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Phramongkutklao Hospital

Evaluation of the Dosimetric Effects of Surface-Guided Radiotherapy with Undergarment Use in Prostate Cancer Treatment

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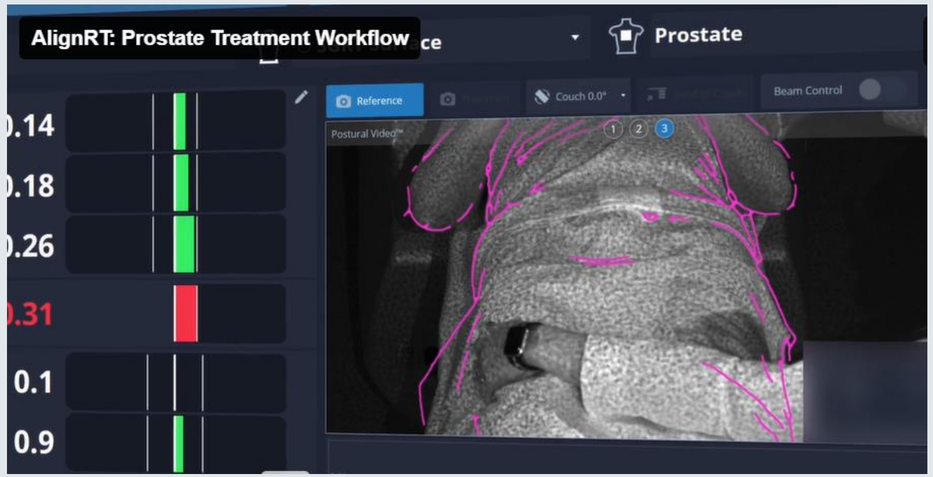
SGRT timeline

- Mostly use – CA breast with DIBH

- Other cases
- HCC using DEBH
- Open face mask in brain tumor
- Head and neck cancer whom cannot use mask
- Lymphoma

- **Recently, prostate and pelvic cancer case >> Our study**



In Pelvic site

- **Standard protocol use**

- Surface marker with foot/knee support
- Pelvis thermoplastic mask
- Vacuum Cushions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If No SGRT…

Use surface marker

Pros
- Low-cost
- Widely available
- Reproduce the exact patient position

Cons
- Cosmetic and psychological distress
- Do not account for internal organ movement
- Risk of human errors

Use Thermoplastic mask

Pros
- Securely immobilize
- Non-Invasive and Custom-Made

Cons
- Claustrophobia and Anxiety
- Skin Irritation and Pressure
- Potential for Reduced Skin Sparing Effect
- **Cost and logistics of creation and storage**


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If SGRT…

Pros

- Non-Invasive and Contact Free
- **tattoo-free** and **mark-free**
- Real-Time, Continuous Monitoring
- Supports Advanced Techniques: DIBH, DEBH

Cons

- High initial cost
- Relies on External Surface not internal organ
- Potential for Human Error in Setup – need training
- Not Ideal for All Treatment Sites

Evidence support of SGRT in pelvic treatment

Research studies on SGRT: tattoo-less

scientific reports

Check for updates

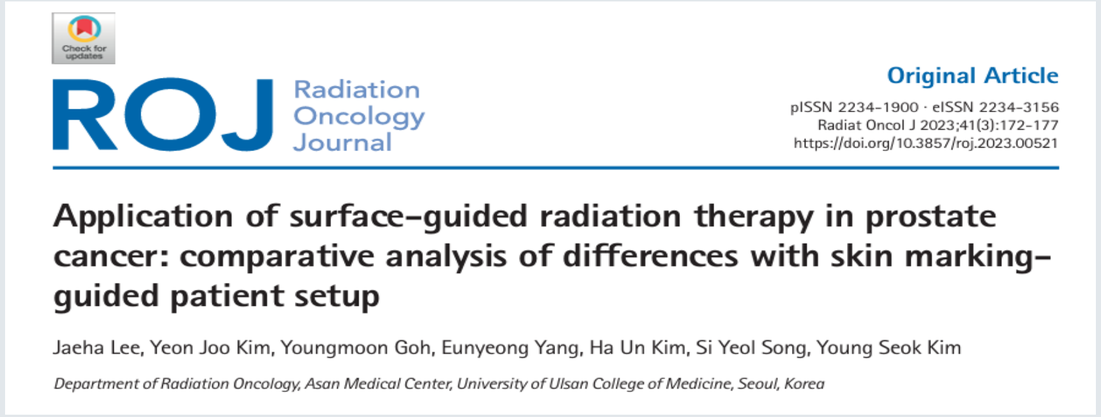
OPEN

Setup accuracy and margins for surface-guided radiotherapy (SGRT) of head, thorax, abdomen, and pelvic target volumes

