THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center
Making Cancer History®

Self-held Breath Control with Respiratory Monitoring and Feedback Guidance

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Contents

What is it?

Technique where patient voluntarily breathes into a set threshold and treated provided breath remains inside set threshold.

Components- Overview

- Infrared tracking camera
  - Acquires video of marker block
- Marker block
  - Surrogate for breathing motion
- Workstation
  - Displays motion info, video
- Gating switch box
  - Toggles from gated to nongated delivery
- Speakers
  - Provide audio prompt
- Goggles
  - Provide visual prompt

Components-infrared tracking camera

CCD tracking camera
- Acquires video images of marker block
- Equipped with illuminator ring
- Infrared light from ring reflects back from marker block on patient

Below camera is the in-room viewfinder
It displays the video image from tracking camera

Components- marker block

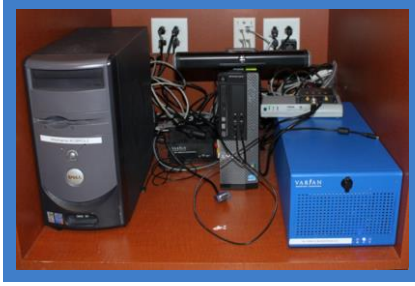
- Markers are circular
- ~ 5 mm diameter
- Positioned vertically
- Separated by ~ 3.0 cm (center to center)

- May require adjustment to accurately account for CW motion
- Place in flat region
- Ensure that the camera has an unobstructed view of marker block

RPM (real time position management) system senses the breathing motion by tracking this pair of reflective markers

Usually placed halfway between xiphoid and umbilicus

Components- Workstation, frame grabber



Workstation:

Digital image analysis and video tracking software

Connected by LAN

Components- Workstation display

Components- Gating switchbox

Located at Tx console has two controls:

1. Gating disabled/Gating enabled (key)

- Toggles between nongated delivery and gated delivery

2. Beam hold (button)

- Allows cancelling of the beam-enable state (turn off radiation beam)
- Normally lit during normal operation

Components- Speakers

Located in Simulation room and Tx room

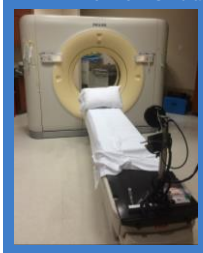
1. Provide audio to patient for inhale and exhale prompts.
2. RPM can play back recorded audio prompts for inhale and exhale

Components- Goggles

Worn by patient at simulation and for all fractions

- Displays video prompts

Workflow- Simulation



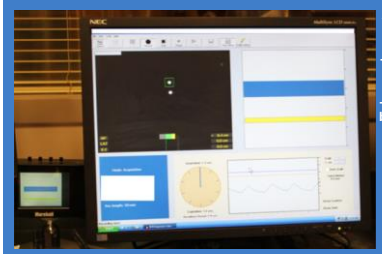
- Camera
- Placed at foot of CT table

- Setup patient in Tx position w marker box
- Taped midway between xiphoid and umbilicus
- Draw marks on skin for reproducible positioning

Workflow- Simulation

•Goggles
  •Assist patient placement

Workflow- Simulation



Acquire respiratory trace

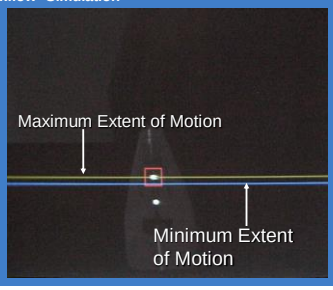
- Allow patient to breathe normally

- Prompt patient to take in deep breath and then relax

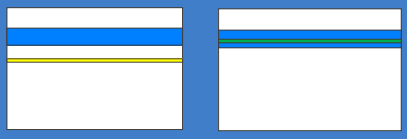
  - Repeat 3 times

- Set upper and lower thresholds

Workflow- Simulation

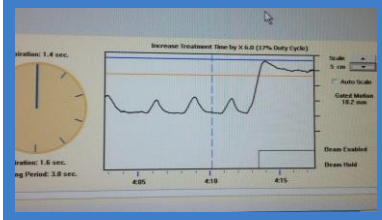


Workflow- Simulation (view through goggles)



"Take in a deep breath and hold."

