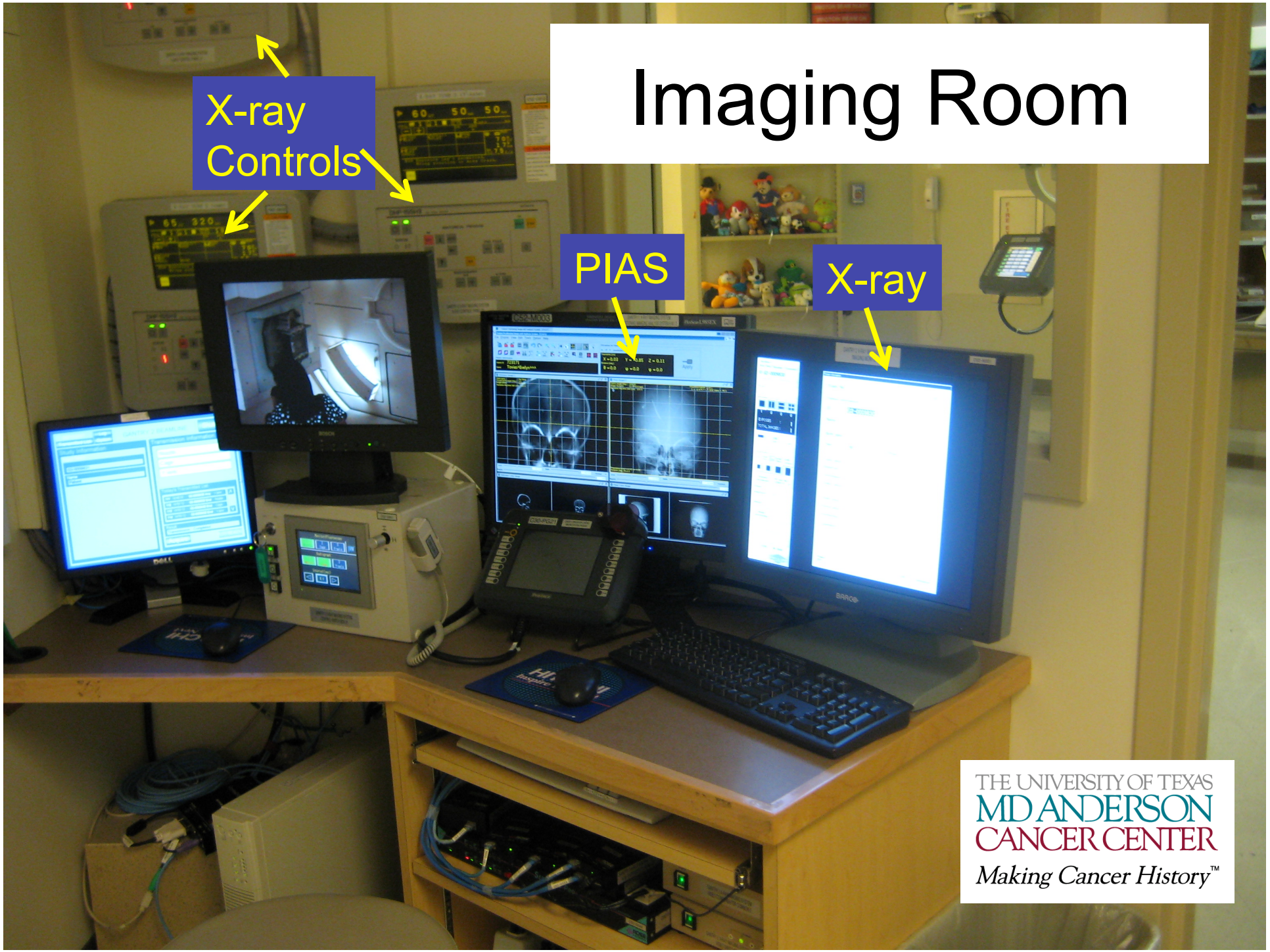


# Imaging Room

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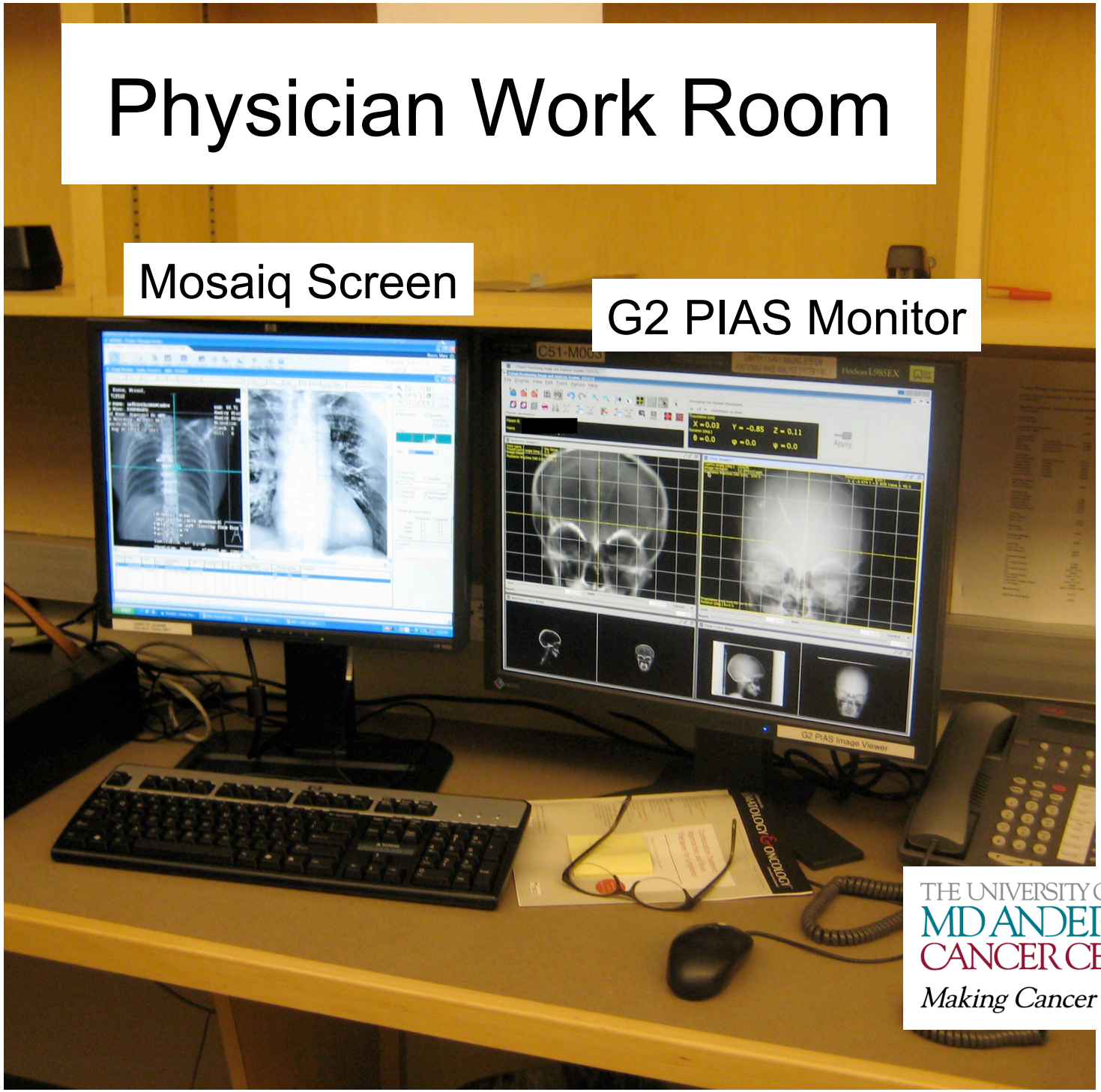