Volker Rudat, Yanyan Shi, Ruping Zhao, Shuyin Xu & Wei Yu

- SGRT vs skin mark+ laser for many regions of cancer
- SGRT showed significantly better inter-fractional setup accuracy compared to laser alignment especially in

“ mean translational setup deviation”



Check for updates

ROJ Radiation Oncology Journal

Original Article

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Application of surface-guided radiation therapy in prostate cancer: comparative analysis of differences with skin marking-guided patient setup

Jaeha Lee, Yeon Joo Kim, Youngmoon Goh, Eunyeong Yang, Ha Un Kim, Si Yeol Song, Young Seok Kim

Department of Radiation Oncology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

- SGRT vs skin-marking-guided for prostate cancer treatment.
- No statistically significant differences.

So what about our institute implement tattoo less in pelvic treatment?

- Internal discussion
- Discussion with Vision RT clinical support team
- Training/discussion before first patient process
- Doctor/ Physicist and RTT training on workflow and consideration before first patient

Our Study for Tattoo-less Pelvic Treatment

“ Evaluation of the Dosimetric Effects of Surface-Guided Radiotherapy with Undergarment Use in Prostate Cancer Treatment ”

Our Study for Tattoo-less Pelvic Treatment

Objectives:

1. Evaluate feasibility of tattoo-less **SGRT with undergarments** vs**. skin marks and pelvic masks**
2. Compare **CTV dose coverage** (V_{Gy}%) between SGRT and mask-based setup
3. Assess **inter-fractional setup accuracy using CBCT** couch shifts (translational & rotational)
4. Compare **setup time and total treatment time** between workflows
5. Evaluate **staff and patient satisfaction** with SGRT using a 5-point Likert scale

Materials and Methods

Materials

- C-arm TrueBeam LINAC radiotherapy system (Varian Medical Systems)
- Surface-guided radiation therapy (SGRT) system (AlignRT, Vision RT)
- Computed tomography (CT) simulation system, Aquilion Prime SP CT simulator (Canon Medical Systems)
- Underwear: White, beige, or light-colored and thigh cutouts underwear

Methods

Patient Cohort and Treatment Specifications

- **Patient cohort** :

The study prospectively analyzed data from total **18 prostate cancer patients** from Feb 2025 – Oct 2025

- **Treatment Protocol**: Compare **SGRT** vs **Pelvic mask**
  - **SGRT cases (n=9):** 70.5Gy30Fx 6 cases, 70Gy28Fx 1 case, 66Gy33Fx 1 case, 60Gy20Fx 1 case
  - **Pelvic mask cases (n=9):** 70.5Gy30Fx 5 cases, 70Gy28Fx 1 case , 66Gy33Fx 1 case, 60Gy20Fx 2 cases
- CBCT every fractions and use CBCT as gold standard for see the accuracy

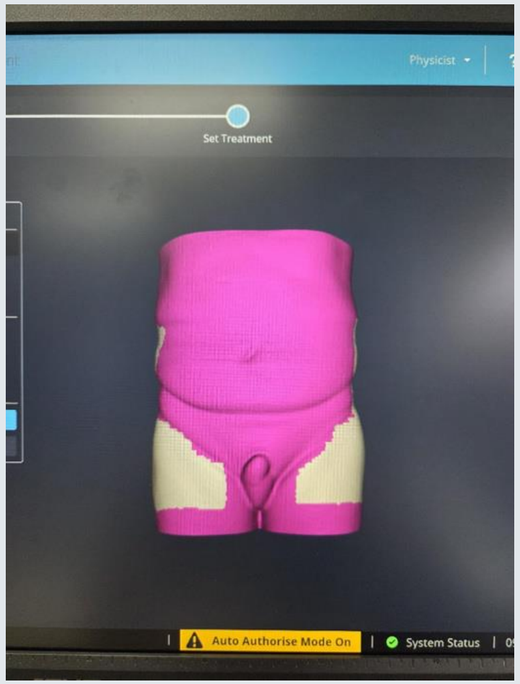
CT simulation

- **Patient Positioning:** Supine, hand on chest
- **Immobilization**: Feet fix, half-circle pillow

