Sultanate Of Oman
University Medical City

SULTAN QABOOS
COMPREHENSIVE
CANCER CENTRE

Application of Surface-Guided Radiation Therapy in Males with Pelvic Cancers:

A Comparative Analysis of Differences with Skin Marking-Guided Patient Setup

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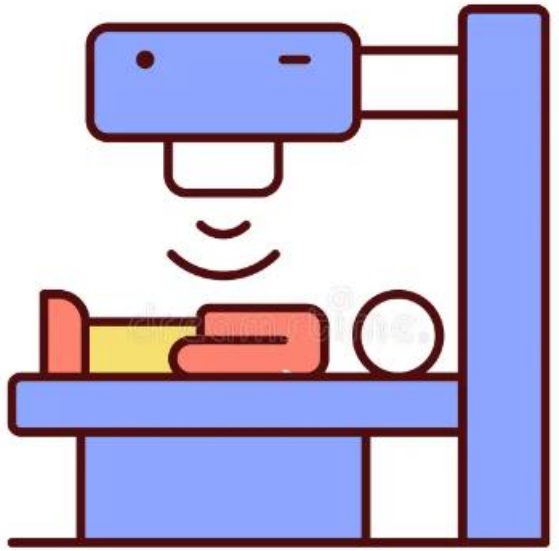
Introduction

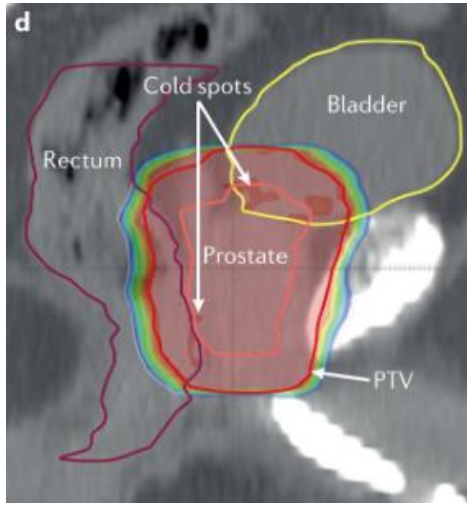
Accurate patient positioning in radiation therapy is essential to enhance the effectiveness and efficiency of treatment

In pelvic cases, this is particularly important because the pelvis houses several critical organs, including the bladder, rectum, and reproductive organs, which are sensitive to radiation.



Inaccurate positioning can lead to:

Underdosing the tumor → reducing treatment effectiveness.



Overdosing nearby healthy tissues → leading to potential side effects like bowel or bladder dysfunction.

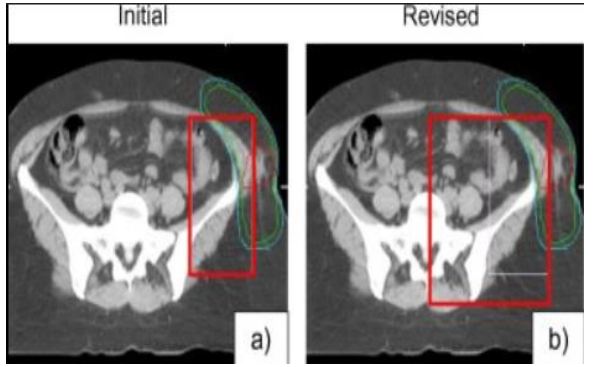
Traditionally, lines or tattoos were applied during simulation and aligned with lasers in the treatment room to ensure reproducible patient setup.

- Simple
- Reliable
- Cost-Effective

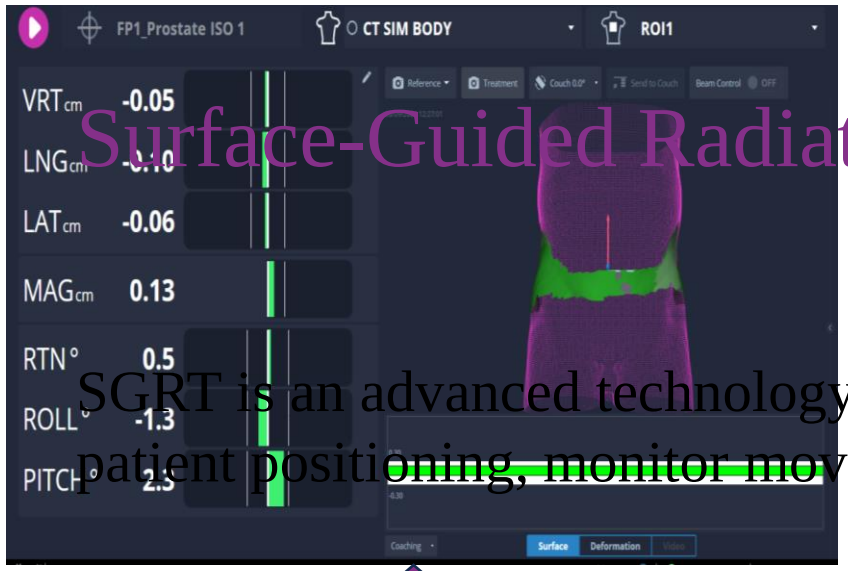
Invasive and may cause physical or psychological discomfort

