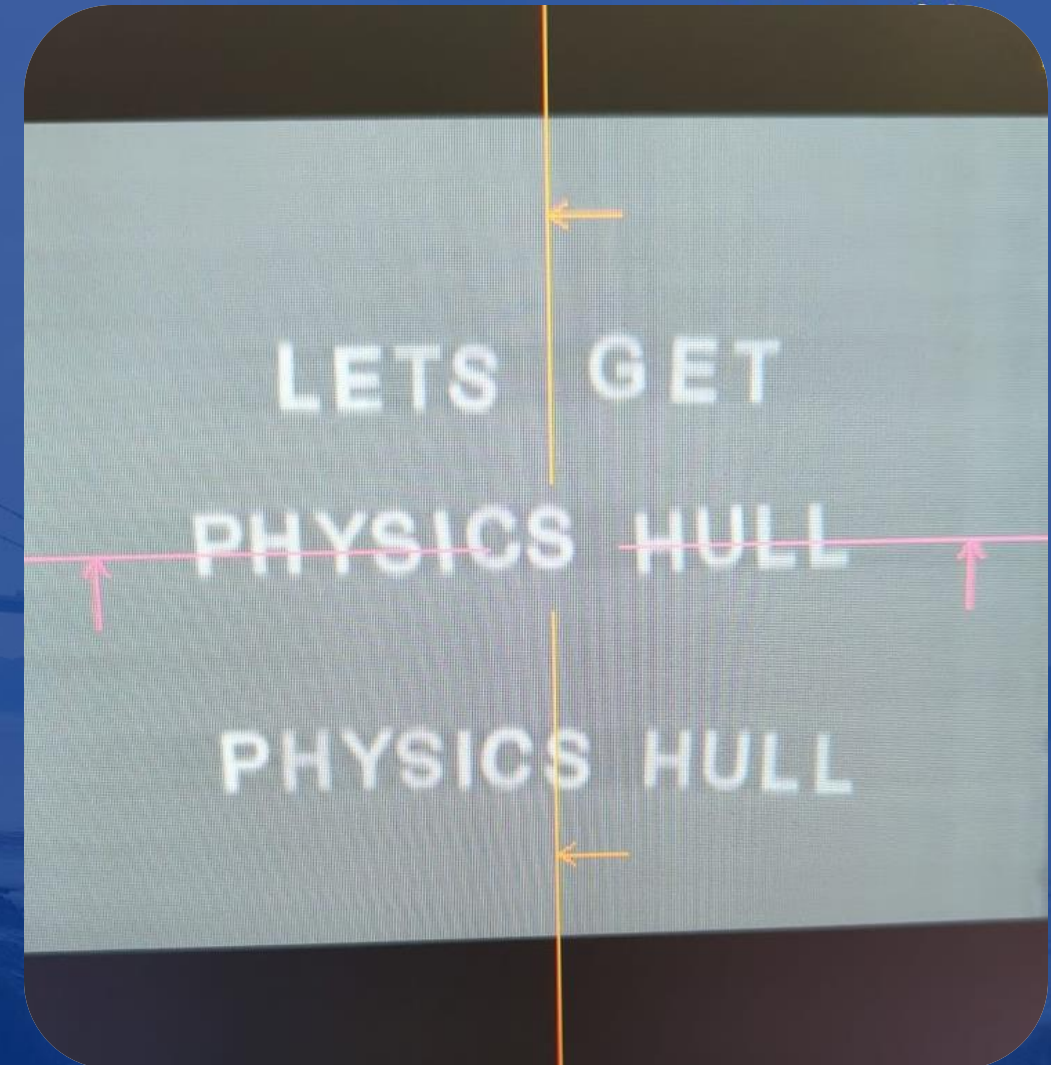


Day 1 Couch Coordinates: Providing a Starting Point Using a Novel Technique

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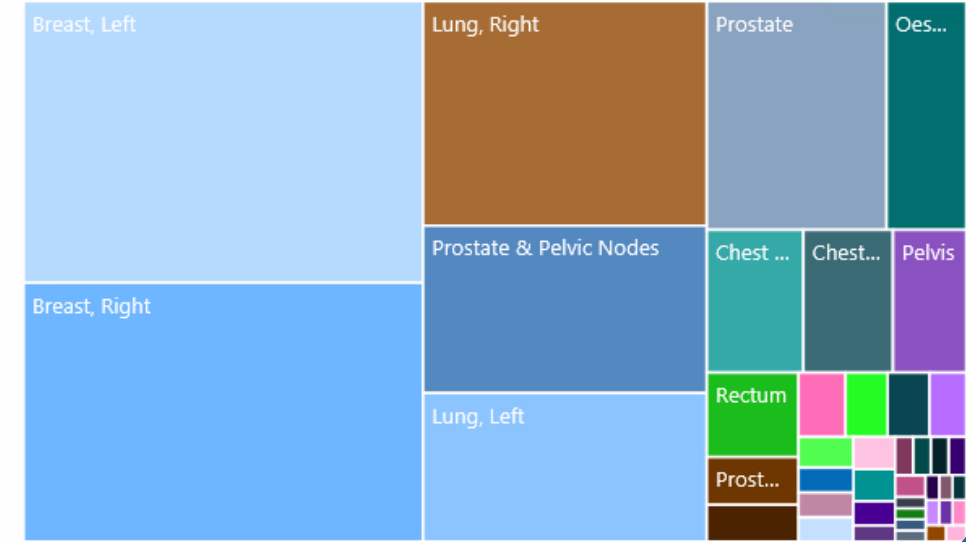
Our SGRT journey so far