  Aim: fix at the pelvic region
- **Underwear Considerations**:
  - **White, beige, or light-colored underwear**
  - Proper **thigh cutouts** for accurate ROI mapping
  - Avoid underwear that is too tight or too loose

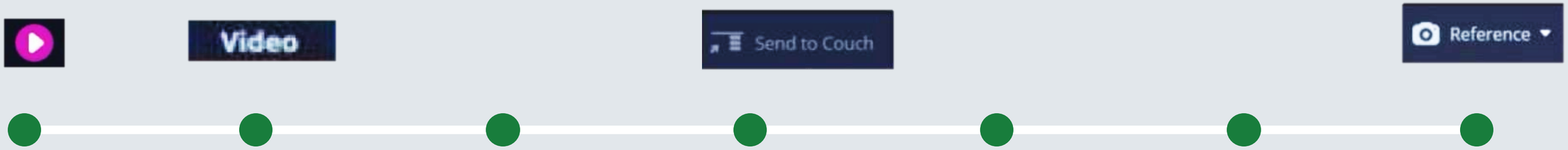
Set up ROI for AlignRT

- Export patient surface from TPS to VisionRT -> Draw the setup ROI



Set up positioning

- AlignRT advanced pelvis positioning workflow



1
Strat monitoring

2
Move the pateint near isocenter using PV

3
Adjust the patient/couch position to

≤ 1cm, ≤ 2 °

4
Send to couch 6DoF

5
Acquire CBCT

6
Apply shift

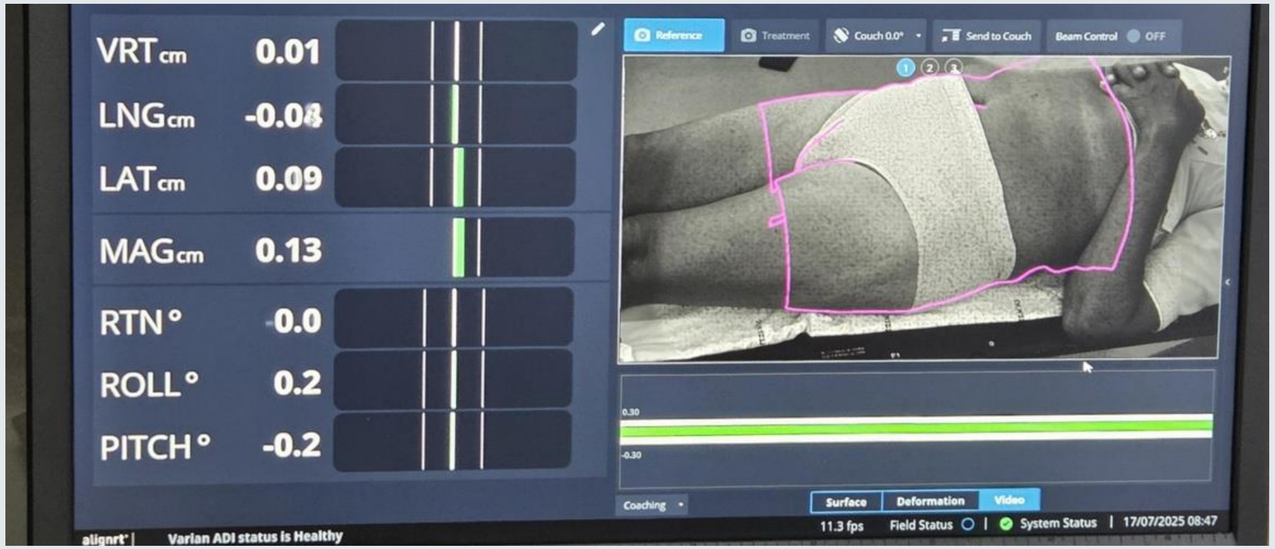
7
Reference capture (for this and future sesstion)

