

SGRT for faster, safer and more accurate  
limb positioning system.

**I. Navarro, M. Rincón, S. Martín, A. Hurtado. L.Guzmán.**

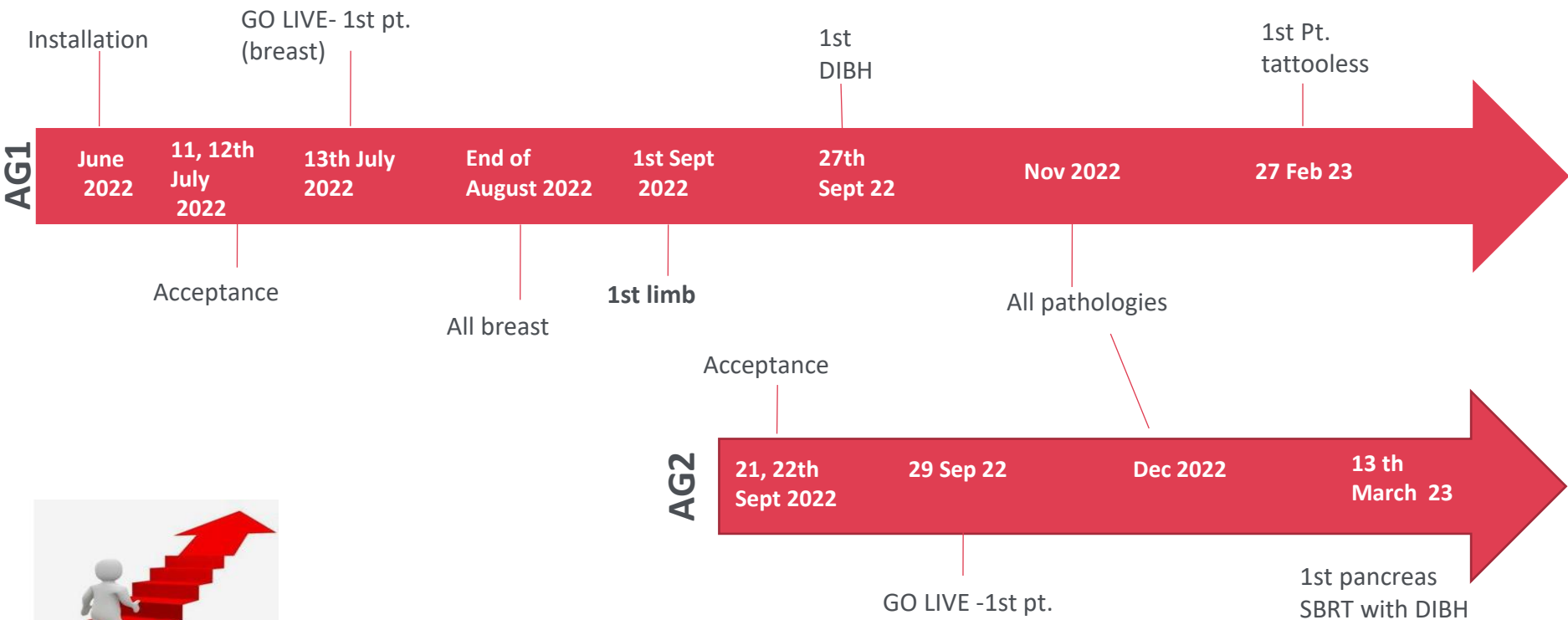
**Radiation Oncology Department.**

**Fundacion Jiménez Díaz Hospital, Madrid. Spain**

# Index.

- Overview of the AlignRT implementation in our Radiation Oncology department
- AlignRT's improvements in limb treatment

# SGRT CHRONOLOGY



## PURPOSE

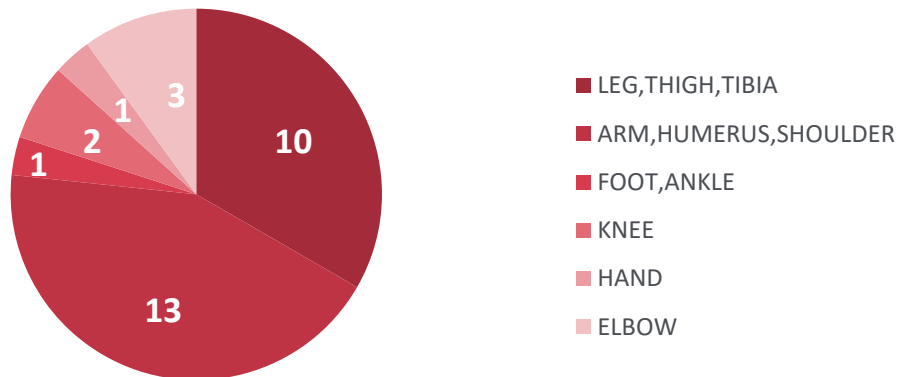
The aim of this retrospective study is to quantify the reliability and accuracy of SGRT in positioning the limb of our patients compared to conventional methods.

