// March 2023

Implementing SGRT for routine use for SABR and non-SABR treatments – The GenesisCare NSW Experience

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Disclaimer

- VisionRT have invited me to present and are covering associated travel and accommodation costs
- The views represented in the following presentation are my own and may not necessarily reflect those of GenesisCare and/or VisionRT

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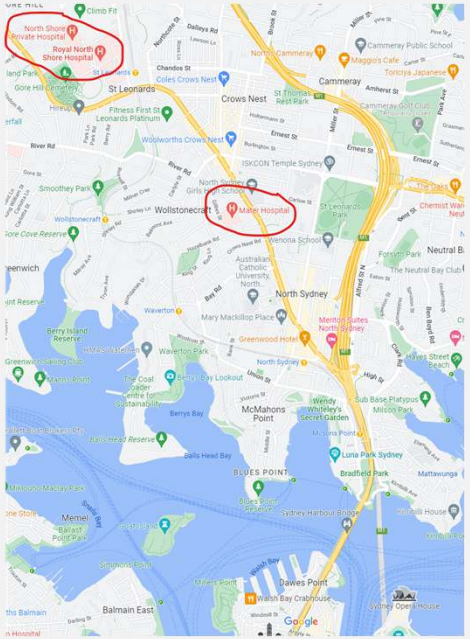
Today's Presenter

GenesisCare | NSW Physics
Solution Driven | Patient Centred

Mark Wanklyn

Senior Medical Physics Specialist

- Trained in the UK
- In Australia for last 5 years
- Based at Mater Hospital & North Shore Health Hub in Sydney
- SGRT SME for GC NSW



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Today's Agenda

01 Introduction to the AlignRT system

02 Internal or external imaging

03 Commissioning AlignRT

04 Routine use of AlignRT

05 SGRT for complex treatments

06 Conclusion and future directions

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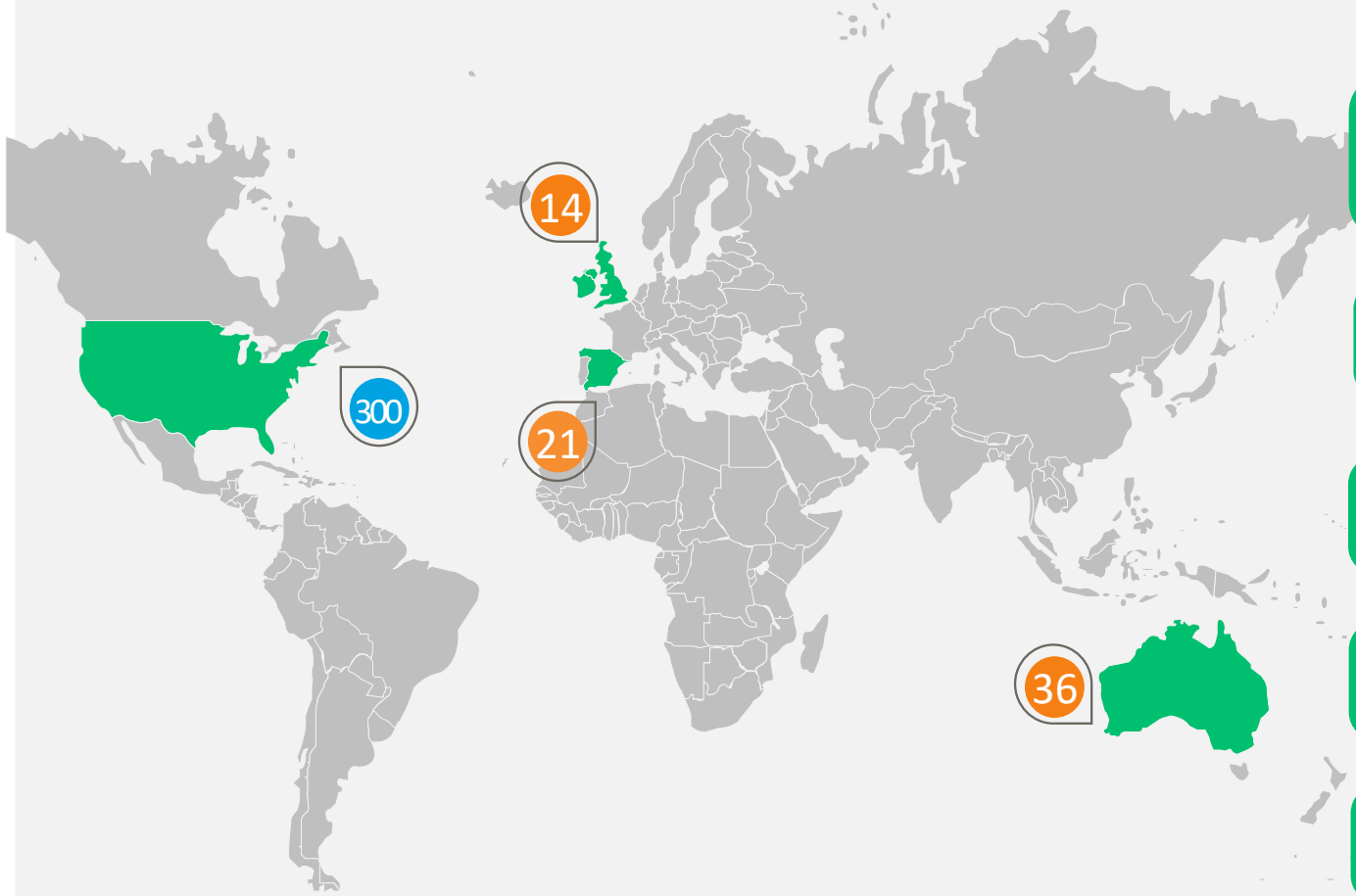
Prologue
Who are GenesisCare

A global network with 443k patient treatments p.a.