1469
Count of Unique Patients

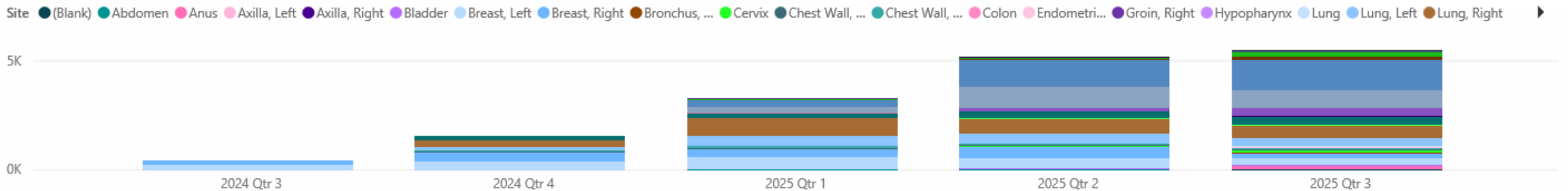
42
Count of Unique Sites

16.01K
Count of SGRT fractions

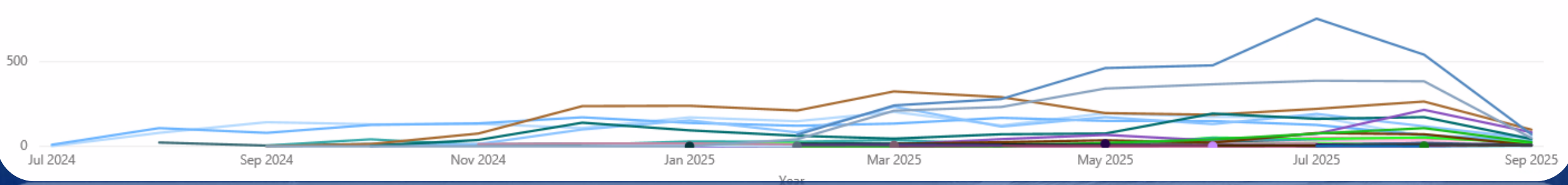
Count of PatientId by Site



Stacked Bar Chart of Fractions Delivery with SGRT



Fraction count for SGRT by site



Objectives of the work



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- *The objectives of this work were to:*
- *Provide a quick and accurate method for positioning patients as a starting point consistent with SGRT expectations.*
- *Minimize the need to “hunt” for a usable surface for SGRT recognition.*
- *Rapidly identify cases with incorrect indexing or immobilisation.*
- *Achieve positioning within 5 cm of the required surface for most setups. This would be used every day to maintain consistency. This means we are aiming to ignore fraction 1 “inconsistencies”.*
- *To ensure we had a system that worked as contingency incase SGRT did not work.*