Secondary objectives included investigating improvement in workflow efficiency, reducing number of CBCTs and reducing repositioning with SGRT.



# MATERIAL AND METHODS

30 patients treated for upper or lower Limb tumors between September 2022 - July 2023 were analysed retrospectively (**Group A**).



## Immobilisation:

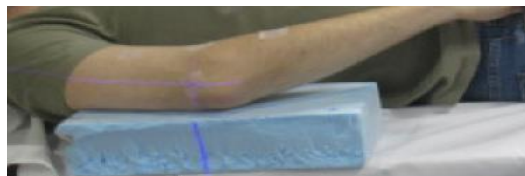
• vacuum bags



• Moldcare



• Polystyrene blocks



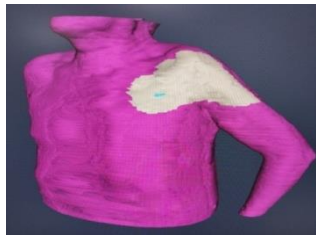
• none

For daily positioning, the AlignRT software (VisionRT Ltd.) was used with the Postural Videomodule (patient setup and correction even faster)



$$\Delta_{VRT}, \Delta_{LNG}, \Delta_{LAT} < 0.5 \text{ mm}$$

$$\Delta_{PITCH}, \Delta_{YAW}, \Delta_{ROLL} < 0.5^{\circ}$$

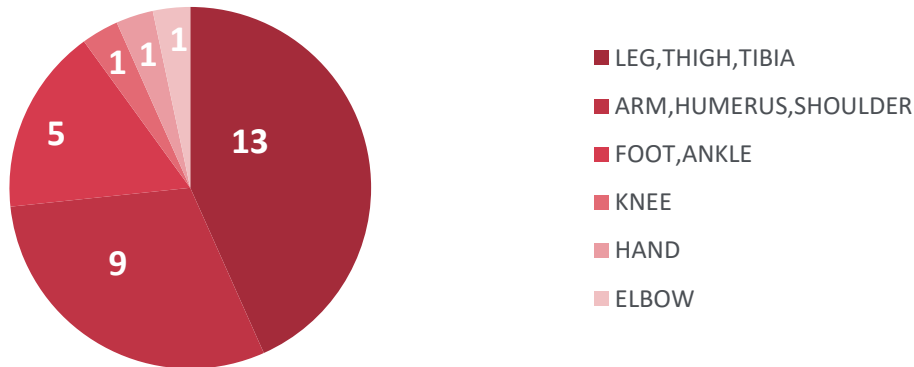


A reasonable ROI was designed to perform an optimal matching between patient's current surface and the reference surface

A daily CBCT was performed, and the translational corrections obtained were recorded.

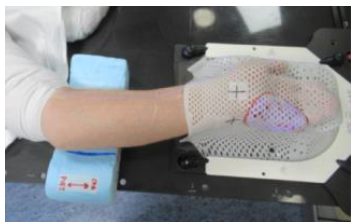
# MATERIAL AND METHOD

30 patients with upper or lower limb tumors, were treated between September 2021 - August 2022 using different traditional setups (lasers and skin marks)



## Immobilisation:

15 pts.- Thermoplastic masks (**Group B**)