Cancer treatment centres and medical offices	**350+** clinics Including **~200** radiotherapy treatment centers
Countries	**4** U.S., Australia, the U.K, Spain
Team	**5,500+** Physicians and staff
Patients	**440,000+** patient treatments p.a.
Clinical trials	**150+** clinical trials

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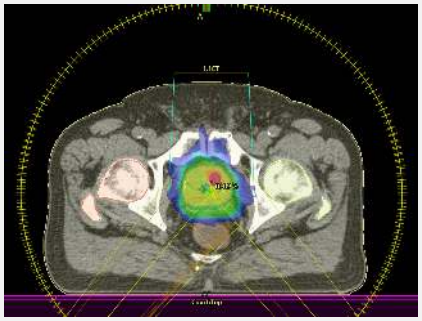
What we have at GC Mater & North Shore

Eclipse TPS

V16.1

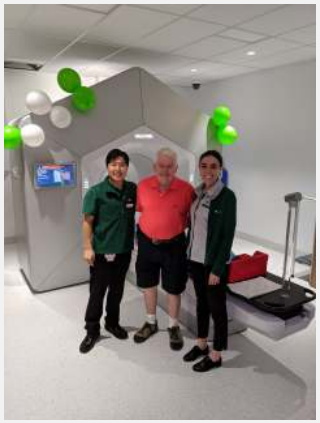


Truebeam & EDGE

With AignRT

Halcyon

V3.0



Siemens and GE CT

With GateCT (SimRT)

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01
Introduction to the AlignRT system

The AlignRT system

What does it do?

- The units project a speckle pattern onto the patient
- The cameras reconstruct the speckle pattern into a 3D surface
- Reconstructed 3D surface is then matched in 6DoF to either reference SGRT image or a CT reference structure
- Intended to complement imaging, and monitor patient throughout their treatment fraction
- Monitors external motion, and can be used to gate respiratory based treatments (e.g. DIBH, DEBH)

The 3 camera system

02
Internal or external imaging

Internal motion doesn’t always translate to external motion

When can you use SGRT?

- Superficial tumours
- Tumours that move with respiration
- Tumours that are unlikely to move
- Initial patient set-up

When should you use SGRT?

- Whenever you can!
- It’s non invasive and non ionising therefore can be used on most patients
- The vast majority of patients will benefit from some form of SGRT
  - Initial setup
  - DIBH
  - DEBH
  - Intrafraction monitoring

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Internal motion doesn’t always translate to external motion

Correlation between internal and external motion

- We have done some work to investigate the correlation between shifts suggested by imaging and SGRT
- A range of tumour sites (breast, prostate, lung, cranial) were investigated
- Results are very promising and for all treatment sites showed very good agreement
- This work is soon to be published but here is a snapshot of the results in the 3 translational directions
- Acknowledgement: Si Wei Sam