Patient ID	Course ID	Plan ID	Machine
	1 LEFTLUNGSABR	LtLungSABR	Truebeam

	X (cm)	Y (cm)	Z (cm)
Isocentre	10.0	-15.3	-5.6

Choose Origin
H2

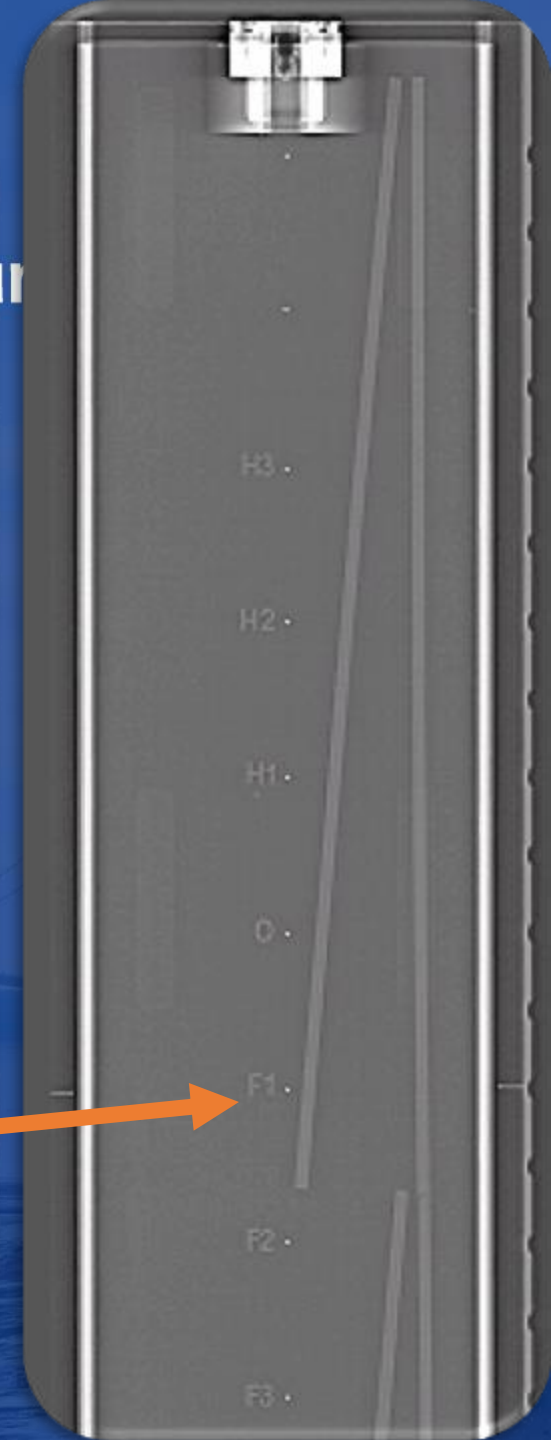
Couch Vrt (cm)	13.9
Couch Lng (cm)	117.6
Couch Lat (cm)	990.0

*This has not yet been developed for Head Boards. It works when the treatment patient position relative to the couch matches setup in CT

Method- Pretreat

Letters align with
Varian Indexing
attached to the
underside of our
couches

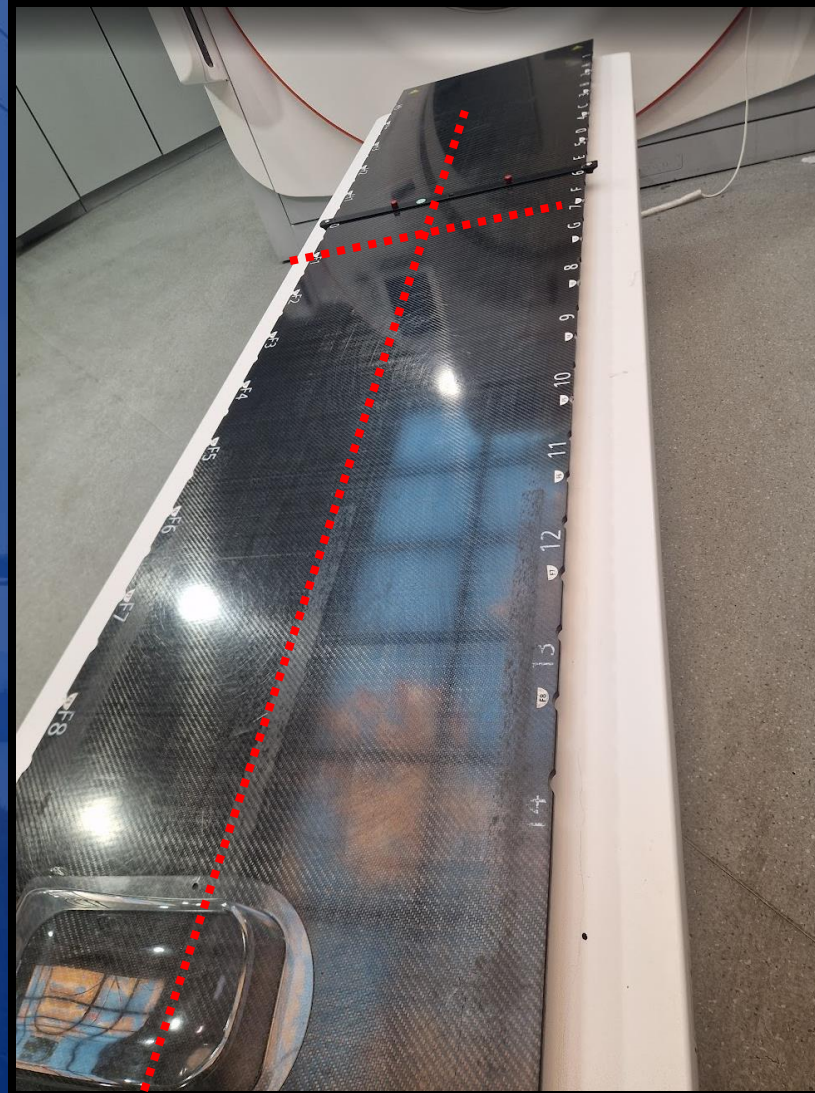
No Isocentres past
here on Halcyon



Getting a match

Basic Method-

- Found the coordinate of the Varian couch “O” marker and matched this with the same marker on the CT couch.
 - This was necessary for both Halcyon and Truebeams
- I have an offset table for each index mark that is used within Eclipse Scripting Code.