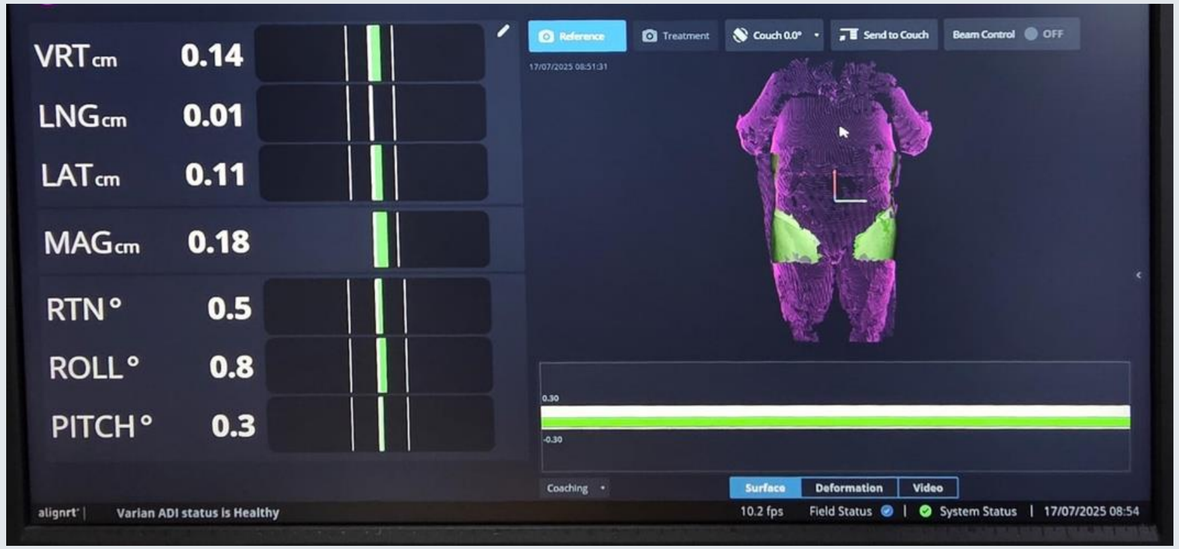
Set up positioning

- Monitoring for setting up patient position before treatment -> **≤ 1cm, ≤2 °**

Set up positioning

- Tracking for patient set up before treatment





Set up positioning

- Daily CBCT result
- **± 5 mm** for translational axes
- **± 3 °** for rotational axes

Results and Discussion

Results and Discussion

- Primary outcomes:
  - **CTV dose coverage ->** CTV volume (%) covered by prescription dose before CBCT shift using SGRT (AlignRT)
  - **Setup accuracy ->** Couch shift from CBCT
- Secondary outcomes:
  - **Setup time** -> From patient arrival on the couch to completion of setup
  - **Total treatment time ->** From patient setup to completion of treatment (file closed)
  - Evaluate **staff and patient satisfaction** with SGRT using a 5-point Likert scale

Results and Discussion

Table 1. Summary of outcomes in patients undergoing **SGRT-based** pre-treatment positioning (n = 9)

SGRT	Fx	Average Couch shift form CBCT (cm)						Average Couch shift form CBCT (°)						Mag (cm)	Setup time (min)	CTV V_{Gy} (%)	BMI (kg/m^2)
No.		vrt (z)	SD	lng (y)	SD	lat (x)	SD	Pitch	SD	Roll	SD	Rtn	SD				
1	30	0.07	0.24	-0.06	0.34	-0.03	0.23	0.07	0.62	-0.17	1.43	0.04	0.76	0.12	0:01:05	95.68	29.4
2	28	-0.01	0.24	0.04	0.37	0.00	0.17	0.03	0.59	-0.16	1.11	-0.18	1.04	0.13	0:01:29	96.48	20.2
3	30	0.21	0.27	0.15	0.37	-0.07	0.28	0.88	1.17	-0.21	0.69	-0.10	0.84	0.12	0:01:02	90.59	28.7
4	30	0.01	0.15	0.10	0.23	-0.01	0.16	0.13	0.85	0.00	0.61	0.19	0.50	0.05	0:00:51	96.93	27.6
5	30	-0.05	0.23	-0.09	0.37	0.00	0.18	1.17	0.99	-0.58	1.16	0.71	0.73	0.10	0:00:57	93.10	20.9
6	20	-0.01	0.17	0.07	0.19	0.00	0.21	-0.42	0.66	-0.02	0.81	0.00	0.48	0.05	0:00:53	99.41	24.6
7	30	0.08	0.17	-0.02	0.34	0.01	0.14	-0.56	1.62	0.13	1.35	0.02	0.73	0.10	0:00:56	96.97	16.2
8	33	0.02	0.12	0.00	0.19	0.01	0.13	-0.19	0.86	0.02	0.73	0.02	0.42	0.03	0:00:54	99.05	25.8
9	30	0.07	0.17	0.06	0.29	-0.05	0.23	-0.59	0.78	0.14	0.95	-0.01	0.52	0.07	0:00:55	97.91	24.0
	Avg	0.04	0.19	0.03	0.30	-0.01	0.19	0.06	0.91	-0.10	0.98	0.08	0.67	0.09	0:01:00	96.24	