# Physician Work Room

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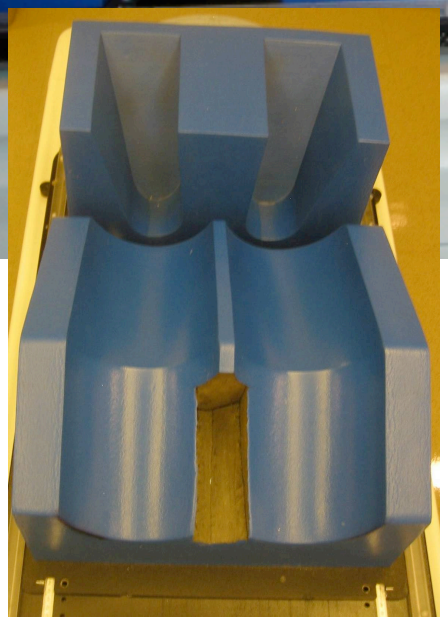
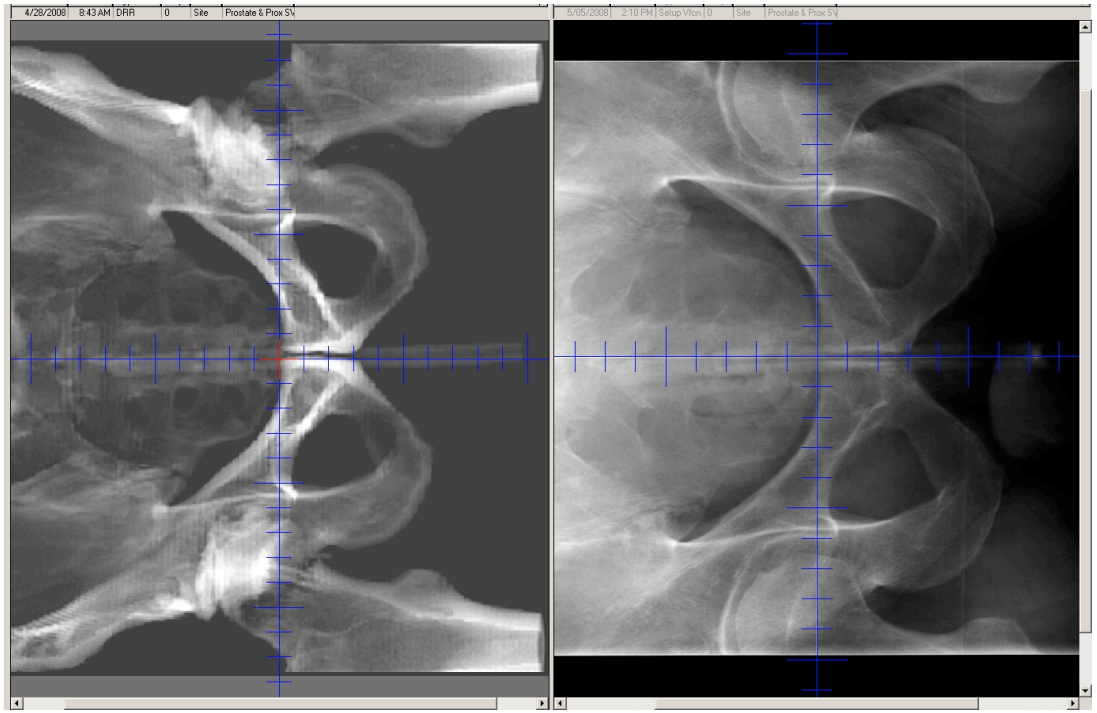
# Prostate