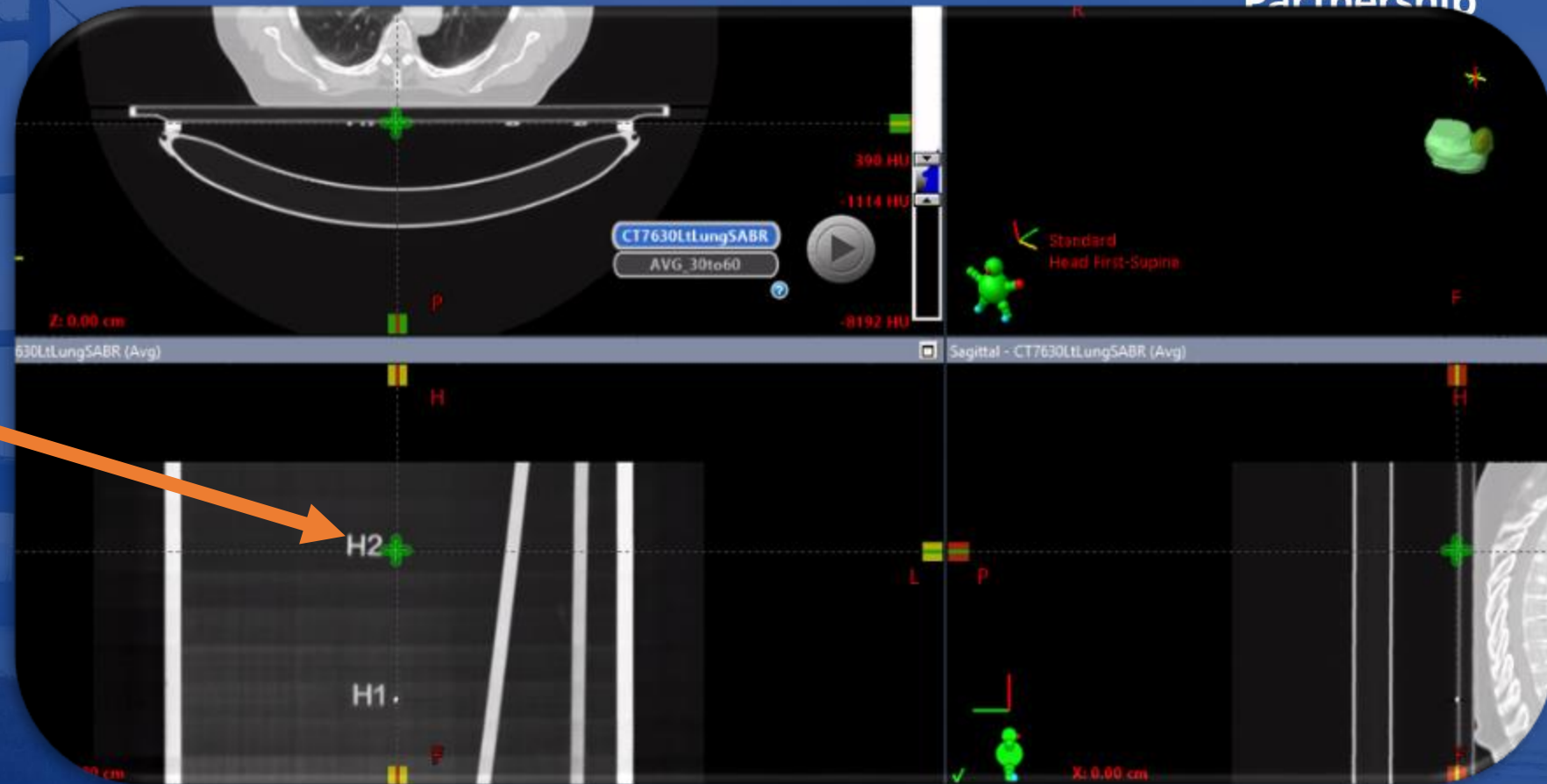


Method- Treatment Planning



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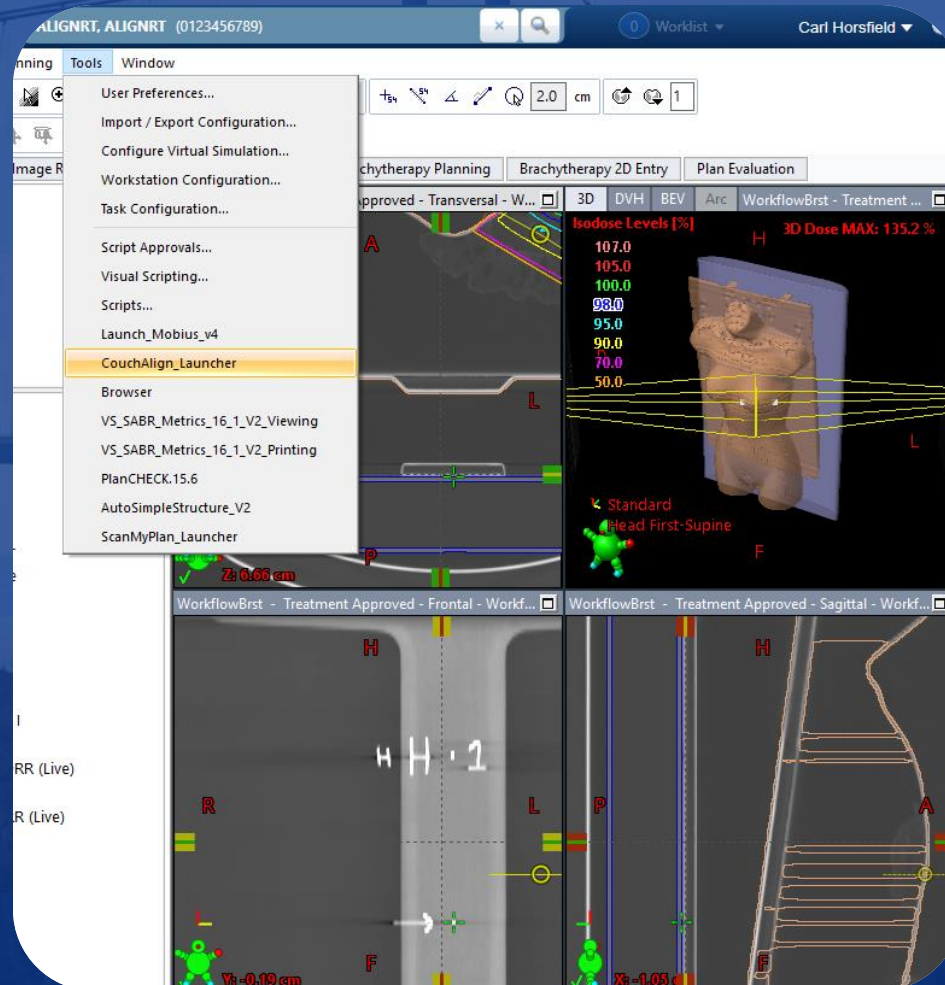
The planner selects the origin that they want to use- Usually just the closest to the Isocentre. The TPS user Origin is placed here. All isocentre selection remain as they were.



Method- Couch Align Application



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CouchAlign_V1

Useful Links

Couch Values Ready.

Patient ID	0123456789		
Course ID	RadsWorkflow		
Plan ID	WorkflowBrst		
	X (cm)	Y (cm)	Z (cm)
Isocentre	7.2	-20.3	4.0
Choose Origin	Centre		
Couch Vrt (cm)	20.3		
Couch Lng (cm)	136.0		
Couch Lat (cm)	992.8		

Method- Couch Align Application

- The application knows the coordinate for the Origin on the Truebeams and the Halcyon based on our data.
 - The app then corrects to find the couch coordinate based on the user selection using a lookup table.
 - The intention was to get within 5cm so AlignRT could do the rest.

CouchAlign 1.0.2.0

Useful Links

Couch Values Ready.

Patient ID