Results and Discussion

Table 2. Summary of outcomes in patients undergoing **pelvic mask-based** pre-treatment positioning (n = 9)

Mask	fx	Average Couch shift form CBCT (cm)						Average Couch shift form CBCT (°)						Mag (cm)	Setup time (min)	CTV V_{Gy} (%)	BMI (kg/m²)
No.		vrt (z)	SD	lng (y)	SD	lat (x)	SD	Pitch	SD	Roll	SD	Rtn	SD				
1	30	0.08	0.09	-0.15	0.31	0.29	0.18	1.07	0.29	0.06	0.48	0.35	0.64	0.12	0:03:43	97.44	22.04
2	30	-0.01	0.22	-0.35	0.32	0.11	0.06	0.99	0.35	0.16	0.47	0.31	0.29	0.14	0:04:49	88.54	21.97
3	30	0.05	0.13	0.16	0.21	0.07	0.18	2.90	0.22	-0.10	0.63	-0.78	0.59	0.06	0:04:38	95.10	19.79
4	30	-0.09	0.17	0.06	0.48	0.15	0.25	1.87	0.92	-0.42	0.65	-0.03	1.00	0.17	0:04:11	93.89	27.73
5	30	0.38	0.22	-0.04	0.17	-0.06	0.24	0.73	0.82	0.03	0.39	0.69	0.54	0.14	0:04:57	96.82	23.73
6	28	-0.11	0.27	-0.18	0.48	-0.22	0.39	1.57	0.70	0.95	0.37	-1.24	0.67	0.26	0:05:38	95.32	28.72
7	20	-0.17	0.13	-0.32	0.30	0.14	0.13	1.86	0.34	0.01	0.41	-0.08	0.41	0.14	0:05:17	94.61	24.38
8	20	-0.15	0.15	0.20	0.43	0.16	0.46	2.36	0.43	1.06	0.41	-1.36	0.58	0.24	0:05:06	97.63	29.03
9	33	0.21	0.08	0.29	0.34	0.06	0.12	2.46	0.41	0.65	0.48	0.39	0.44	0.13	0:04:32	90.37	24.38
	Avg	0.02	0.16	-0.04	0.34	0.08	0.22	1.76	0.50	0.27	0.48	-0.19	0.57	0.16	0:04:46	94.41	

Results and Discussion

Table 3. Patient characteristics

Patient characteristics	SGRT (n=9)	Mask (n=9)	p-value
	n (%)	n (%)	
Staging			0.999
1	1 (11.11)	1 (11.11)	
2	-	1 (11.11)	
3	8 (88.89)	7 (77.78)	
Age			
Mean ± SD	75.33 ± 5.98	73.56 ± 6.73	0.562
BMI			
Mean ± SD	24.16 ± 4.37	24.64 ± 3.24	0.793
Fx			
20	1 (11.11)	2 (22.22)	
28	1 (11.11)	1 (11.11)	
30	6 (66.67)	5 (55.56)	
33	1 (11.11)	1 (11.11)	
Mean ± SD	29.00 ± 3.61	27.89 ± 4.65	0.579

No difference

*p < 0.05: Statistical significance

Results and Discussion

Procedures for recalculating dose coverage

- Percentage of CTV volume covered by **prescription dose**

Table 4. Isocenter positioning and CTV dose coverage for **first patient** during the first 5 fractions using SGRT positioning errors (back calculation using CBCT shifts)