Prostate immobilization:

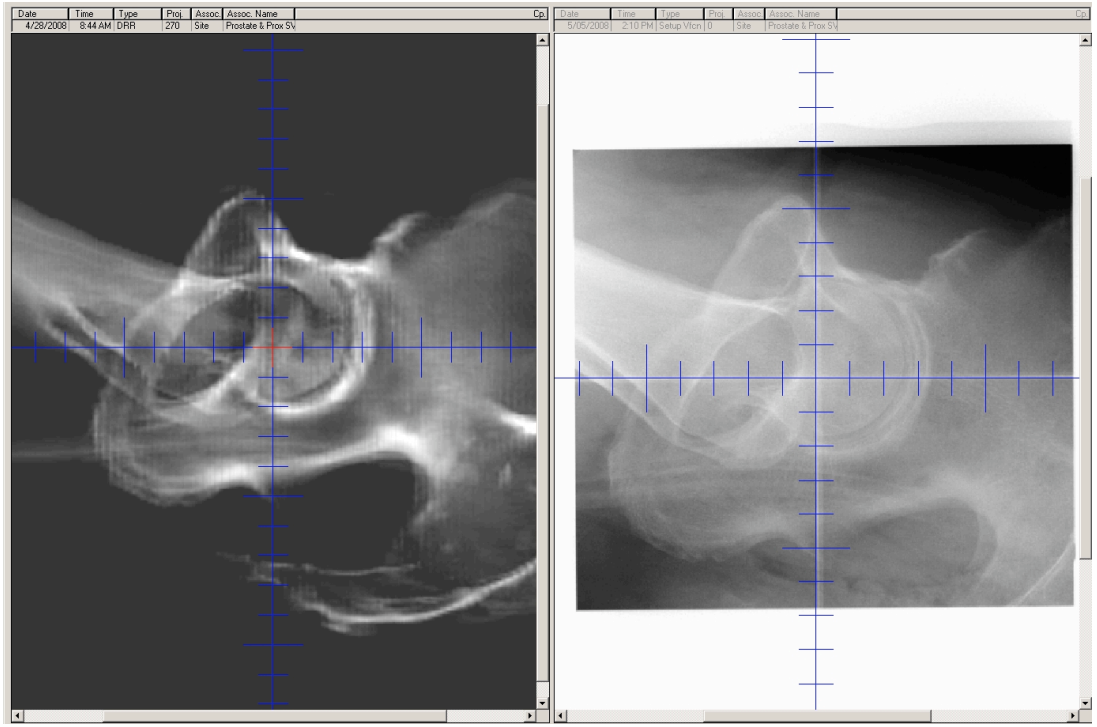
- Rectal balloon – 65 cc Water
- Leg immobilization
- Full bladder – checked by bladder scanner

AP
DRR



AP
X-ray

Lateral
DRR



Lateral
X-Ray

# Localization Results - Prostate

- Translational only
- Manual alignment
- Retrospective study
  - 3 mm geometric margin is sufficient*