Course ID 1 LEFTLUNGSABR

Plan ID LtlungSABR

Machine Truebeam

Isocentre X (cm) 10.0 Y (cm) -15.3 Z (cm) -5.6

Choose Origin H2

Couch Vrt (cm) 13.9

Couch Lng (cm) 117.6

Couch Lat (cm) 990.0

*This has not yet been developed for Head & Neck. It works when the treatment patient position relative to the couch is setup in CT



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Couch

Couch Vrt 20.30 cm Delta Vrt

Couch Lng +136.00 cm Delta Lng

Couch Lat 992.90 cm Delta Lat

Couch Rtn 0.0 °

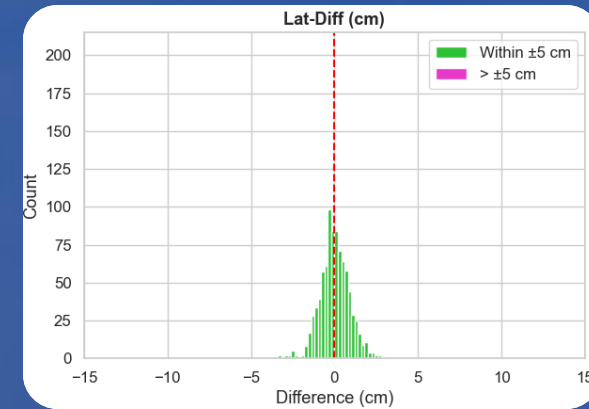
Phantom Tests

- How close we got?
 - On all phantom tests the results were within 0.5cm giving us confidence in the methodology.
 - This was for a none moving, plastic phantom on a breast board.



Effectiveness Review

To determine how effective the strategy was, a review was started after 6 months of use. The results will be shown here.



Log from Code
collected every use
over 15 months

Used code (Entity
framework written
in C#) to access the
database for every
entry. Determined
first fraction couch
values for the plan.