Workflow- Simulation



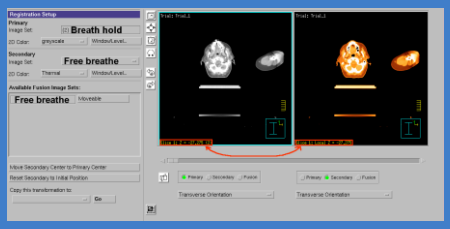
Remember to save CT reference breathing trace

Export it to Tx machine RPM computer

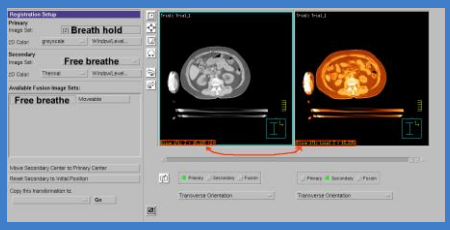
Workflow- Simulation

- Acquire FB scan
  - Record scan start and stop S/I coordinates
- Mark isocenters
- Repeat inspiration practice
- Acquire DIBH scan
  - Use above FB scan limits
- Fuse FB and DIBH scans
  - Examine FB and DIBH for matching start and stop coordinates
  - Examine DIBH for stair-step or other artifacts

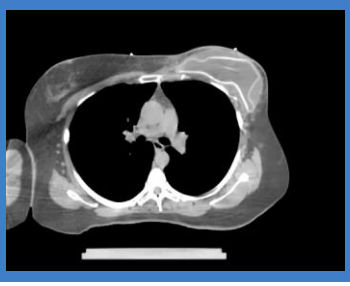
Workflow- Simulation



Workflow- Simulation

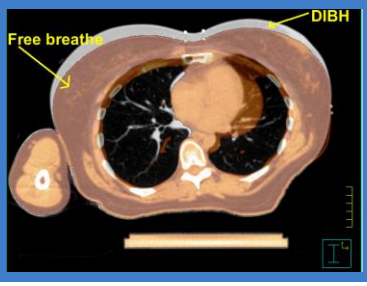


Workflow- Simulation (stair step artifact)



Workflow- Simulation (stair step artifact)

Workflow- Simulation



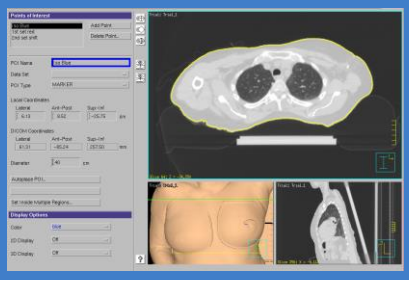
Workflow- Planning

- Copy isocenter coordinates from FB into DIBH
- Export and import DICOM RT, screen snapshot, or manual transfer

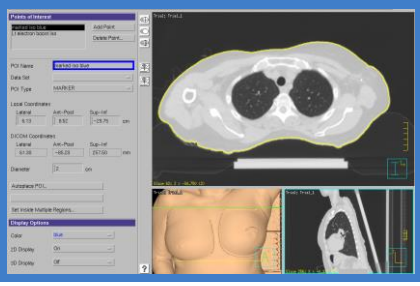
- Set superior border in DIBH
- Use screen snapshot to match anterior anatomy

- Set beams and compute dose as usual
- Be certain to provide AP and LAT SSDs
- Be certain to label plan as DIBH
- Rx requires note indicating DIBH

Workflow- Planning (isos & superior border)



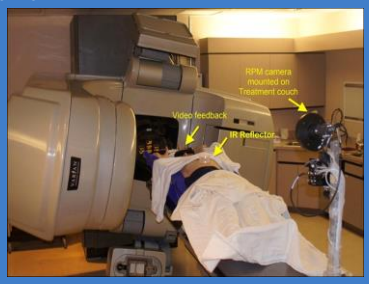
Workflow- Simulation (isos & superior border)



Workflow- DIBH Tx

- Place marker block on patient
  - Align with marks scribed at CT sim
- Setup patient to 1st set red and shift to final isocenter
- Load respiratory trace exported from CT sim
- Turn key on gating switchbox

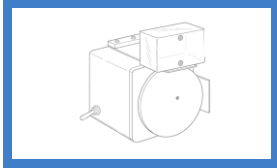
Workflow- DIBH Tx



Workflow- DIBH Tx

- Prompt patient to take in deep breath and hold
- Acquire portal image for at least one field (typically med. tangent)
- Beam on
  - Radiation will only be delivered when patient holds breath in set limits

Workflow- QA



- Place phantom on couch at isocenter
- Acquire respiratory trace
- Set threshold to occur at peak of cycle
- Play back recording
- Beam on
- Check for functionality
- Repeat monthly and annually

Check goggles daily
- Functionality
- Battery life
- Cords/connectors

Thank You!

References:

1. RPM™ *Real-Time Position Management Respiratory Gating System Reference Guide* Varian medical systems P/N 1107335-05 March 2004.
2. Keall, et al. "The management of respiratory motion in radiation oncology report of AAPM Task Group 76," Med. Phys. 33, 3874-3900 (2006).
3. Klein, et al. "Task Group 142 report: Quality assurance of medical accelerators," Med. Phys. 36, 4197-4212.

4. *RPM Gating System SW 1.7 for Clinac* P/N IPA-RG-17CLINAC-D July 2013.