* Choi *et al.* PTCOG-47, 2008

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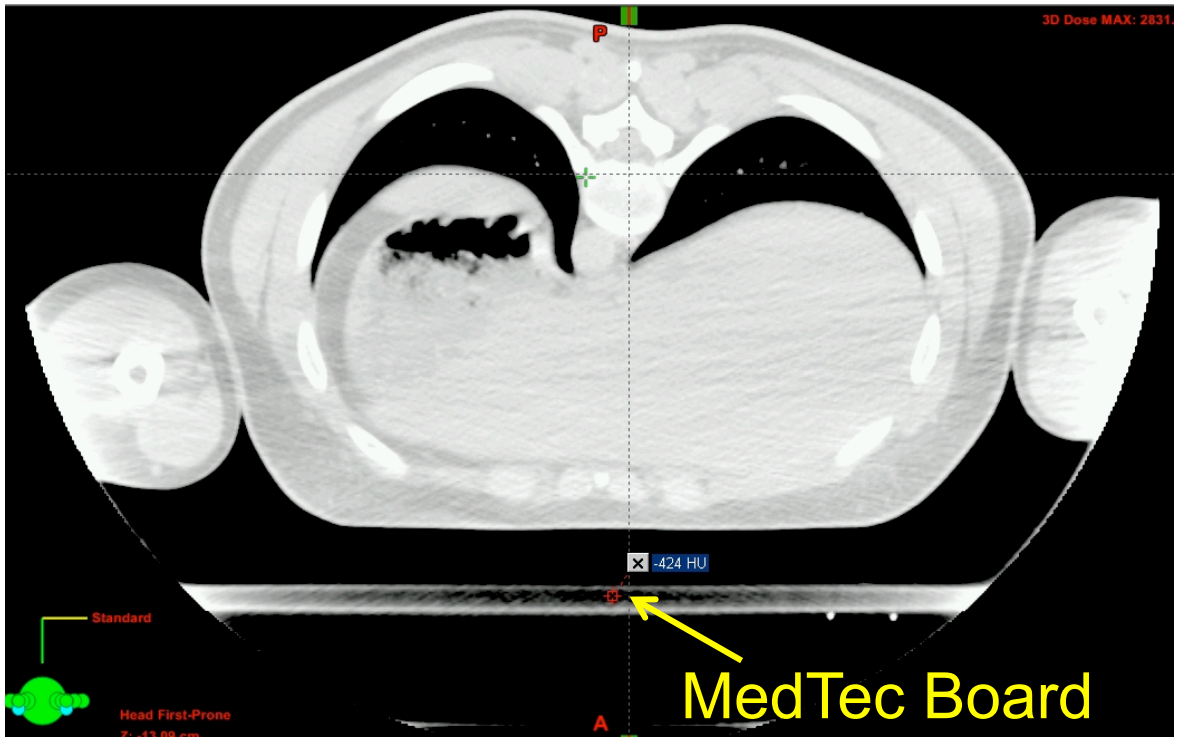
# Beyond Prostate

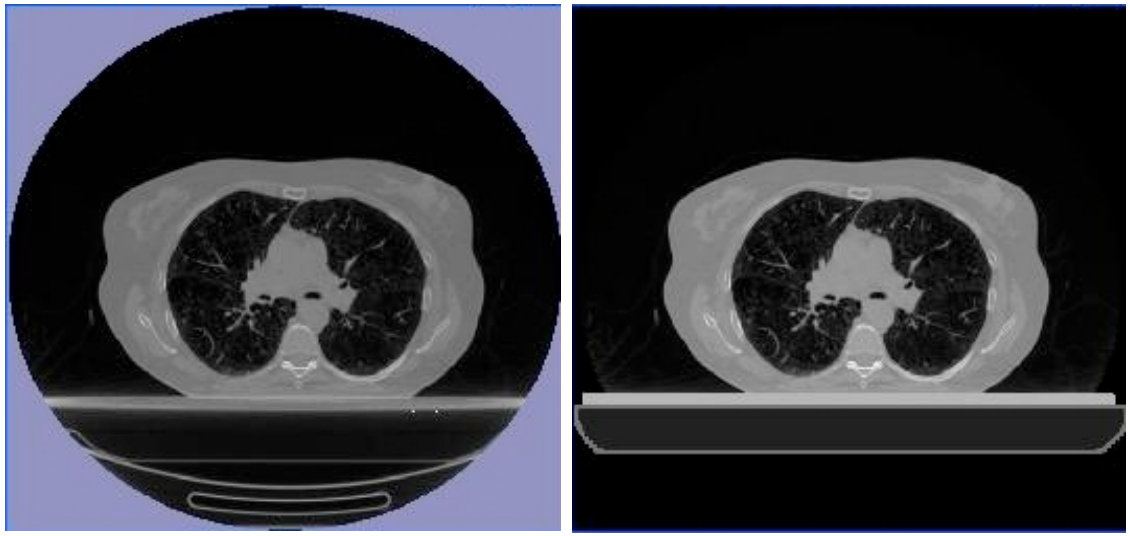
- Two issues for posterior beam:
  - CT couch is not the same as treatment couch
  - Imaging artifacts of thin high density plate




The measured WET is 1.5 cm WET, but CT number as low as -400 HU.

