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Intrafraction Motion Detection with SGRT

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Overview:

- SGRT at ICHNT
- Aims/Methodology
- Results
  - Intrafraction motion in Breast Radiotherapy
  - Intrafraction motion in DIBH vs Freebreathing
  - Intrafraction motion in MV vs CBCT Imaging
- Challenges going forward

Radiotherapy Service at ICHNT

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Approximately **1,500** patients per year receive complex planned radiotherapy treatments (3DCRT/VMAT/SABR)

5 Varian Truebeam linacs across 2 hospitals

Aria Record & Verify System

RayStation TPS

Only one SGRT system

AlignRT Advance 6.3 installed on one Truebeam at Hammersmith Hospital

Upcoming installation on Radixact machines as part of replacement programme

Breast Workflow at ICHNT

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DIBH and Freebreathing CT scan for all DIBH patients

Daily MV imaging for Breast, Daily CBCT imaging for Breast + IMC or Breast VMAT

Conventional Workflow:

- Conventional set up with tattoos and daily imaging
- Intrafraction motion tracked with CCTV
- DIBH monitored with CCTV and Varian RPM block
- Resetup if patient movement noticed by radiographers

SGRT Workflow

3mm/3 degrees setup/beam control tolerance

MV imaging: setup using CT reference, image, if image shifts >5mm apply shift and **reference** otherwise treat using CT reference

CBCT imaging: setup using CT reference, centre couch, **reference**, image, apply shifts, **reference**, treat

Intrafraction motion corrected up to 0.5cm. Reimage 0.6cm-1cm

Intrafraction Motion Audit - Aims and Methodology

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- Limited SGRT capacity so audit required to investigate Breast intrafraction motion to optimise SGRT utilisation

- Audited the frequency and magnitude of intrafraction movement for Breast patients April-July 2025
  - Which patient cohorts move more often?
    - CBCT?
    - MV?
    - Freebreathing?
    - DIBH?
  - Can we predict when patients move and schedule SGRT accordingly?
    - Early treatment nerves = more freezing or more moving?

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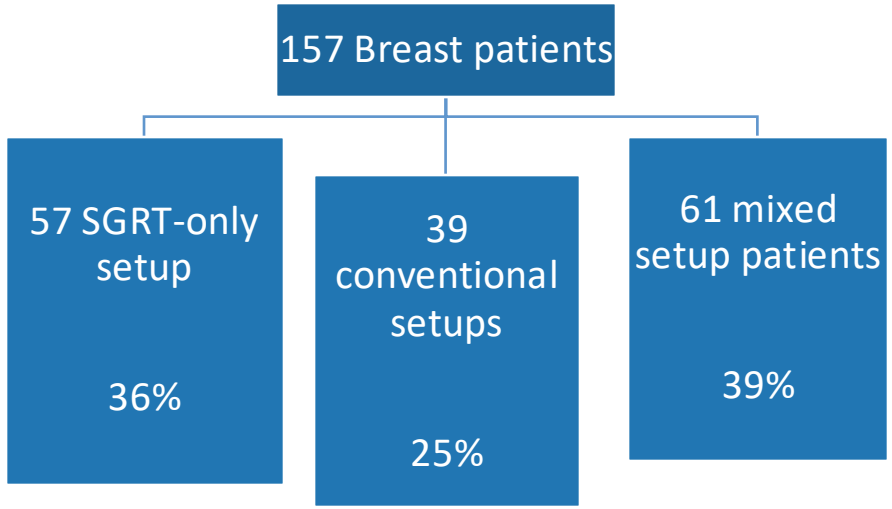
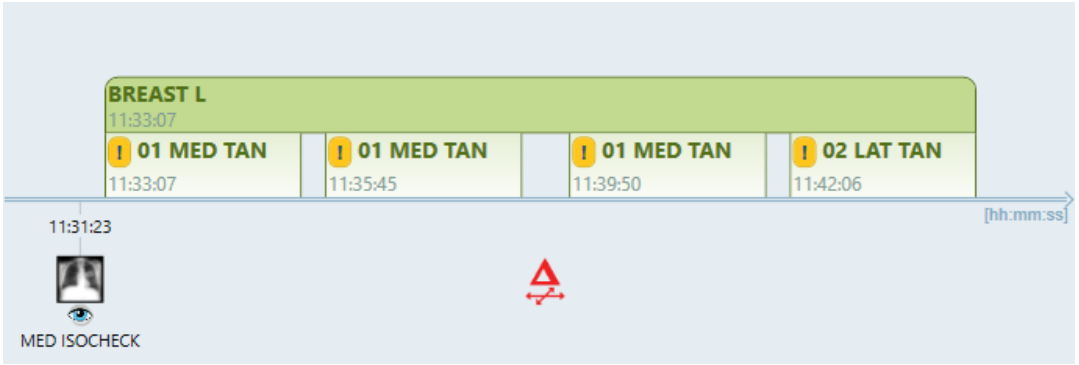