Skin elasticity can lead to positioning inaccuracies

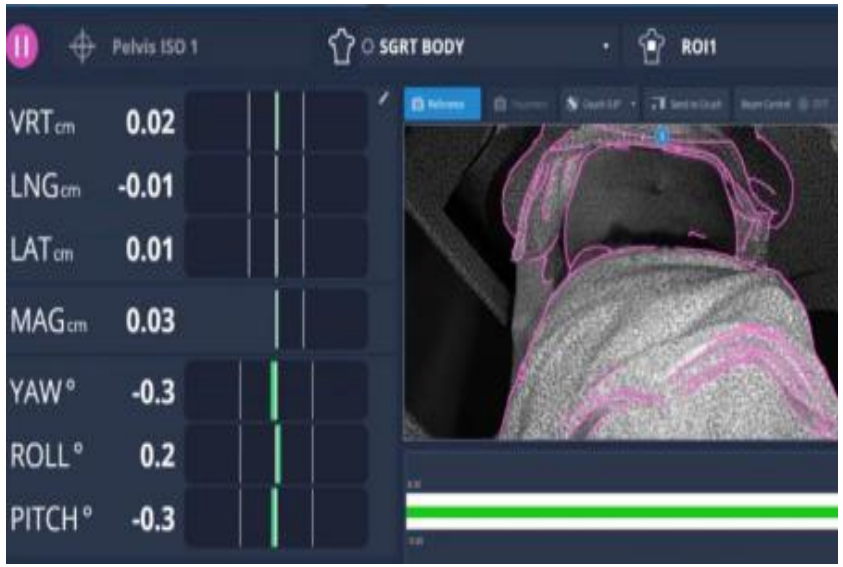
Increased radiation exposure

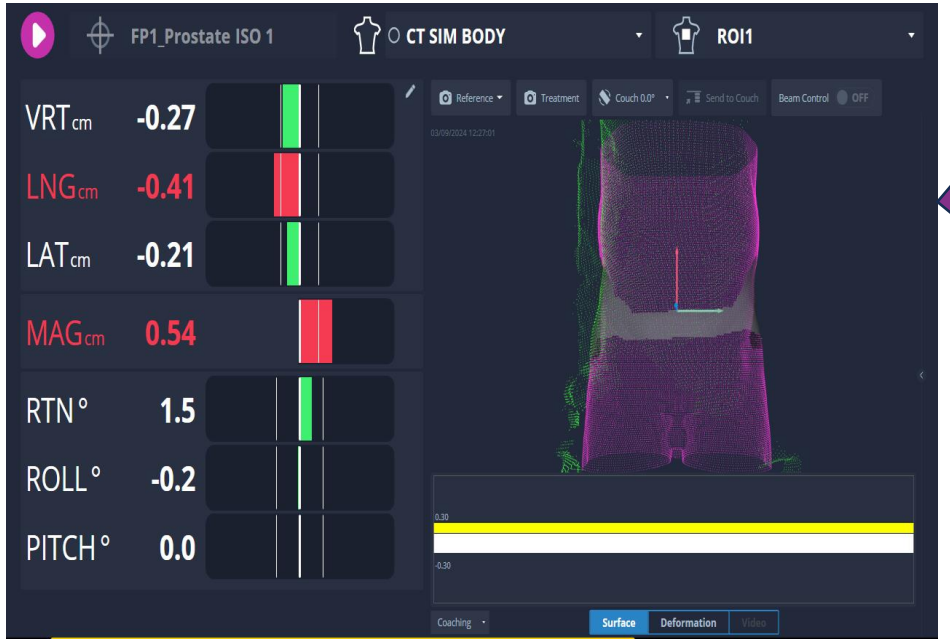


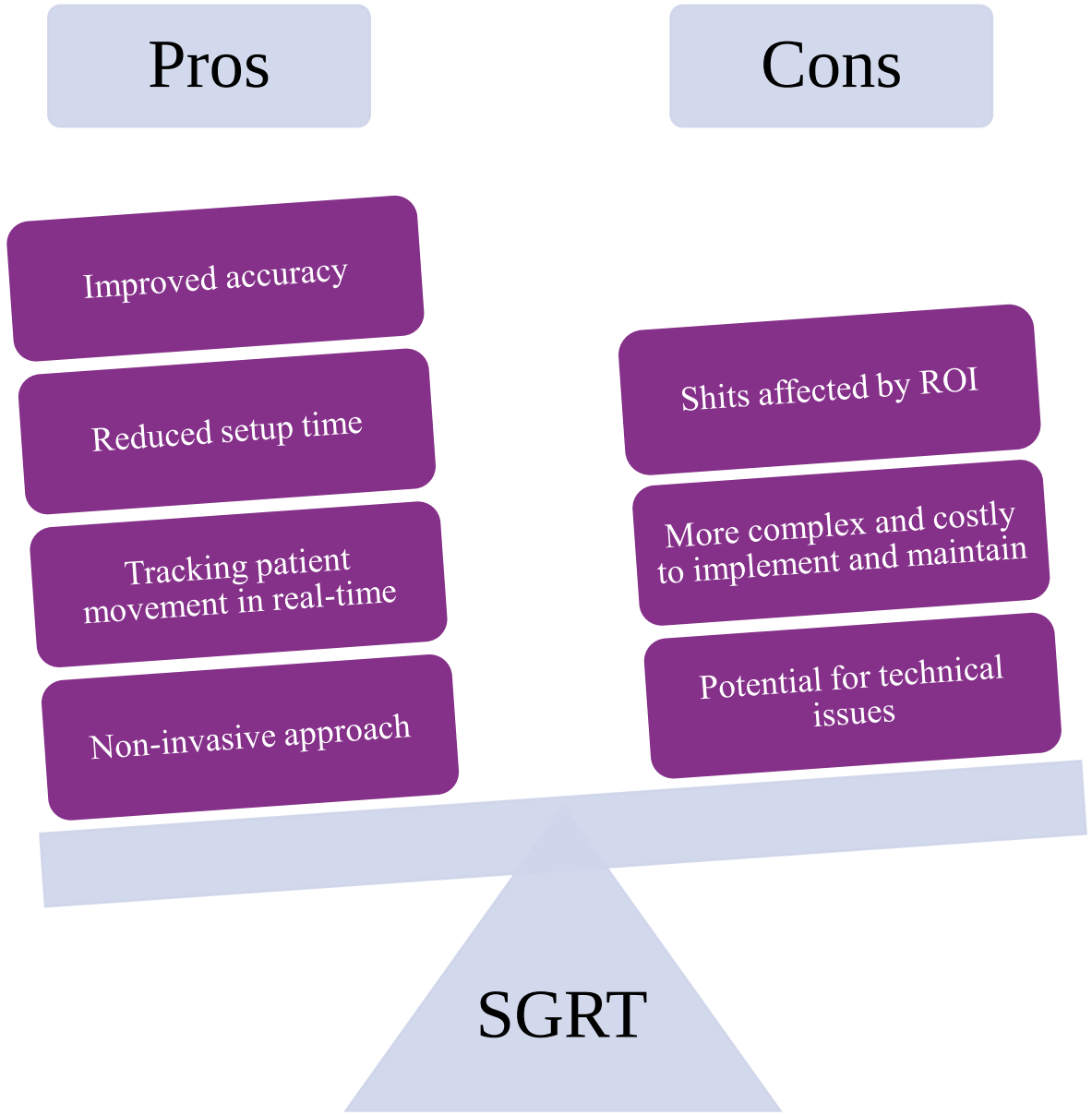
Surface-Guided Radiation Therapy (SGRT)



SGRT is an advanced technology that utilizes 3D surface imaging to ensure precise patient positioning, monitor movement during treatment, and motion management.






Pros
Cons
Improved accuracy
Reduced setup time
Tracking patient movement in real-time
Non-invasive approach
Shits affected by ROI
More complex and costly to implement and maintain
Potential for technical issues
SGRT

Study Objective