Calculated the
offset:
871 usable results.
115 outside 2cm
10 outside 5cm

Used Python to
analyse the results
and present the
data.

```
logfile - Notepad
File Edit Format View Help
2024-07-01 16:43:06 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.9, Vrt(cm): 20.3, Lng(cm): 108.0
2024-07-01 16:43:07 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.9, Vrt(cm): 20.3, Lng(cm): 94.0
2024-07-01 16:56:21 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.9, Vrt(cm): 20.3, Lng(cm): 136.0
2024-07-01 16:58:12 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.9, Vrt(cm): 20.3, Lng(cm): 136.0
2024-07-01 16:59:10 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.9, Vrt(cm): 20.3, Lng(cm): 136.0
2024-07-01 17:00:55 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.9, Vrt(cm): 20.3, Lng(cm): 136.0
2024-07-02 11:17:26 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.9, Vrt(cm): 20.3, Lng(cm): 150.0
2024-07-02 16:25:55 [INFO] Patient ID: HEY1106332, Course: IRTBREAST, Plan: RTBREAST, Lat(cm): -12.2, Vrt(cm): 10.0, Lng(cm): 172.1
2024-07-02 16:26:27 [INFO] Patient ID: HEY1106332, Course: IRTBREAST, Plan: RTBREAST, Lat(cm): -12.2, Vrt(cm): 10.0, Lng(cm): 158.1
2024-07-02 16:26:29 [INFO] Patient ID: HEY1106332, Course: IRTBREAST, Plan: RTBREAST, Lat(cm): -12.2, Vrt(cm): 10.0, Lng(cm): 144.1
2024-07-02 16:26:31 [INFO] Patient ID: HEY1106332, Course: IRTBREAST, Plan: RTBREAST, Lat(cm): -12.2, Vrt(cm): 10.0, Lng(cm): 88.1
2024-07-02 17:02:02 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.9, Vrt(cm): 20.3, Lng(cm): 150.0
2024-07-03 10:24:14 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.8, Vrt(cm): 20.3, Lng(cm): 136.0
2024-07-03 10:24:32 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.8, Vrt(cm): 20.3, Lng(cm): 150.0
2024-07-03 10:24:34 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.8, Vrt(cm): 20.3, Lng(cm): 164.0
2024-07-03 10:24:35 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.8, Vrt(cm): 20.3, Lng(cm): 178.0
2024-07-03 10:24:37 [INFO] Patient ID: 0123456789, Course: RadWorkflow, Plan: WorkflowBrst, Lat(cm): 992.8, Vrt(cm): 20.3, Lng(cm): 172.0
```

```
// e.PatientId.StartsWith("HE")
// e.PatientId.StartsWith("PAS")
}.ToList();

Console.WriteLine($"Filtered down to {filteredEntries.Count} entries\n");

using (VARIAN_REPORTSEntities aria = new VARIAN_REPORTSEntities())
{
    // Show the filtered results
    foreach (var entry in filteredEntries)
    {
        Console.WriteLine($"{entry.Timestamp} | Patient: {entry.PatientId} | " +
            $"{entry.Course} | Plan: {entry.Plan} | " +
            $"{entry.Lat} | Vrt: {entry.Vrt} | Lng: {entry.Lng}");

        var p = aria.PatientALLs.Where(x => x.PatientId.Contains(entry.PatientId)).FirstOrDefault();
        if (p == null)
        {
            continue;
        }

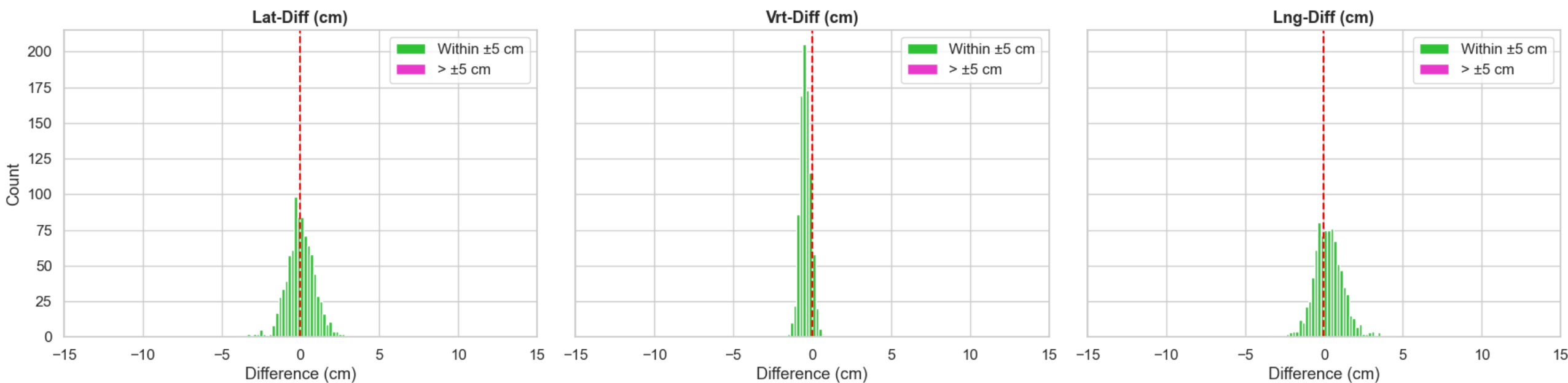
        Func<string, string> normalize = s =>
        {
            if (string.IsNullOrEmpty(s)) return s;
            return Regex.Replace(s, @"\s+", ""); // strip leading 1-10 + optional space
        };

        var formatted = normalize(entry.Course);
    }
}
```