- 157 Breast patients included in audit
  - Mix of SGRT only, conventional only and mixed
- Aria RT Summary used to document couch positional changes after beam-on



Results - All treatments are equal but some treatments are more equal than others

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- 157 patients and 1300 fractions included in audit

- 67% of fractions [n=873] were treated with SGRT
  - Even with only one system 2/3 of fractions treated with SGRT
  - 75% of all breast patients had ≥1 SGRT fraction

- **Intrafraction motion corrected during treatment in 12% of all SGRT treatments [109/873 #s]**
  - No examples of patient movement noted with conventional setup
  - For mixed setup cohort higher SGRT Usage(>60% vs<40%) correlates with intra-fraction movement($p<0.05$)
  - 2 patients moved on their one and only SGRT fraction

Results - All treatments are equal but some treatments are more equal than others

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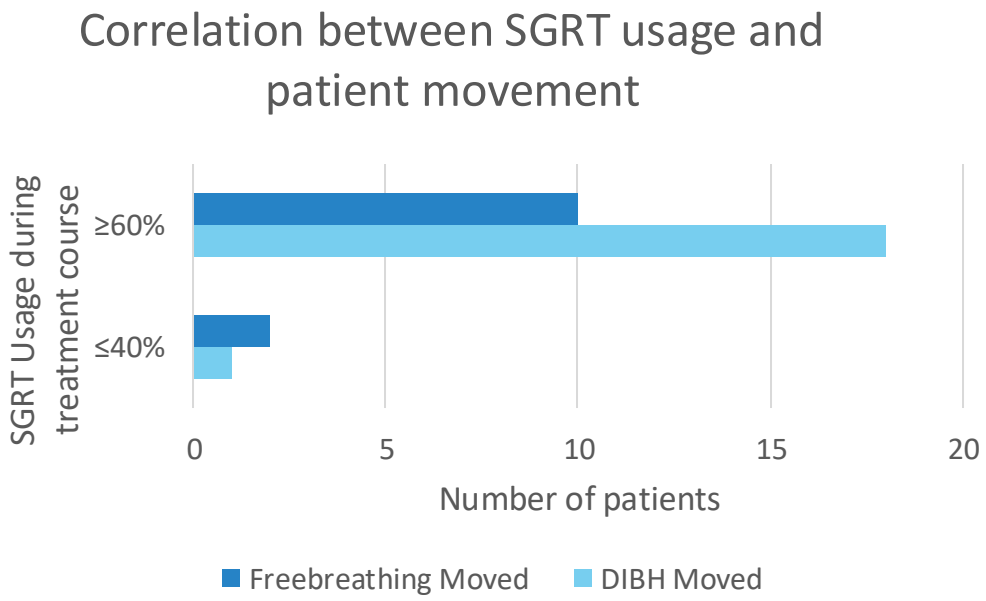
- Intrafraction motion corrected during treatment in 12% of all SGRT treatments [109/873 #s]

- **Mixed cohort results show that SGRT is picking up intrafractional movement that we might be missing**
  - For mixed setup cohort higher SGRT Usage(>60% vs <40%) correlates with intra-fraction movement ($p<0.05$)
  - 2 patients moved on their one and only SGRT fraction



Results – Which fractions do they move?