This study aims to evaluate and compare the accuracy and efficiency of surface-guided radiation therapy setup compared to the tattoo/skin-marking guided radiation therapy in males with pelvis cancer treatment utilizing data obtained from Cone Beam Computed Tomography (CBCT) images.

Materials and Methods

Study design

11 male patients with pelvic malignancies were included

Treatment Protocol

- Bladder protocol
- VMAT
- >20 sessions

Positioning

- All-in-one setup with pelvic board
- 10 sessions with tattoos
- 10 sessions with SGRT

Verification

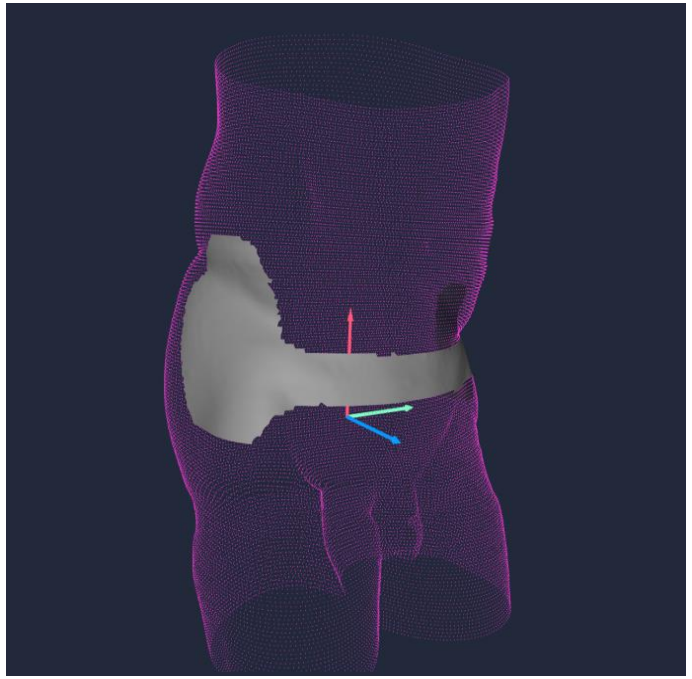
- MV/Kv images acquired with tattoo setups.
- CBCT performed before each treatment