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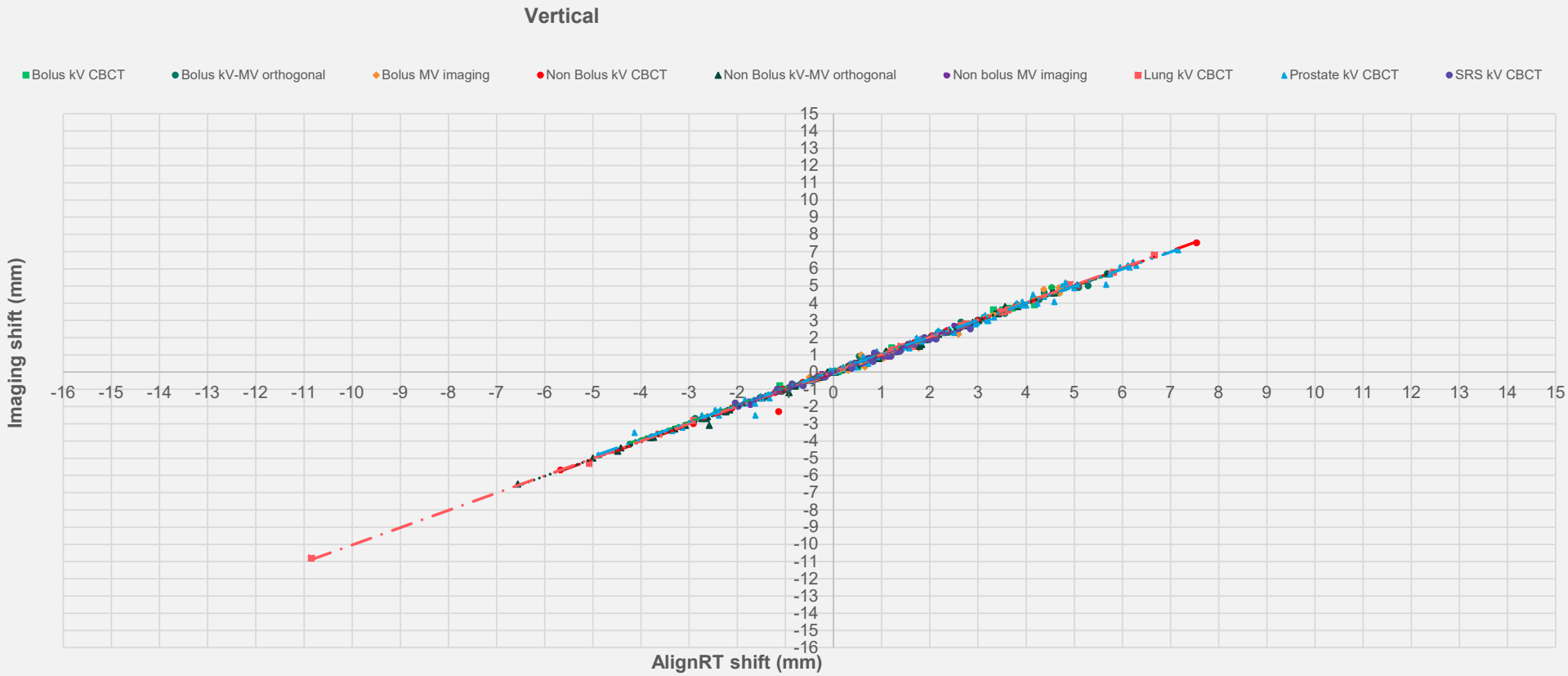