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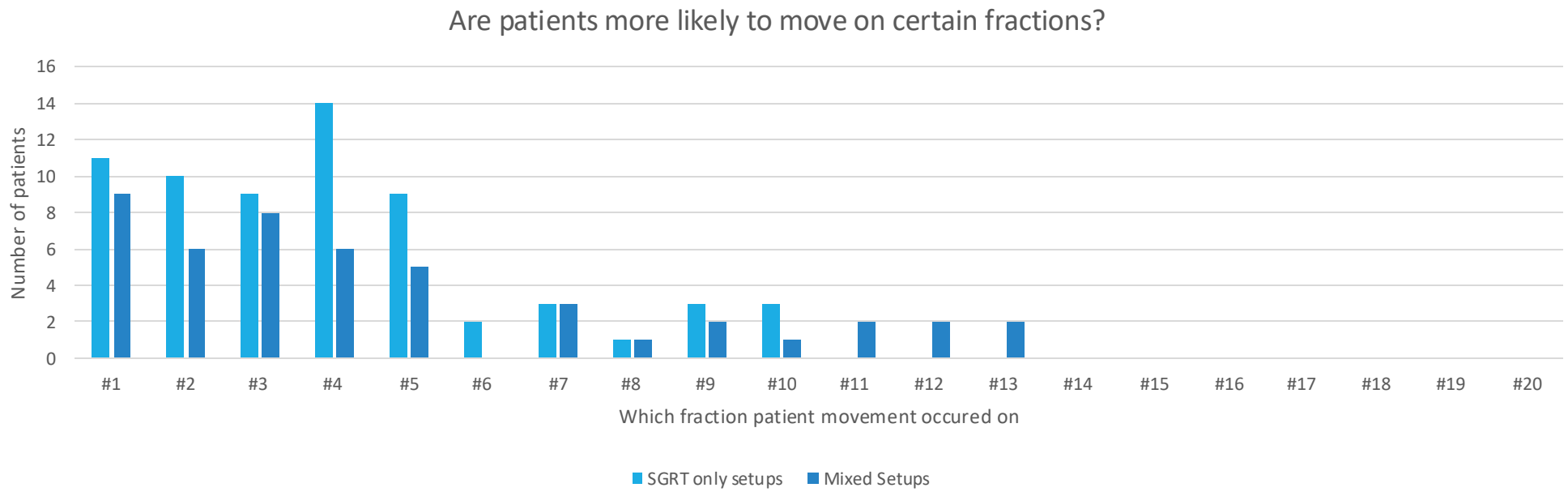
- No specific fraction was associated with increased patient movement:
  - E.g. not more likely #1 due to nerves
- General trend after #5 for patient movement to decrease
  - 64% of SGRT-only patients treated with 26Gy/5#, yet they accounted for **85%** of all movement
  - No movement after #10 (SGRT-only cohort), despite 20% of SGRT-only courses being >10#
- Consistency/Familiarity reduces patient movement



Results - A Tale of Two Breath-Holds: CBCT vs MV

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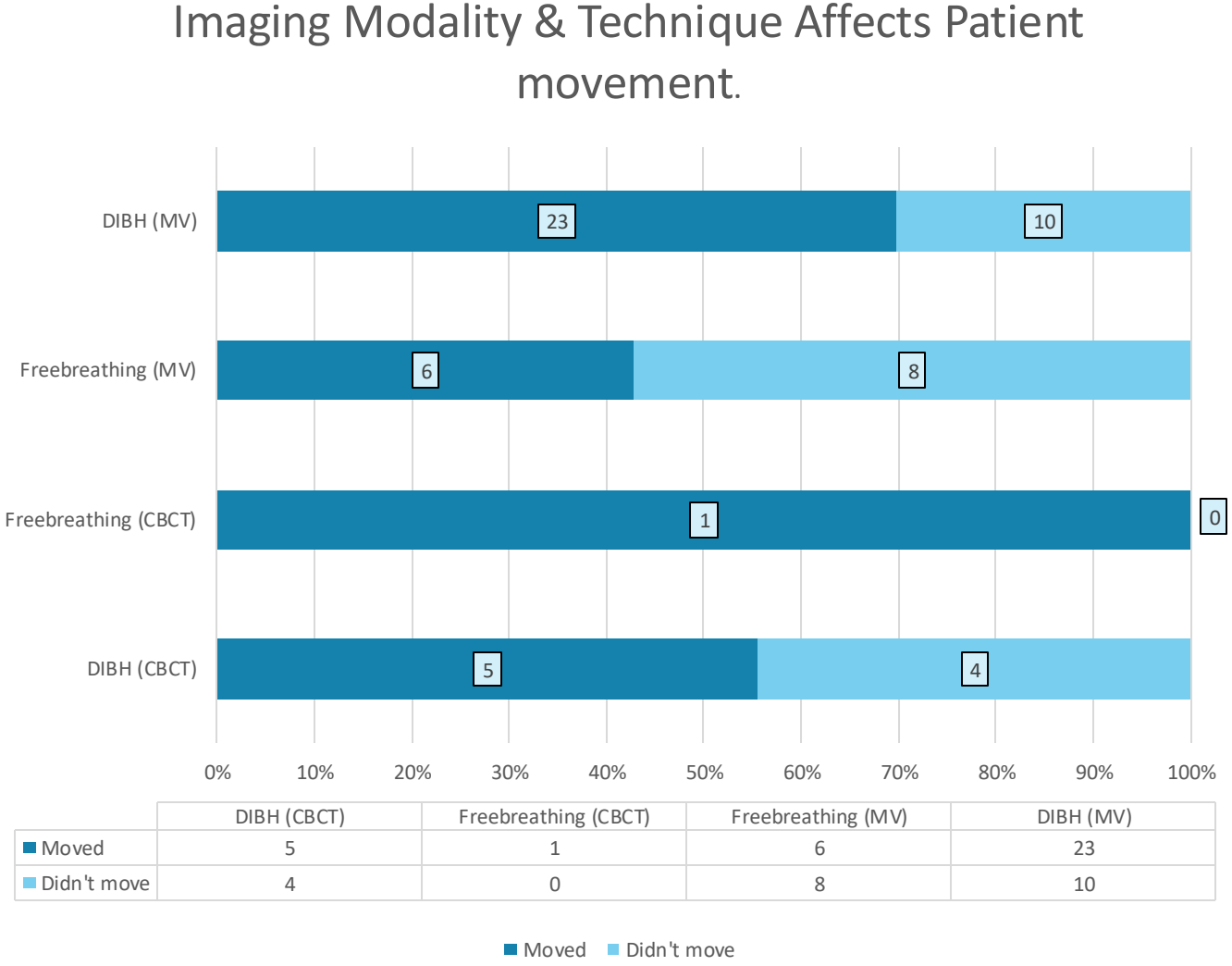
- DIBH patients are more likely to move than freebreathing ($p<0.05$)
  - SGRT-only MV imaging cohort (n=47)
  - Active nature of DIBH treatment causes increased intra-fraction patient movement