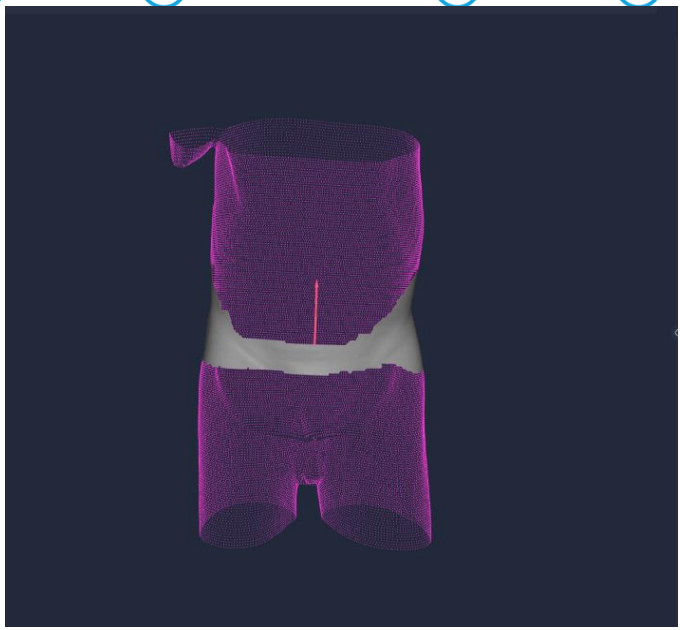
Data Analysis

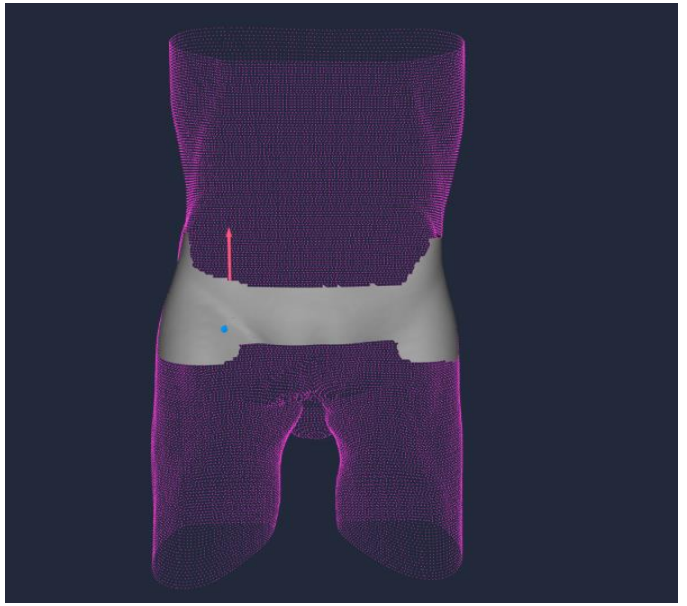
Translational and rotational shifts recorded from 220 CBCT images retrospectively and documented in excel sheet for analysis

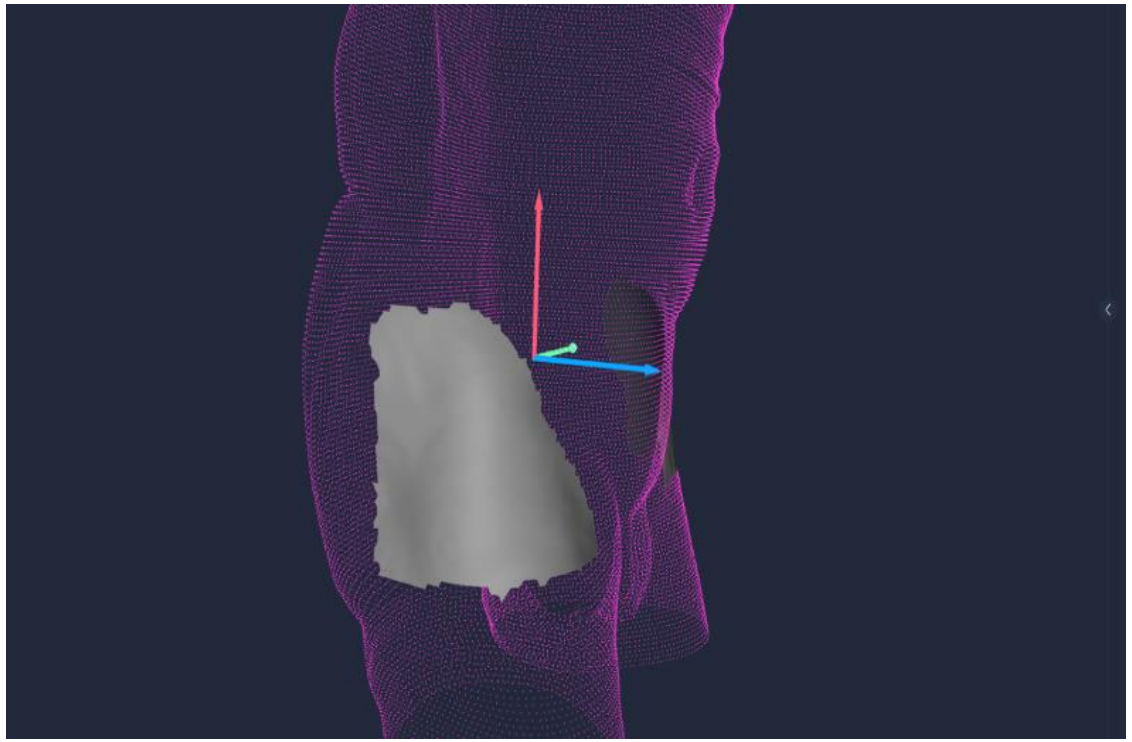
Region of interest (ROI):