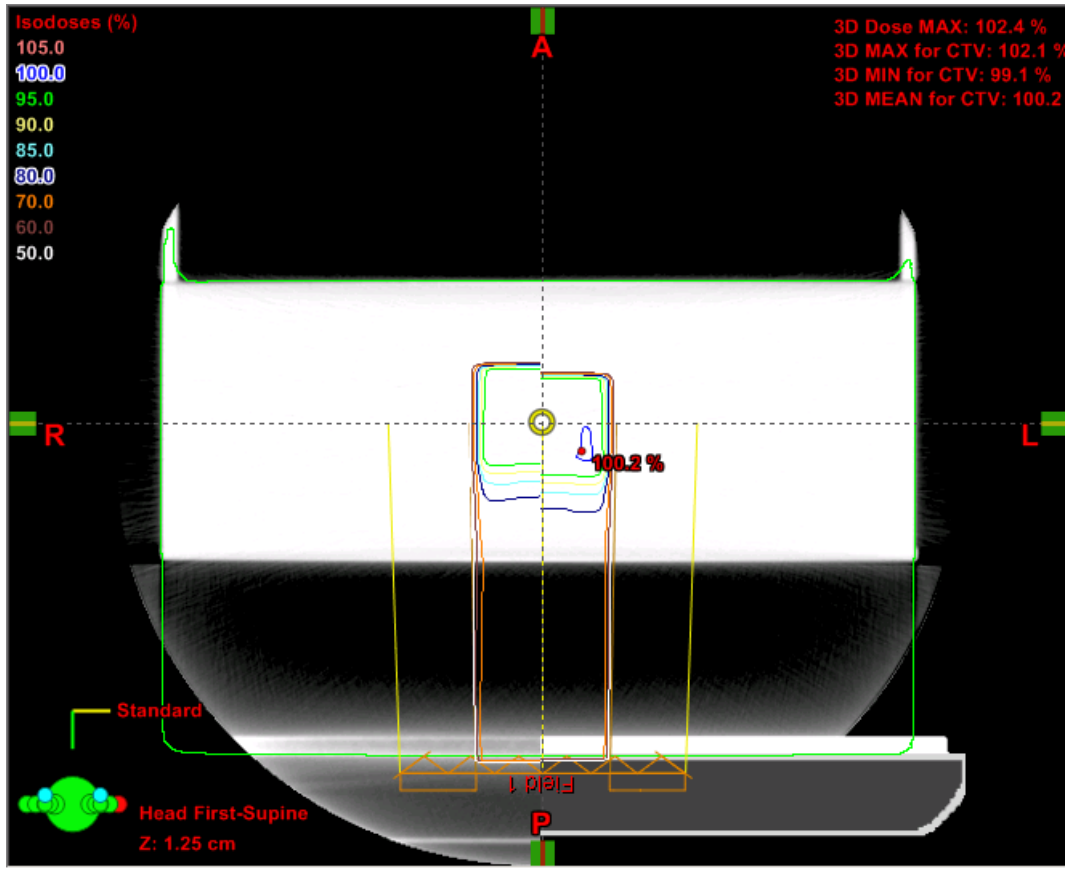
# Digital couch

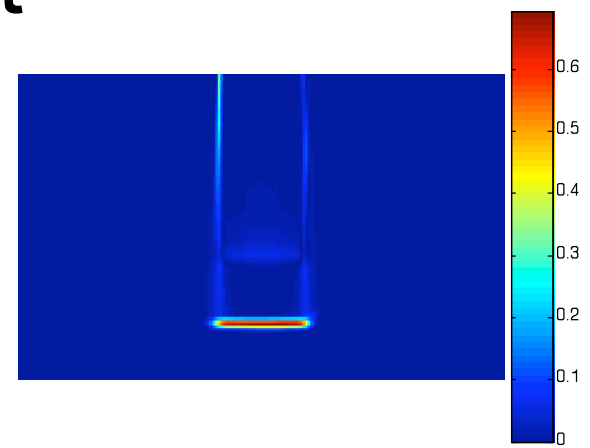
- Digital couch is necessary:
  - Replacing CT couch with treatment couch
  - Remove imaging artifacts