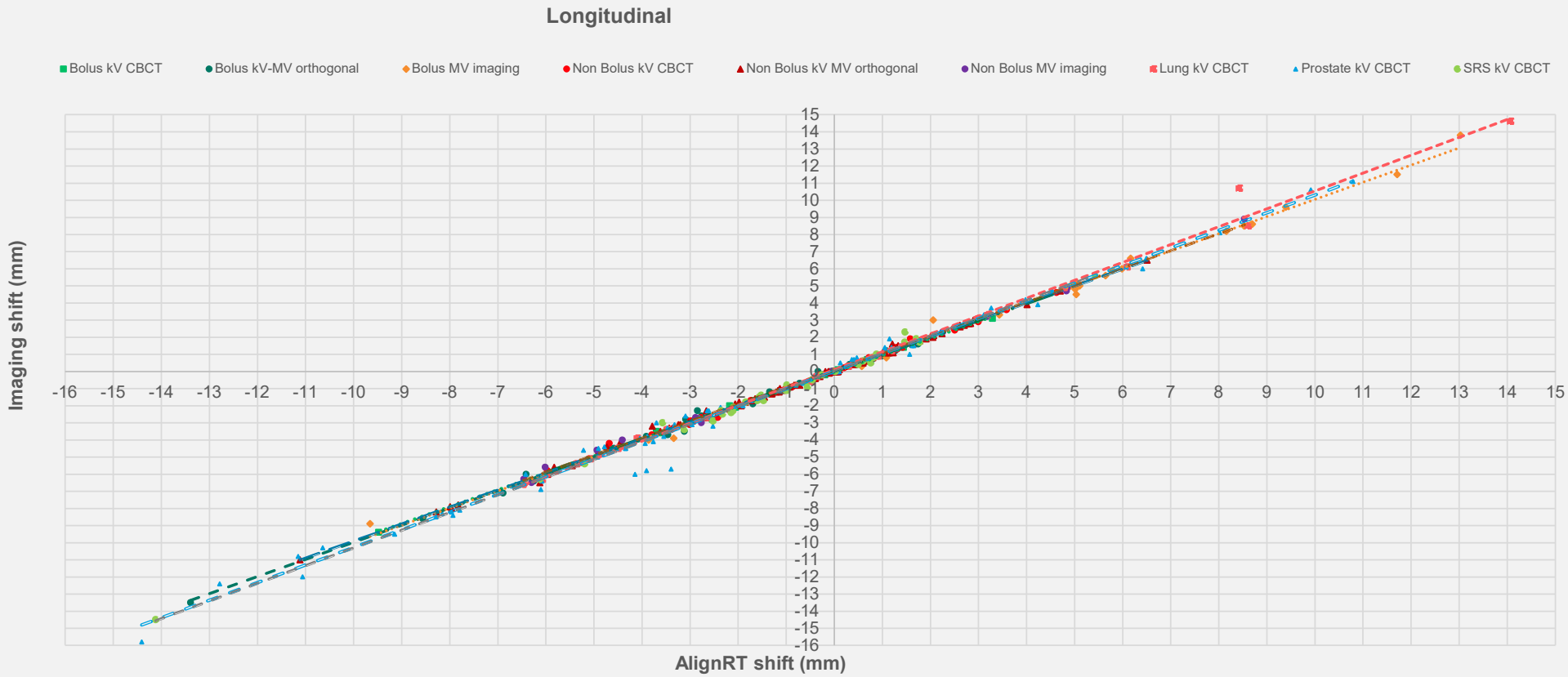
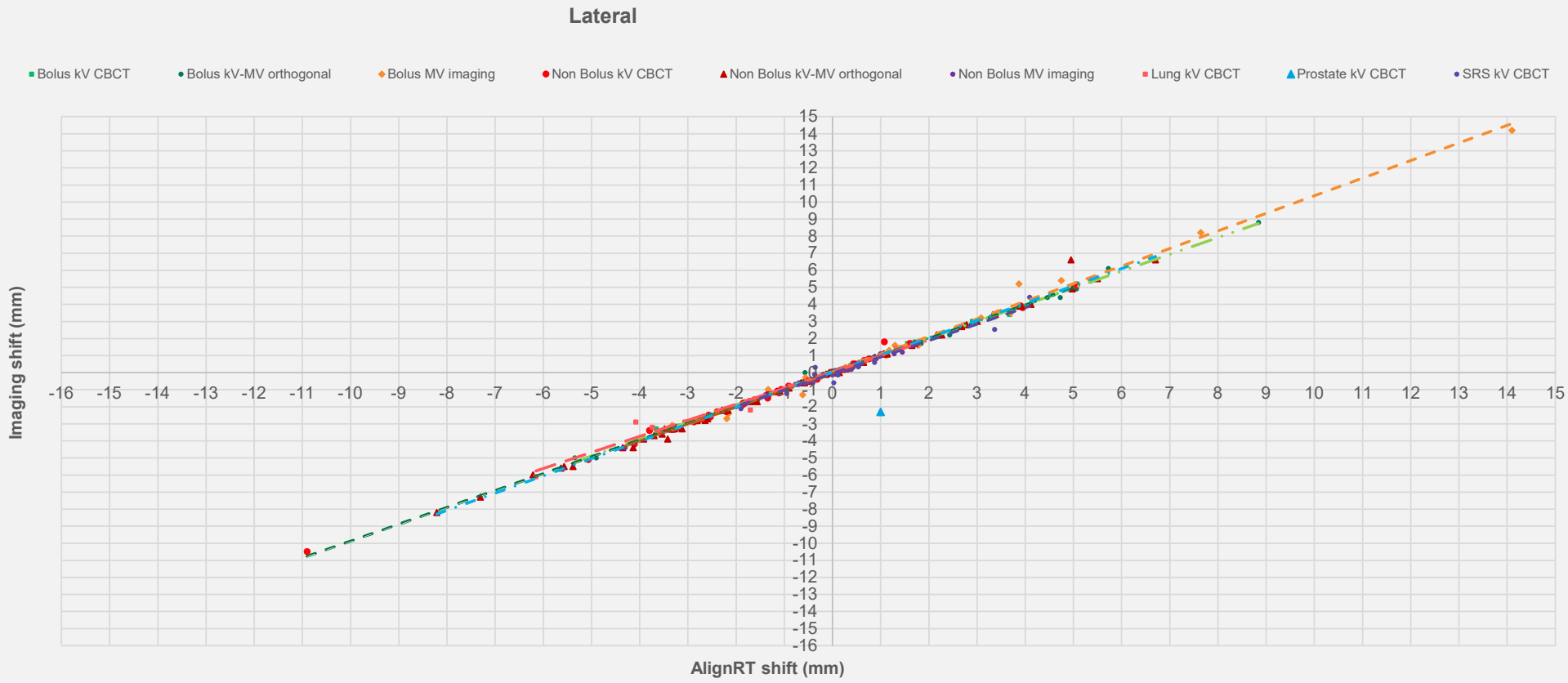
...Or does it?