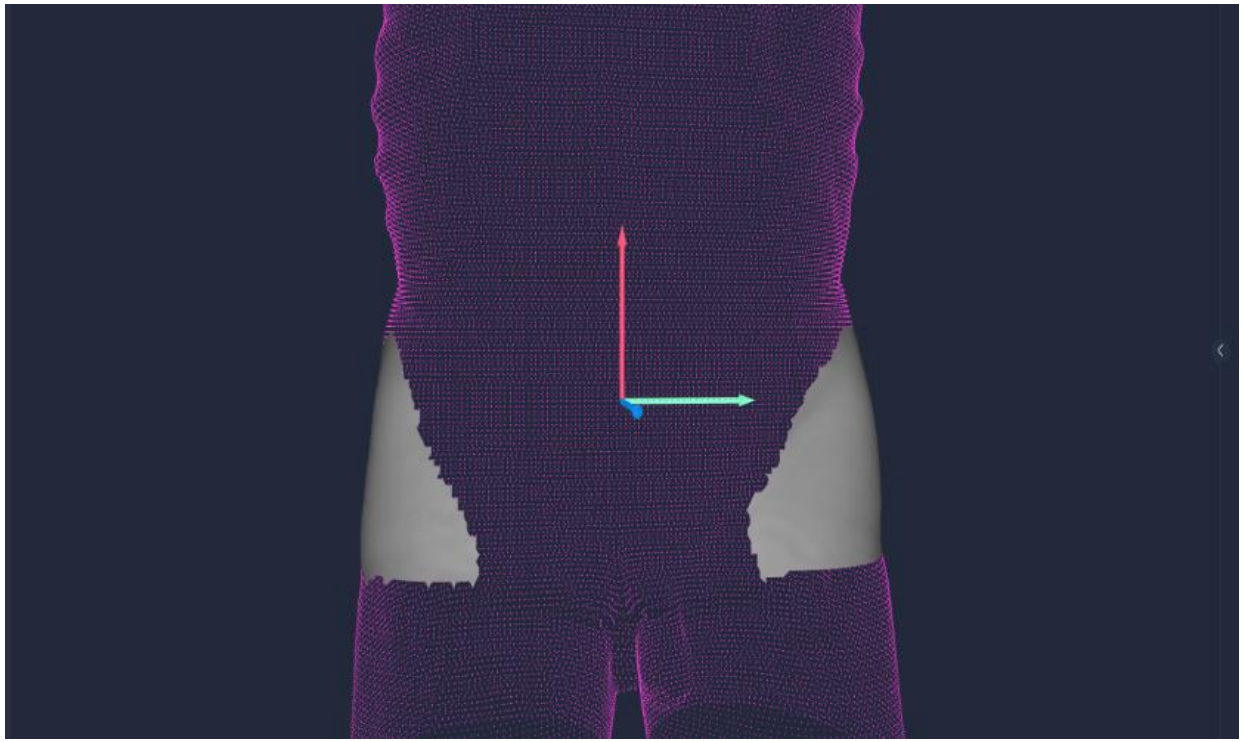
- Include only the patient's surface, avoiding sheets and immobilization devices.
- Exclude unstable areas, such as the abdomen.
- Drawing the ROI too inferior may result in more unwanted pitch rotation.
- Consider including include more anatomy in middle, superiorly or laterally if needed.