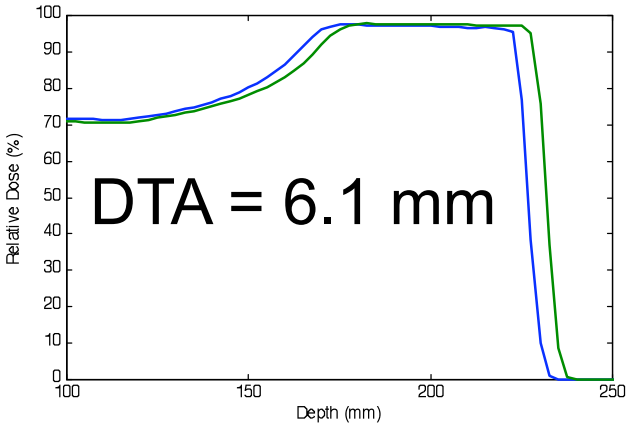


Lei Dong, PhD

# Dosimetric Impact



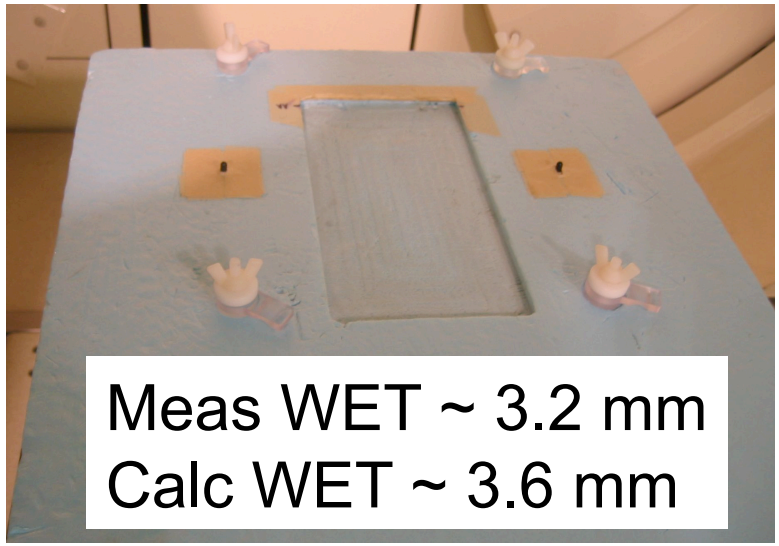




Water phantom with and without Digital couch

Heng Li, PhD

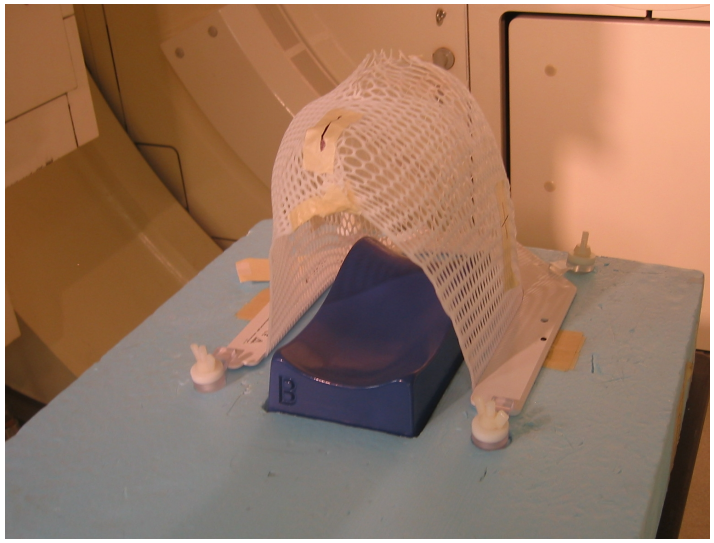