	DIBH (CBCT)	Freebreathing (CBCT)	Freebreathing (MV)	DIBH (MV)
Moved	5	1	6	23
Didn't move	4	0	8	10

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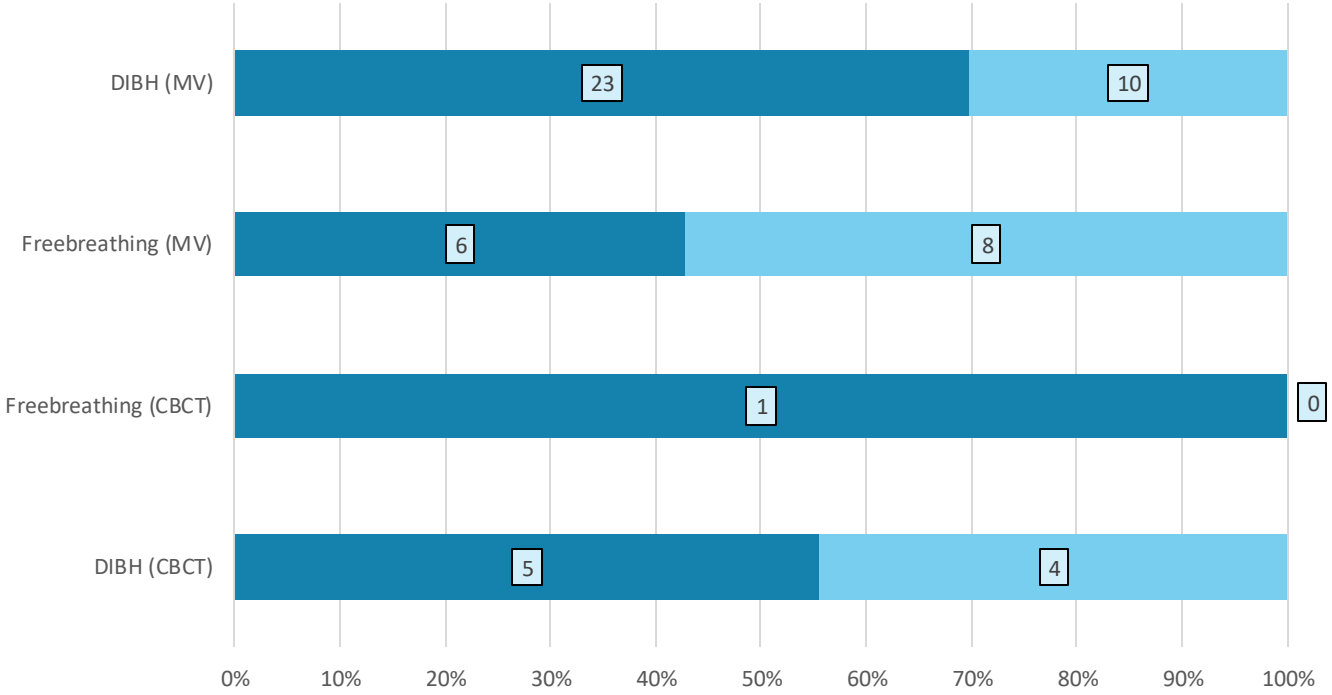
- DIBH patients are more likely to move than freebreathing ($p<0.05$)
  - SGRT-only MV imaging cohort (n=47)
  - Active nature of DIBH treatment causes increased intrafraction patient movement
- 69% of DIBH MV imaging patients moved compared with 44% of CBCT DIBH in SGRT-only cohort
  - CBCT treatments take longer and have more fractions!
  - New references created when centring couch and applying imaging shifts for CBCT
- Repeated SGRT references may mask small patient movement that accumulates over a treatment course.