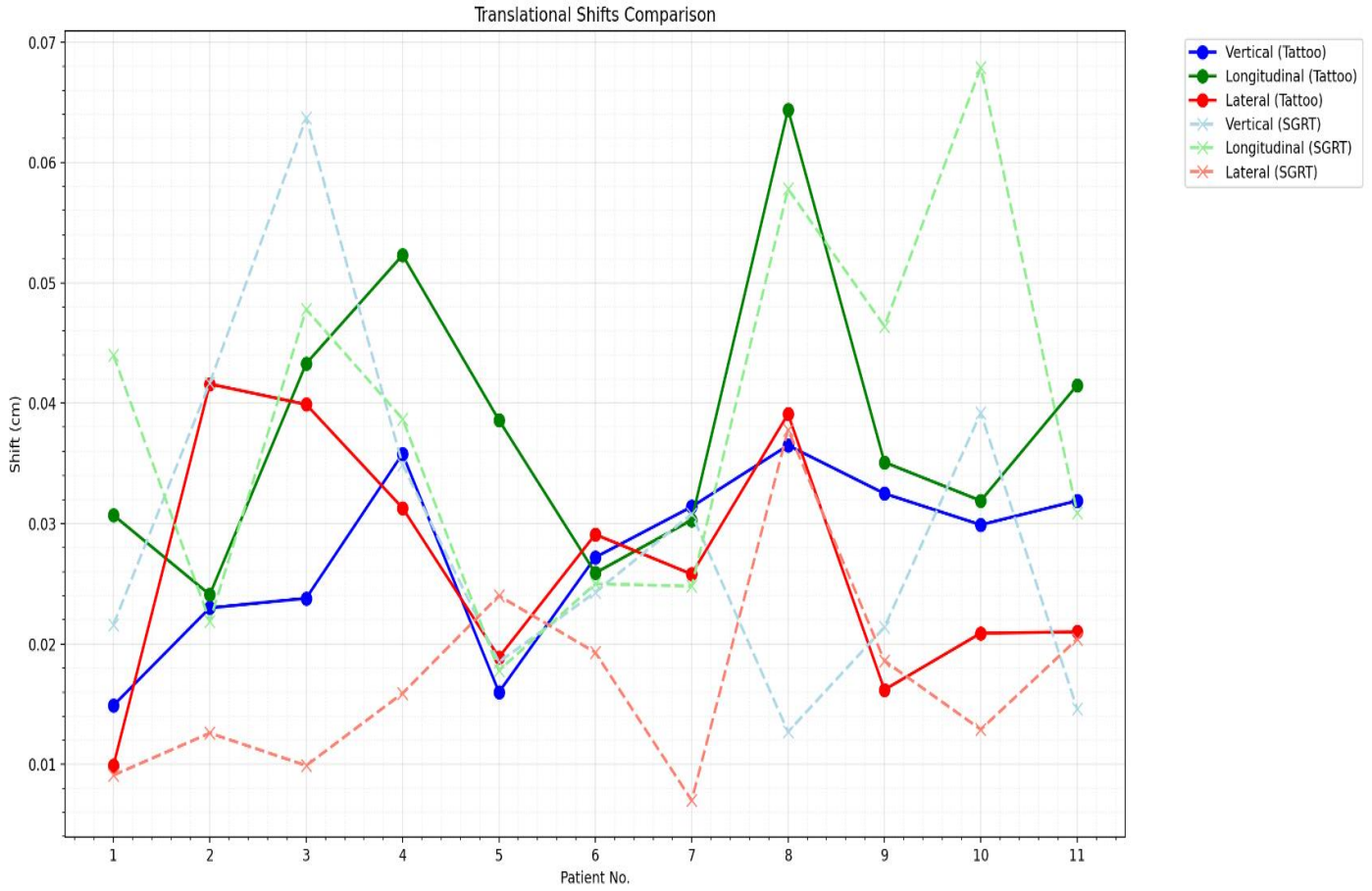






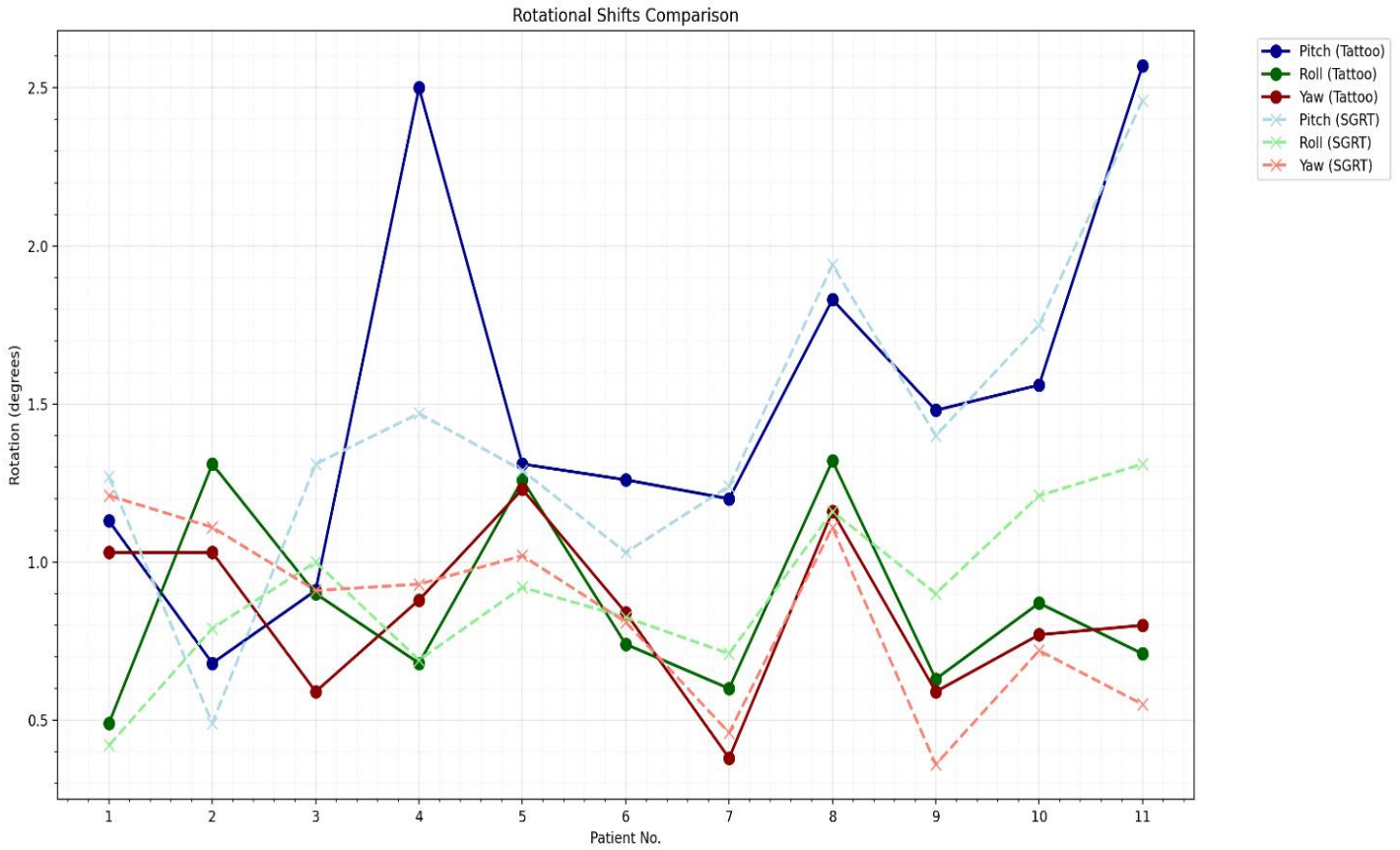
Results

	Tattoo			SGRT		
Patient No.	Vertical (cm)	Longitudinal (cm)	Lateral (cm)	Vertical (cm)	Longitudinal (cm)	Lateral (cm)
1	0.149	0.307	0.099	0.216	0.44	0.091
2	0.23	0.241	0.416	0.417	0.219	0.126
3	0.238	0.433	0.399	0.637	0.478	0.099
4	0.358	0.523	0.313	0.349	0.387	0.159
5	0.16	0.386	0.189	0.185	0.178	0.24
6	0.272	0.259	0.291	0.243	0.25	0.193
7	0.314	0.303	0.258	0.308	0.248	0.07