# Craniospinal Irradiation

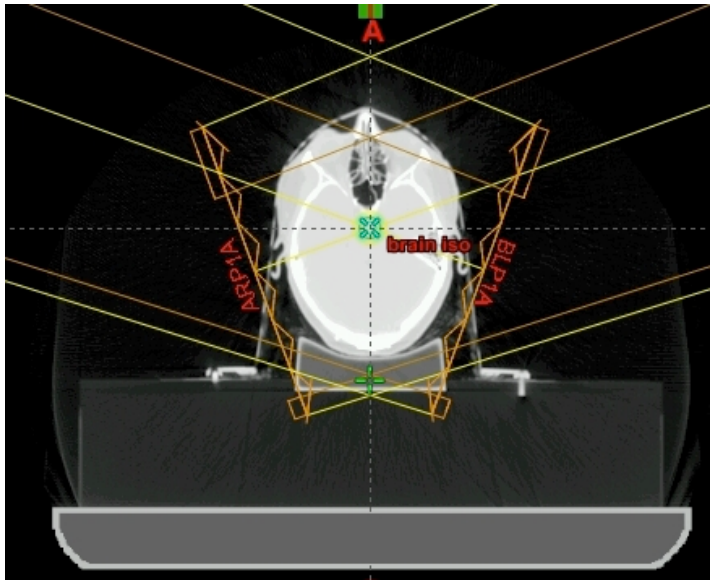


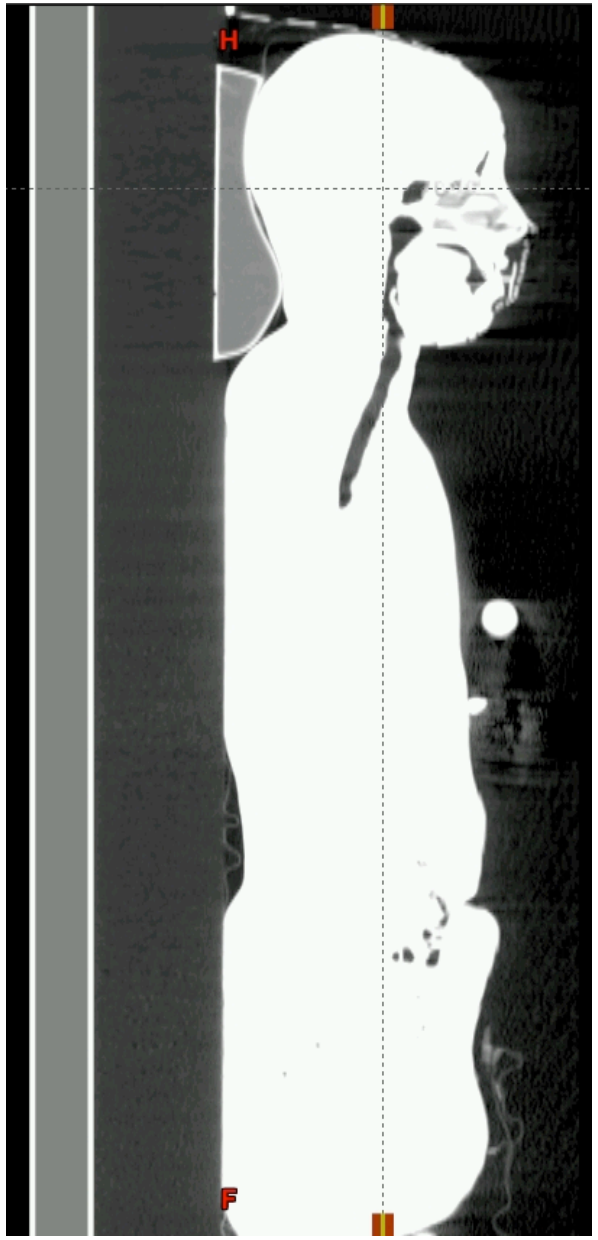

- Styrofoam to raise the patient from table.

- Mouth piece attached to mask to reduce rotation.