Imaging Modality & Technique Affects Patient movement.



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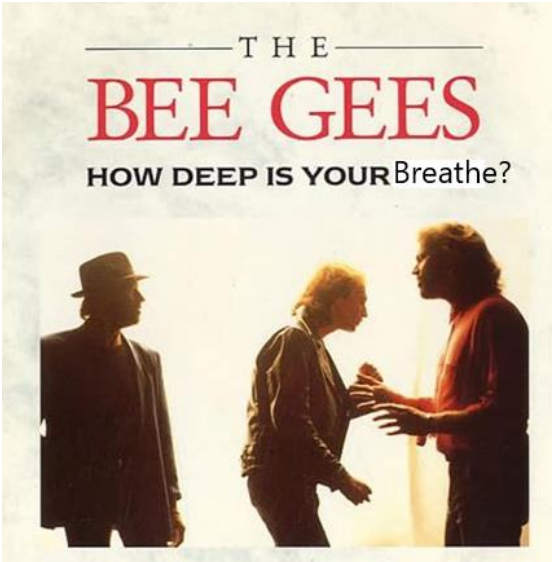
Moved Didn't move

Results - Deep(er) Inspiration Breath-hold

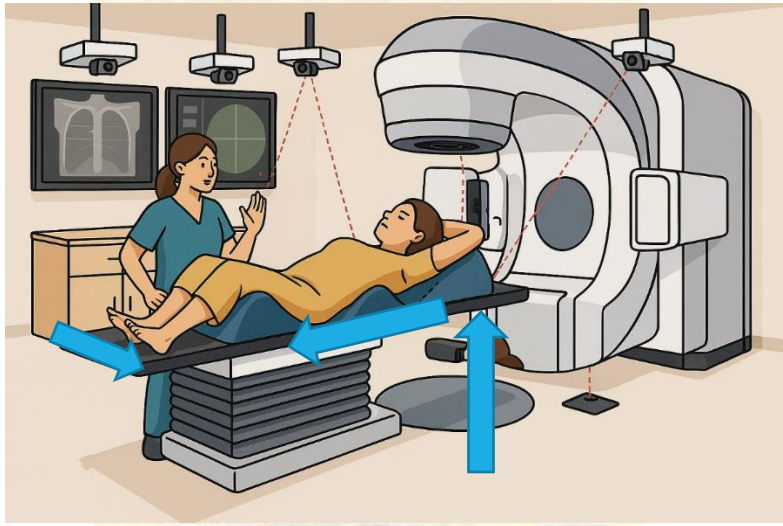
- Analysed direction/magnitude of shifts detected
  - Ignored absolute values ≤0.2cm