8	0.365	0.644	0.391	0.127	0.578	0.378
9	0.325	0.351	0.162	0.214	0.464	0.186
10	0.299	0.319	0.209	0.392	0.679	0.129
11	0.319	0.415	0.21	0.146	0.309	0.204



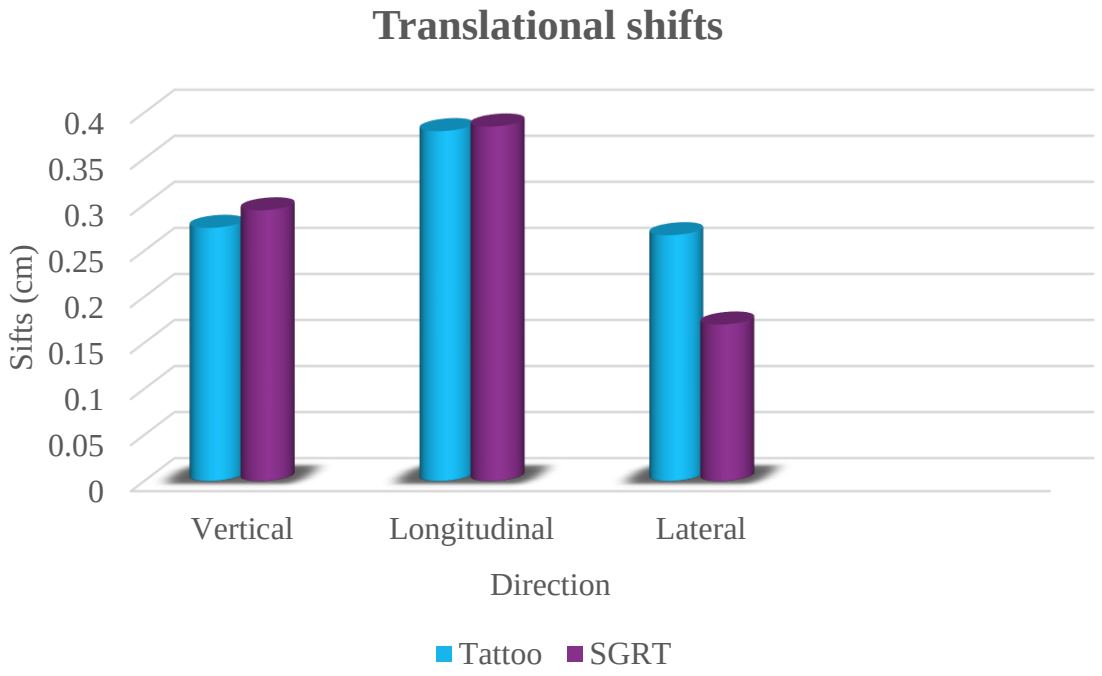
- Solid lines with circles (●) represent Tattoo measurements
- Dashed lines with crosses (×) represent SGRT measurements
- Each direction has its own color scheme:
  - Blue shades for Vertical
  - Green shades for Longitudinal
  - Red shades for Lateral