...Or does it?


Longitudinal
Bolus kV CBCT
Bolus kV-MV orthogonal
Bolus MV imaging
Non Bolus kV CBCT
Non Bolus kV MV orthogonal
Non Bolus MV imaging
Lung kV CBCT
Prostate kV CBCT
SRS kV CBCT
Imaging shift (mm)
AlignRT shift (mm)

...Or does it?


Lateral
Bolus kV CBCT
Bolus kV-MV orthogonal
Bolus MV imaging
Non Bolus kV CBCT
Non Bolus kV-MV orthogonal
Non Bolus MV imaging
Lung kV CBCT
Prostate kV CBCT
SRS kV CBCT
Imaging shift (mm)
AlignRT shift (mm)

…Or does it?

- It can be seen that there is a really good correlation in all 3 directions between the imaging shift and AlignRT shift
- Regardless of tumour site
- Important to note that this is just at the setup stage
- CBCT is still the gold standard in our centres and is performed to align the patient prior to treatment.
- It is difficult to assess this relationship intrafractionally
- We are currently working on this for Liver DEBH and will be able to report soon

03

Standard Commisisoning AlignRT

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Commissioning tests

- **Integration of peripheral equipment**
  - Communication with Record and Verify and planning systems
  - Integration with the linear accelerator
- **Localisation of field of view**
  - Determination of localisation field of view
  - Determination of gantry/couch angles causing camera blockage
- **Spatial reproducibility and Drift**
  - Drift
  - Determination of positioning stability
  - Determination of the positioning reproducibility
  - Determination of non-coplanar tracking accuracy

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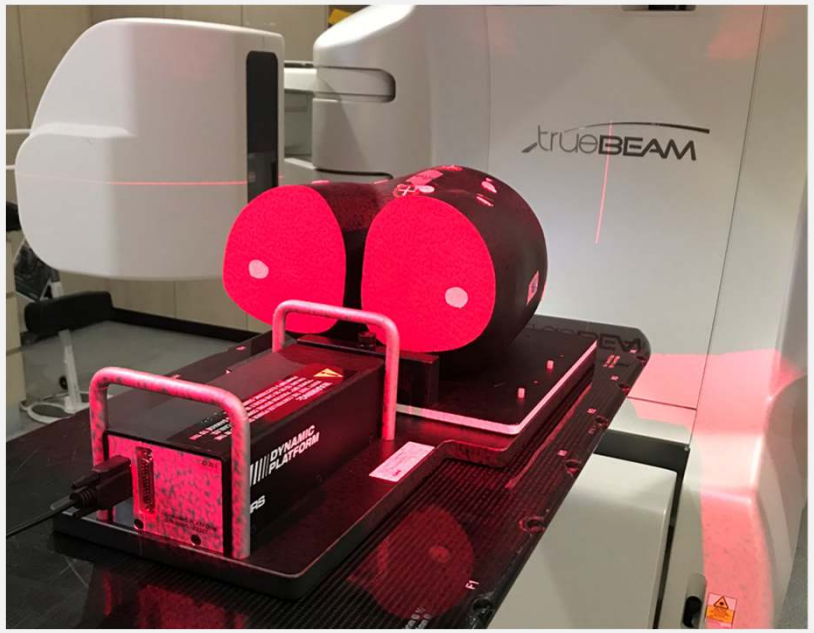
Commissioning tests

- **Static localisation accuracy**
  - Localisation displacement accuracy
  - Localisation angular accuracy

- **Dynamic localisation accuracy**
  - Spatial accuracy
  - Dynamic radiation delivery for gating



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Results

➢ Localisation of field of view

- Determination of localisation field of view

	Vertical		Longitudinal		Lateral		Rotation	
Field of view at each direction	19.53	-16.96	24.74	-28.05	20.48	-20.61	48.8	314

Couch Angle (°)	270		315		0		45		90	
	CW	CCW	CW	CCW	CW	CCW	CW	CCW	CW	CCW
Gantry Angle (°)	9.2	346.7	10.2	346.2	6	352.8	12.5	348.4	13	350

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Results

➢ Spatial reproducibility and Drift

- Drift
  - ✓ Not observed
- Determination of the positioning reproducibility
  - ✓ Max variations for monitoring for 5 min interval for 25 min: **0.1 mm**
- Determination of non-coplanar tracking accuracy

	Vertical (mm)	Longitudinal (mm)	Lateral (mm)	Rotation (°)
Max variations in Non-coplanar tracking accuracy	0.2	1.5	0.7	0.4

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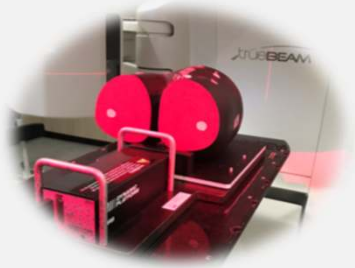
Results



➢ Static localisation accuracy

- Localisation displacement accuracy

Diff between AlignRT and applied imaging shift (mm/°)							
2 cm/2° shift				1 cm/1° shift			
Vert	long	lat	Rot	Vert	long	lat	Rot
0.8	1.0	-0.6	-0.3	0.6	0.7	-0.8	0.1

- Localisation angular accuracy

Diff between AlignRT and applied rotational shift (°)		
Rot	Pitch	Roll
0.1	0.0	0.0

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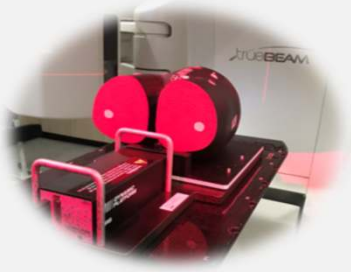
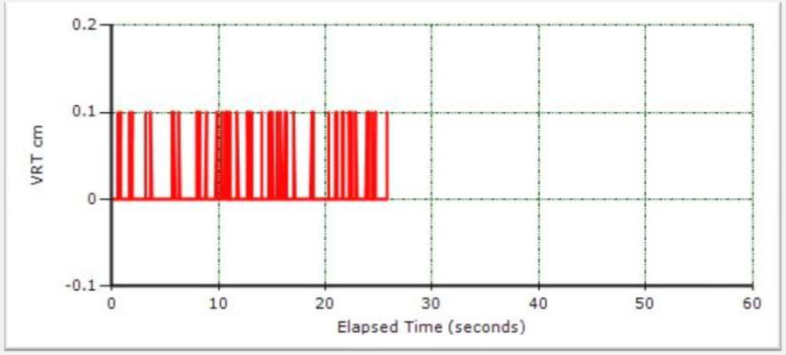
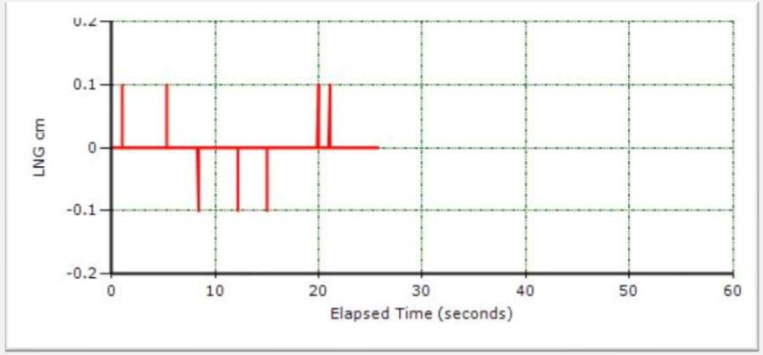
Results