Agreement with Treatment Values



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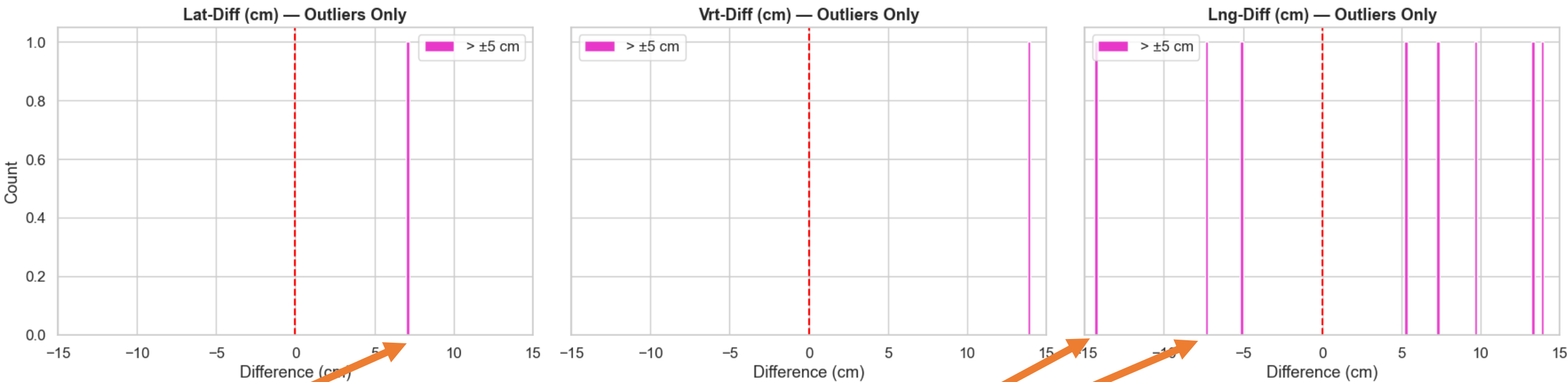


Systematic shift present on Vertical and Longitudinal axis, but Lateral is in good agreement. The vast majority of results are within the target of 5cm and largely within 2cm.

Metric	#	Mean (cm)	#	± 2 SD (cm)
Lat-Diff (cm)		-0.007		1.881
Vrt-Diff (cm)		-0.432		1.191
Lng-Diff (cm)		0.32		3.131