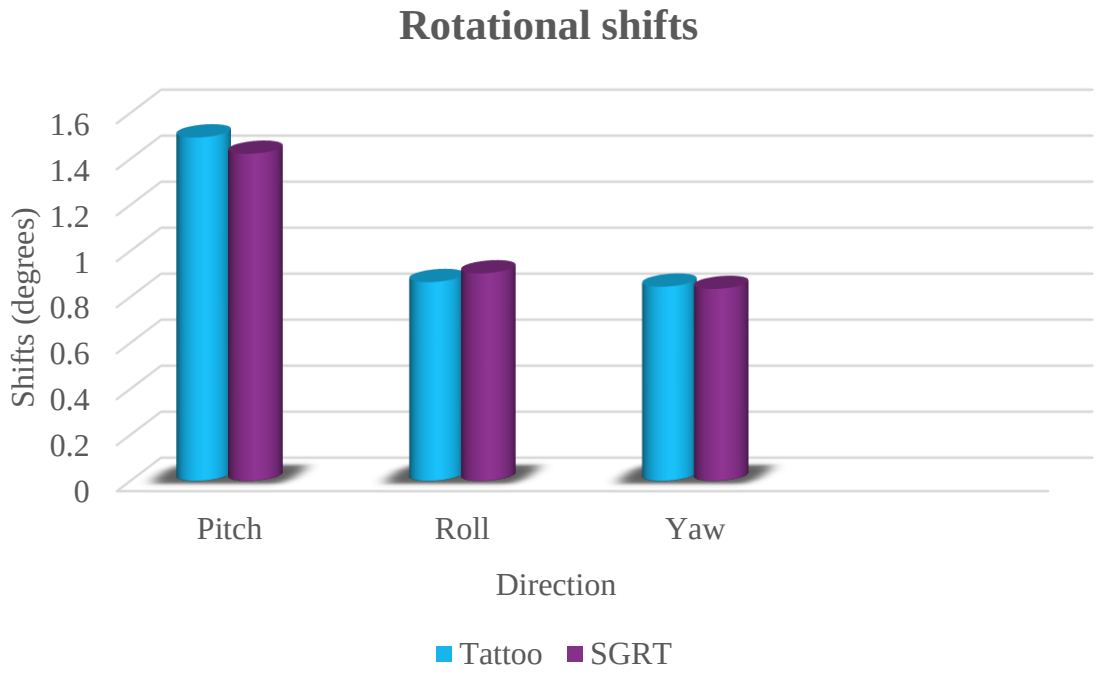
	Tattoo			SGRT		
Patient No.	Pitch (º)	Roll (º)	Yaw (º)	Pitch (º)	Roll (º)	Yaw (º)
1	1.13	0.49	1.03	1.27	0.42	1.21
2	0.68	1.31	1.03	0.49	0.79	1.11
3	0.91	0.9	0.59	1.31	1	0.91
4	2.5	0.68	0.88	1.47	0.69	0.93
5	1.31	1.26	1.23	1.29	0.92	1.02
6	1.26	0.74	0.84	1.03	0.825	0.81
7	1.2	0.6	0.38	1.24	0.71	0.46
8	1.83	1.32	1.16	1.94	1.16	1.11
9	1.48	0.63	0.59	1.4	0.9	0.36
10	1.56	0.87	0.77	1.75	1.21	0.72
11	2.57	0.71	0.8	2.46	1.31	0.55



- Solid lines with circles (●) represent Tattoo measurements
- Dashed lines with crosses (×) represent SGRT measurements
- Each direction has its own color scheme:
  - Blue shades for Pitch
  - Green shades for Roll
  - Red shades for Yaw

	Vertical (cm)	Longitudinal (cm)	Lateral (cm)	Pitch (º)	Roll (º)	Yaw (º)
Tattoo	0.275 (± 0.074)	0.38 (± 0.12)	0.267 (± 0.105)	1.494 (± 0.6)	0.865 (± 0.3)	0.845 (± 0.259)
SGRT	0.294 (± 0.149)	0.385 (± 0.16)	0.17 (± 0.087)	1.423 (± 0.506)	0.903 (± 0.259)	0.835 (± 0.283)





Conclusion

Both Tattoos and SGRT methods provide almost similar accuracy

Reduce the frequency of imaging exposure by utilizing SGRT

SGRT has the potential to significantly enhance treatment accuracy and efficiency

We recommend always performing a CBCT scan to confirm setup position, regardless of using tattoos or SGRT

Key Takeaways:

- ✓ SGRT is a valuable tool in the treatment of pelvic cancer.
- ✓ Accurate and skillful ROI drawing is essential to maximize SGRT benefits.
- ✓ Following the CBCT scan, applying SGRT shifts and capturing a new surface image helps analyze intrafraction movements.
- ✓ In pelvic cases, SGRT complements IGRT rather than replacing it.
- ✓ Further studies are required to optimize the implementation of SGRT and maximize its benefits for patients.

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Any Questions ??

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