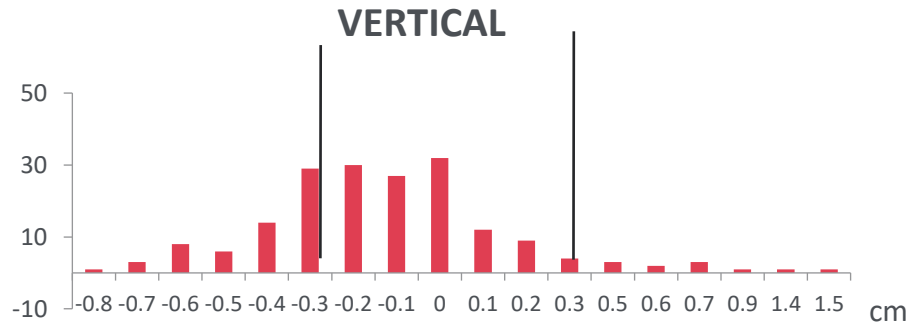
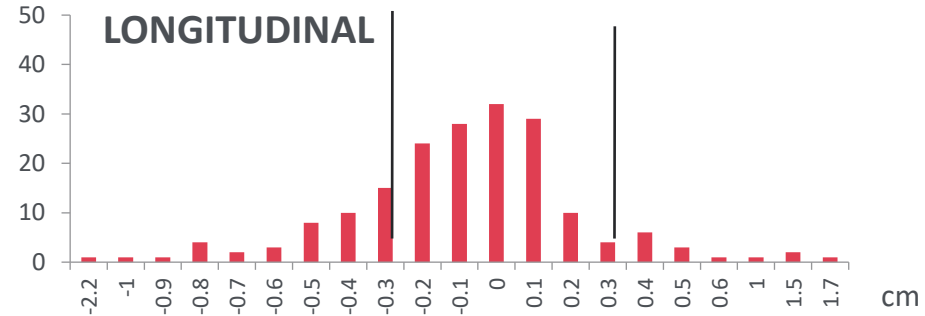
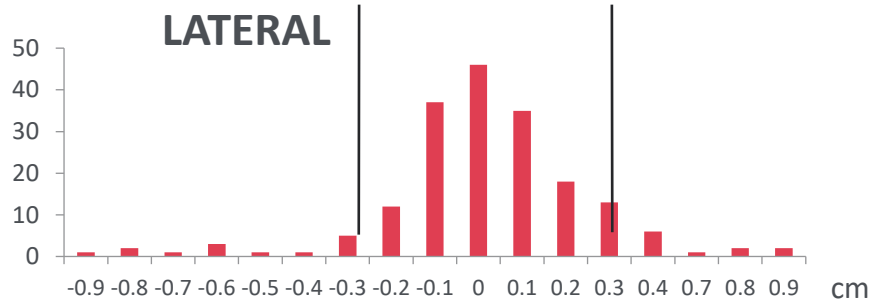


15 pts.- Other devices (**Group C**)



# RESULTS. PRECISION. ALIGN RT SETUP (Group A)

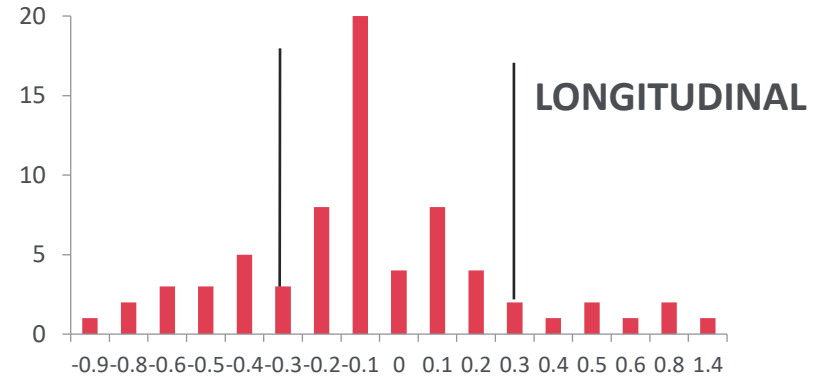
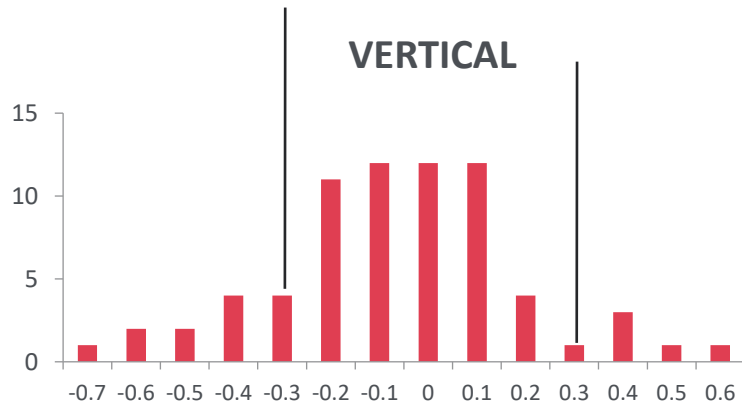
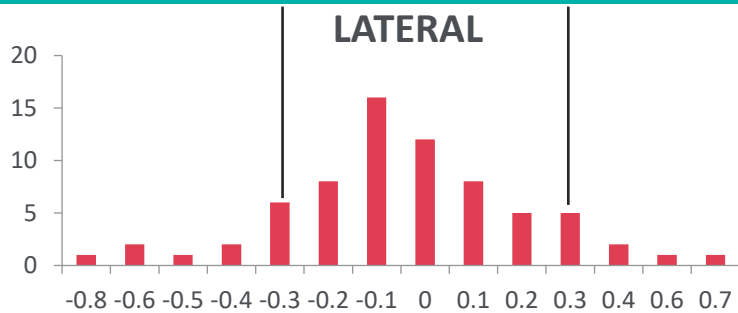
Data collected included deviations in the three translational directions of the reference surface compared to the CBCT. The deviation size and its frequency were represented.