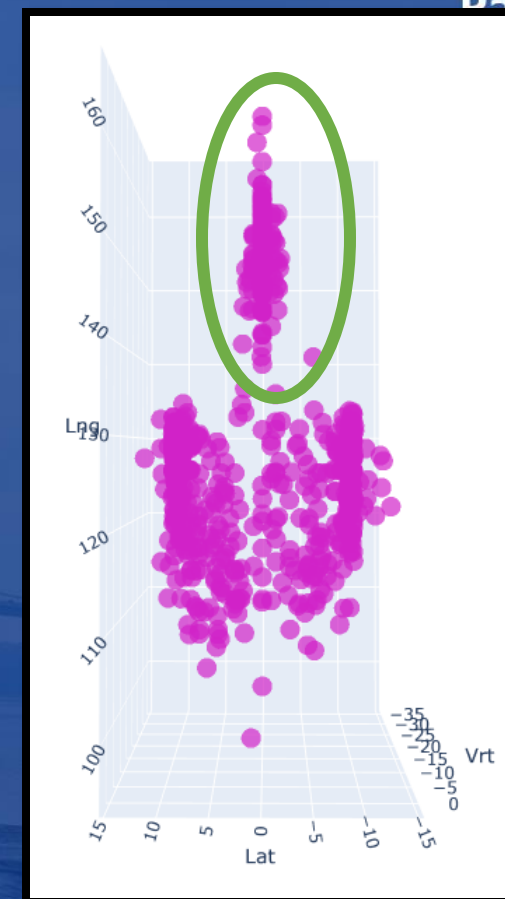
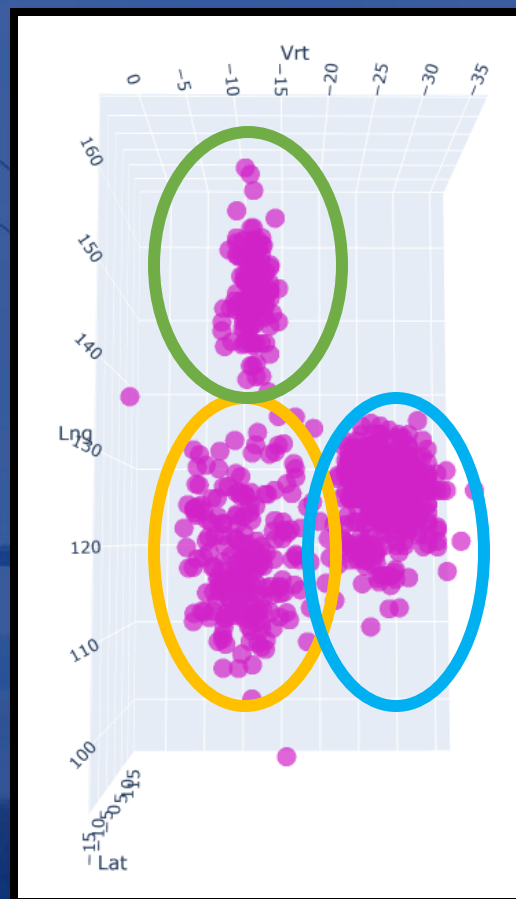
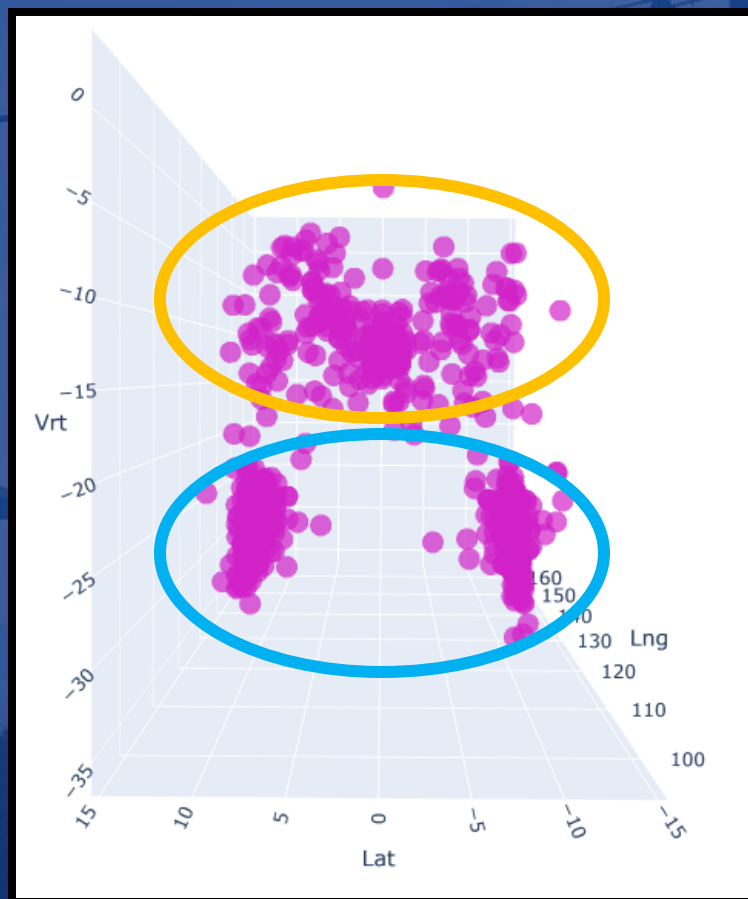
Disagreements

Outliers Only ($|Diff| > 5$ cm)



- 14cm Offset by 1 Varian Couch Index due to an incorrect reading at CT.
- 7cm Offset by 1 Elekta Couch Index due to our multi index couch top.
- 7cm Lat offset was a breast patient that needed to be offset to avoid couch incident beams or collisions.
- Other various long offsets.

Distribution of Couch Values



● Breast ● Pelvis ● Thorax

Incidental findings

- **Inferior Isocentres:** This gave us a means to flag when an isocentre was set too inferior longitudinally at planning that the linac couldn't deliver.
- **Transcription errors:** These are often now found fraction one and corrected.
- **Clearance testing:** The couch values seem accurate so we can load these on treatment before the patient arrives to confirm clearance.
- **Incorrect index marks from CT:** Either 1 full Varian index or an Elekta index (7cm).
- **Reduced Documentation:** We needed to record less at CT as we didn't need to describe a reference anatomical structure.
- **Forgetting to Capture Couch Actuals:** This hasn't been a problem as the preference has been to use the planning couch values rather than actuals.

Contingency Planning



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- **What if AlignRT breaks:** For a while we discussed how we would handle breakdowns and the need to setup without AlignRT. This has proved a robust method to get us close to the correct setup most of the time, allowing an image to be taken to confirm position. We would then mark the patient and use tegaderm until the issue was resolved.

Conclusion



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- *We have demonstrated a simple, reproducible method that has been successfully integrated with SGRT for over one year.*
- *This method is transferable and could be readily implemented in other departments using similar resources and workflows.*

Thanks for your time, Any Questions?

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