➢ Dynamic localisation accuracy

- Spatial accuracy
  - ✓ 1 mm shift applied in different intervals





- Dynamic radiation delivery (gating/tracking)
  - ✓ **0.3% diff in dose delivery, with 20 interruptions during delivery**

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These tests were developed at GC before the TG302 report was published

- However, we have adopted the recommendations of the TG302 report in terms of routine QA of the system
- The expected values we had are consistent with the findings in the report
- No major deviations or drifts have been observed in routine QA


AAPM SCIENTIFIC REPORT | Open Access

AAPM task group report 302: Surface-guided radiotherapy

Hania A. Al-Hallaq, Laura Cerviño, Alonso N. Gutierrez, Amanda Havnen-Smith, Susan A. Higgins, Malin Kügele, Laura Padilla, Todd Pawlicki, Nicholas Remmes, Koren Smith, Xiaoli Tang, Wolfgang A. Tomé

First published: 18 February 2022 | https://doi.org/10.1002/mp.15532 | Citations: 9

Vendor consultants:
Lisa Hampton, Chris Huyghe, and James Turner, Varian Medical Systems
Mattias Nilsing, PhD, C-Rad
Ben Waghorn, PhD, Vision RT

SECTIONS PDF TOOLS SHARE

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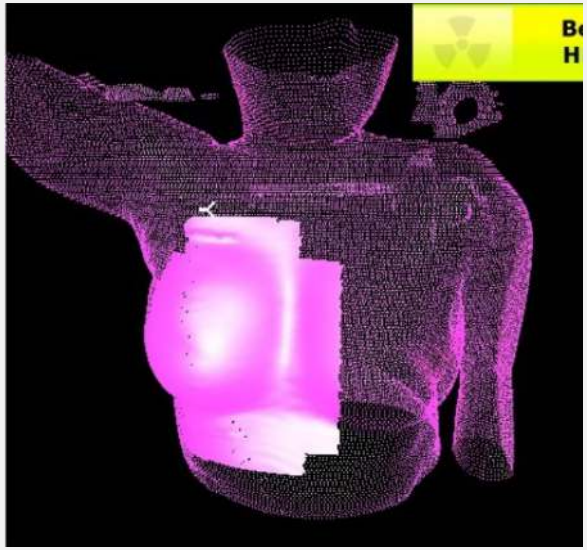
04
Routine use of AlignRT

Credit Tina Gorjiara

Why Surface Guided Radiotherapy (SGRT)

- **Goal: To improve overall accuracy of radiation delivery**
  - **Patient positioning**
    - ✓ Reduce setup time
    - ✓ Improve inter-fractional set-up accuracy (not relying on limited number of body markers)
    - ✓ Better visualisation of surface changes (weight-loss etc)
  - **Patient monitoring**
    - ✓ Monitor patient intra-fractionally (post imaging shift)
    - ✓ Minimise the need for re-imaging
  - **Gating delivery**
    - ✓ Can be used as gating device to manage patient motion
    - ✓ It can be used for acquiring breathing trace for 4DCT purposes



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We basically use AlignRT for most patients

Since we went live at the Mater in Aug 2019…

- Over 13,500 SGRT fractions have been treated
- Well over 700 tatooless breast patients
  - First centre in NSW providing this service
- Over 500 prostate SABR patients
- We have GateCT (soon to be SimCT) which provides us with the breathing traces for SGRT 4DCT which we use for Lung SABR
- AlignRT is now standard for all new Varian machine purchases in GC
- Installed in most of our Australian centres. At least one in each state

A bit of a media plug

Postural Video & 6DoF send to couch

Postural video has become a vital part of the workflow

- It has reduced clinical setup times for RTs
- Minimised the amount of repeat imaging as patients are closer to planned positions
- Now standard with AlignRT in our centres

6DoF Send to Couch

- This has meant our staff handle the patients less
- Makes use of available tech to get patient in the correct position
- Has reduced repeat imaging