- The corrections applied after the CBCT were  $\leq 3\text{mm}$  in 90% of the cases for lateral movements, 79% for longitudinal movements, and 79% for vertical movements.
- 20 patients consistently had corrections of  $\leq 3\text{mm}$  in all translational directions. Only 3 had displacements of  $> 5\text{mm}$ .
- 90% of them could have had weekly CBCT.

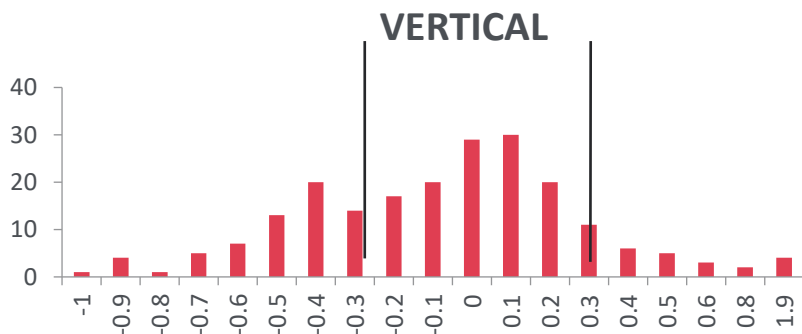
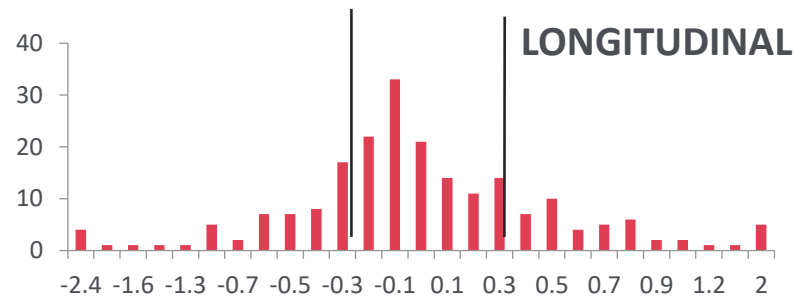
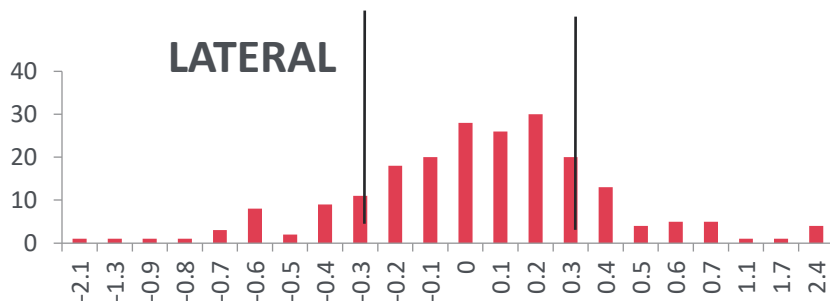


# RESULTS. PRECISION. TATTOO'S SETUP. MASK IMMOBILISATION (Group B)



- In this group, deviations from the CBCT were  $\leq 3$  mm in 86% of the cases for lateral movements, 70% for longitudinal movements, and 77% for vertical movements.
- In 9 out of the 15 patients, the deviations were always  $< 3$  mm in all directions. Only 2 had deviations greater than 5 mm.
- 75% of them could have had weekly CBCT

# RESULTS. PRECISION. TATTOO'S SETUP. NO MASK IMMOBILISATION (Group C)



- In this case, the CBCT had deviations that were  $\leq 3$ mm in 72% of the cases for lateral directions, 62% for longitudinal directions, and 67% for vertical directions.
- Only 20% could have had weekly CBCT because only 3 patients had deviations of  $\leq 5$ mm in all three translational directions.