Fx	CBCT Shift (cm)			SGRT Setup (cm)			CTV V70 (%)
	x (Lat)	y (Lng)	z (Ver)	x	y	z	
Original plan				-0.20	-11.20	-0.80	99.90
1	0.34	-0.40	-0.07	-0.54	-10.80	-0.73	99.70
2	0.02	0.16	-0.04	-0.22	-11.36	-0.76	99.50
3	-0.11	0.01	0.03	-0.09	-11.21	-0.83	99.91
4	-0.07	0.16	-0.35	-0.13	-11.36	-0.45	99.10
5	-0.12	-0.03	0.06	-0.08	-11.17	-0.86	99.90

SGRT Setup : Shifts measured before CBCT verification.

CBCT Shift : Adjustments after CBCT to achieve final isocenter position.

CTV Dose Coverage : Percentage of clinical target volume receiving prescribed dose, in this case was CTV V70Gy.

Results and Discussion

Table 5. Comparison of CTV dose coverage, CBCT-derived average couch shifts, and setup magnitude between using SGRT and pelvic mask immobilization (Mean ± SD).

Primary outcomes	CTV V_{Gy} (%)	Average couch shift from CBCT (cm)			Average couch shift from CBCT (°)			Mag (cm)
		Vrt	Lng	Lat	Pitch	Roll	Rtn	
SGRT (n=9)	96.24 ± 2.82	0.04 ± 0.19	0.03 ± 0.30	-0.01 ± 0.19	0.06 ± 0.91	-0.01 ± 0.98	0.08 ± 0.67	0.09 ± 0.04
Mask (n=9)	94.41 ± 3.12	0.02 ± 0.16	-0.04 ± 0.34	0.08 ± 0.22	1.76 ± 0.50	0.27 ± 0.48	-0.19 ± 0.57	0.16 ± 0.06
p - value	0.212	0.745	0.443	0.108	< 0.001	0.075	0.323	0.009

*p < 0.05: Statistical significance

Results and Discussion

Table 6. Comparison of patient setup time and total treatment duration between SGRT-based positioning and pelvic mask immobilization (Mean ± SD).

Secondary outcomes	Setup time (min:ss)	Total treatment time (min:ss)
SGRT (n=9)	01:00.2 ± 00:11.7	09:03.3 ± 01:05.7
Mask (n=9)	04:45.7 ± 00:34.7	11:27.3 ± 01:03.7
p - value	<0.001	<0.001

*p < 0.05: Statistical significance

Results and Discussion

Table 7. Likert-Scale Questionnaire ItemsParticipants rated each item on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree).

No	Staff Group	Gender	RT Experience	1. Ease of use (CT simulation)	2. Satisfaction (CT simulation)	3. Ease of use (pre-treatment setup)	4. Setup time efficiency	5. Patient comfort vs. conventional method	6. Setup accuracy and reproducibility	7. Satisfaction (treatment delivery)	8. Confidence in treatment quality	9. Ease of use (treatment planning)	10. Overall satisfaction (treatment planning)
1	RO	F	>10Y	4	4	4	4	4	4	4	4	4	4
2	MP 1	F	>6Y	4	5	4	4	4	4	4	4	5	5
3	MP 2	F	>6Y	4	5	4	4	4	4	4	5	5	4
4	MP 3	F	1-3Y	5	5	4	5	4	5	4	5	5	5
5	RTT 1	F	>10Y			4	4	5	5	4	4		
6	RTT 2	M	>10Y			4	4	3	4	4	4		
7	RTT 3	M	>10Y			4	4	4	4	4	4		
8	RTT 4	F	>6Y			4	4	3	4	4	4		

- **High level of** satisfaction with the use of SGRT (average score of 4 out of 5).

Summary

- **Enhanced Setup Accuracy and Efficiency:**

Real-time monitoring improves positioning precision, **particularly for rotational values**, shortening treatment times.

CTV dose coverage is comparable to using a pelvic mask.

- **Improved Patient Experience:**

Patients don’t need to maintain marking on their body .

No special care in the treatment area which reduces psychological distress.

- **Underwear Considerations:**

Proper underwear choice, for setup accuracy and SGRT surface capture.

- **Clinical Potential:**

Effective in pelvic radiotherapy, SGRT shows promise for broader clinical applications

Thank you
for your attention