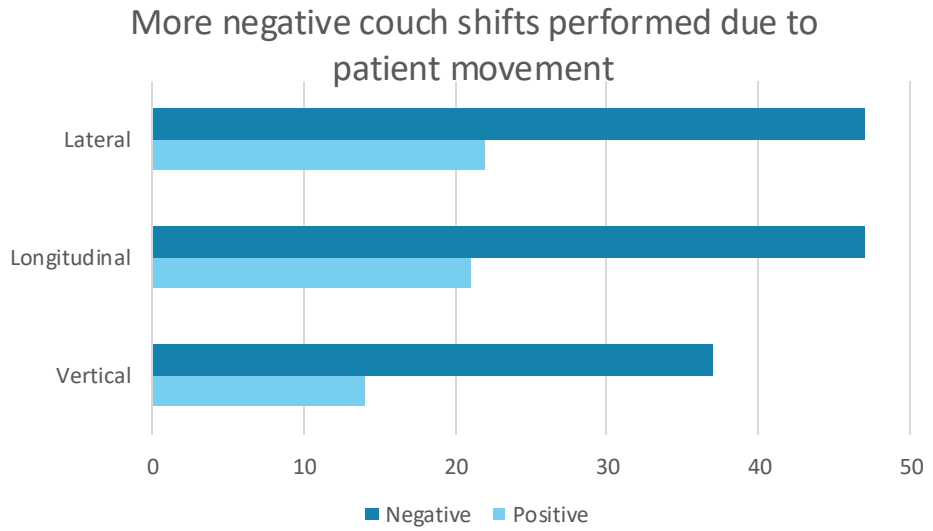


Results - Deep(er) Inspiration Breath-hold

- Analysed direction/magnitude of shifts detected
  - Ignored absolute values ≤0.2cm

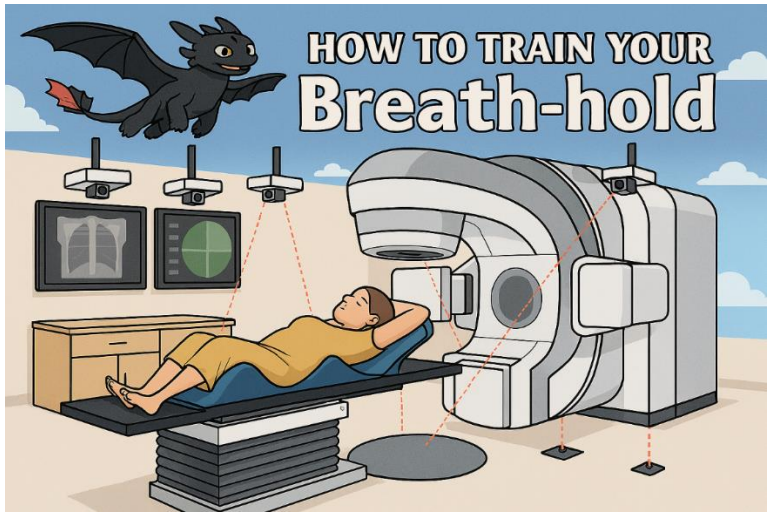
- Patient movement resulted in more negative couch shifts:
  - Raised ($p<0.05$)
    - Patient slipping down the breast board? Thoracic relaxation? Coaching bias? Patient Compliance?
    - Not correcting means patients must breathe deeper (if they can)
  - Further from gantry ($p<0.05$)
    - Shoulder tension? Coaching bias?
  - Couch moves to the left ($p<0.05$)
    - More Left sided ROI? Lack of coaching strategies

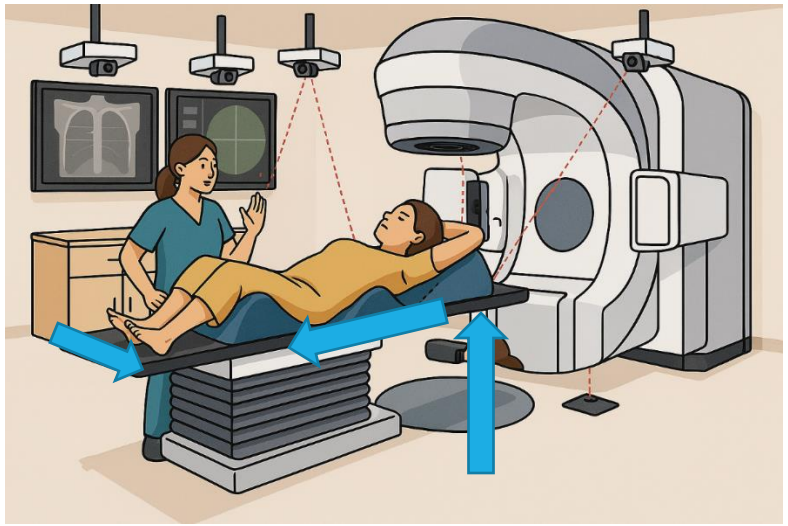




Challenges going forward

- Prioritise SGRT for DIBH over freebreathing patients when at max capacity
- Proactive rather than Reactive Send to Couch shifts
- Use of introductory videos/pre-treatment walkthroughs to increase familiarity





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Thanks for listening!

Questions?

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