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05

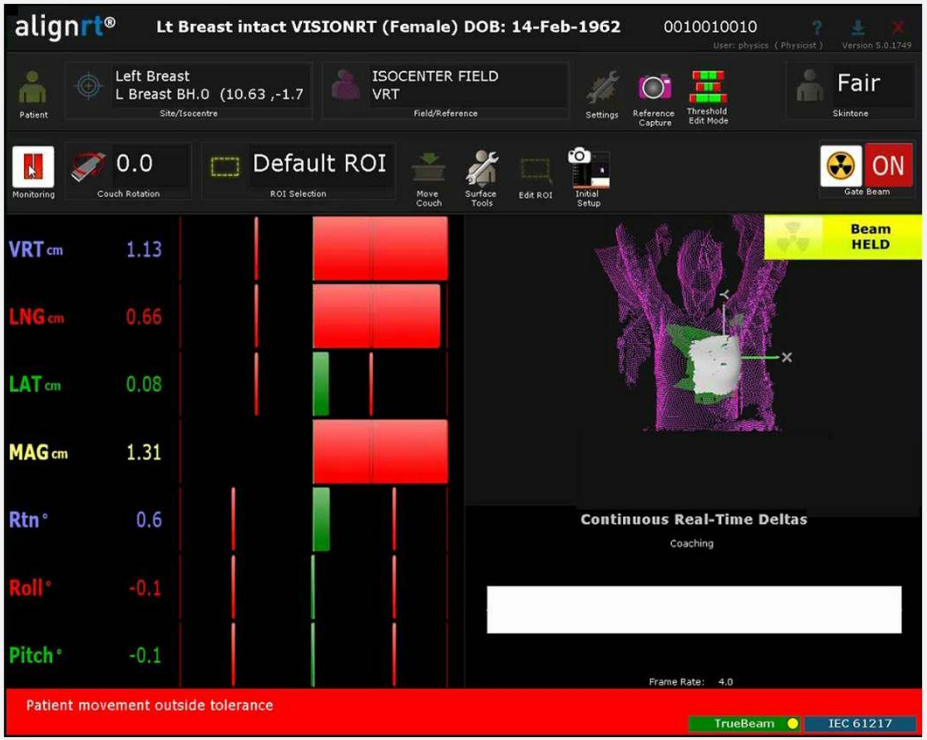
SGRT for complex treatments

AlignRT for Tatooless Breast DIBH

Our new standard

- AlignRT used for setup
- New reference captured after imaging
- AlignRT gates the beam should the patient move out of breathhold
- No cheating by arching backs!
- Easier and less invasive for patients, used to have the ABC system

(an old screenshot but you get the idea)



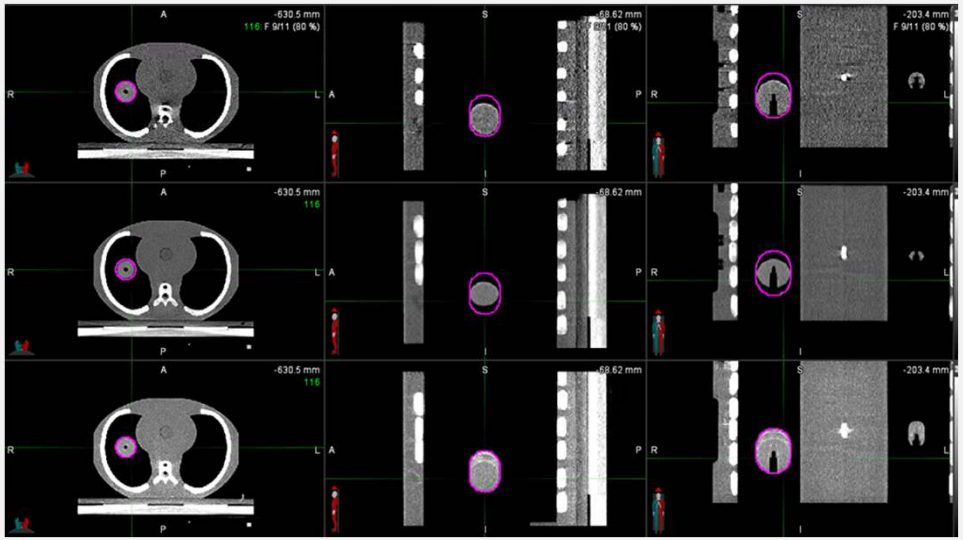
Liver SBRT in DEBH

Same, same, but different!

- We have treated over 15 Liver SBRT DEBH patients with AlignRT
- Patient is imaged in DEBH and daily ref captured after shift
- Like DIBH, AlignRT has control of the beam for gating should the patient moved out of expiration breathhold
- Patients have fiducials implanted which are manually tracked using triggered imaging for when internal motion doesn’t correlate with AlignRT
- A review of intrafraction marker motion vs AlignRT surface motion is currently under way

4DCT with GateCT (SimRT)

- GateCT allows us to obtain breathing trace information for 4DCT binning
- Commissioned using the CIRS moving platform
  - Tumour motion assessed in MIM and compared to known values →
- Single camera system
- Provides very good breathing traces which in turn make for very good 4D scans