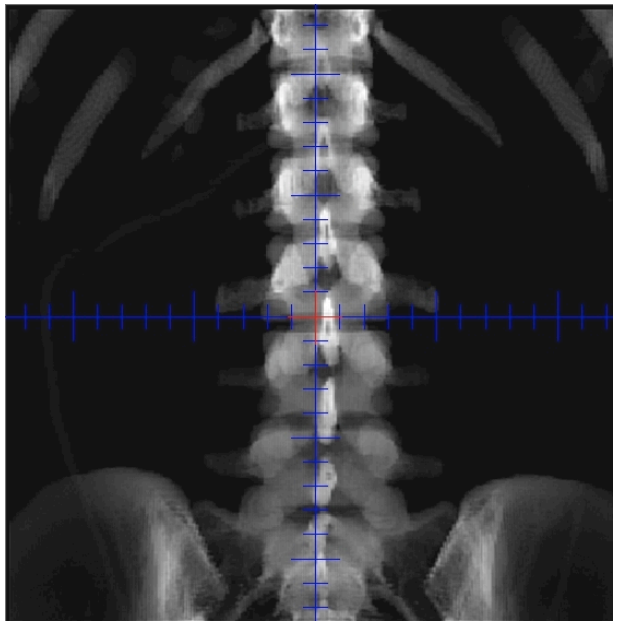
# Craniospinal Irradiation

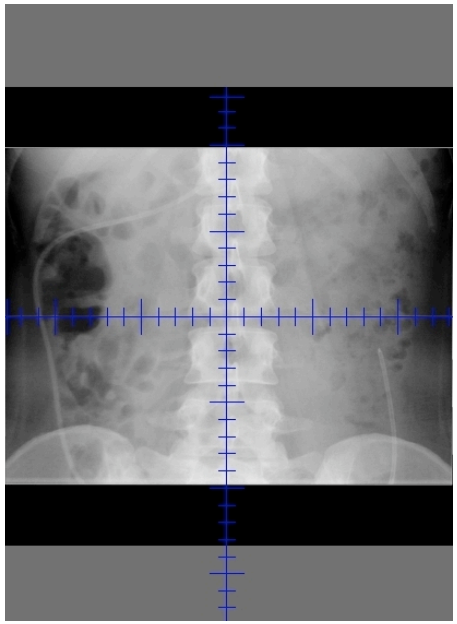




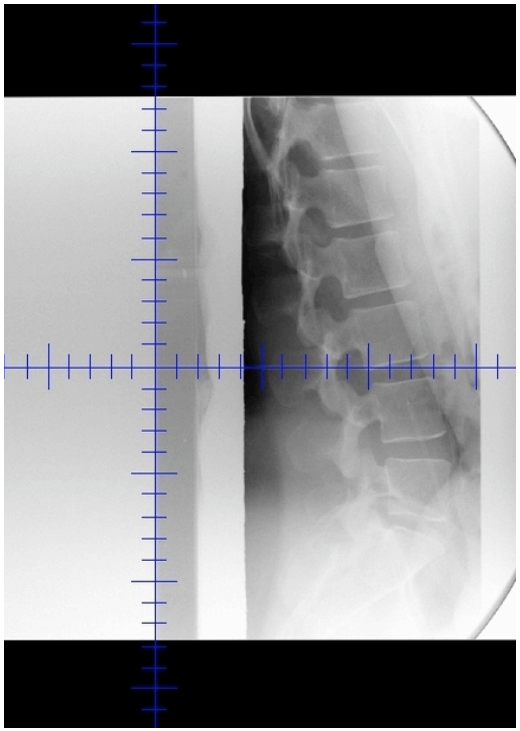
AP
DRR





AP
X-ray

Lateral
DRR

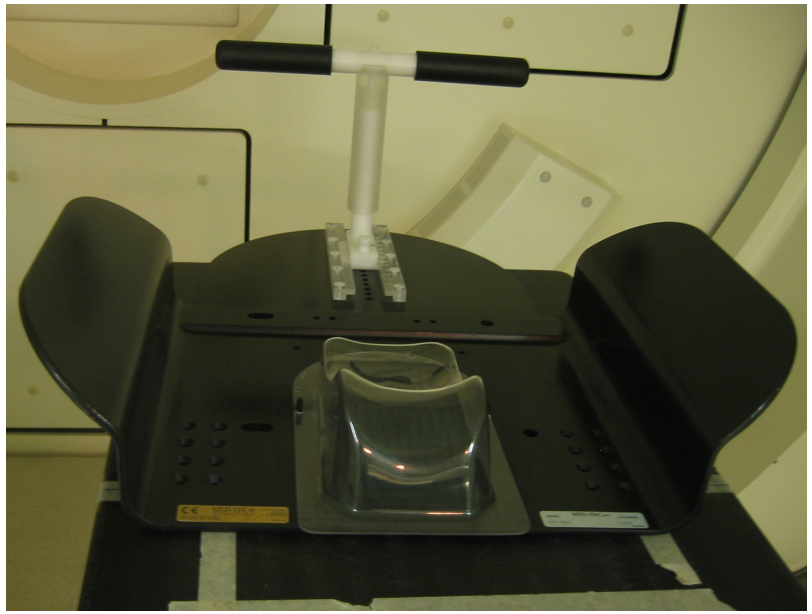


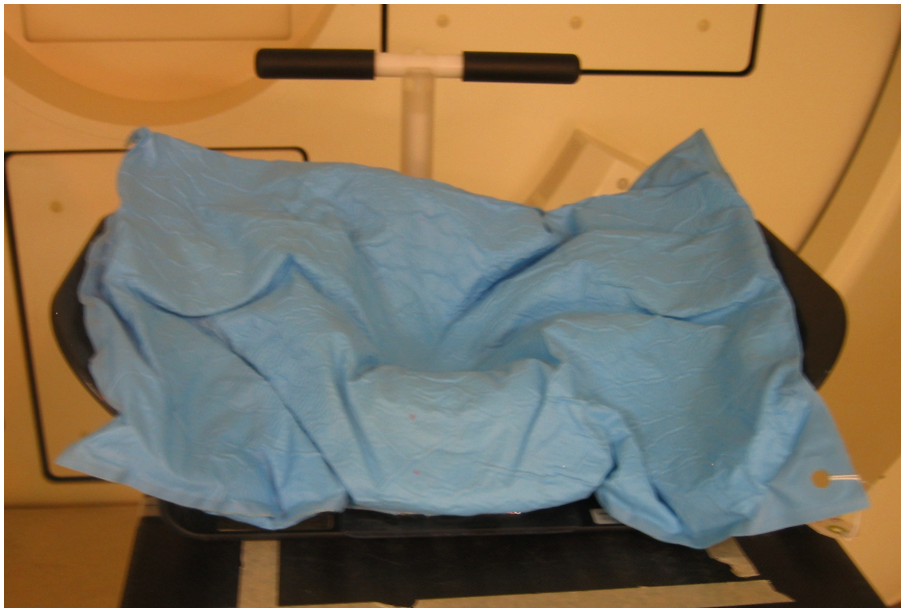
Lateral
X-Ray

# Thoracic Patients


- T-bar + wing board with vacuum-bag.
- Limit the vacuum-bag above the treatment fields – skin folding*

*Richard Amos





# Summary

- Immobilization is one of most important aspects in proton therapy:
  - Avoid use high density thin plate and sharp edges
  - Range uncertainty introduced by immobilization
- Localization – 2 orthogonal x-ray images:
  - Translational only
  - Manual alignment
  - Improvement in imaging alignment method