## SUMMARY OF PRECISION RESULTS

Range (mm)	$\leq 3$		
	Group A	Group B	Group C
X (lateral)	90%	86%	72%
Y(longitudinal)	79%	70%	62%
Z (vertical)	79%	77%	67%

Range (mm)	x,y,z $\leq 3$			x,y or z $> 5$		
	Group A	Group B	Group C	Group A	Group B	Group C
No. Pts.	20 (30)	9(15)	0	3(30)	2(15)	12(15)

↓  
27 pts.  
Weekly CBCT

↓  
3 pts.  
Weekly CBCT

# CALCULATION OF TRASLATIONAL SET UP ERRORS

Systematic deviation ( $S_p$ ) and random deviation ( $\sigma_p$ ) were obtained for each patient  $p$  based on the corrections made  $r(p,f)$  over  $F$  fractions,  $f \in \{1, 2, \dots, F\}$ :

$$S_p = \langle d(p,f) \rangle_F \quad \sigma_p = SD(d(p,f))_F$$

Subsequently, **systematic errors** ( $\Sigma$ ), defined as the standard deviation of the distribution of systematic displacements, and **random errors** ( $\sigma$ ), defined as the average value of random displacements, were calculated for each anatomical region  $A$ .

$$\Sigma = SD(S_p)_A \quad \sigma = \text{SQRT} \langle \sigma_p^2 \rangle_A$$

Also, the average systematic deviation of the population ( $\mu$ ) was obtained for each anatomical region  $A$  :  $\mu = \langle S_p \rangle_A$

	Group A			Group B			Group C		
	Systematic Errors (mm)		Random Errors (mm)	Systematic Errors (mm)		Random Errors (mm)	Systematic Errors (mm)		Random Errors (mm)
Direction	Mean ( $\mu$ )	SD ( $\Sigma$ )	$\sigma$	Mean ( $\mu$ )	SD ( $\Sigma$ )	$\sigma$	Mean ( $\mu$ )	SD ( $\Sigma$ )	$\sigma$
Left/right	0.5	2.2	2	0.7	2.1	2.1	-0.4	2	3.4
Sup/Inf	-0.5	2.3	2.0	-0.8	3.2	3.1	0.6	5.3	4.3
Ant/post	-0.5	2.2	1.9	-0.9	1.4	1.6	-0.8	2	3.1

## RESULTS. SETUP TIMES.

The patient **set up time** was defined as the time that elapses from when the previous patient is registered in MOSAIQ until the site configuration for the next patient is approved. It does not represent the actual positioning time and includes patient changing and dressing up.

	ALIGNRT	NO ALIGNRT	
		MASK	NO MASK
t(min.)	12±2	13±4	11±3

$t_{\text{secondary}} = 6 \text{ min}$

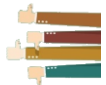
	ALIGNRT	NO ALIGNRT	
		MASK	NO MASK
t(min.)	6±1	7±2	5±1

AlignRT's positioning times are similar to those without AlignRT with a mask but longer than without either of them. Logically, it is faster to position with only the three tattoos, although it results in many repositionings.



## CONCLUSIONS. PRECISION AND TIME SET UP

- Patients positioning was more accurate. Corrections of  $\leq 3$  mm in the different translational directions were achieved in 79% of our patients.
- Positioning times are similar to those treated with a mask, but longer than those treated without a mask.
- Treatment time was reduced by eliminating the need for repositioning.
- A significant reduction in daily CBCT was observed. **In 90% of the cases, weekly CBCT could have been performed.**
- The translational systematic errors were around 2 mm, except in the longitudinal coordinate, where they ranged from 2 mm (ALIGNRT) to 3-5 mm (NO ALIGNRT)
- The random translational errors decreased in all three directions ( $\leq 2\text{mm}$  vs  $3-4\text{mm}$ ) when using AlignRT for positioning.



## TO TAKE HOME

After our first year using AlignRT system for limb tumors, the staff agrees on :

- Treatment positioning in extremities is **more effective and precise**.
- The number of **repositionings** has been completely **reduced**.
- Treatment times have not increased.
- The **postural video module** is **very useful** for visualizing the opposite limb, thus avoiding the arrival of scattered radiation in that area.
- **Control during treatment** is very important.
- **Patients** are **happier** without tattoos.
- **VERY SATISFIED**. data collection should continue.





**THANK YOU  
FOR YOUR  
ATTENTION**