SRS with AlignRT

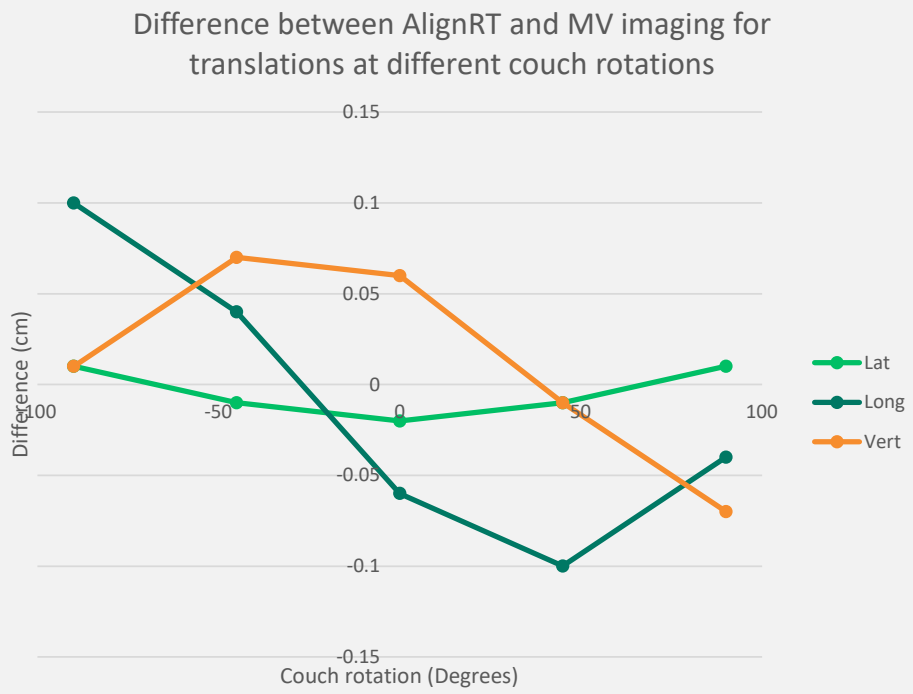
Faceless masks still provide great immobilisation

- Use Varian Hyperarc planning but unautomated delivery
- Use the Encompass immobilisation system with their faceless masks
- We monitor the patient's face NOT the mask
- Allows for easy correction of pitch/roll in the mask
- Patients prefer the faceless masks
- We did some special commissioning tests for SRS with the faceless masks
  - Effect of couch rotation (block & anthropomorphic)
  - Full Dosimetric E2E with STEEV phantom
- Intrafraction motion tolerances of 0.5mm and 0.3 degrees

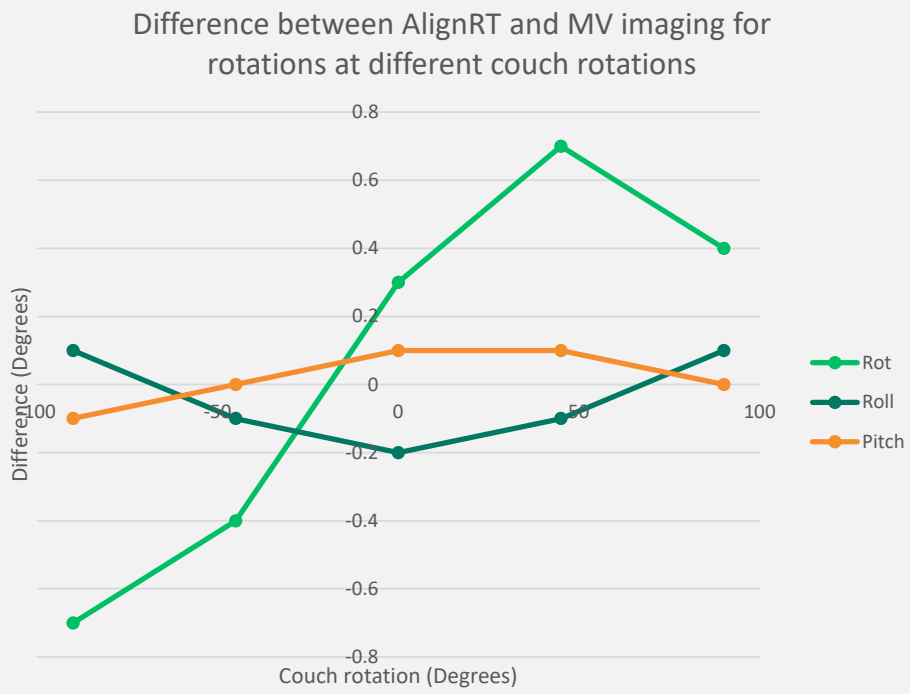
Full E2E testing performed using STEEV phantom

SRS AlignRT checks with anthropomorphic head phantom

Effect of couch rotation on translation



Effect of couch rotation on rotation



06
Conclusion and Future Directions

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AlignRT has become invaluable to us

In conclusion…

- The majority of patients can benefit from SGRT and AlignRT in one way or another
- Complex treatments can also benefit
- Useability of the system is great, the treatment and sim staff love it
- Allows us to monitor patients in a much less invasive manner
- Provides realtime information that can affect the clinical outcome of the patient

In the future…

- We will be looking to implement In-Bore on our Halcyon once MMI is available
- At least 2 more sites will come online using the system
- Look to implement new upgrades when available
- We are looking at introducing maskless RT for Head and Neck patients who suffer from severe claustrophobia